UC Berkeley Archaeobotany Laboratory Report #86: Compilation of Phytolith and Starch Images of Taxa Relevant to the Contemporary Caribbean

Natasha A. Fernández-Pérez and Christine A. Hastorf

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Background:

In Spring 2018, Natasha A. Fernández-Pérez approached Christine A. Hastorf because she wanted to do a Directed Reading on phytolith and starch applications to archaeology. Since she wanted to work on the Historical/Contemporary Caribbean, where there plantscape has been affected by colonialism, imperialism and globalization, the readings ranged from all over the Neotropics and included few relevant plants from the Old World (e.g. rice, bananas and Near Eastern cereals). To organize the information and morphotypes presented in these readings by plant taxa, and following professor Hastorf's advice, she created a file where the images were arranged in alphabetical order by family, genus and specie, with their respective references. In total, 81 families were included:

Acanthaceae
Amaranthaceae
Anacardiaceae
Annonaceae
Apiaceae
Araceae
Arecaceae
Asteraceae
Barringtoniaceae
Basellaceae
Bataceae
Bignoniaceae
Bixaceae
Bombacaceae
Boraginaceae
Brassicaceae
Bromeliaceae
Burmanniaceae
Burseraceae
Cactaceae
Cannabaceae
Cannaceae
Chloranthaceae
Chrysobalanaceae
Clusiaceae
Combretaceae
Commelinaceae
Convulvulaceae
Costaceae
Cucurbitaceae
Cyatheaceae
Cyperaceae
Dasypogonaceae
Dichapetalaceae
Dilleniaceae
Dioscoreaceae
Ebenaceae
Elaeocarpaceae
Ericaceae
Erithroxelaceae
Euphorbiaceae
Fabaceae
Fagaceae
Flacourtiaceae
Haemodoraceae
Heliconiaceae
Hernandiaceae
Humiriaceae
Hymenophyllaceae
Juglandaceae
Juncaceae
Lauraceae
Loranthaceae
Lowiaceae
Lygodiaceae
Magnoliaceae
Malvaceae
Marantaceae
Menispermaceae
Moraceae
Musaceae
Myristicaceae
Myrtaceae
Orchidaceae
Oxalidaceae
Piperaceae
Poaceae
Pteridaceae
Restionaceae
Simaroubaceae
Smilacaceae
Solanaceae
Sterculiaceae
Strelitziaceae
Thelypteridaceae
Thurniaceae
Tropeolaceae
Ulmaceae
Urticaceae
Zamiaceae
Zingiberaceae

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- Australian Museum
- Korstanje and Babot

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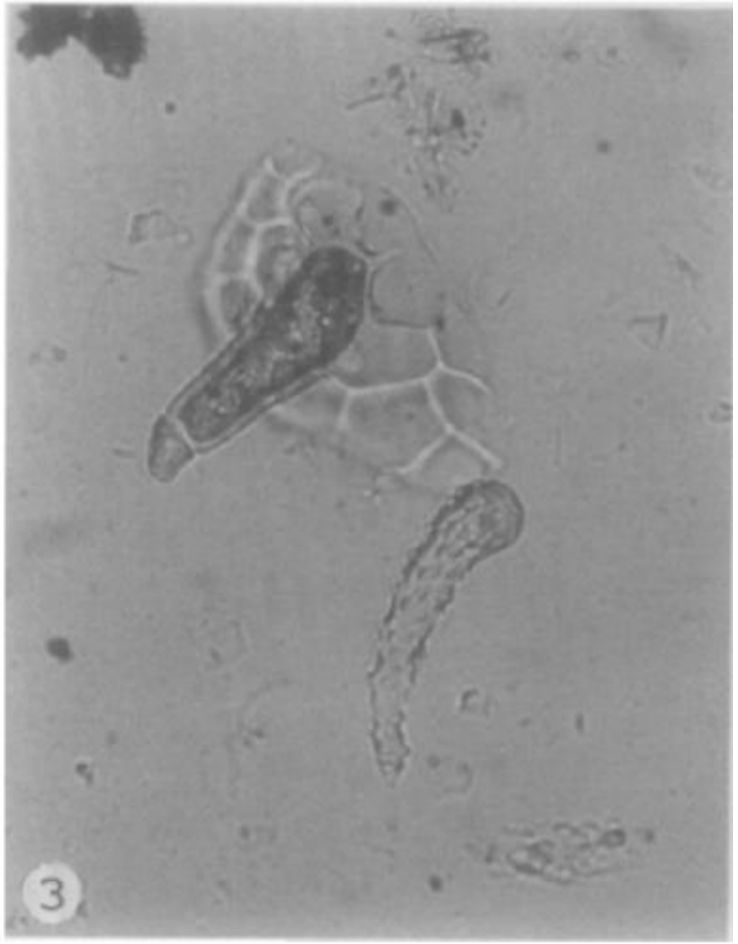
ACANTHACEAE

Justicia pringlei

Phytolith

2. Segmented hairs from Justicia pringlei with tapered shafts and small, rounded apexes. The hair on the left is broken near the base (156 x).
3. Right, a cystolith from Justicia pringlei showing the tuberculate surface decoration. On the left is a completely silicified segmented hair attached to a hair base (156 ×).



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Mendoncia spp.

Phytolith

Fig. 5. Genus-specific phytolith from the seeds of Mendoncia spp. recovered from modern soils underneath tropical montane forest in Panama.

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Mendoncia coccinea

Phytolith

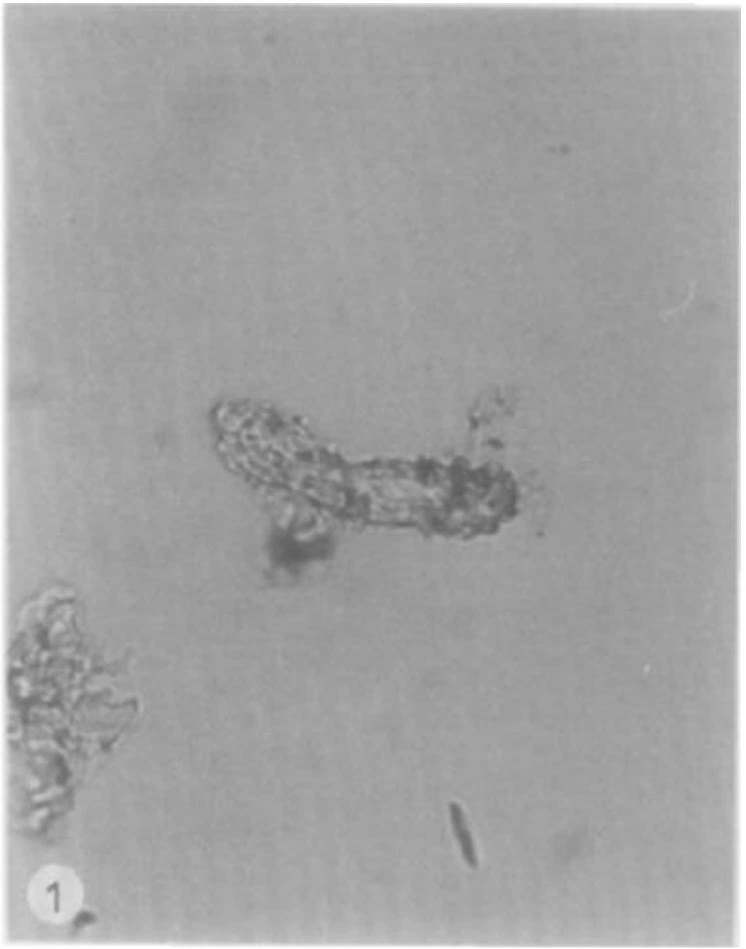
4. Non-segmented club-shaped hairs from Mendoncia coccinea (156 x).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Odontonema bracteolata

Phytolith

1. An elongate cystolith from Odontonema bracteolata. The tuberculate surface pattern is developed only on the right end of the cystolith (156 x)



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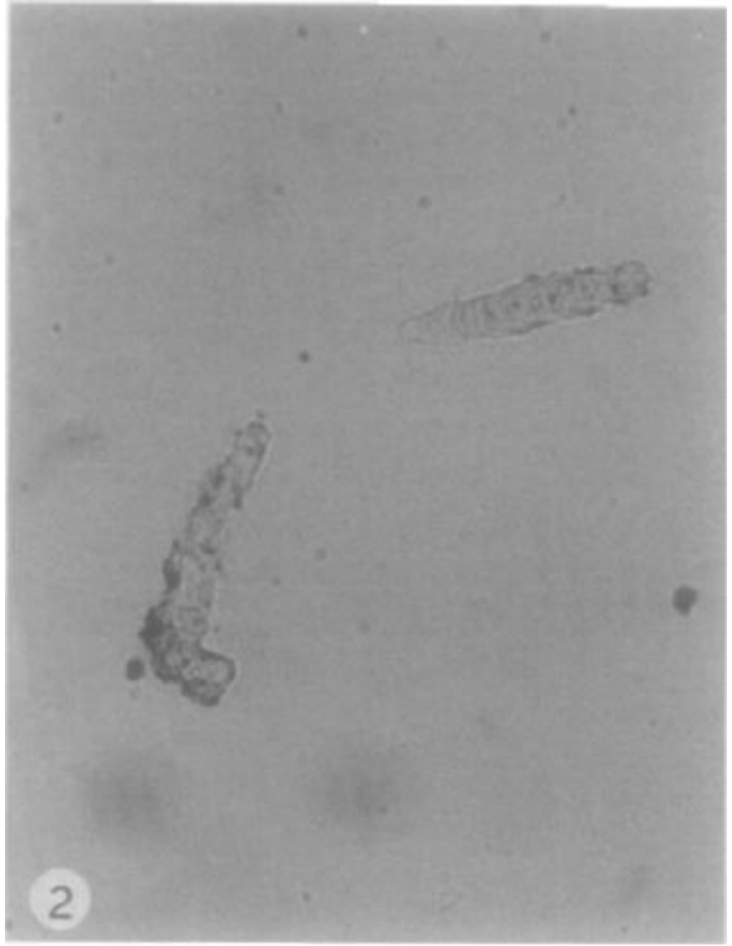
Pseuderanthemum davei

Phytolith

2. Cystoliths from Pseuderanthemum davei (250x).



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AMARANTHACEAE

Amaranthus caudatus

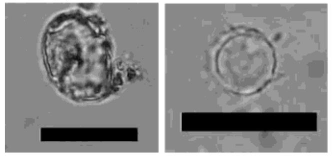
Amaranthaceae *Amaranthus caudatus* "amaranto, coimi or quiwicha"

Phytolith assemblage characterization

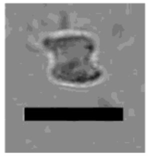
flower and seed

Non diagnostic phytoliths **(*):**

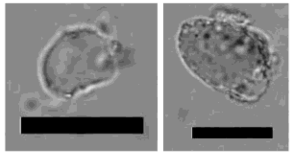
a) Flat round scrobiculate margin silica phytolith. Rare.



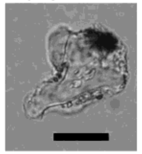
b) Asymmetrical bilobate (saddle) silica short cell. Rare.



c) Conical scrobiculate silica phytolith. Rare.



d) Asymmetrical silica phytolith. Rare.

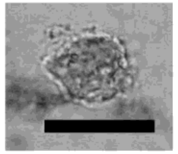


References: Reported as not present in Piperno 1988:30 for *Amaranthus* sp.

stem

Non diagnostic phytoliths **(*):**

a) Sub-spherical globose silica phytolith. Rare.

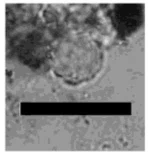


References: Reported as not present in Piperno 1988:30 for *Amaranthus* sp.

leaf

Non diagnostic phytoliths **(*):**

a) Spherical globose silica phytolith. Rare.

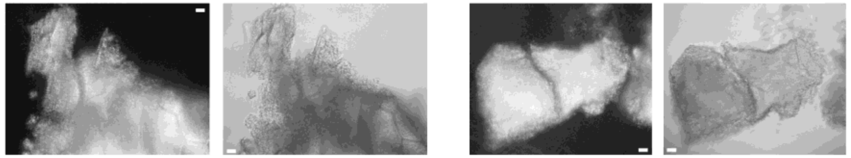


References: Reported as not present in Piperno 1988:30 for *Amaranthus* sp.

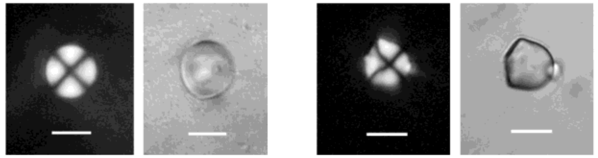
Starch assemblage characterization

flower and seed

a) Mainly semi-compound grains called "starch chunks", compounded by single grains compactly disposed and filling the whole cell. Granula spherical and polyhedral; ranging in size from 1,5µm to 5µm long length; not visible hilum and lamella; distinct cross.



b) Also, single grains, spherical and bell-shaped with facets; variable in size from 11µm to 75µm; visible hilum as a dot; not visible lamella; distinct centric cross, with four arms visible. May occur in aggregates.



References: Partially based on Bello Perez et al. 1998; Cortella and Pochettino 1990 and 1994; Wilhelm et al. 1998.

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Amaranthus mantegazzianus

Amaranthaceae *Amaranthus mantegazzianus* "amaranto, chaclión or chaquillón"

Phytolith assemblage characterization

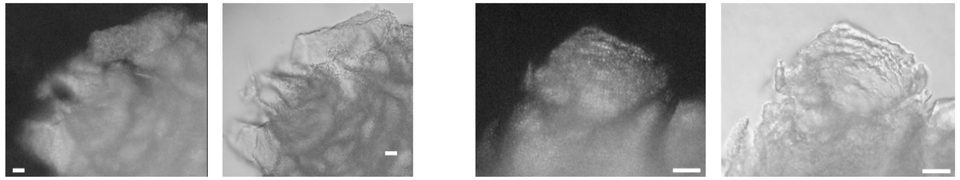
flower and seed

References: Reported as not present in Piperno 1988:30 for *Amaranthus* sp.

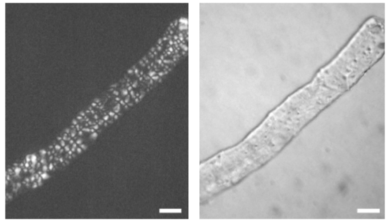
Starch assemblage characterization

seed

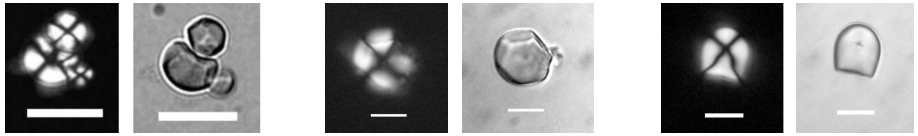
a) Mainly semi-compound grains called "starch chunks", compounded by single grains compactly disposed and filling the whole cell. Single grains, spherical or polyhedral; ranging in size from 0,5µm to 3µm long length; not visible hilum and lamella; sometimes indistinct cross.



b) Another compound grains, fiber-like, with a single external package; variable in size and number of granula. Granula; uncertain shaped; distinct centric hilum as a dot; distinct centric cross, with four arms visible.



c) Also, single grains, polyhedral, spherical, irregular and bell-shaped, with facets; variable in size from 5µm to 75µm long length; visible hilum as a dot; not visible lamella; distinct centric cross, with four arms visible. May occur in aggregates.



References: Partially based on Cortella and Pochettino 1990 and 1994.

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Amaranthus mantegazzianus

Starch

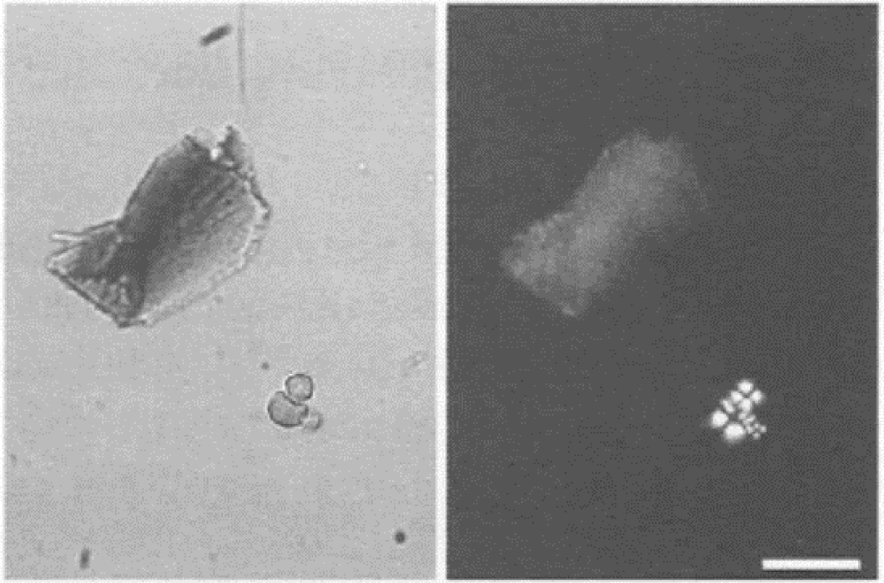
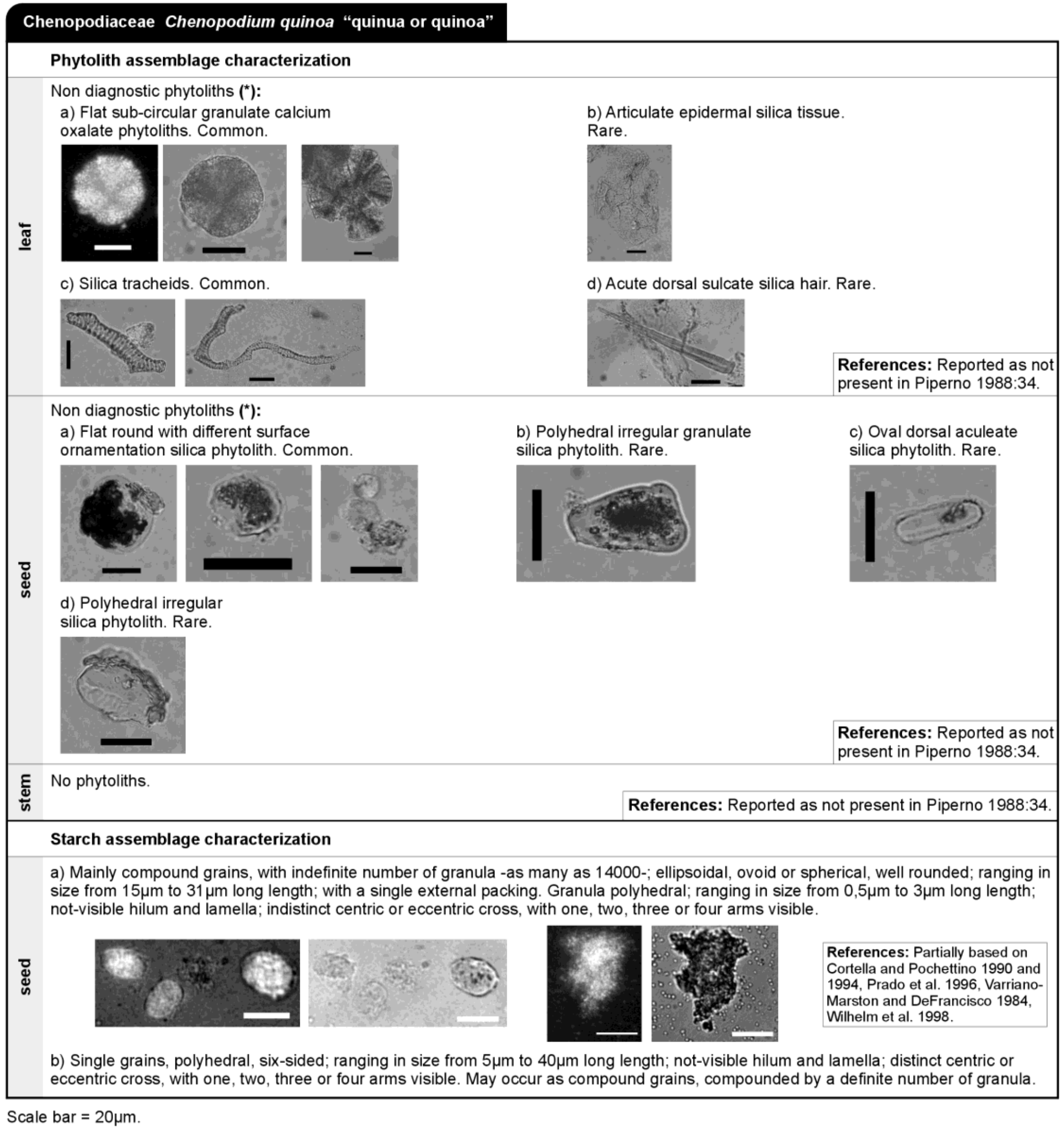


Figure 2. Amaranth (*Amaranthus mantegazzianus*) non-processed perispermatic cells compactly filled with starch grains and medium-sized grains. Views with normal (left) and polarised light (right). Scale bar = 40µm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Chenopodium quinoa



Chenopodiaceae *Chenopodium quinoa* "quinua or quinoa"

Phytolith assemblage characterization

leaf

Non diagnostic phytoliths **(*)**:

a) Flat sub-circular granulate calcium oxalate phytoliths. Common.

b) Articulate epidermal silica tissue. Rare.

c) Silica tracheids. Common.

d) Acute dorsal sulcate silica hair. Rare.

References: Reported as not present in Piperno 1988:34.

seed

Non diagnostic phytoliths **(*)**:

a) Flat round with different surface ornamentation silica phytolith. Common.

b) Polyhedral irregular granulate silica phytolith. Rare.

c) Oval dorsal aculeate silica phytolith. Rare.

d) Polyhedral irregular silica phytolith. Rare.

References: Reported as not present in Piperno 1988:34.

stem

No phytoliths.

References: Reported as not present in Piperno 1988:34.

Starch assemblage characterization

seed

a) Mainly compound grains, with indefinite number of granula -as many as 14000-; ellipsoidal, ovoid or spherical, well rounded; ranging in size from 15µm to 31µm long length; with a single external packing. Granula polyhedral; ranging in size from 0,5µm to 3µm long length; not-visible hilum and lamella; indistinct centric or eccentric cross, with one, two, three or four arms visible.

References: Partially based on Cortella and Pochettino 1990 and 1994, Prado et al. 1996, Varriano-Marston and DeFrancisco 1984, Wilhelm et al. 1998.

b) Single grains, polyhedral, six-sided; ranging in size from 5µm to 40µm long length; not-visible hilum and lamella; distinct centric or eccentric cross, with one, two, three or four arms visible. May occur as compound grains, compounded by a definite number of granula.

Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Chenopodium quinoa

Starch

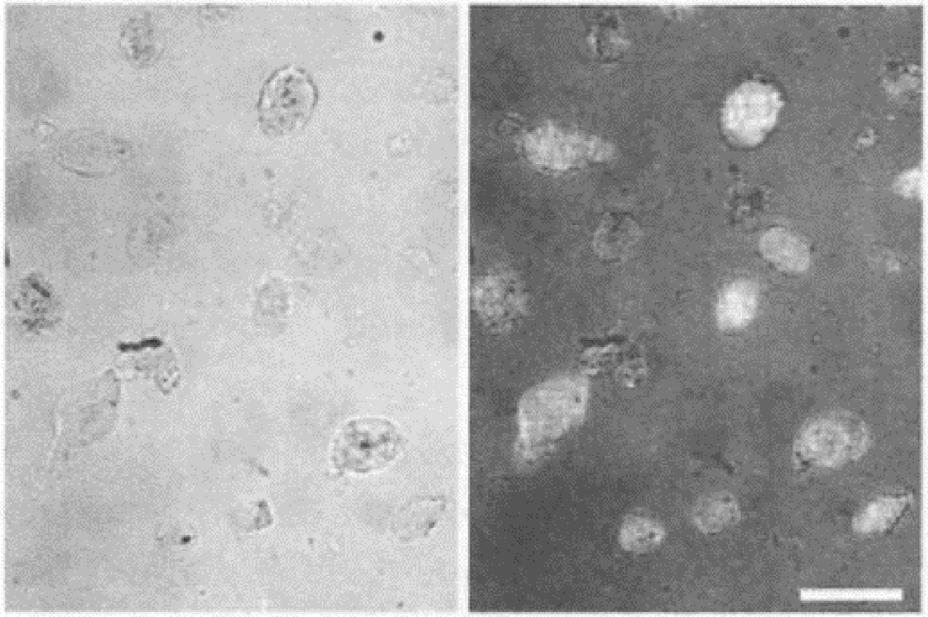


Figure 3. Quinoa non-processed compounded starch grains. Views with normal (left) and polarised light (right). Scale bar = 40μm.

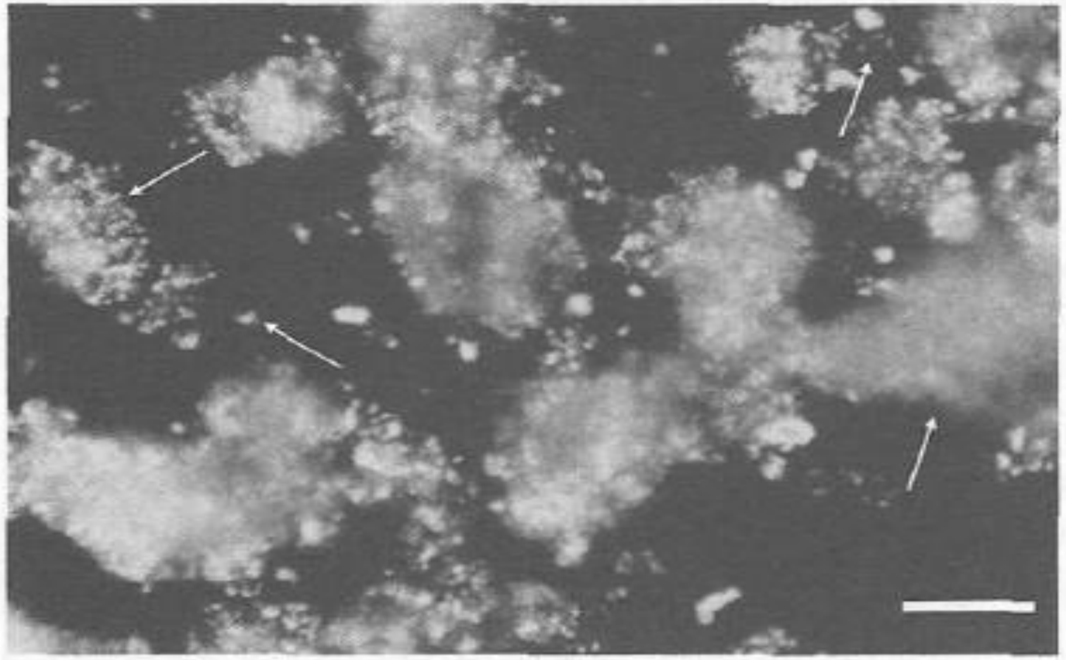


Figure 7. Starch of quinoa *llipta* showing charring effects. Clustered grains in the process of disjoining, a disjoined individual granule, a medium-sized grain with low birefringence and clumps of gelatinised grains are marked with arrows. View with polarised light. Scale bar = 40μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Chenopodium quinoa

Starch

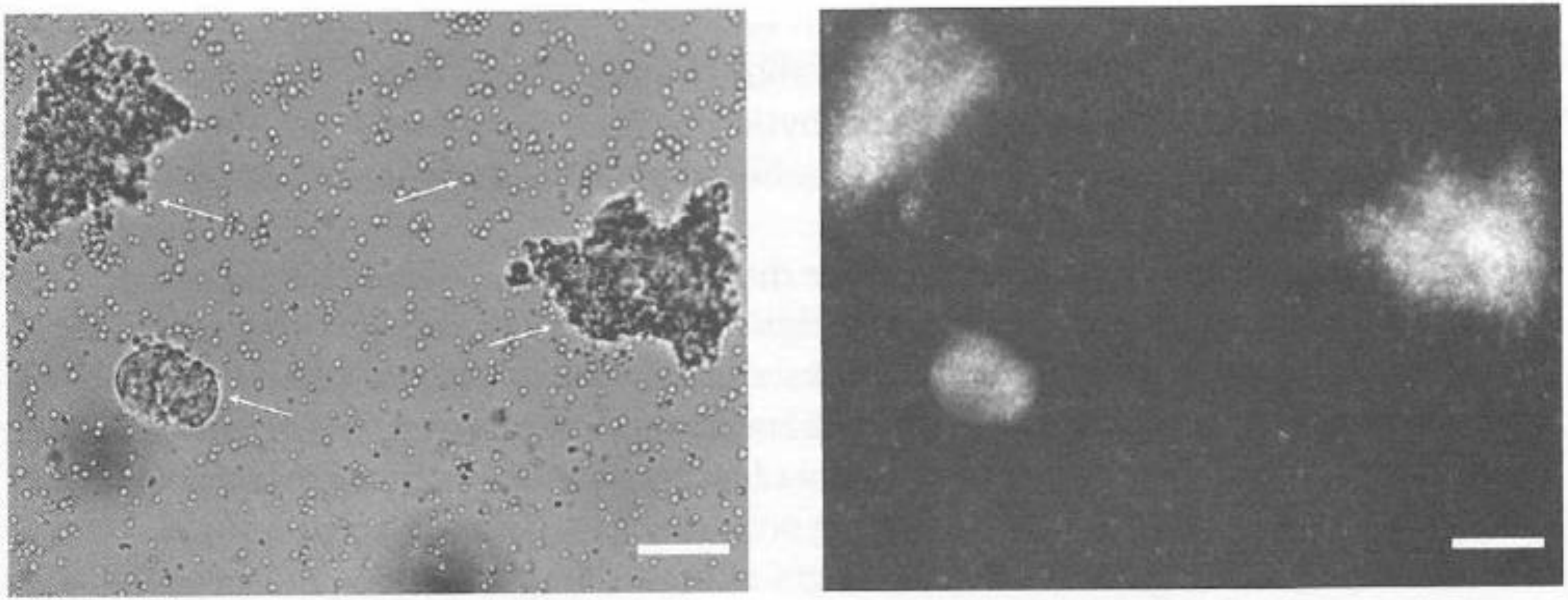


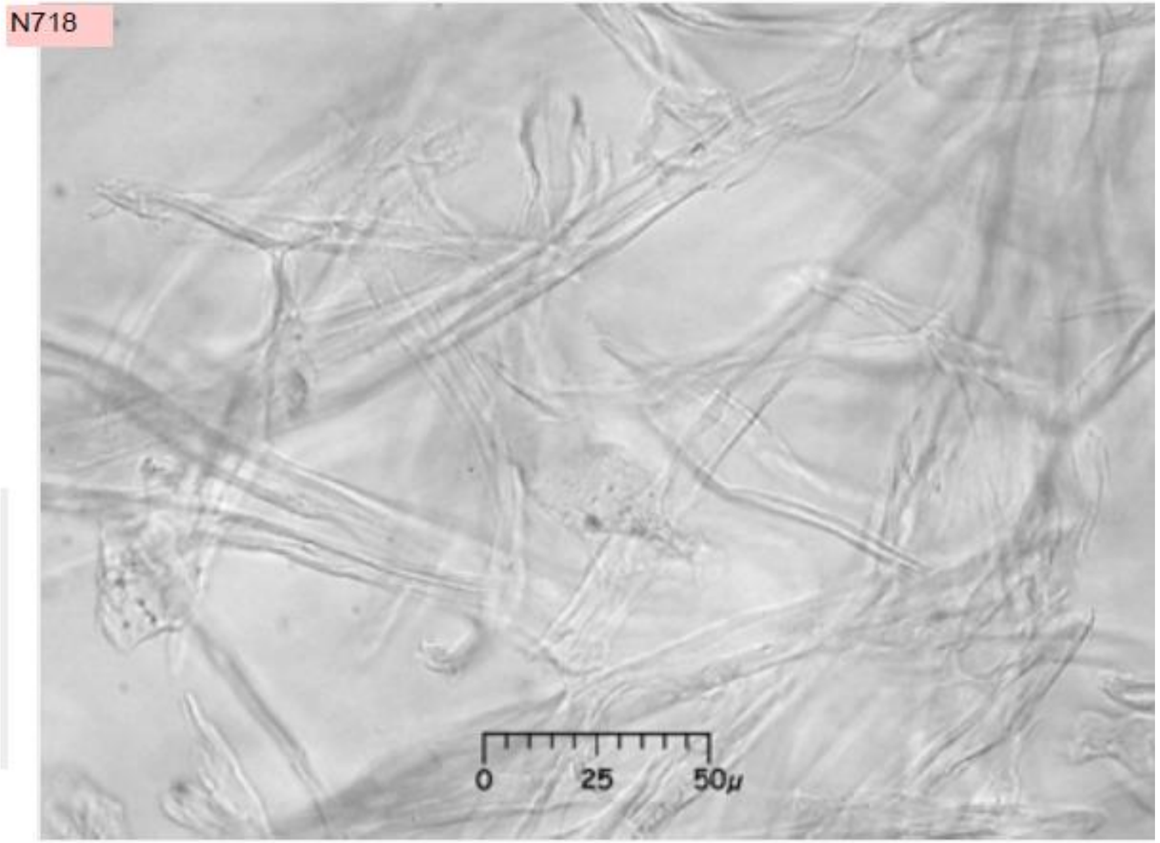
Figure 12. Starch of quinoa flour showing milling effects. (a) Compounded grains in different stages of disjoining and a disjoined individual grain are marked with arrows. View with normal light (left). (b) View with polarised light (right). Scale bar = 20μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

ANACARDIACEAE

Spondias purpurea

Phytolith



Type established by Karol Chandler- Ezell, 2004
Diagnostic level: fruit/seed

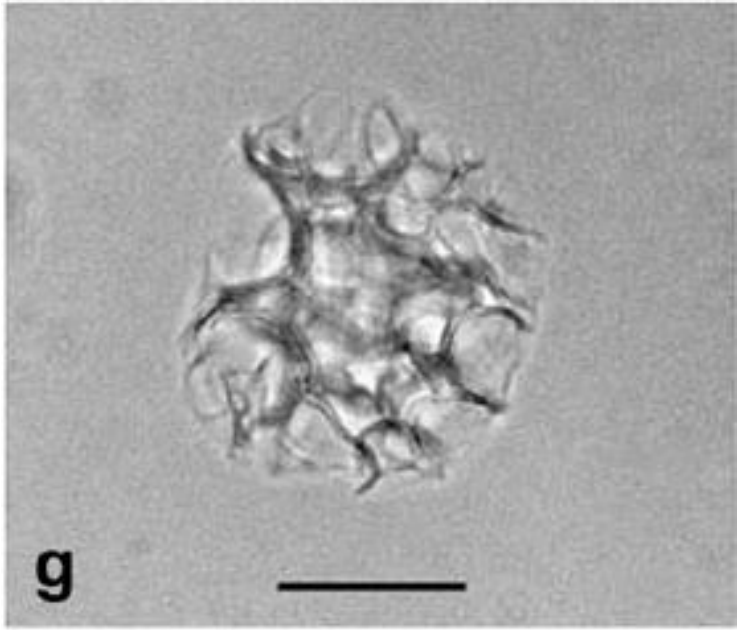
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

ANNONACEAE

Annona glabra

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. g) Hair base from Annona glabra leaf

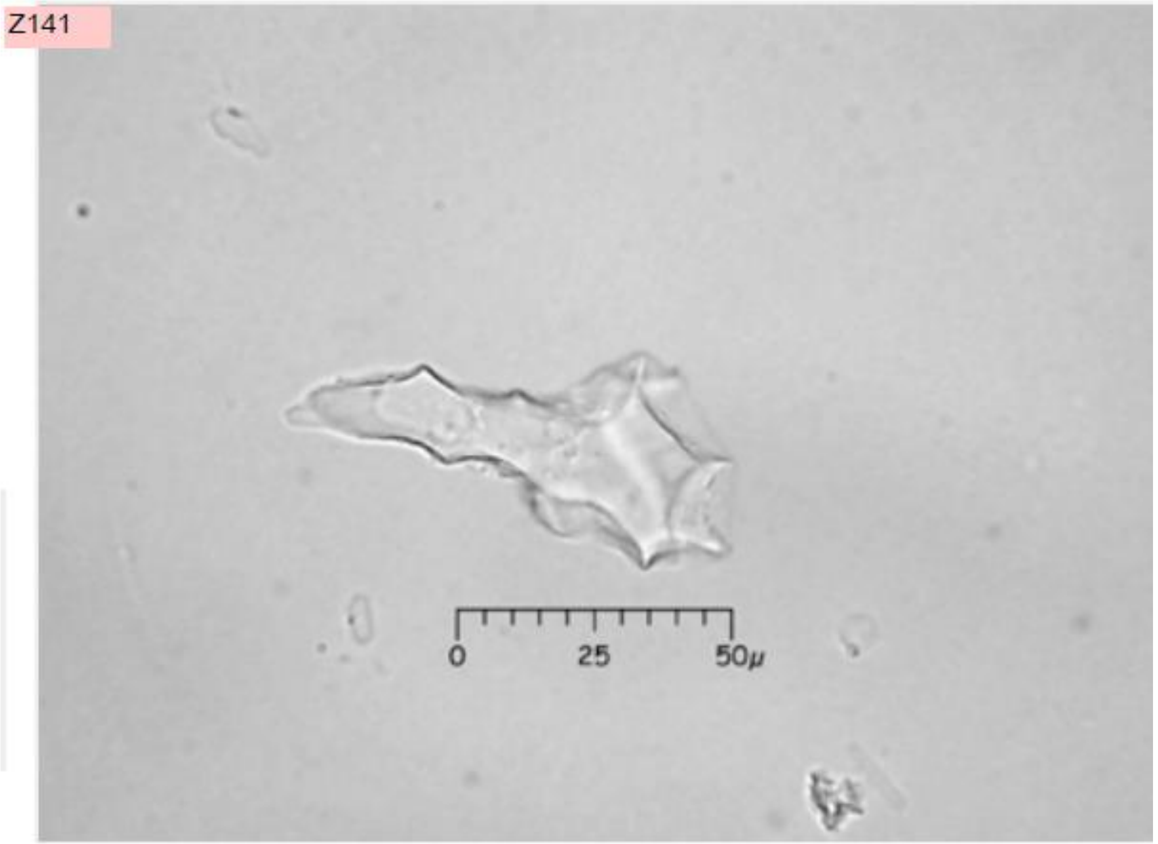


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Duguetia sp.

Phytolith

Facets and overall shape both irregular, often with concave surfaces. NOT a regular, symmetrical sphere.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Goniothalamus marcani

Phytolith

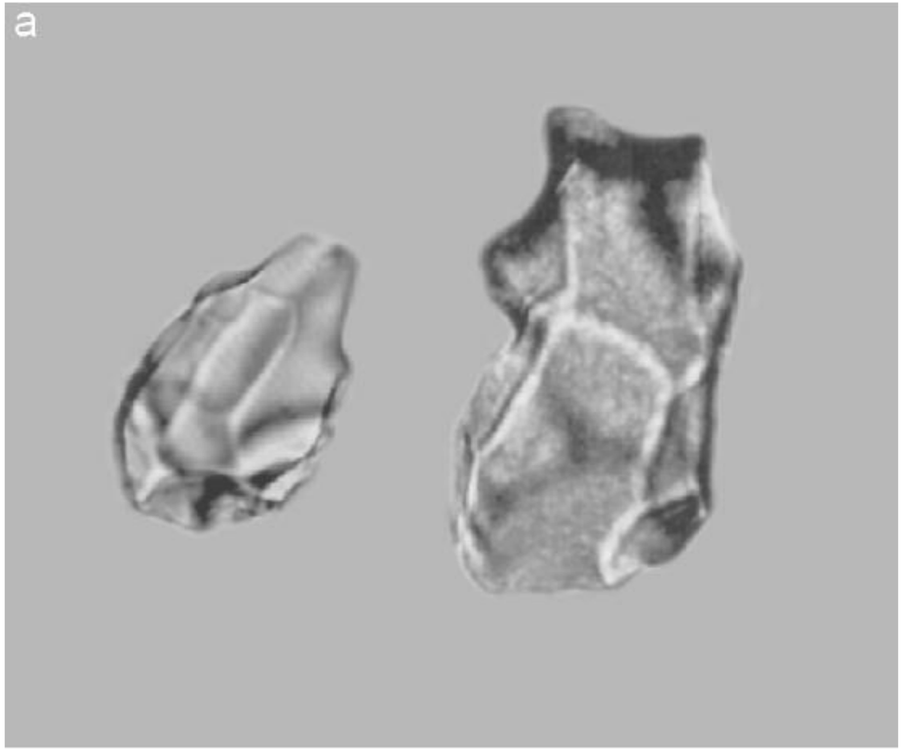


Fig. 3. (a) Facetate phytoliths from Asian Fagaceae (Lithocarpus acuminatissima), left, and Annonaceae (Goniothalamus marcani), right. Reprinted from Kealhofer and Piperno, 1998. Reprinted from Piperno (2006a), Copyright AltaMira Press.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

Guatteria dumetorum

Phytolith

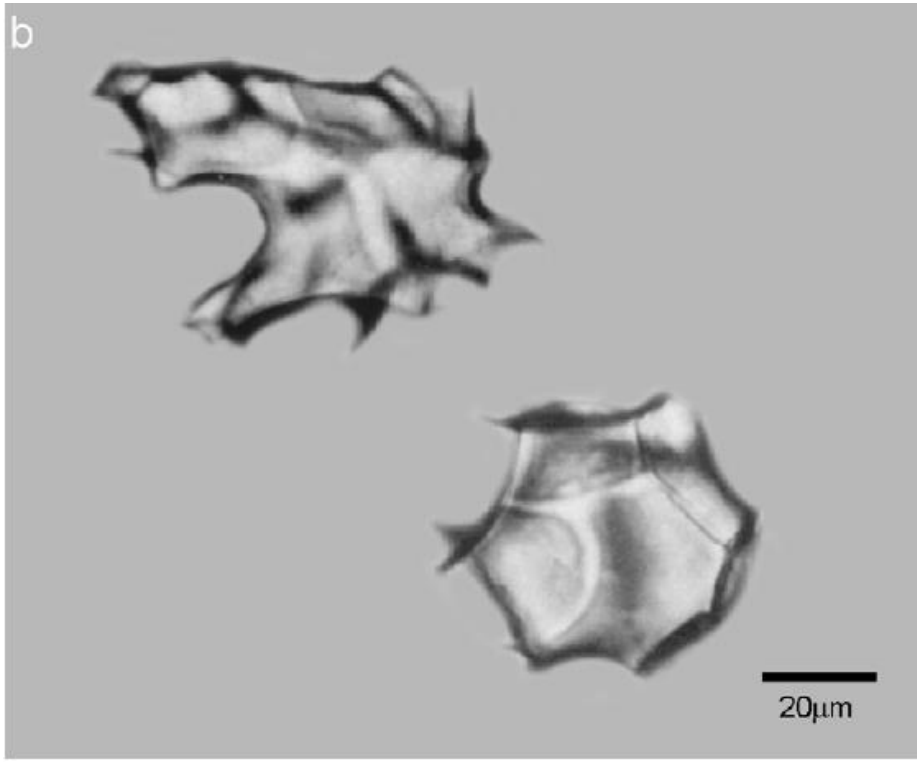


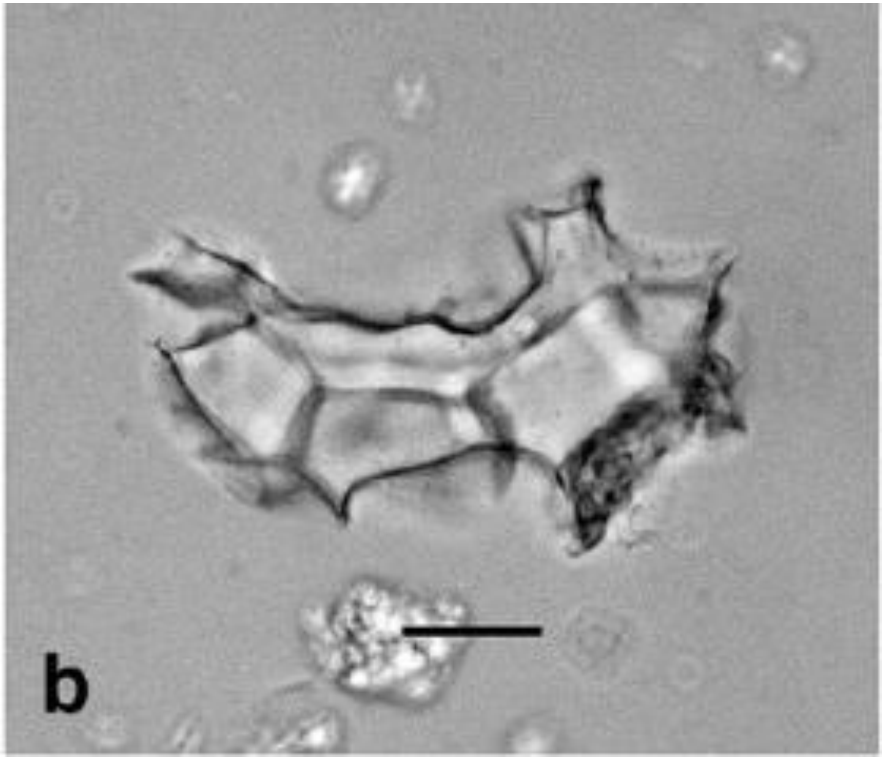
Fig. 3. (b) Spherical facetate, right (Unonopsis pittieri), and irregular facetate phytoliths, left (Guatteria dumetorum) from tropical American Annonaceae. Reprinted from Piperno (2006a), Copyright AltaMira Press.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

Guatteria guianensis

Phytolith

Fig. 5. Phytoliths from dicotyledons.
b) Irregular multi-faceted phytolith
from Guatteria guianensis leaf



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Unonopsis pittieri

Phytolith

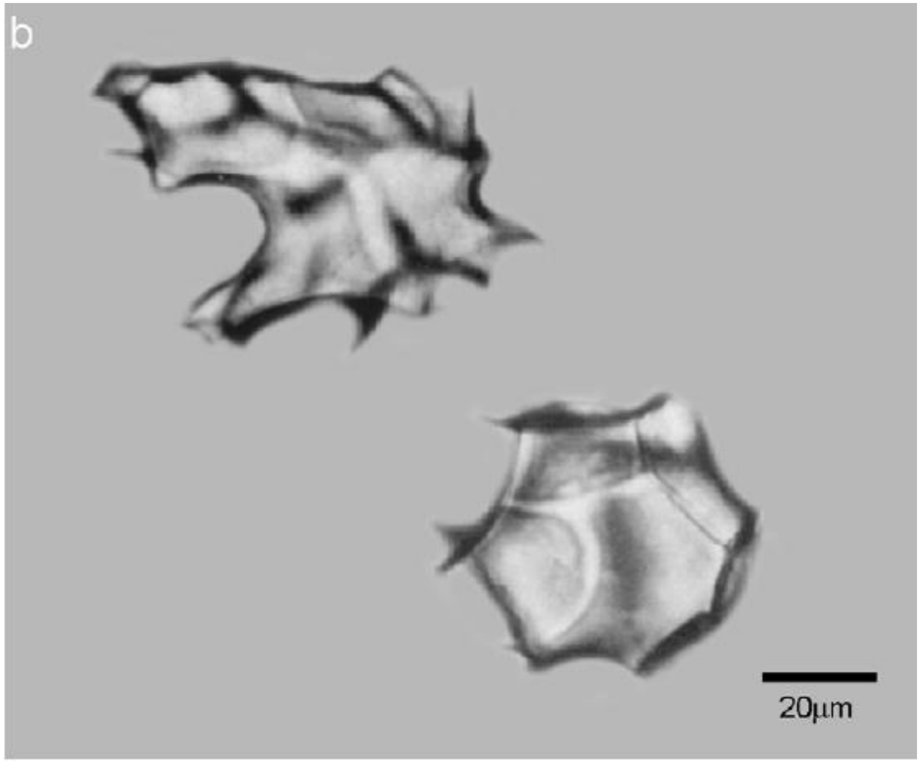


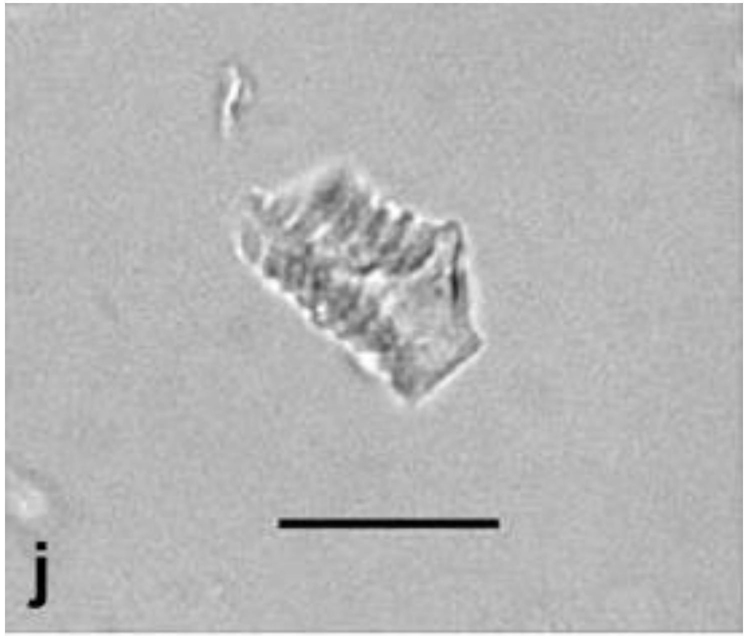
Fig. 3. (b) Spherical facetate, right (Unonopsis pittieri), and irregular facetate phytoliths, left (Guatteria dumetorum) from tropical American Annonaceae. Reprinted from Piperno (2006a), Copyright AltaMira Press.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

Unonopsis stipitata

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. j) Tracheid from Unonopsis stipitata

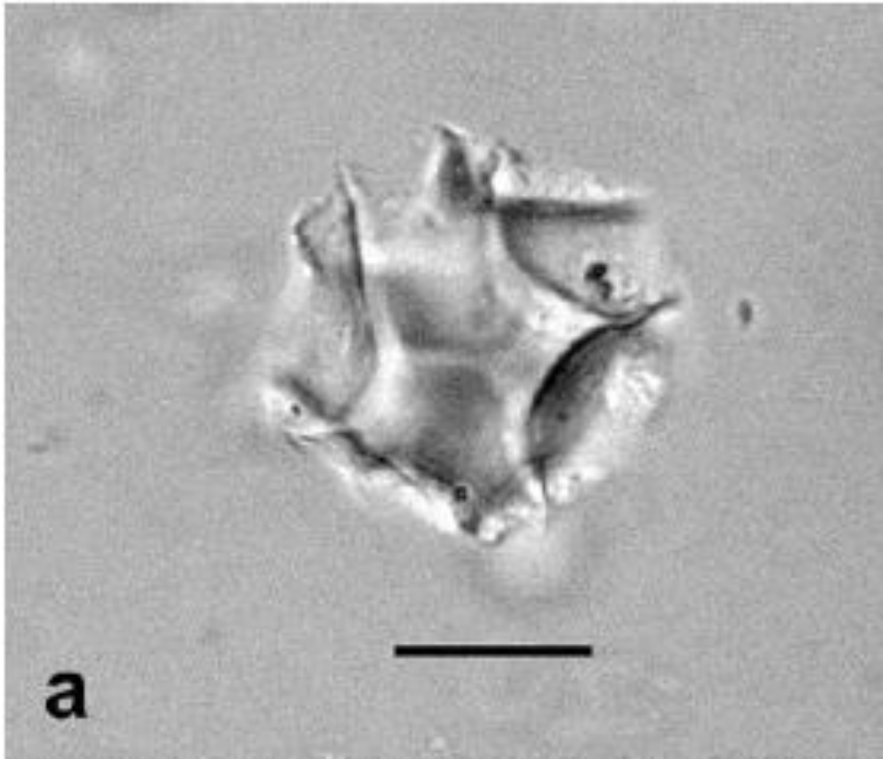


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Unonpsis stipitata

Phytolith

Fig. 5. Phytoliths from dicotyledons.
a) Spherical multi-faceted phytolith
from Unonpsis stipitata



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

APIACEAE

Arracacia xanthorriza

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

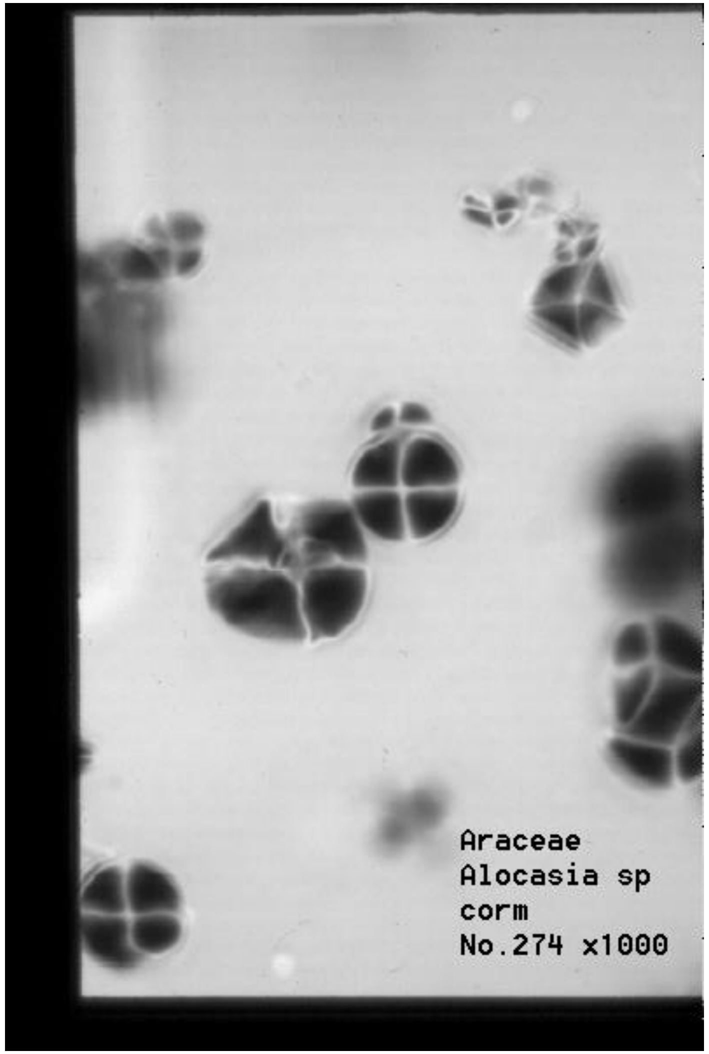
Apiaceae *Arracacia xanthorriza* "arracacha"	
	Phytolith assemblage characterization
tuber	**References:** Reported as a family where phytoliths have been found to be not present, rare or not taxonomically significant in Pearsall 2000:371.

Scale bar = 20μm.

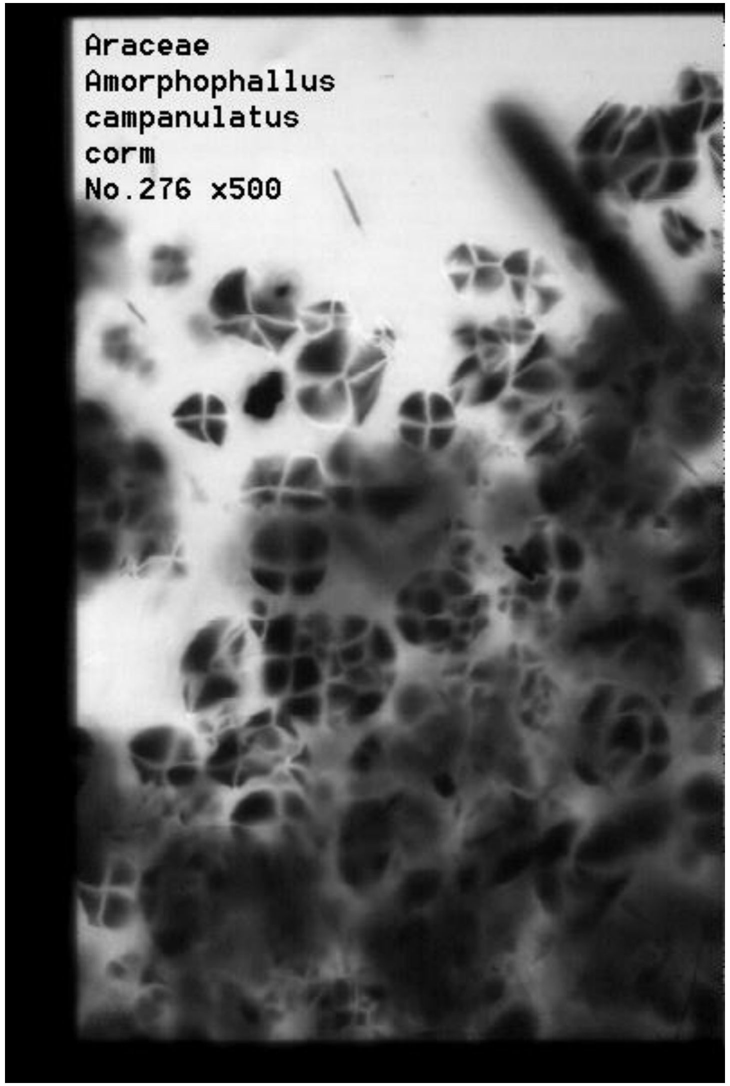
ARACEAE

Alocasia sp.

Australian Museum, McCown Archaeobotany Laboratory Collection



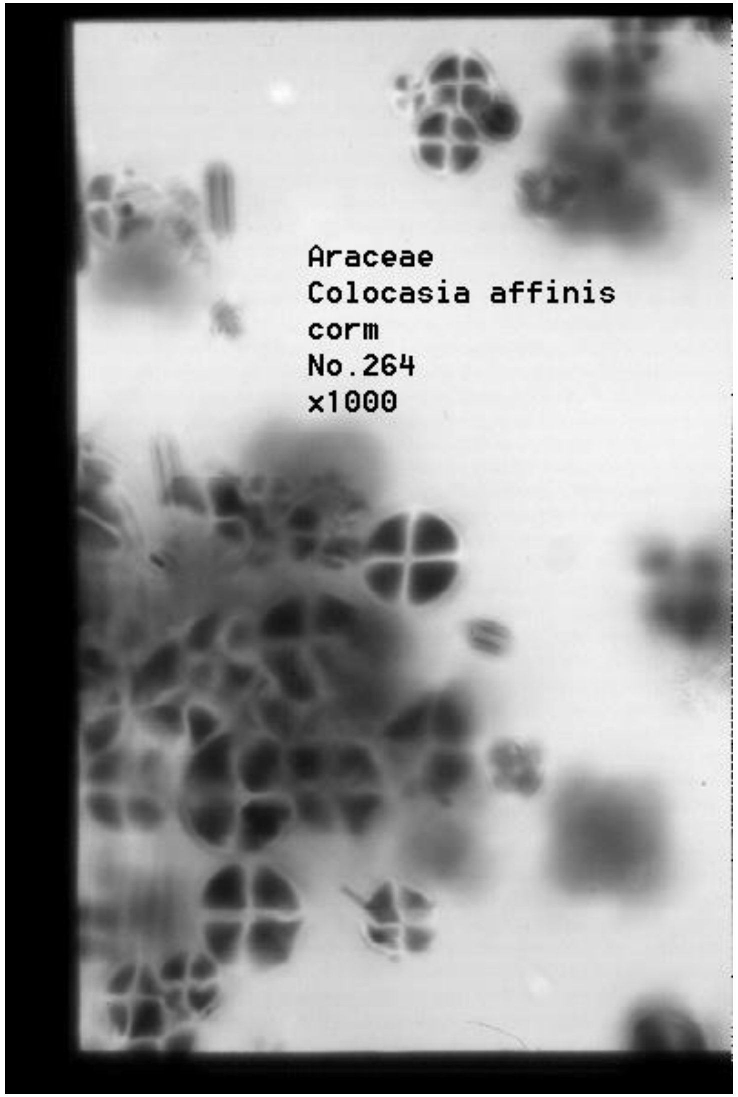
Amorphophallus companulatus

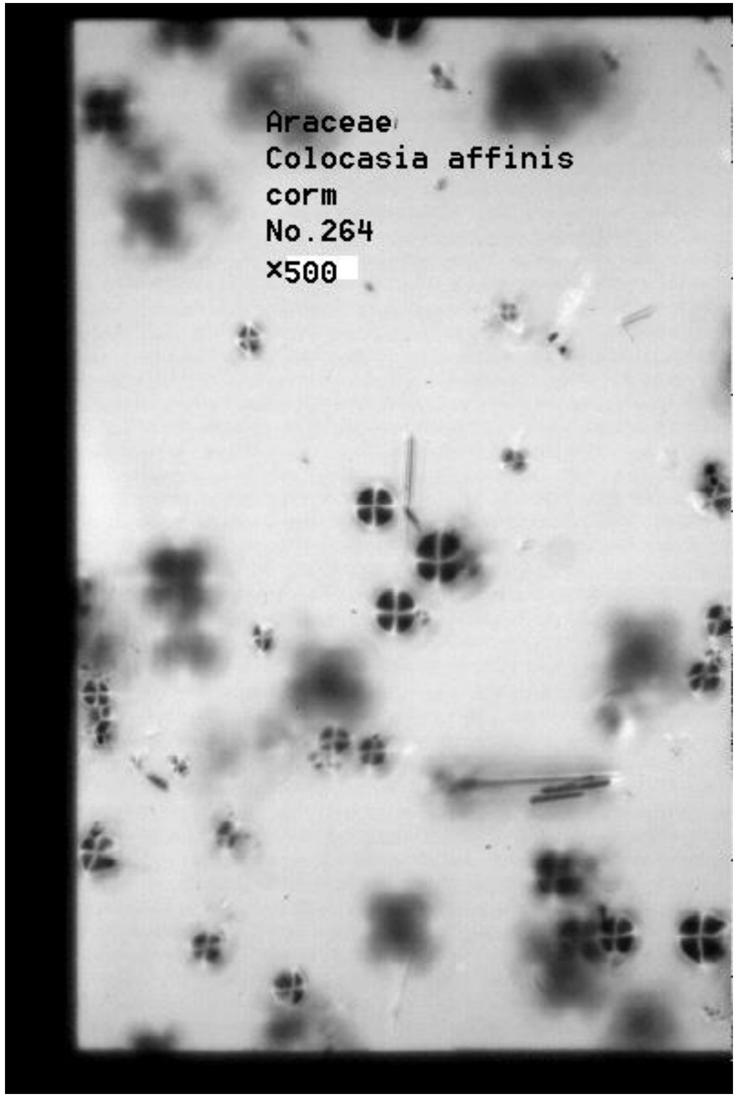


Australian Museum,
McCown Archaeobotany
Laboratory Collection

Colocasia affinis

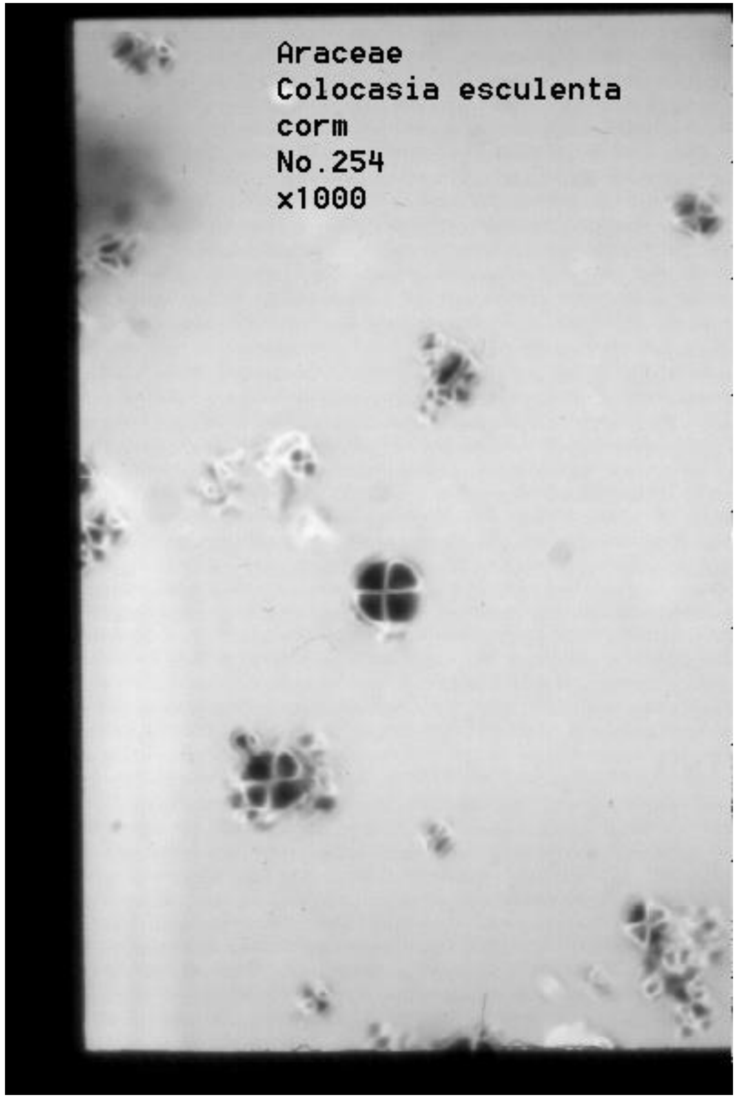
Australian Museum, McCown Archaeobotany Laboratory Collection

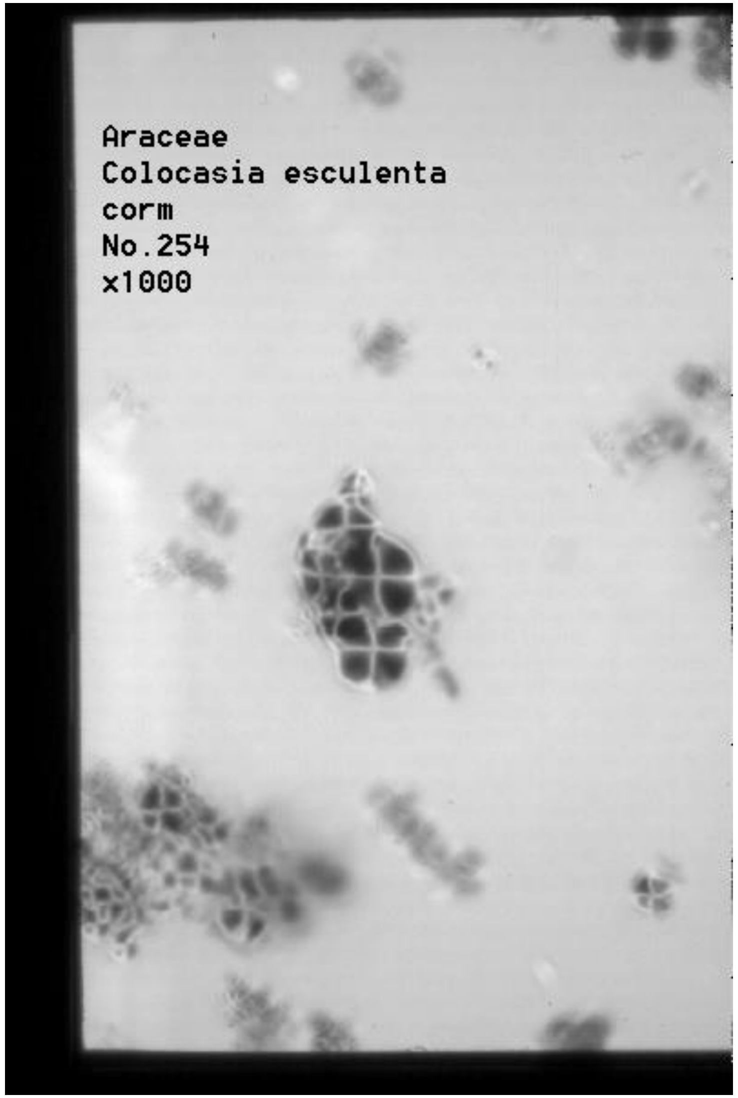


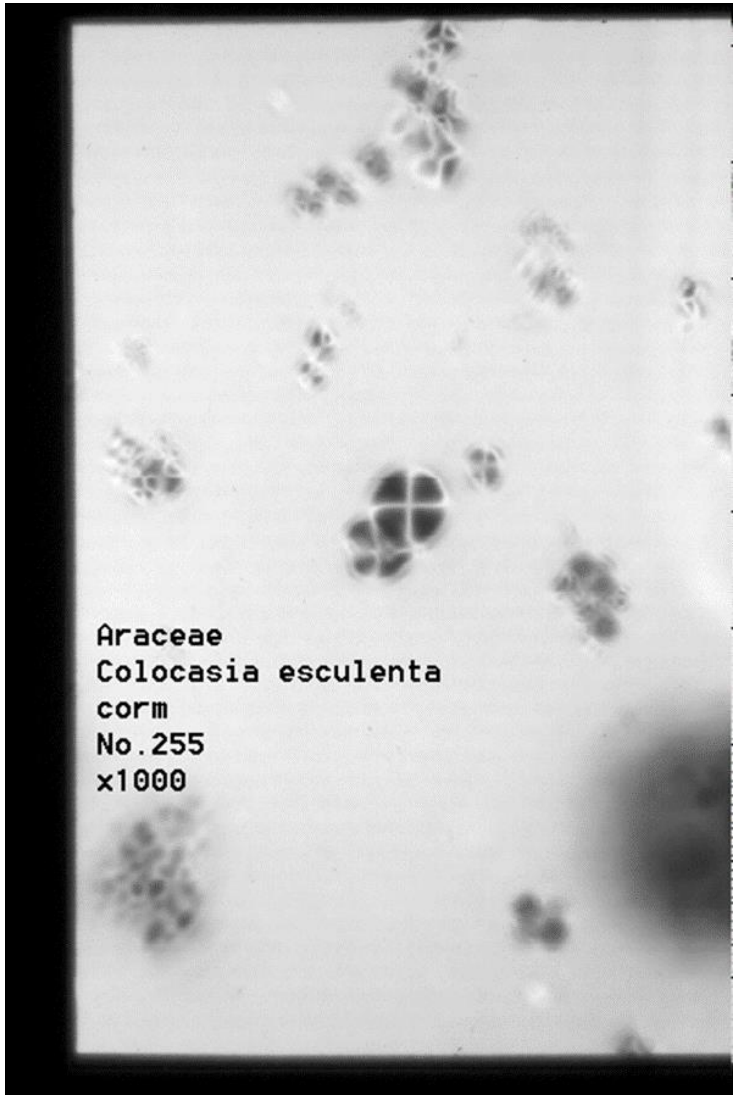


Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

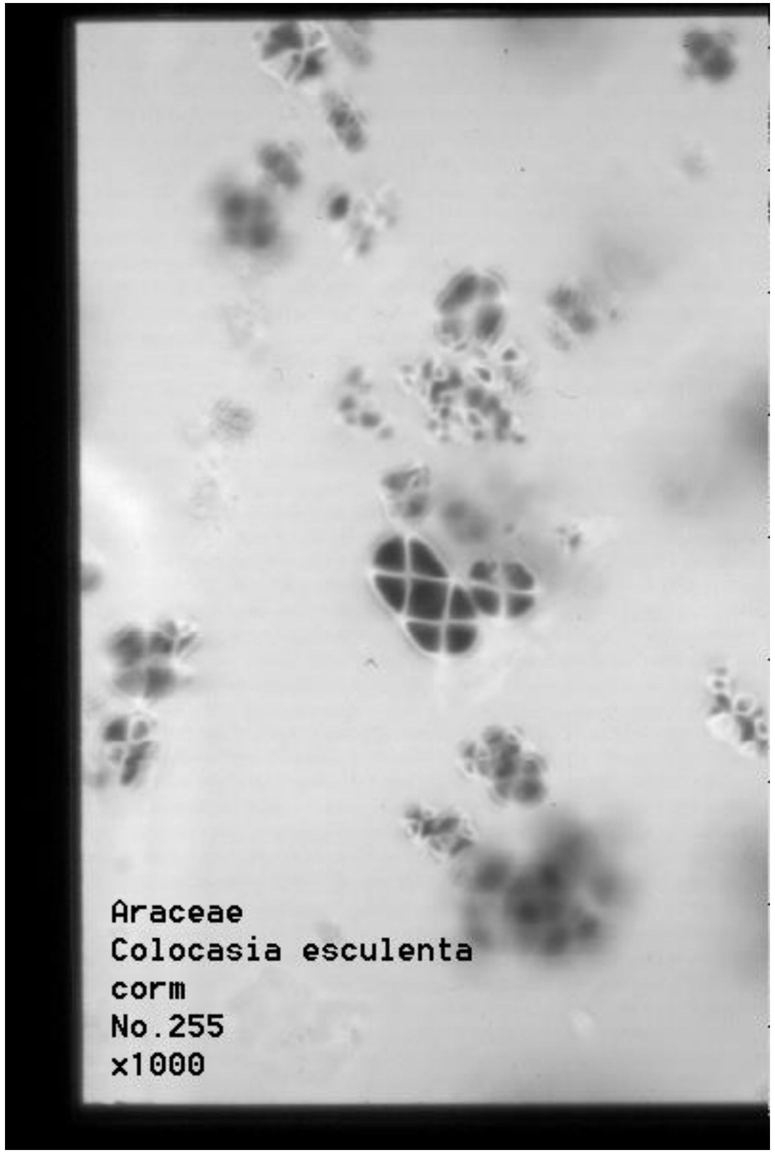


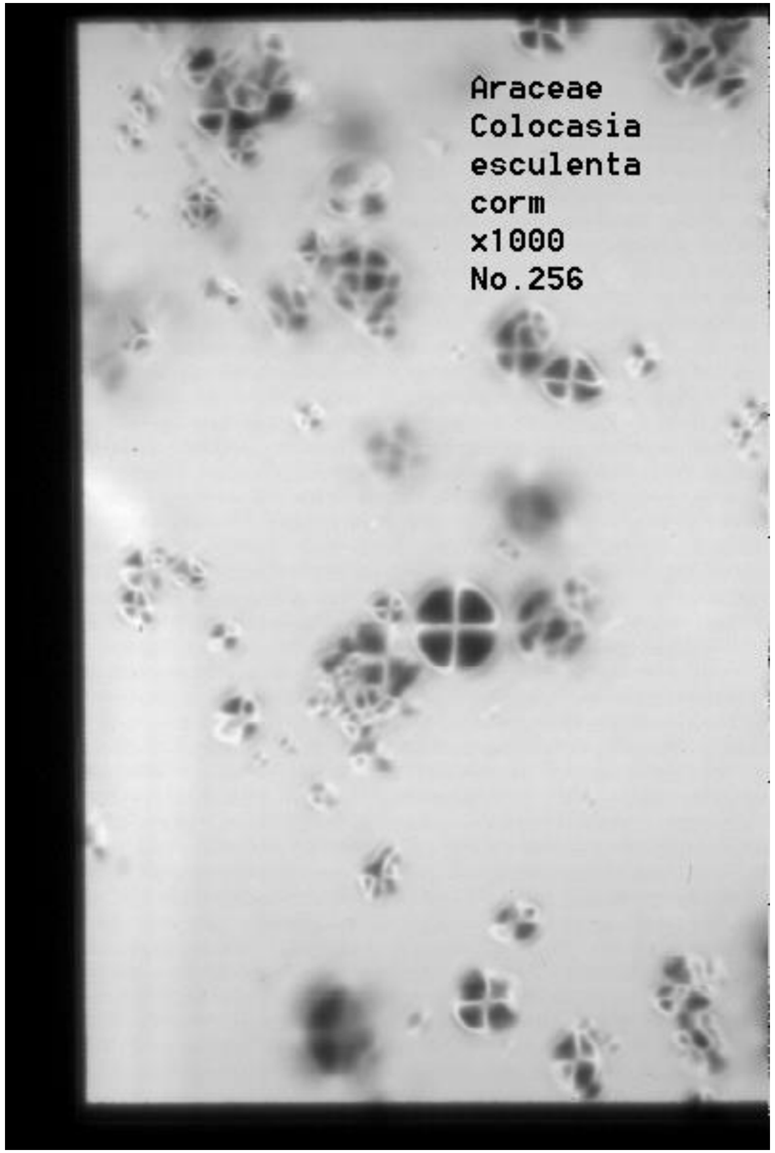


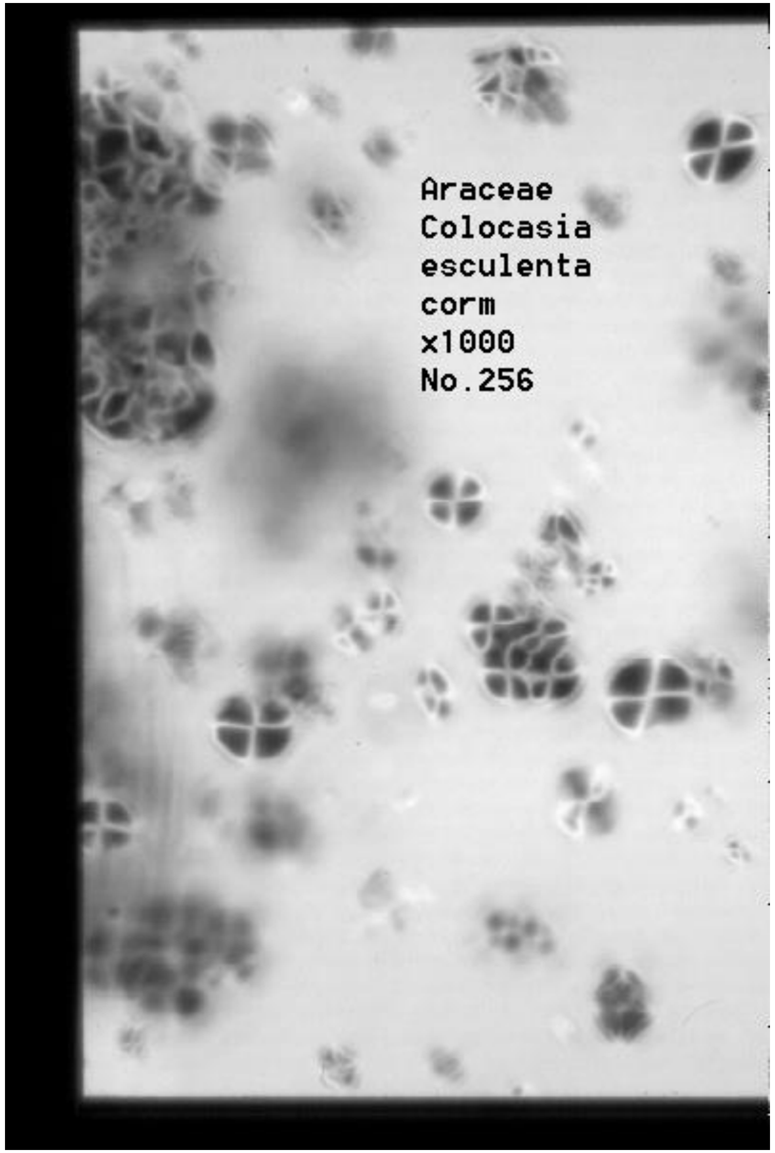


Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

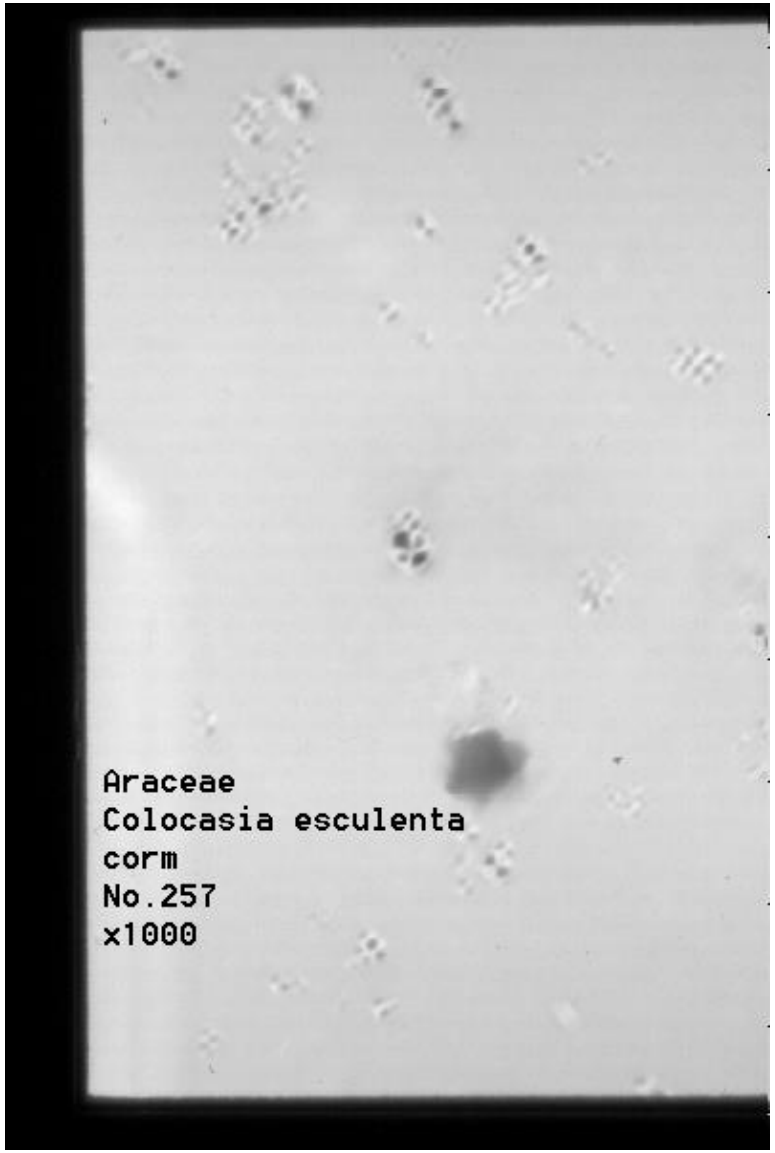


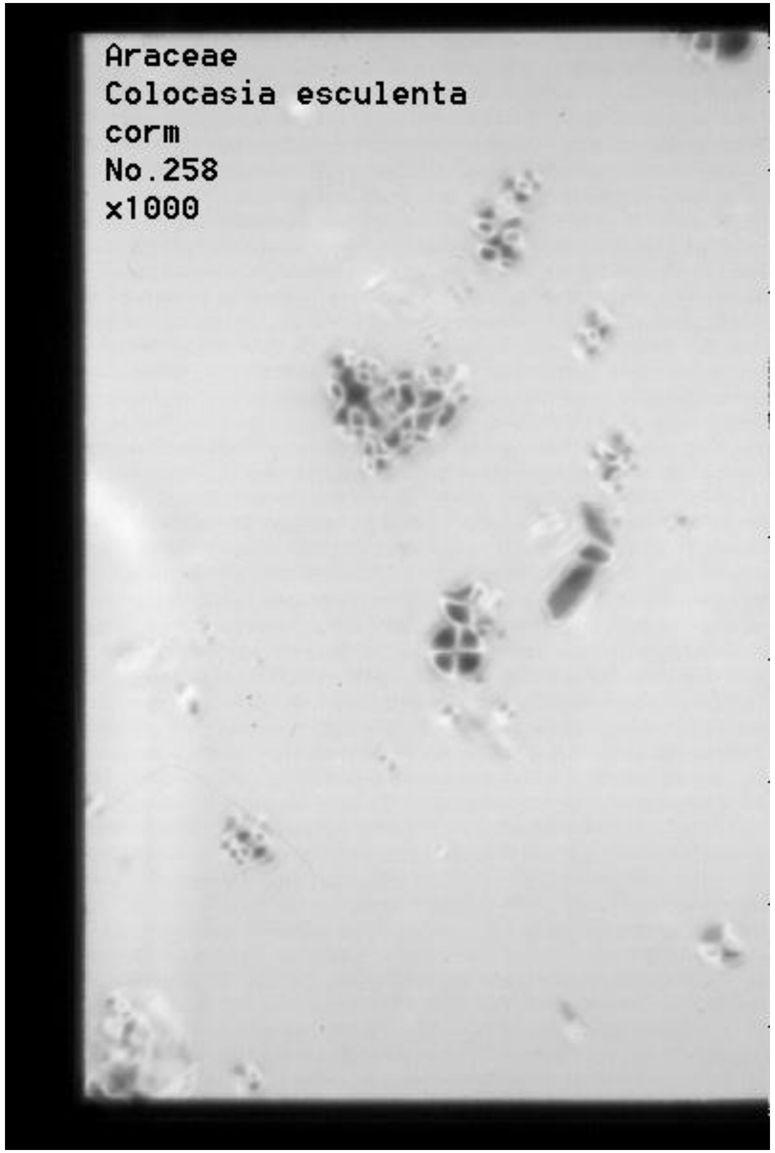


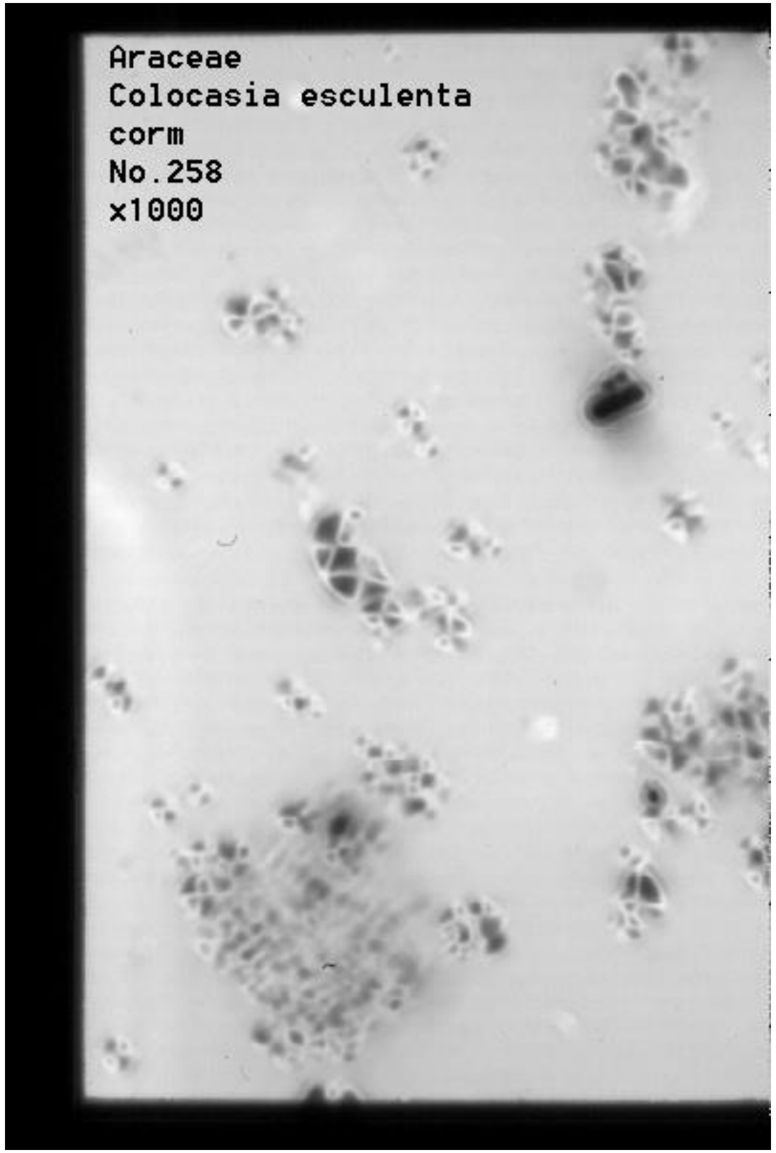


Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

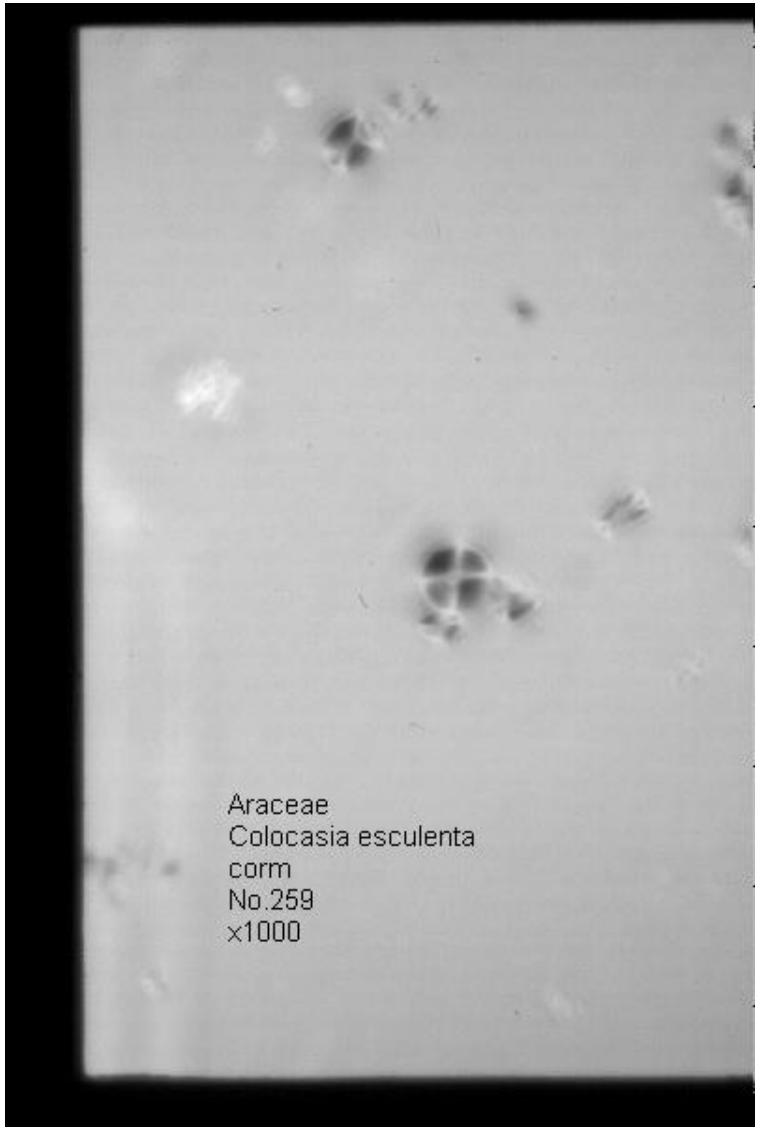


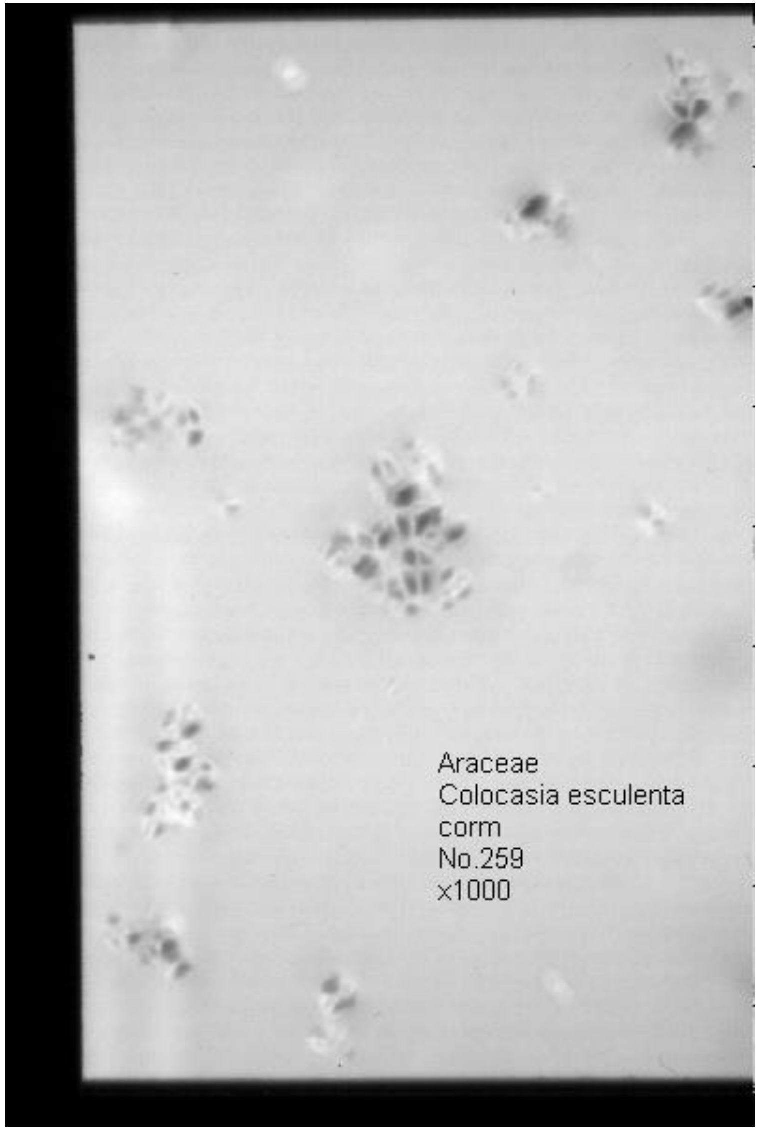


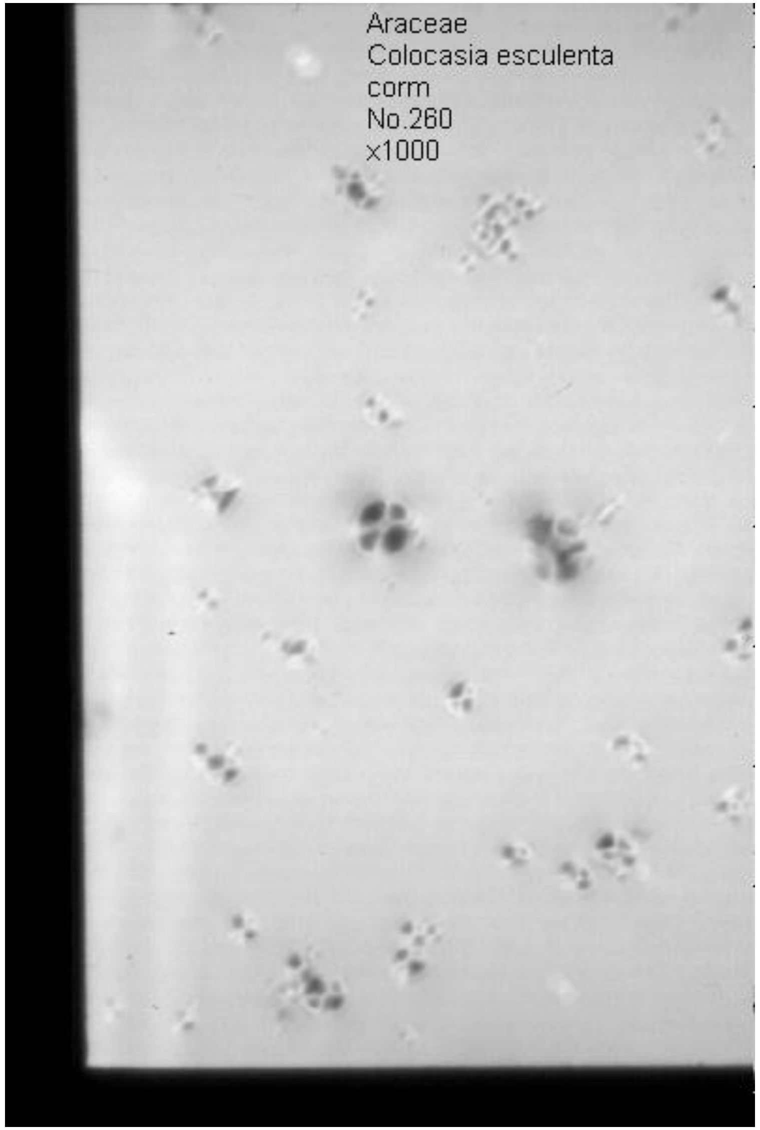


Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

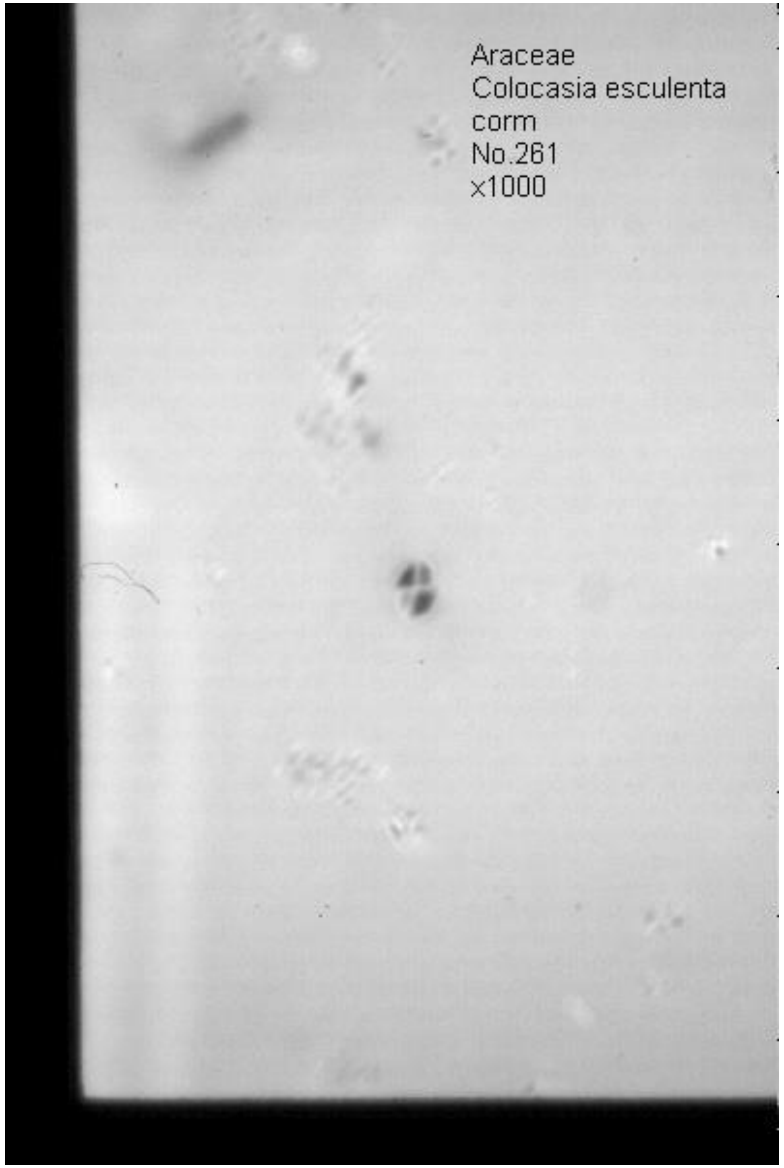


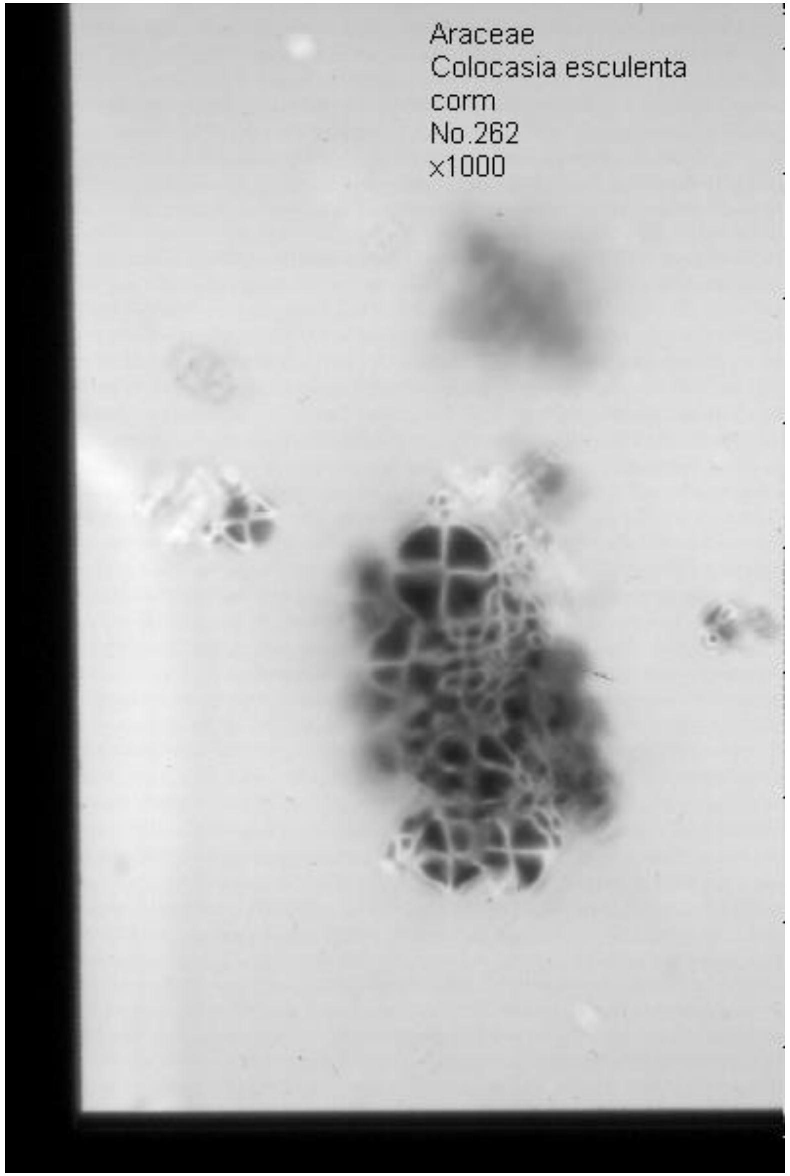




Colocasia esculenta

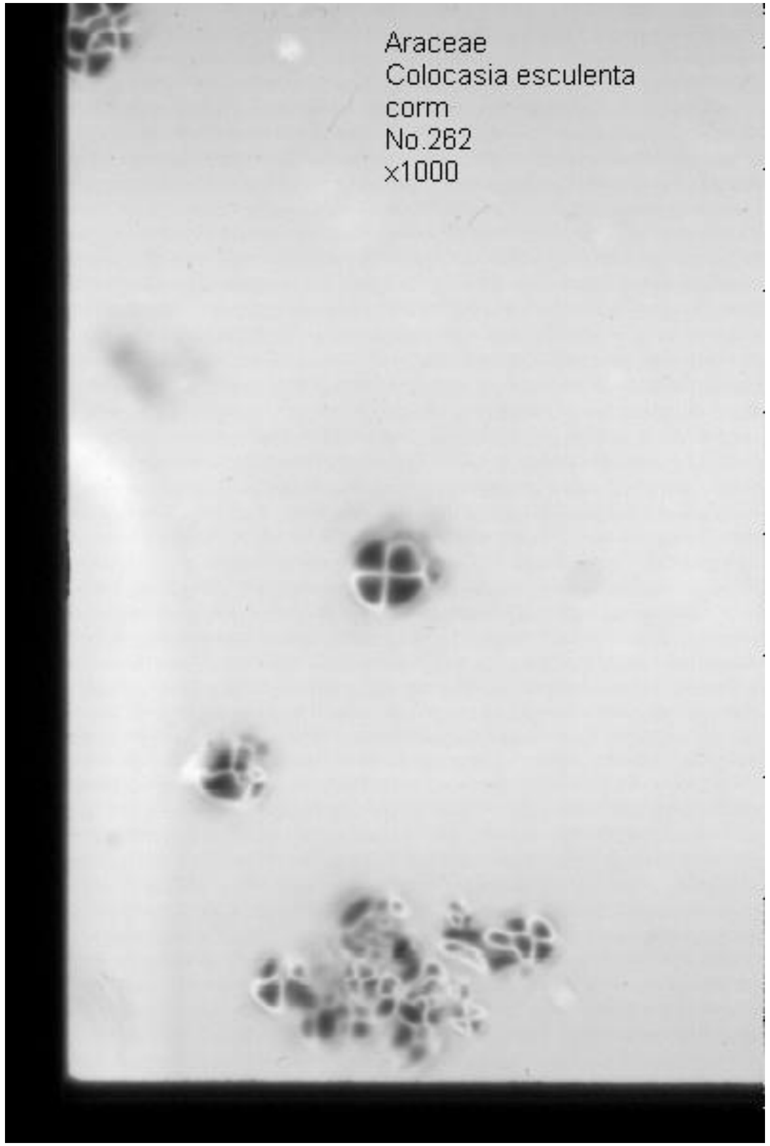
Australian Museum,
McCown Archaeobotany
Laboratory Collection

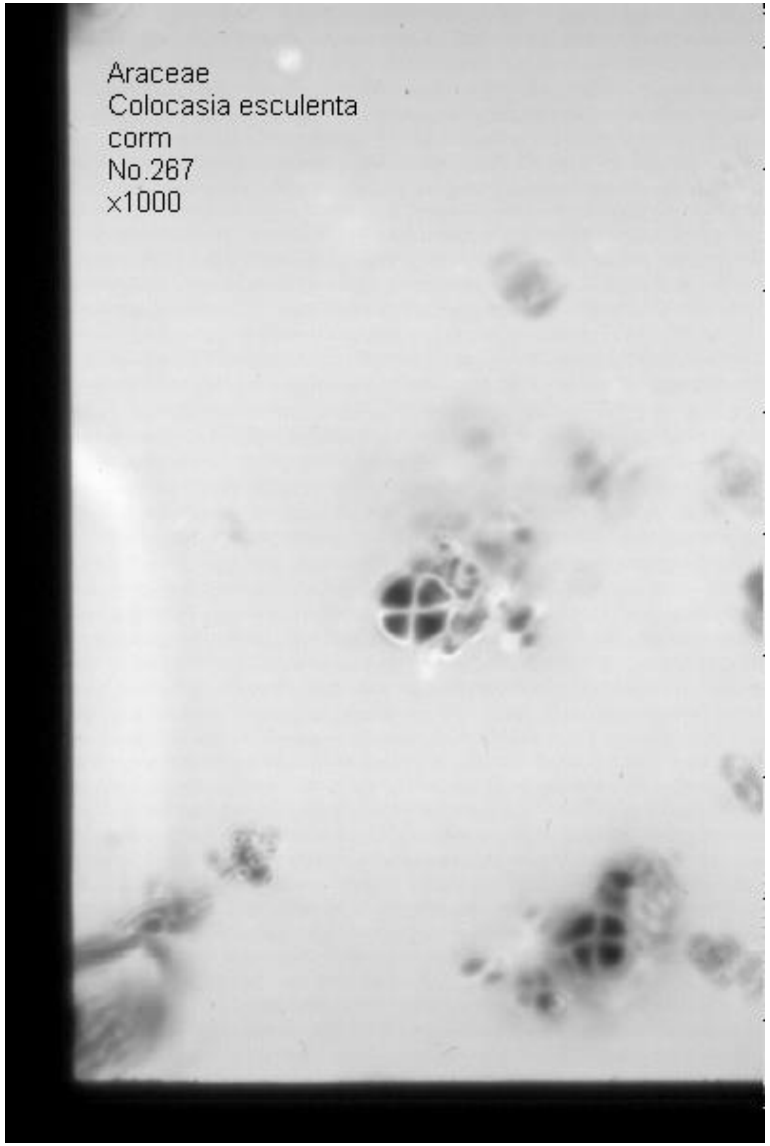


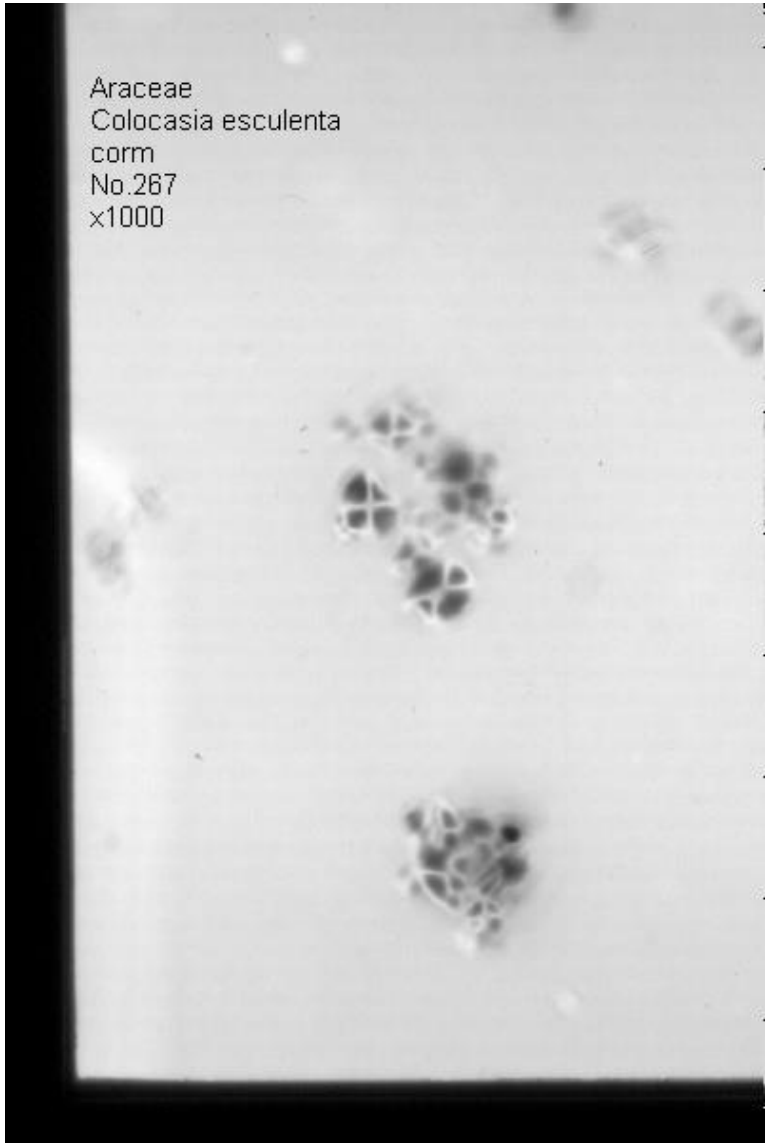


Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

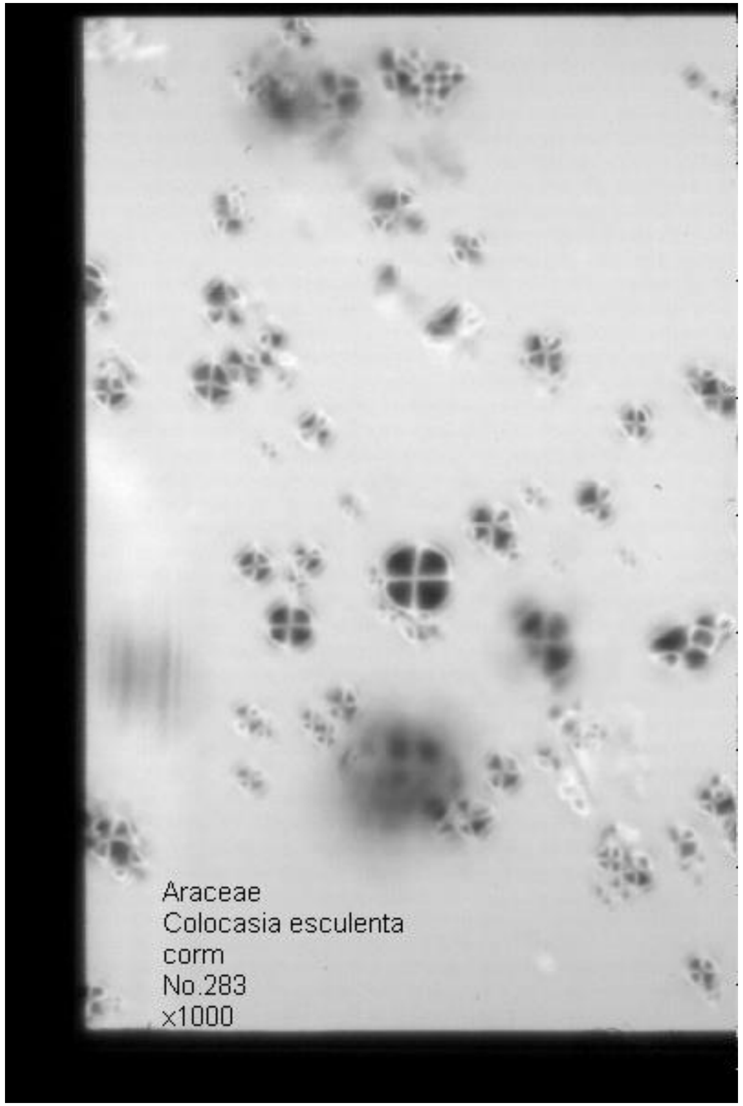


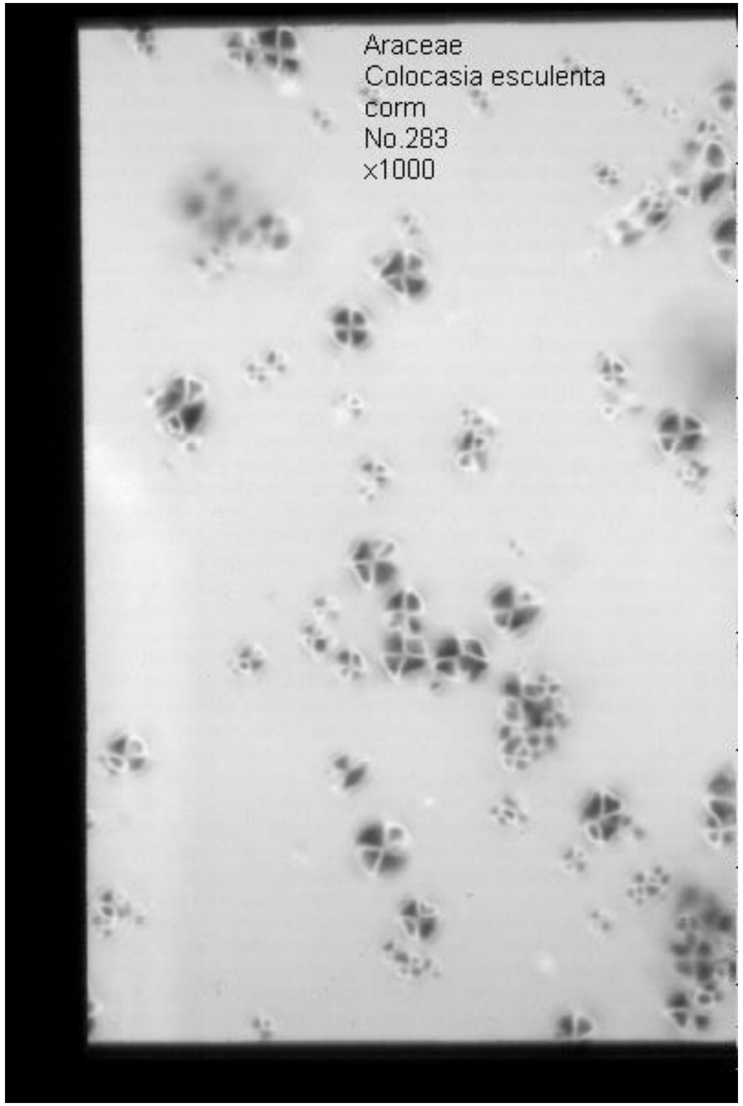




Colocasia esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

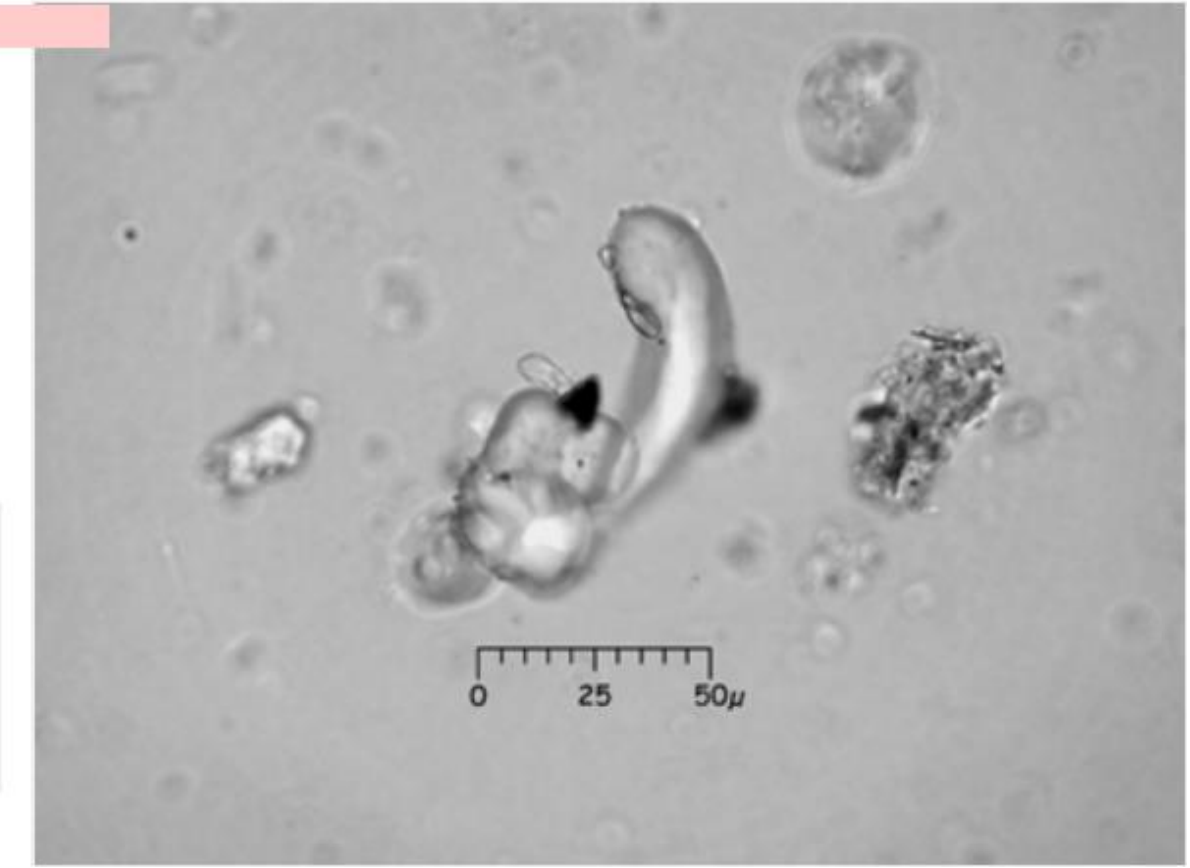




Colocasia esculenta

Phytolith

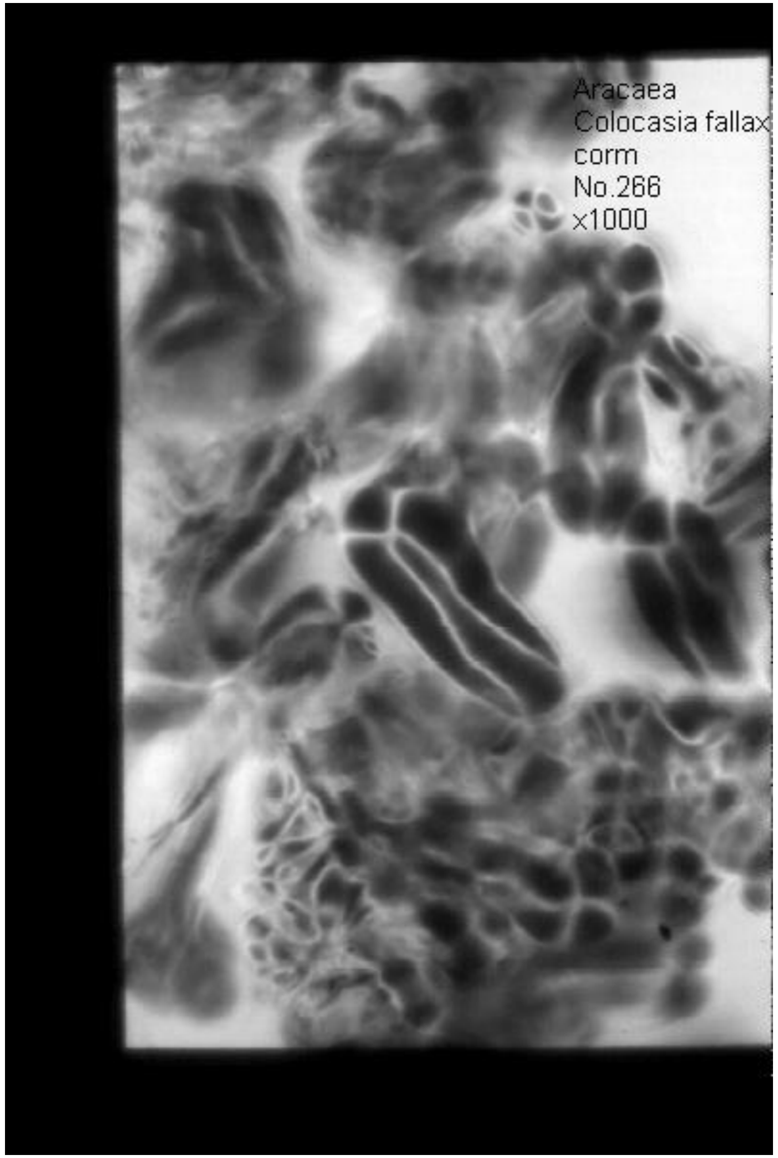
Type established by Karol Chandler- Ezell, 2004. Cultivated tuber. Diagnostic level: undetermined

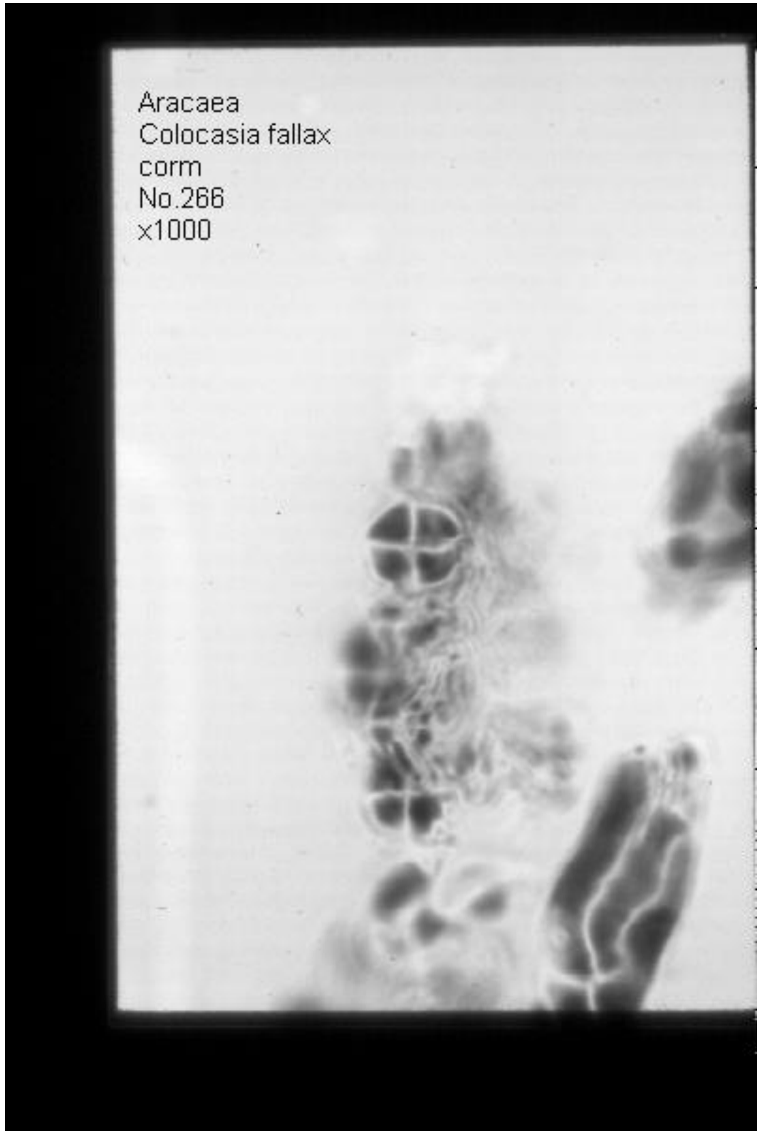


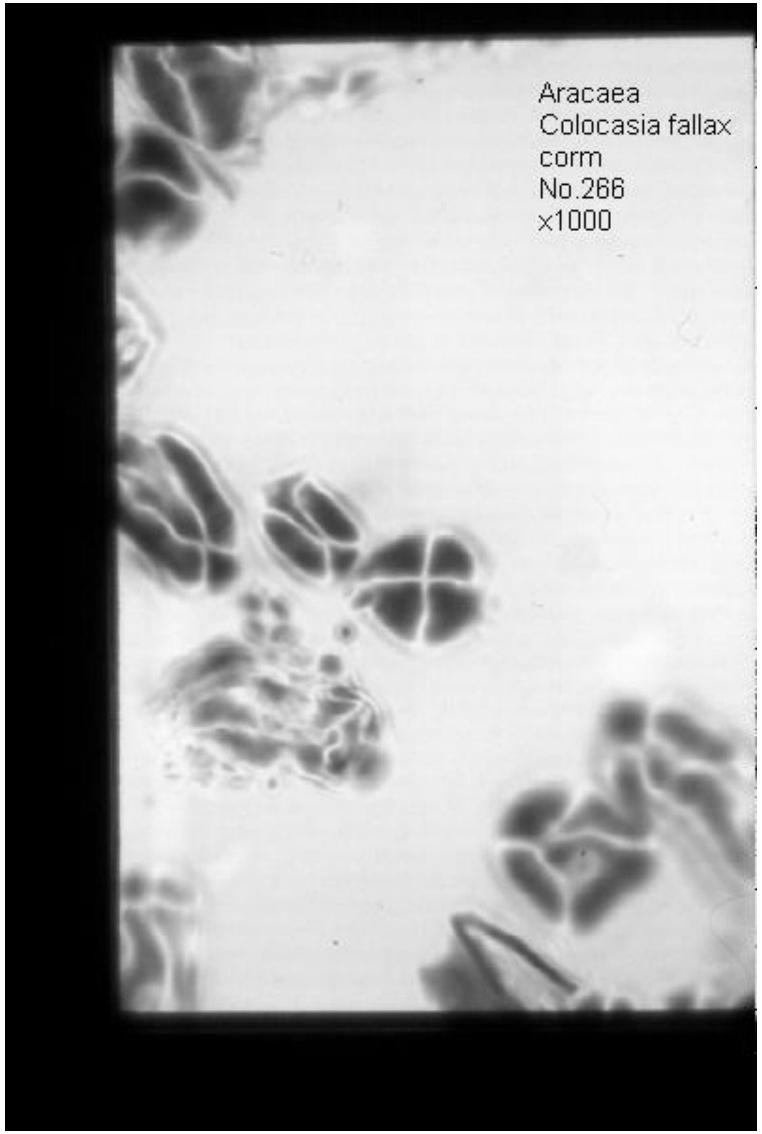
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Colocasia fallax

Australian Museum,
McCown Archaeobotany
Laboratory Collection

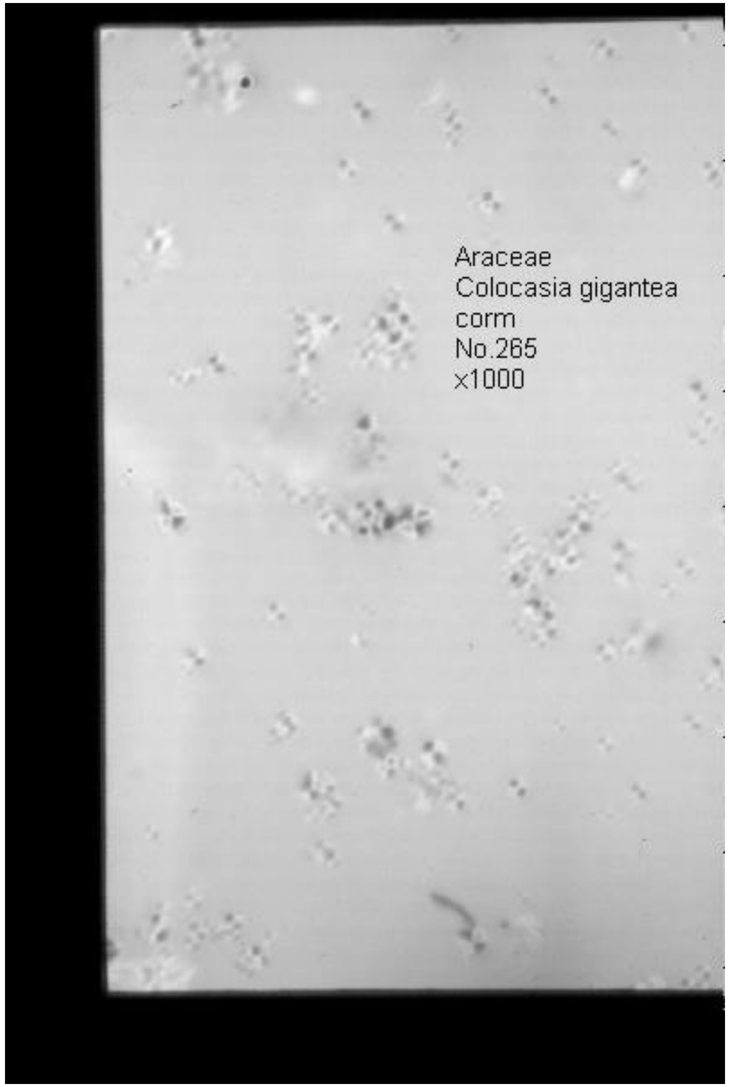


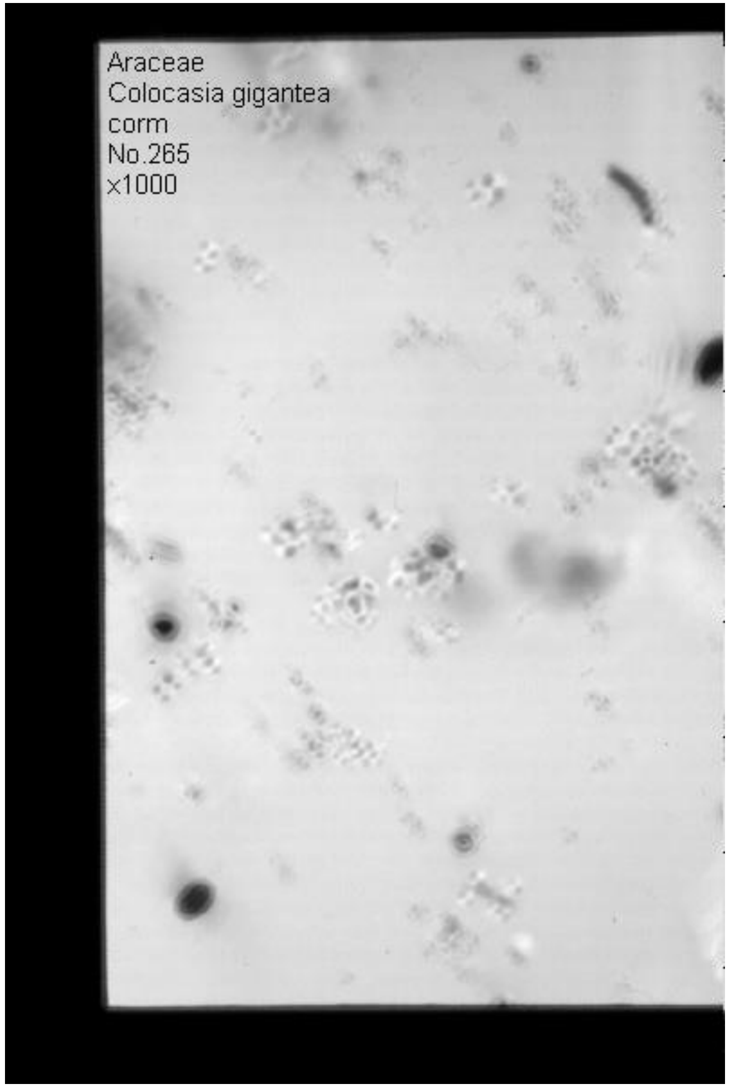




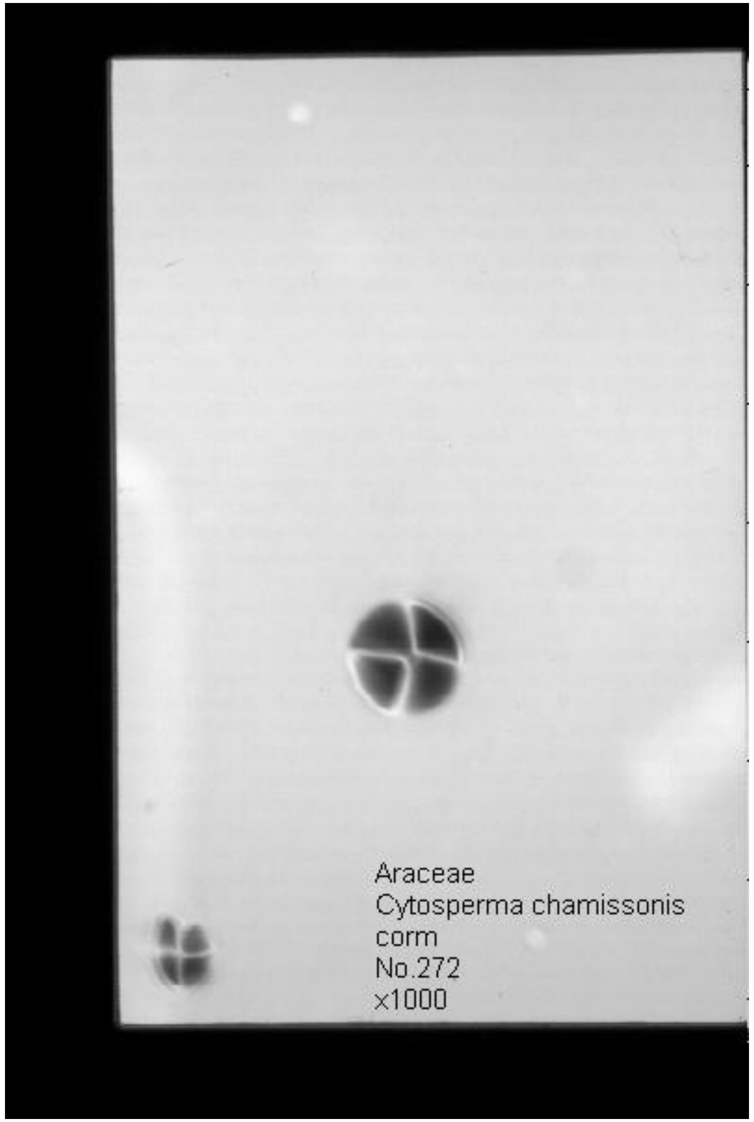
Colocasia gigantea

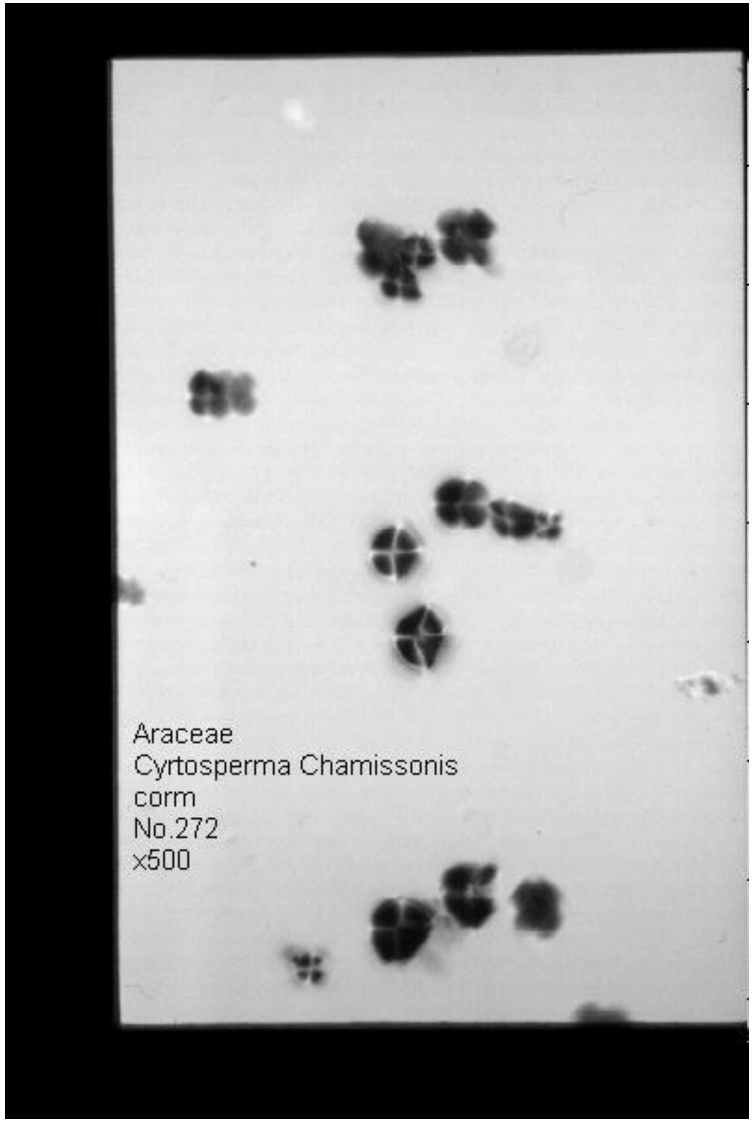
Australian Museum,
McCown Archaeobotany
Laboratory Collection





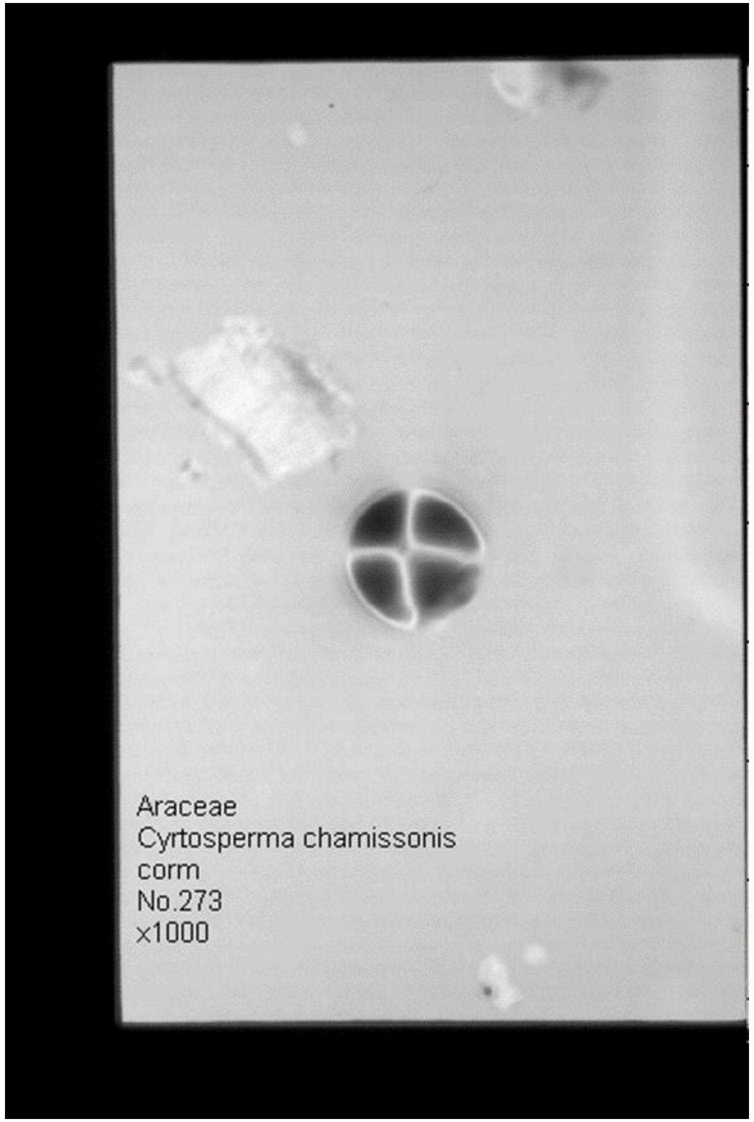
Cyrtosperma chamissonis

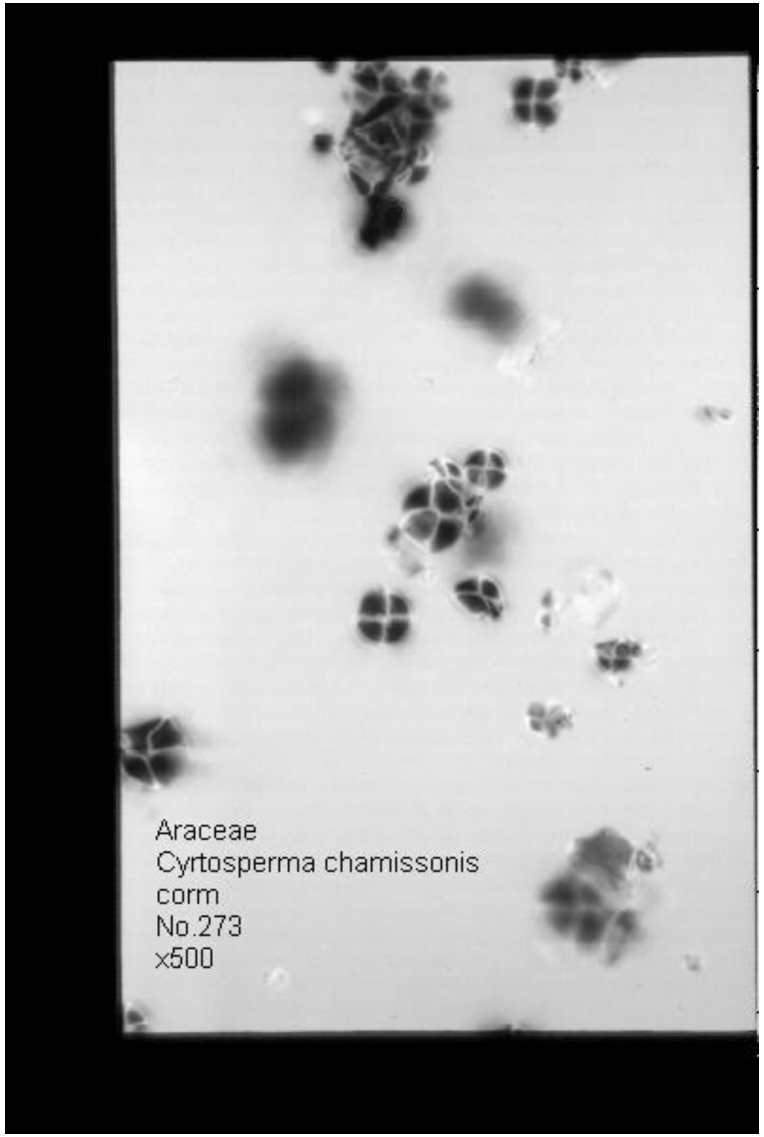




Australian Museum,
McCown Archaeobotany
Laboratory Collection

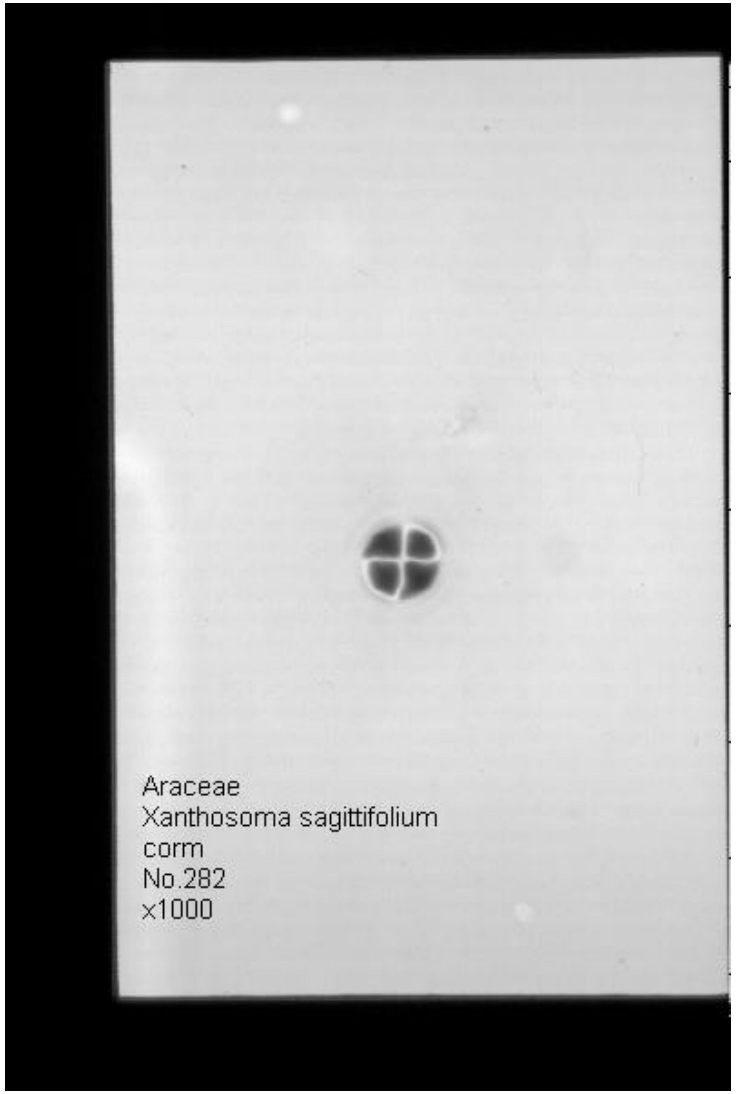
Cyrtosperma chamissonis

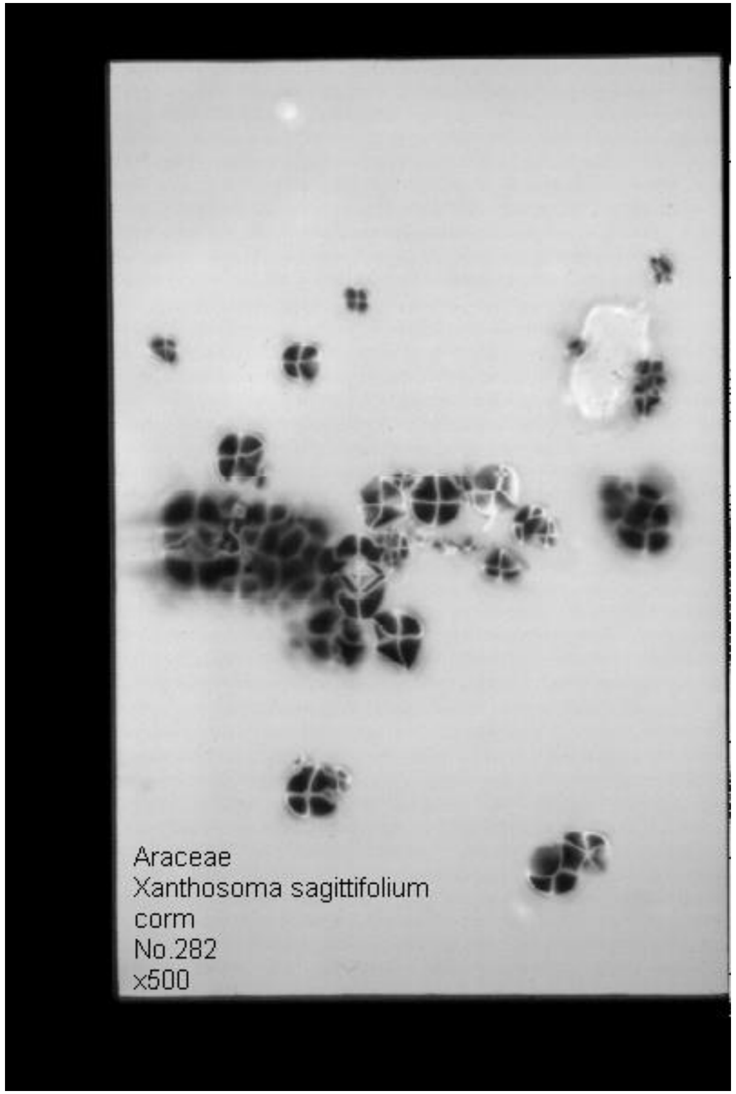




Australian Museum,
McCown Archaeobotany
Laboratory Collection

Xanthosoma sagittifolium





Australian Museum,
McCown Archaeobotany
Laboratory Collection

Xanthosoma sagittifolium

Starch

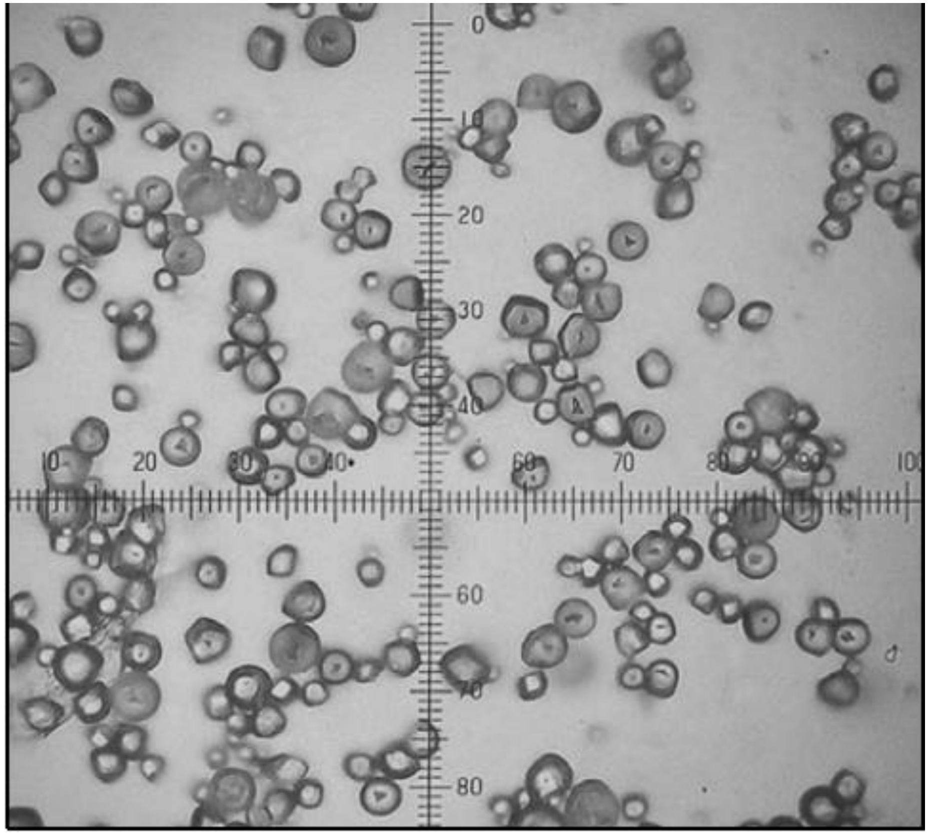
APPENDIX:
Xanthosoma sagittifolium (yautia, malanga). Com- pound grains, not laminated often without a fissure. Very defined pressure facets with conspicuous edges. Size: 2–16 microns long

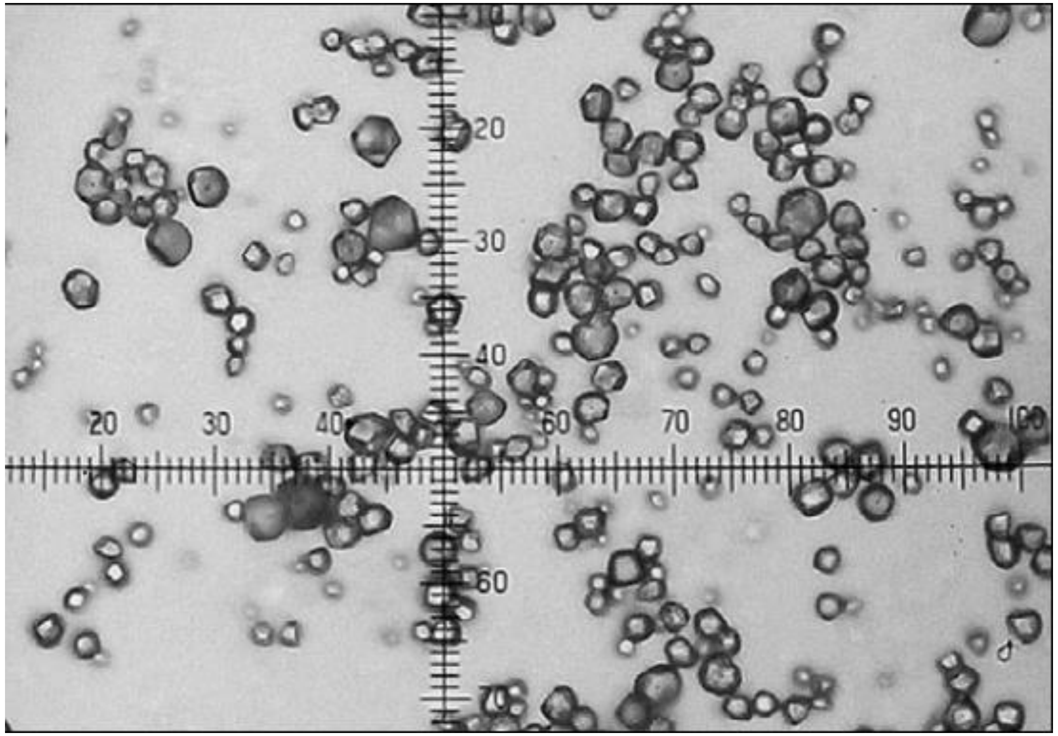
Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Xanthosoma sagittifolium

Starch

cf.

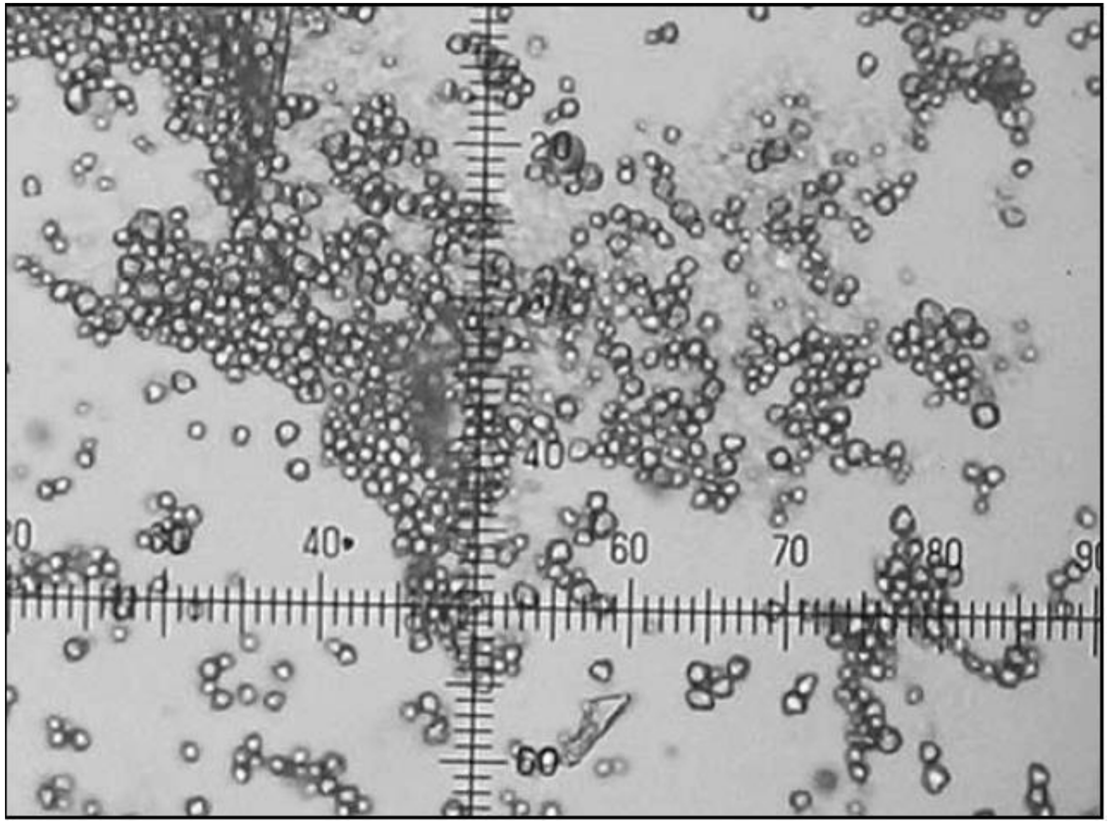




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Xanthosoma undipes

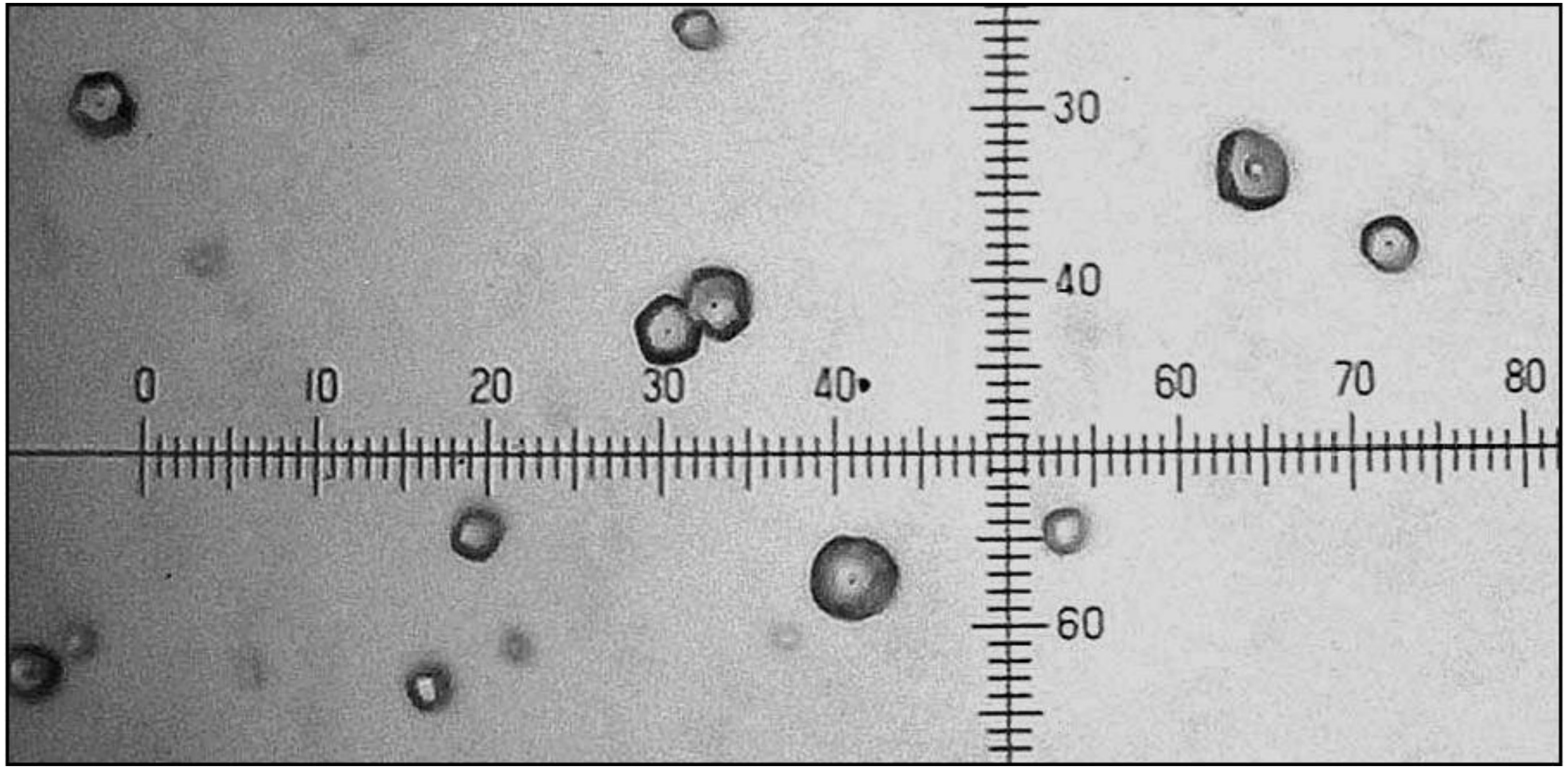
Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Xanthosoma violaceum

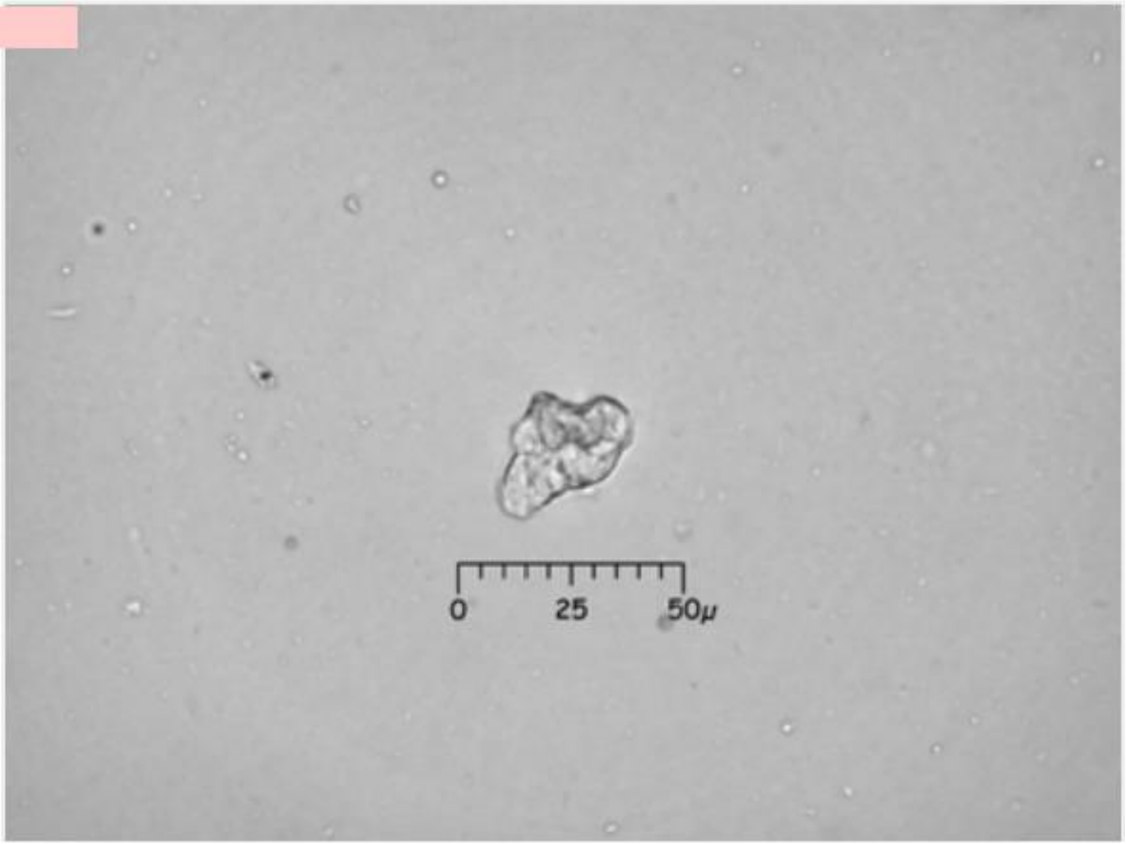
Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Xanthosoma sp.

Phytolith



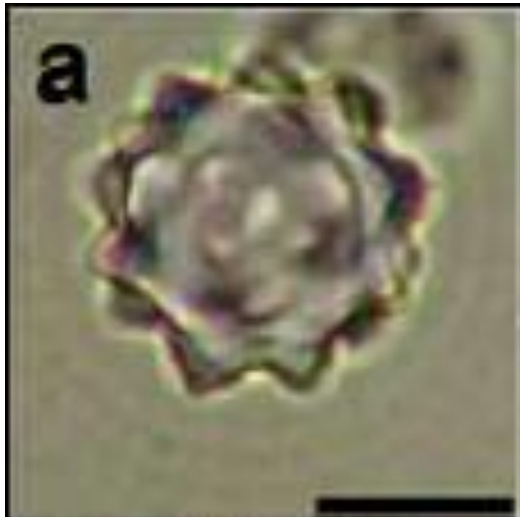
Type established by Karol Chandler- Ezell, 2004
Diagnostic level: not determined

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

ARECACEAE

Arecaceae

Phytolith



a. Globular echinate diagnostic of the Arecaceae

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Arecaceae

Phytolith

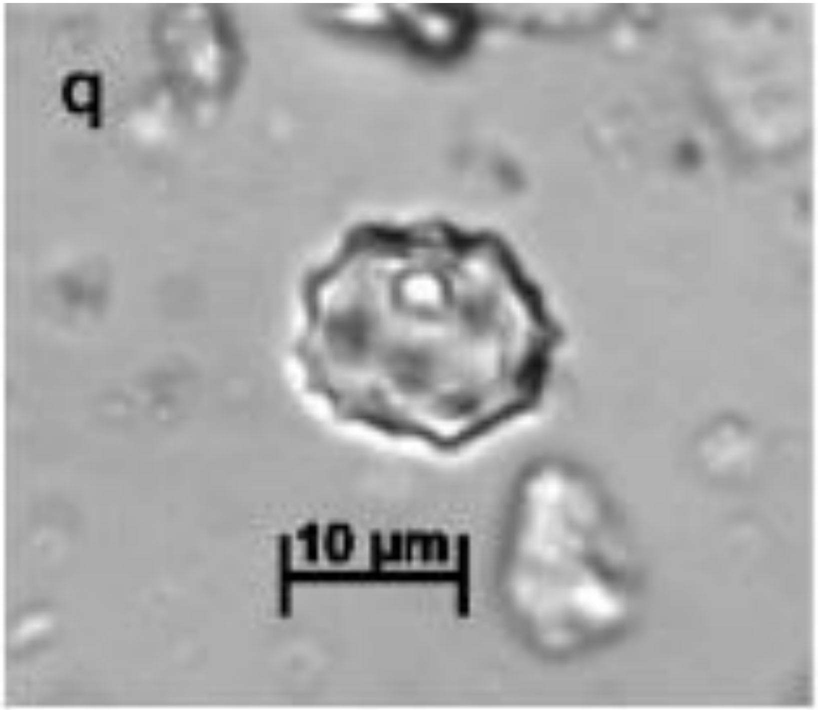


Fig. 5. Selected microbotanical remains. Phytoliths: q) Arecaceae globular echinate (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Acrocomia sp.

Palmae *Acrocomia* sp. "chonta"

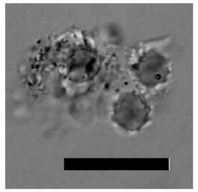
Phytolith assemblage characterization

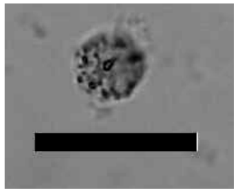
leaf

Diagnostic phytoliths:

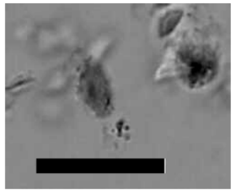
a) Conical echinate silica phytoliths. Very common.

Plane view.

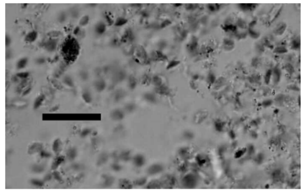




Lateral view.



Assemblage.

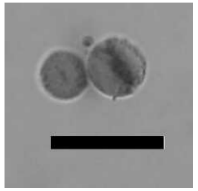


References: Reported in Piperno 1988:24 from Tomlinson 1961.

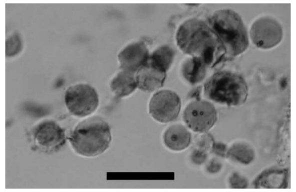
leaf trunk

Diagnostic phytoliths **(*):**

a) Round psilate silica phytolith. Very common.



Assemblage.



Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Acrocomia aculeata

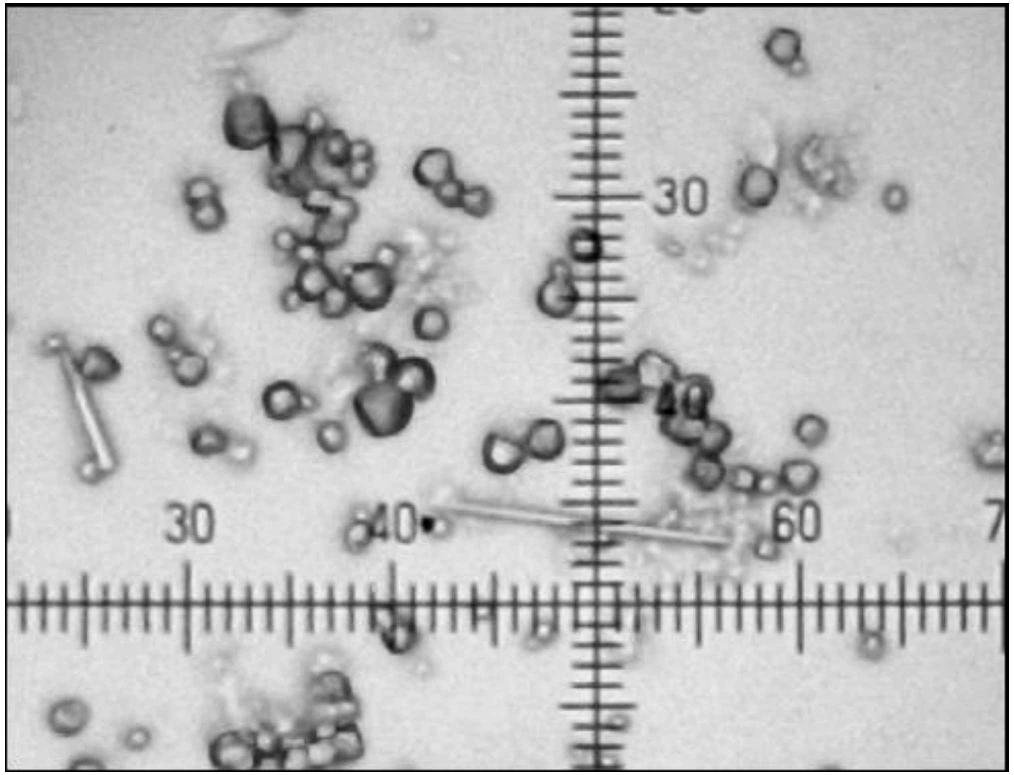
Phytolith

A. Silicified cells of Acrocomia aculeata. ICN 0842.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Acrocomia media

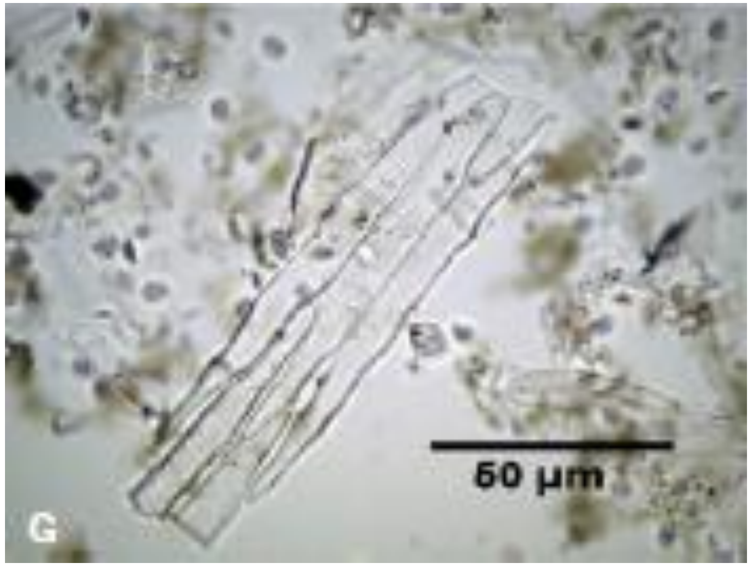
Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Aiphanes deltoidea

Phytolith

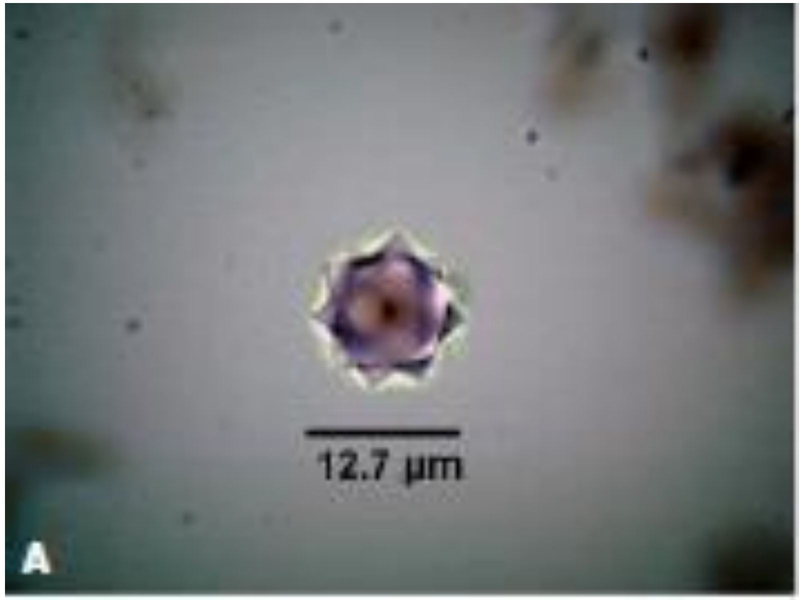


G. Silicified cells of Aiphanes deltoidea. ICN 0242.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Ammandra decasperma

Phytolith



A. globular echinate symmetrical (Ammandra decasperma. ICN 0244).

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Astrocaryum acaule

Phytolith

H. Silicified cells of Astrocaryum acaule. ICN 0245.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Astrocaryum chambira

Phytolith

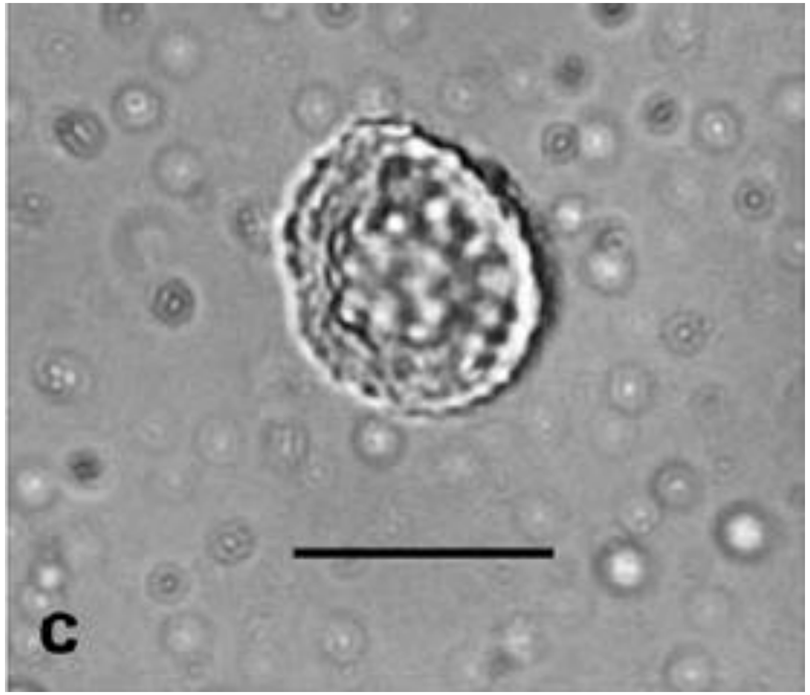
B. Silicified cells of Astrocaryum chambira. ICN 0249.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Astrocaryum murumuru

Phytolith

Fig. 3. Phytoliths from non-grass monocots. c) Conical body from Astrocaryum murumuru



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Attalea butyracea

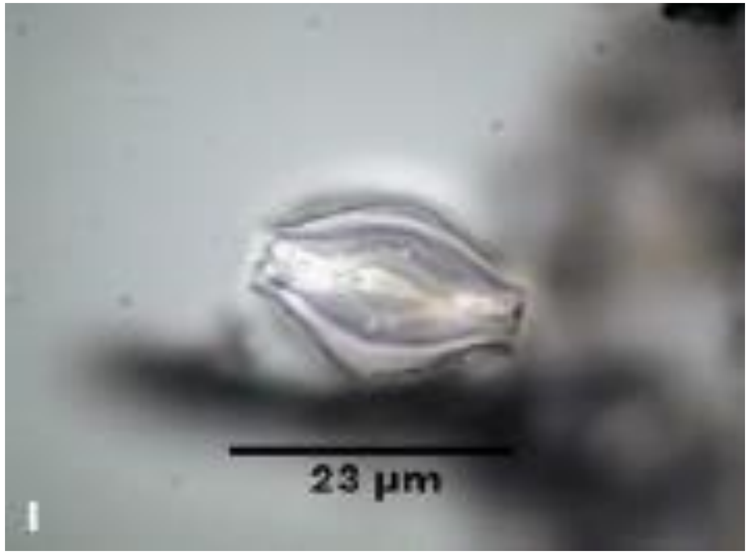
Phytolith

B. globular echinate (Attalea butyracea. ICN 0255).
C. globular echinate elongate (Attalea butyracea. ICN 0254).

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Attalea maripa

Phytolith

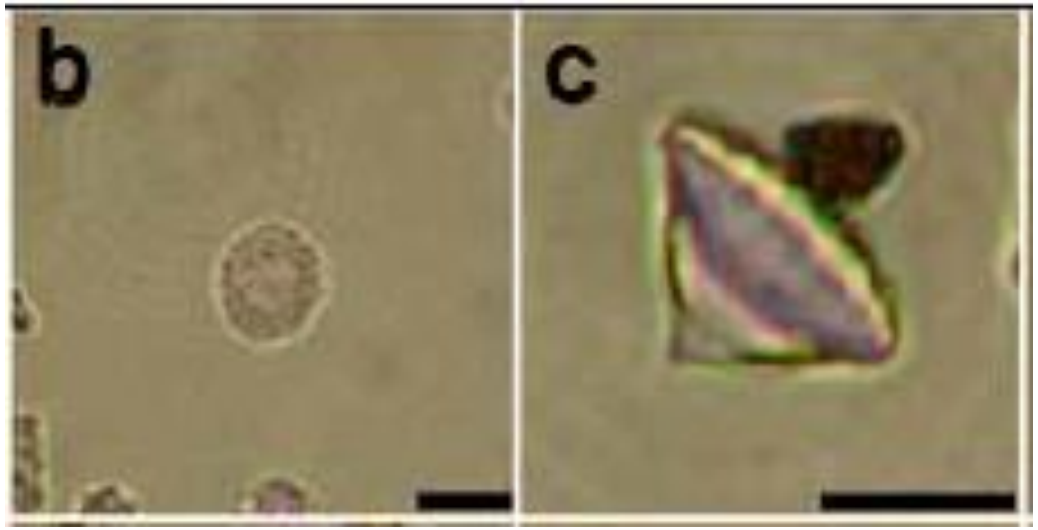


I. Silicified cells of Attalea maripa. ICN 0263.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Bactris-type

Phytolith

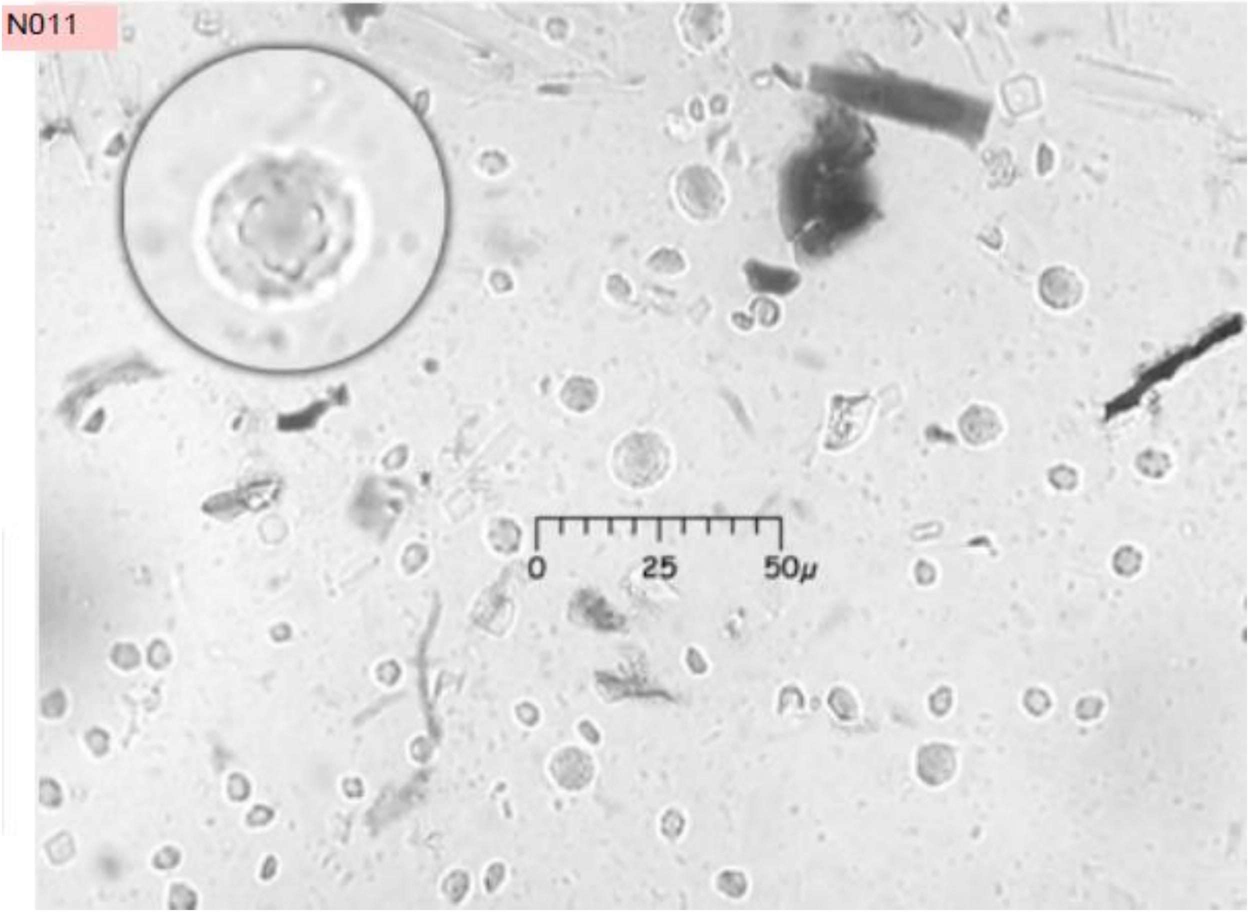


b. *Bactris*-type spinulose conical body diagnostic of the Arecaceae, but may be distinctive of certain palm genera such as *Bactris*, *Geonoma*, *Caryota*, and *Chamaedorea*.
c. *Bactris*-type in side-view.

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Bactris sp.

Phytolith

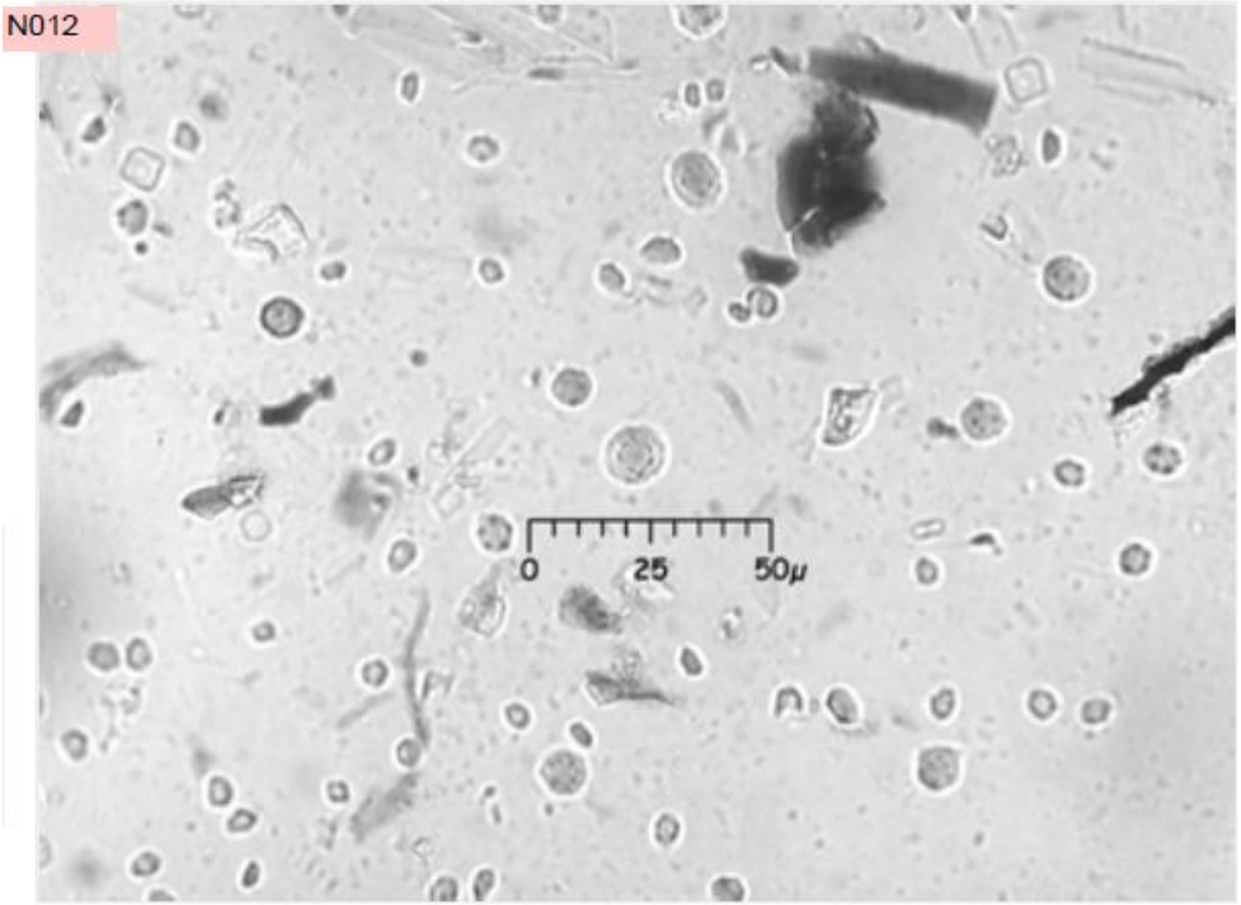


Side view of body shows profile of two projections on top, smooth bottom surface.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bactris sp.

Phytolith

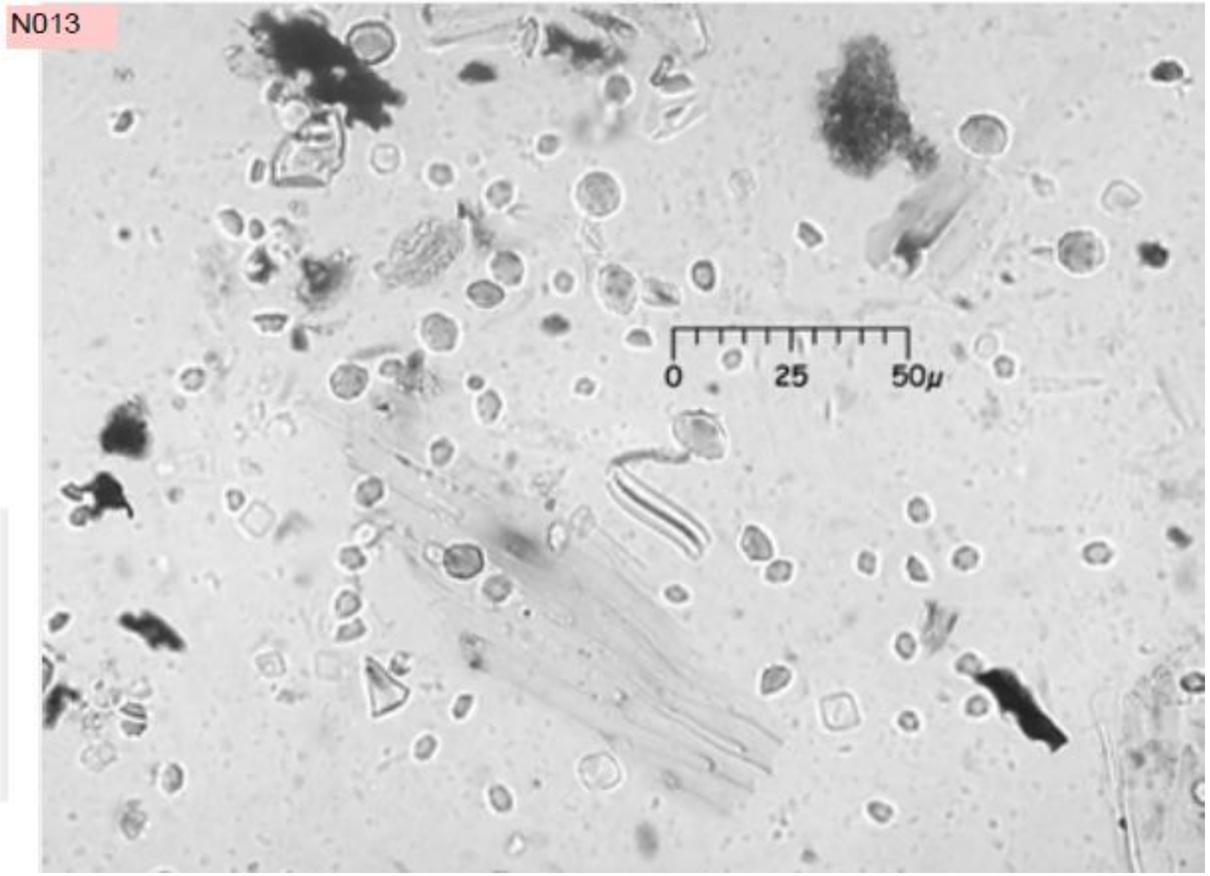


There are several small spinulose spheres and other conical bodies in the background of this image.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bactris sp.

Phytolith



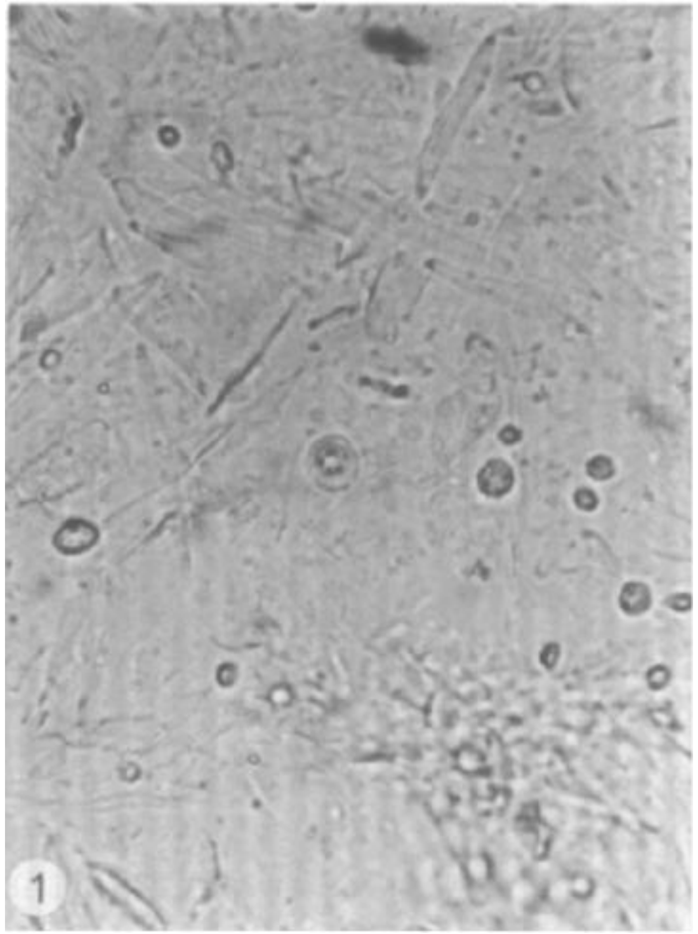
You can spot several spinulose spheres and other conical bodies in the background of this image. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bactris sp.

Phytolith

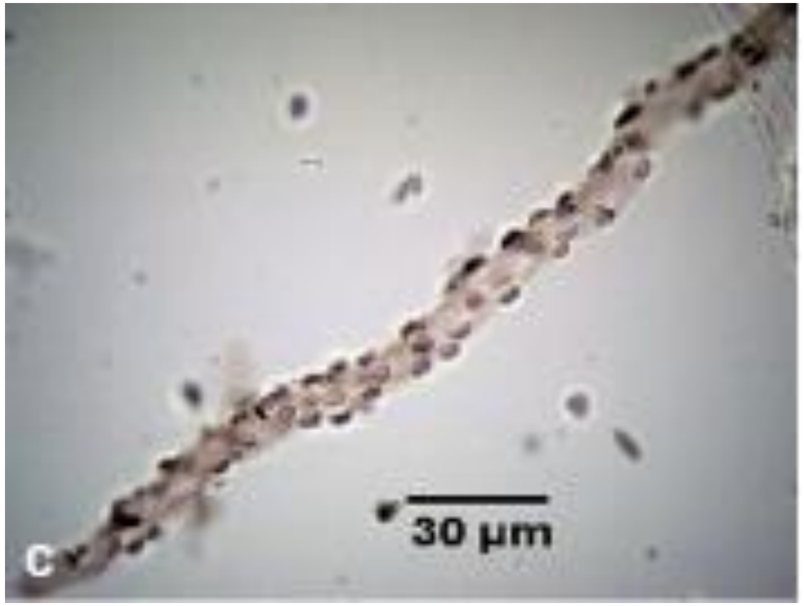
1. Hat-shaped silica bodies from Bactris (400 ×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Bactris gasipaes var. gasipaes

Phytolith



C. Silicified cells of Bactris gasipaes var. gasipaes. ICN 0855

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Bactris gasipaes

Starch

APPENDIX:
Bactris gasipaes (pejibaye, peach palm). Mostly simple grains, rarely compound, with slight depressions. Size: 4–14 microns long. Most palms contain few starch grains, which are unremarkable in shape, and very small. Size: 1–2 microns

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Bactris killipii

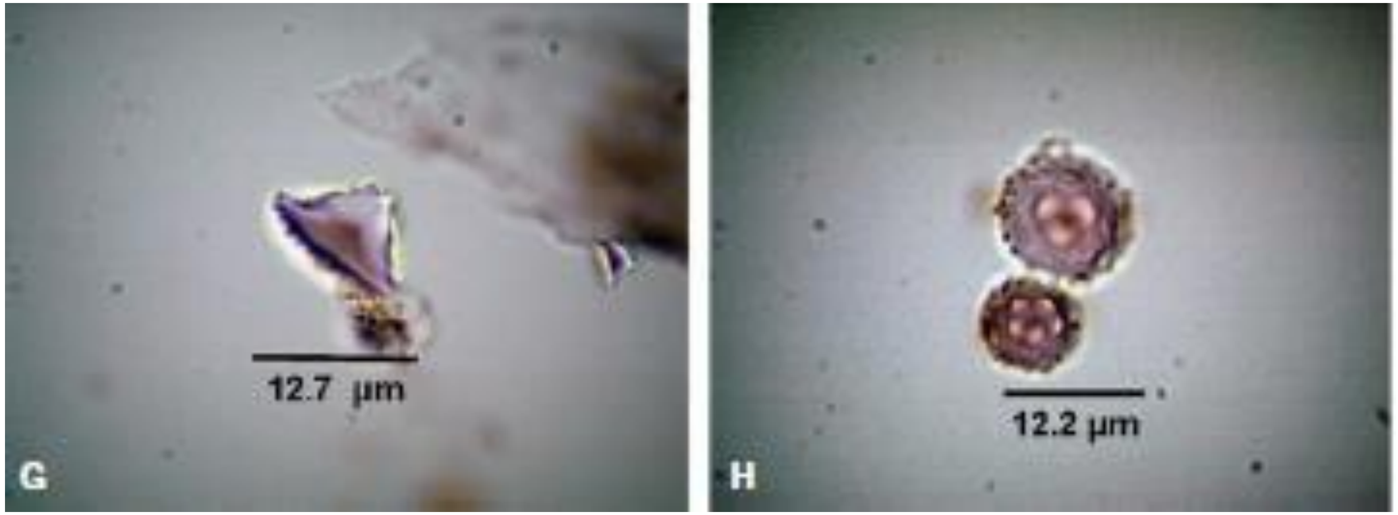
Phytolith

F. Silicified cells of Bactris killipii. ICN 0858.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Bactris sphaerocarpa

Phytolith

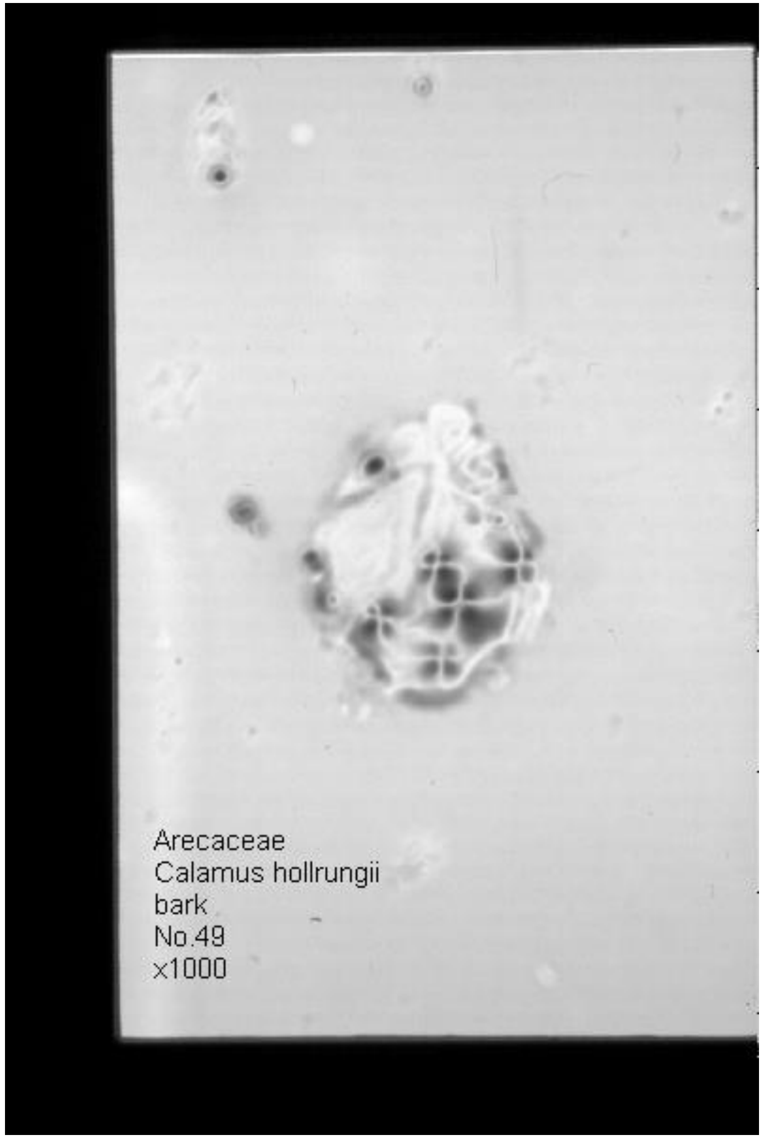


G. conical (front view) (Bactris sphaerocarpa. ICN 0299).
H. conical (top view) (Bactris sphaerocarpa. ICN 0299).

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

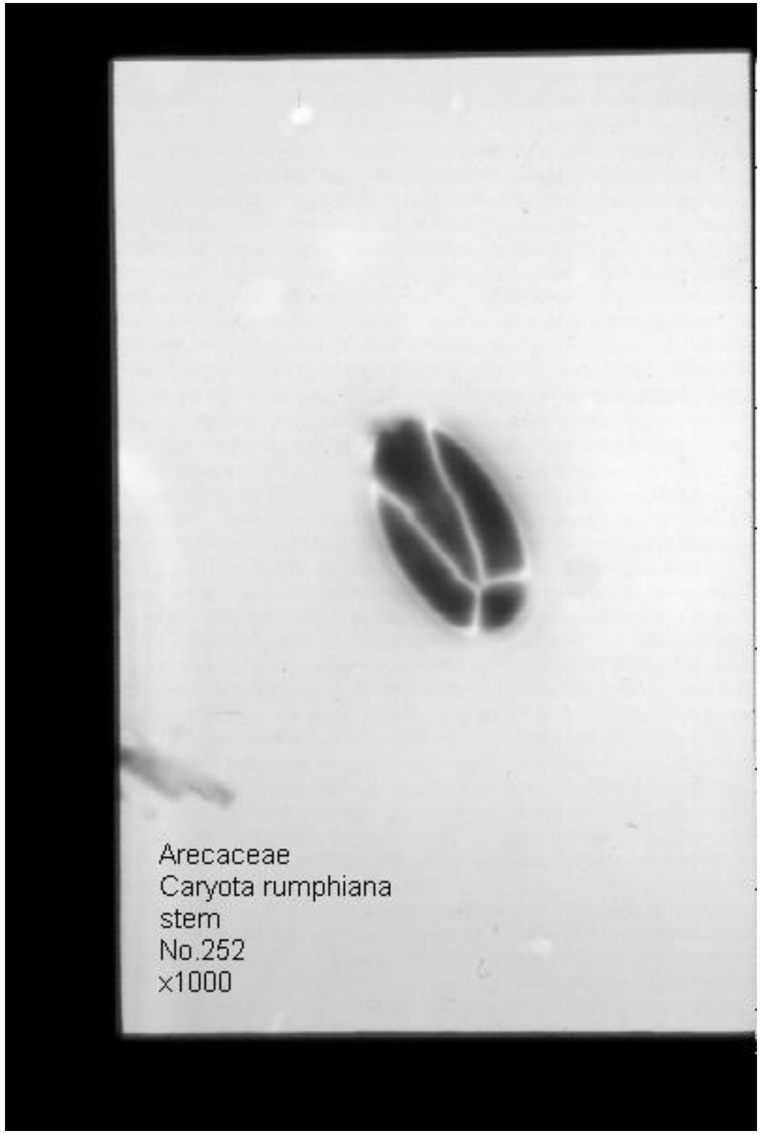
Callamus hoorungii

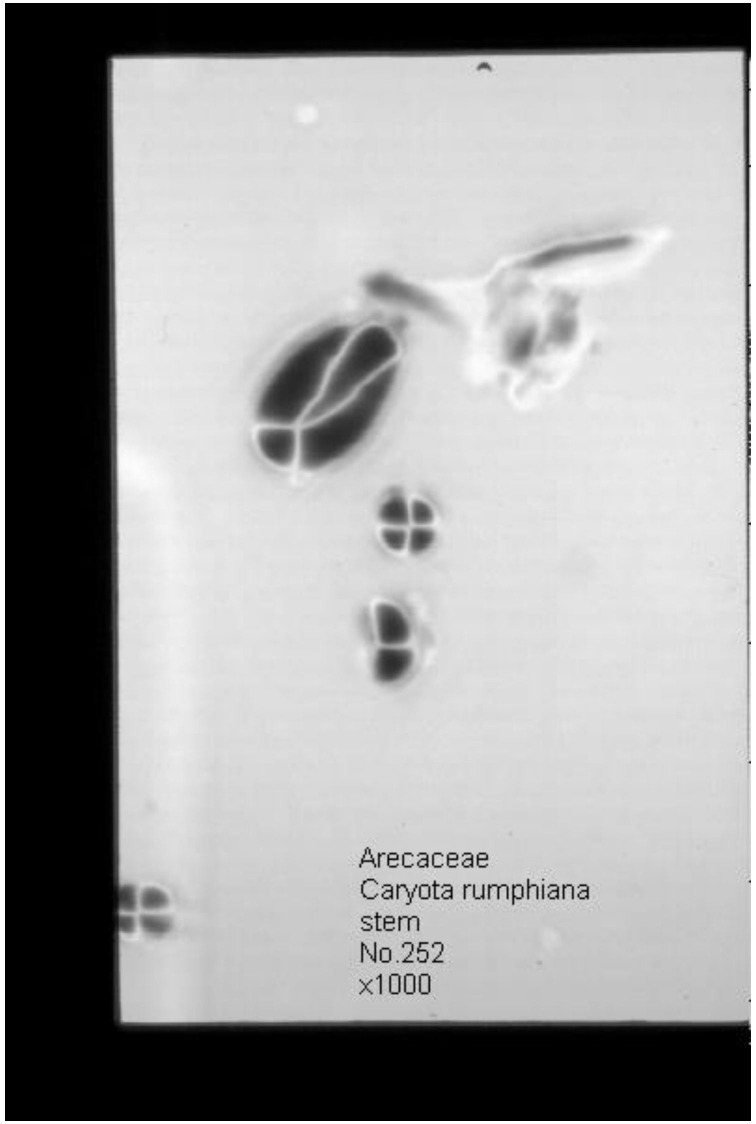
Australian Museum,
McCown Archaeobotany
Laboratory Collection

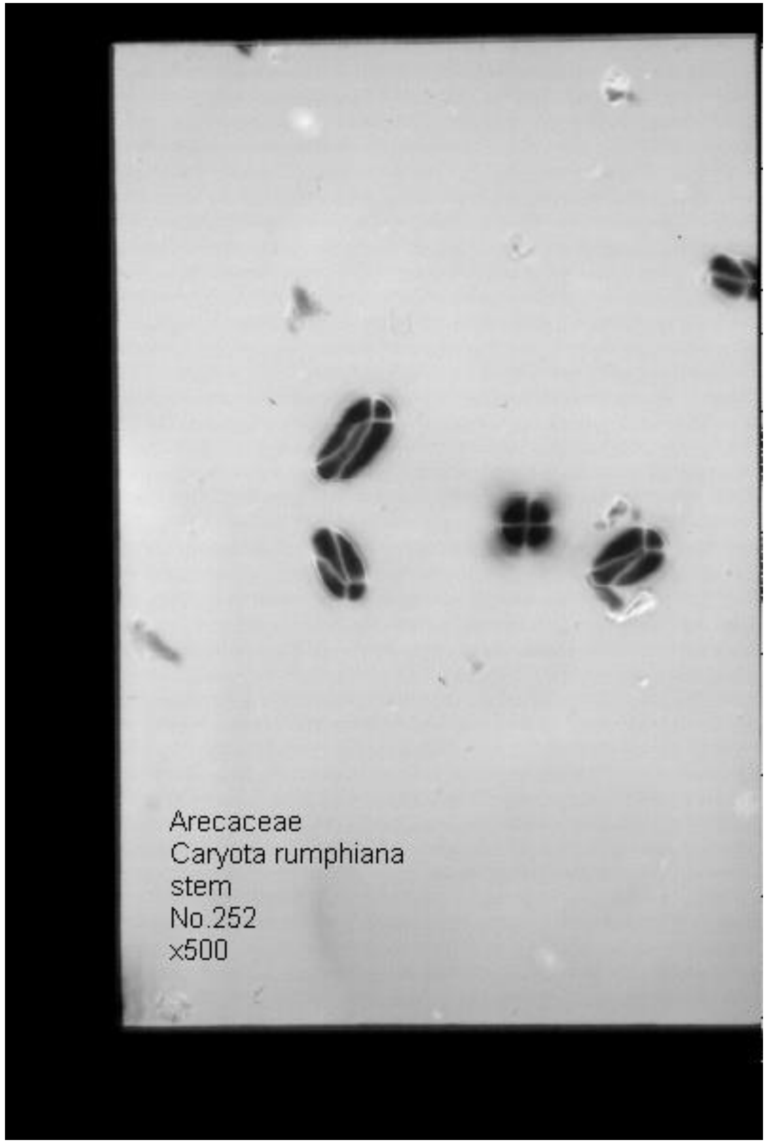


Caryota rumphiana

Australian Museum,
McCown Archaeobotany
Laboratory Collection



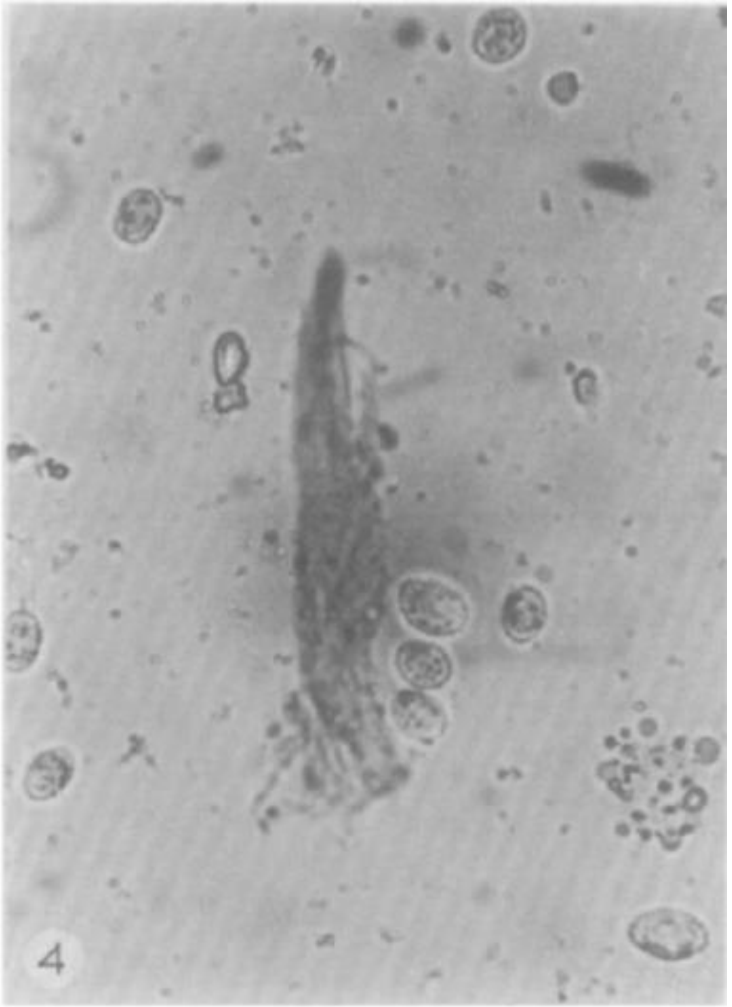




Chamaedora sp.

Phytolith

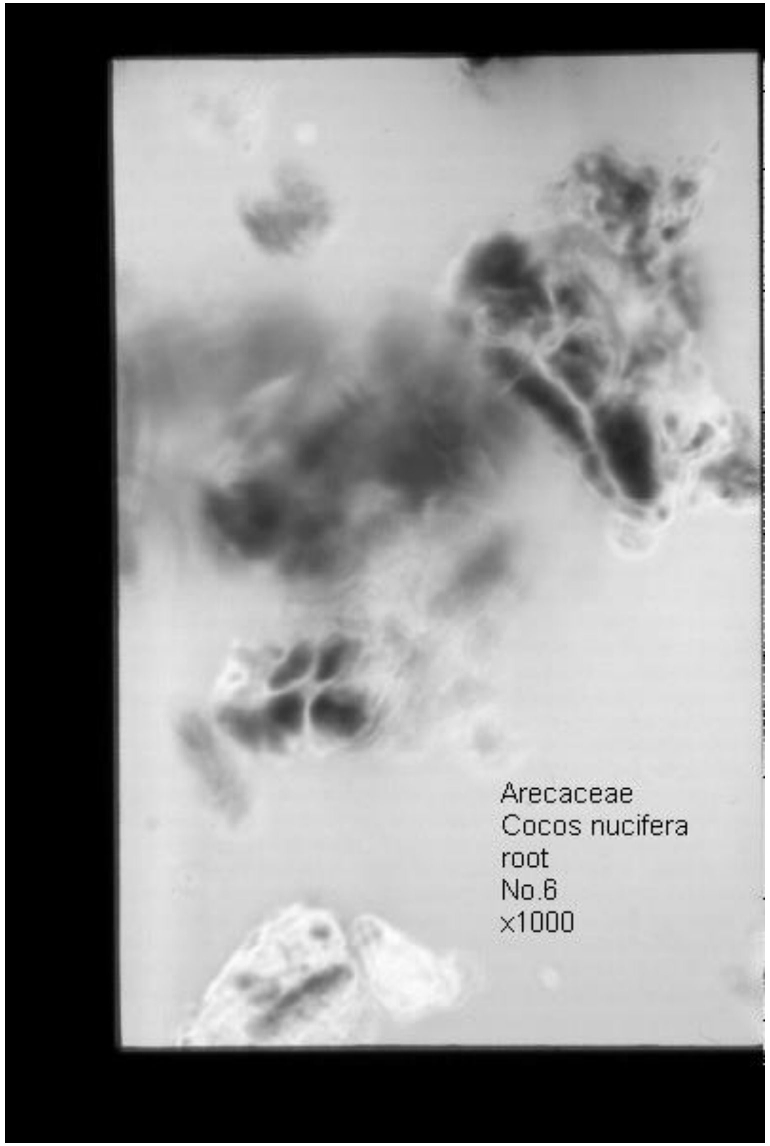
4. Hat-shaped silica bodies from Chamaedorea (400 ×).

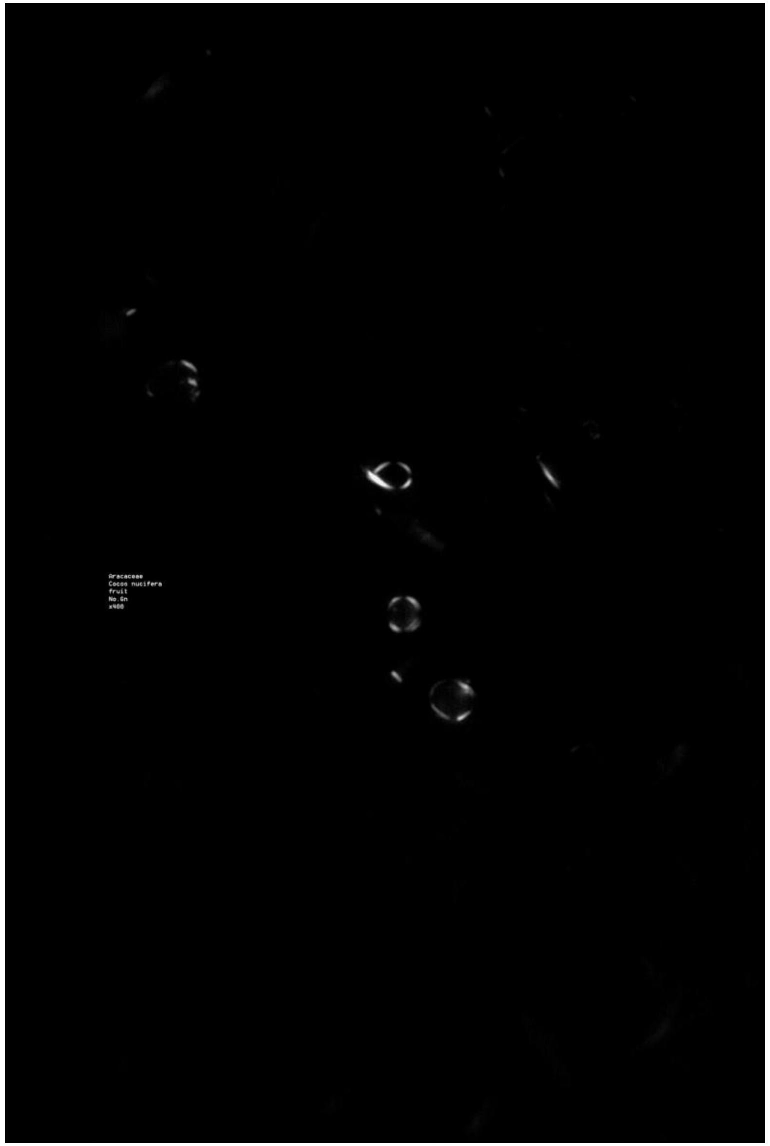


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Cocos nucifera

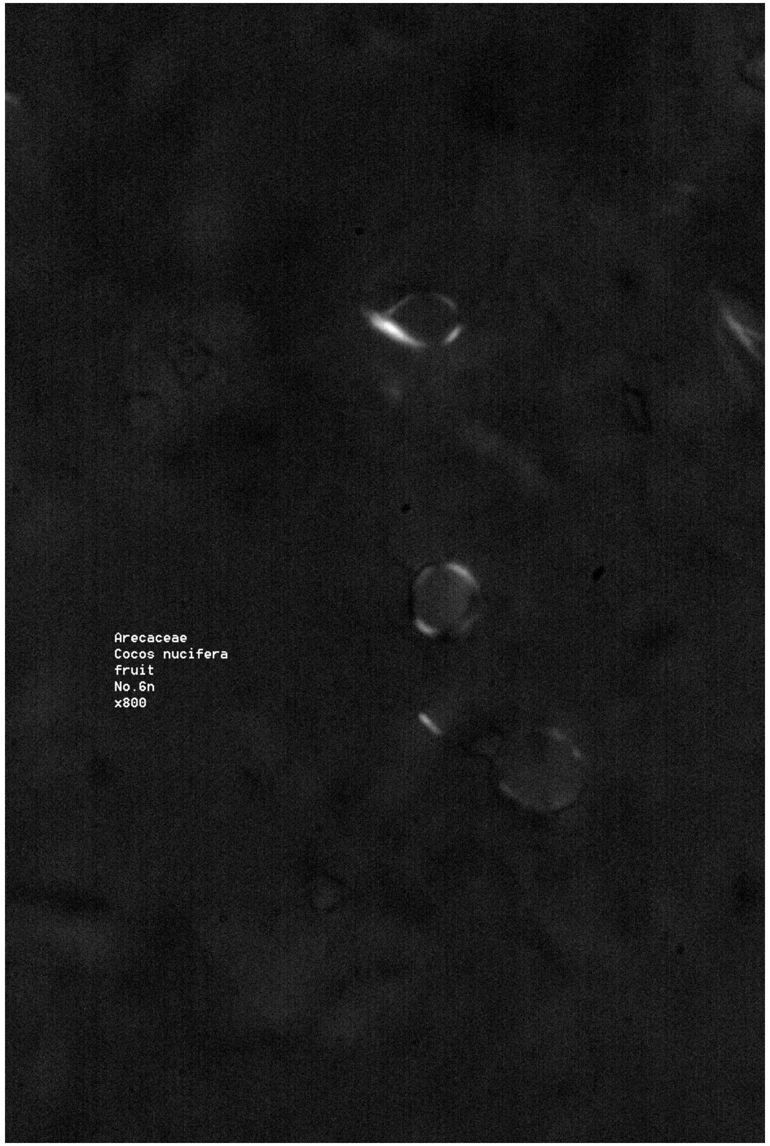
Australian Museum, McCown Archaeobotany Laboratory Collection





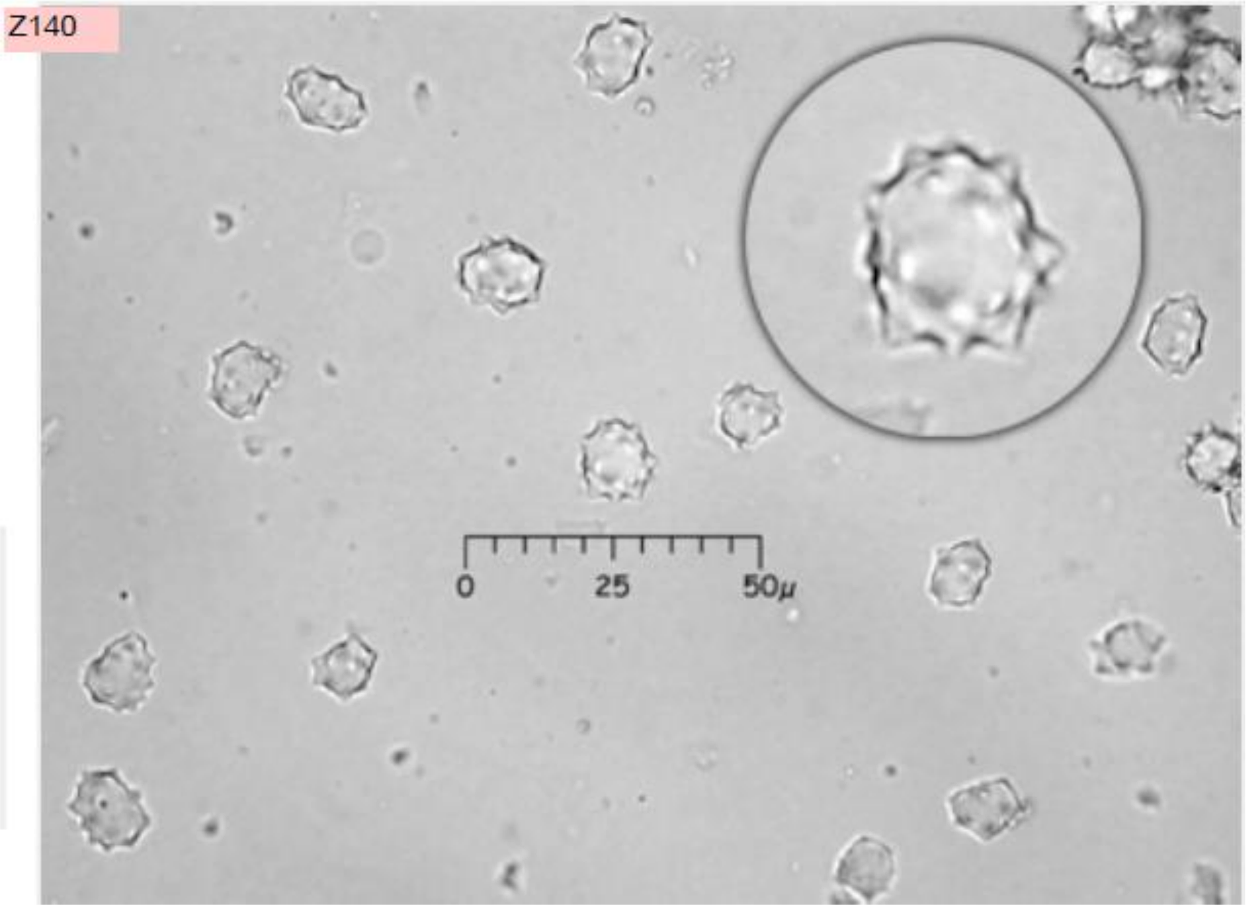
Cocos nucifera

Australian Museum,
McCown Archaeobotany
Laboratory Collection



Cocos nucifera

Phytolith



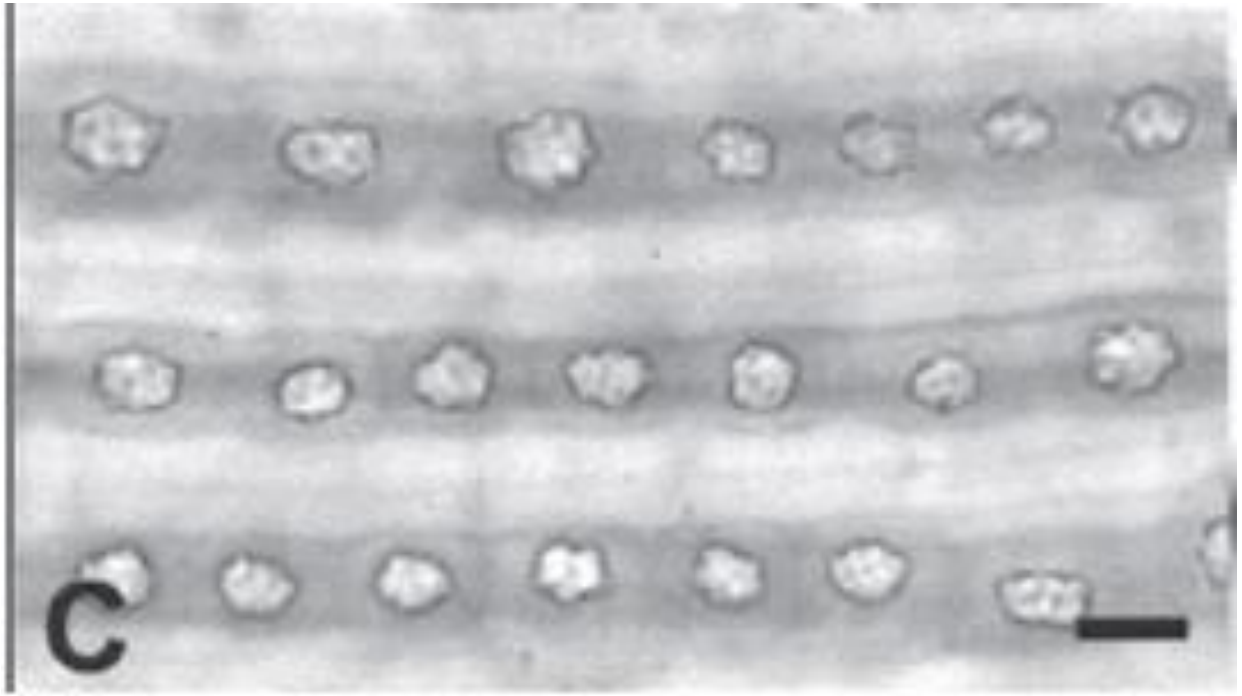
Spinulose spheres.
Be sure to rotate to determine whether body is a sphere or conical body with spinulose projections.
Diagnostic level: family, Arecaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Drymophloeus beguinii

Phytolith

Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. C. Drymophloeus beguinii (Arecaceae), irregularly spherical bodies in vascular bundle-sheath cells (bar = 10 μm).

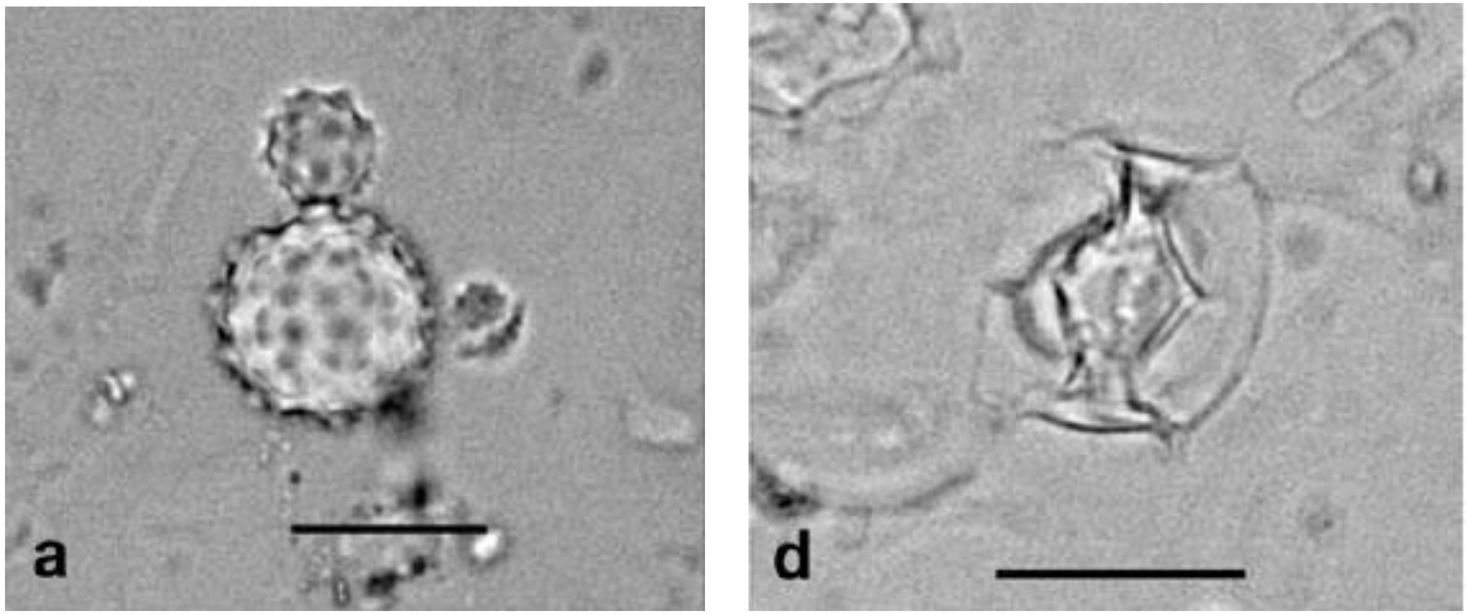


Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Euterpe oleracea

Phytolith

Fig. 3. Phytoliths from non-grass monocots. a) Globular echinate phytoliths from Euterpe oleracea, d) Stomata from E. oleracea leaf



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Euterpe precatoria

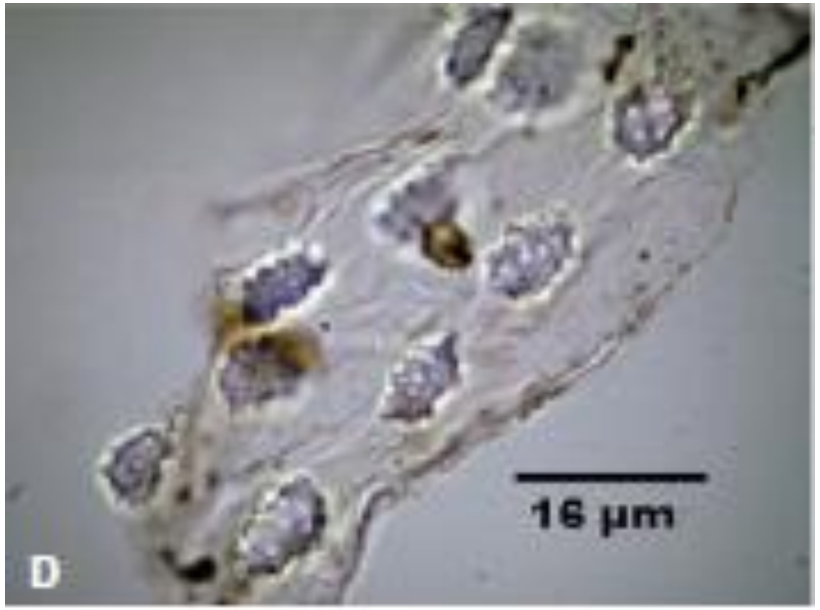
Phytolith

E. Silicified cells of Euterpe precatoria. ICN 0865.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Geonoma atrovirens

Phytolith



D. Silicified cells of Geonoma atrovirens. ICN 0320.

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Geonoma camana

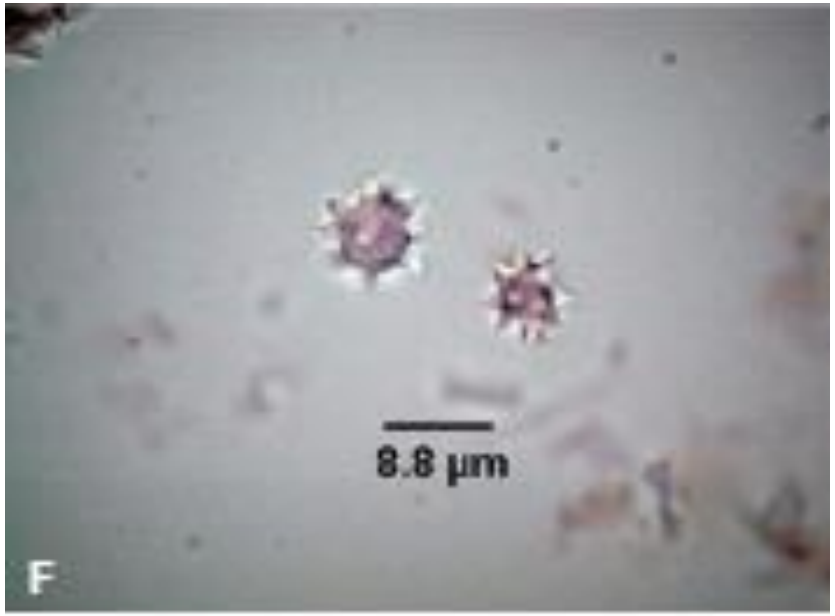
Phytolith

i. globular echinate symmetric (Geonoma camana. ICN 0323).

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Geonoma orbignyana

Phytolith



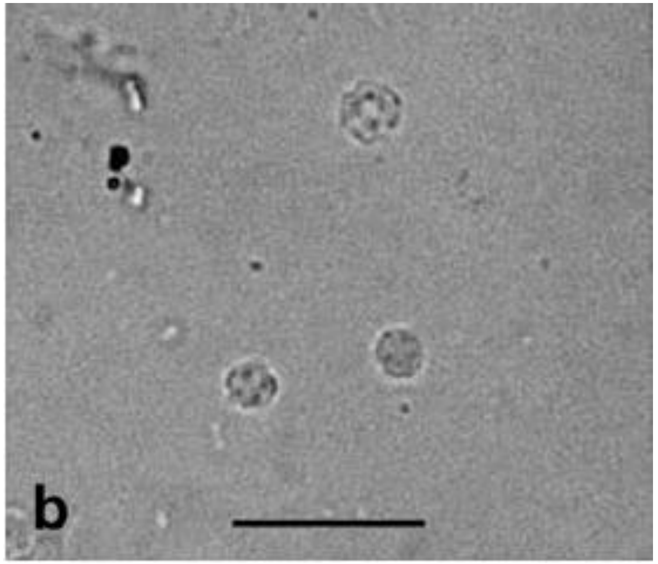
F. globular echinate with long acute projections (Geonoma orbignyana. ICN 0341).

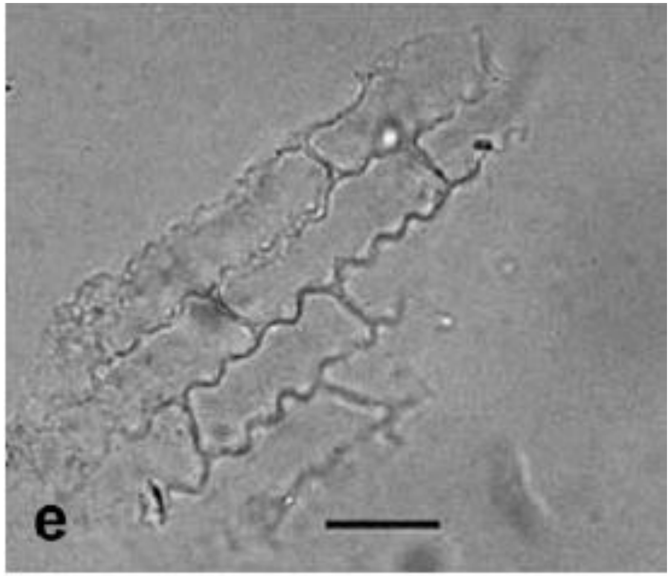
Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Mauritia flexuosa

Phytolith

Fig. 3. Phytoliths from non-grass monocots. b) Globular echinate phytoliths from Mauritia flexuosa, e) Adaxial epidermis from M. flexuosa leaf

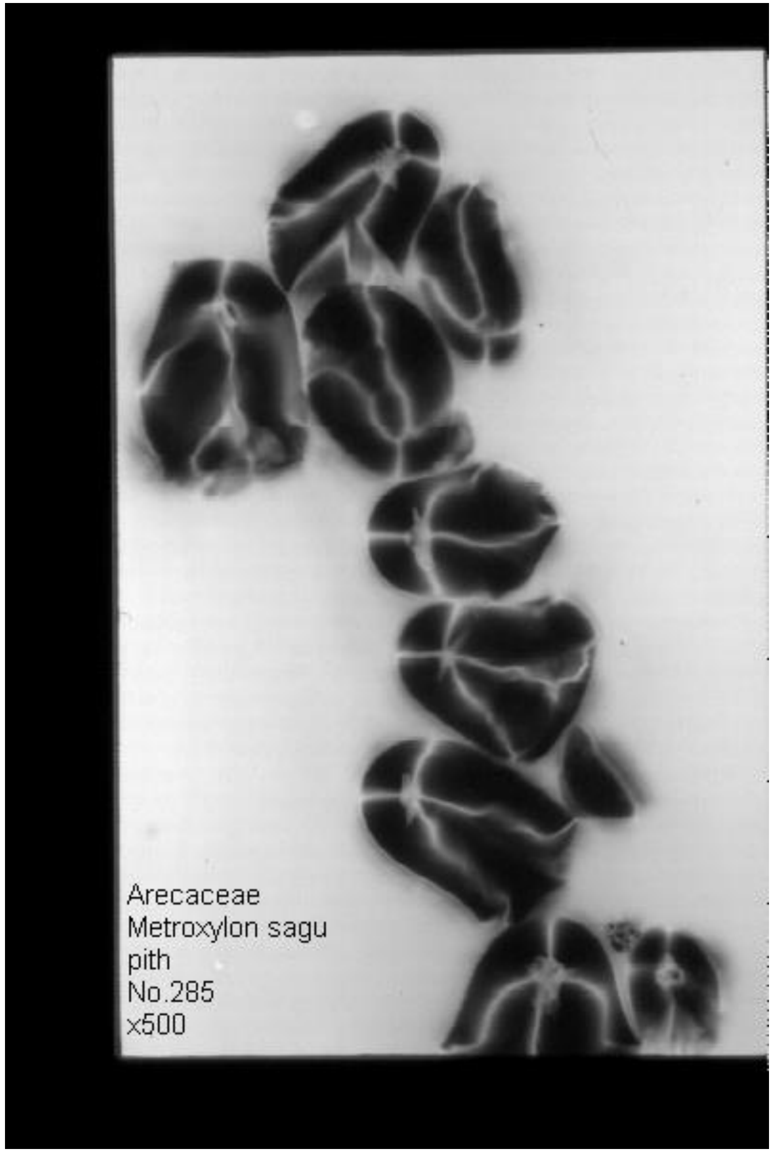


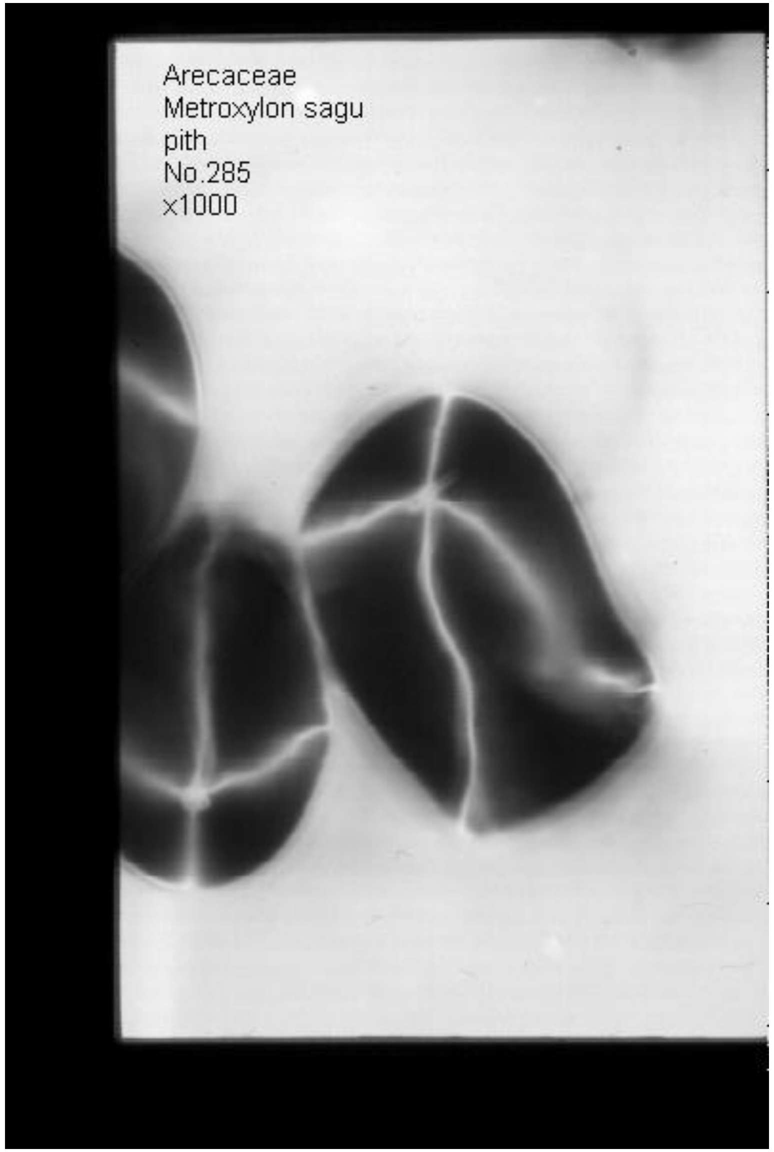


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Metroxylon sagu

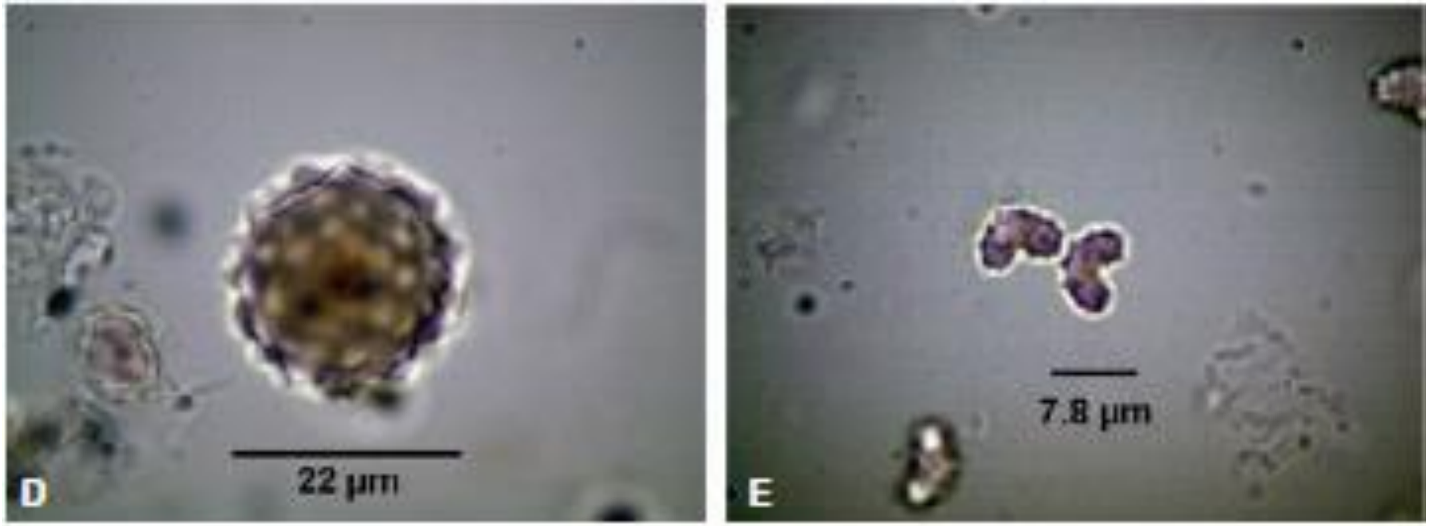
Australian Museum,
McCown Archaeobotany
Laboratory Collection





Oenocarpus bataua

Phytolith



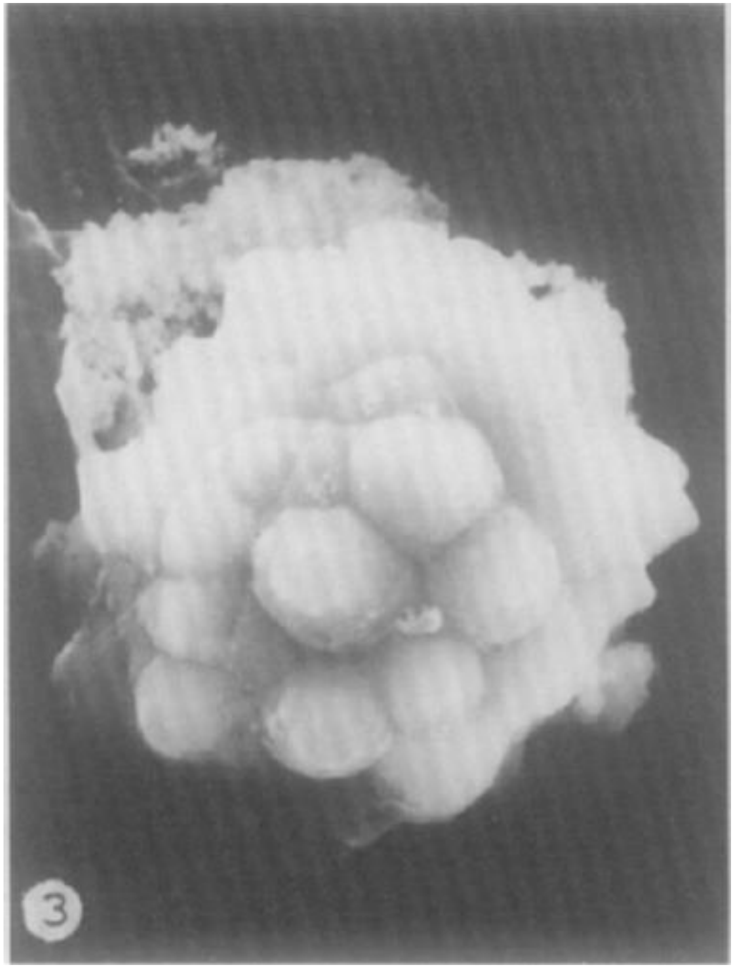
D. globular echinate with short acute projections (Oenocarpus bataua. ICN 0878).
E. reniform echinate (Oenocarpus bataua. ICN 0878).

Morcote-Ríos, Gaspar, Rodrigo Bernal, and Lauren Raz. 2016. Phytoliths as a Tool for Archaeobotanical, Palaeobotanical and Palaeoecological Studies in Amazonian Palms. *Botanical Journal of the Linnean Society* 182:348–60.

Sabal minor

Phytolith

3. SEM photograph of a spherical, spinulose phytolith from Sabal minor (5000 x)

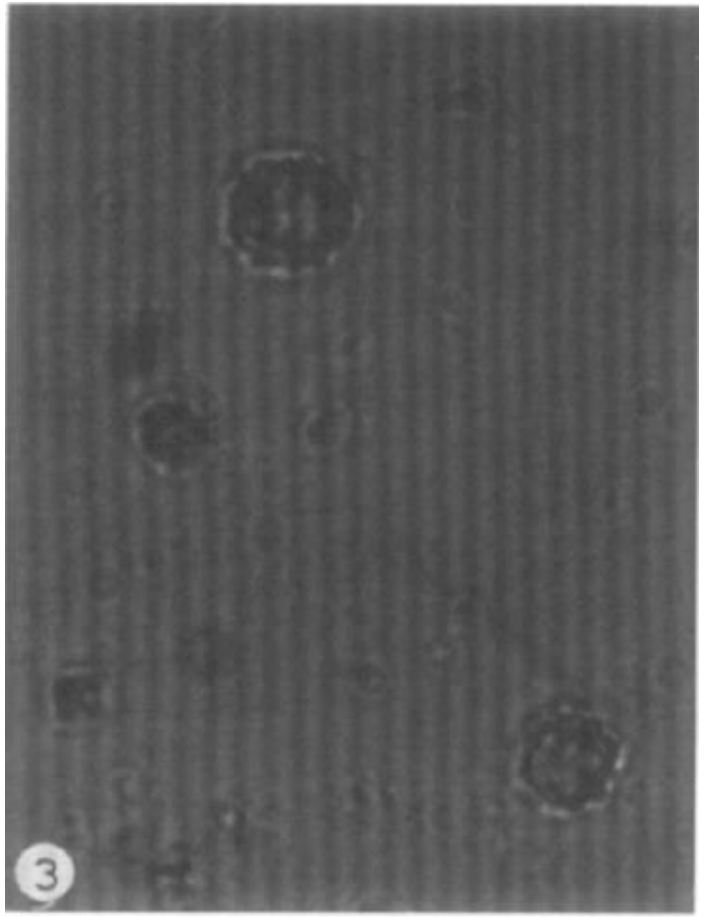


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Sabal minor

Phytolith

3. Spherical, spinulose phytoliths from Sabal minor (650 x).

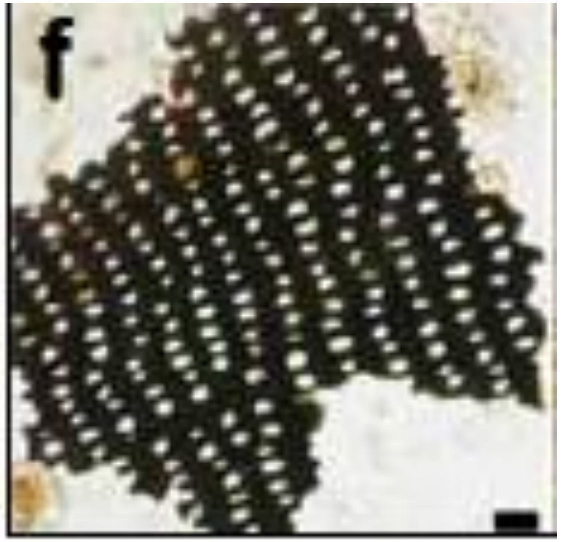


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

ASTERACEAE

Asteraceae

Phytolith



f. Opaque perforated platelet diagnostic of an Asteraceae inflorescence.

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Asteraceae

Phytolith

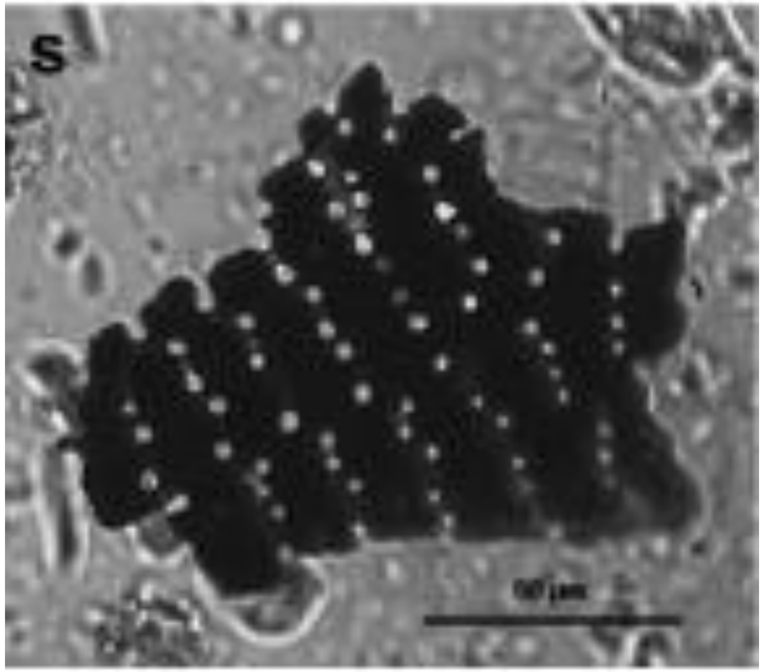


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. s) Asteraceae opaque perforated platelets (GM Profile 4 0-10 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Asteraceae

Phytolith

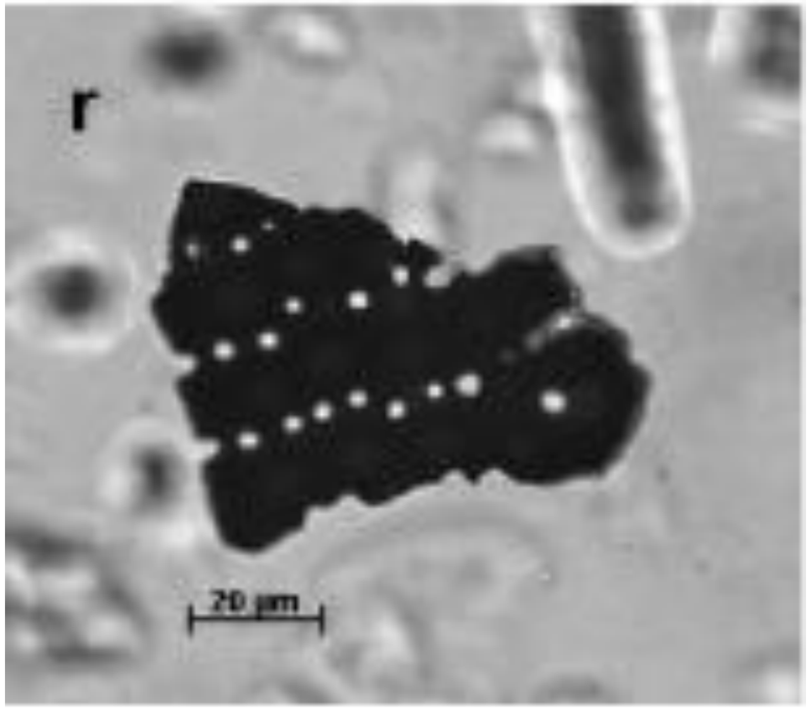


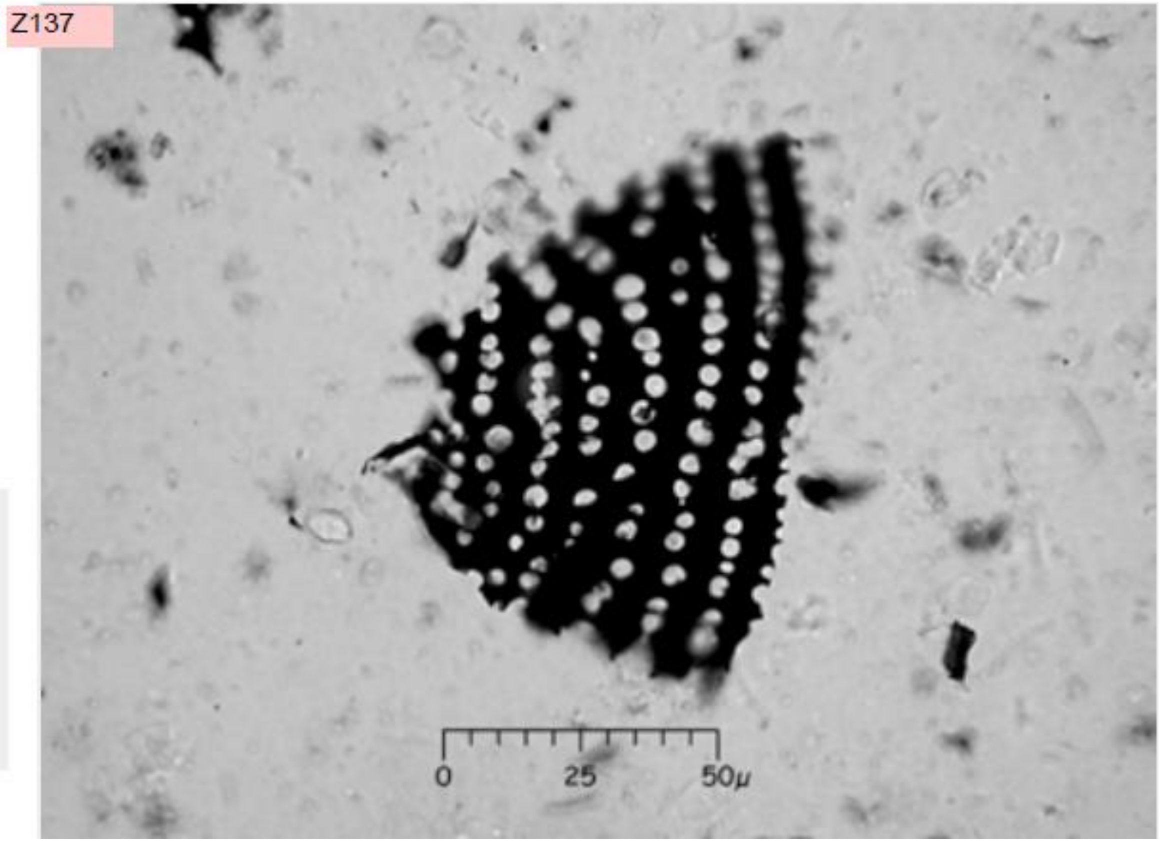
Fig. 5. Selected microbotanical remains. Phytoliths: r) Asteraceae opaque perforated plate (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Asteraceae

Phytolith

Be sure sheet is occluded and flat. Three dimensional, irregularly surfaced sheets are another type. Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bidens sp.

Phytolith

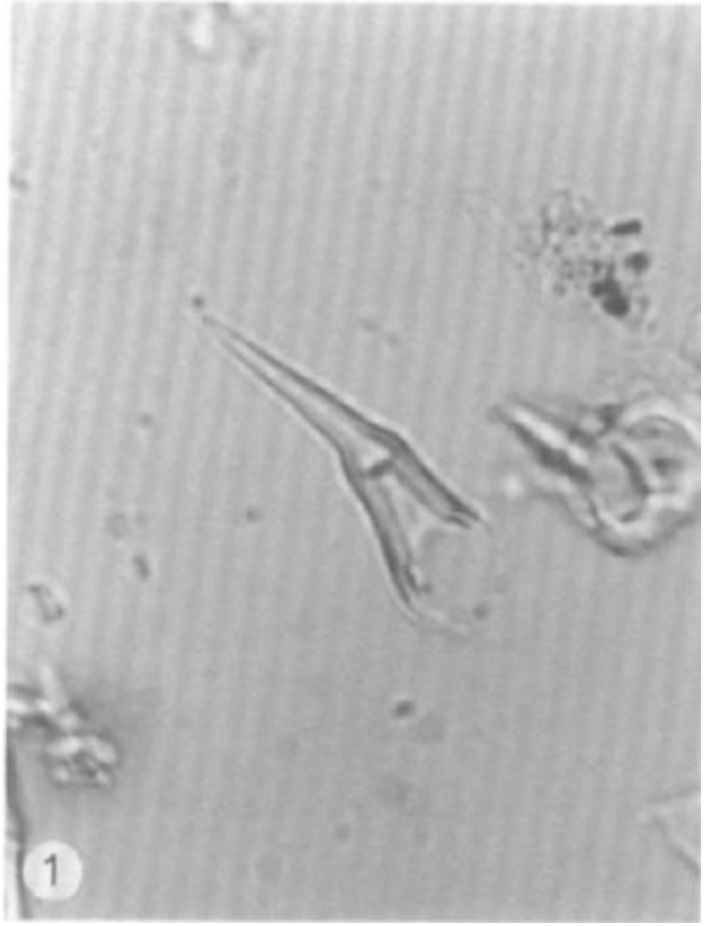
4. A segmented hair with squarish segments and thick cell walls from Bidens (400 x).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Calea urticifolia

Phytolith

1. A segmented hair from Calea urticifolia with a spherical base and thick cell walls (250 ×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Eclipta alba

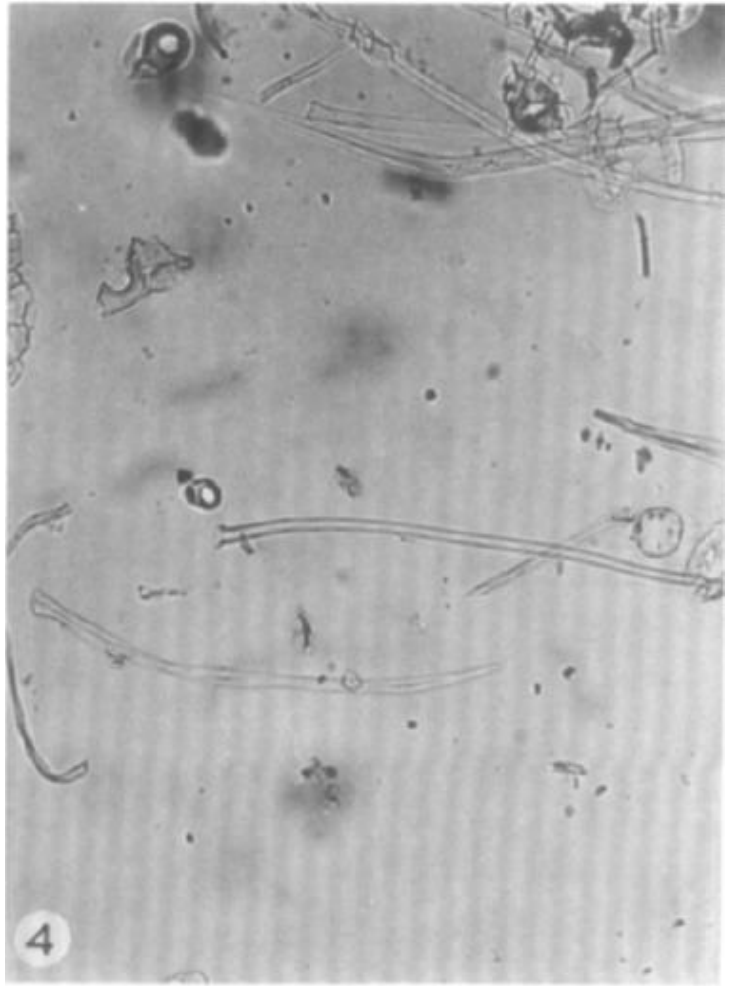
Phytolith

1. An armed segmented hair with an unarmed apex and base from Eclipta alba. The apex is not shown (400 X).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Elephantopus mollis

Phytolith

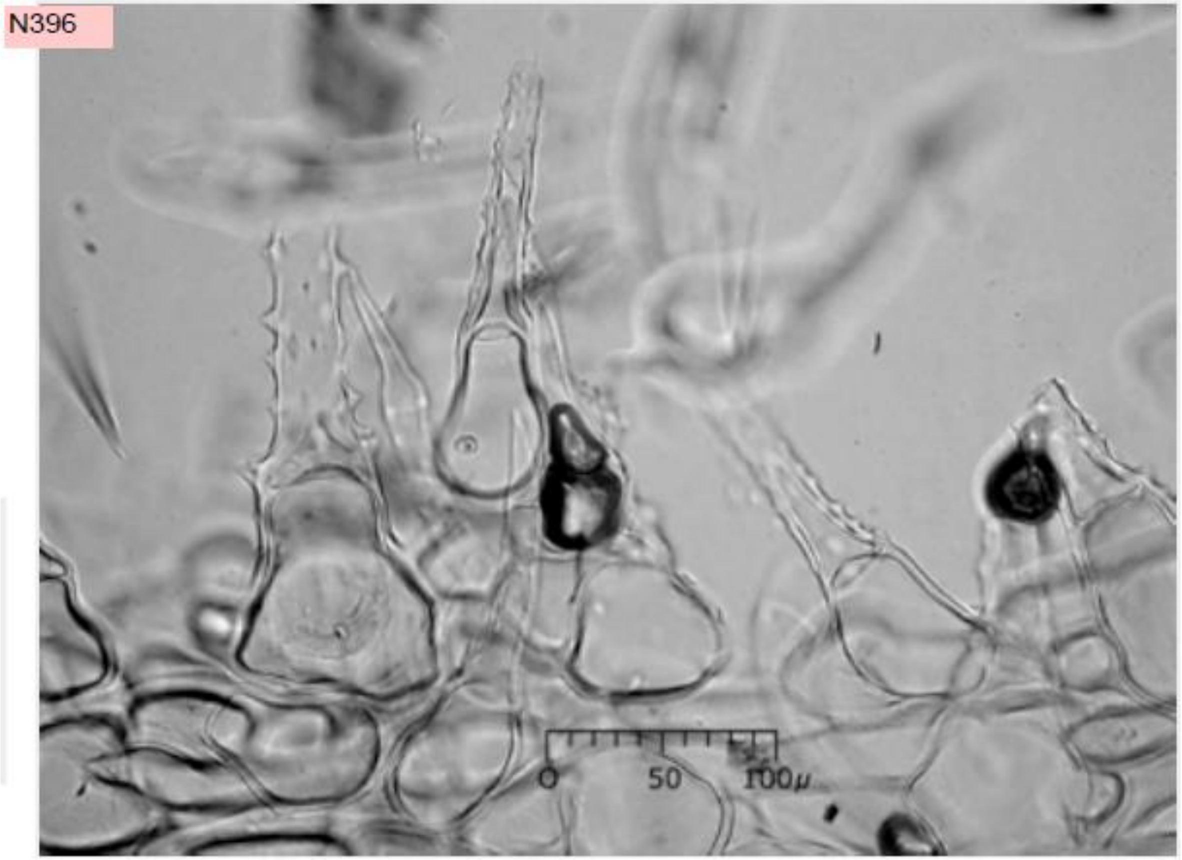


4. Non-segmented threadlike hairs from Elephantopus mollis. They have small, circular bases (125 x).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Lipochaeta sp.

Phytolith

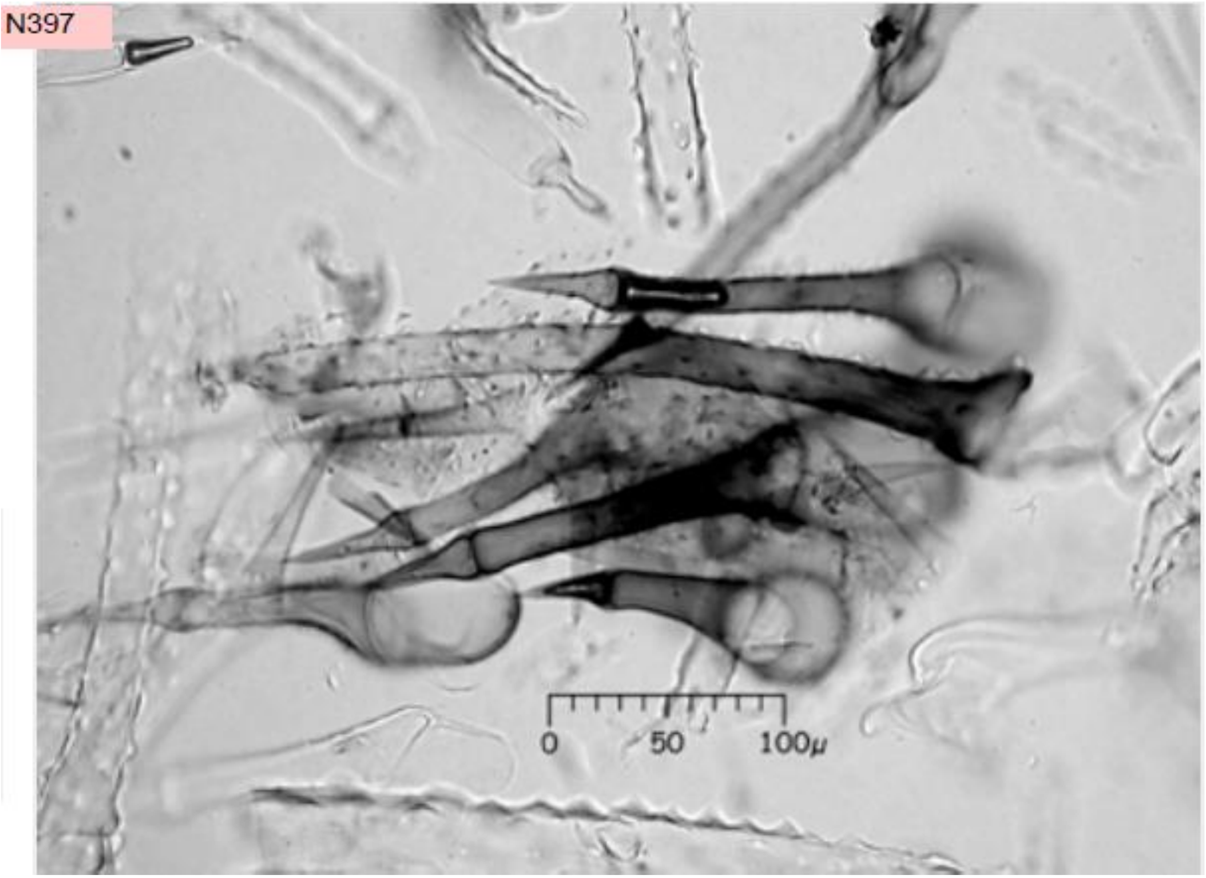


Asteraceae hairs tend to be armed. Compare to 40IIIBa201 Cucurbitaceae/Asteraceae hair and 40IIIBa202 Croton fraseri (Euphorbiaceae) hair.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lipochaeta sp.

Phytolith



Asteraceae hairs tend to be armed. Compare to 40IIIBa201 Cucurbitaceae/Asteraceae hair and 40IIIBa202 Croton fraseri (Euphorbiaceae) hair. May occur with some hairs segmented and unarmed: type 40IIIBa201 (see lower right) Sometimes occluded as shown, or blackened.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lipochaeta sp.

Phytolith

Be careful of confusion with other Asteraceae multicellular hair types such as armed hairs (40IIIBa1) and 40IIIBa202, Croton fraseri (Euphorbiaceae) hair.
Diagnostic level:
Asteraceae/Cucurbitaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lipochaeta sp.

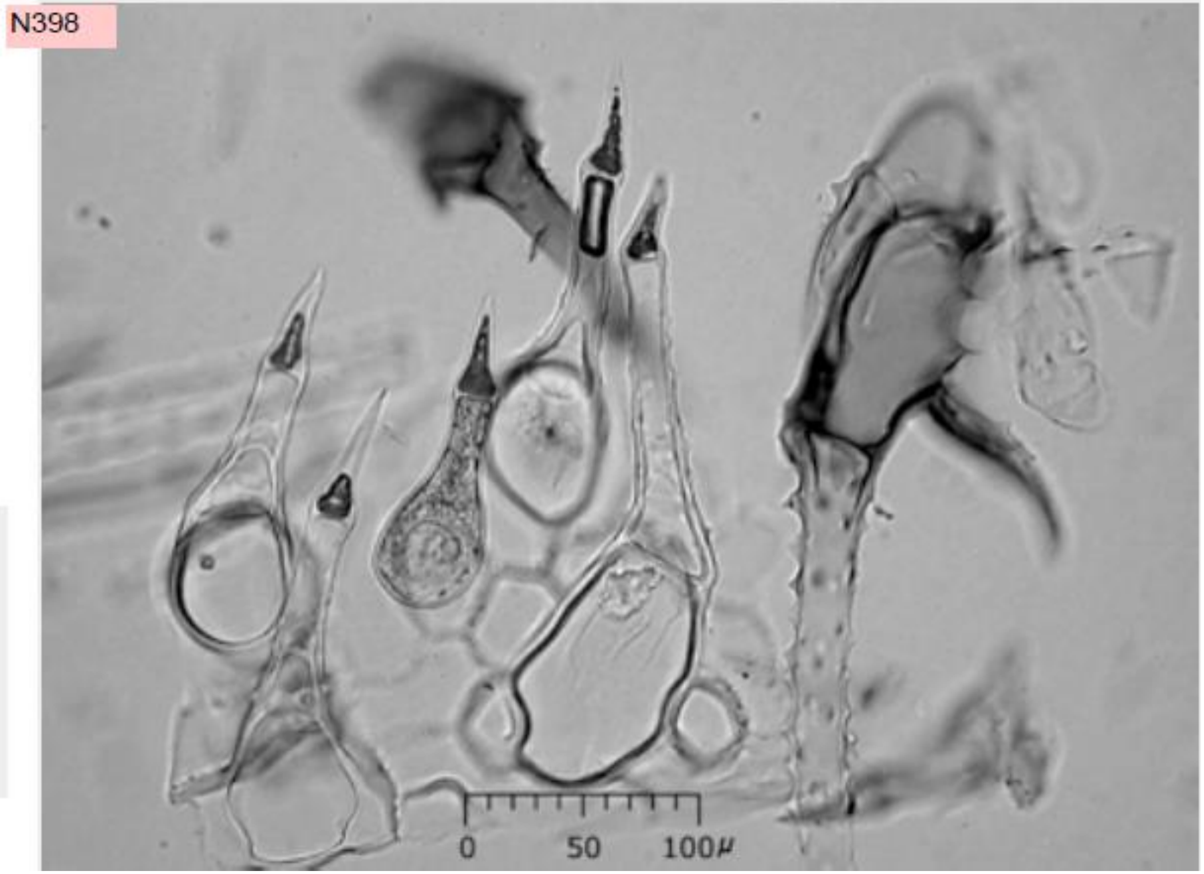
Phytolith

Asteraceae hairs tend to be armed. Compare to 40IIIBa201 Cucurbitaceae/Asteraceae hair and 40IIIBa202 Croton fraseri (Euphorbiaceae) hair. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lipochaeta sp.

Phytolith



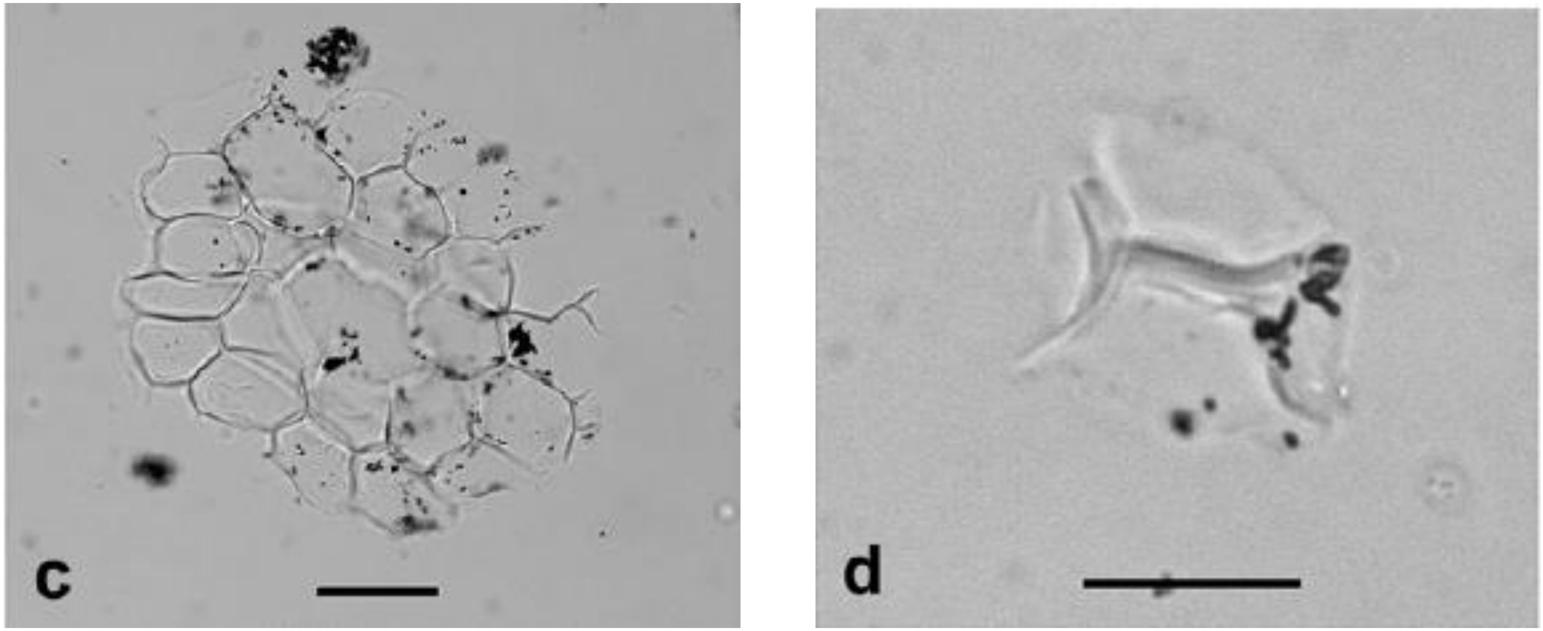
Asteraceae hairs tend to be armed. Compare to 40IIIBa201 Cucurbitaceae/Asteraceae hair and 40IIIBa202 Croton fraseri (Euphorbiaceae) hair. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Melampodium camphoratum

Phytolith

Fig. 5. Phytoliths from dicotyledons. c) Hairbase from Melampodium camphoratum, d) Blocky polyhedrals from M. camphoratum

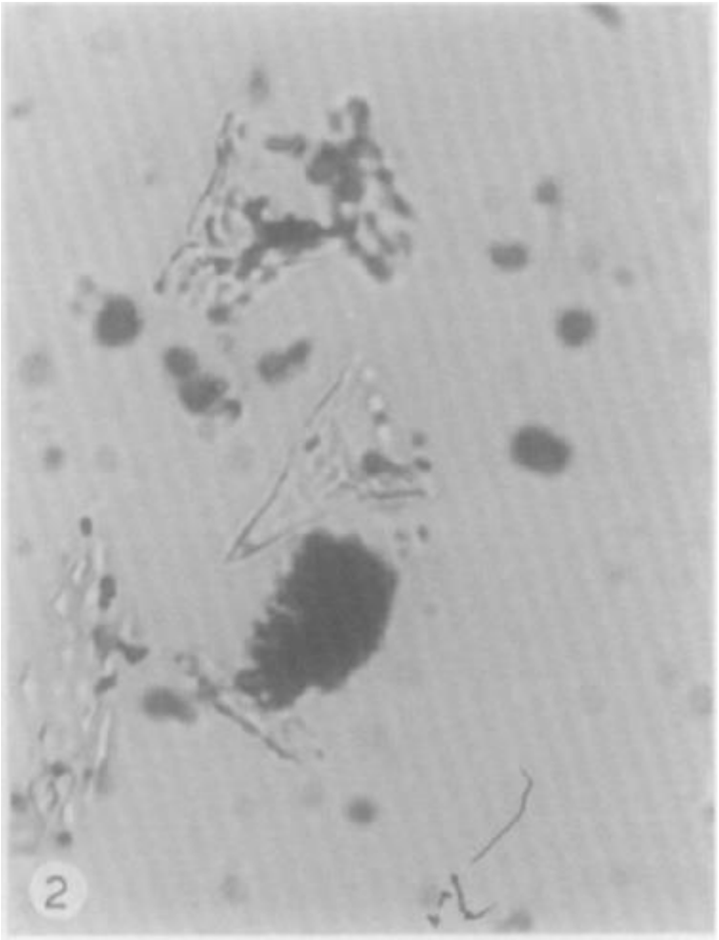


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Melanthera hastata

Phytolith

2. An armed segmented hair with an unarmed apex from Melanthera hastata (250 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Smallantus sonchifolius

Asteraceae *Smallanthus sonchifolius* "yacón"

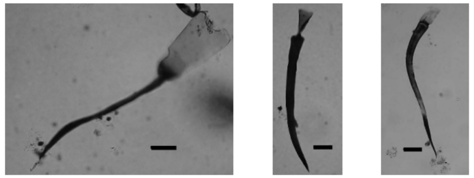
Phytolith assemblage characterization

tuber	Non diagnostic twisted hairs. Segmented hairs, platelets and other **(*).**	**stem**	No opal phytoliths **(*).**

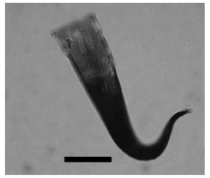
leaf

Diagnostic hairs **(*):**

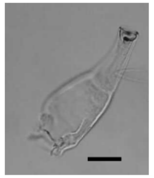
a) Acute opaque silica hair. Different terminal bases. Very common.



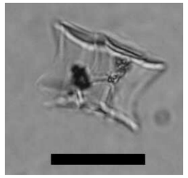
b) Unciform opaque silica hair. Not common.



c) Segmented translucent silica hairs. Not common.



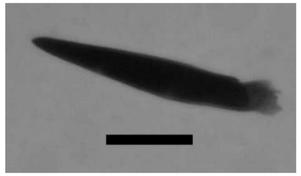
d) Roundel concave in lateral margins. Rare.



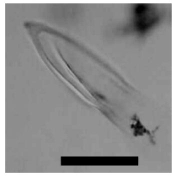
flower

Non diagnostic phytoliths **(*):**

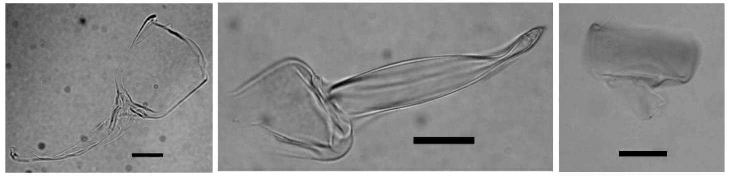
a) Acute opaque silica hair. Different terminal bases. Rare.



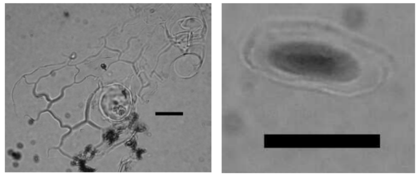
b) Acute translucent silica hairs. Rare.



c) Acute translucent silica hair. Different terminal bases. Not common.



d) Translucent stoma and epidermal silica cells. Rare.



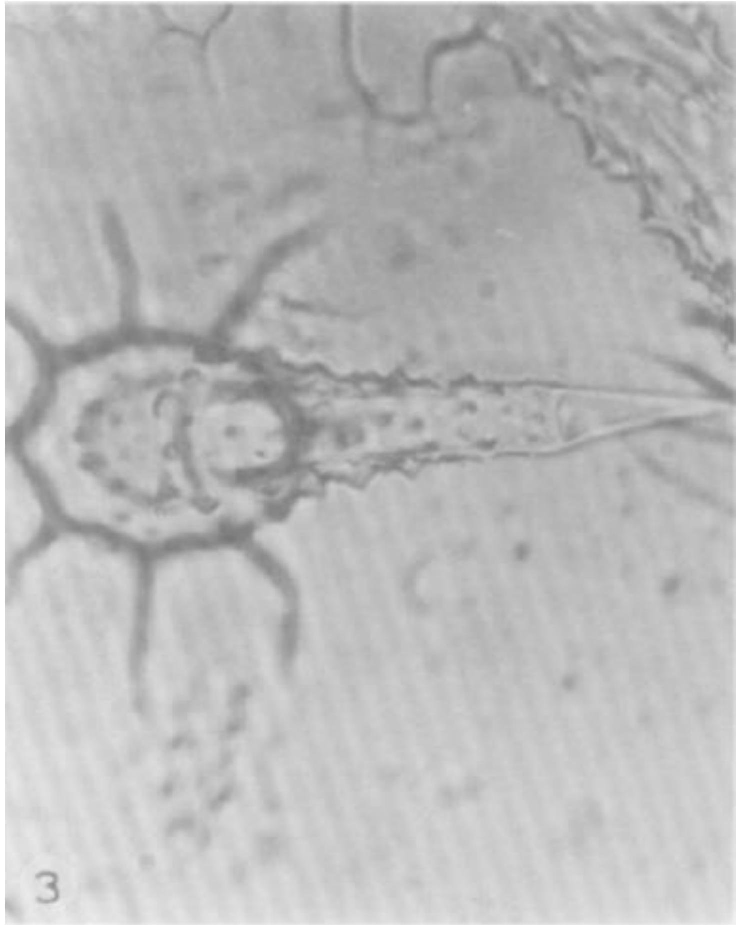
Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Wulffia baccata

Phytolith

3. An armed segmented hair with an unarmed apex from Wulffia baccata (400 x). It is attached to the hair base.

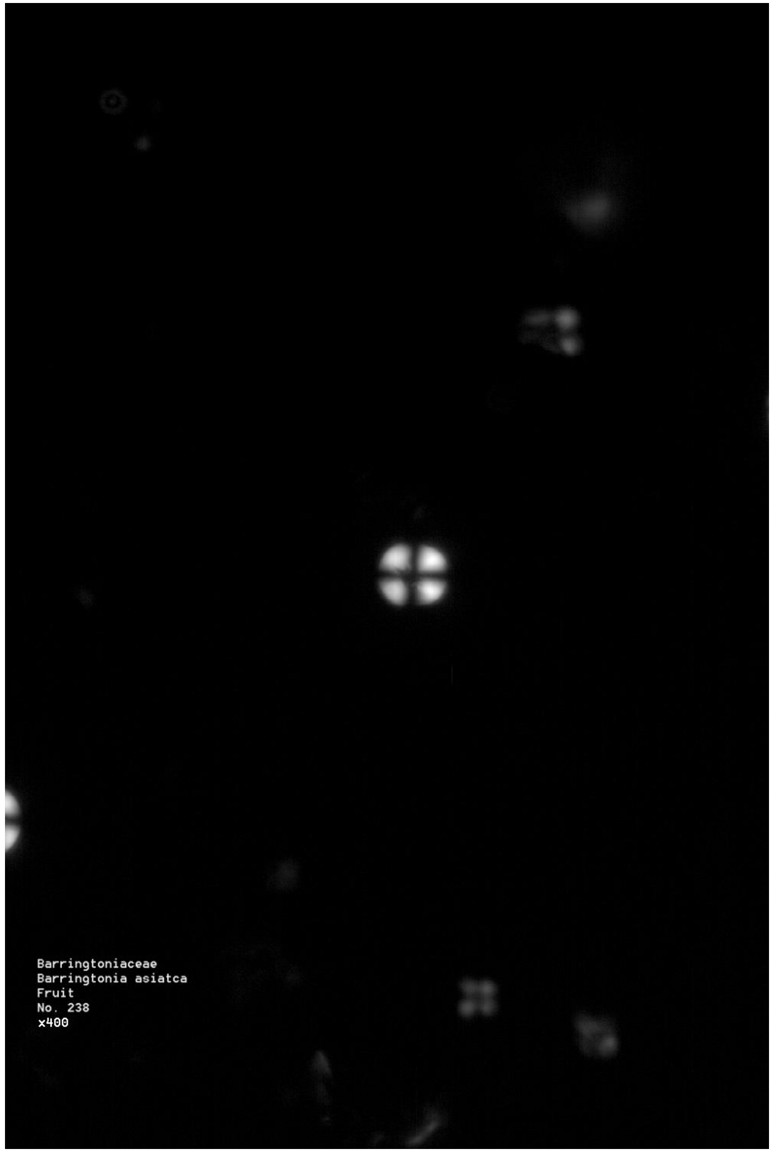


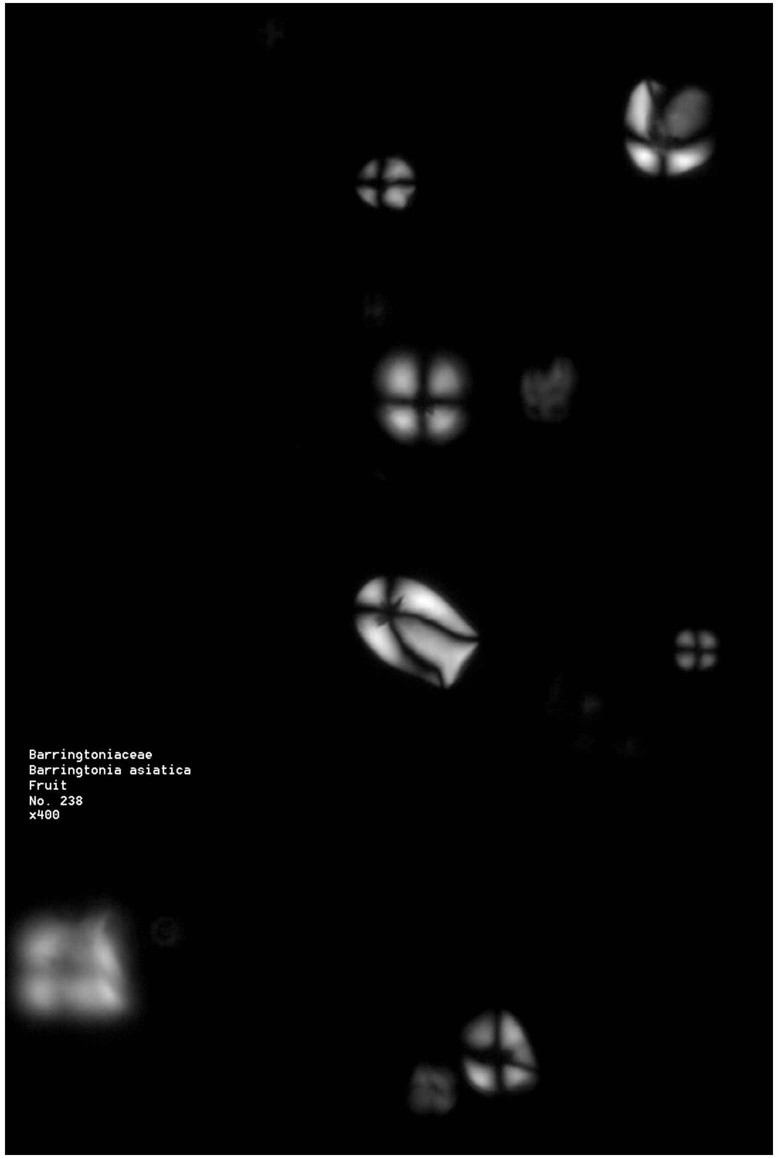
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

BARRINGTONIACEAE

Barringtonia asiatica

Australian Museum,
McCown Archaeobotany
Laboratory Collection

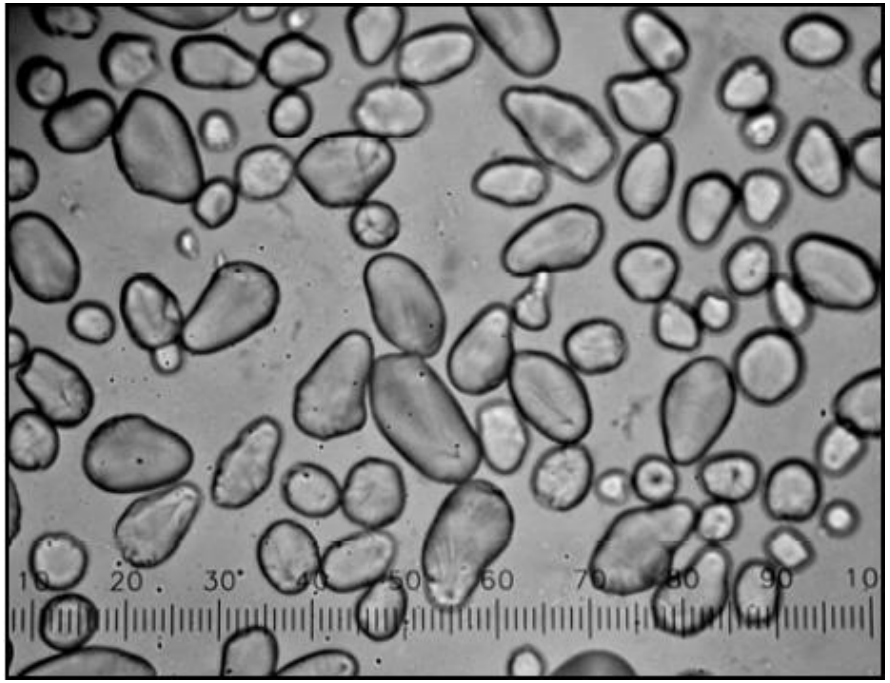


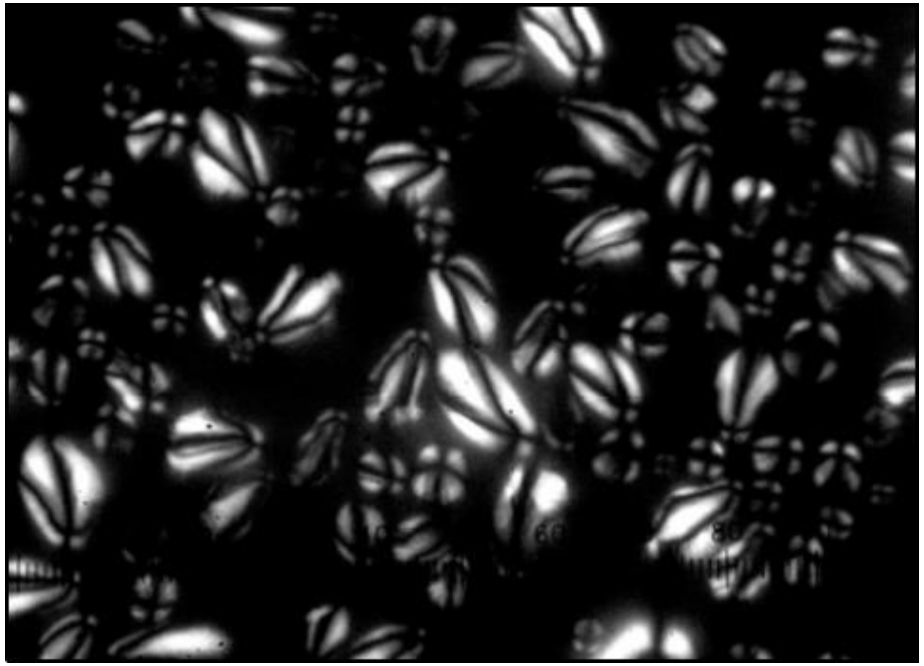


BASELLACEAE

Anredera vesicaria

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Ullucus tuberosus

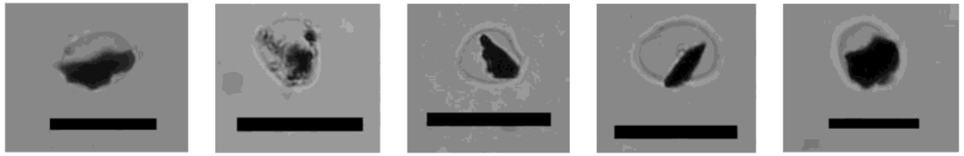
Basellaceae *Ullucus tuberosus* "ulluco"

Phytolith assemblage characterization

leaf

Diagnostic phytoliths **(*):**

a) Round to sub-round silica phytoliths with charcoal spots. Common.



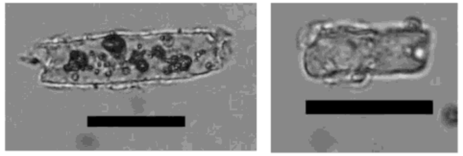
flower

No phytoliths **(*).**

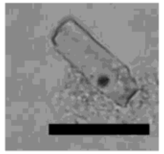
tuber

Non diagnostic phytoliths **(*):**

a) Rectangular irregularly cavate silica phytolith. Rare.



b) Rectangular psilate silica phytolith. Rare.



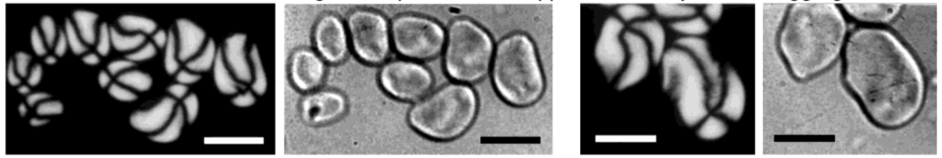
c) Sub-spherical irregularly cavate silica phytolith. Rare.

Starch assemblage characterization

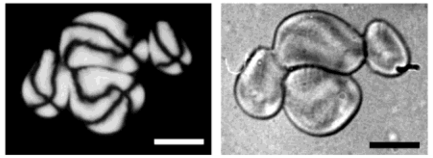
tuber

a) Single grains, globular or subglobular; less than 7µm.

b) Single grains, generally asymmetrical, variable in shape, irregular, prismatic, ovoid, oval, pear-, bow- and bell-shaped, sometimes with one or more rounded projections and/or truncations in different parts; from 10µm to 30µm long length; highly eccentric distinct hilum as a circle or line; very distinct lamella; radiating lines from the hilum to the border of the grain; distinct eccentric cross to the rounded end, with sinuous, non-well definite dark arms intersecting at one point, fibrous appearance. May occur in aggregates.



c) Compound grains compounded by two-five granula. Granula generally unequal, with at less a symmetry axis.



References: Partially based on Cortella and Pochettino 1995.

Scale bar = 20µm.

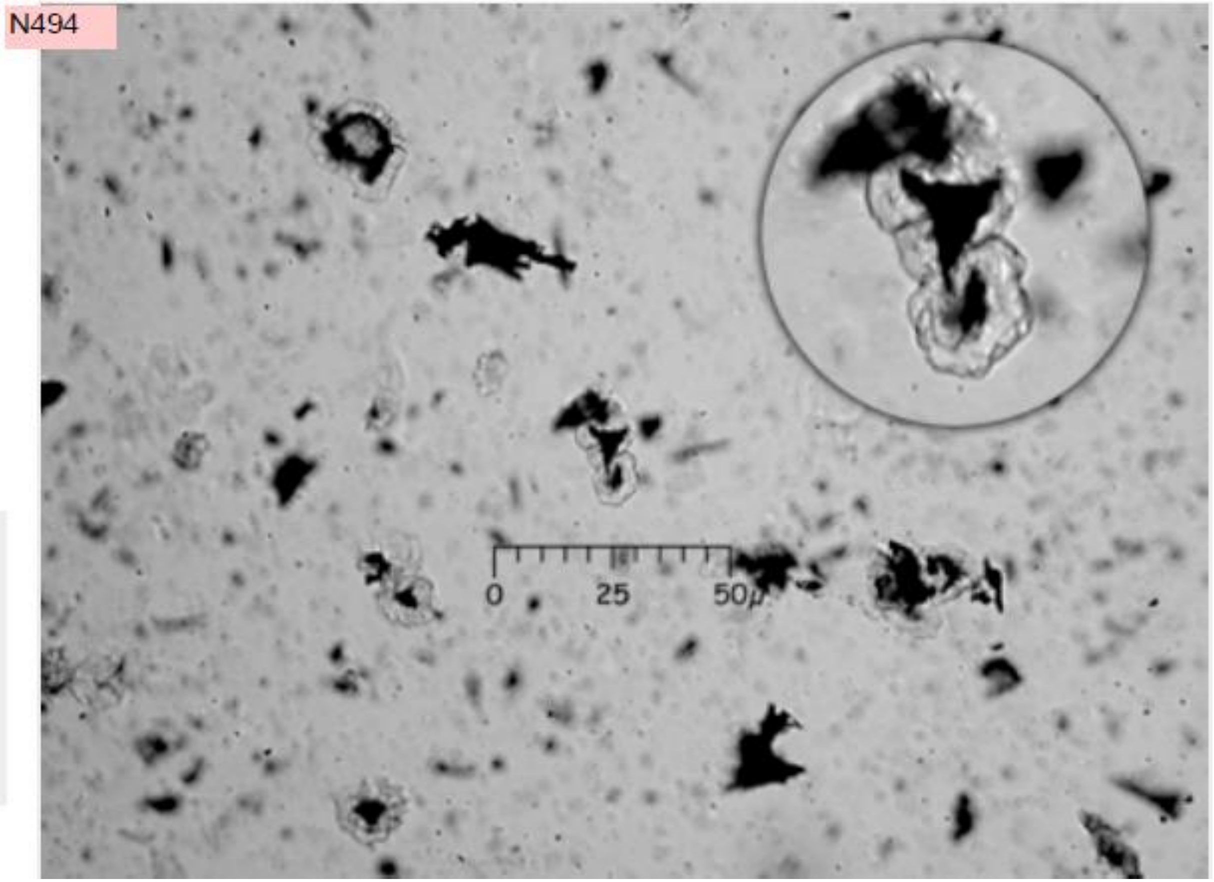
Korstanje and Babot, McCown Archaeobotany Laboratory Collection

BATACEAE

Batis maritima

Phytolith

Unknown origin in tissue.
Perhaps a cystolith with occluded fragments in interior.
Diagnostic level: family



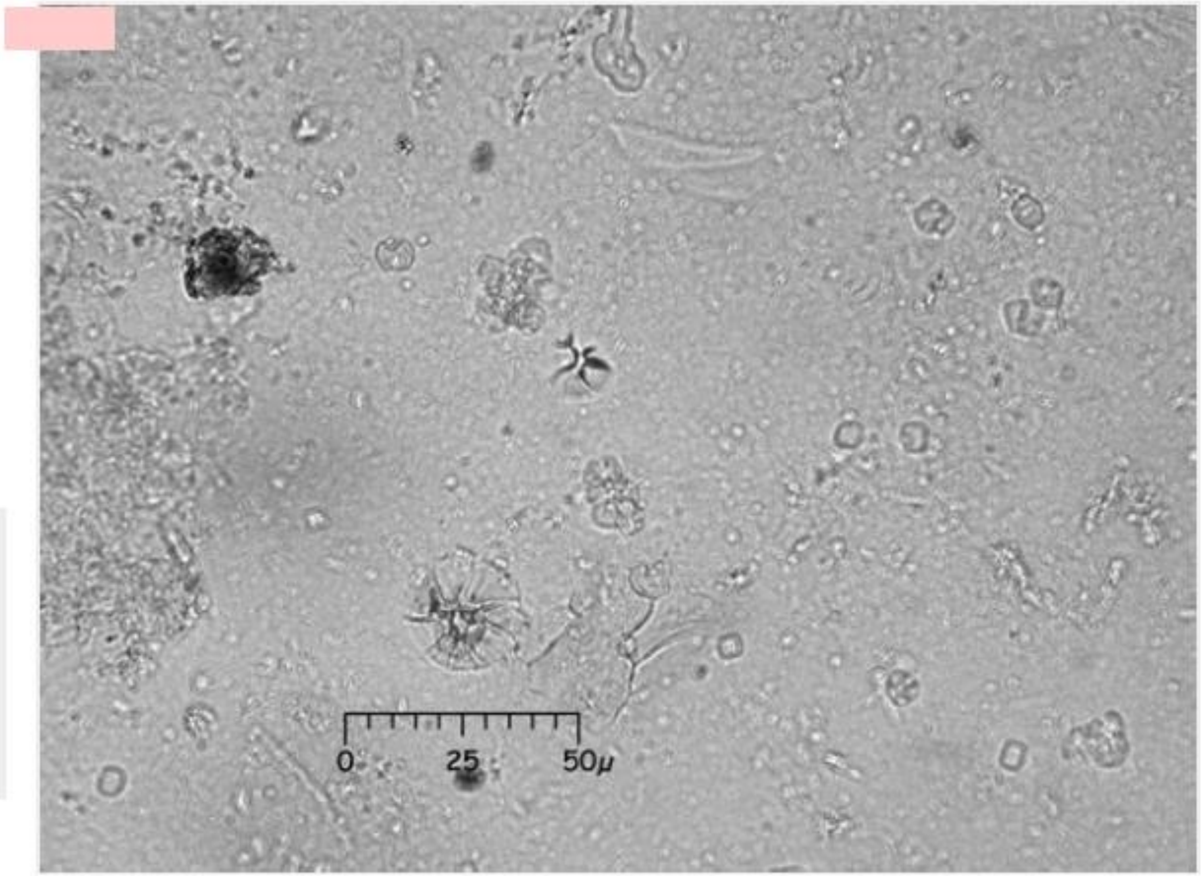
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

BIGNONIACEAE

Tecoma gandichiandi

Phytolith

Slide E101.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

BIXACEAE

Bixa orellana

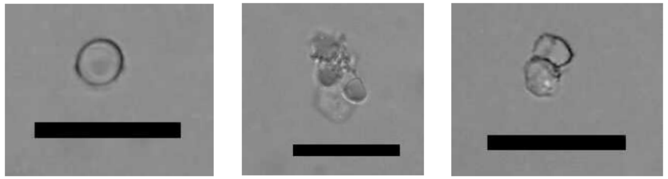
Bixaceae ***Bixa orellana*** **"urucú or achiote"**

Phytolith assemblage characterization

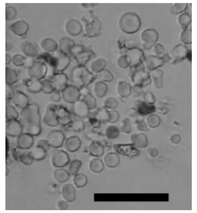
seed

Diagnostic phytoliths **(*)**:

a) Round to sub-round planar psilate silica phytolith. Very common.



Assemblage view.

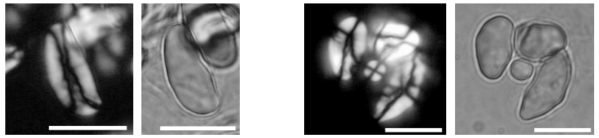


References: Reported as not present in Piperno 1988:35 (it does not say which part of the plant was sampled).

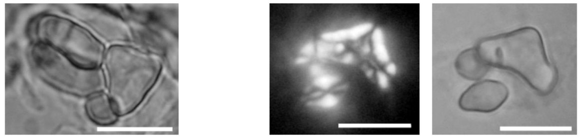
Starch assemblage characterization

seed

a) Single grains, oval, subspherical, ellipsoidal, sausage-, and pear-shaped, sometimes with one or two truncations and a well rounded opposite end; variable in size from 5µm to 37µm long length; sometimes distinct hilum; not visible lamella; mainly centric, but also eccentric cross, with four arms visible, intersecting at the center or meeting two by two.



b) Commonly compound grains, generally boomerang-shaped but also oval, without an external unique packing, compounded by two granula. Granula, variable in size and shape, typically bell-, bowl-shaped, and subquadrangular oblique, with a wavy or concave truncation at broader end; from 15µm to 37µm long length; distinct eccentric cross. Some compound grains, compounded by two sausage-shaped granula. Aggregates.

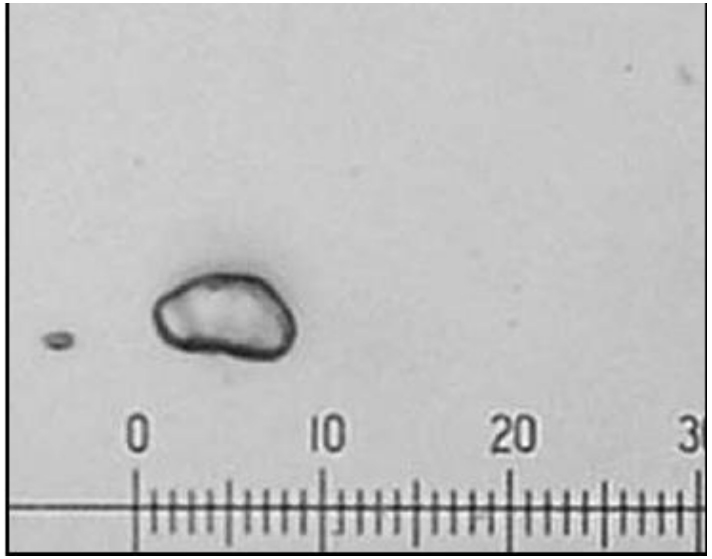


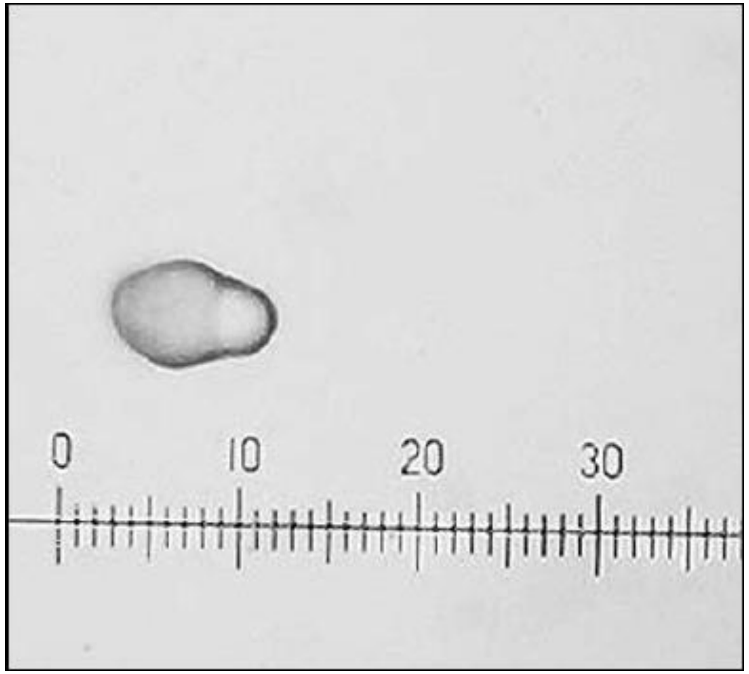
Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Bixa orellana

Starch



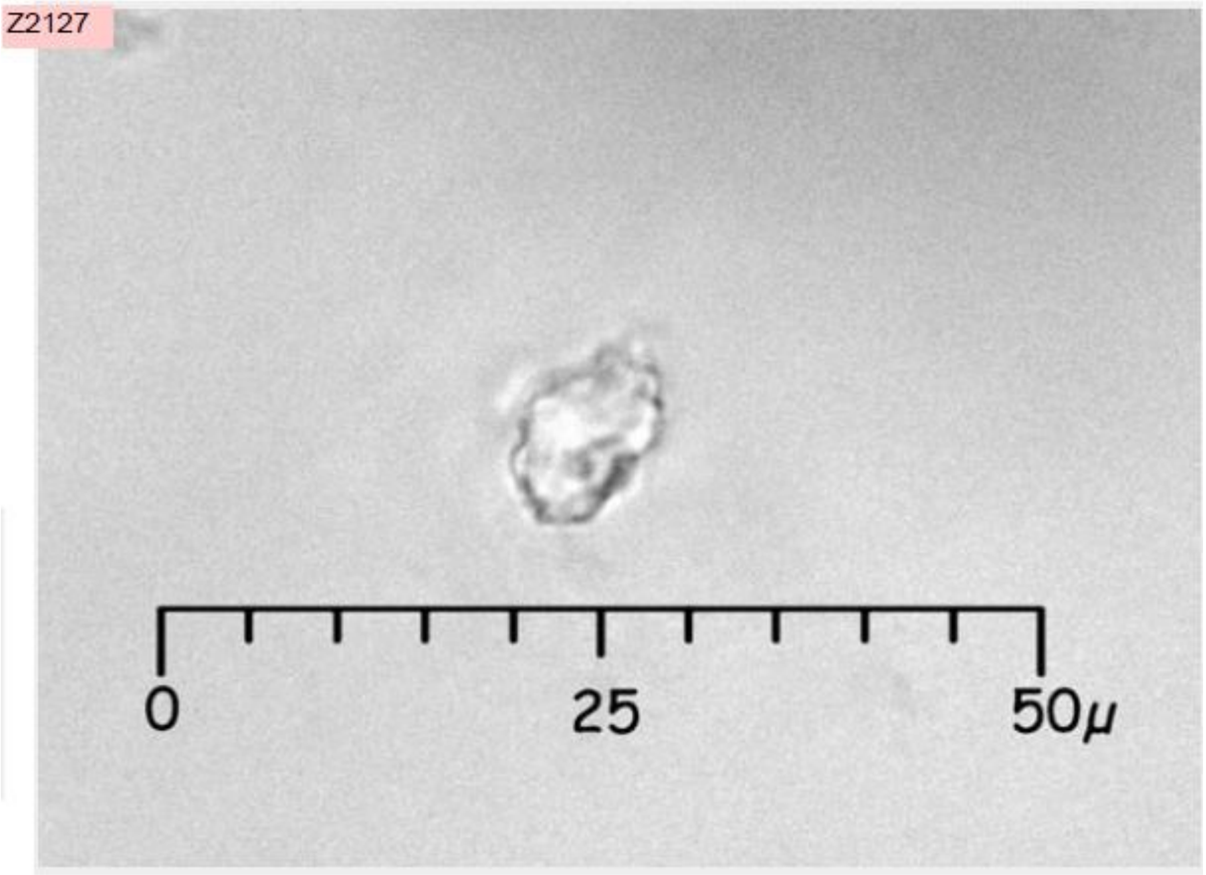


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Bixa orellana

Phytolith

Diagnostic level under investigation. Observed in Bixa orellana (PC1691).

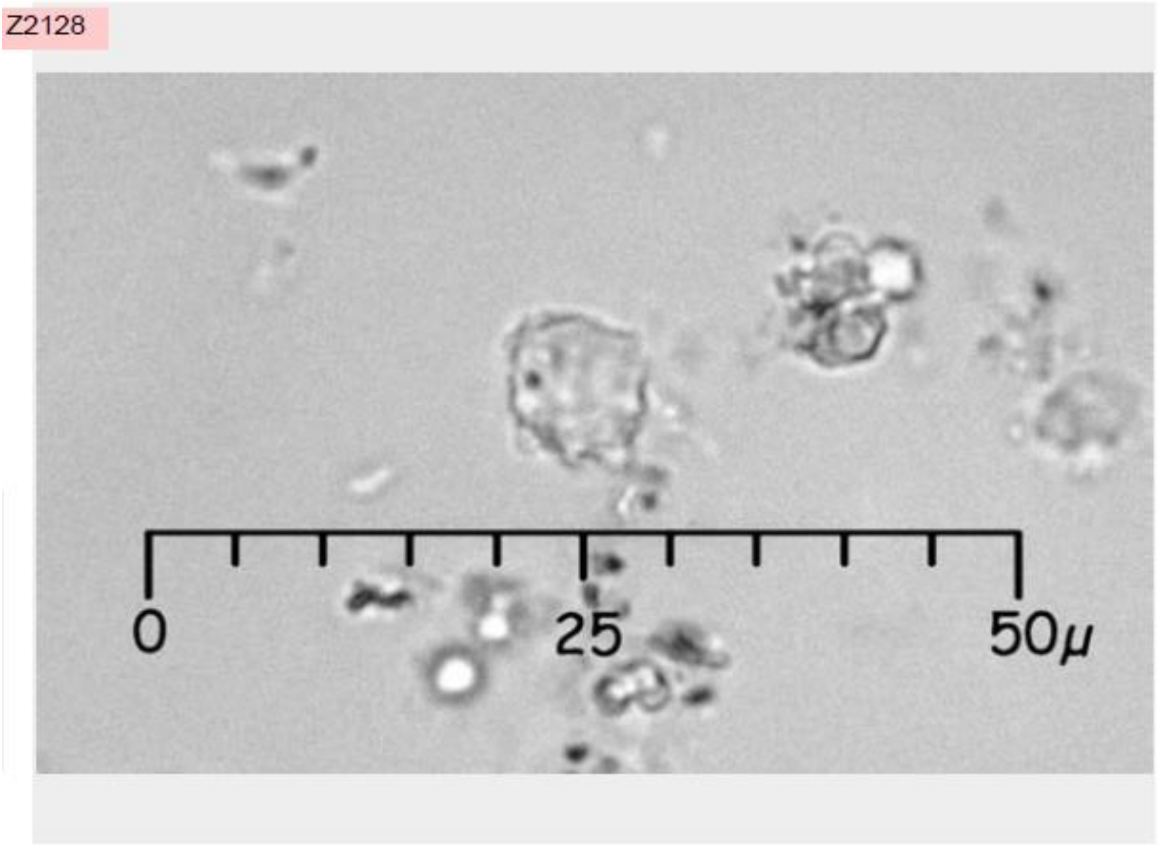


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bixa orellana

Phytolith

Diagnostic level under investigation. Observed in Bixa orellana (PC1691)

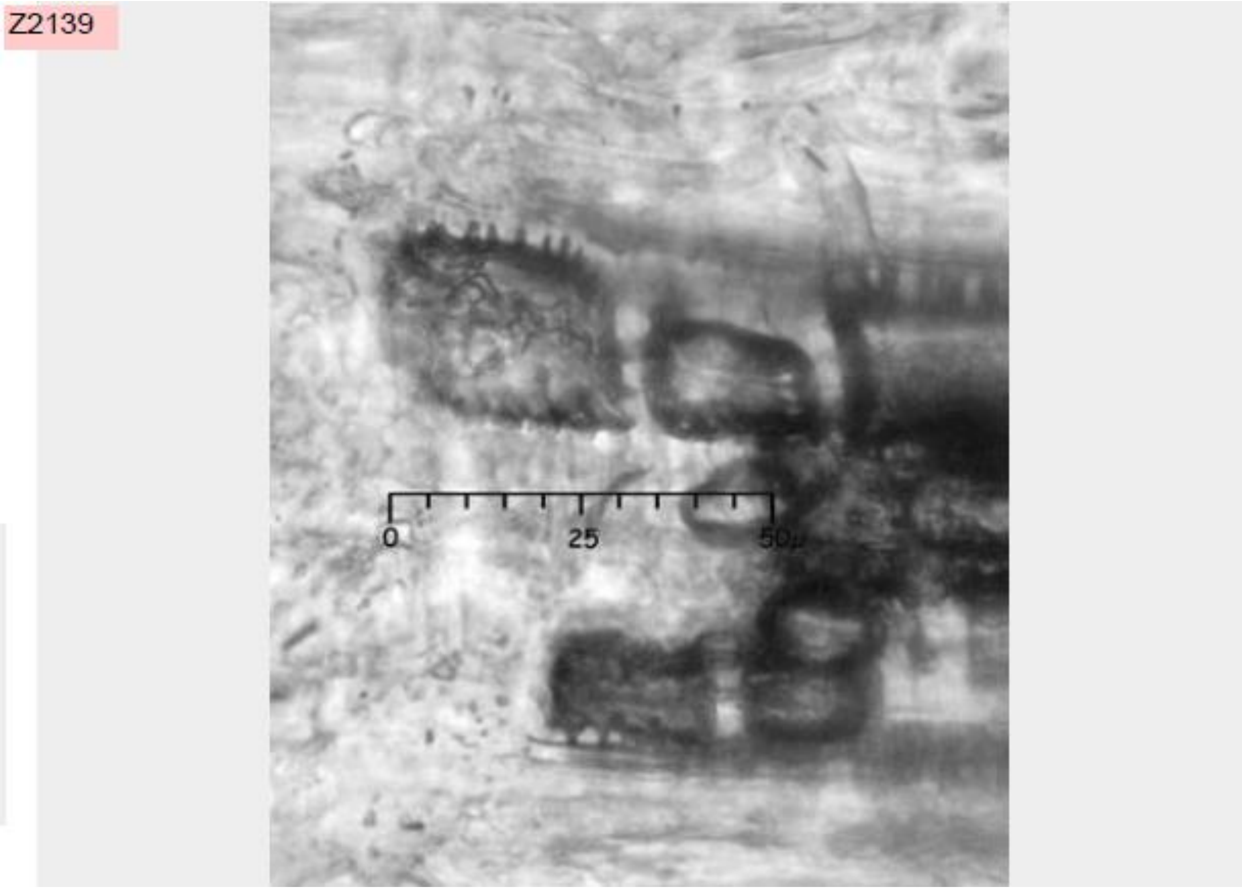


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bixa orellana

Phytolith

Projections are not speculate,
ie, not 22VIII.
Not diagnostic

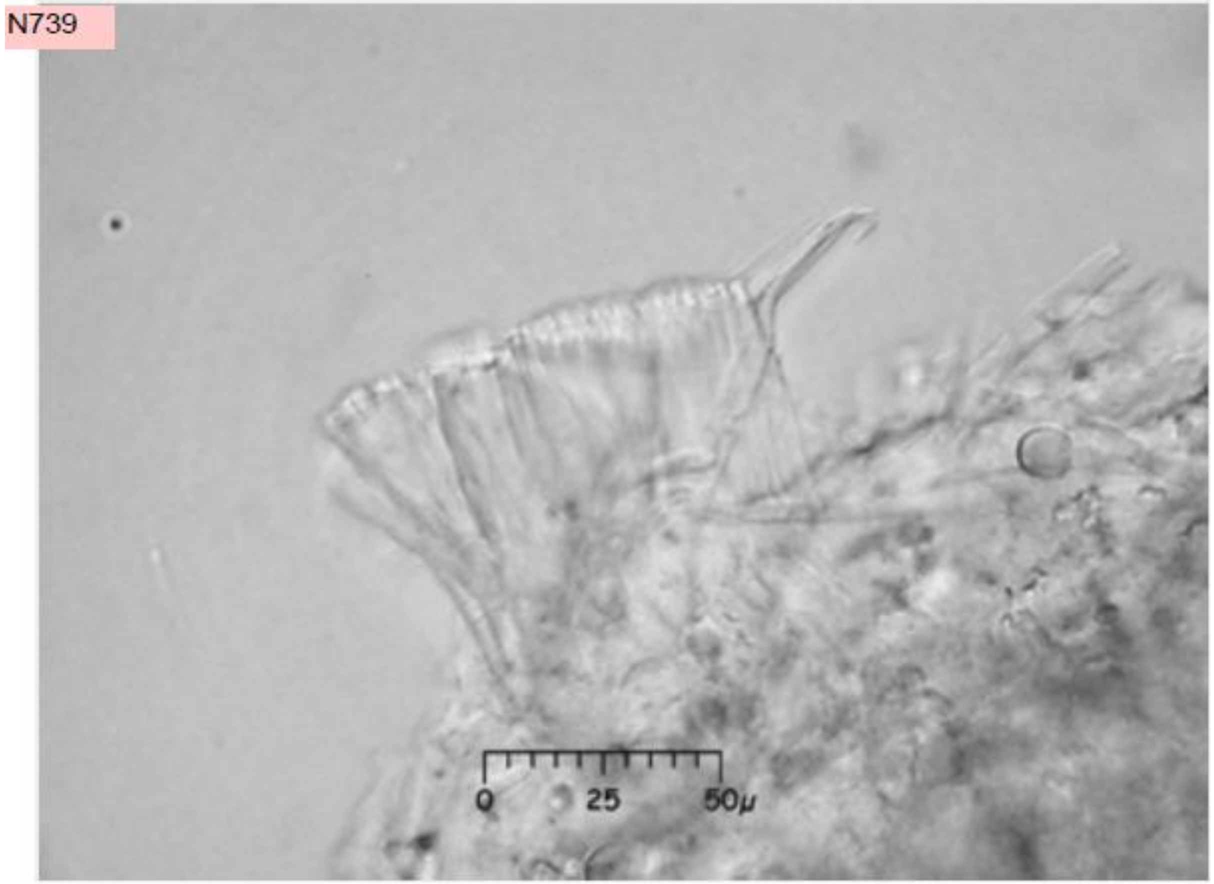


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Bixa orellana

Phytolith

Type established by Karol Chandler- Ezell, 2004
Diagnostic level: fruit/seed



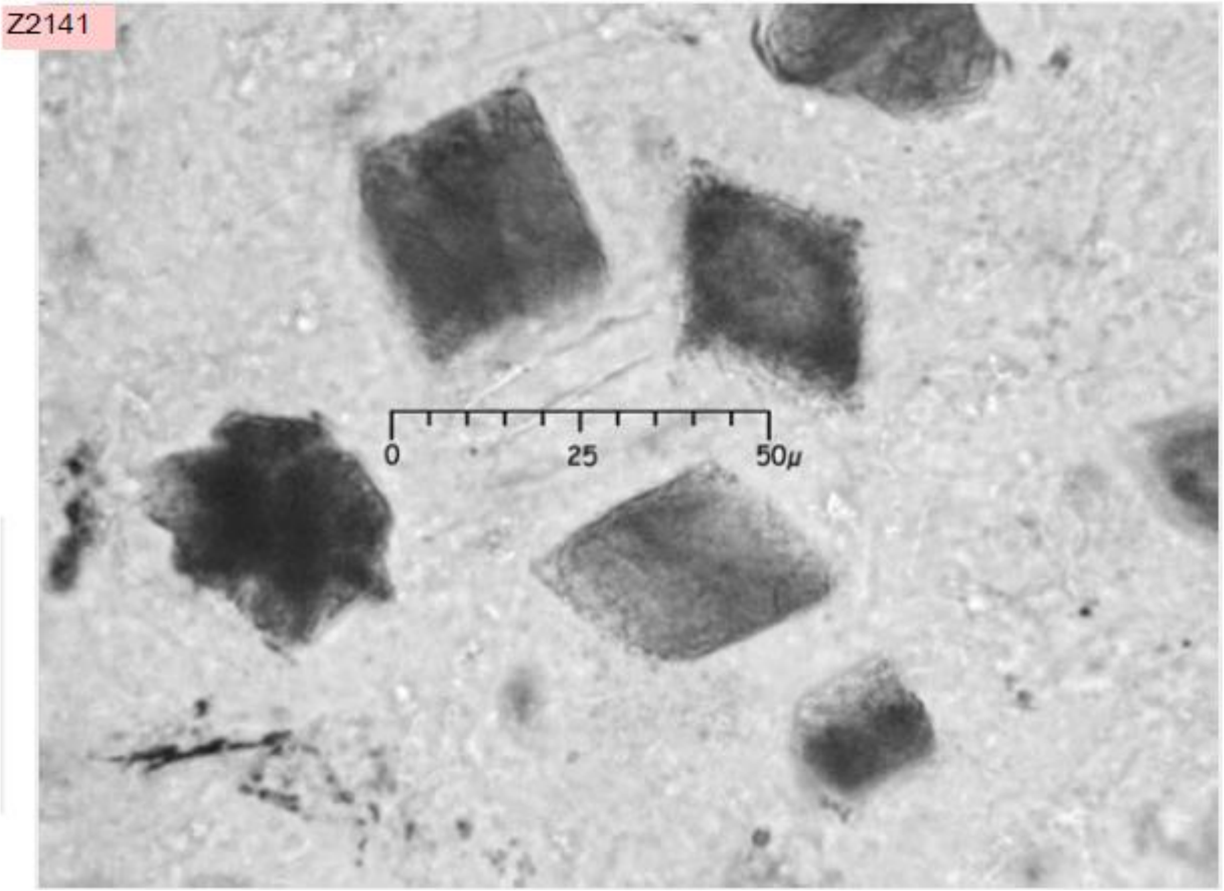
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

BOMBACACEAE

Ceiba sp.

Phytolith

PC2866, wood specimen
Diagnostic level: under study

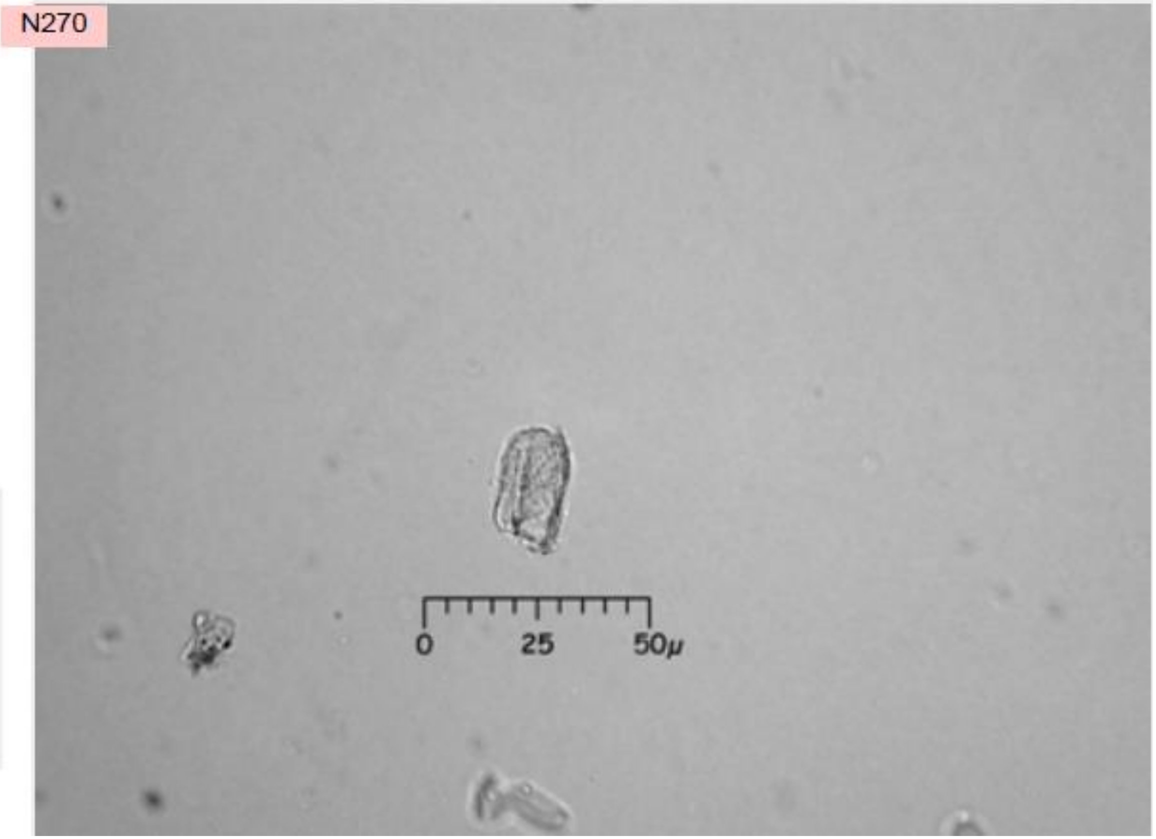


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Huberodendron patinoi

Phytolith

See top view (Record #155) of this body .
Not diagnostic

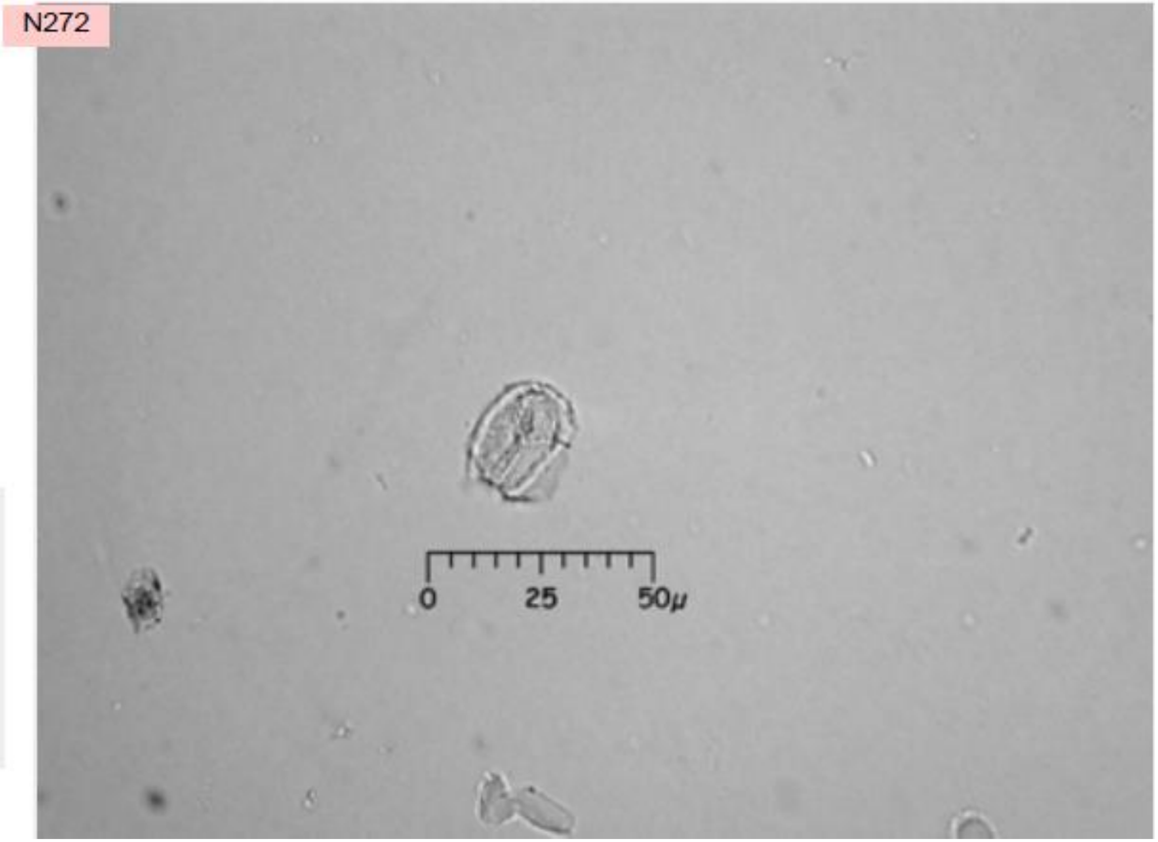


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Huberodendron patinoi

Phytolith

See side view (Record #154) of this body.
Not diagnostic

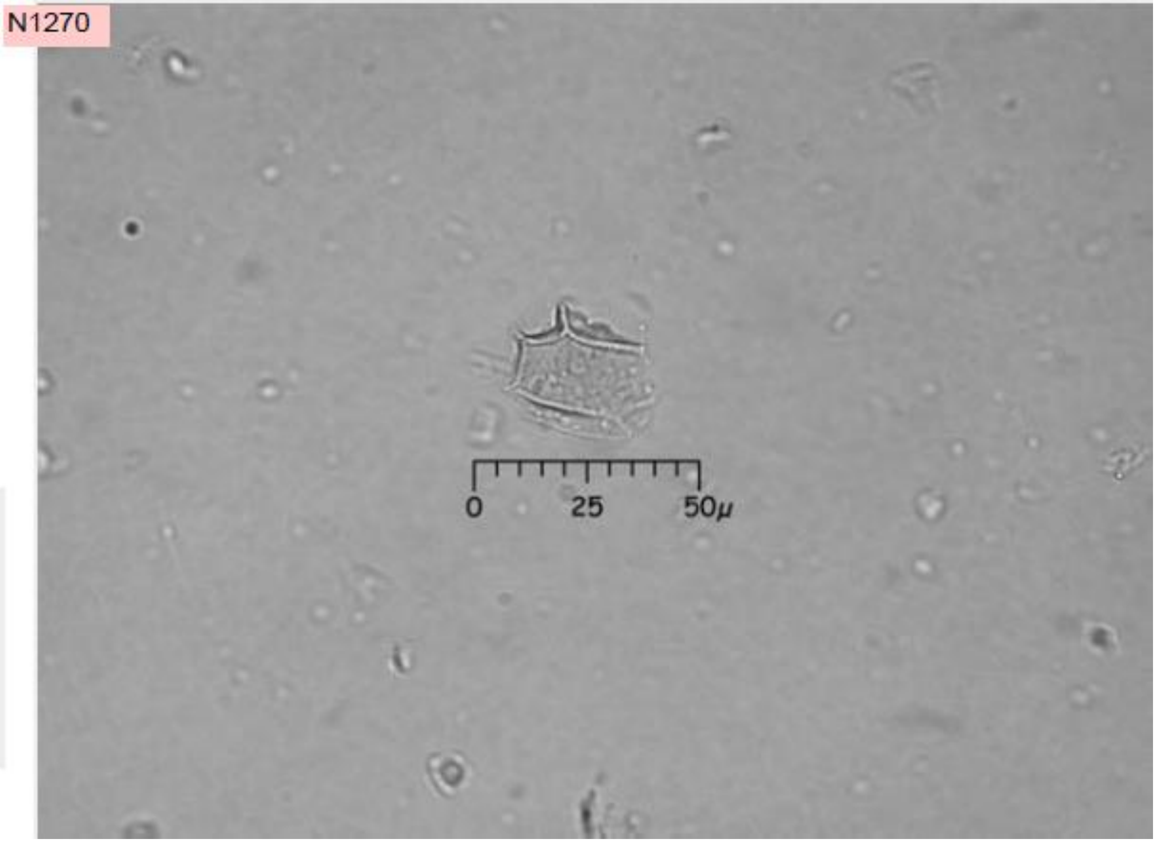


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Huberodendron patinoi

Phytolith

Slide 1372a.
Diagnostic level: genus

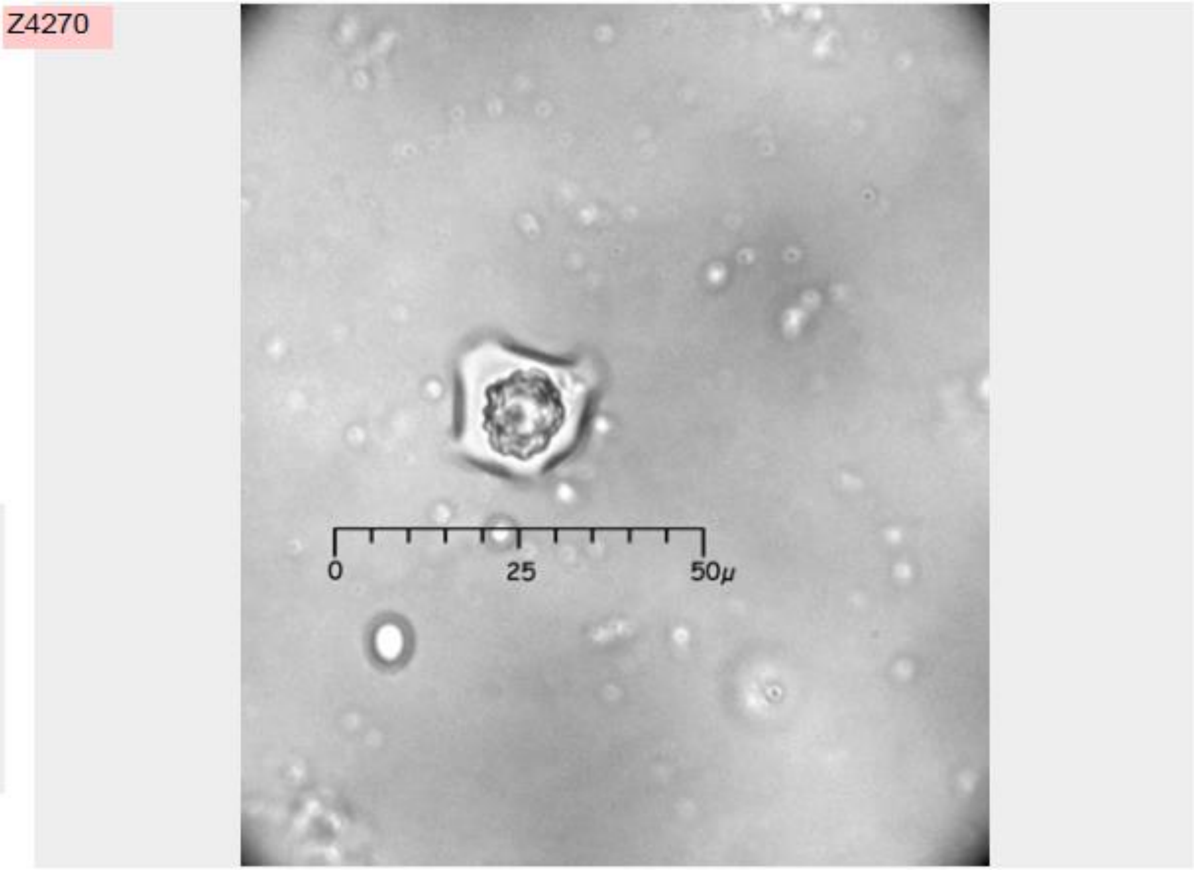


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia cf. alata

Phytolith

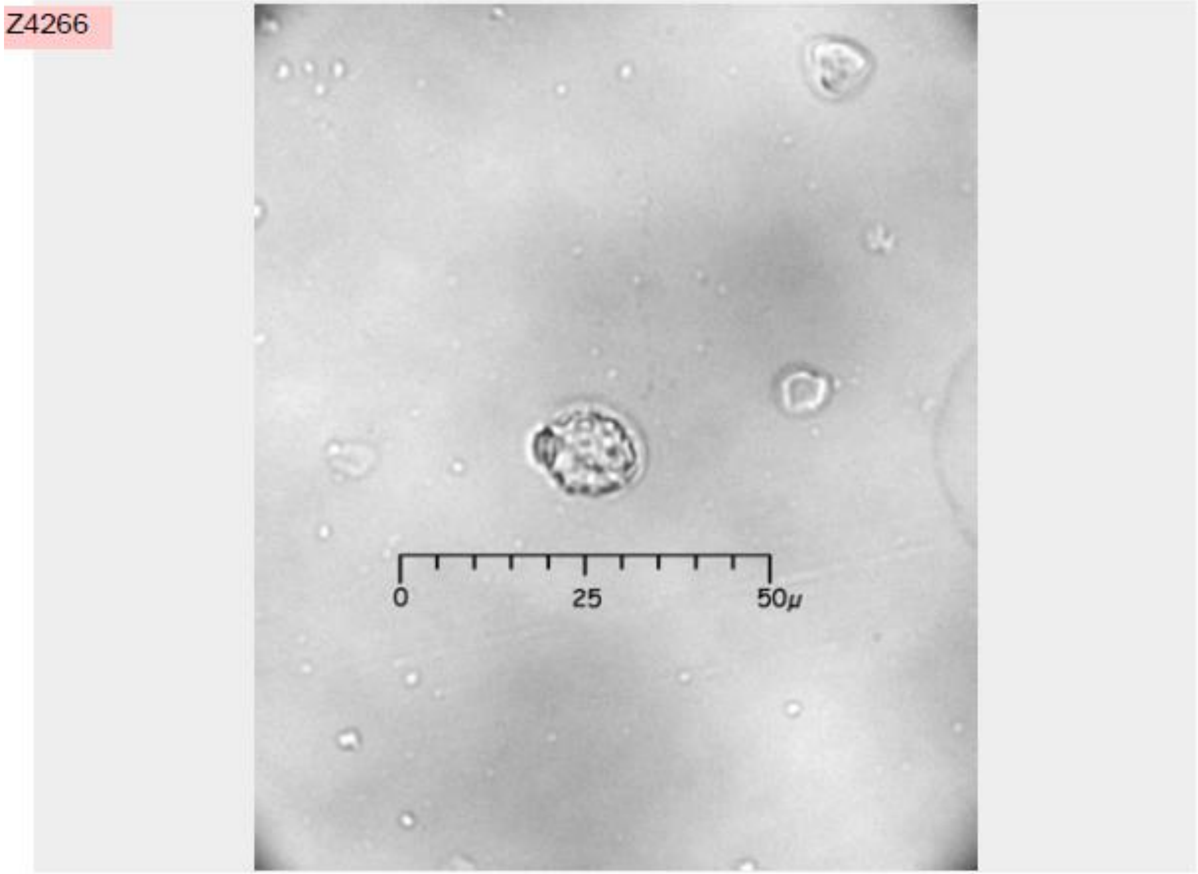
Nodular spheres occur in moderate levels in Matisia cf. alata. Size range: 8 -22 microns. Overlaps with Marantaceae nodular spheres. Marantaceae/Bombacaceae mixed type



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia cf. alata

Phytolith

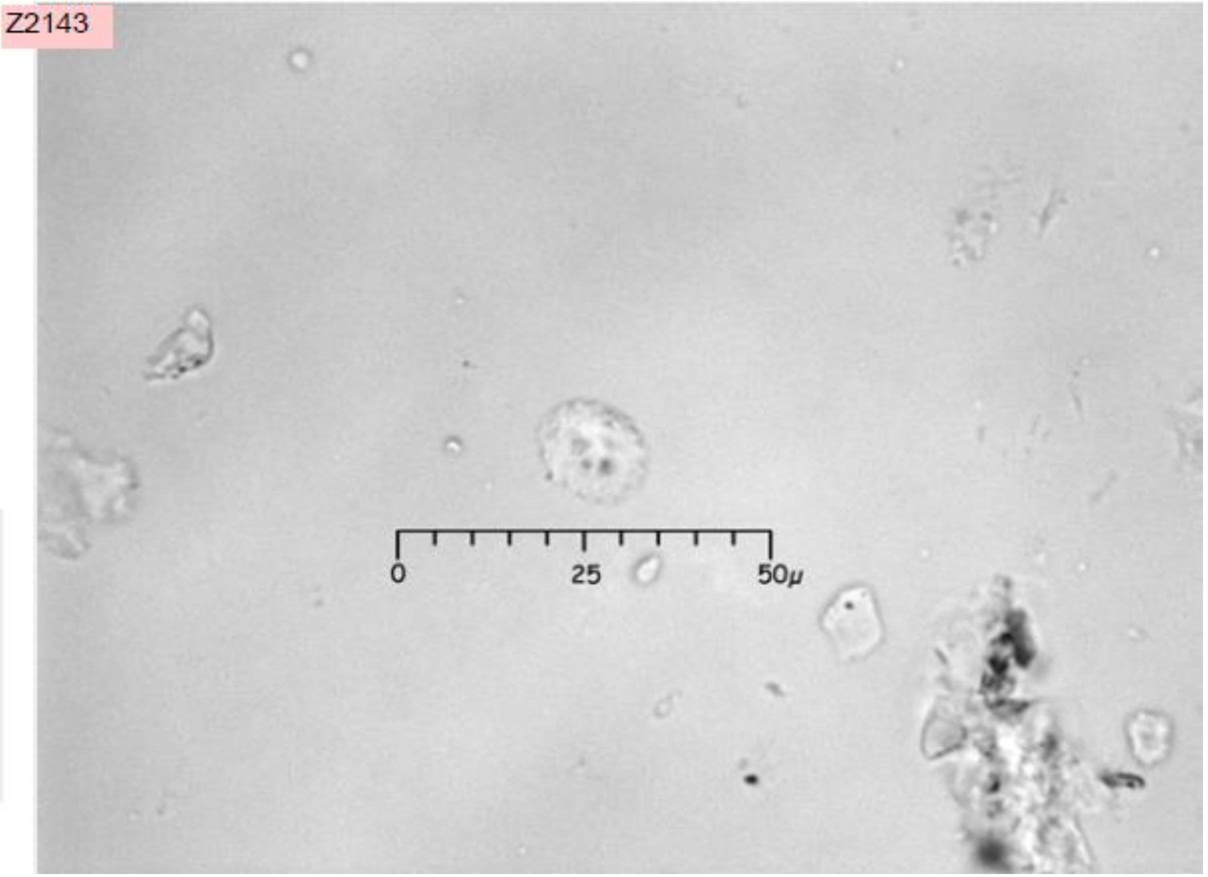


Nodular spheres occur in moderate levels in Matisia cf. alata. Size range: 8 -22 microns. Overlaps with Marantaceae nodular spheres. Marantaceae/Bombacaceae mixed type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia cordata

Phytolith



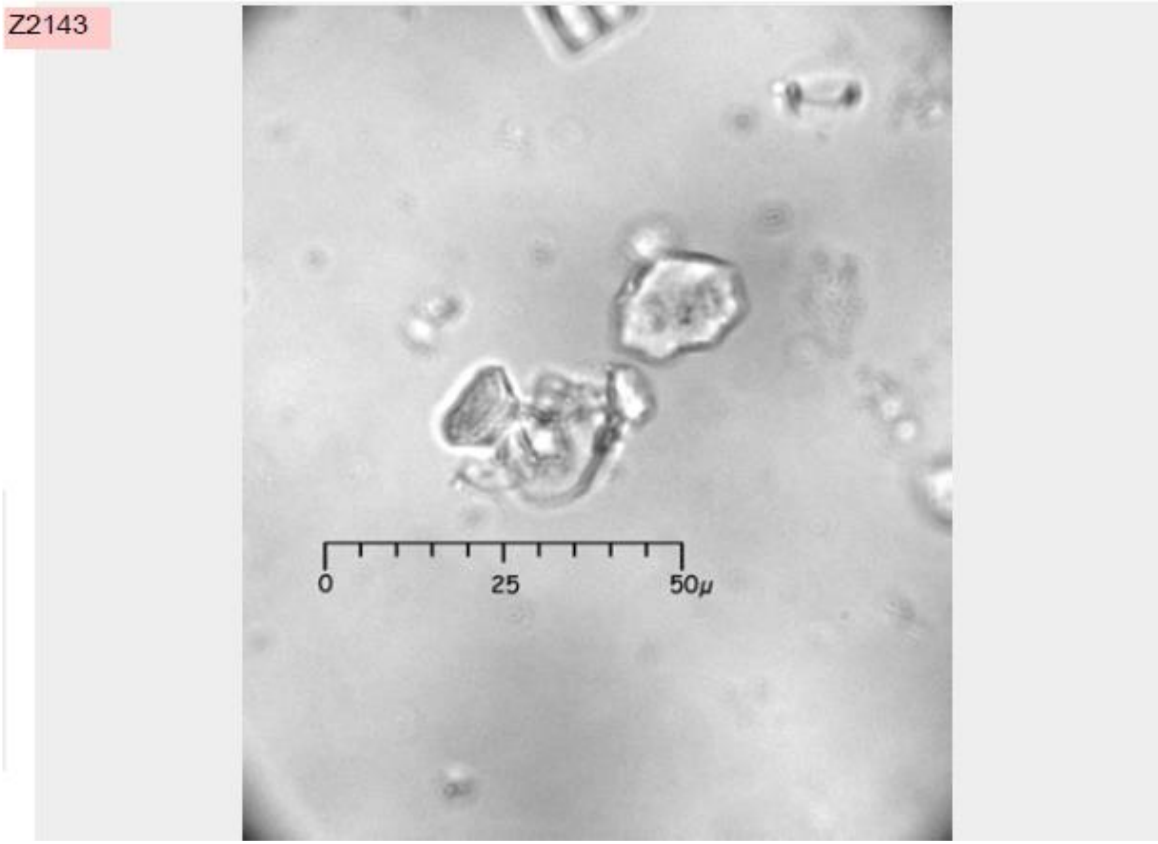
80IIIB has been considered is a Marantaceae family diagnostic. Occurs rarely in PC2127, Matisia cordata, Bombacaceae. Marantaceae/Bombacaceae mixed type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia cordata

Phytolith

80IIIB has been considered is a Marantaceae family diagnostic. Occurs rarely in PC2127, Matisia cordata, Bombacaceae.
This image shows the rugulose bottom.
Marantaceae/Cannaceae/Bombacacea e mixed type



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia longipes

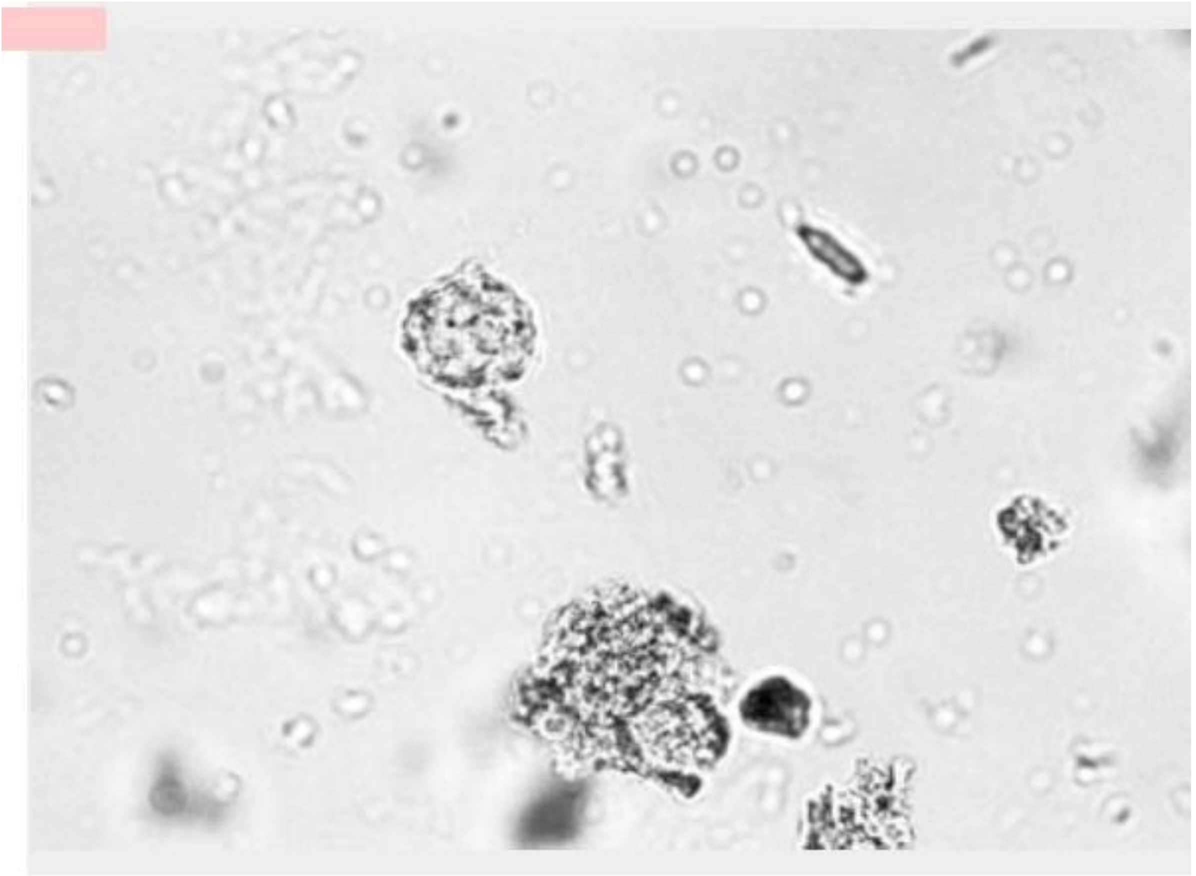
Phytolith

Stomate.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia longipes

Phytolith



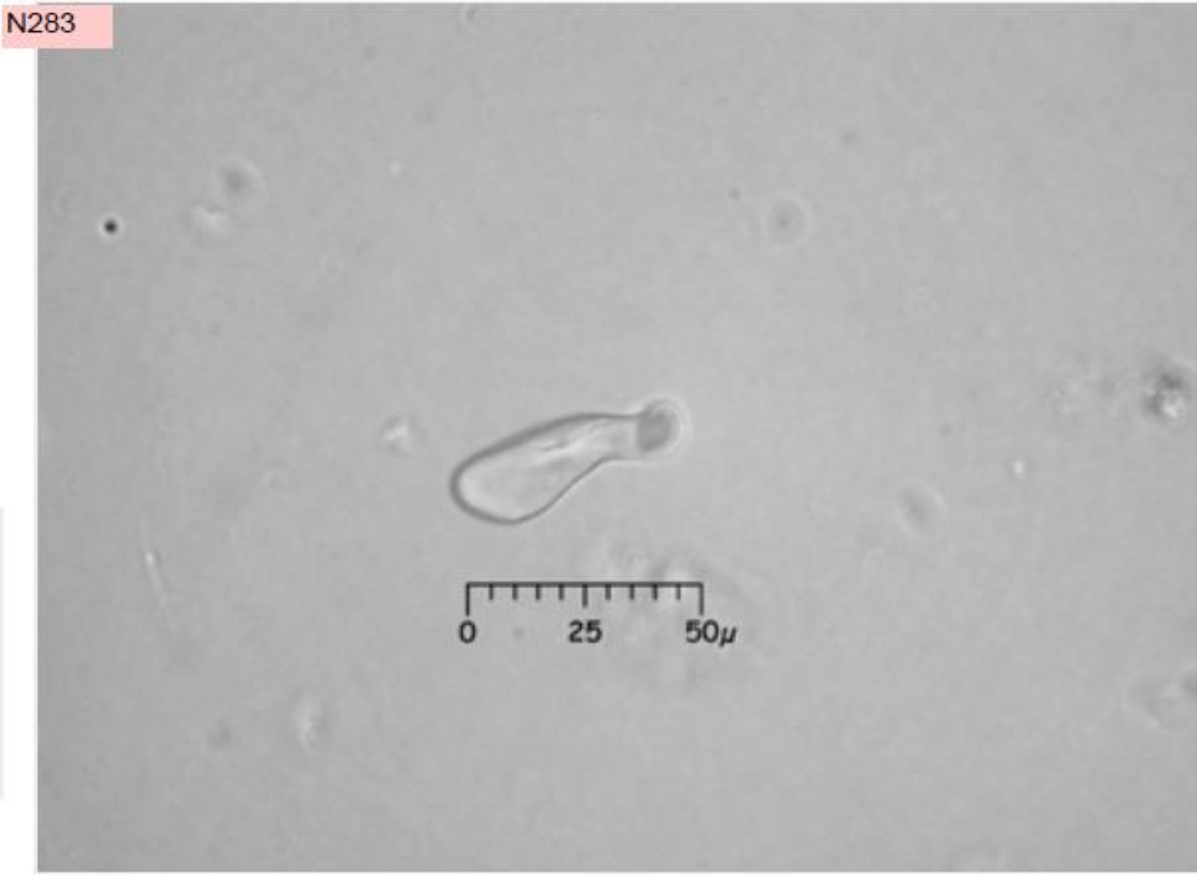
Cystolith with stalk
Diagnostic level: generalized arboreal indicator

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia longipes

Phytolith

Note flat tip of hair. Occur rarely.
Slide 1366.
Diagnostic level: species



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maltisia longipes

Phytolith

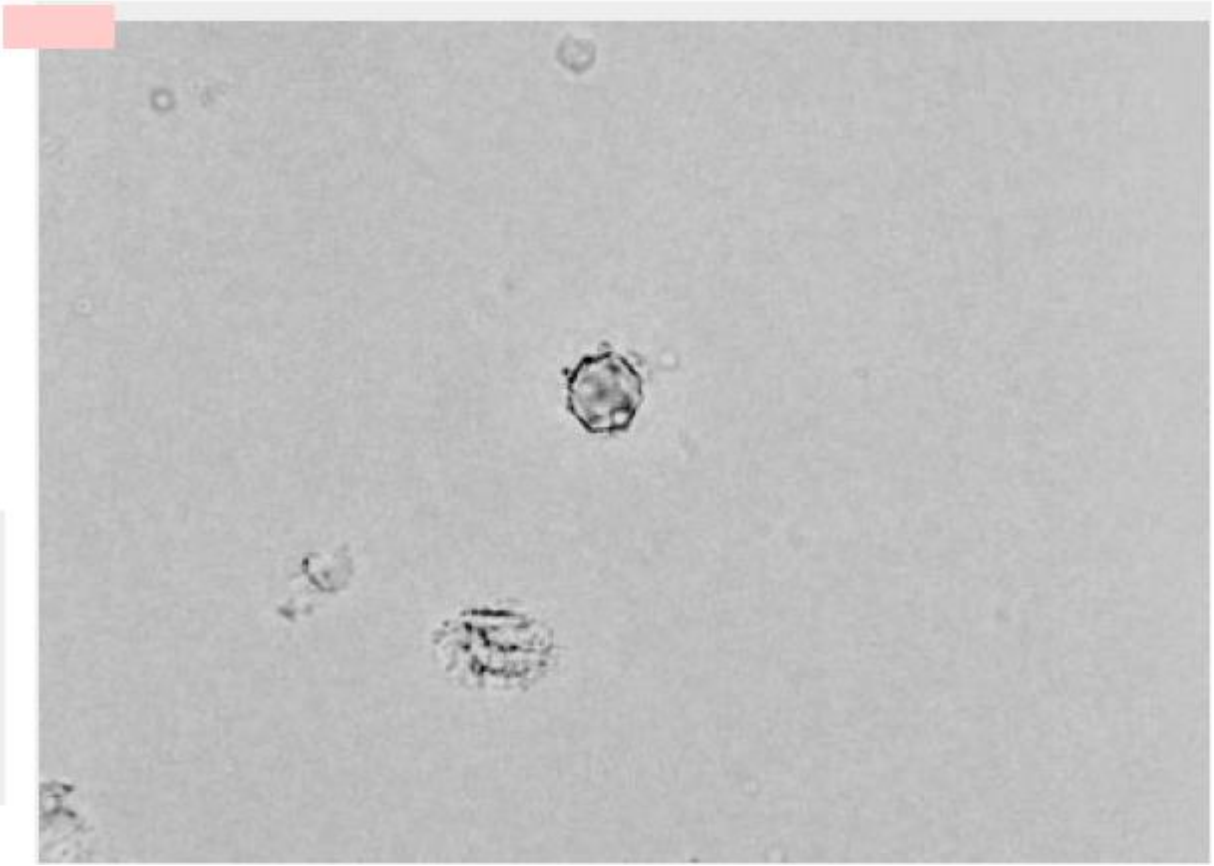
Slide 1366 leaf.
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Ochroma pyramidalis

Phytolith

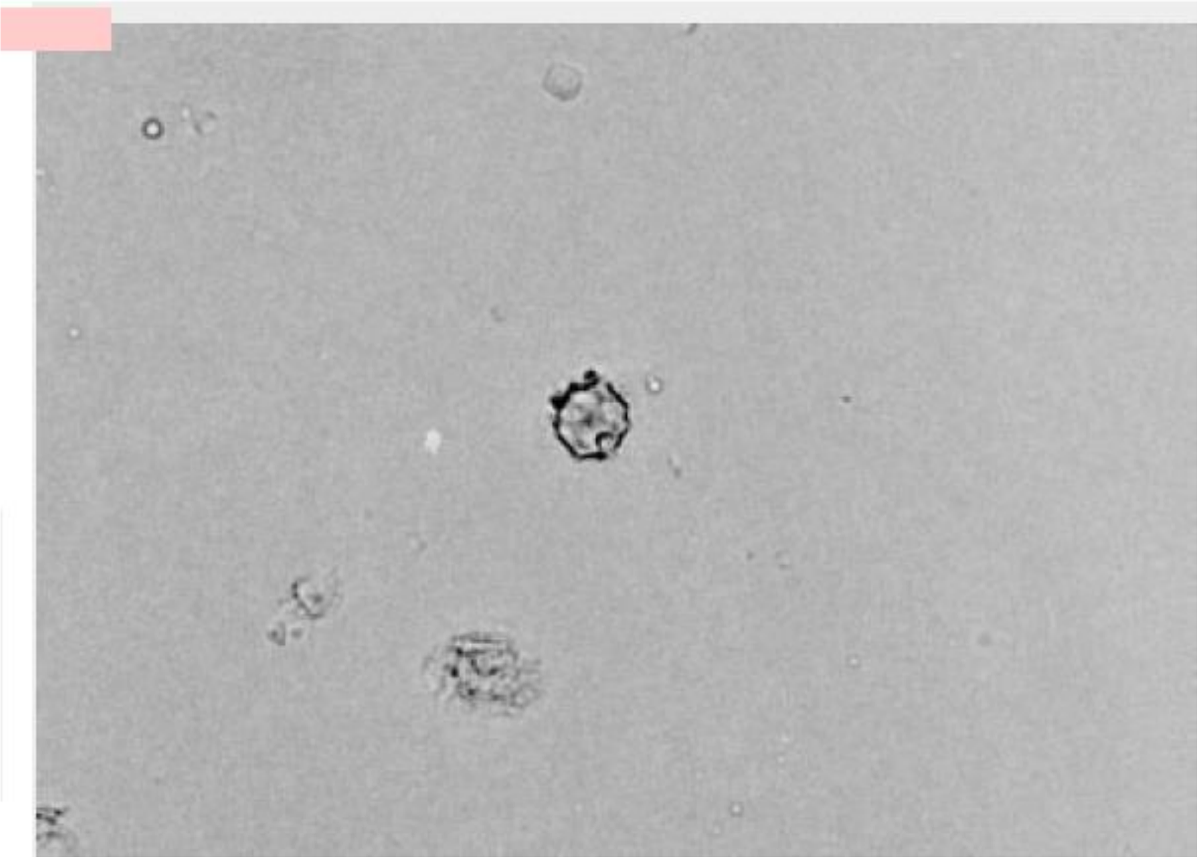
Category currently overlaps with Marantaceae nodular spheres.
Diagnostic level: Marantaceae/Bombacaceae



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Ochroma pyramidalis

Phytolith



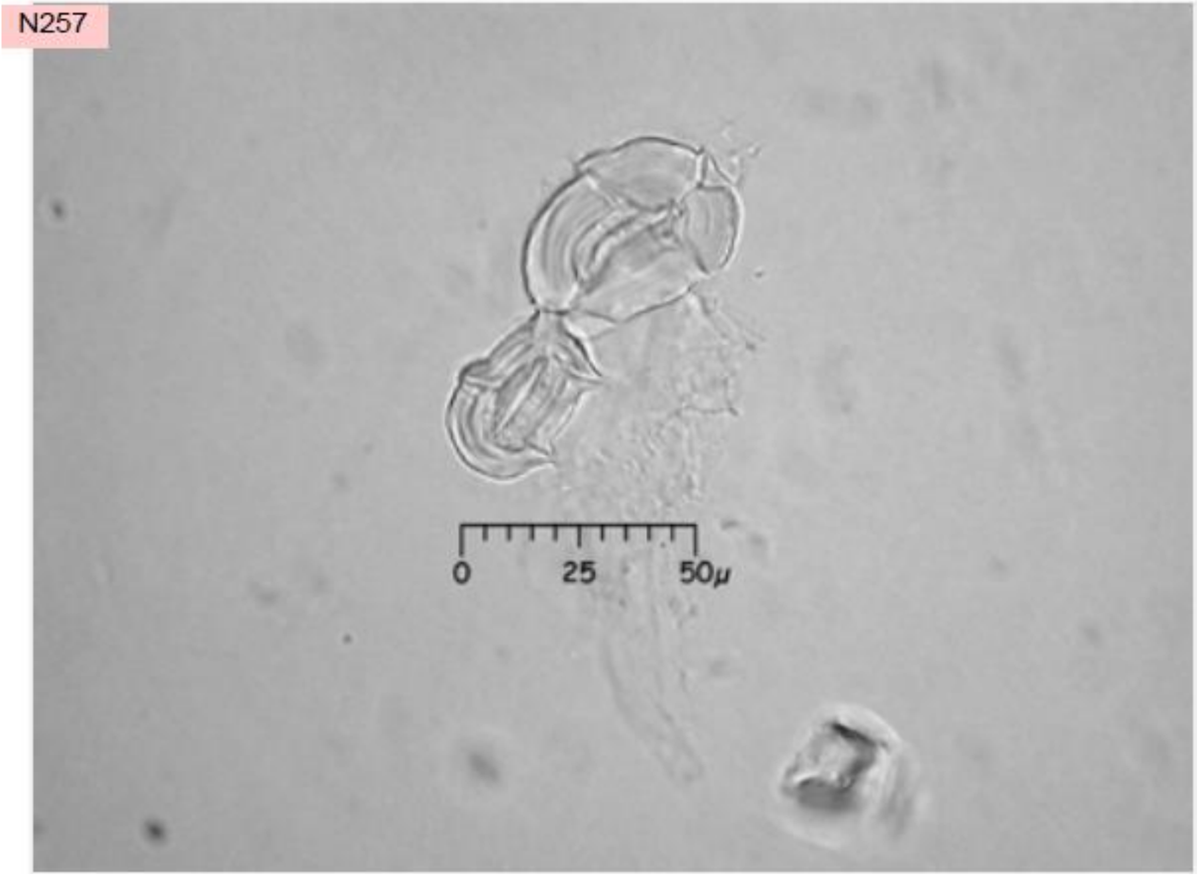
Category currently overlaps with Marantaceae nodular spheres.
Diagnostic level: Marantaceae/Bombacaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

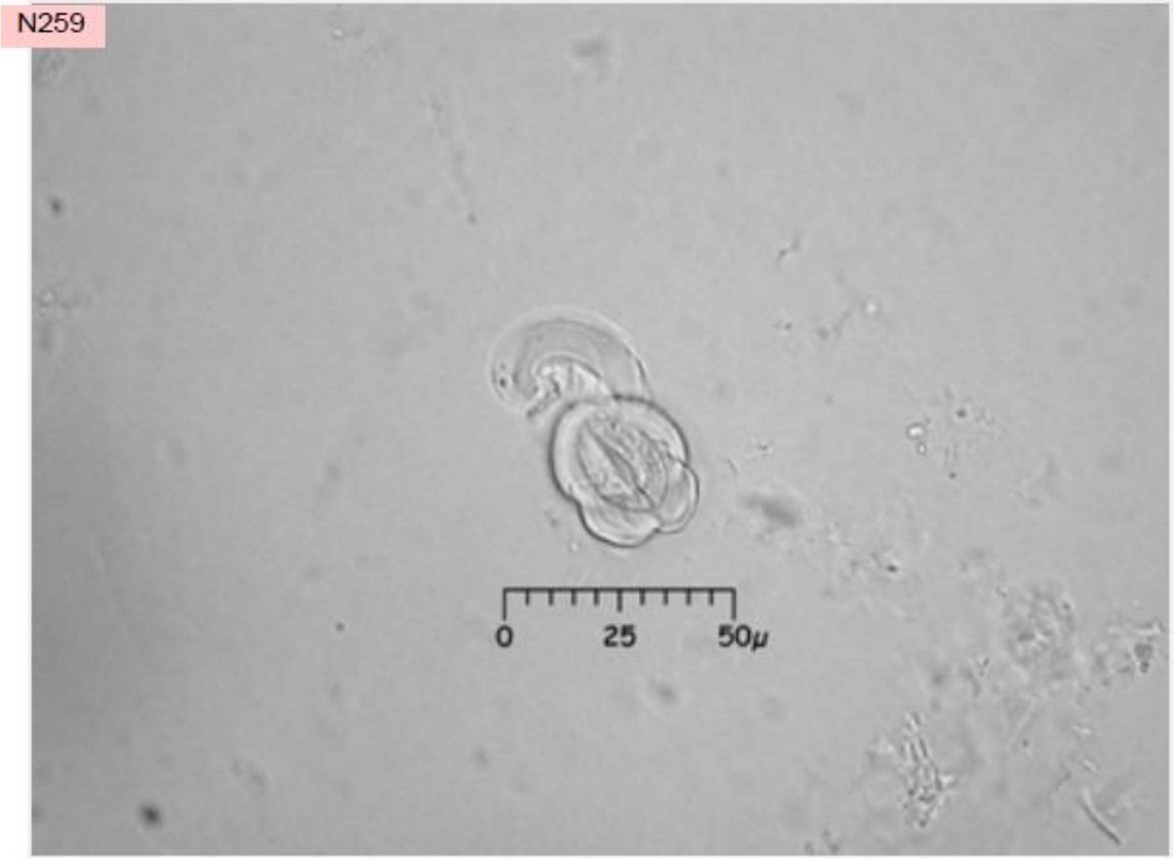
Diagnostic level: family
Note the “corners” of the body, where angular structure cups rounded interior. When broken, forms 20VD See also Record #147, 148 and 149. Note angular structure. From the bottom, it forms one stripe across length of back and two crossing body from side to side. In this top view, they appear as angular bands crossing



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith



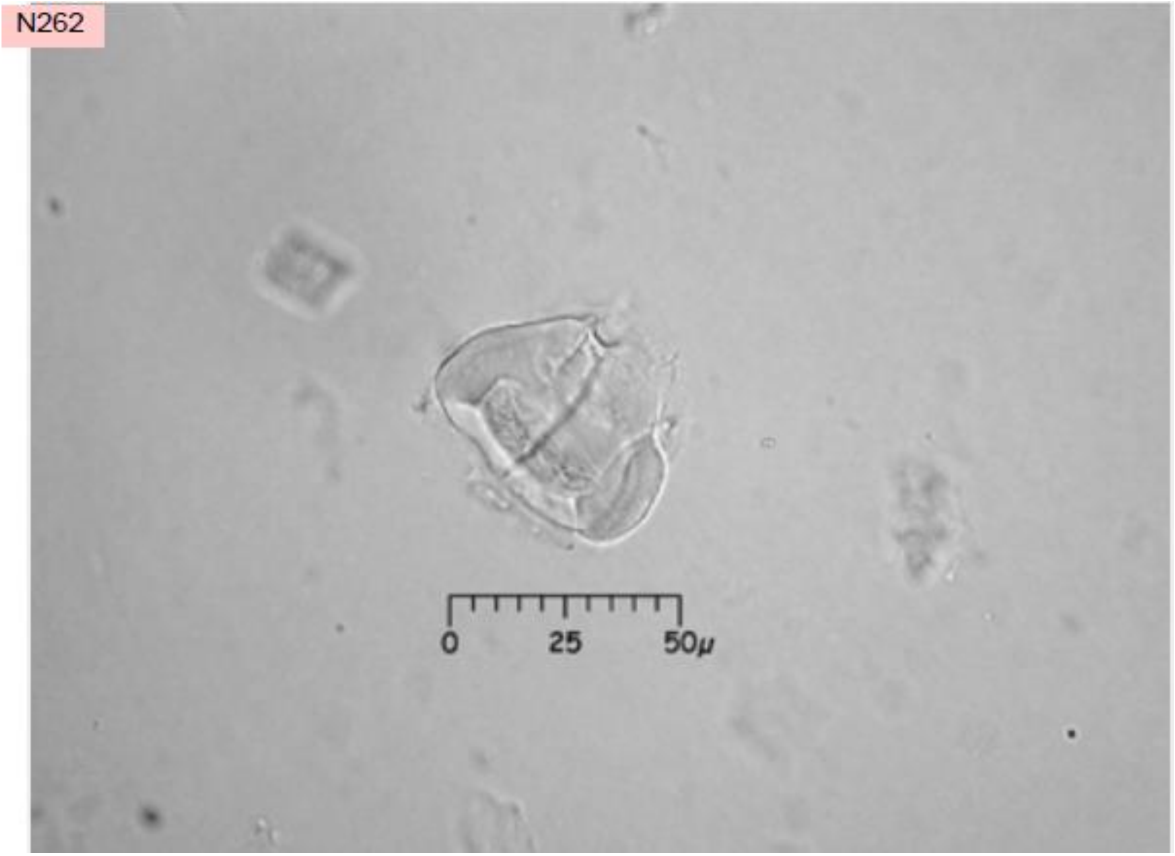
Top view. Note attached filament. See also Record #146, 148 and 149.
Angular structure that forms one stripe across length of back and two crossing body from side to side is not in focus in this view.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

Side view.
See also Record #146,147 and 149.
Diagnostic level: family
Note angular structure that forms one stripe across length of back and two crossing body from side to side. These appear in “top” of body as angular bands crossing subsidiary cells. In this side view they appear as angular



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

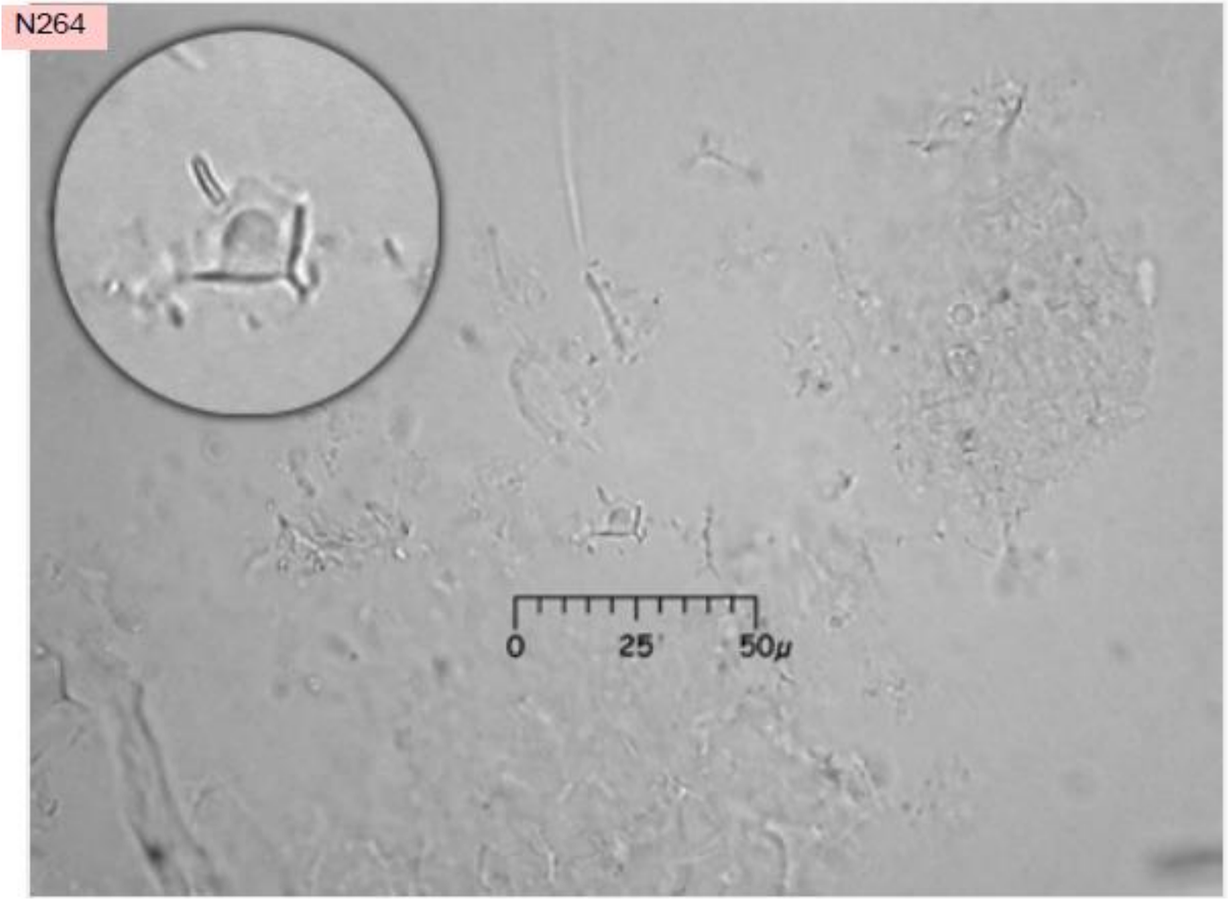
Phytolith

Note the “corners” of the body, where angular structure cups rounded interior. When broken, forms 20VD.
Bottom view.
See also Record #146,147 and 148.
Note angular structure that forms one stripe across length of back and two crossing body from side to side. These are visible from “top” of body as angular

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

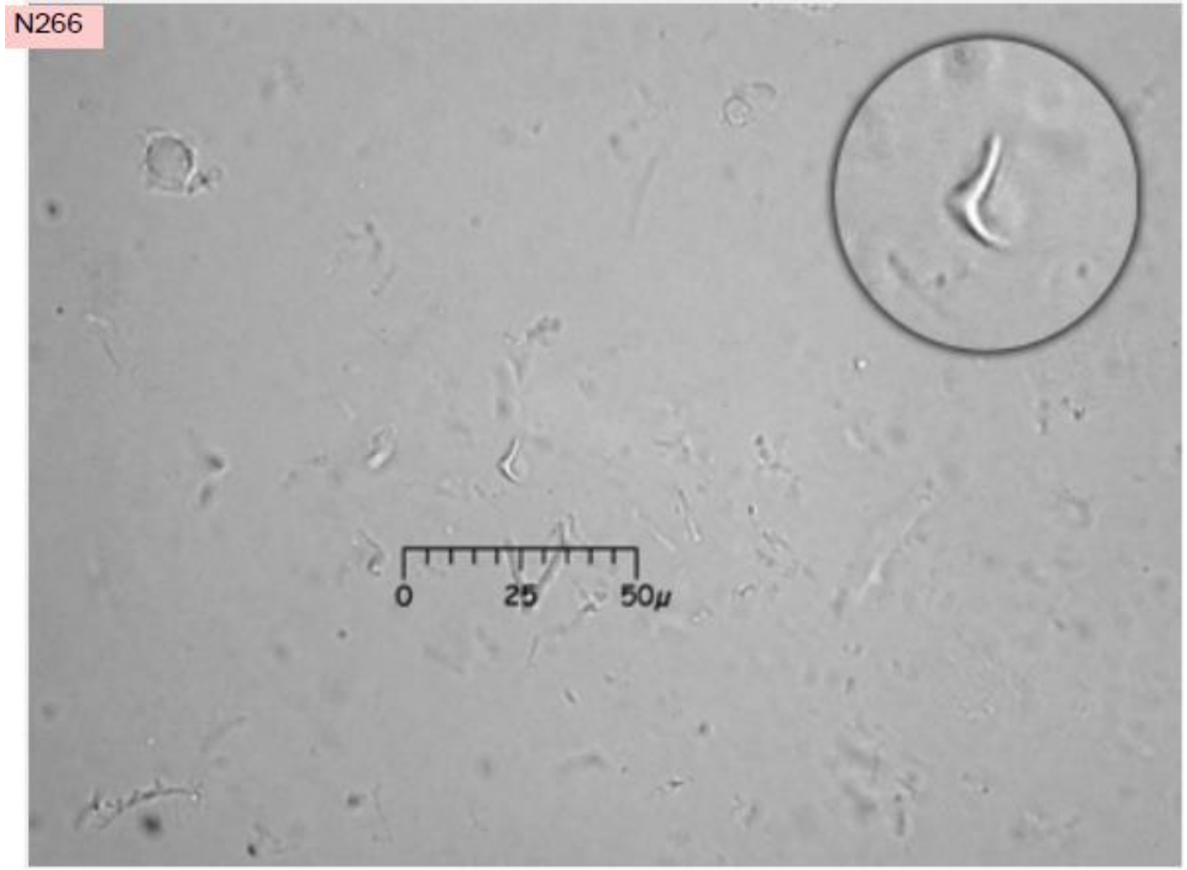


Body is very faint. Notice y-shaped triangular cup around interior rounded part of body.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith



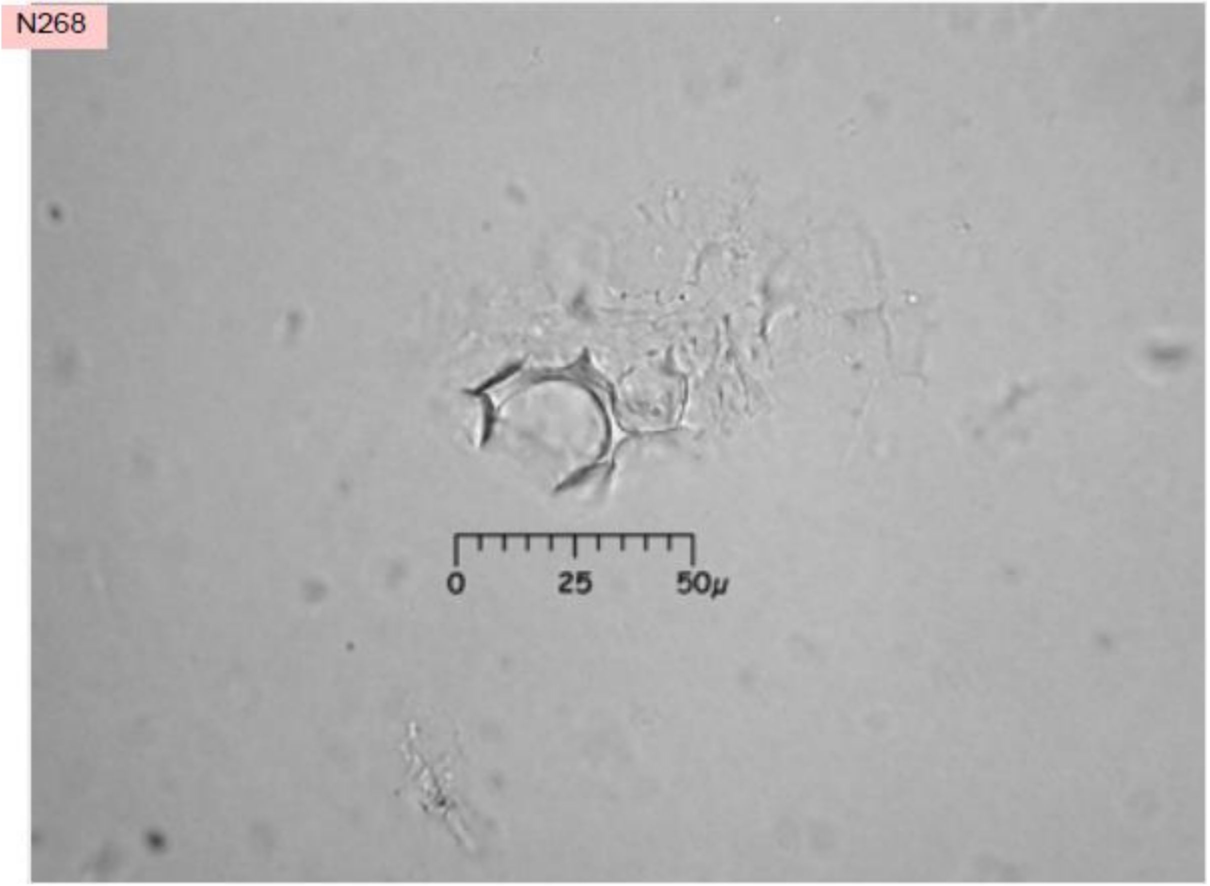
Body is very faint. This view shows the triangular rim.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

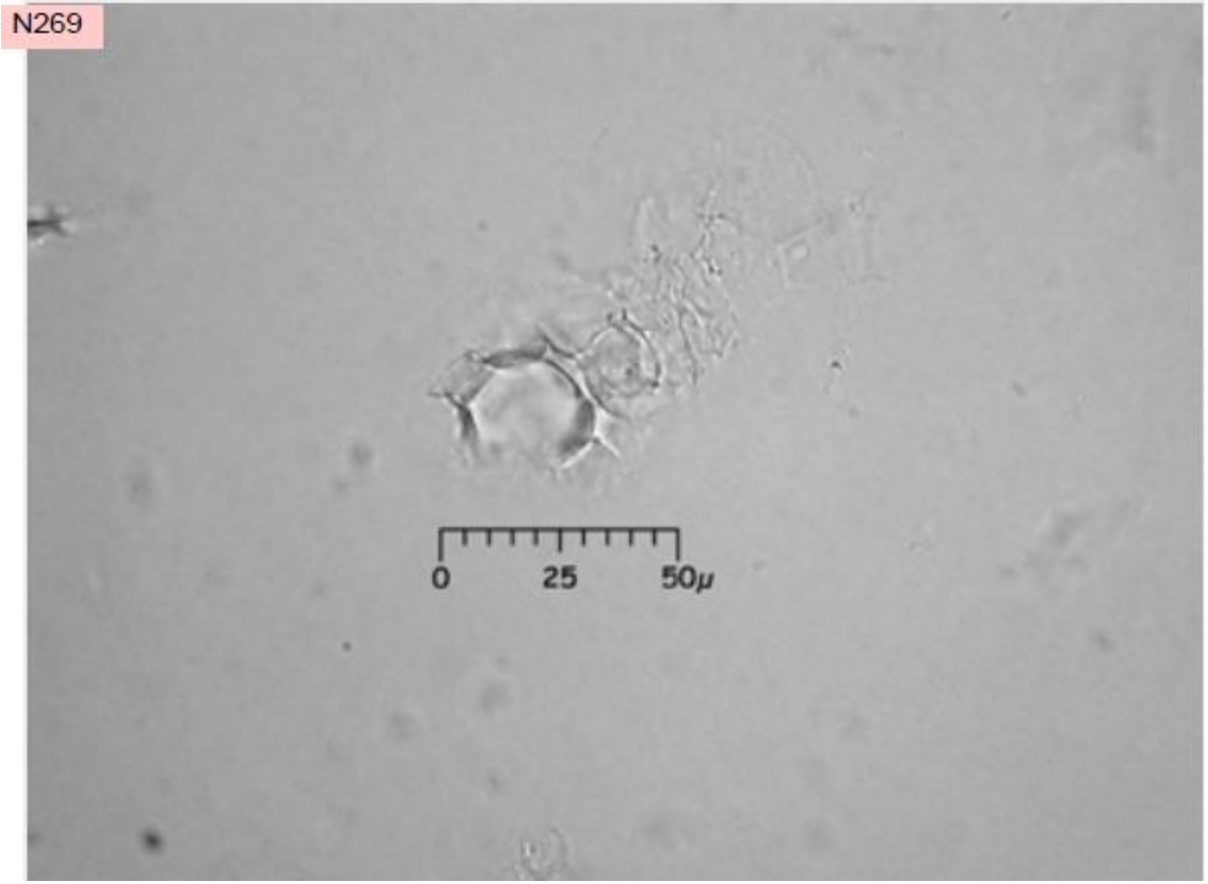
See alternate view (Record #153) to see bottom of hair cell base. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith



Hair cell base, view of bottom. See image of hair cell base top also (Record #152).
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

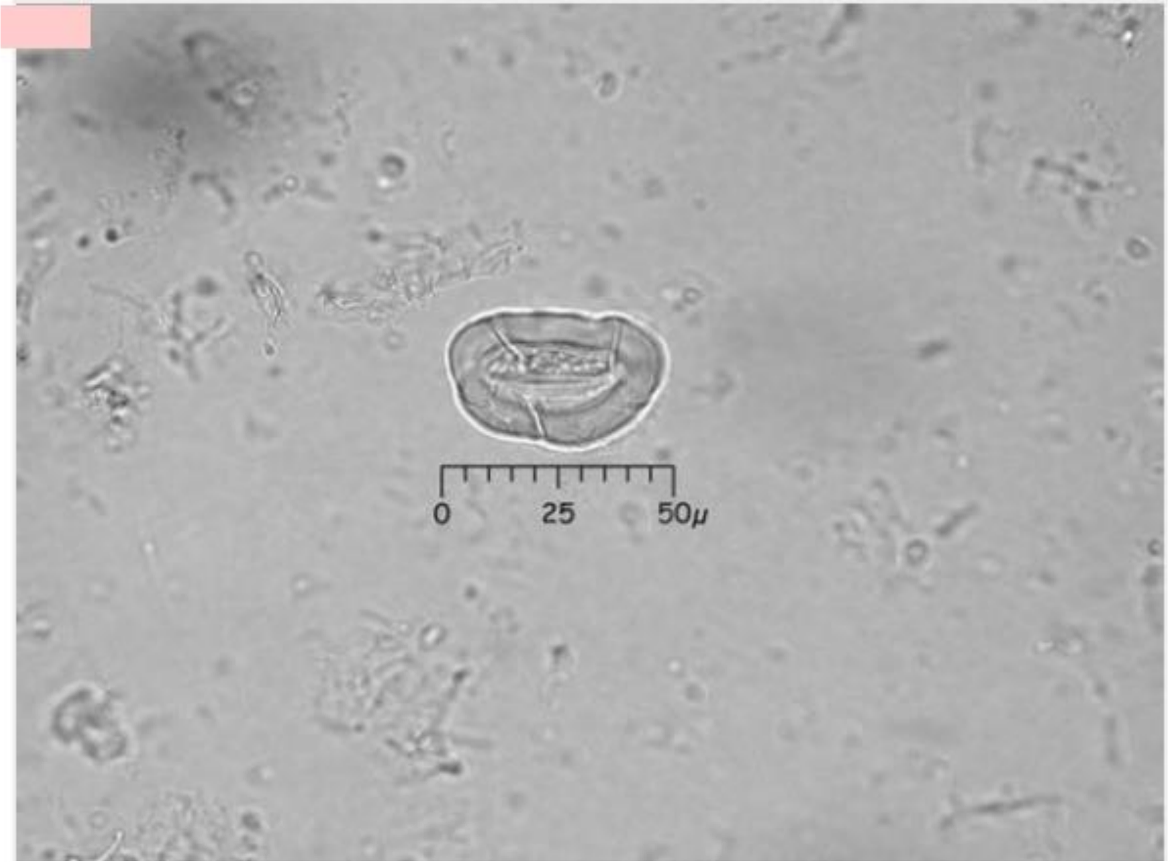
Slide 1367c. Diagnostic level: family
Note the “corners” of the body, where angular structure cups rounded interior. When broken, forms 20VD See also Record #147, 148 and 149. Note angular structure. From the bottom, it forms one stripe across length of back and two crossing body

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pachira aquatica

Phytolith

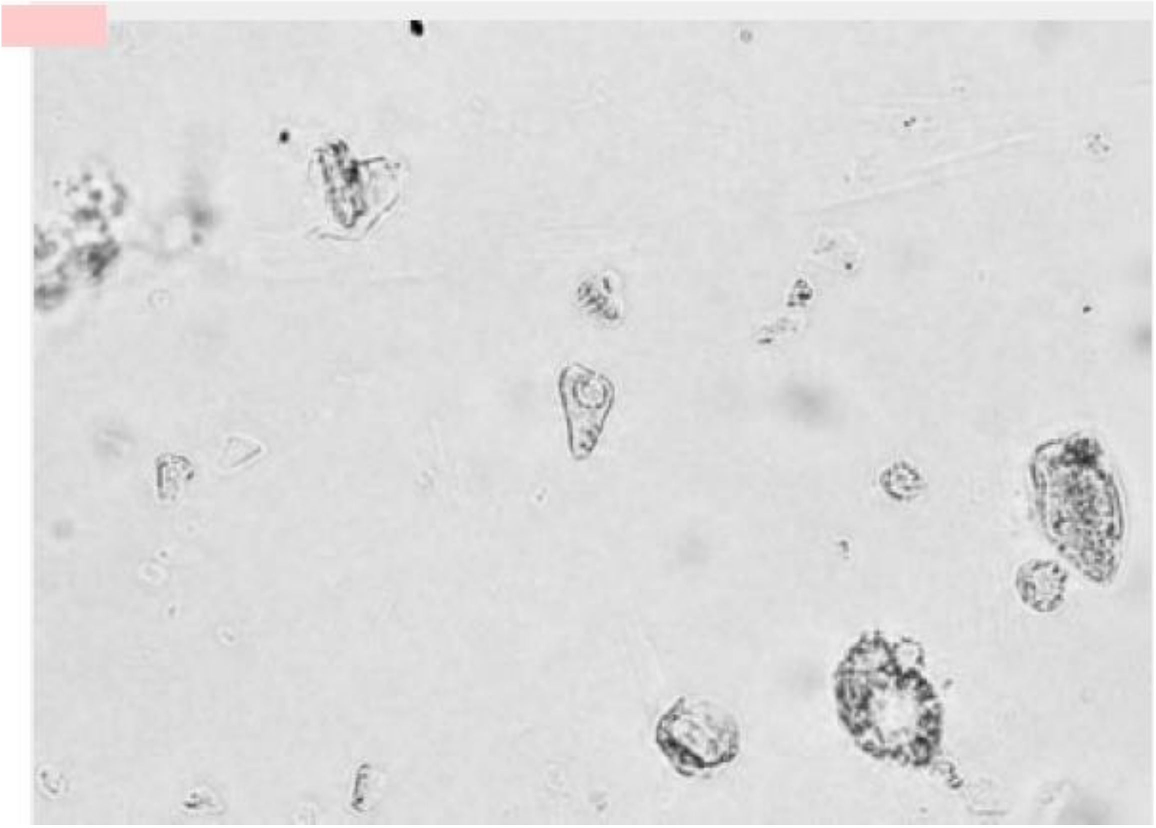
Slide 1367c. Diagnostic level: family Note the “corners” of the body, where angular structure cups rounded interior. When broken, forms 20VD See also Record #147, 148 and 149. Note angular structure. From the bottom, it forms one stripe across length of back and two crossing body from side to side. In this top view, they



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

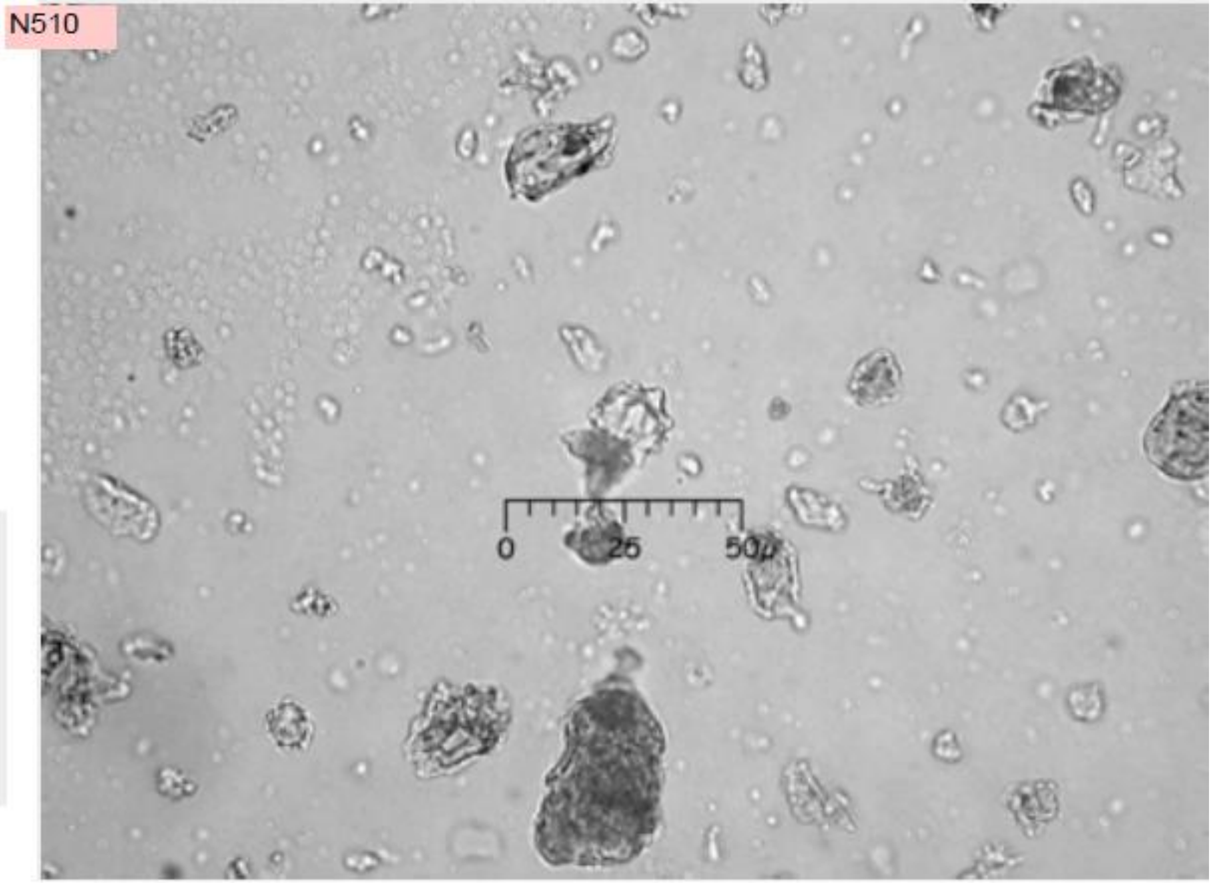


This is a verrucose cystolith encased in a short, broad trichome. Slide 813.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

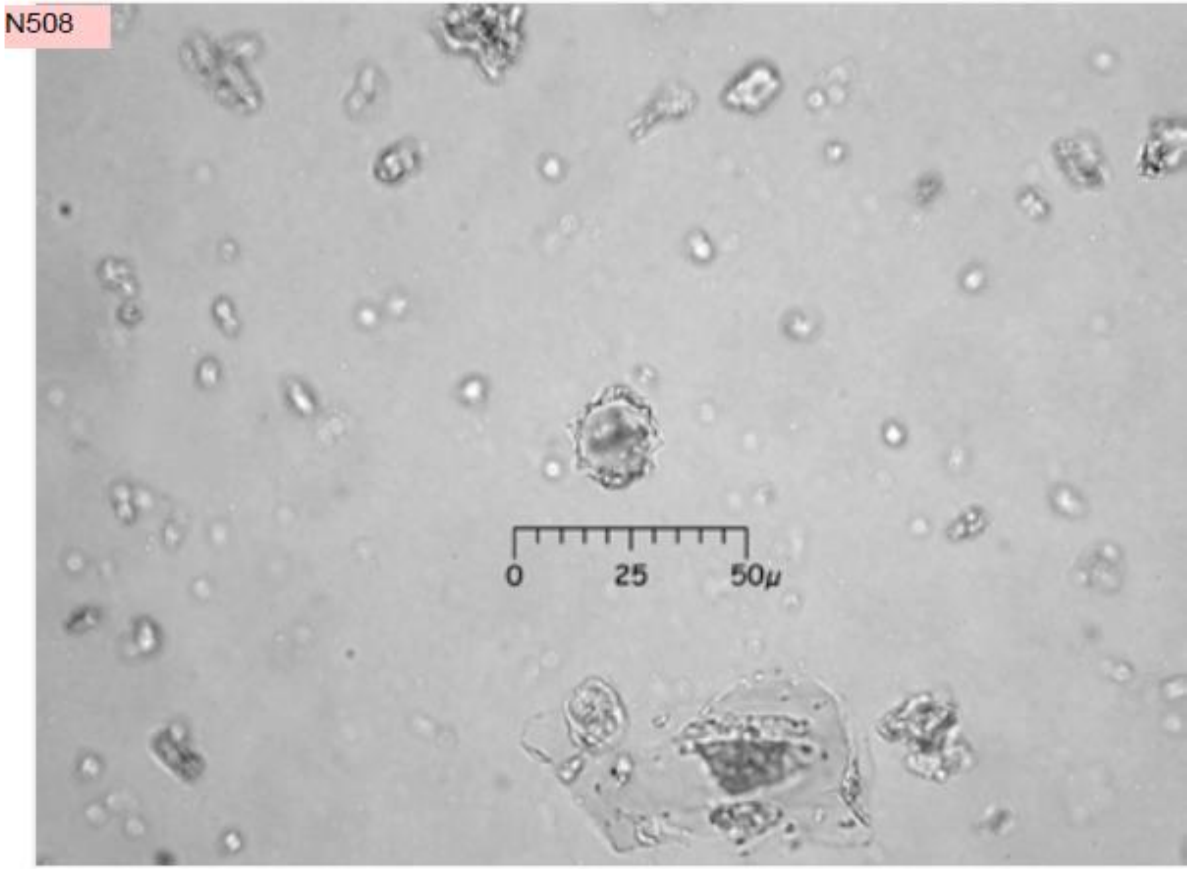


Also occurs in the Zingiberaceae
Diagnostic level: mixed, Zingiberaceae, Bombacaceae. There are subtle differences in the smoothness and abundance of nodules between the two families

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith



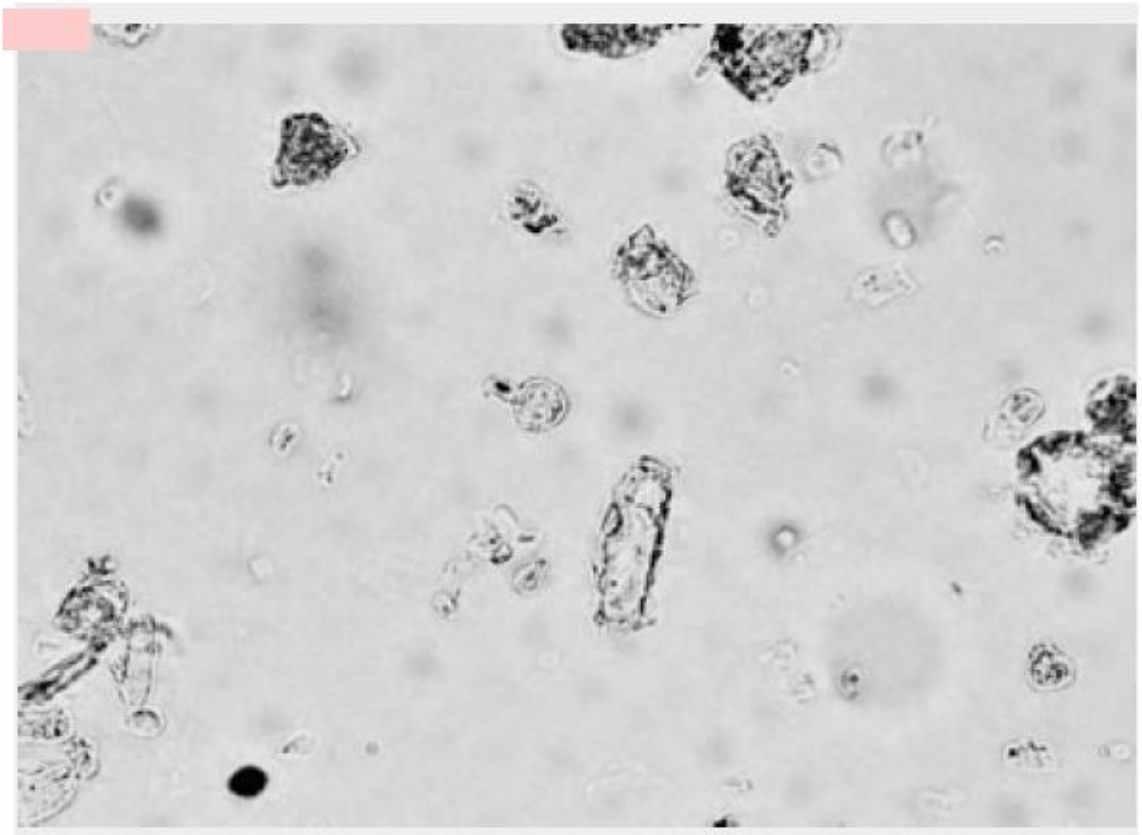
Also occurs in the Zingiberaceae Diagnostic level: mixed, Zingiberaceae, Bombacaceae. There are subtle differences in the smoothness and abundance of nodules between the two families

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

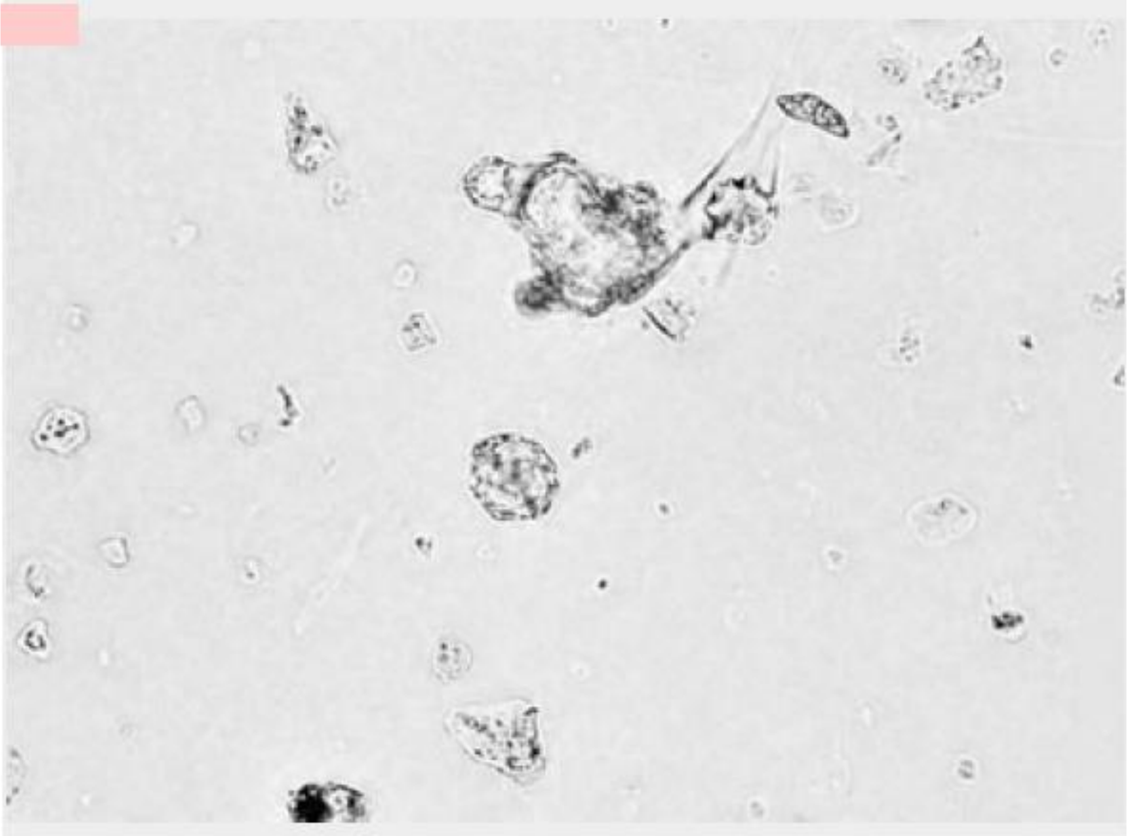
Type is not diagnostic to Bombacaceae alone. Cystolith body may be very rugulose, verrucose, or nearly smooth. Diagnostic level: generalized arboreal



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith



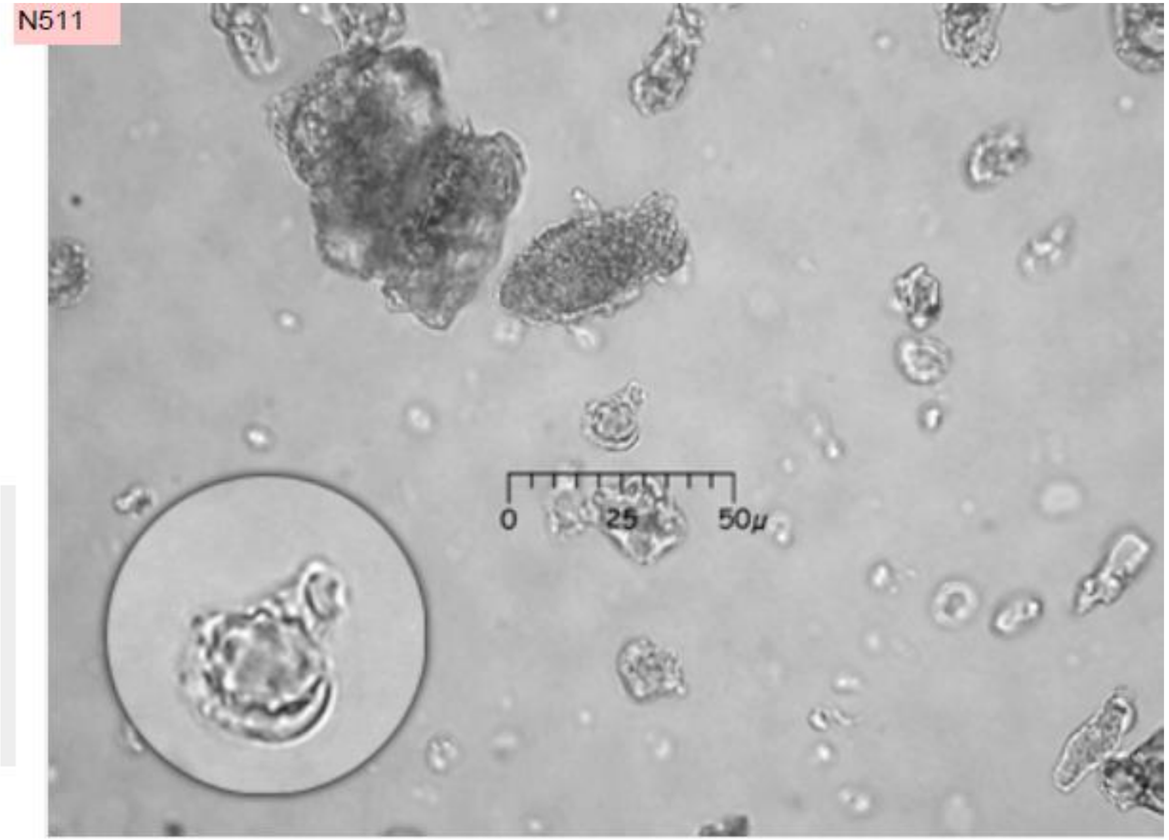
Small nodular spheres overlap with Marantaceae Diagnostic level: Marantaceae/Bombacaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

This is a verrucose cystolith encased in a short, broad trichome.

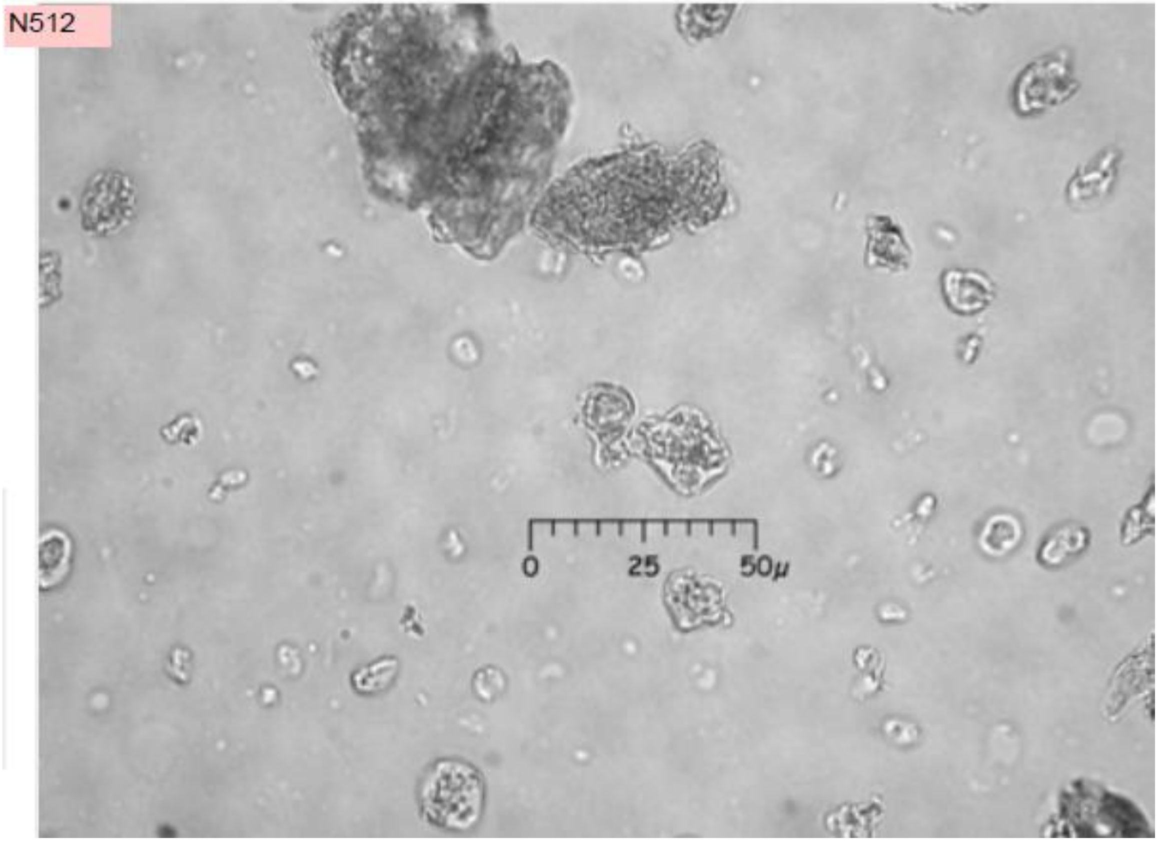


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

Diagnostic level: generalized arboreal

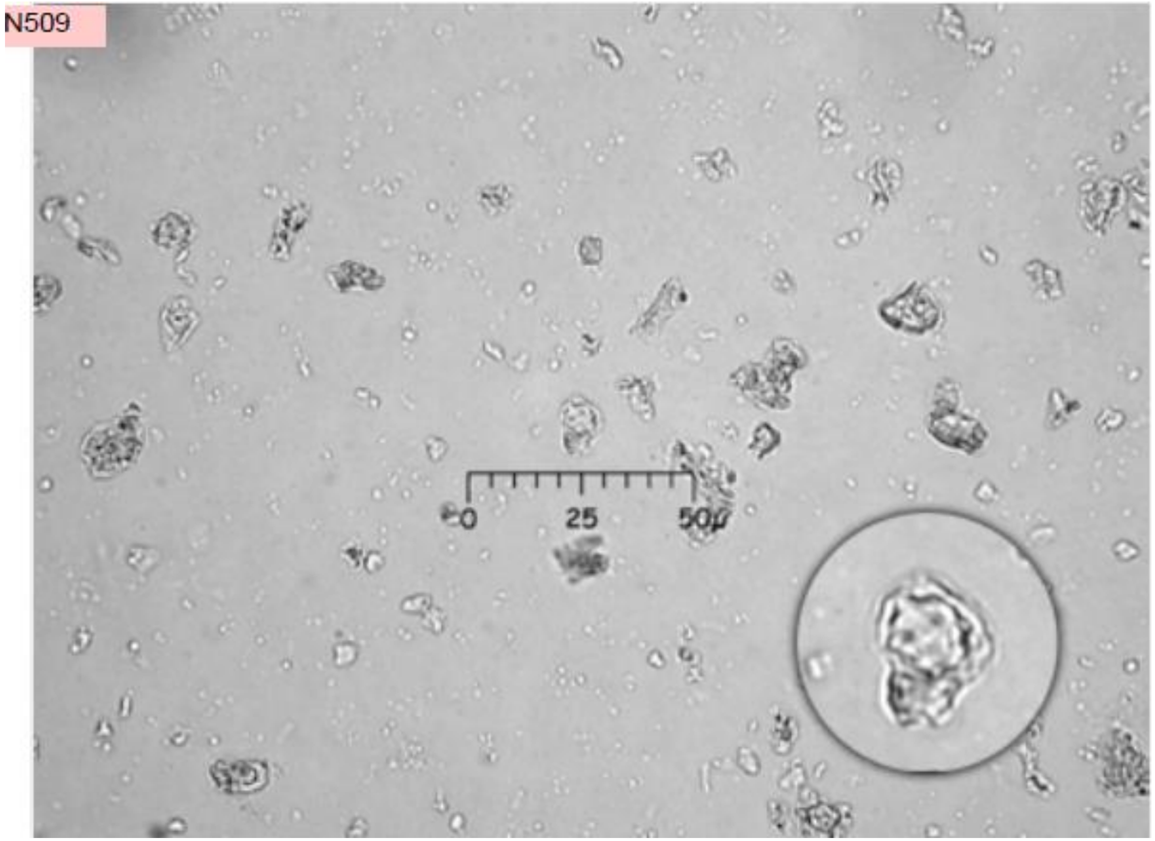


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

Diagnostic level: generalized arboreal

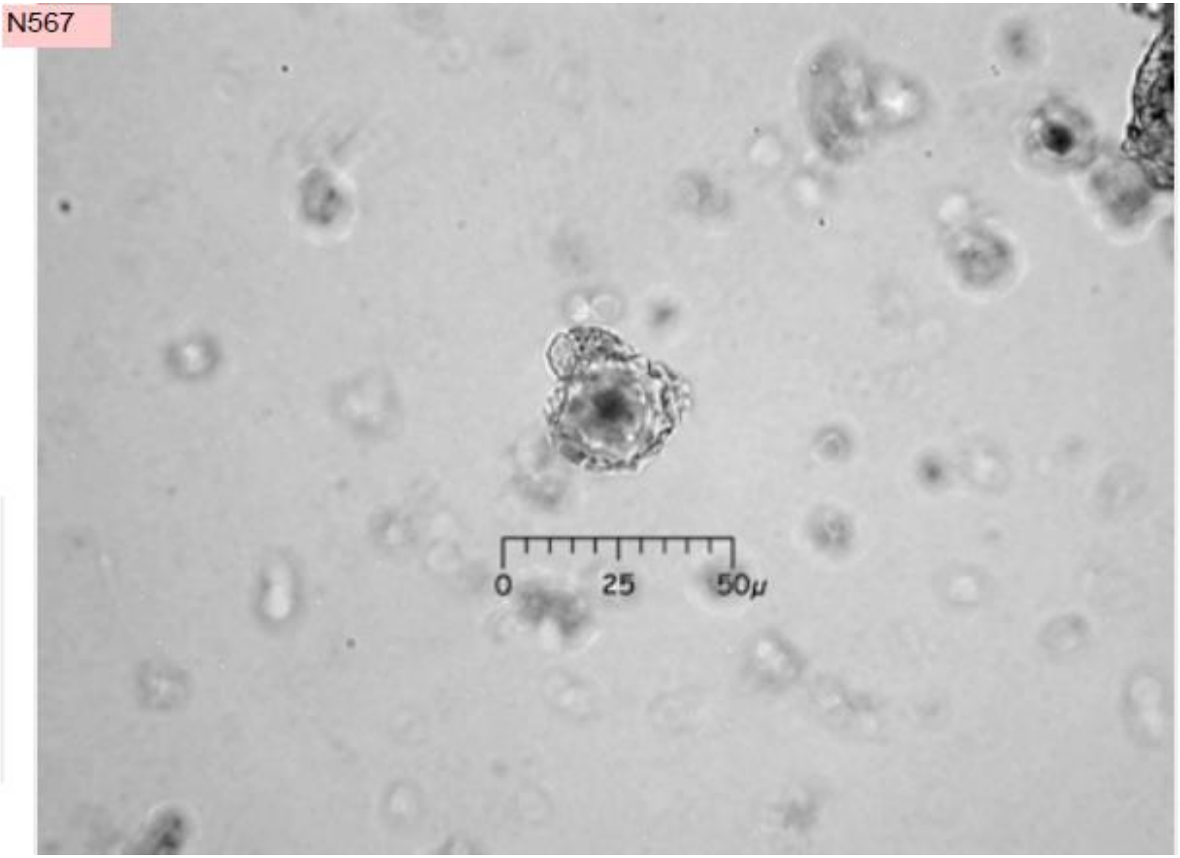


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

Also occurs in the Zingiberaceae
Diagnostic level: mixed, Zingiberaceae, Bombacaceae. There are subtle differences in the smoothness and abundance of nodules between the two families.

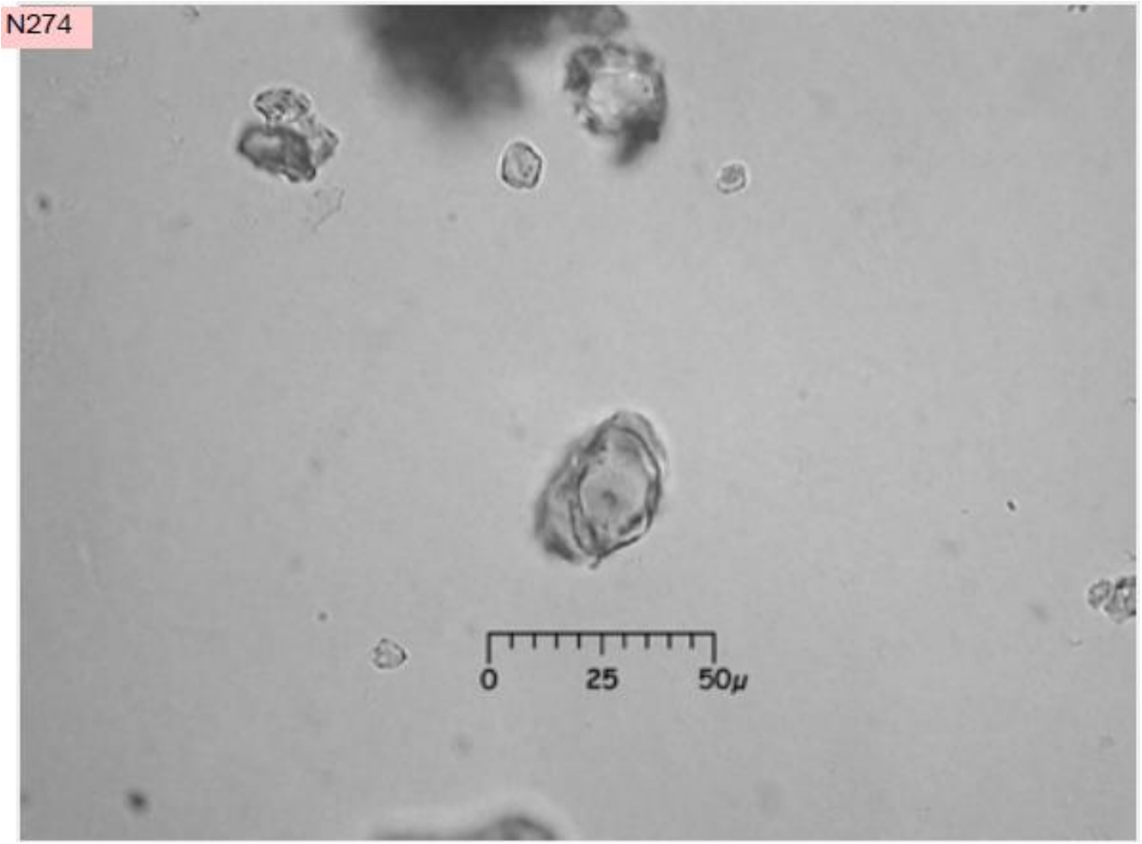


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pseudobombax millei

Phytolith

Also observed in Matisia longipes leaf.
Diagnostic level: family

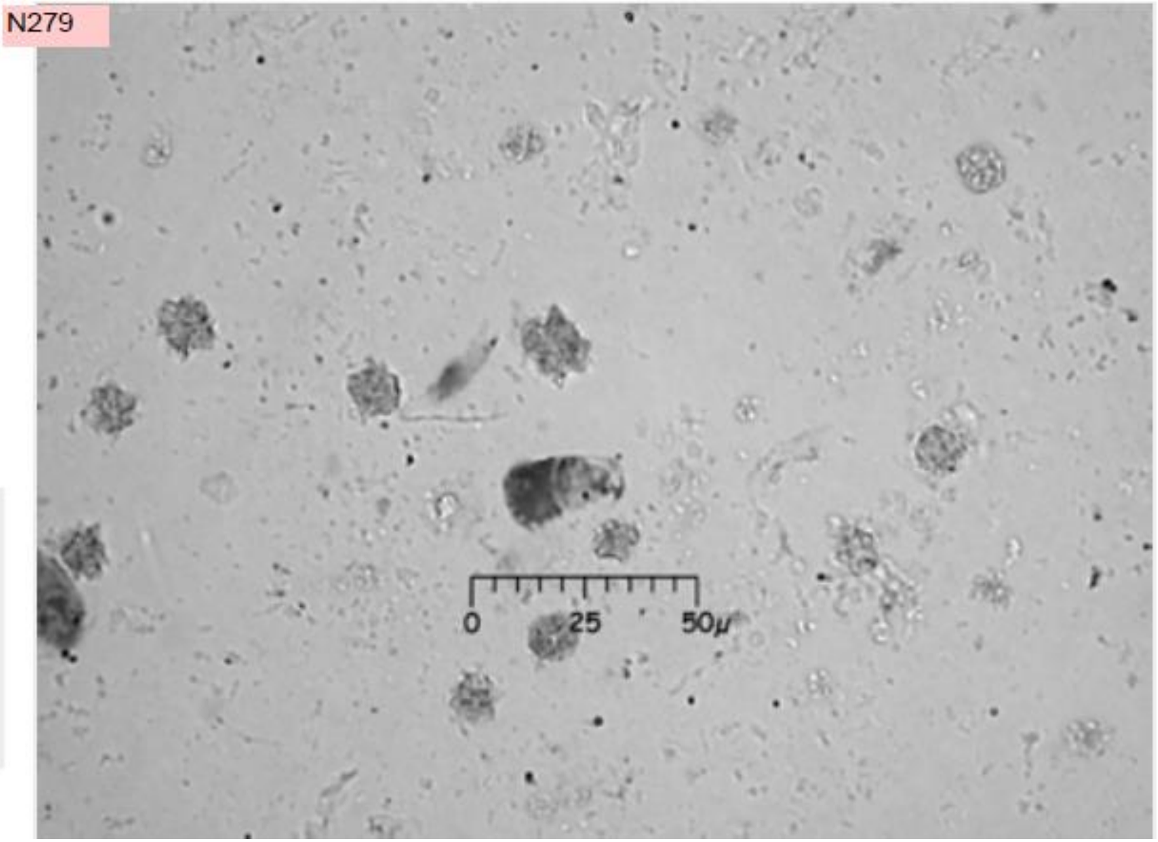


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Quarariba cf. grandifolia

Phytolith

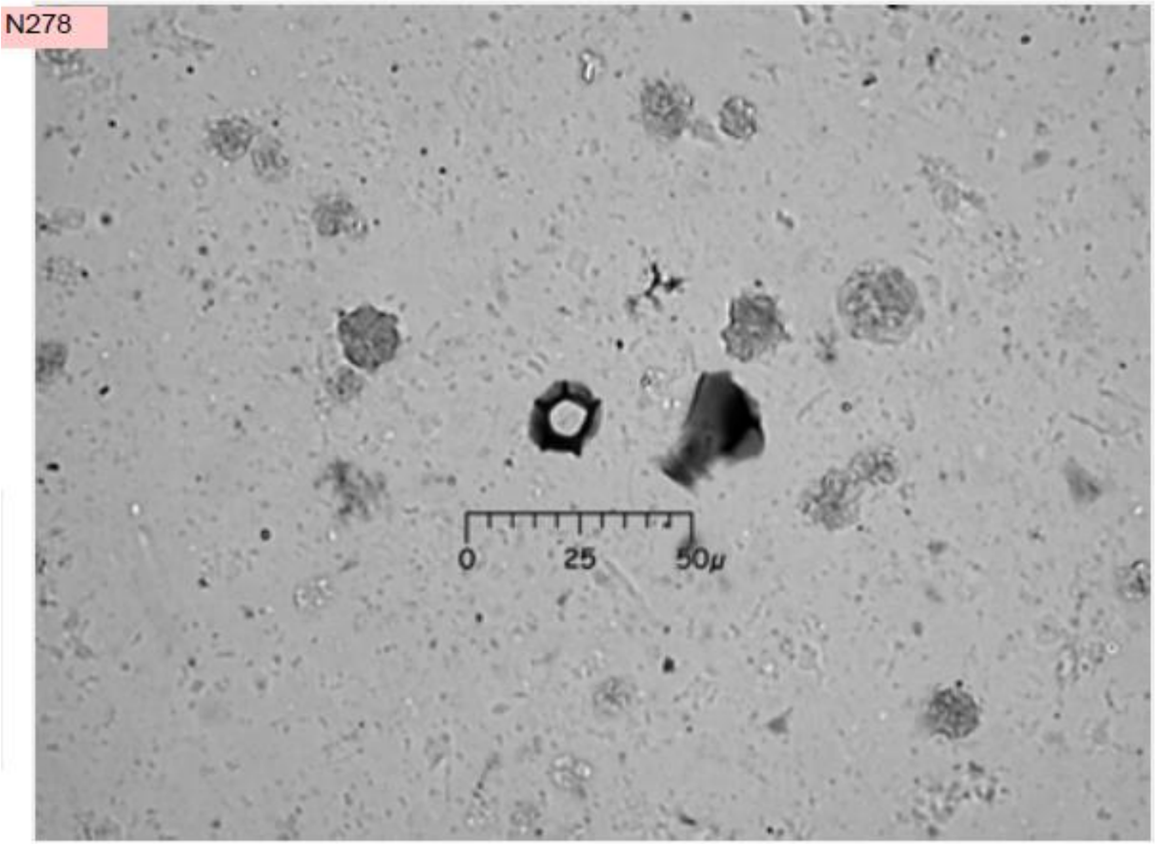
See Record #171 to compare. Very broad obtuse tip (rarely pointed) and overall broad, short nature of hair distinguishes type. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Quarariba cf. grandifolia

Phytolith



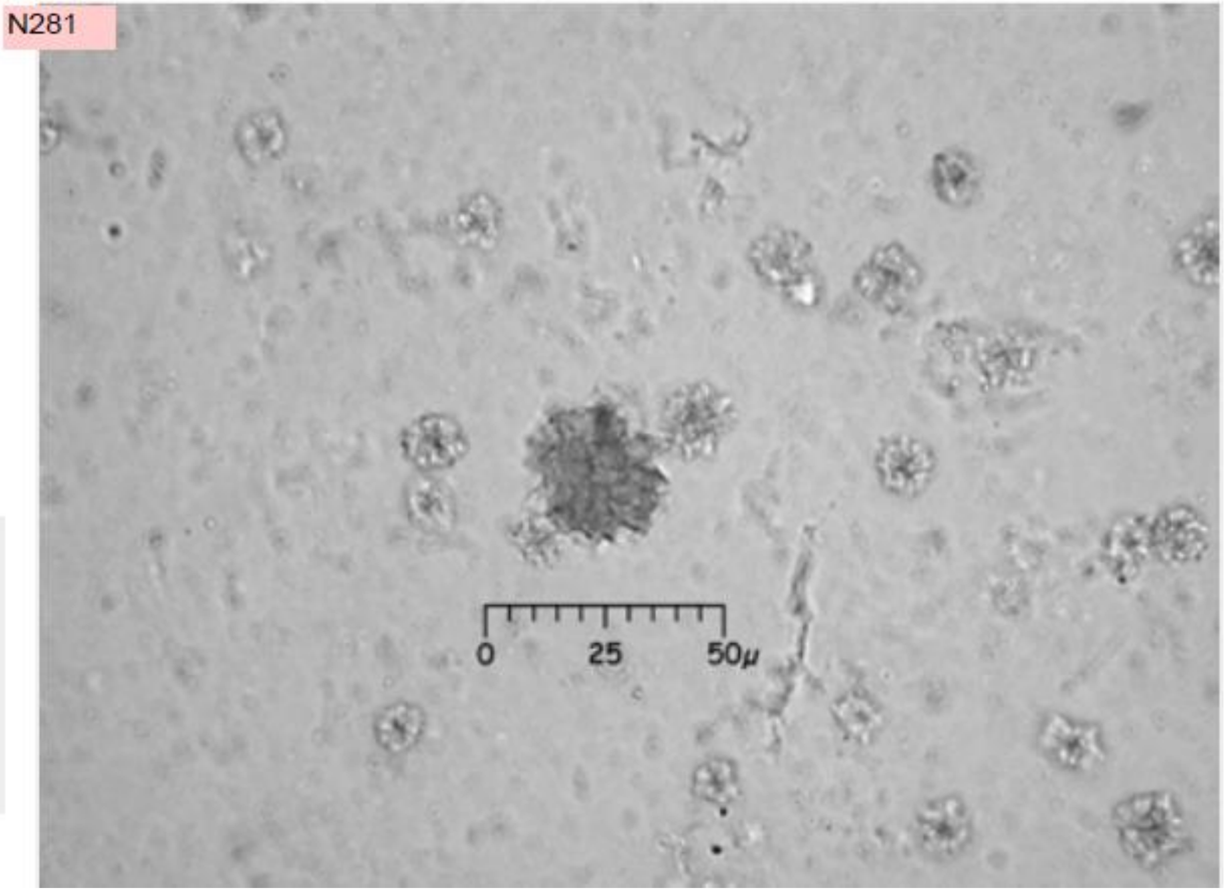
Unusual because of it’s very dark, occluded rim and attached tissue.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Quararibea grandifolia

Phytolith

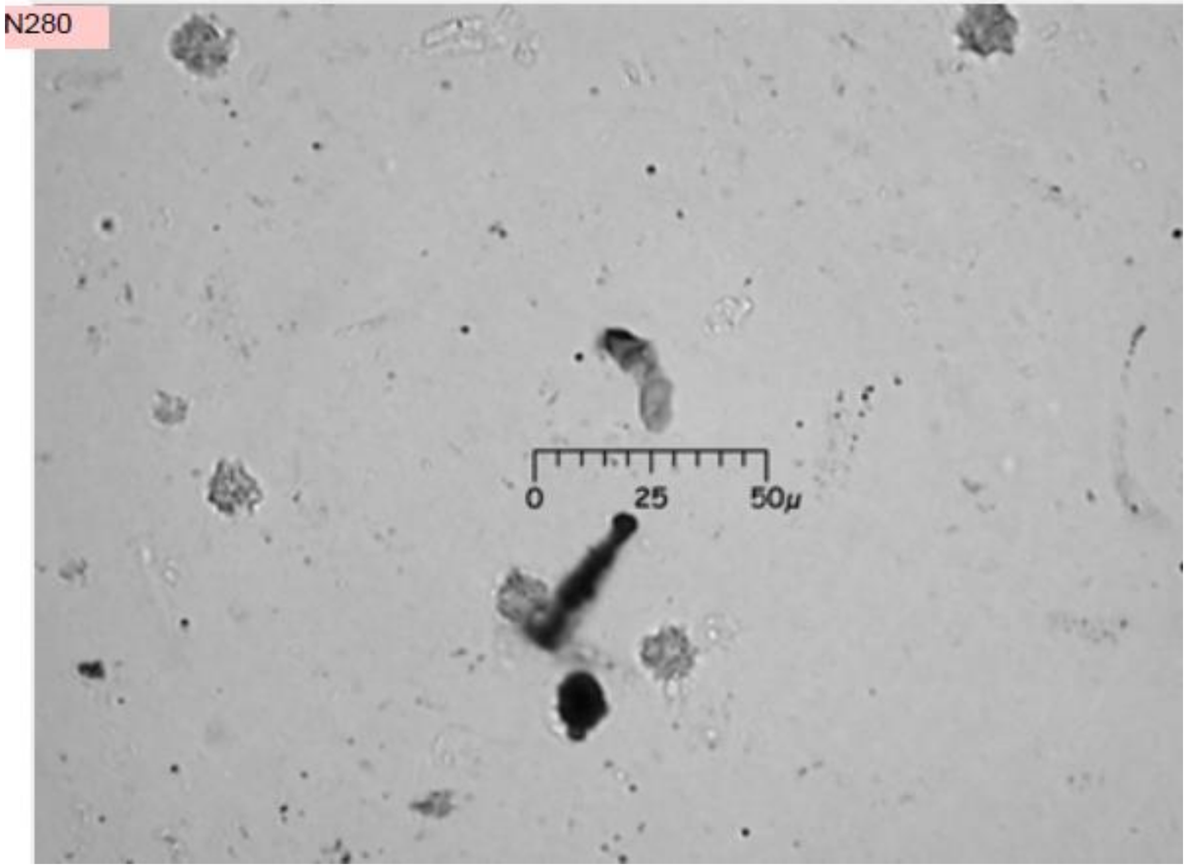
See size variation in cystoliths.
Diagnostic level: generalized arboreal



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Quararibea grandifolia

Phytolith



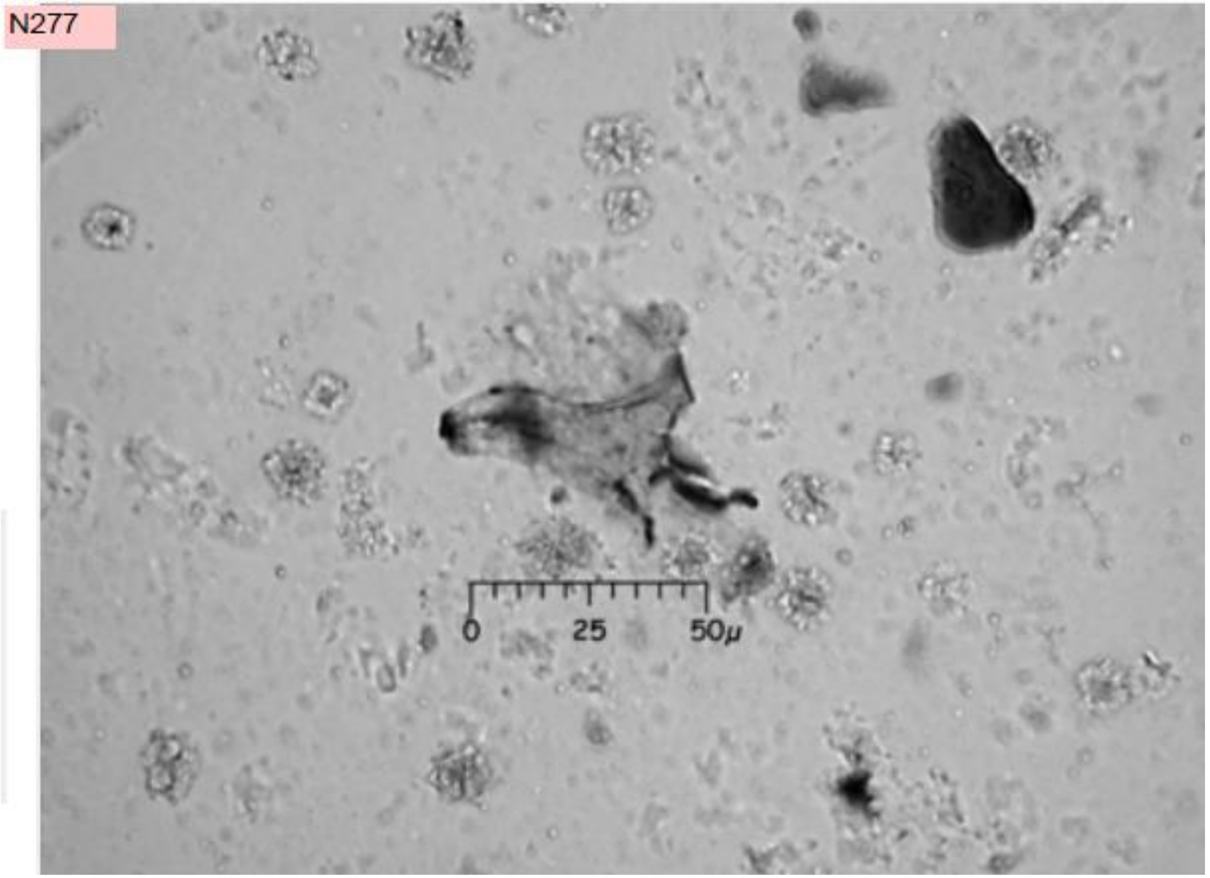
See Record #170 to compare. Very broad obtuse tip (rarely pointed) and overall broad, short nature of hair distinguishes type. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Quararibea grandifolia

Phytolith

Schlerids occur widely in woody plants. Note distinctive central ridge in this body that identifies schlerids.
Diagnostic level: generalized arboreal



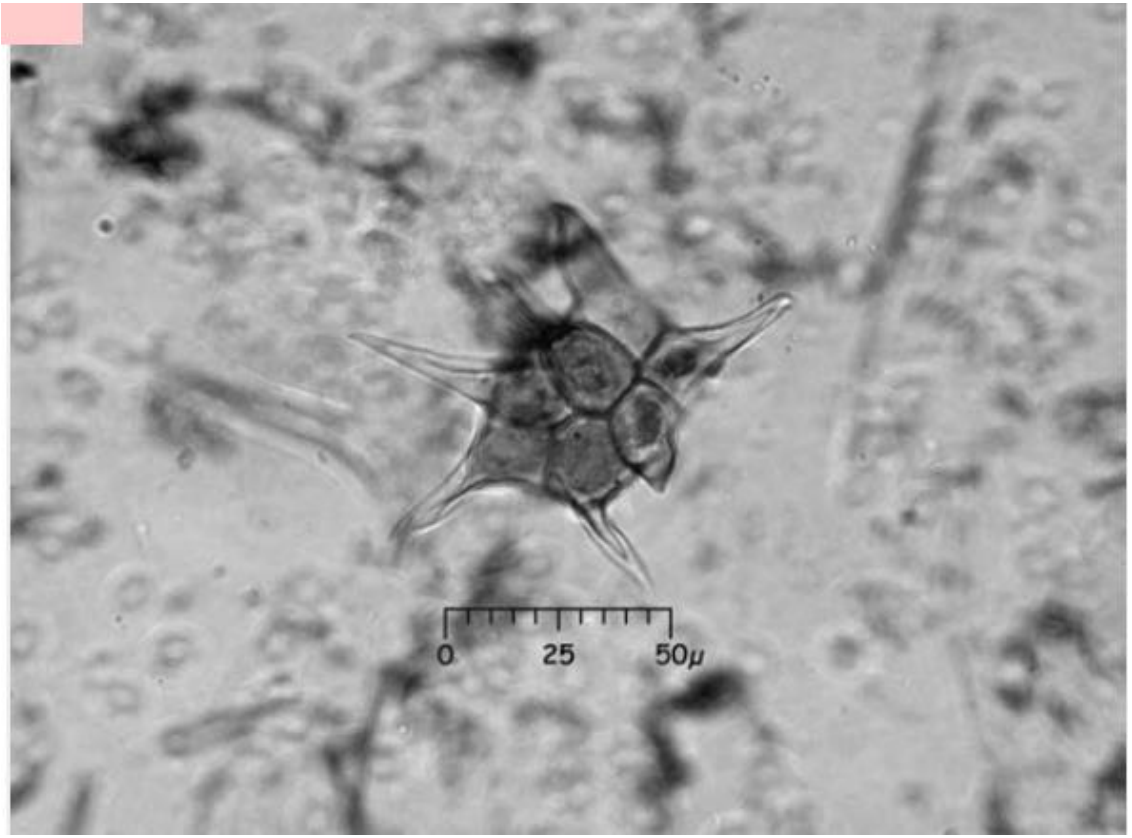
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

BORAGINACEAE

Cordia polyantha

Phytolith

Slide E1030.
Diagnostic level: species?

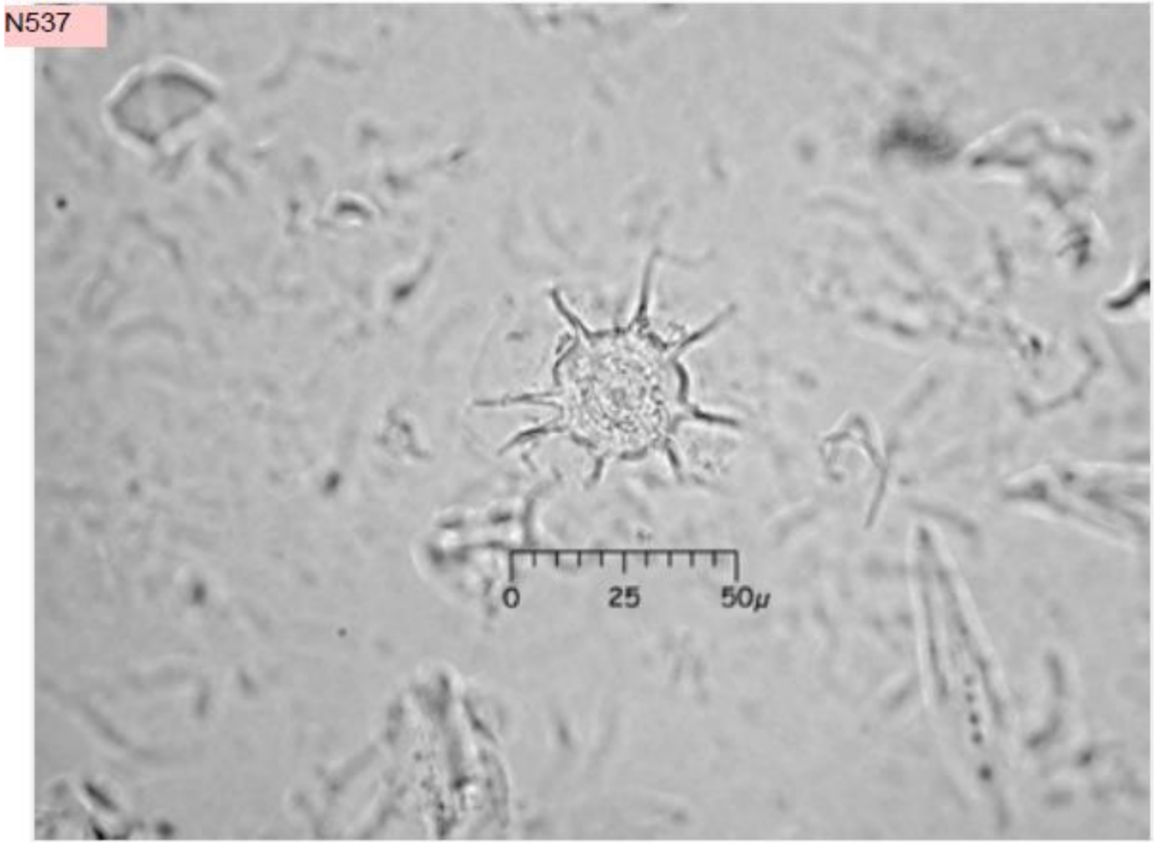


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

Rotate to see rounded concavity in base where hair inserts. Slide 468 leaf. Type defined by Cesar Veintimilla 06/1991. Diagnostic level: species

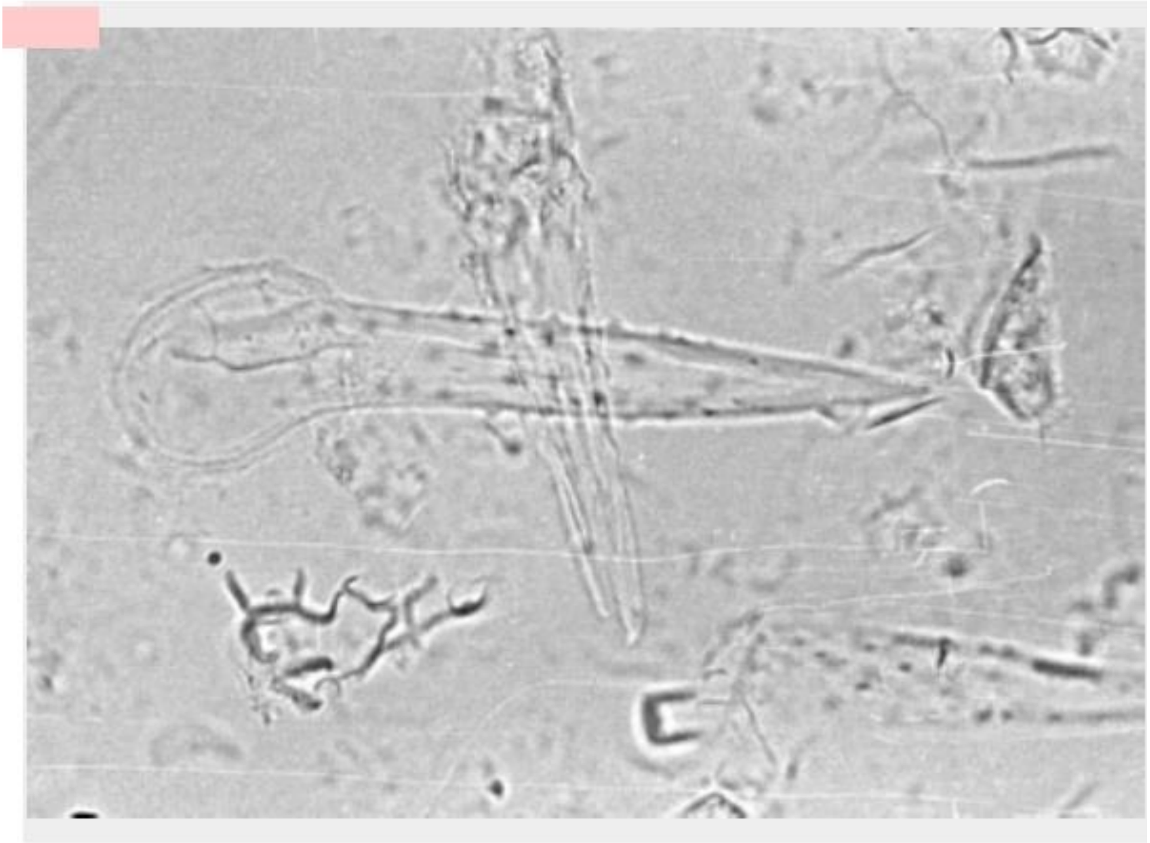


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

Diagnostic level: Cordia/Heliotropium

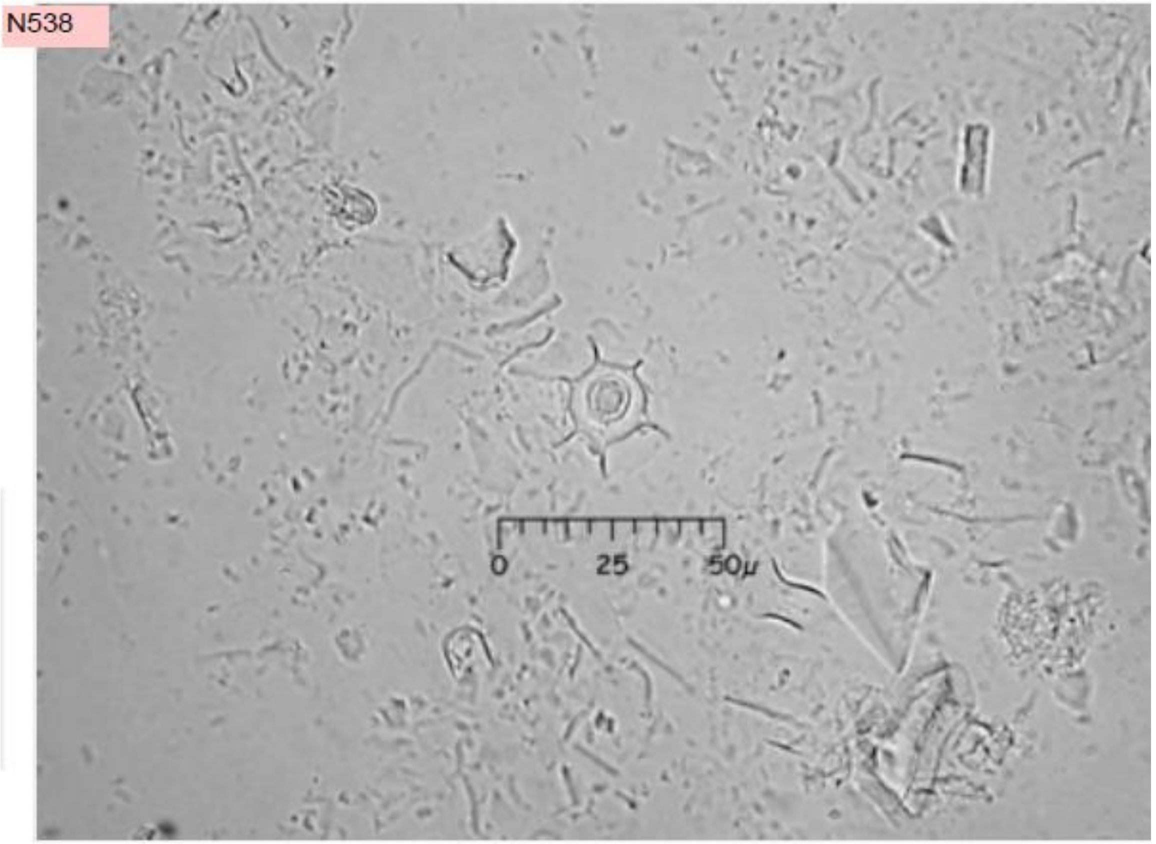


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

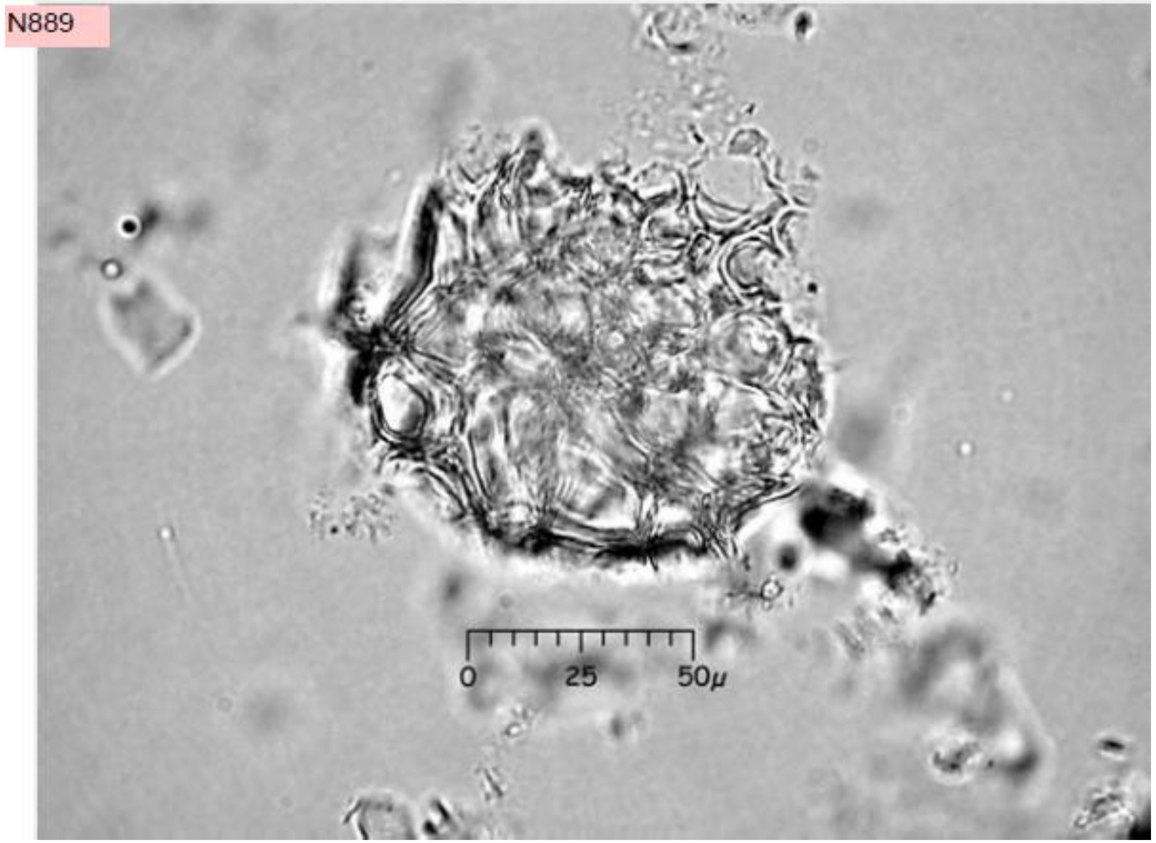
Slide 468 leaf. Type defined by Cesar Veintimilla 06/1991. See also Record #108.



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith



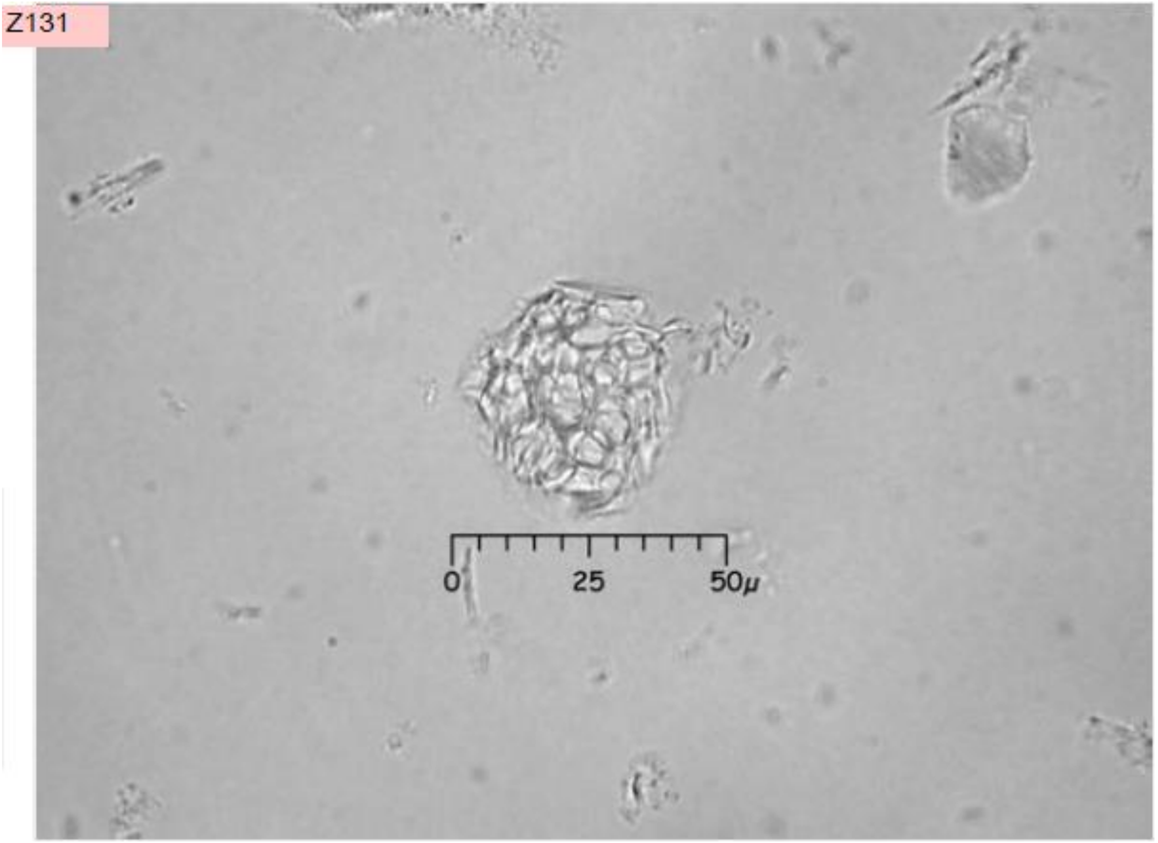
Slide 1772a leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

Slide 1772a leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

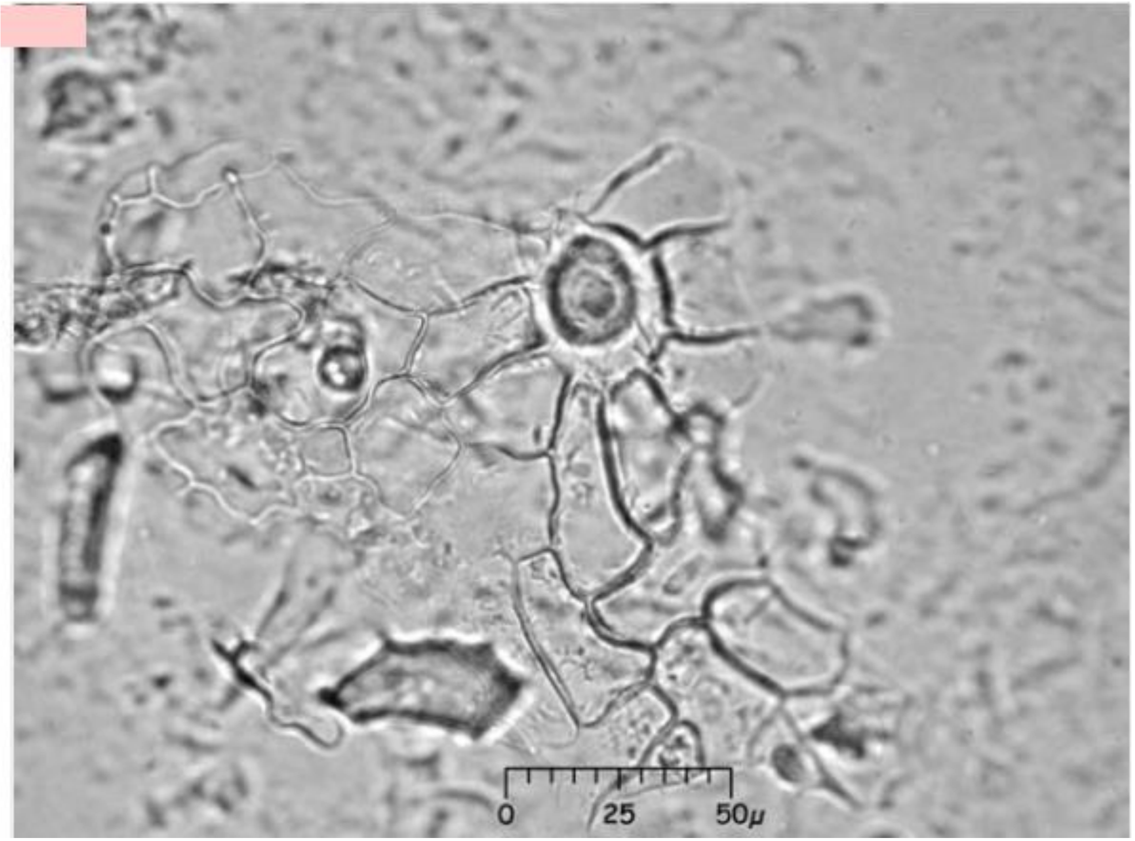
Occurs in leaf. Also occurs in Cordia lutea (fruit) and Heliotropium. Type defined by Cesar Veintimilla. Diagnostic level: Cordia/Heliotropium

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

Slide 468 leaf. Type defined by Cesar Veintimilla 06/1991. Diagnostic level: species



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia hebeclada

Phytolith

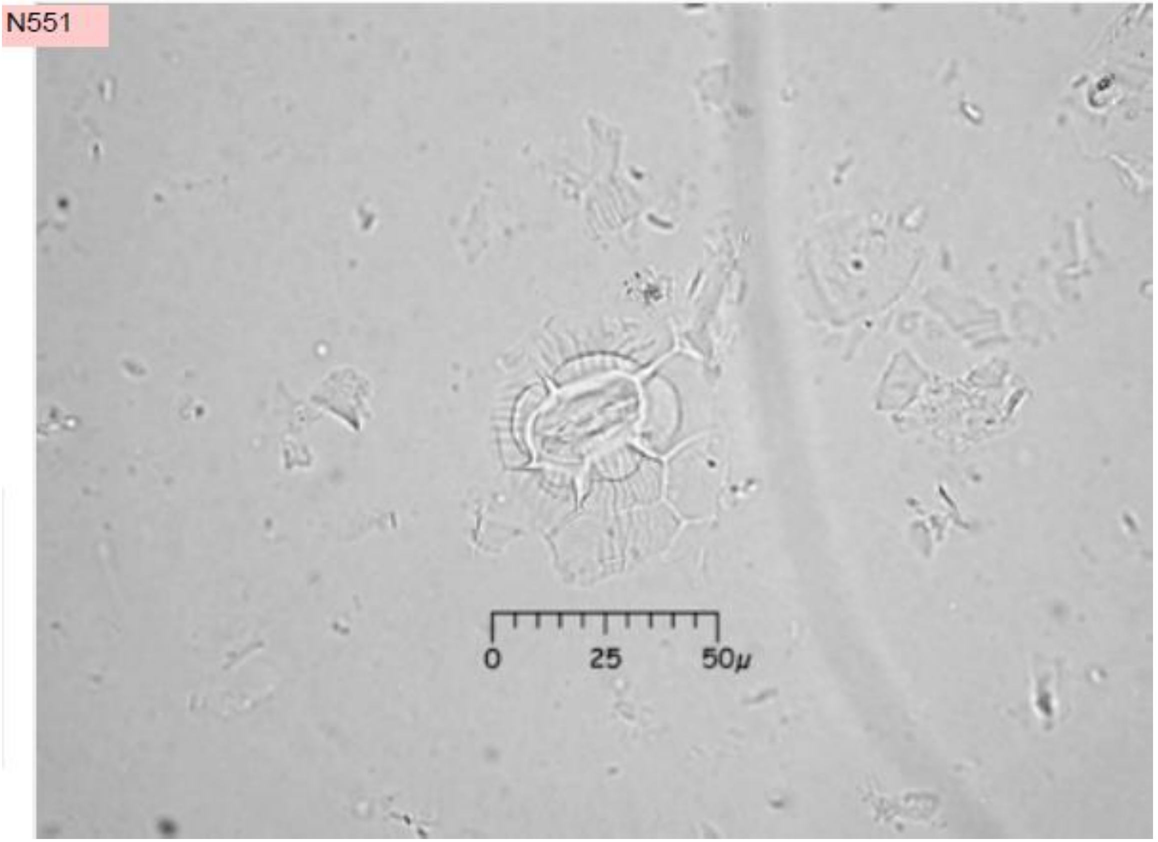
Occurs in leaf. Also occurs in Cordia lutea (fruit) and Heliotropium. Type defined by Cesar Veintimilla. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

These simple stomata are not diagnostic to family or even order level at this time.
Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

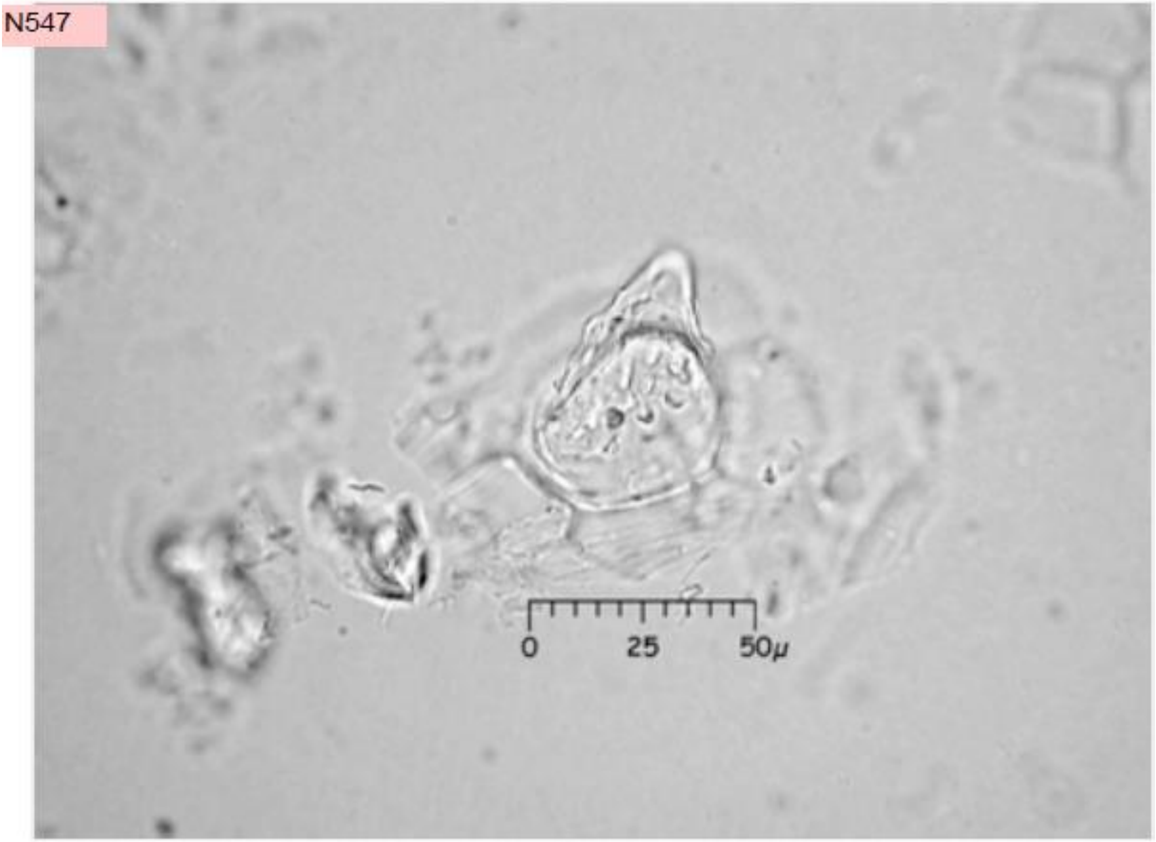
Diagnostic level: Cordia/Heliotropium

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

Diagnostic level: Cordia/Heliotropium



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

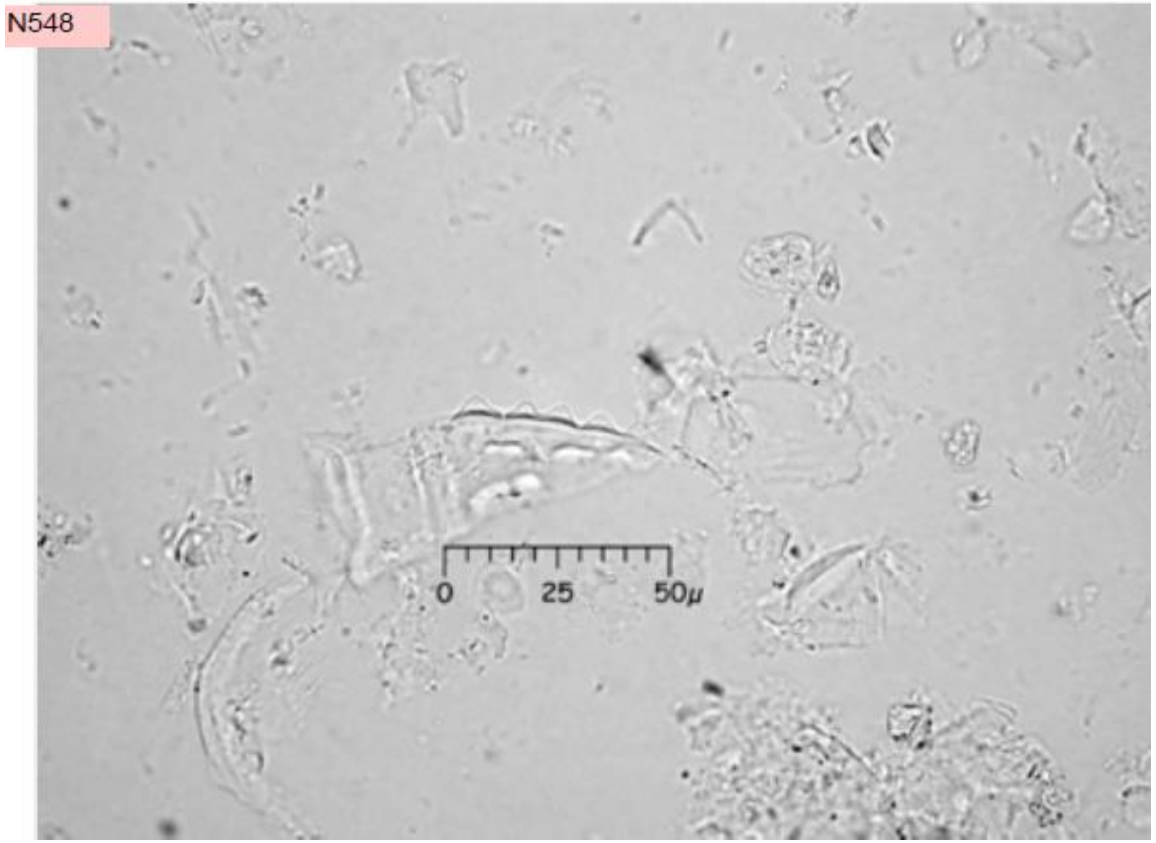
Phytolith

Type defined by Cesar Veintimilla 05/1991.
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith



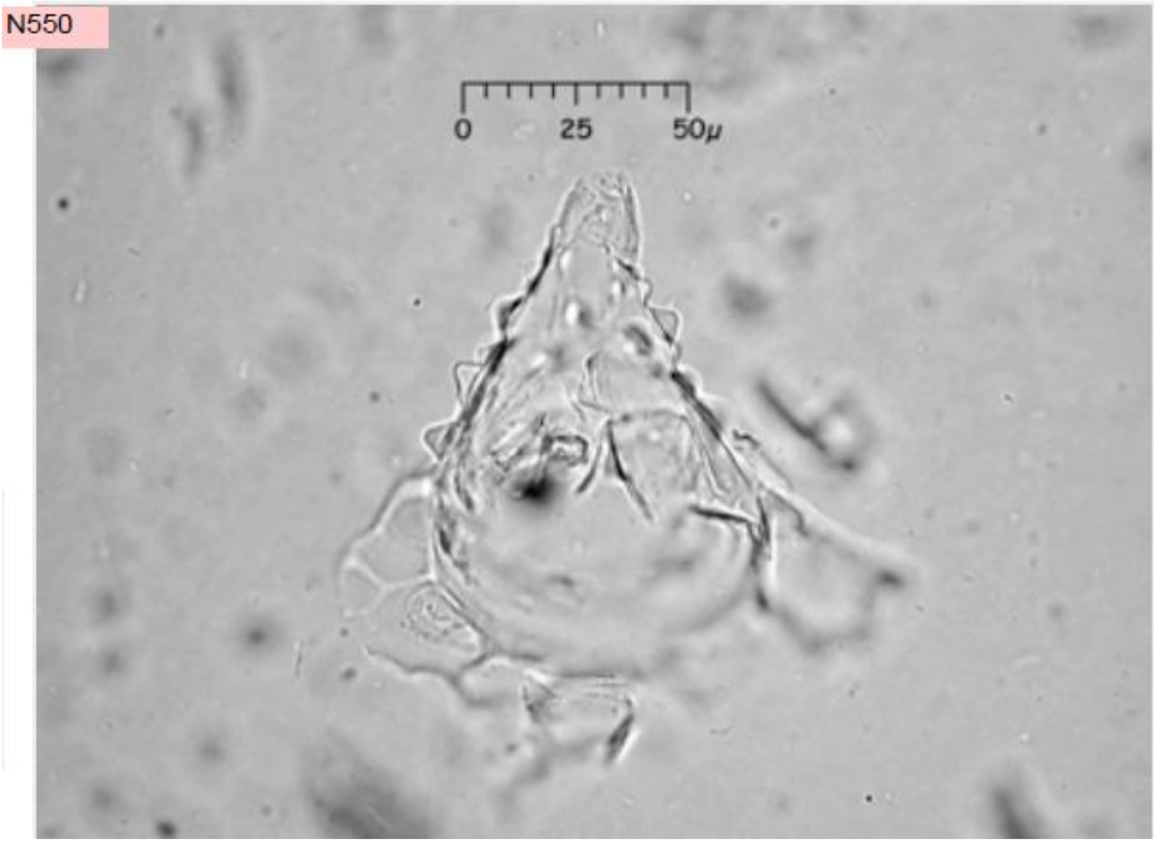
Side view.
See Cordia lutea hairs (40IIIAb100), conical bodies may come from projections on hair surface. Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

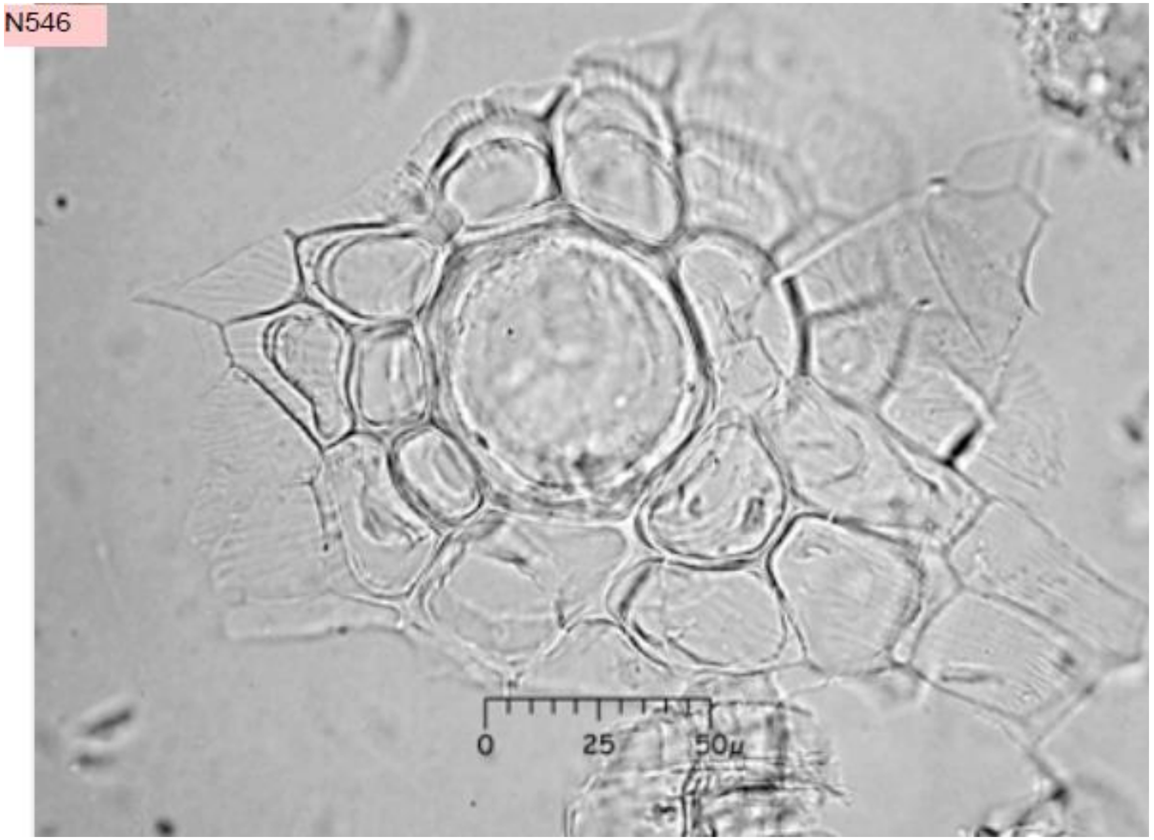
Top view shows a Cordia lutea hair (40IIIAb100) with conical projections. Conical bodies (20VCd) may come from projections on hair surface. Diagnostic level (both): species



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith



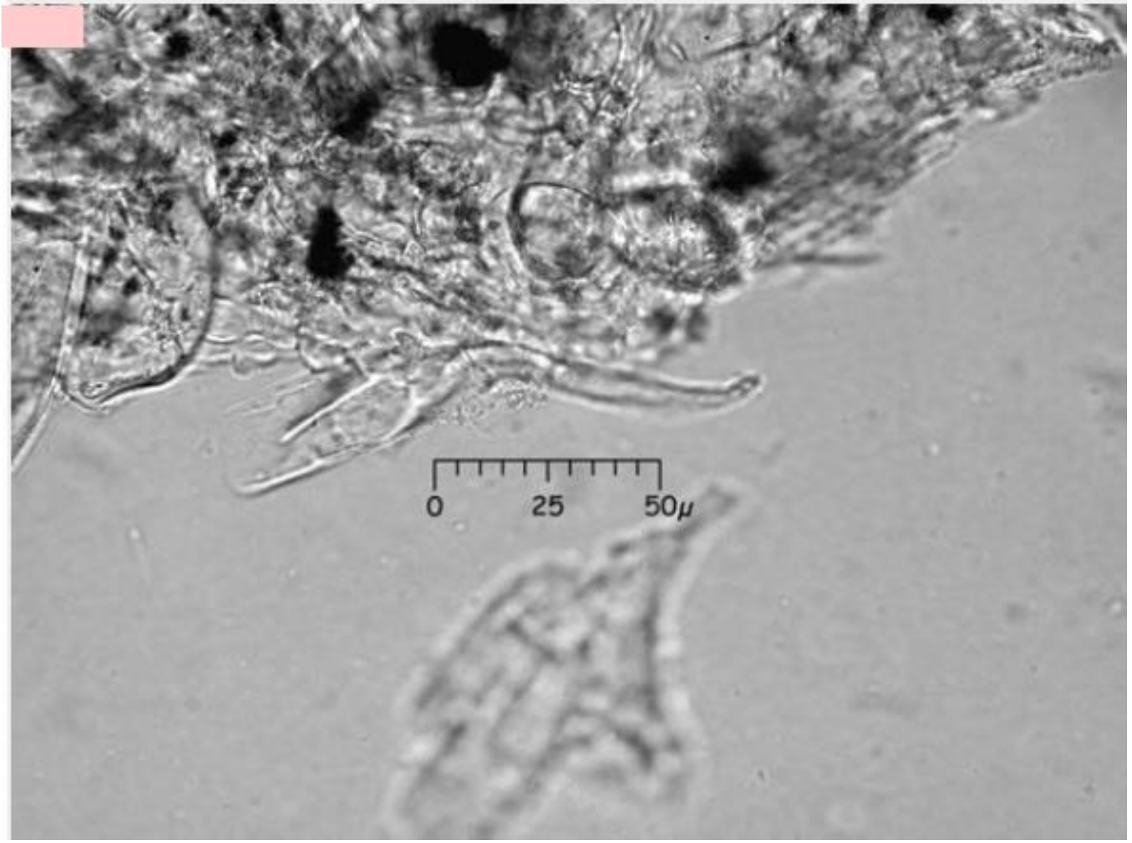
See Record #112 for another view. See other Cordia lutea types (20VCd), conical bodies may be derived from hair surface. Type defined by Cesar Veintimilla 05/1991. Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

Occurs in fruit. Type defined by Cesar Veintimilla.
Diagnostic level: species

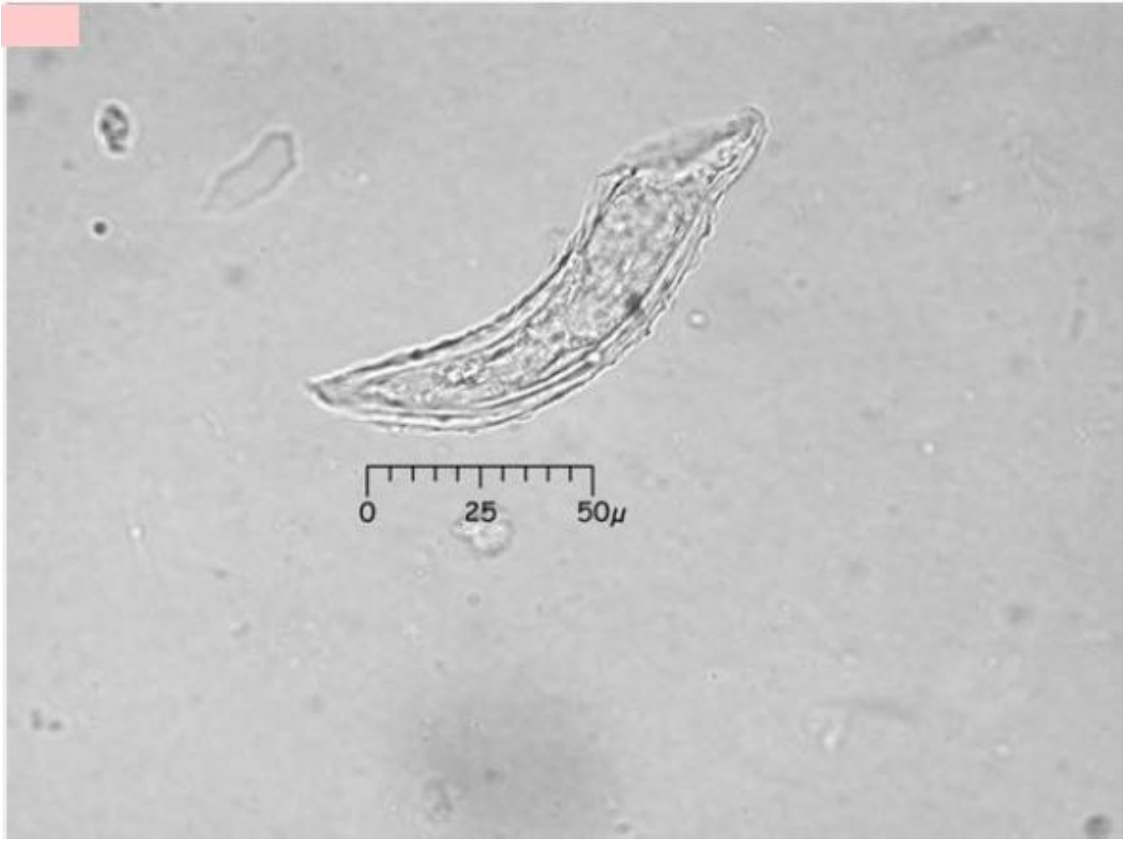


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

Occurs in leaf. Also occurs in Cordia hebeclada (fruit) and Heliotropium. Type defined by Cesar Veintimilla. Diagnostic level: family

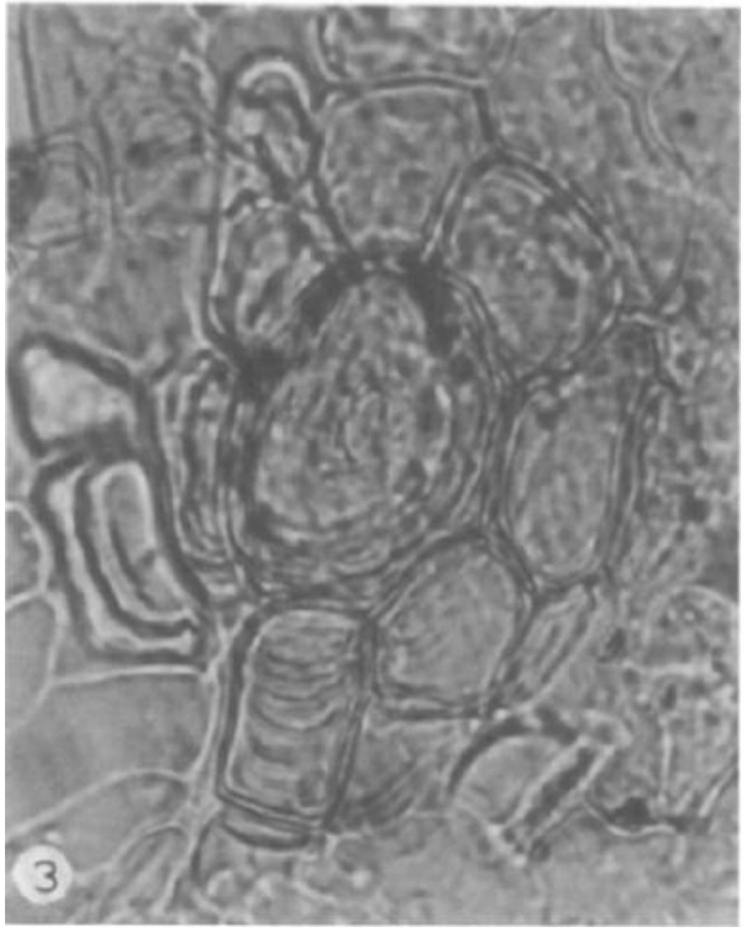


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cordia lutea

Phytolith

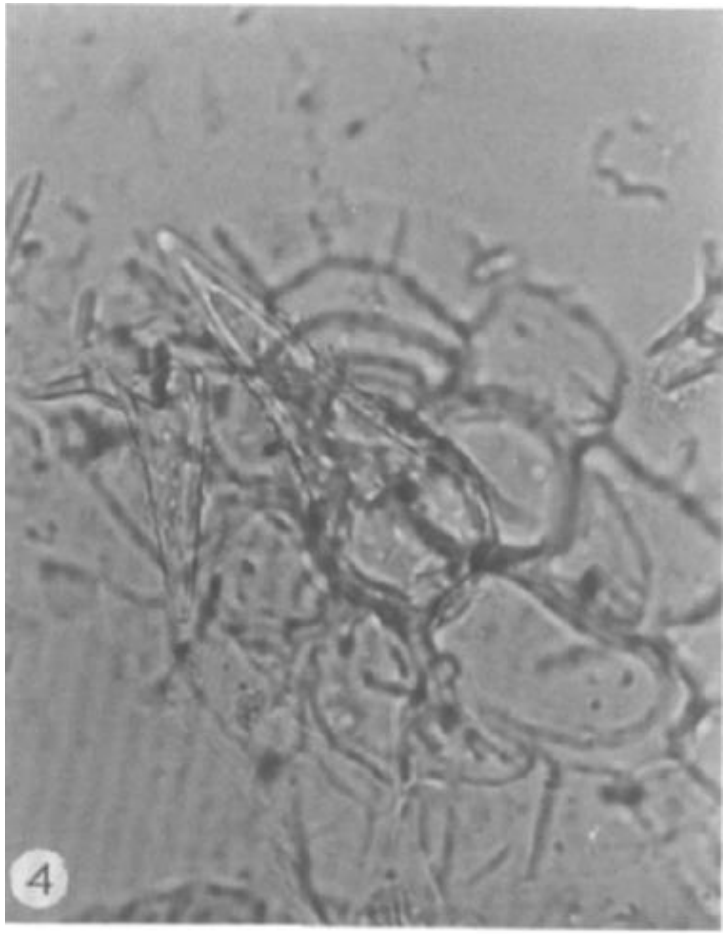
3. A silicified hair base from Cordia lutea showing the elliptical pore in the center. It is surrounded by silicified epidermal cells with spherical inclusions (250 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Ehretia anacua

Phytolith



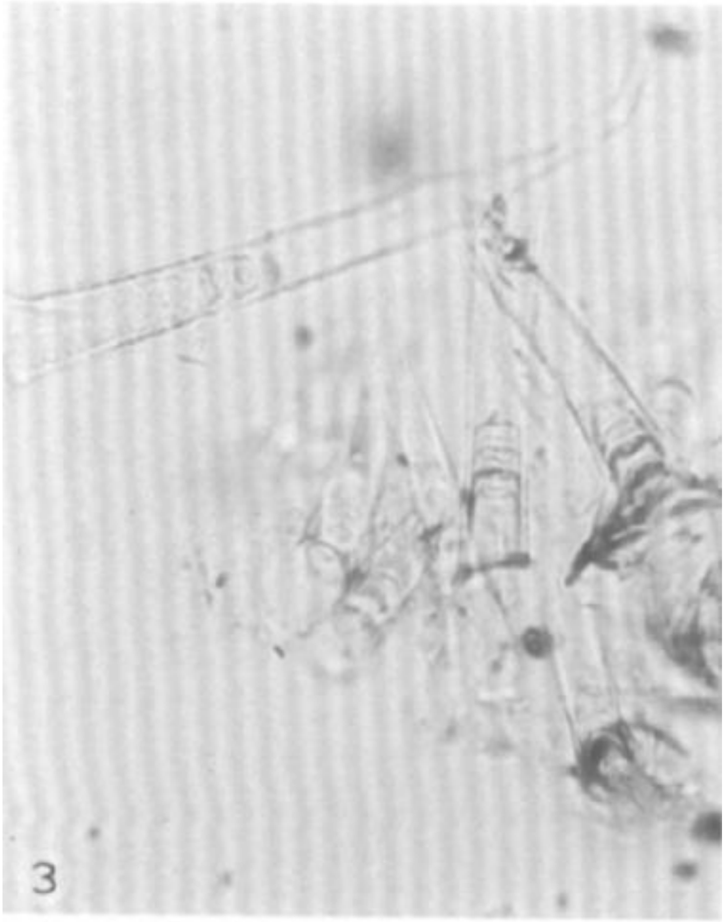
4. Non-segmented armed hair from Ehretia anacua. It is attached to the hair base (156×)

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Hackelia mexicana

Phytolith

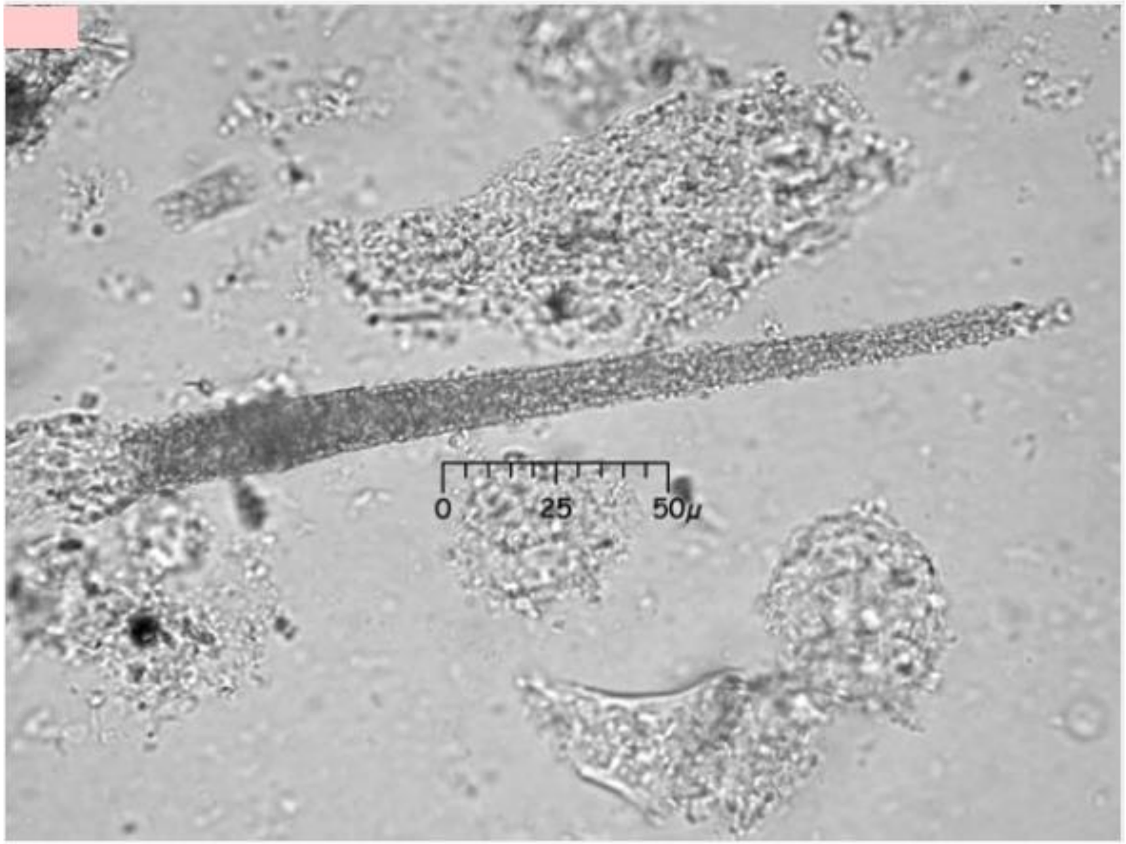
3. Segmented armed hairs with shortly divided segments near the base from Hackelia mexicana (156 ×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Heliotropium angiospermum

Phytolith



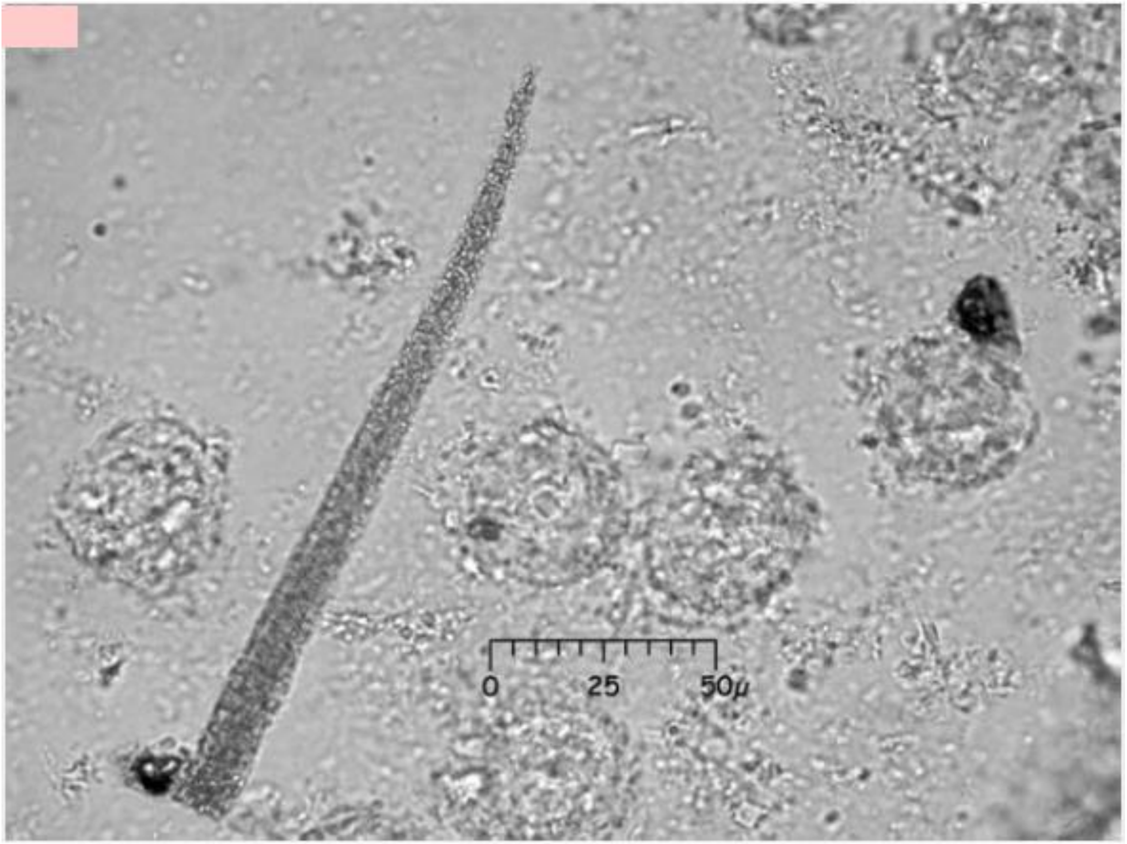
Slide E227.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliotropium angiospermum

Phytolith

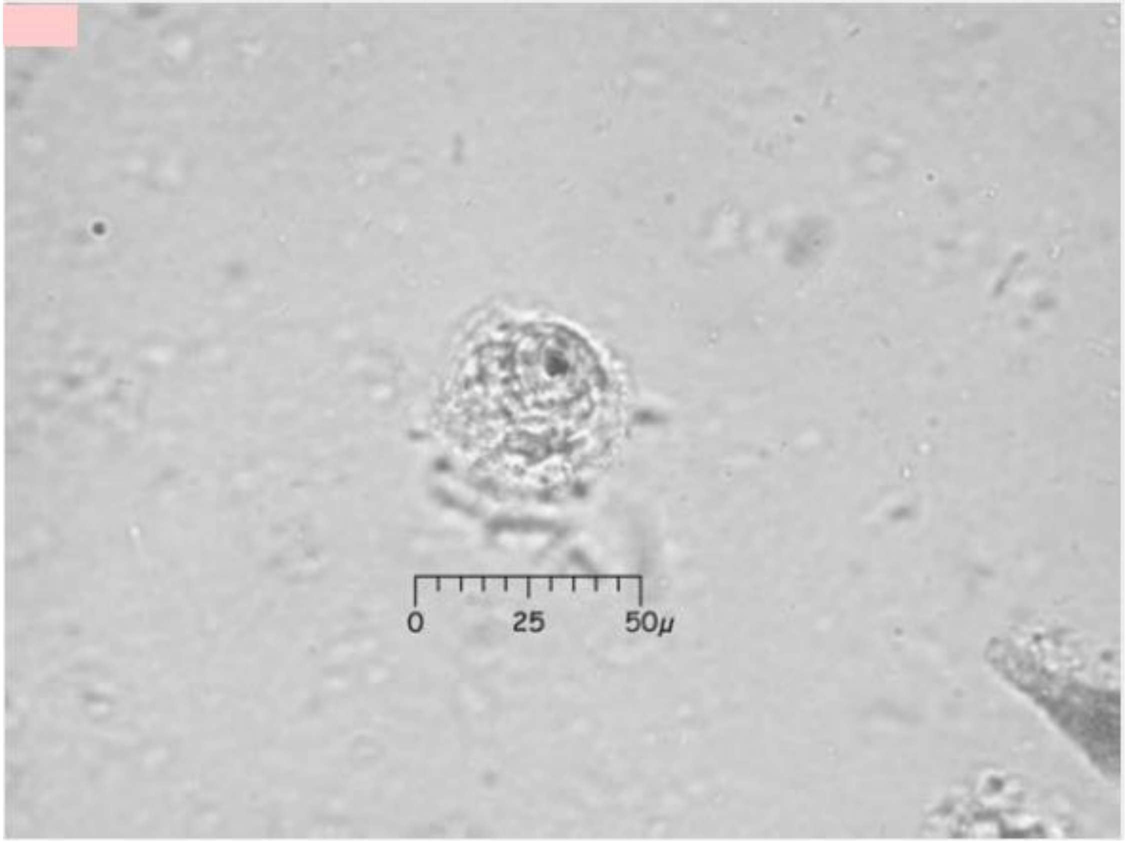
Slide E227. Several hair bases occur in picture next to unicellular hair (40IIIAb201). Concentric ring pattern not easily seen in picture. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliotropium angiospermum

Phytolith



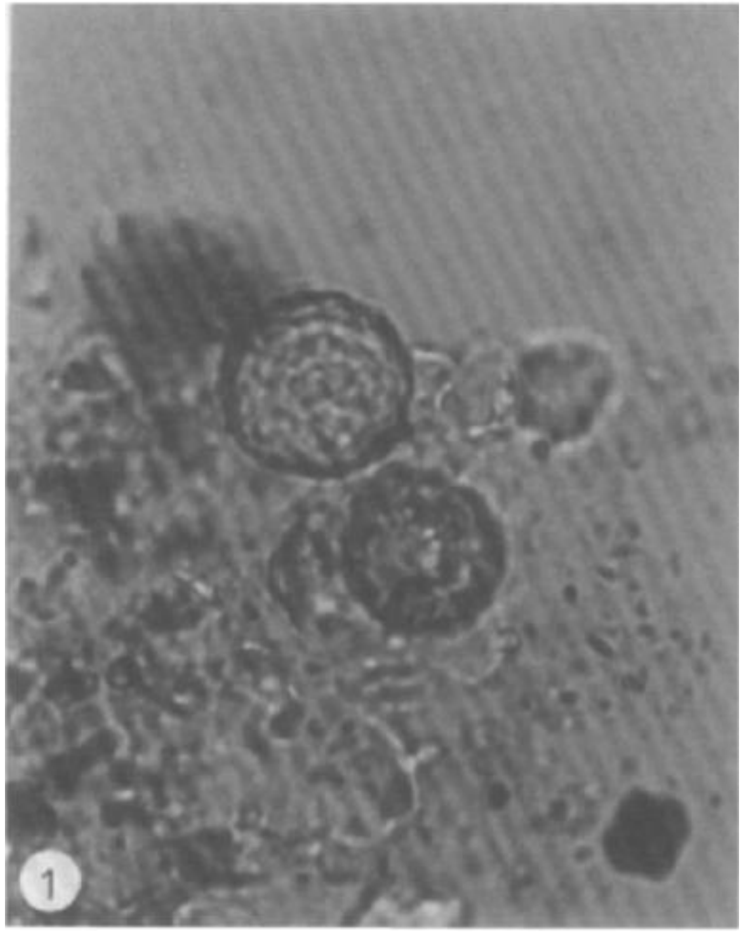
Slide E227.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliotropium angiospermum

Phytolith

1. Silicified hair bases from Heliotropium angiospermum (250 x).

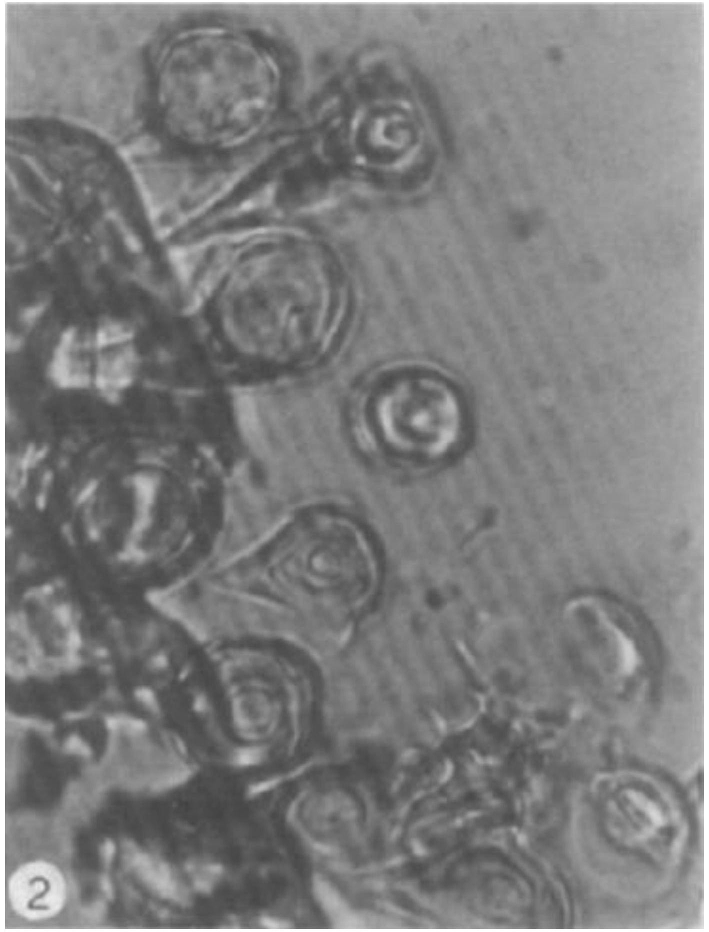


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Heliotropium indicum

Phytolith

2. Silicified hair bases from Heliotropium indicum. Some have hair cells attached (250 x).

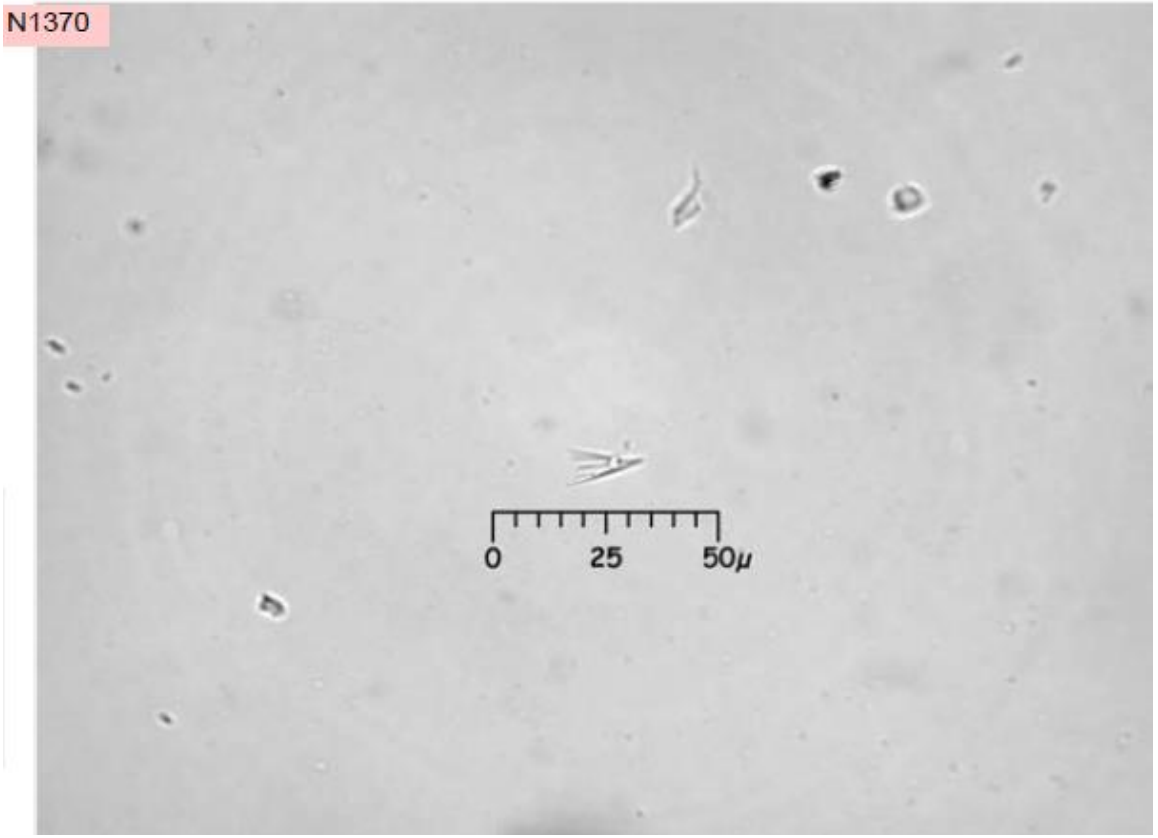


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Lithospermum carolinense

Phytolith

Slide 1723a. Leaf. Hair tip

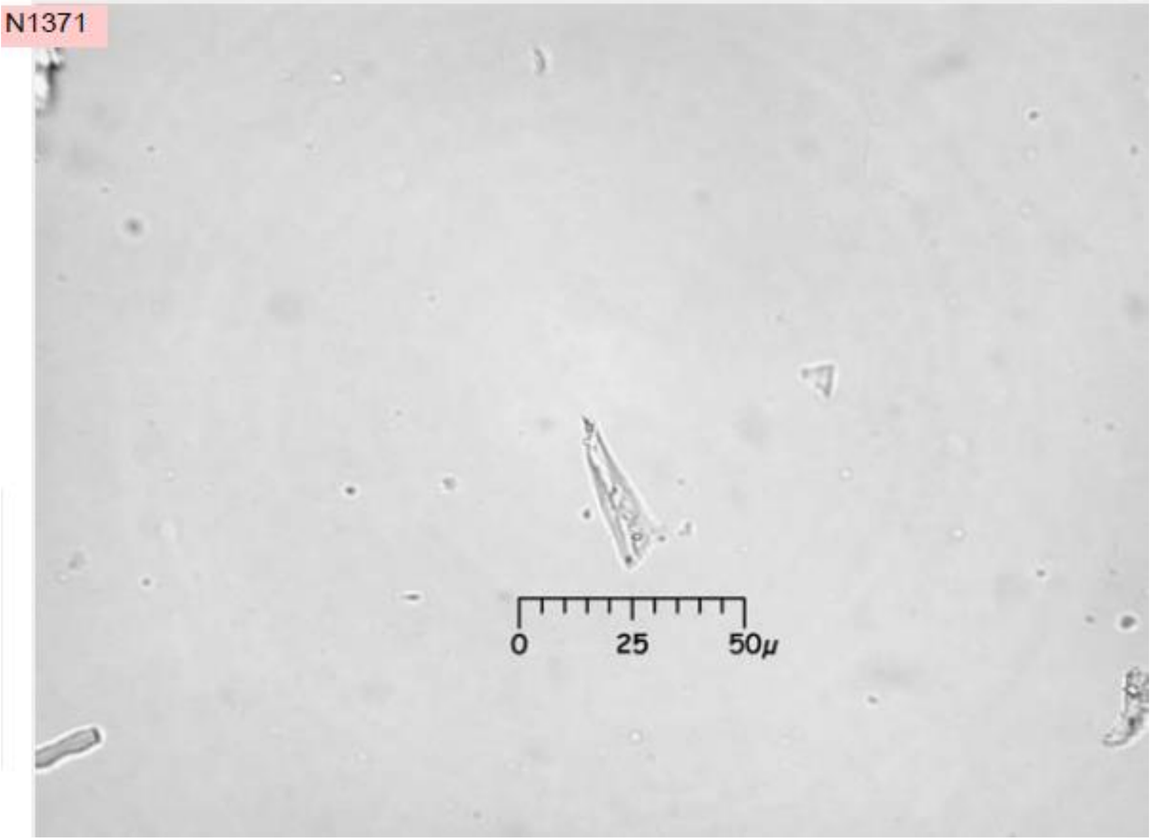


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith

Slide 1723a. Leaf. Hair tip.

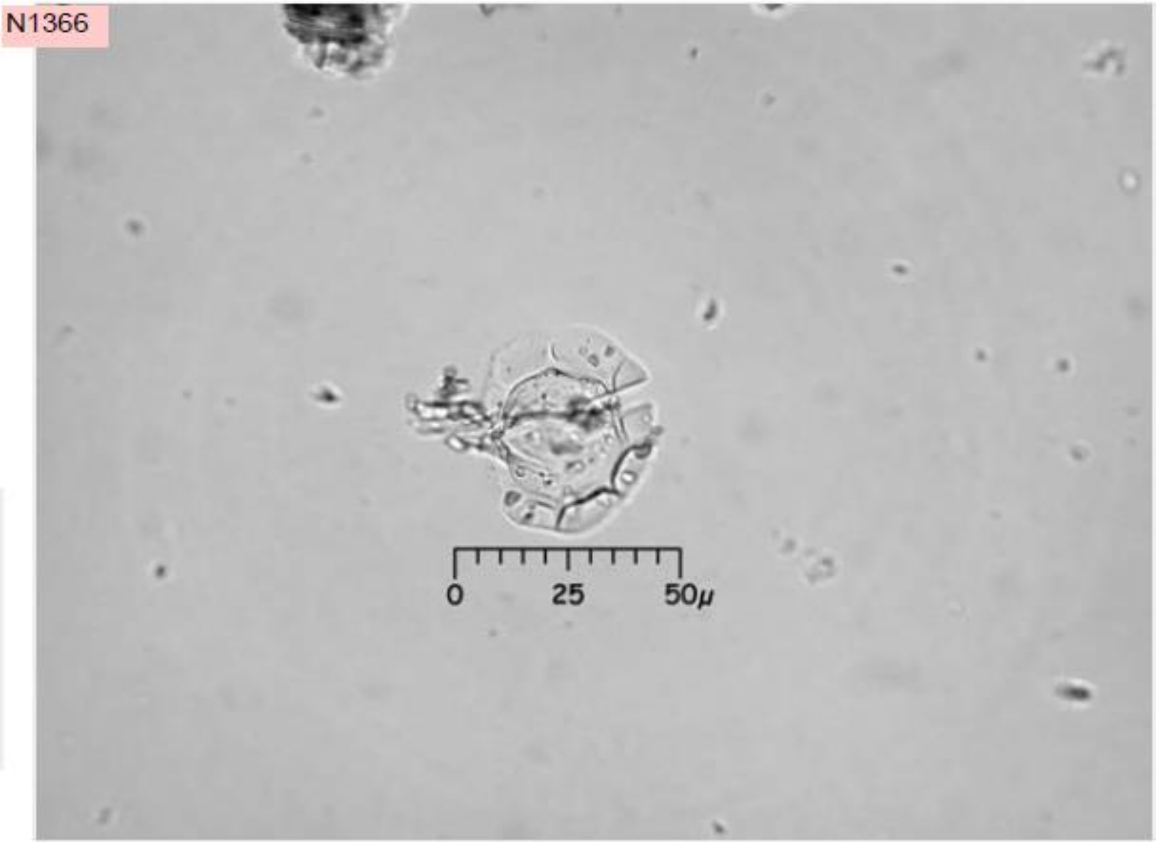


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith

Slide 1723a. Leaf. Hair with base



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

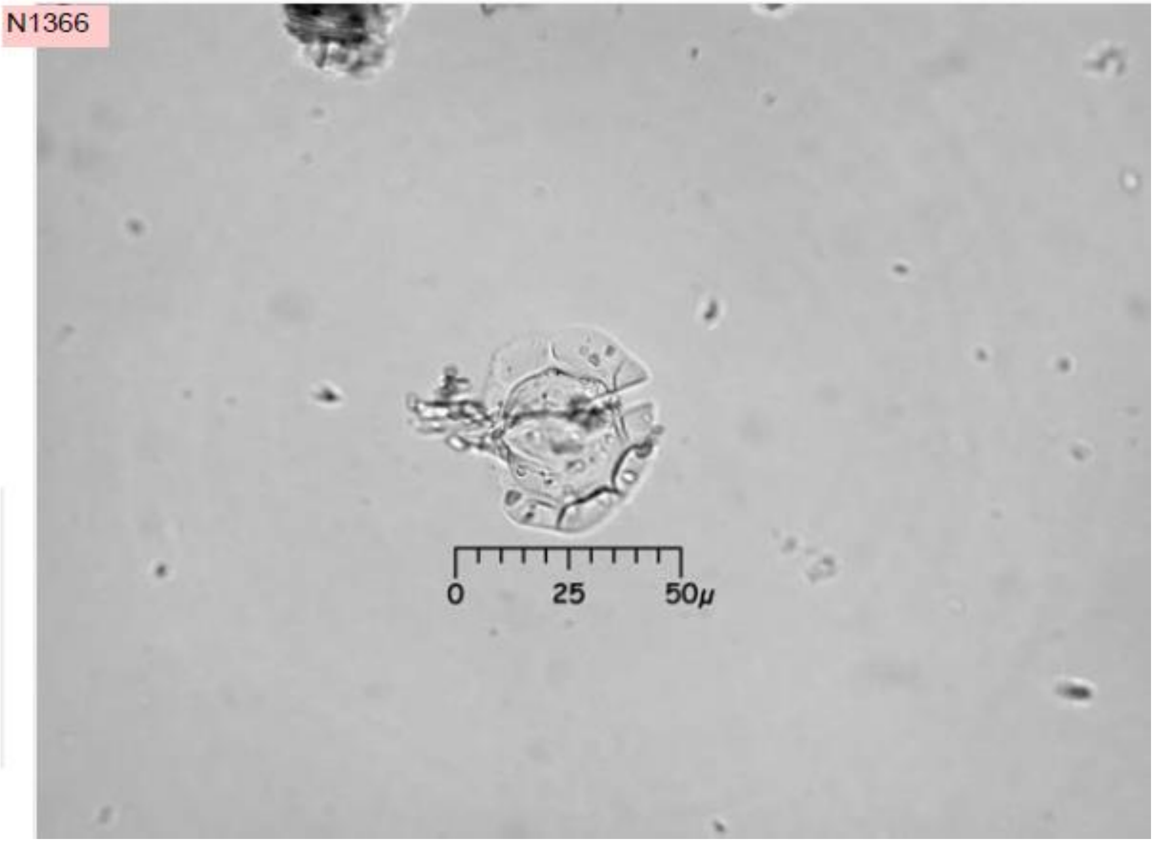
Phytolith

Slide 1723b. Leaf.
Hair with partial base attached and tip broken off.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith



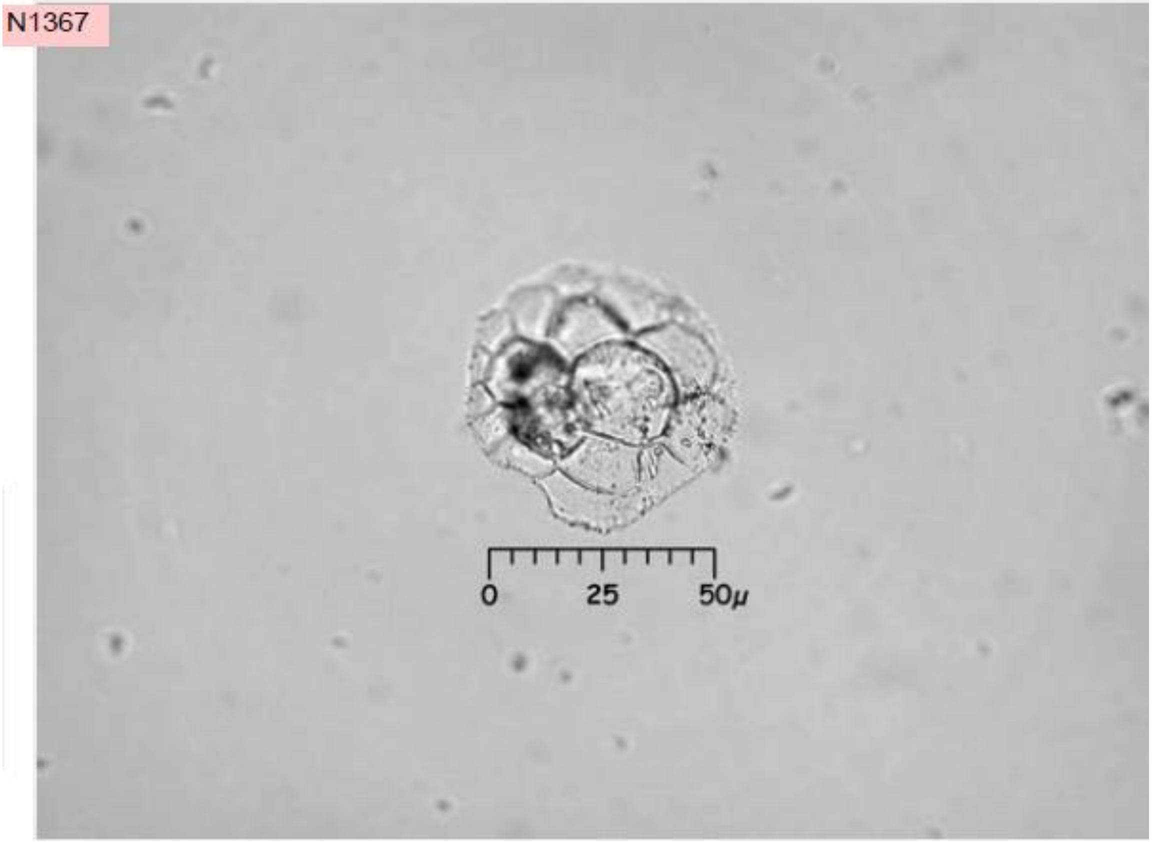
Slide 1723a. Leaf. Hair with base attached.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith

Slide 1723a. Leaf.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith

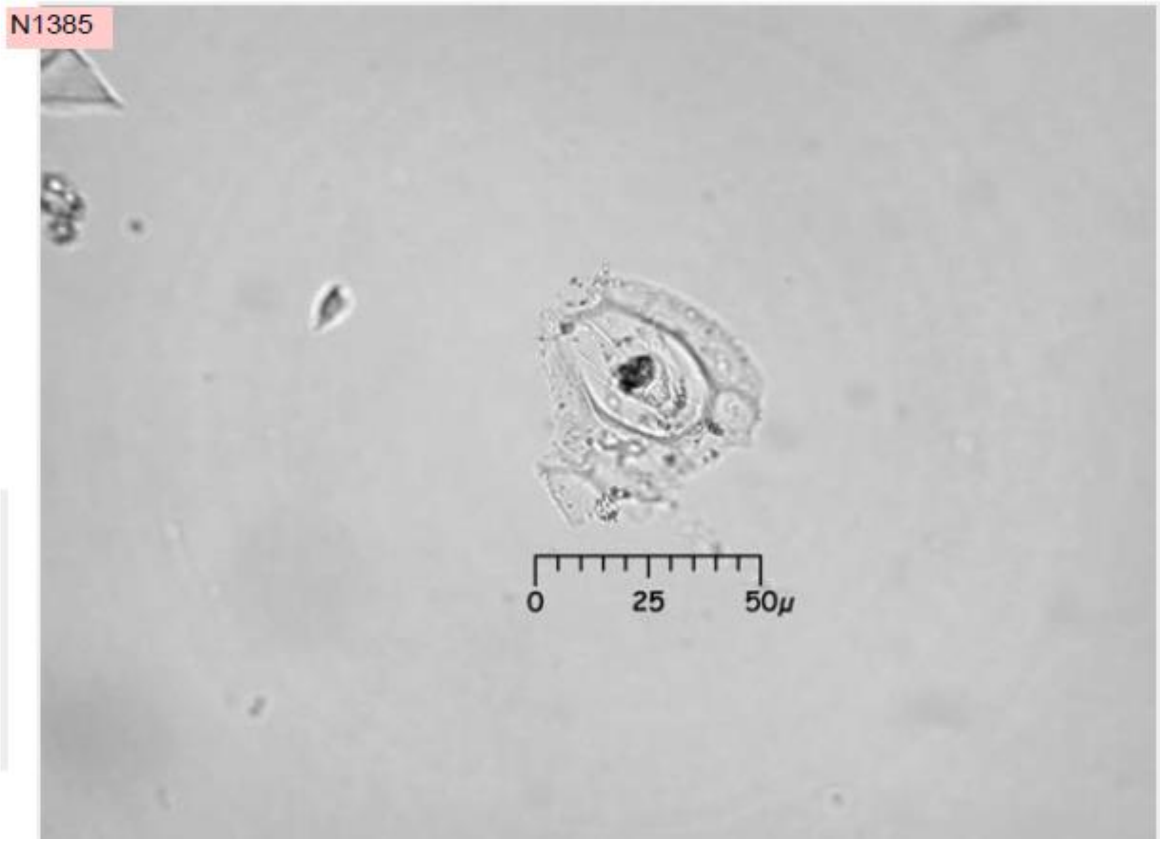
Slide 1723c. Leaf.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith

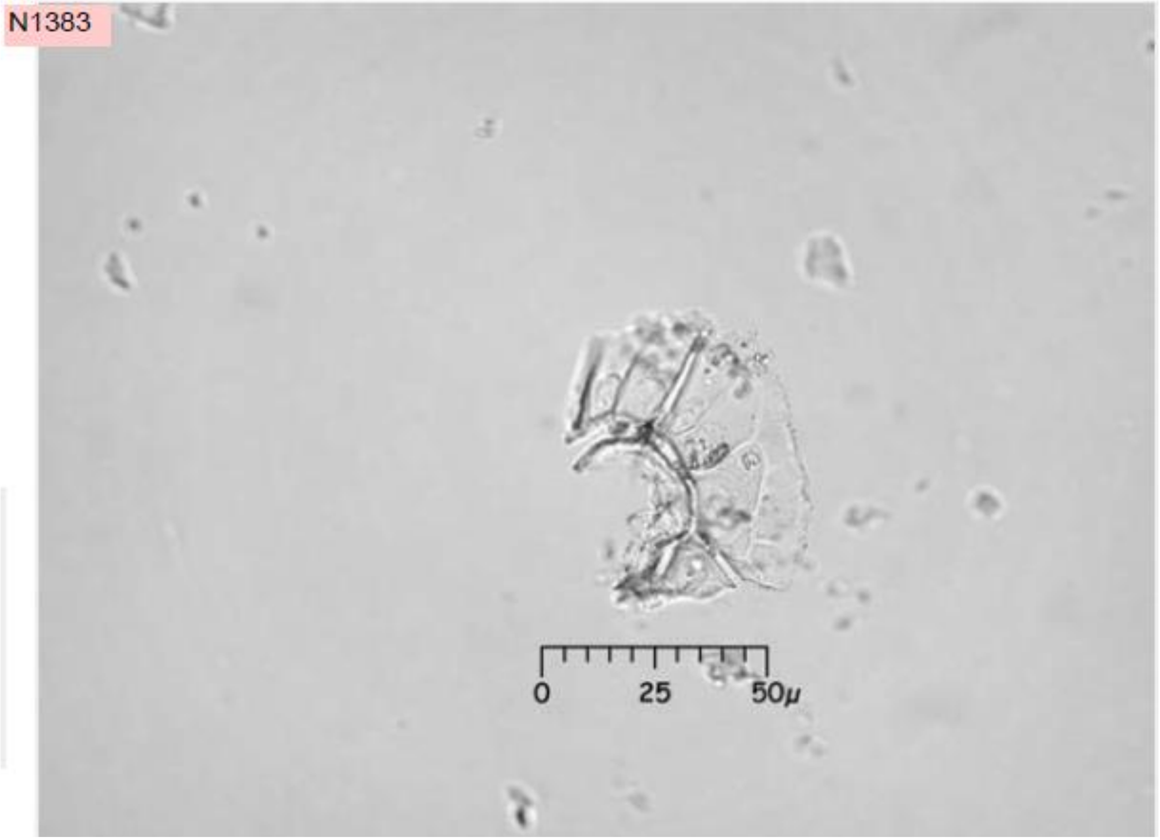
Slide 1723c. Leaf.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lithospermum carolinense

Phytolith



Slide 1723c. Leaf.
Partial hair base, shows radiating appendages.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

BRASSICACEAE

Lepidium meyenii

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

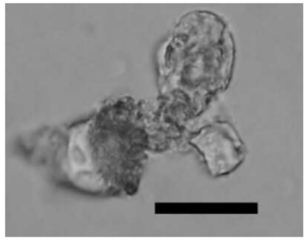
Brassicaceae *Lepidium meyenii* "maca"

Phytolith assemblage characterization

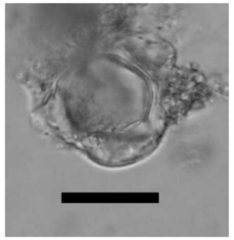
tuber

Different non diagnostic forms **(*):**

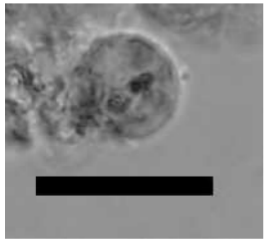
a) Semi-round irregular facetate silicaphytolith. Not common.



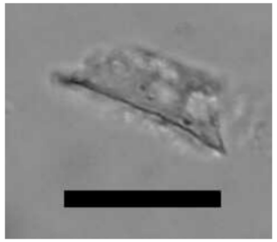
b) Globose concave silica phytolith. Not common.



c) Spherical dense silica phytolith. Rare.



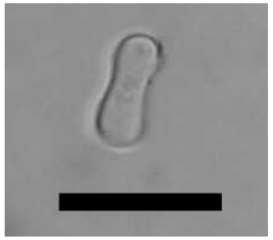
d) Lateral view of a round irregularly perforated silica phytolith. Rare.



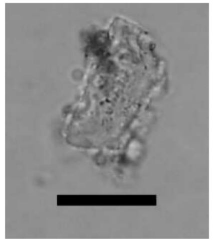
leaf attached to the tuber

Different non diagnostic forms **(*):**

a) Bilobate psilate silica phytolith. Rare.



b) Sub-rectangular irregularly verrucate silica phytolith. Rare.



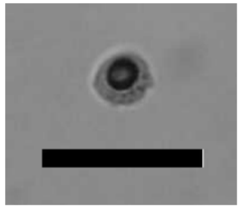
Scale bar = 20μm.

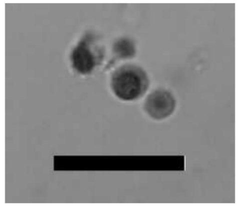
BROMELIACEAE

Abromeitiela sp.

Bromeliaceae *Abromeitiela* sp. “chaguar”

	Phytolith assemblage characterization
leaf	Non diagnostic phytoliths **(*):** a) Spherical centrally cavate silica phytolith. Common.





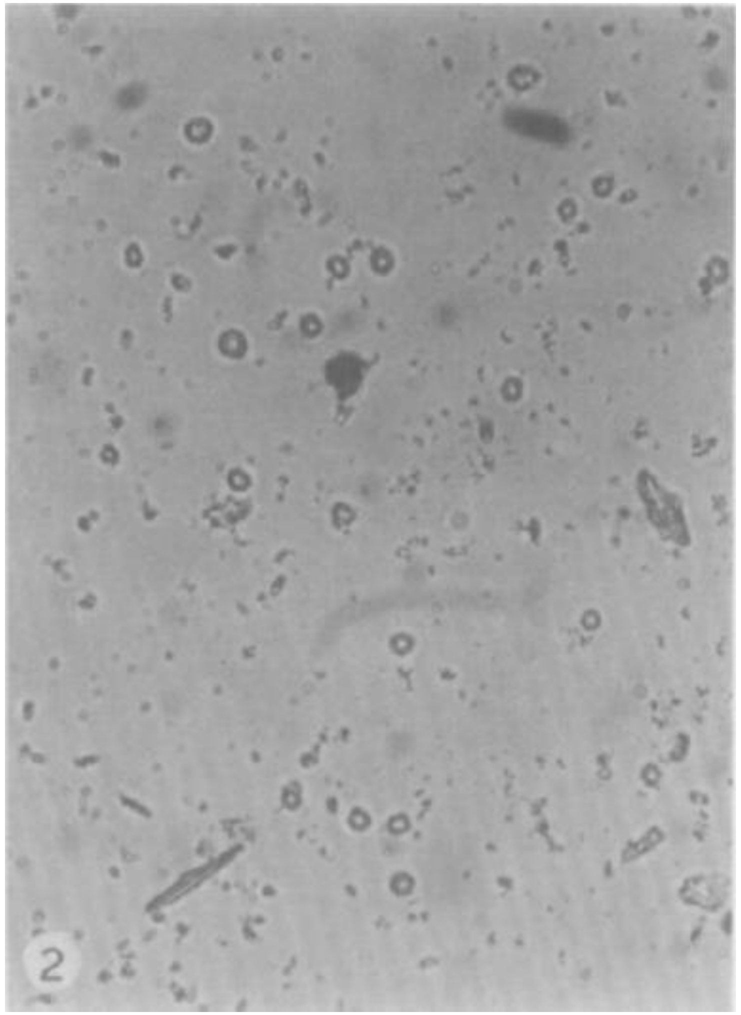
Scale bar = 20μm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Bromelia balanense

Phytolith

Spherical spinulose phytoliths from Bromelia balanense (400x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Tillandisia sp.

Bromeliaceae *Tillandisia* sp. “clavel del aire”

Phytolith assemblage characterization

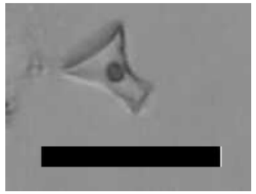
leaf

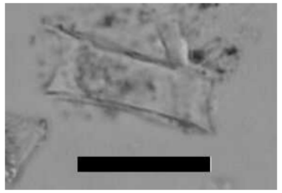
Non diagnostic phytoliths **(*)**:

a) Round silica phytolith.
Rare.

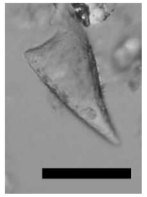
Lateral view.

Plane view.





b) Acuminate silica phytolith.
Rare.

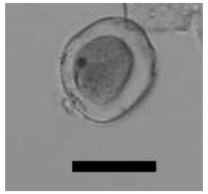


References: Reported as not present in Piperno 1988:27, on *Tillandisia polystachya* sample.

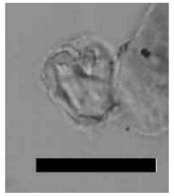
flower

Non diagnostic phytoliths **(*)**:

a) Round central cavated silica phytolith.
Rare.



b) Irregular silica phytolith.
Rare.



References: Reported as not present in Piperno 1988:27, on *Tillandisia polystachya* sample.

Scale bar = 20μm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

BURMANNIACEAE

Burmannia bicolor

Phytolith

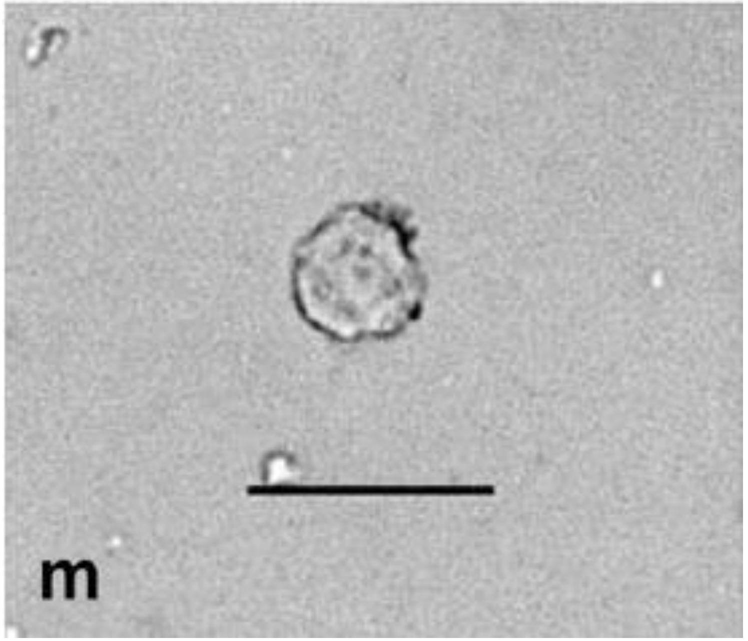


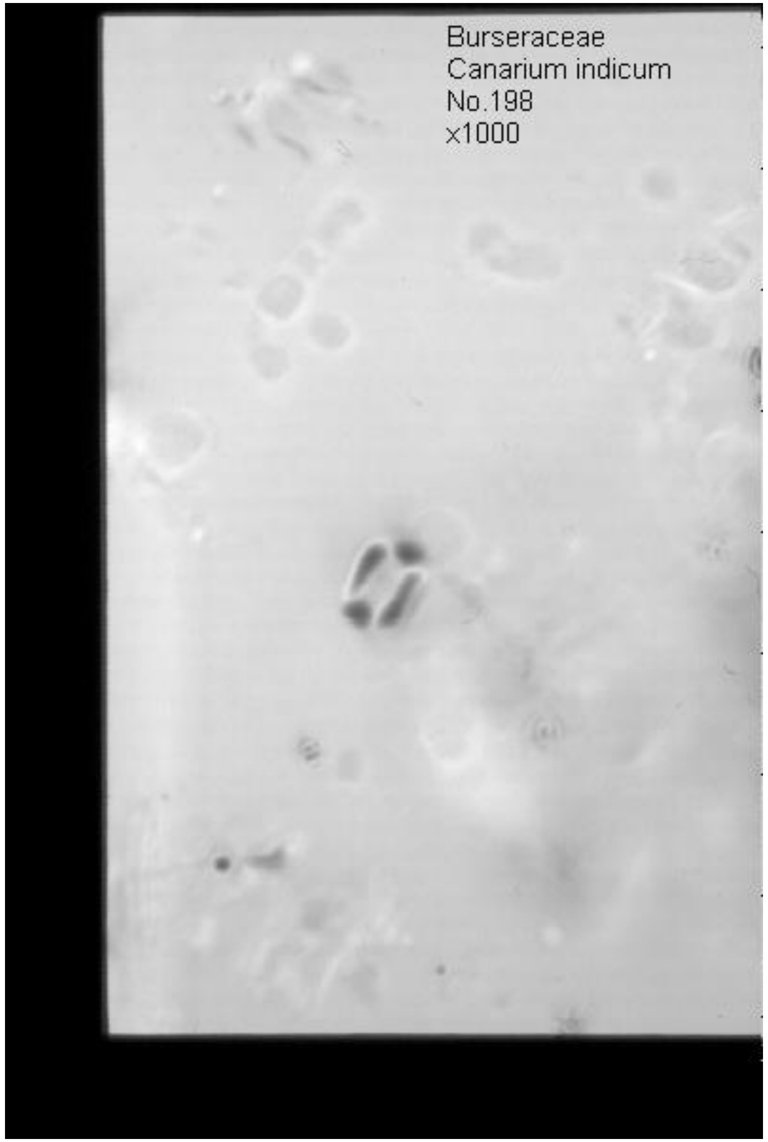
Fig. 2. Phytoliths with little or no taxonomic value. m) Globular granulate phytolith from Burmannia bicolor

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

BURSERACEAE

Canarium indicum

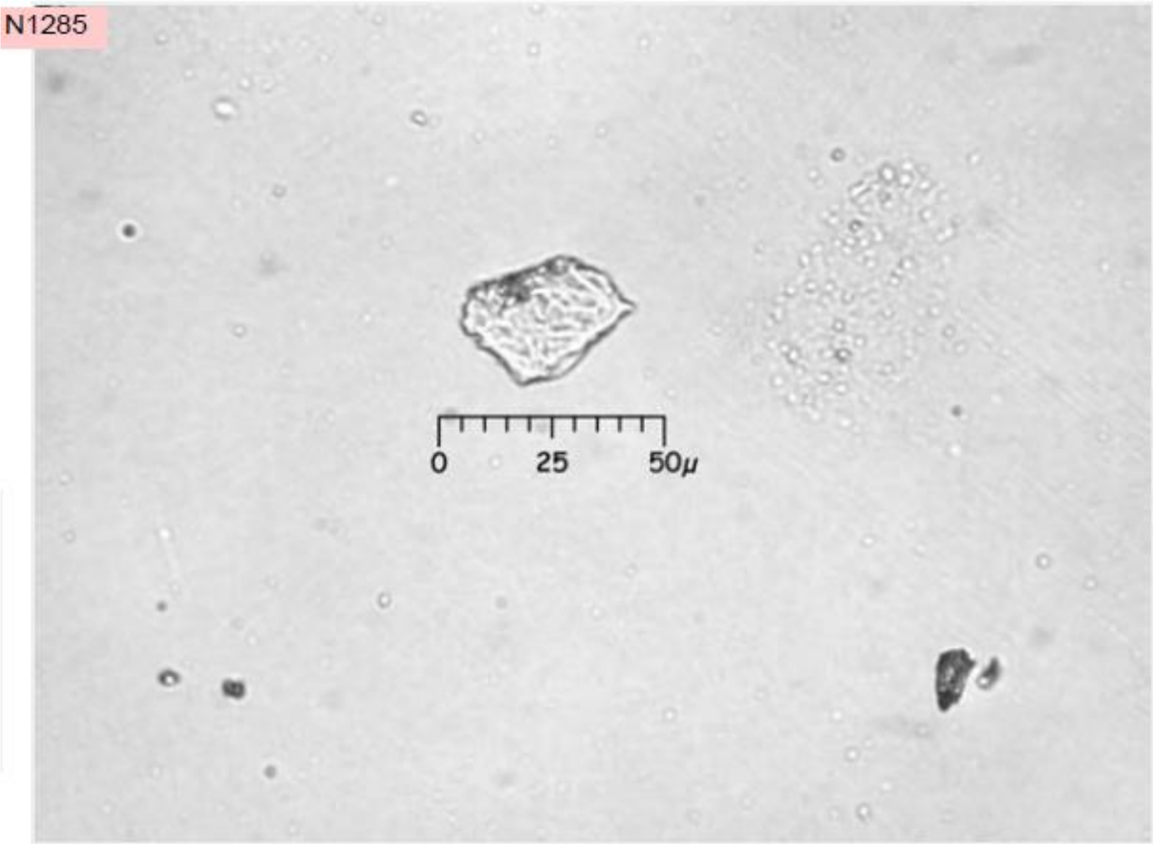
Australian Museum,
McCown Archaeobotany
Laboratory Collection



Dacryodes occidentalis

Phytolith

Slide 58. Also occurs inTrattinnickia glaziouii, slide 64. Diagnostic level: family

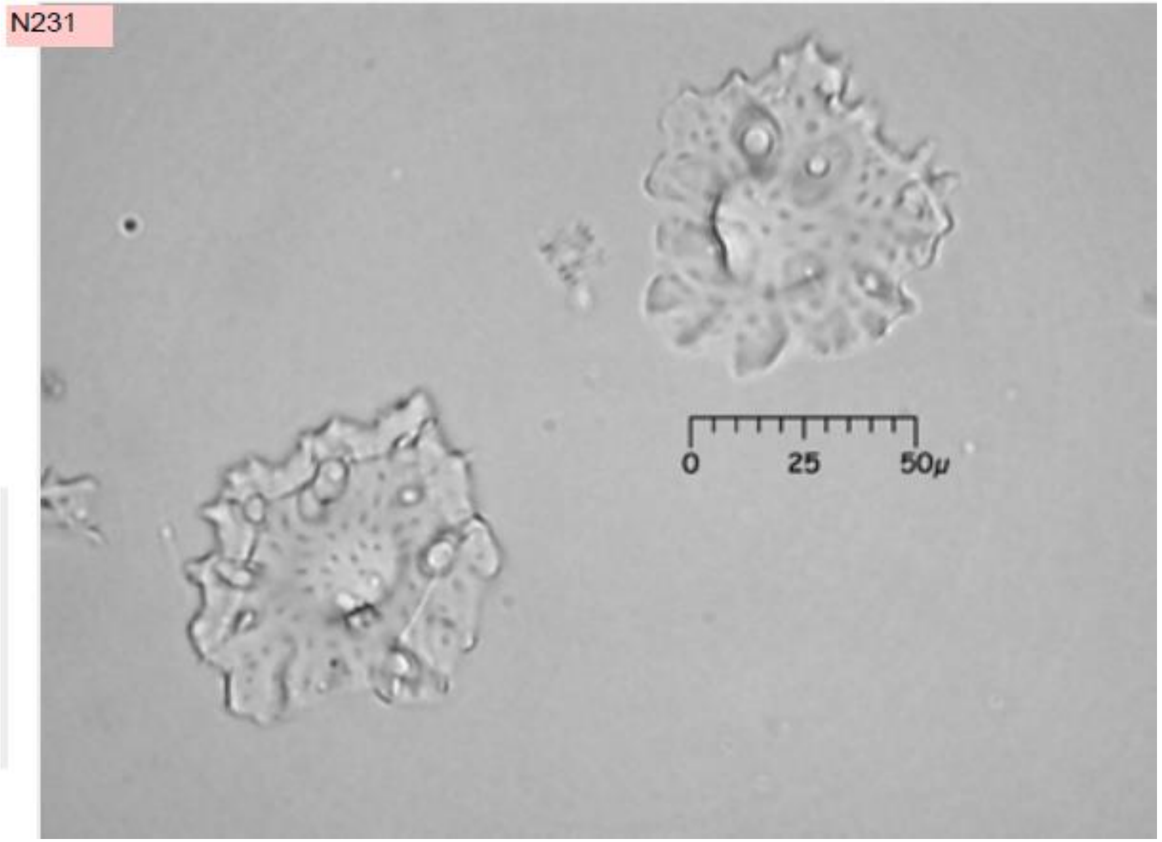


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Protium fimbriatum

Phytolith

See other rotations (Records 163 and 164) to get an idea of the three-dimensional shape. This body is very tall with a very ruffled or undulating edge.
Diagnostic level: family

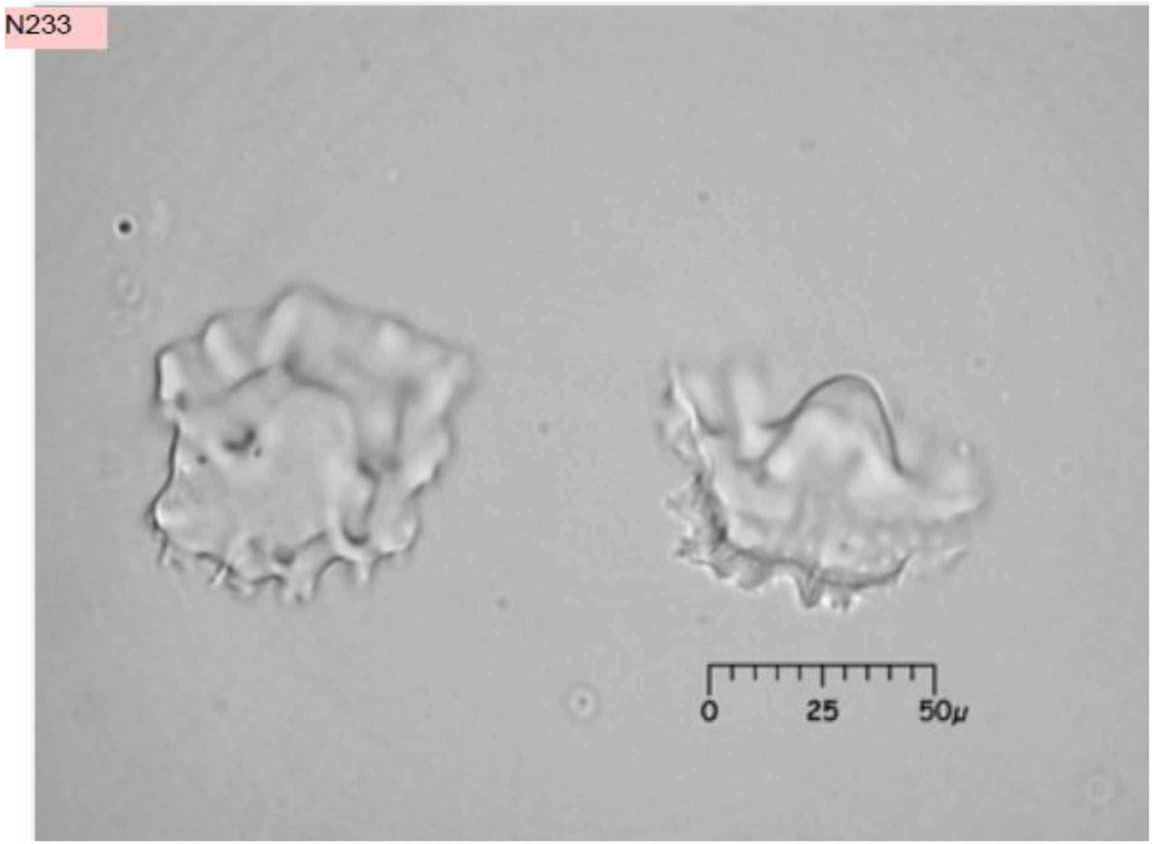


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Protium fimbriatum

Phytolith

See other rotations (Records 162 and 164) to get an idea of the three-dimensional shape. This body is very tall with a very ruffled or undulating edge. Diagnostic level: family

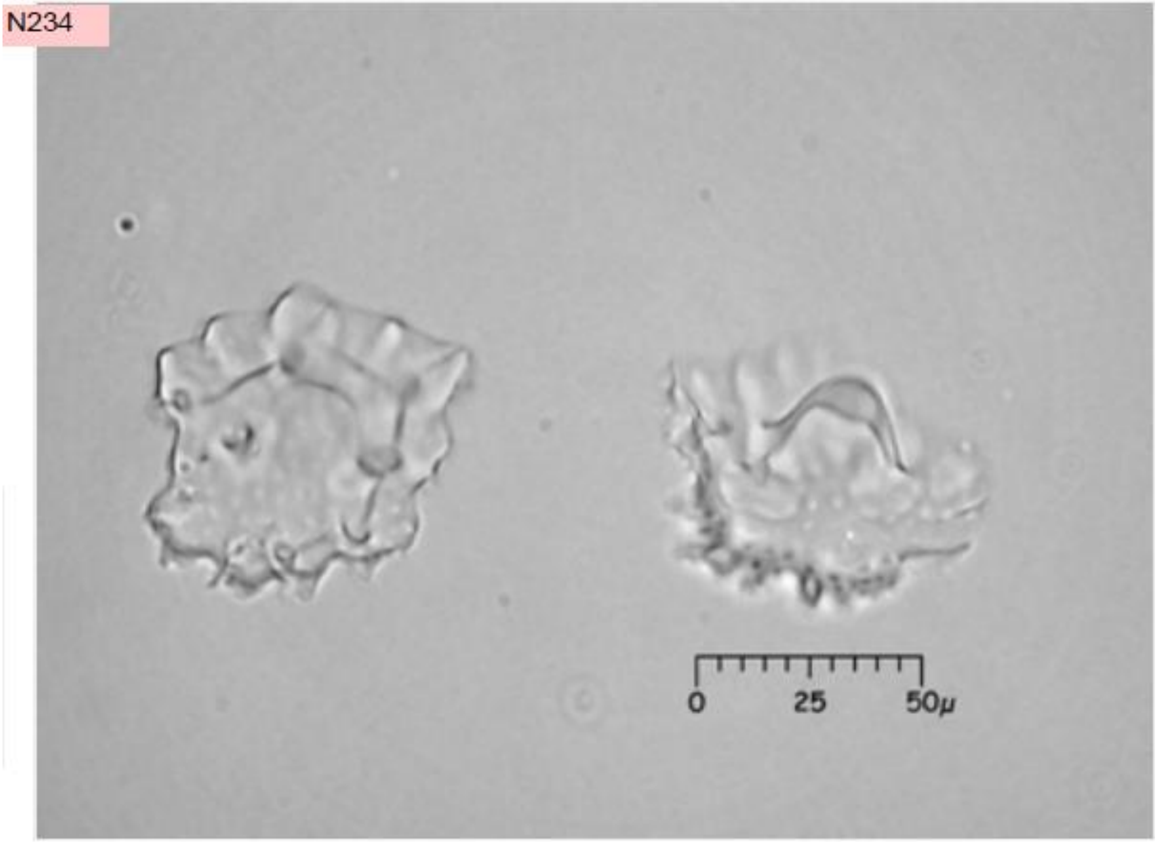


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Protium fimbriatum

Phytolith

See other rotations (Records 162 and 163) to get an idea of the three-dimensional shape. This body is very tall with a very ruffled or undulating edge. Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Protium guianense

Phytoliths

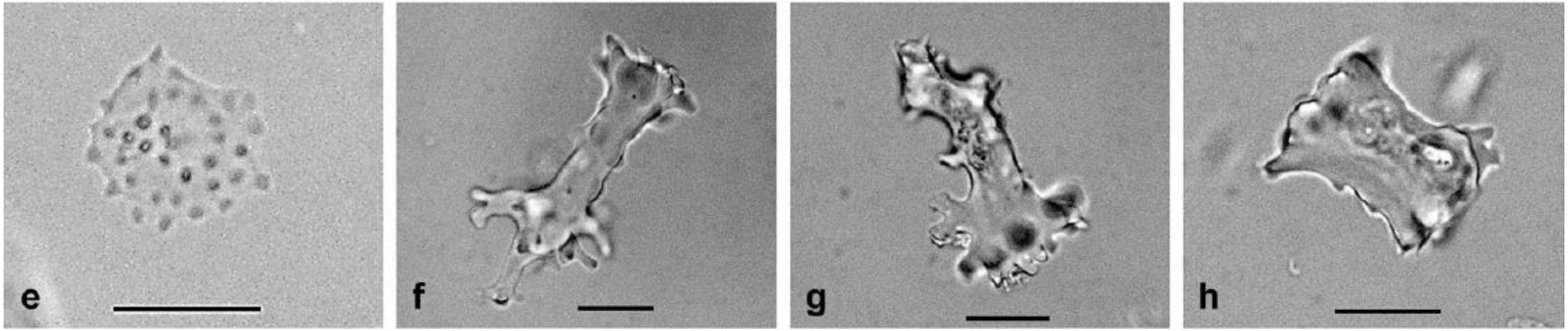


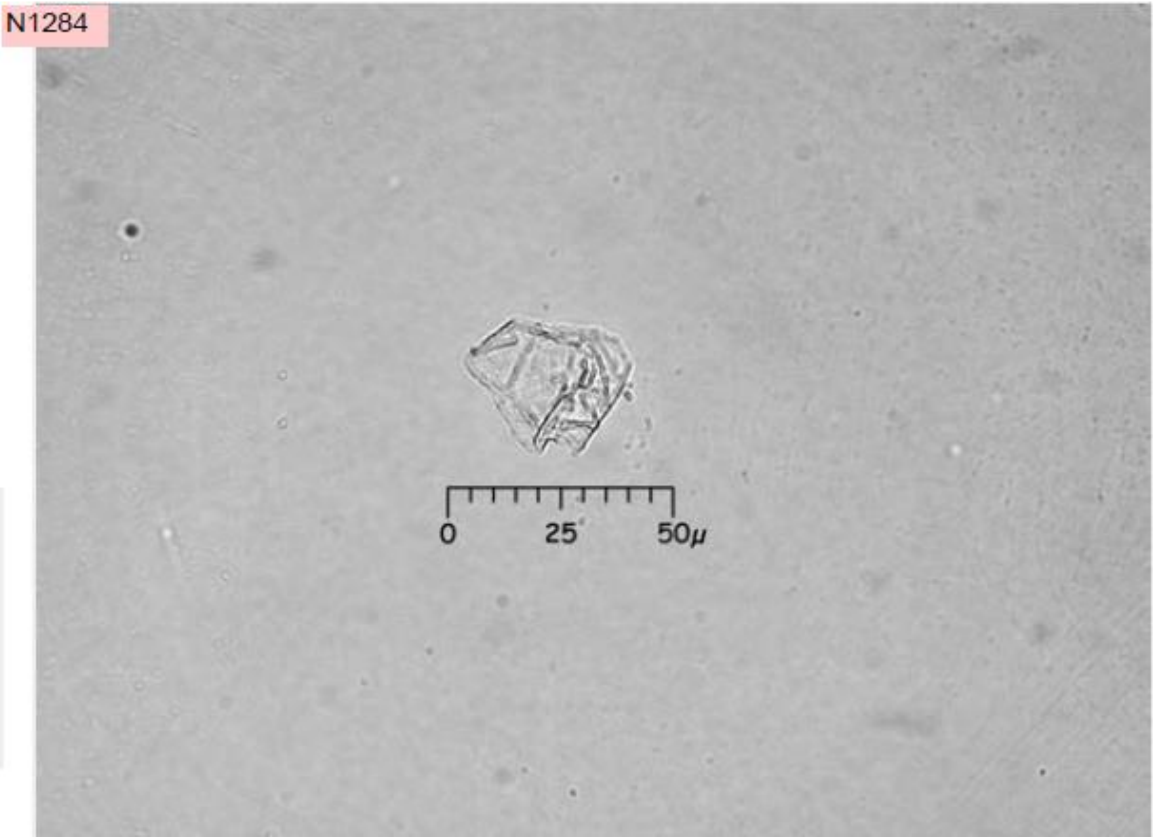
Fig. 5. Phytoliths from dicotyledons. e) Stippled body from Protium guianense fruit, f-h) “Boney” bodies from P. guianense leaf

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Trattinnickia glaziouii

Phytolith

Slide 64. Also occurs in Dacryodes occidentalis, slide 58. Diagnostic level: family

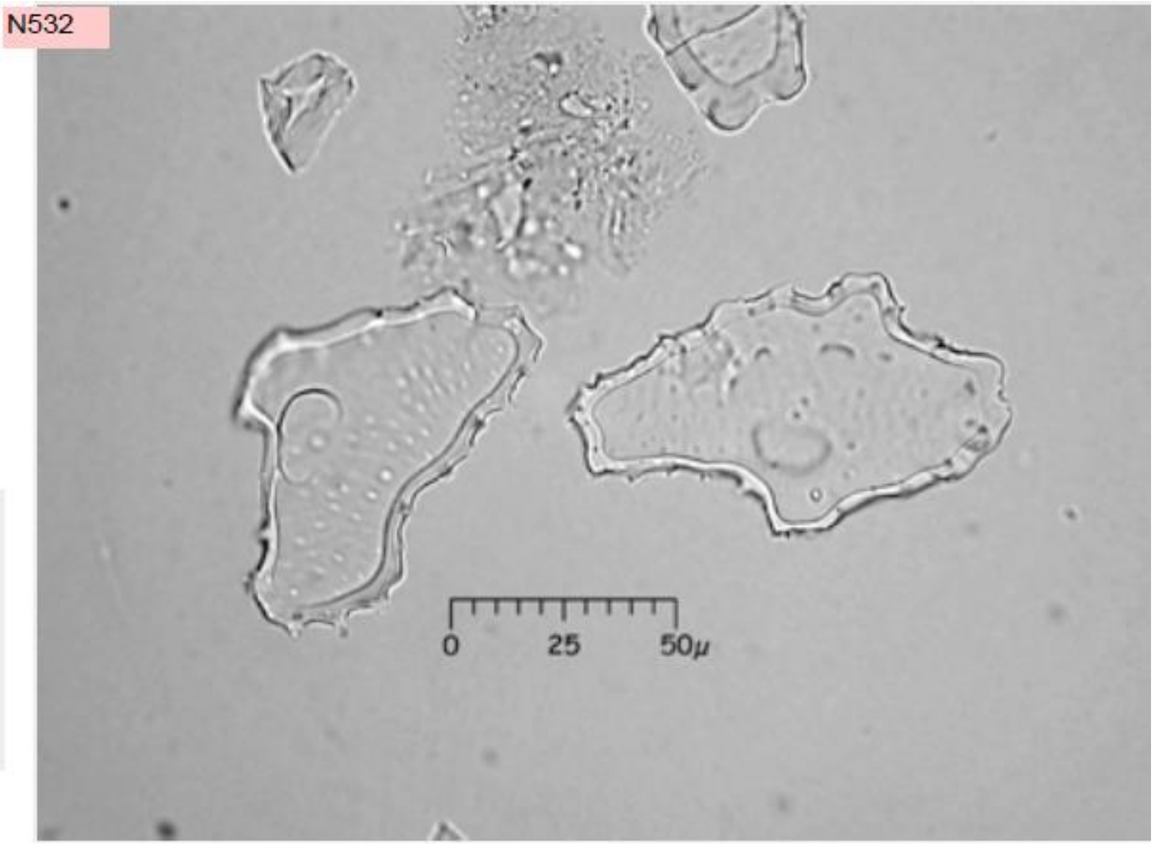


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia glaziovii

Phytolith

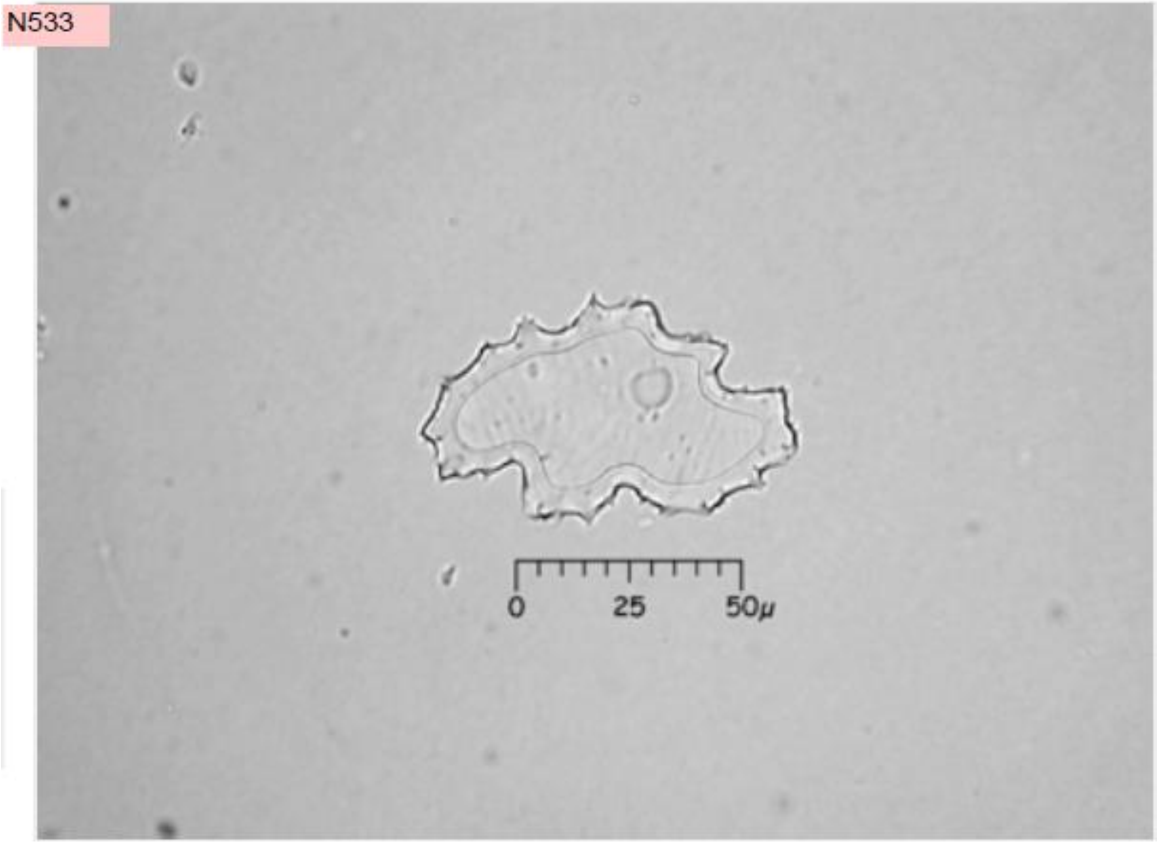
Seed epidermis. Projection is not centered and may not be present on all fragments. The projection is often very low. Surface decoration not always evident unless focus is moved up and down.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia glaziovii

Phytolith



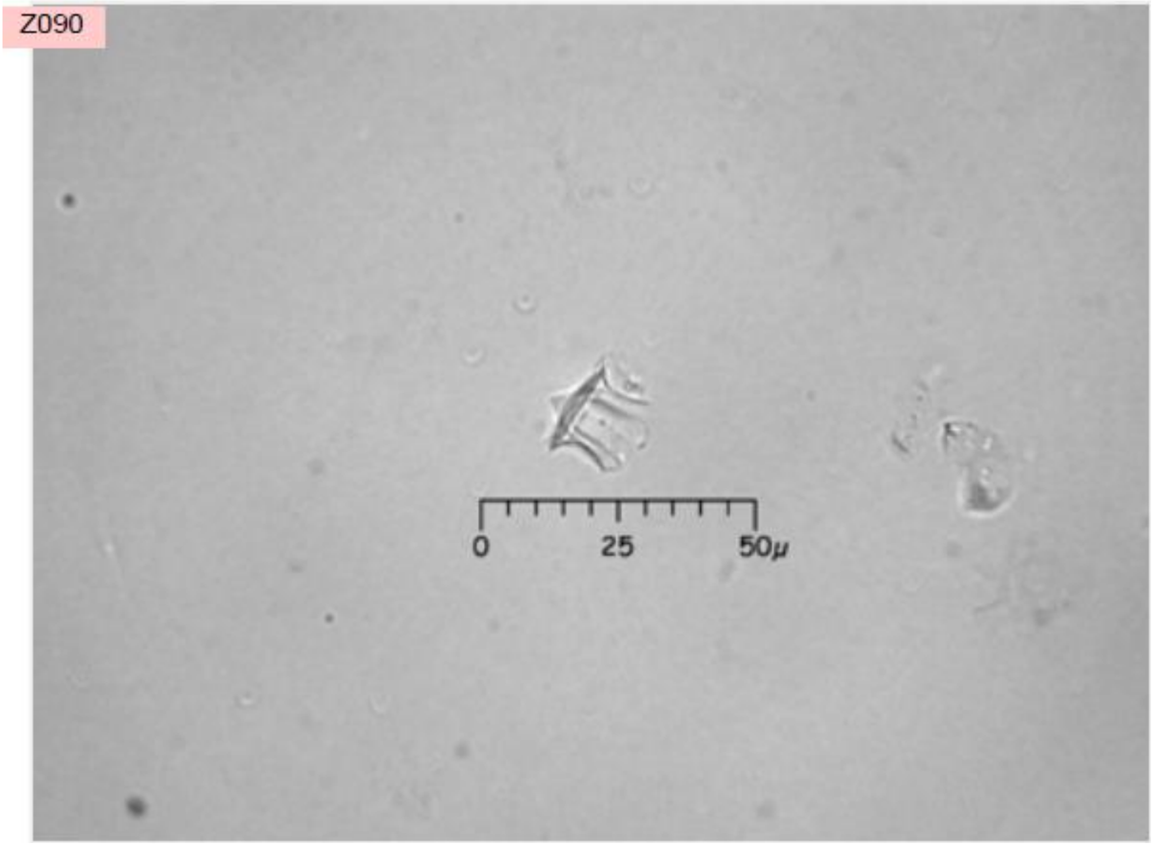
Seed epidermis. Projection is not centered and may not be present on all fragments. The projection is often very low. Surface decoration not always evident unless focus is moved up and down.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia peruviana

Phytolith

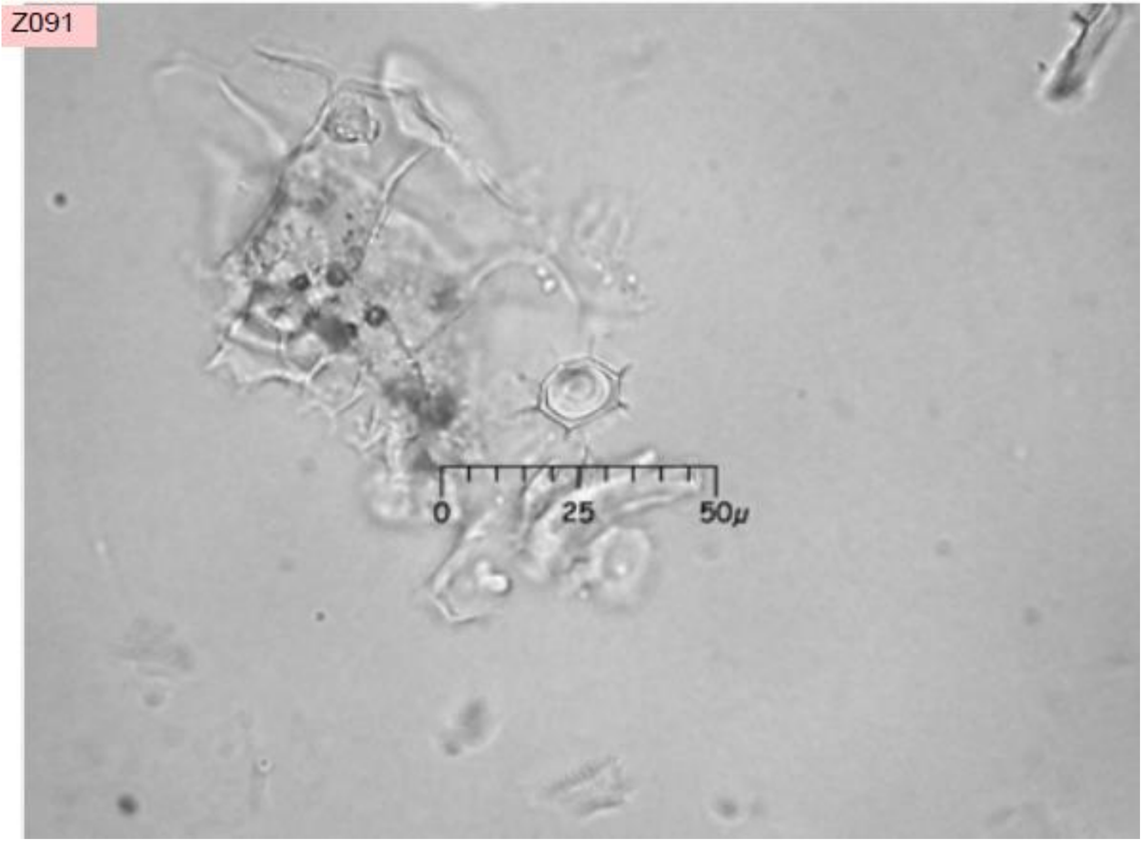
Side view; see Record #134 for top view. Occurs in the leaf. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia peruviana

Phytolith



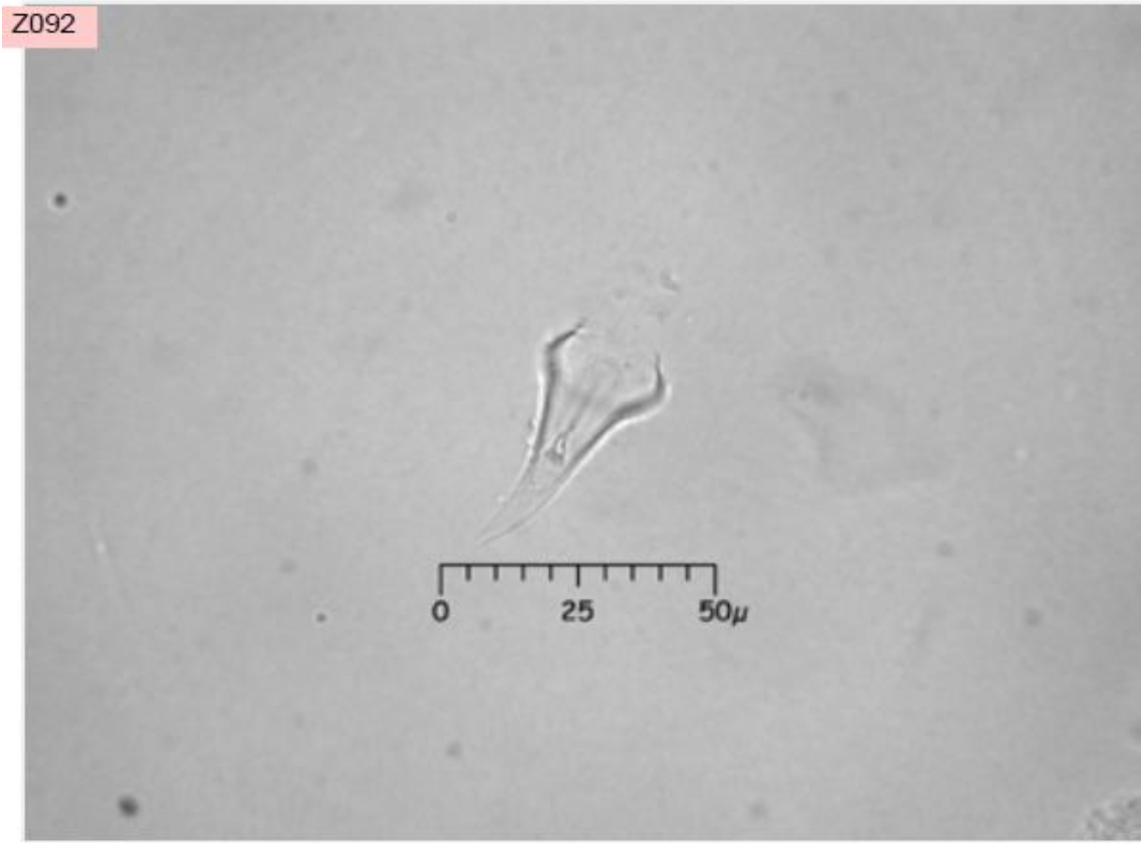
Top view; see Record #133 for side view. Occurs in the leaf. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia peruviana

Phytolith

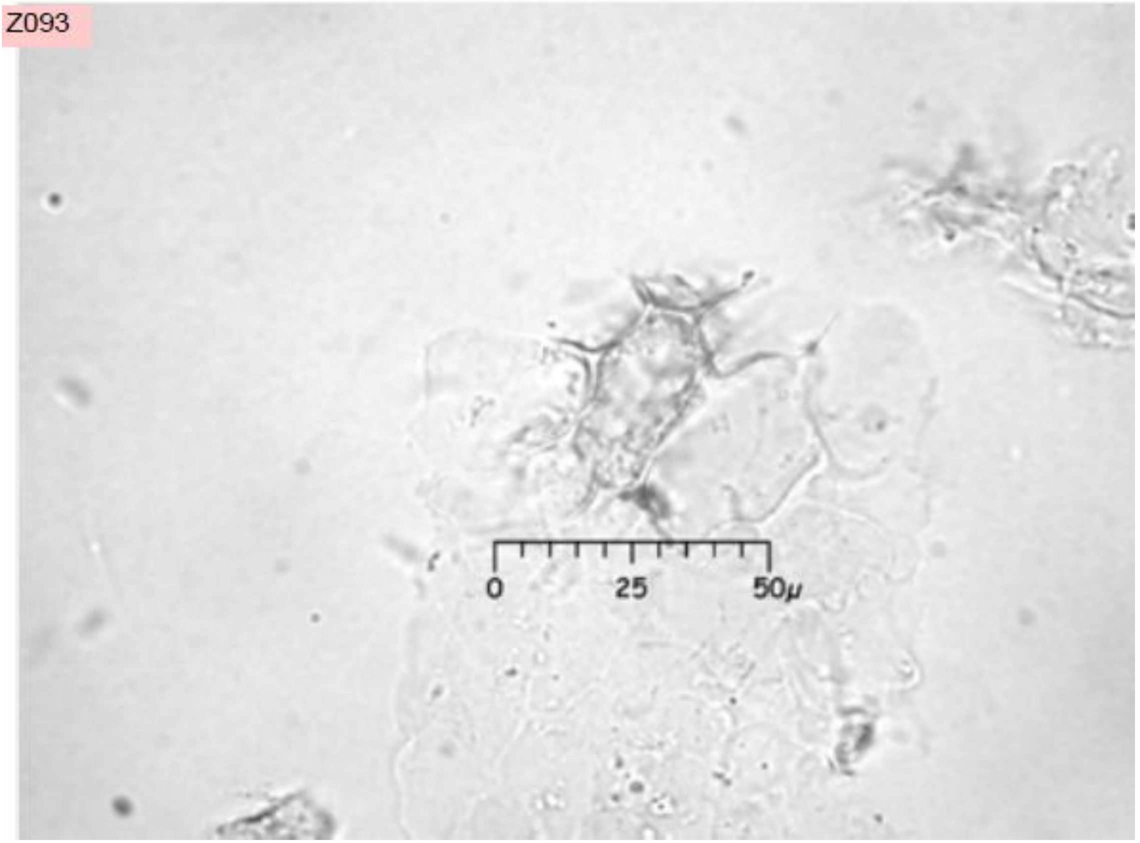
Occurs in the leaf. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia peruviana

Phytolith



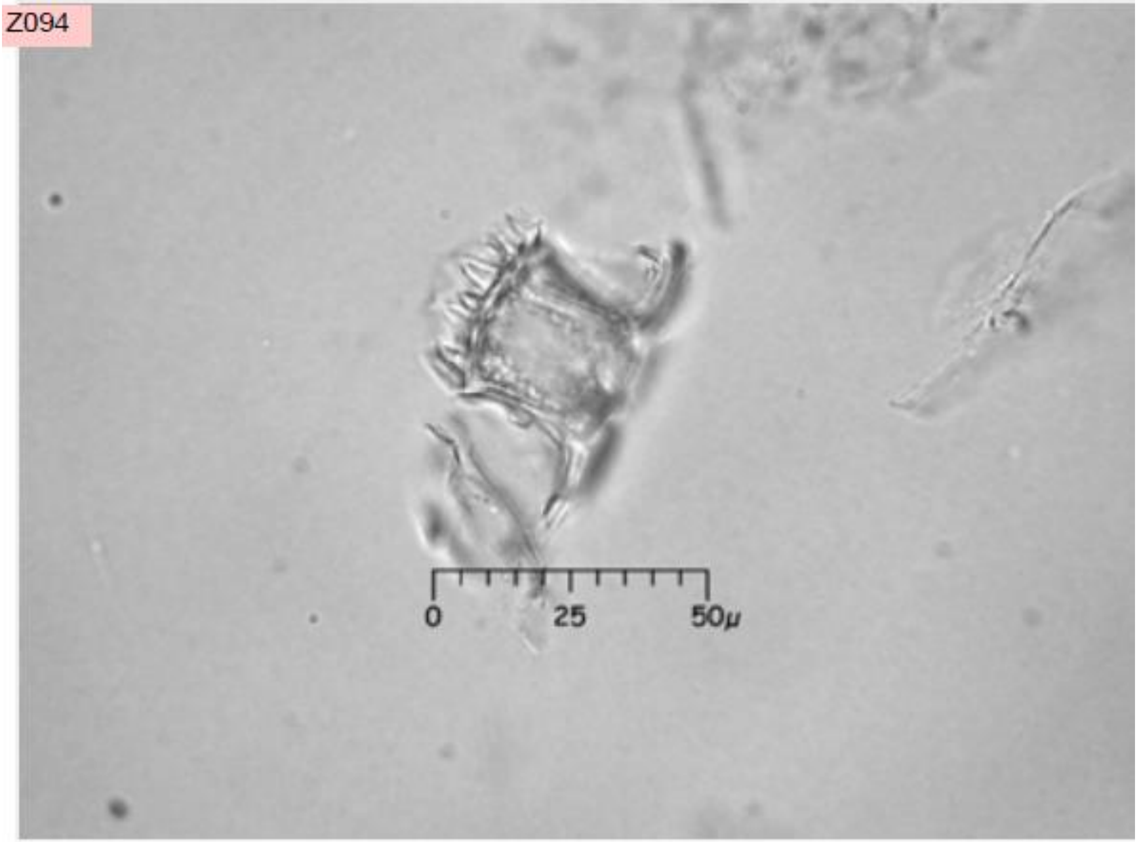
Top view; see Record #137 for side view. The small cells that overlay the large central cell appear as a “corona” when viewed from the side. Occurs in the leaf.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trattinnickia peruviana

Phytolith

Side view; see Record #136 for top view. The small cells that overlay the large central cell appear as a “corona” when viewed from the side. Occurs in the leaf. Large, 30-50 microns. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

CACTACEAE

Opuntia sp.

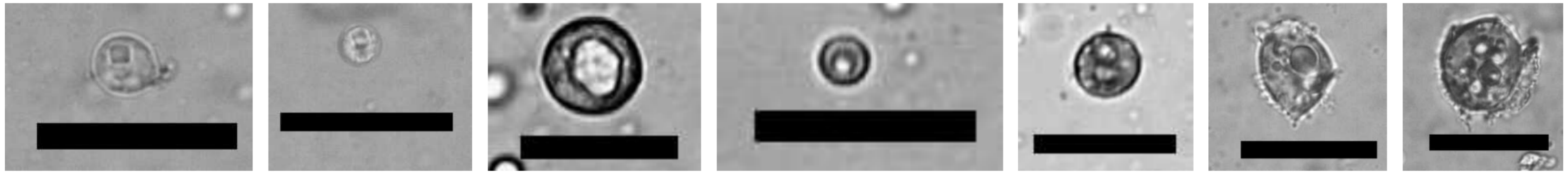
Cactaceae *Opuntia* sp. "pasacana"

Phytolith assemblage characterization

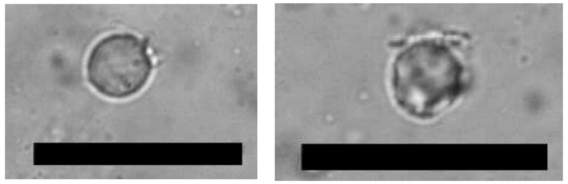
fruit

Diagnostic phytoliths **(*)**:

a) Sub-spherical with central perforations silica phytolith. Common.



b) Sub-spherical silica phytolith. Common.



References: Reported in Jones and Bryant 1992 for calcium oxalates.

Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

CANNABACEAE

Celtis iguanea

Phytolith

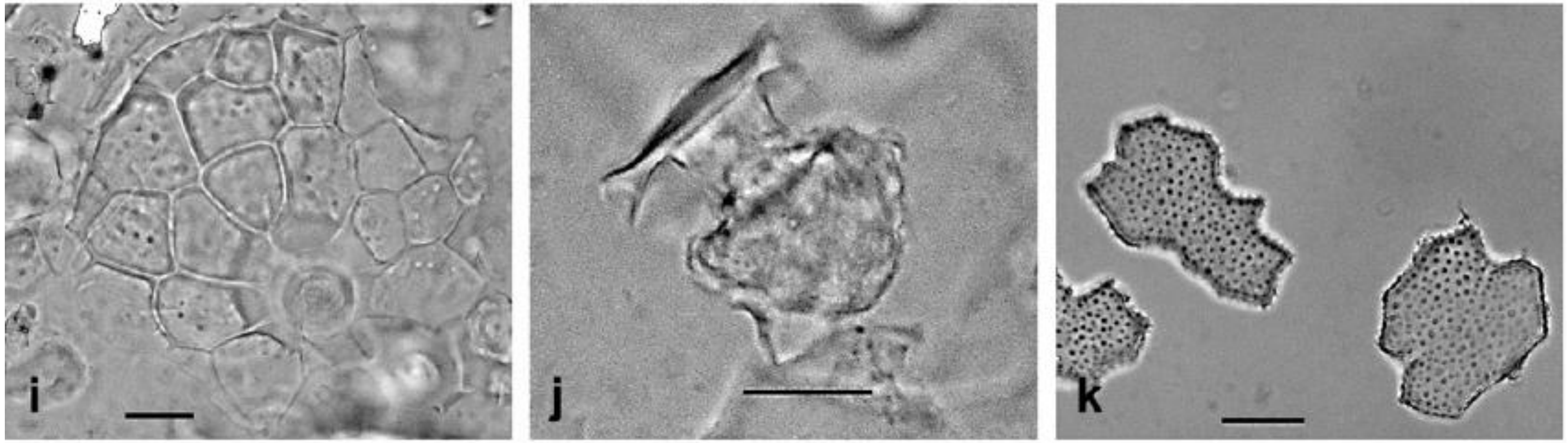
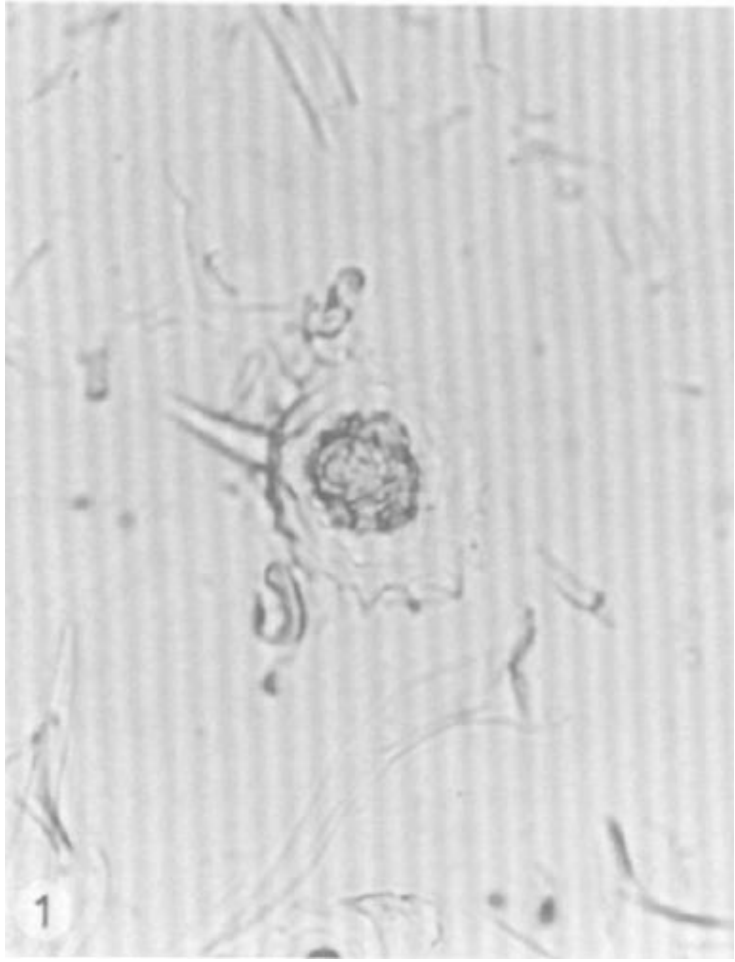


Fig. 5. Phytoliths from dicotyledons. i) Hair base and polyhedral epidermal complex from C. iguanea leaf, j) Cystolith from Celtis iguanea, k) Stippled epidermis from C. iguanea seeds

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Trema micrantha

Phytolith



1. Center, hair base from Trema micrantha with the remnants of armed hairs. Also present are non-segmented hairs (200 x).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Trema micrantha

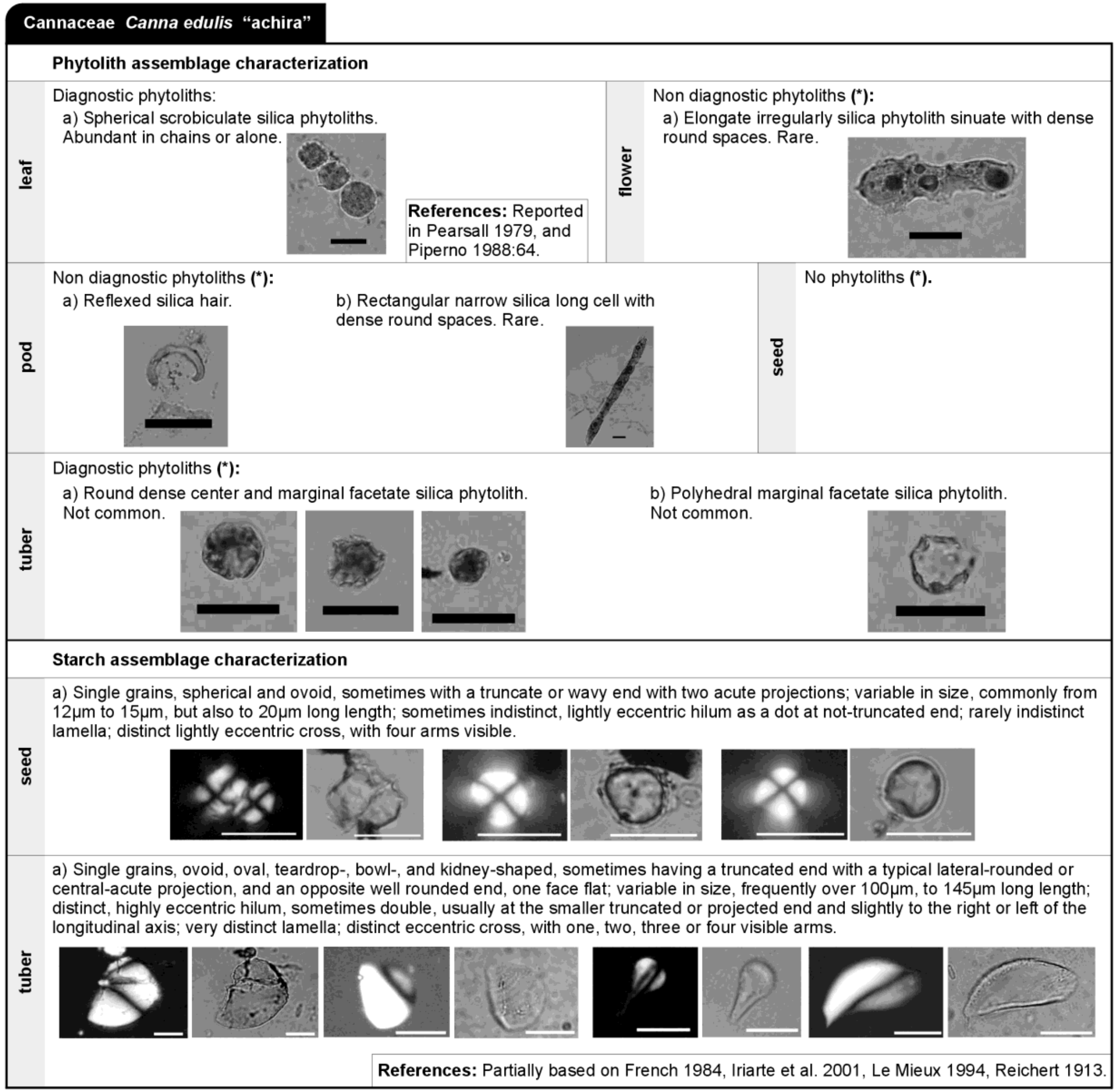
Phytolith

Fig. 4. A genus-specific phytolith from the fruit of Trema micrantha (Moraceae).

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

CANNACEAE

Canna edulis



Cannaceae *Canna edulis* "achira"

Phytolith assemblage characterization

leaf

Diagnostic phytoliths:
a) Spherical scrobiculate silica phytoliths. Abundant in chains or alone.

References: Reported in Pearsall 1979, and Piperno 1988:64.

flower

Non diagnostic phytoliths **(*):**
a) Elongate irregularly silica phytolith sinuate with dense round spaces. Rare.

pod

Non diagnostic phytoliths **(*):**
a) Reflexed silica hair.
b) Rectangular narrow silica long cell with dense round spaces. Rare.

seed

No phytoliths **(*).**

tuber

Diagnostic phytoliths **(*):**
a) Round dense center and marginal facetate silica phytolith. Not common.
b) Polyhedral marginal facetate silica phytolith. Not common.

Starch assemblage characterization

seed

a) Single grains, spherical and ovoid, sometimes with a truncate or wavy end with two acute projections; variable in size, commonly from 12µm to 15µm, but also to 20µm long length; sometimes indistinct, lightly eccentric hilum as a dot at not-truncated end; rarely indistinct lamella; distinct lightly eccentric cross, with four arms visible.

tuber

a) Single grains, ovoid, oval, teardrop-, bowl-, and kidney-shaped, sometimes having a truncated end with a typical lateral-rounded or central-acute projection, and an opposite well rounded end, one face flat; variable in size, frequently over 100µm, to 145µm long length; distinct, highly eccentric hilum, sometimes double, usually at the smaller truncated or projected end and slightly to the right or left of the longitudinal axis; very distinct lamella; distinct eccentric cross, with one, two, three or four visible arms.

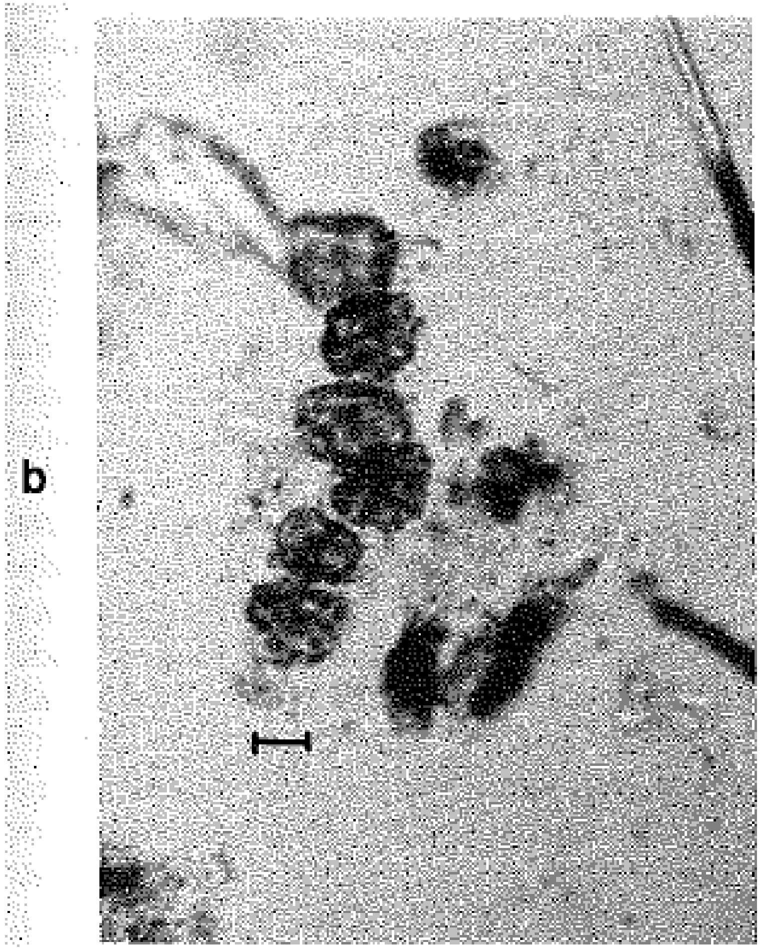
References: Partially based on French 1984, Iriarte et al. 2001, Le Mieux 1994, Reichert 1913.

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Canna edulis

Phytolith



b. Angled and folded spheres from Canna edulis

Pearsall, Deborah Marie. 1993. Contributions of Phytolith Analysis for Reconstructing Subsistence: Examples from Research in Ecuador. *Current Research in Phytolith Analysis: Applications in Archaeology and Paleoecology*. MASCA.

Canna edulis

Phytolith

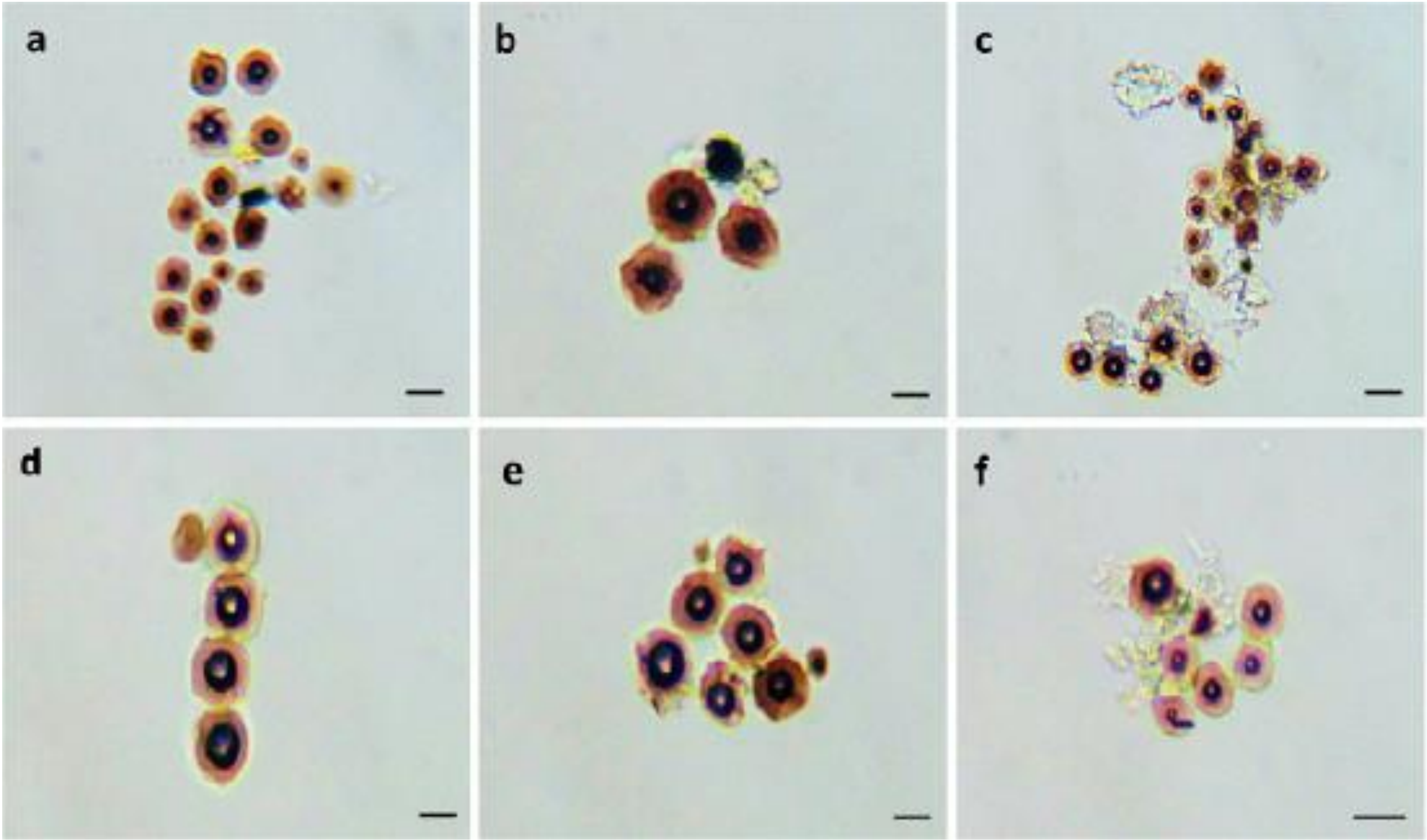


Figure 2. Phytoliths found in achira leaves (Canna indica L.). a) Major axis: 97.56 µm, minor axis: 82.44 µm; b) 31.26 µm, 10.45 µm; c) 36.1 µm, 9.99 µm; d) 38.58 µm, 14.19µm; e) 25.53µm, 24.91µm; f) 24.96 µm, 23.58 µm. Scale: 10 µm by 40X

Poveda-Díaz, Nataly, Maria Eugenia Morales-Puentes, and Gregory Vaughan. 2016. Phytoliths Produced by Common Bean (Phaseolus Vulgaris L.), Achira (Canna Indica L.), and Squash (Cucurbita Ficifolia Bouché), Crop Species from Boyacá, Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 40 (154):137–46.

Canna edulis

Phytolith

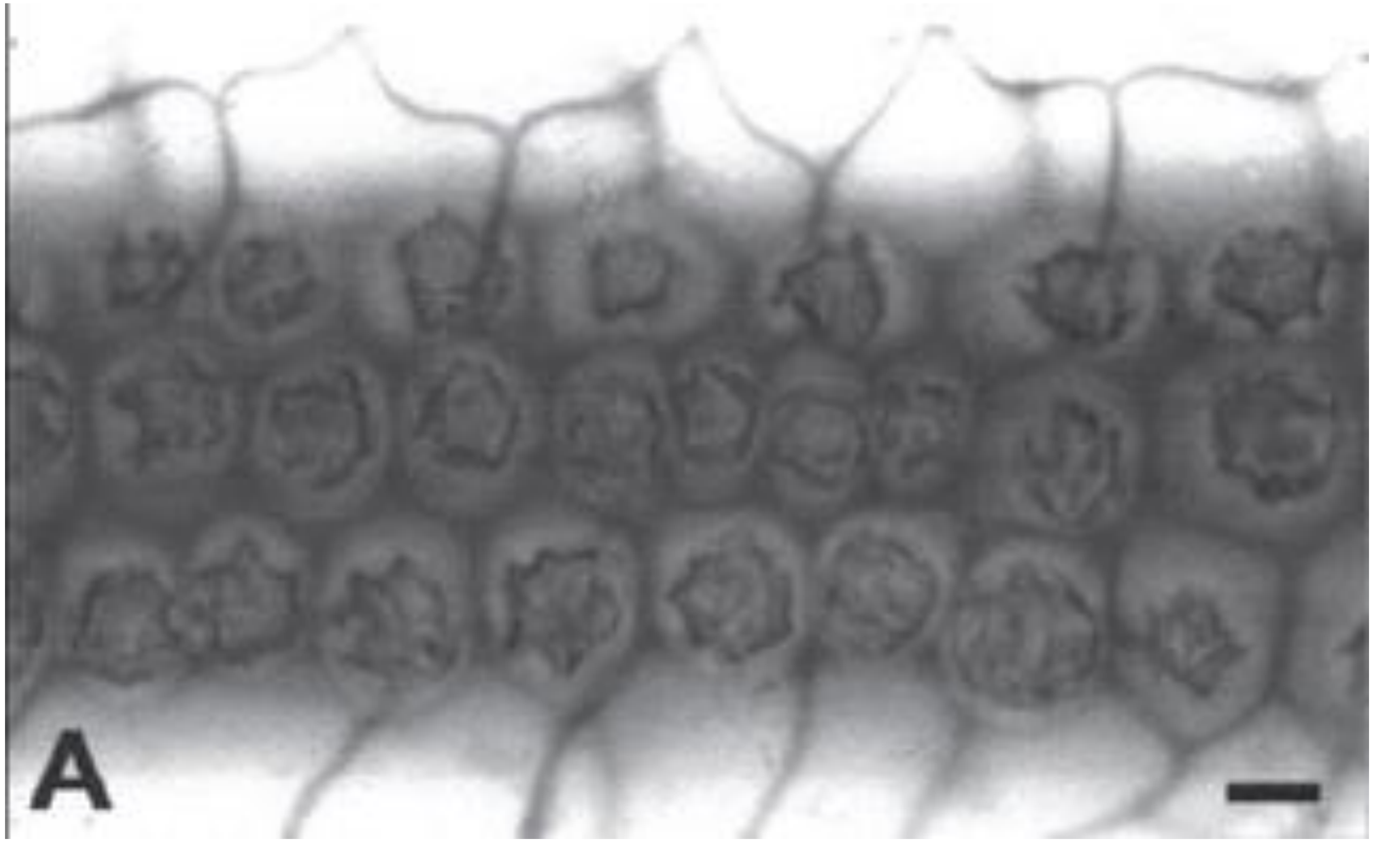


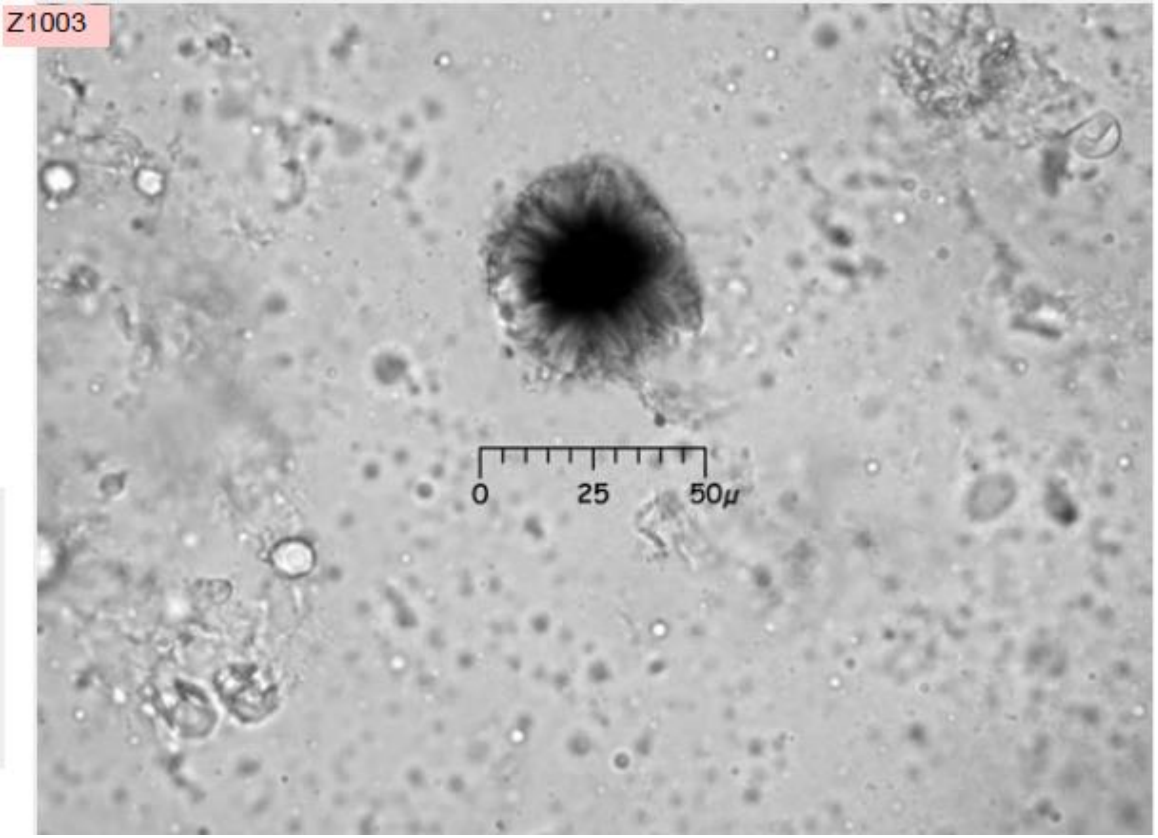
Fig. 3. Various silica body morphologies found in the order Zingiberales. A. Canna edulis (Cannaceae), druse-like silica bodies over vascular bundle sheath (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Canna edulis

Phytolith

Spheres produced by Canna range from smooth to rugulose to irregularly angled or folded. Type 80IAa200 is based on an archaeological specimen of Canna edulis leaf, from the coast of Peru. Diagnostic level: Unknown. Does not occur in chemically extracted specimens; probably not silica.

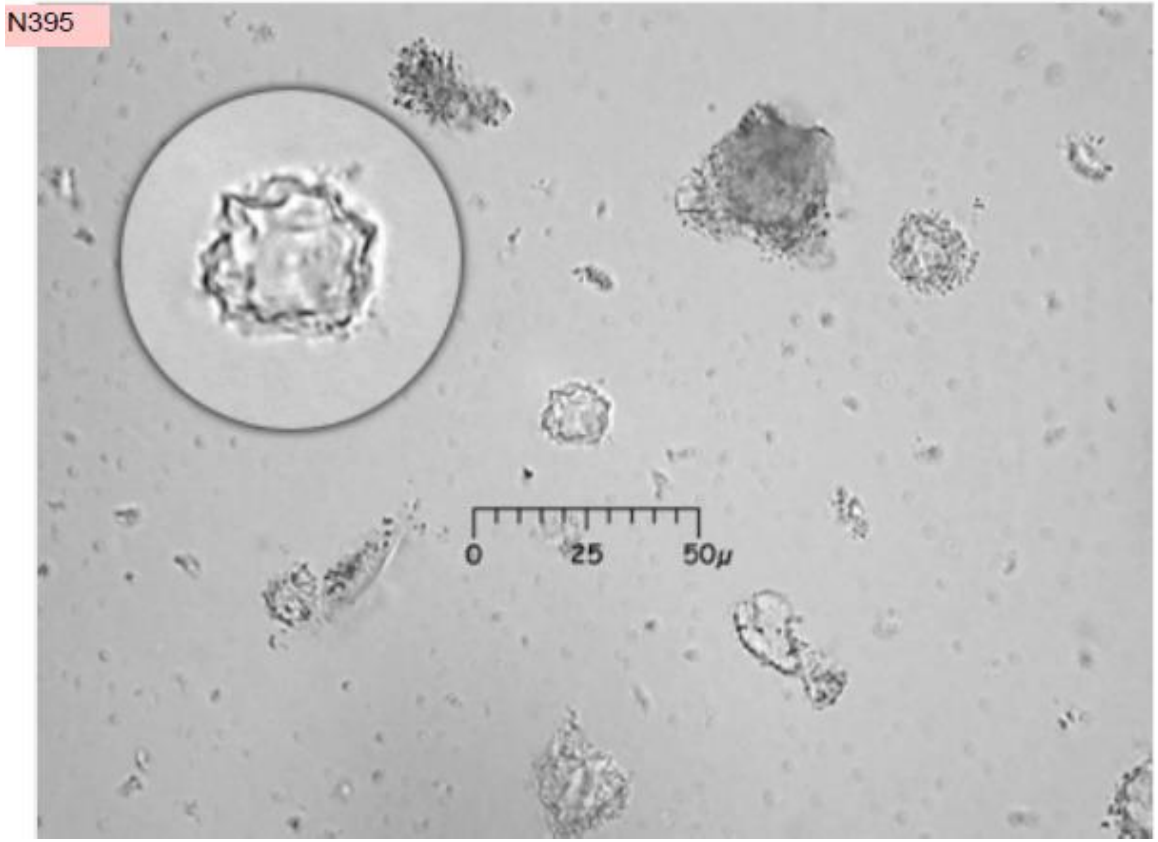


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna edulis

Phytolith

Large rugulose sphere (10-30 microns). Rugulose spheres occur in many taxa, such as the Marantaceae, Bombacaceae, Cannaceae, Heliconiaceae, and Chrysobalanaceae. Large spheres (10-30 microns) characterize Marantaceae and Cannaceae. Diagnostic level: Marantaceae/Cannaceae

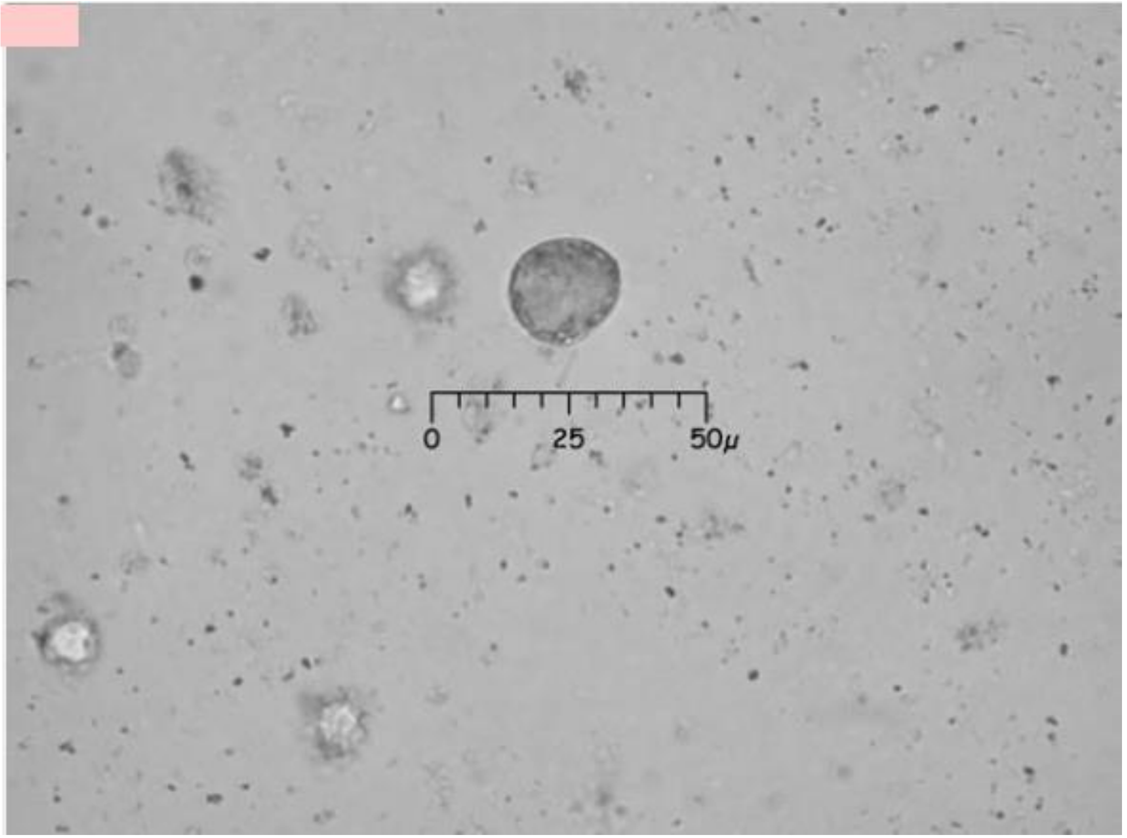


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna edulis

Phytolith

Spheres produced by Canna range from smooth to rugulose to irregularly angled or folded. Type 80IAa201 is based on a modern specimen of Canna edulis leaf. Ephemeral spherical bodies are not included in this type. Diagnostic level: genus

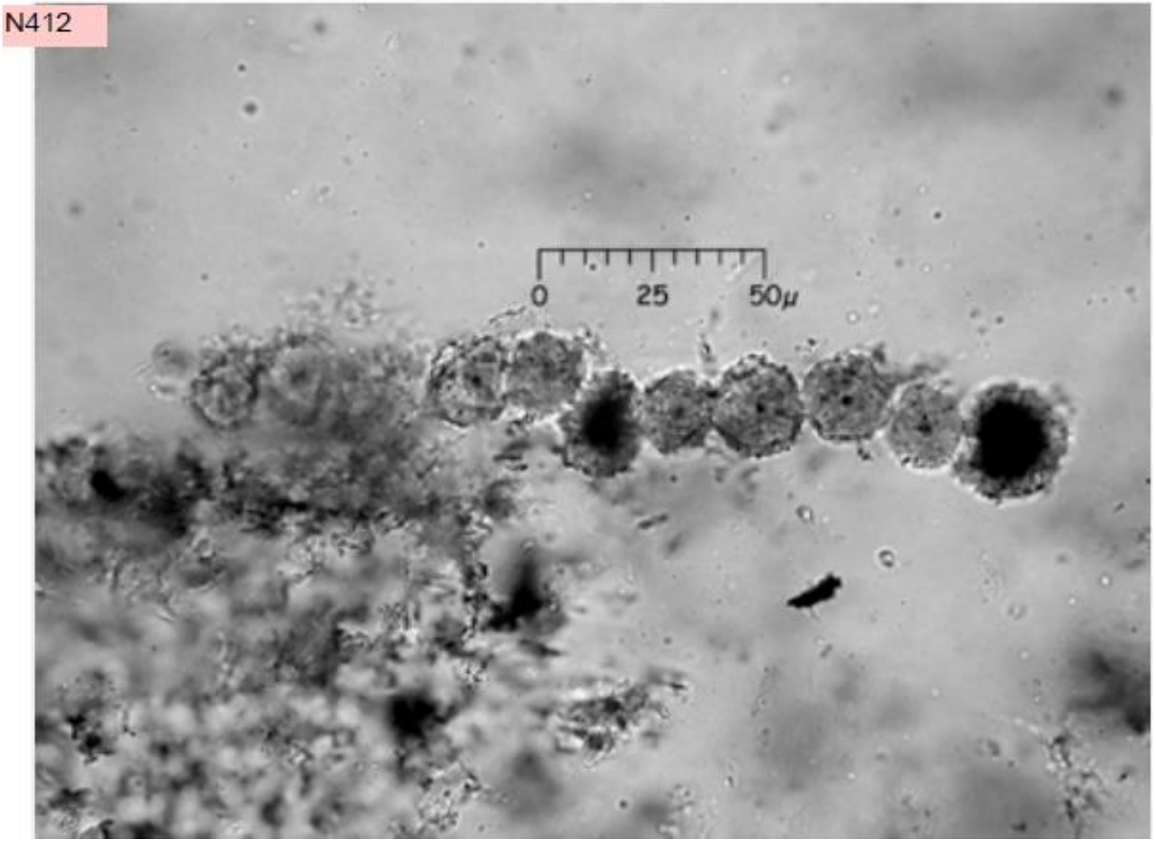


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna edulis

Phytolith

Canna produces smooth, rugulose, and irregularly folded and angled spheres. Diagnostic level (irregularly folded and angled): order Zingiberales



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna indica

Phytolith

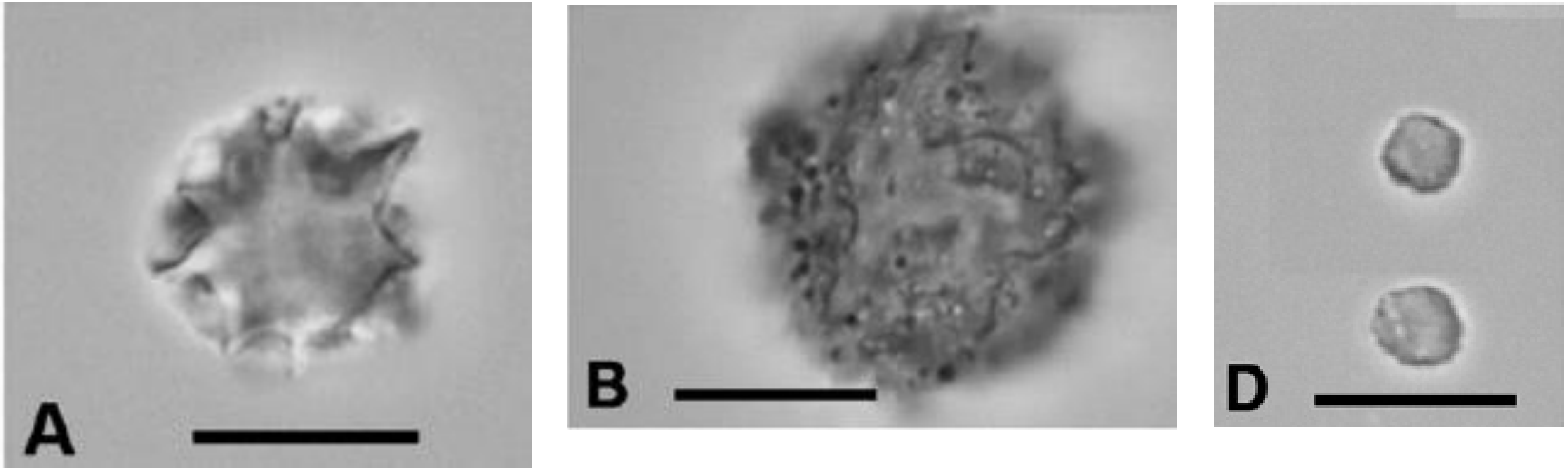


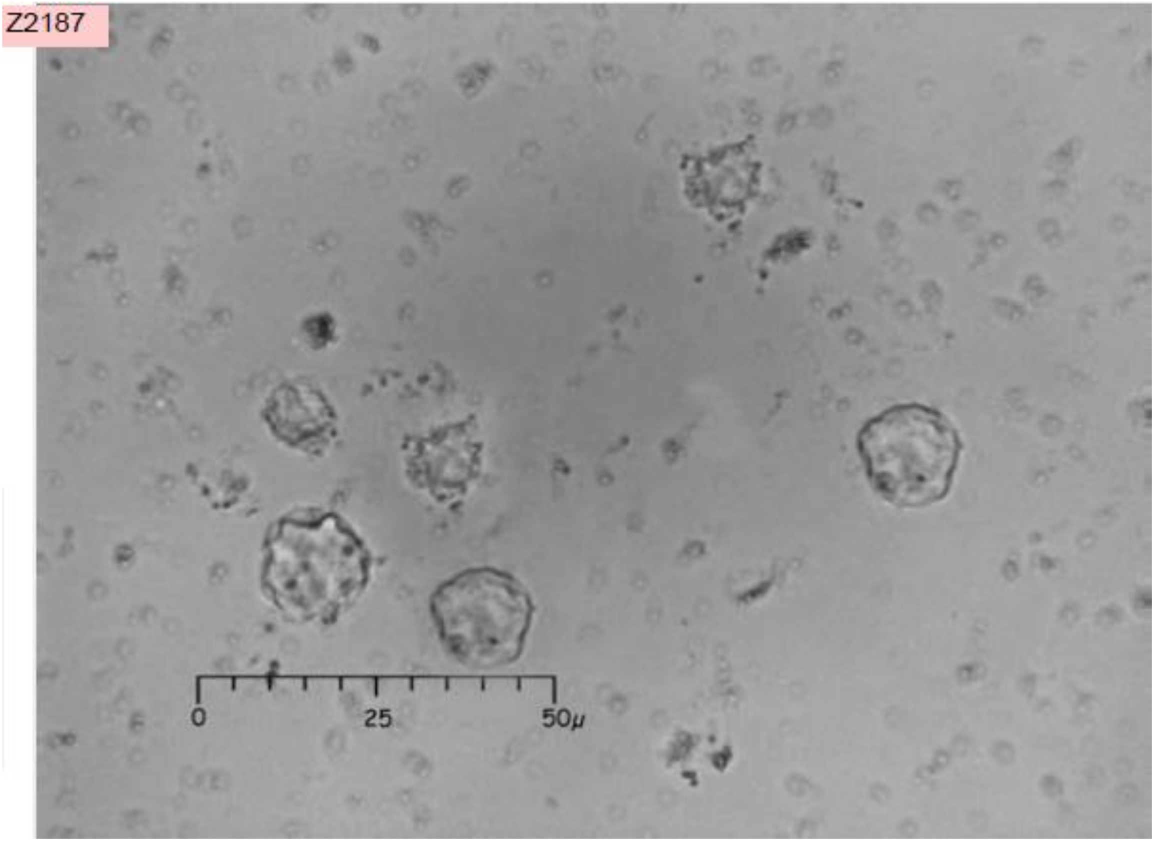
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). A,D1-type druse with small fringe from Canna indica leaf. B, granular D2-type druse from Canna indica leaf. D, globular-micropapillate from Canna indica seed. Scale bars: A–J,M–Z=12 µm; K, L=5 µm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Canna indica

Phytolith

PC1390, leaf. Contrast irregularly angled and folded spheres (80IEa left above scale bar) and rugulose spheres (80IBb right above scale bar).



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna indica

Starch

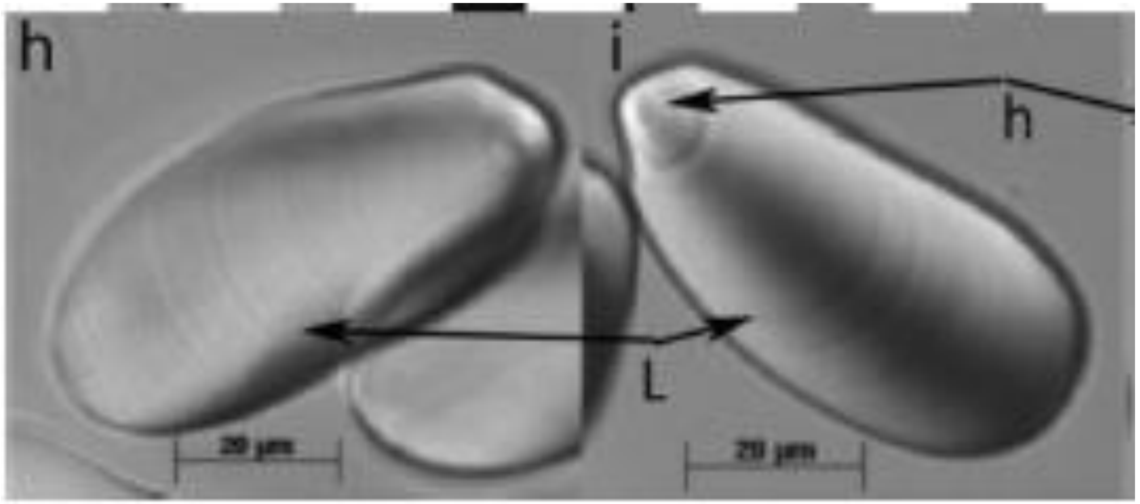
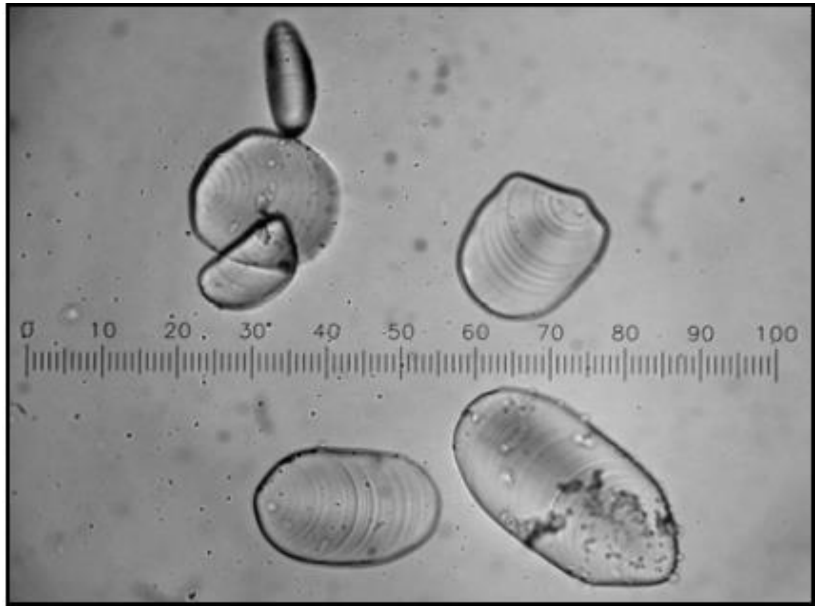


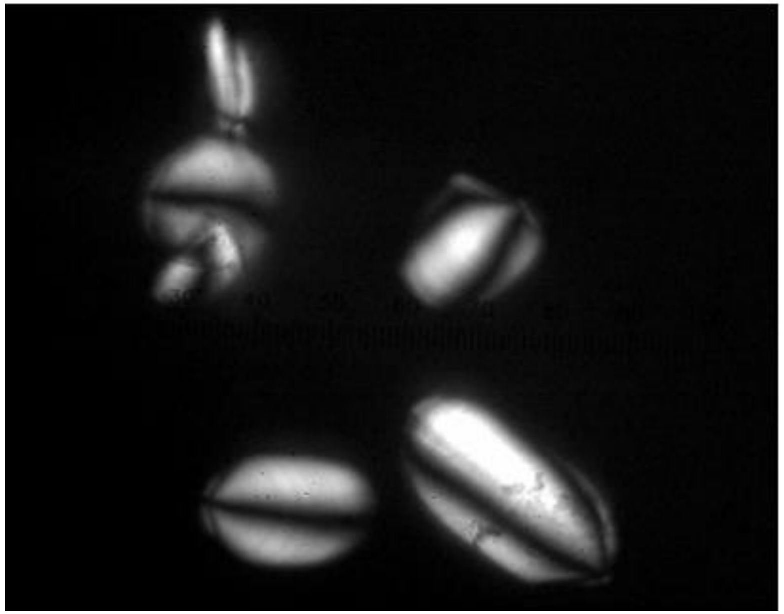
Fig. 9. Modern and unaltered Canna spp. starch grains comes from comparative species (Pagan-Jimenez, 2015): h-i, obovate starches (Canna indica, Ecuador).

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Canna indica

Starch

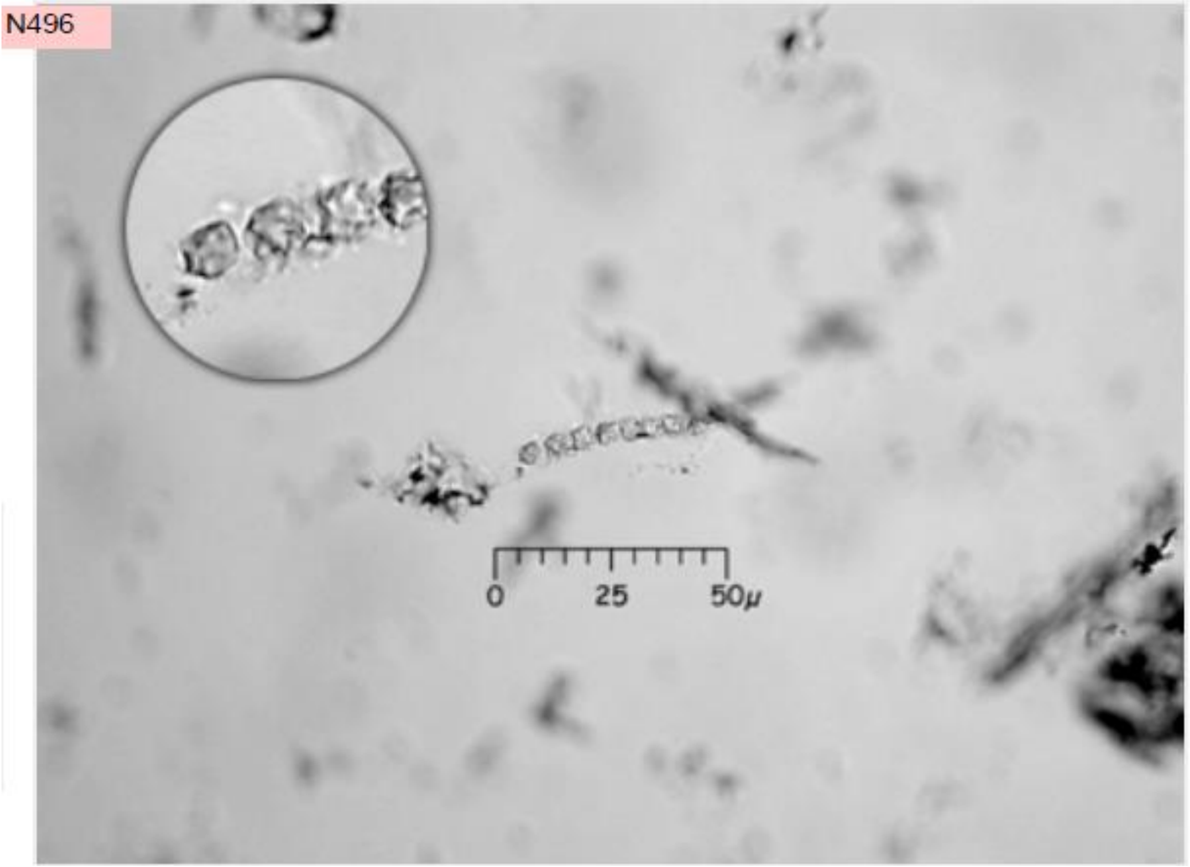




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Canna jaegeriana

Phytolith

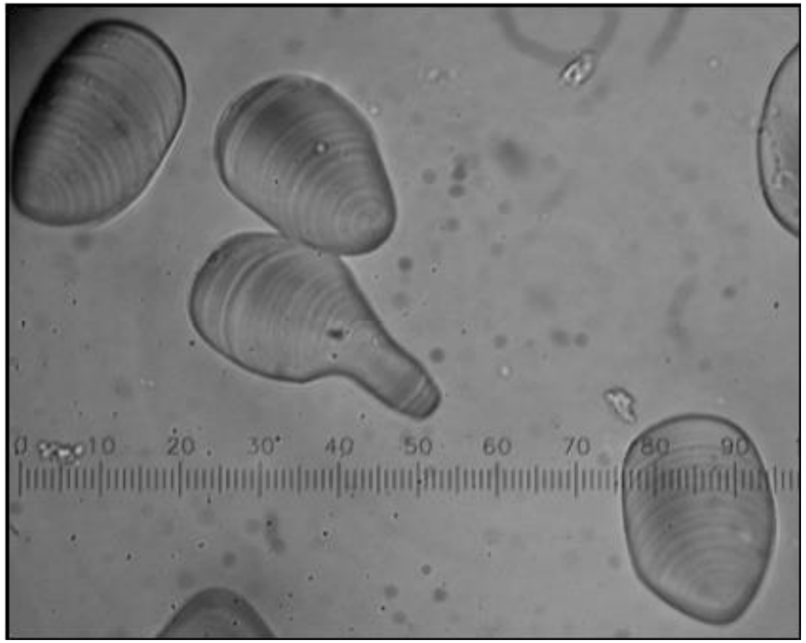


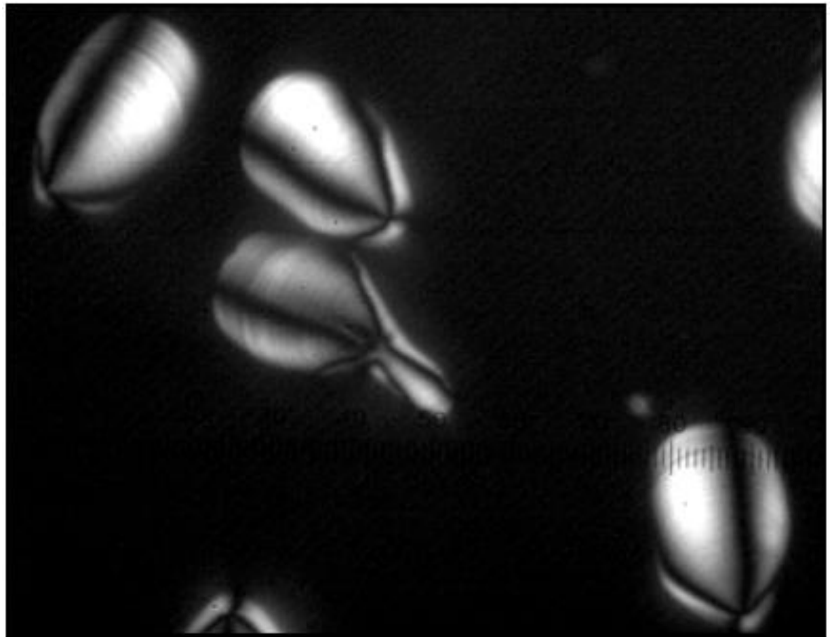
Small rugulose spheres (< 10 microns) that are well silicified (i.e., opaque). According to Iriarte and Piperno, characteristic of woody dicots. Also occur in Canna and Marantaceae. Diagnostic level: woody dicot, with above qualification

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna sylvestris

Starch

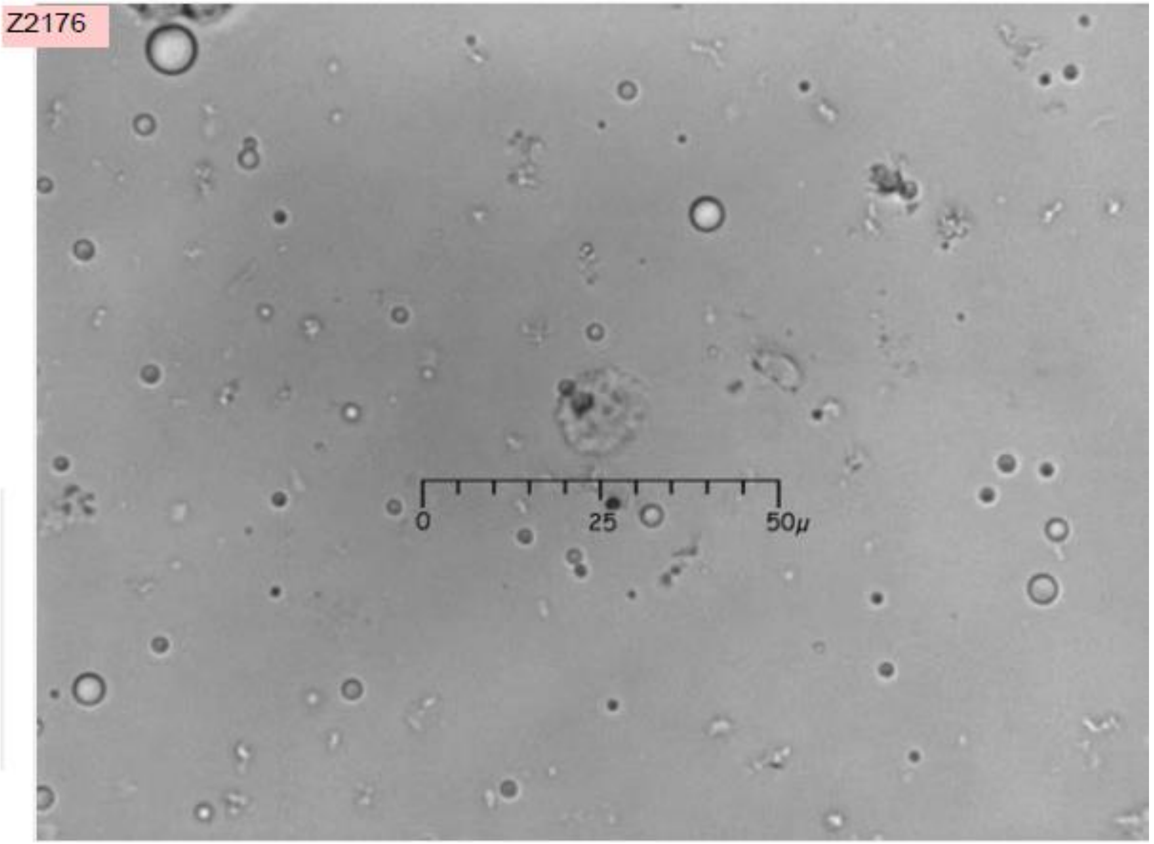




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Canna tuerckheimii (=edulis)

Phytolith



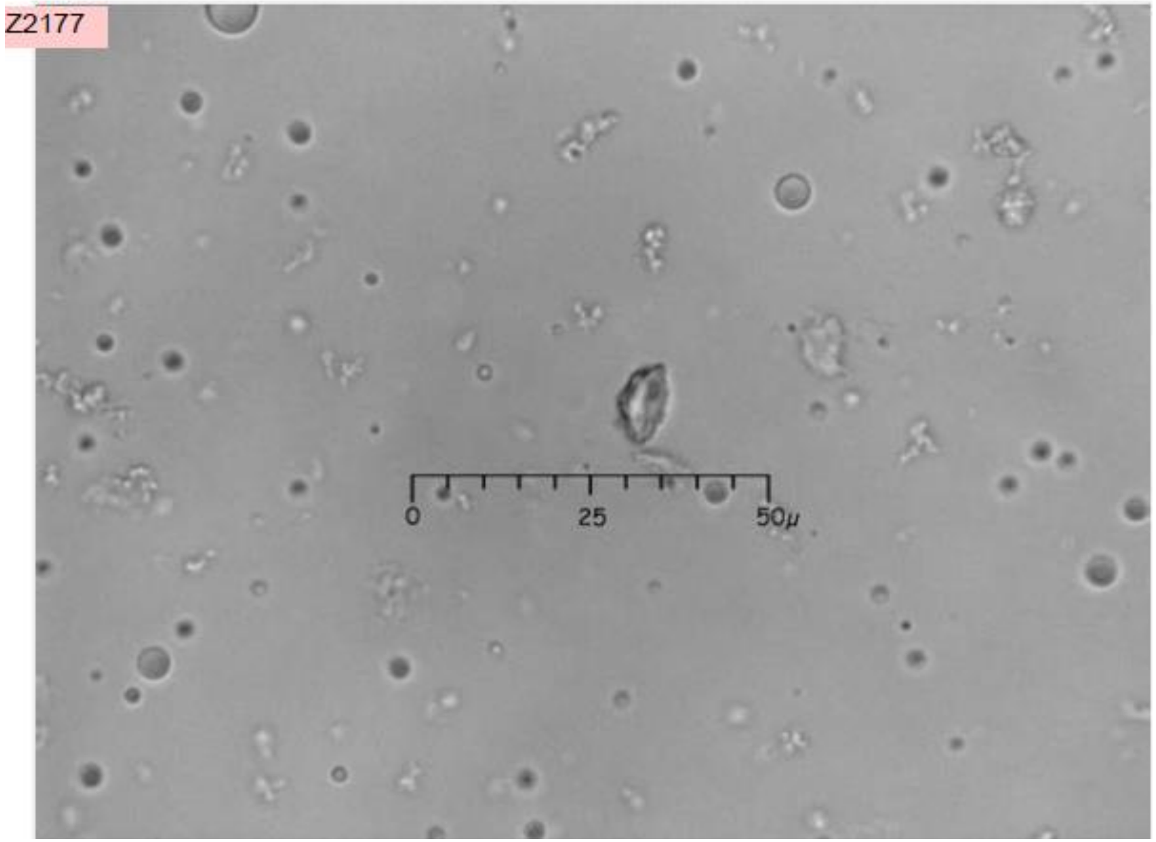
80IIIB has been considered is a Marantaceae family diagnostic. Occurs rarely in PC2127, Matisia cordata, Bombacaceae; VR in PC961 Canna tuerckheimii (epidermis) Marantaceae/Cannaceae/Bombacacea e mixed type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii (=edulis)

Phytolith

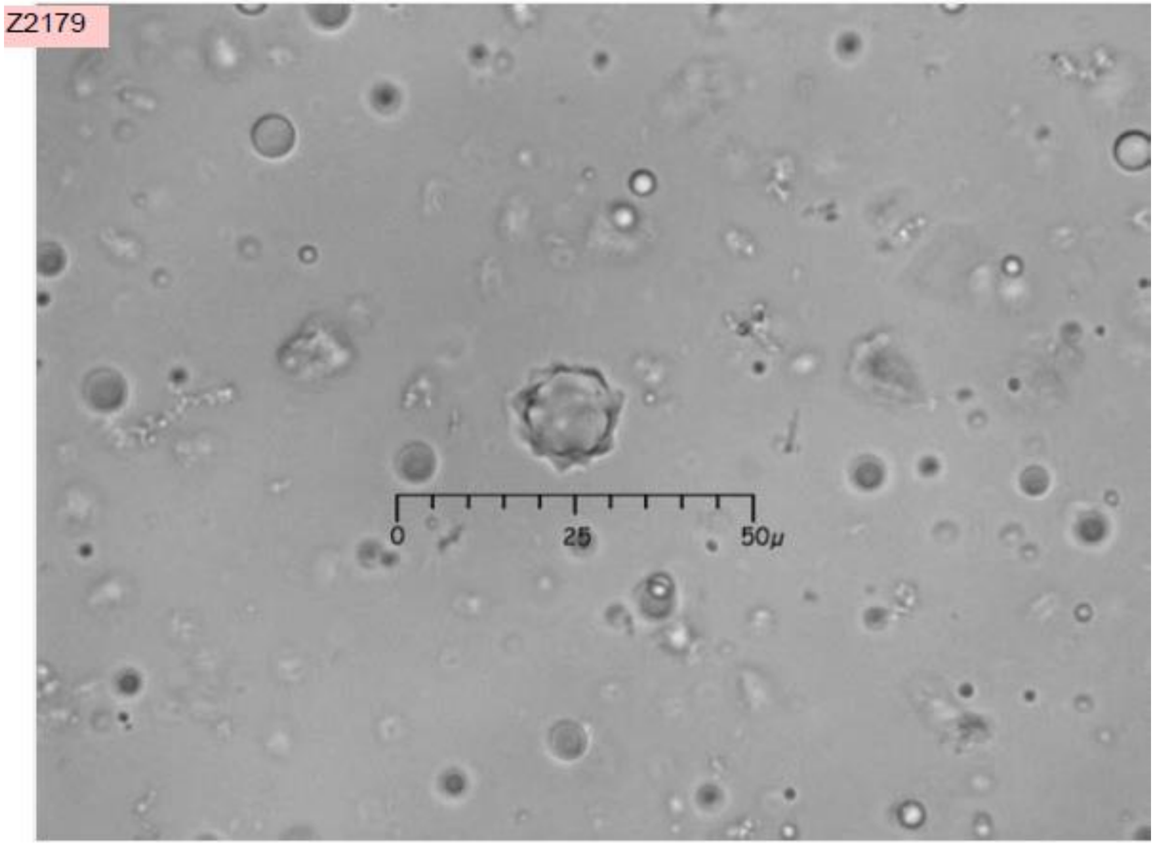
80IIIB has been considered is a Marantaceae family diagnostic. Occurs rarely in PC2127, Matisia cordata, Bombacaceae; VR in PC961 Canna tuerckheimii (epidermis) Marantaceae/Cannaceae/Bombacacea e mixed type



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii (=edulis)

Phytolith



PC961 (epidermis). Small nodular spheres, moderate in occurrence, variable in size and height of projections. This is a larger example, but smaller than 18 microns. Compare to 80ICc, 80ICa2. Overlaps with Marantaceae/Bombacaceae type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii (=edulis)

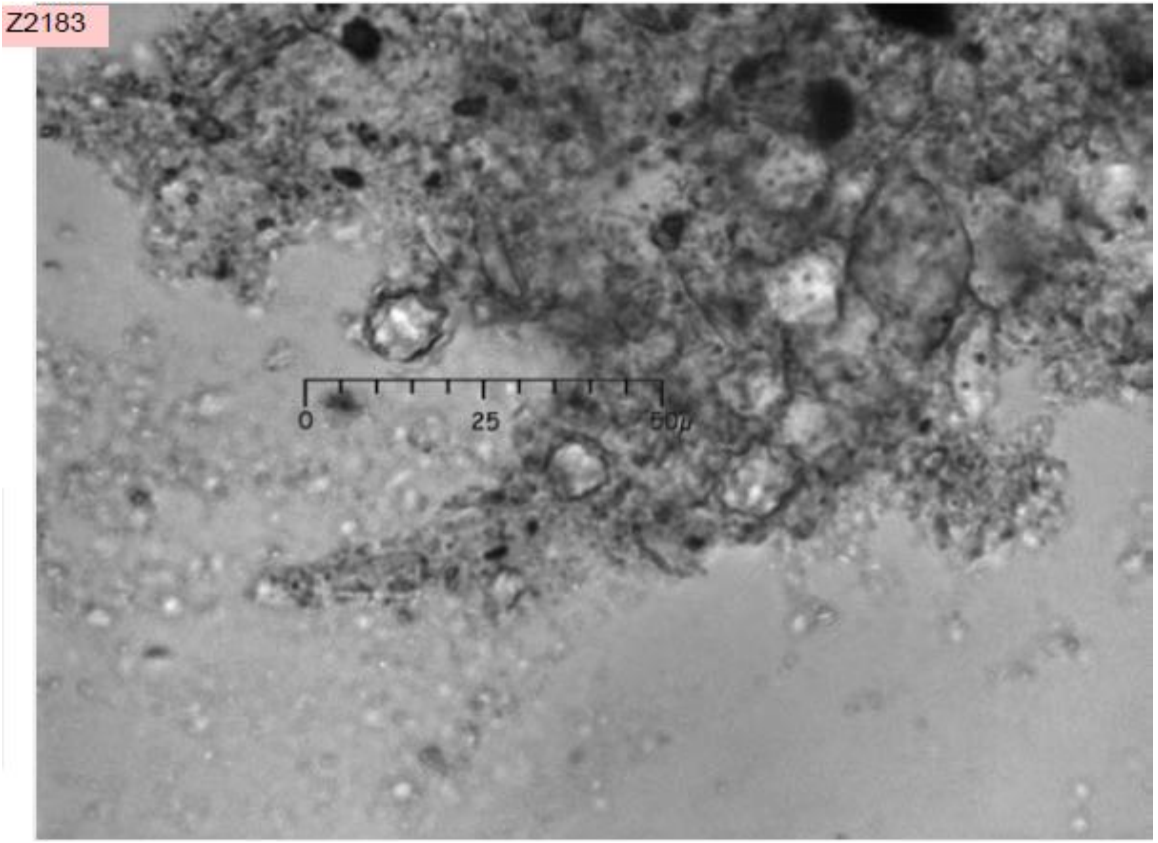
Phytolith

PC961 (epidermis). Nodular spheres moderate in occurrence, variable in size and height of projections. Compare to 80ICc, 80ICa2.
Overlaps with Marantaceae/Bombacaceae type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii (=edulis)

Phytolith

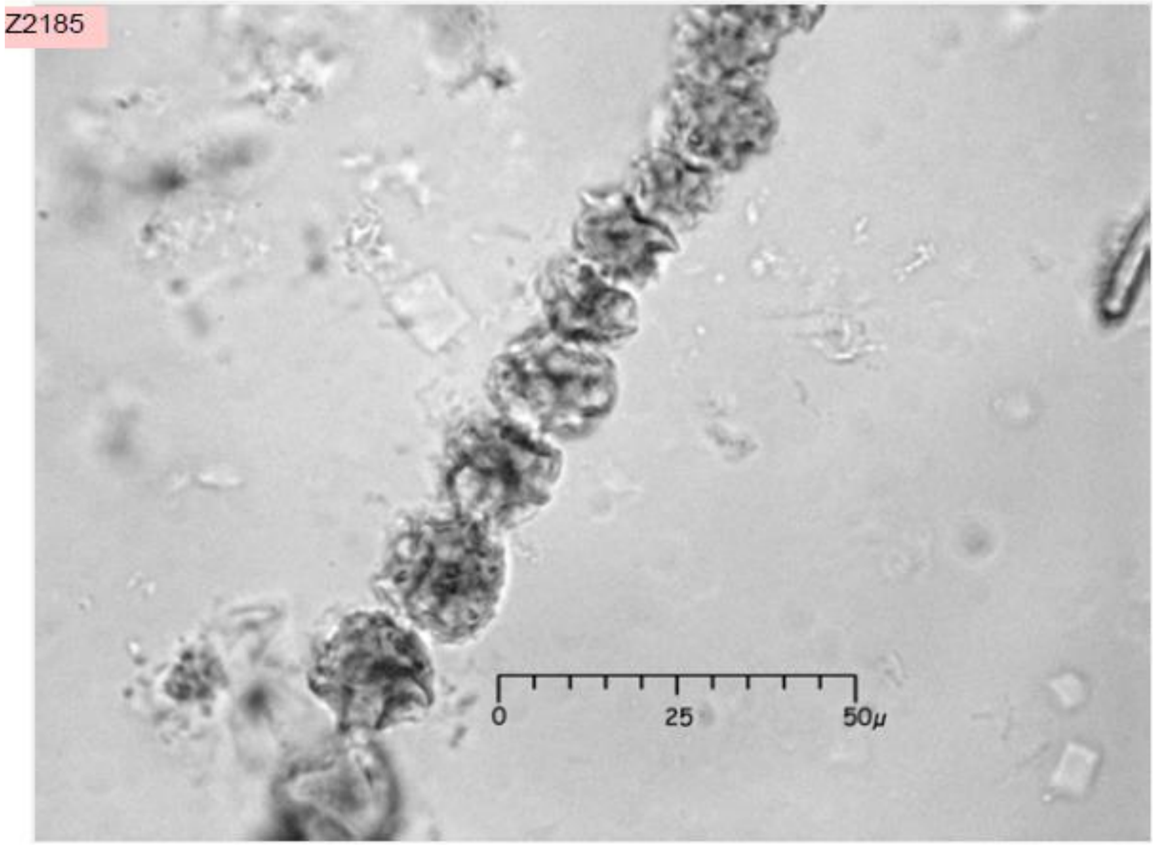


PC2592, seed. Folded and angled spheres in situ in tissue. Typical size is 10-15 microns.
Diagnostic: Zingiberales

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii (=edulis)

Phytolith



OS511, leaf. Chain of irregularly folded/angled spheres
Diagnostic: Zingiberales

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canna tuerckheimii

Starch

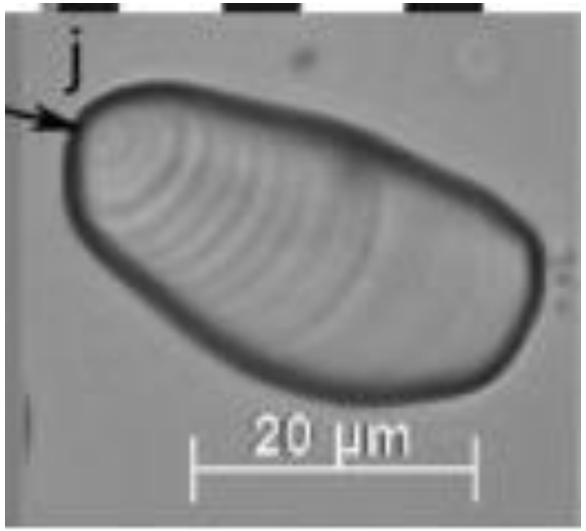


Fig. 9. Modern and unaltered Canna spp. starch grains comes from comparative species (Pagan-Jimenez, 2015): j, obovate starch (Canna tuerckheimii, Ecuador).

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Canna sp.

Phytolith

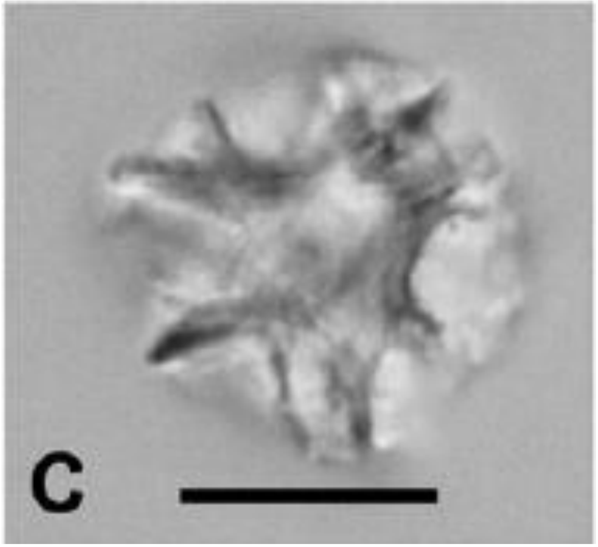


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). C,D1-type druse with fringe from Canna sp. rhizome. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Canna spp.

Starch

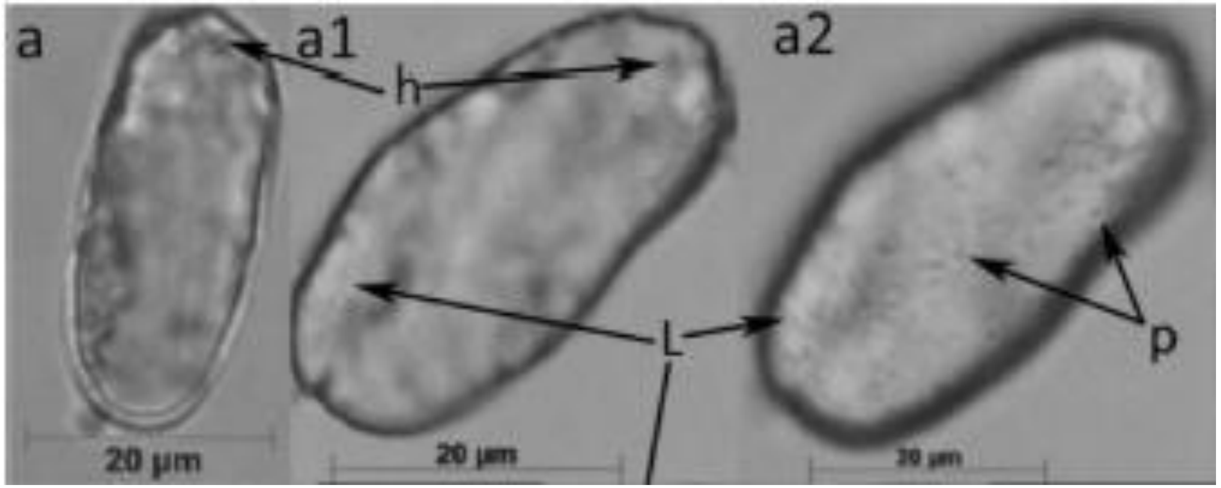


Fig. 9. Other ancient starch grains (a-g) recovered at St. John and Eva 2. a-a2, Canna spp. obovate starch with rough surface (in a), with partial view of the hilum (or “h” in a-a1), with partial and diffuse view of the lamellae (or “L” in a1-a2), and pits (or “p”, in a2) over the surface when re-focused.

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Canna sp.

Starch

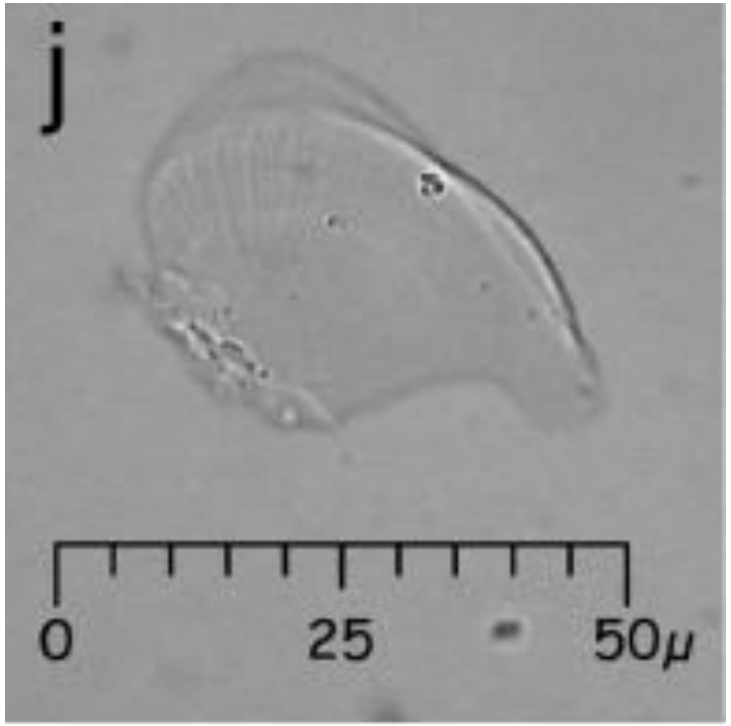


Fig. 5. Selected phytoliths and starch granules recovered from tools. See MU Phytolith website (http://www. missouri.edu/~phyto) for other photographs j. Broken Canna starch granule, SS15 FS3290-A. k.

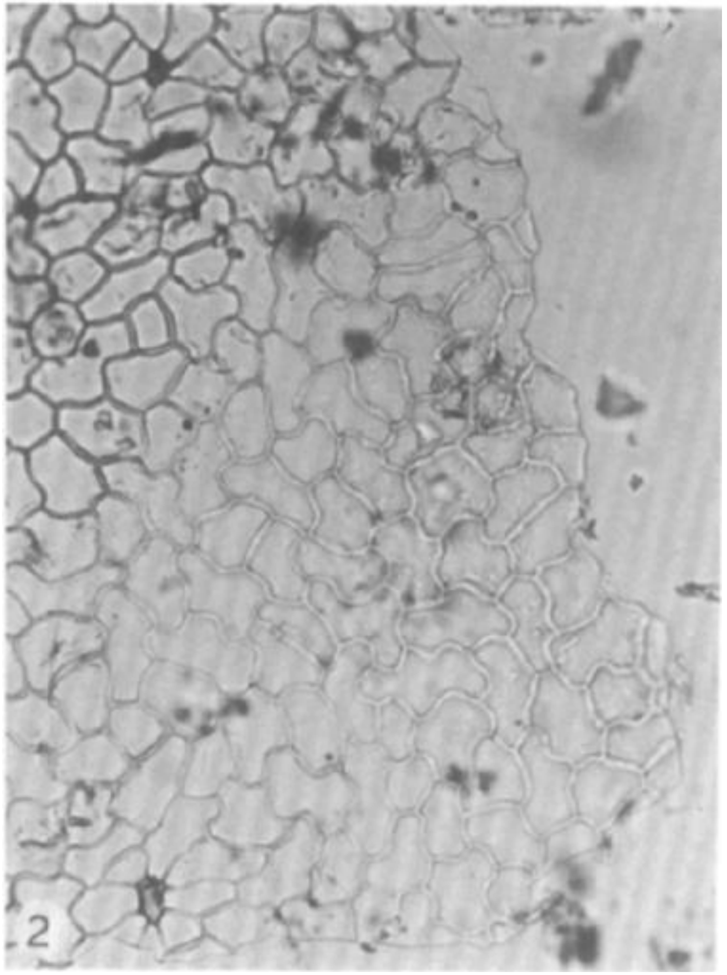
Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

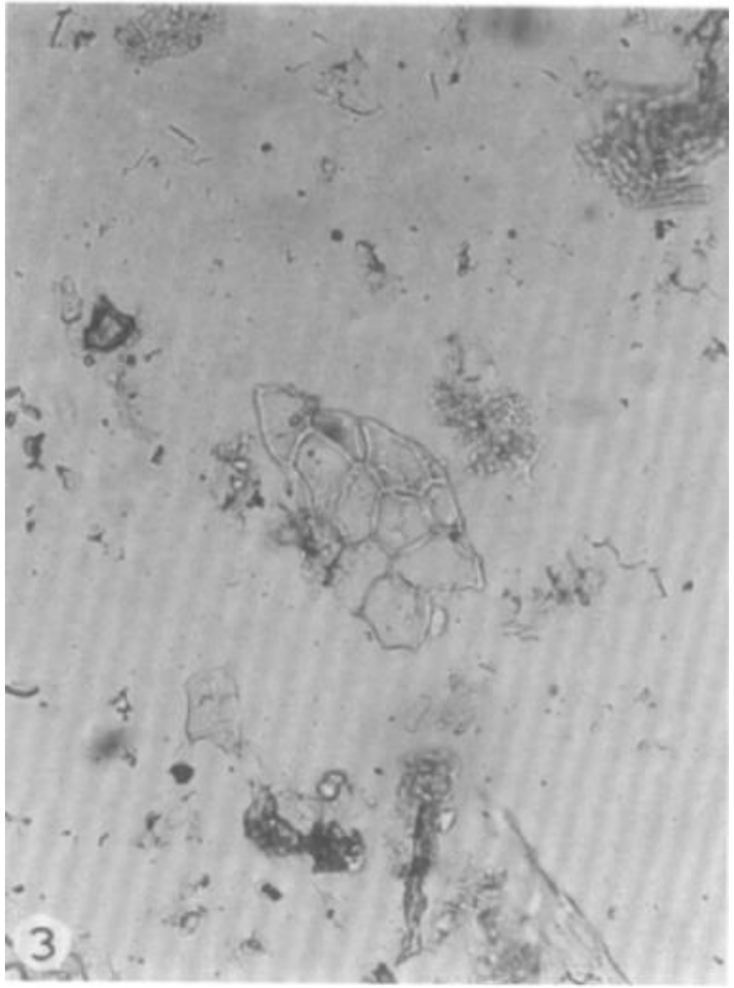
CHLORANTHACEAE

Hedyosmum sp.

Phytolith

2. Anticlinal epidermis from Hedyosmum (400 x).
3. Polyhedral epidermis from Hedyosmum (400 x).



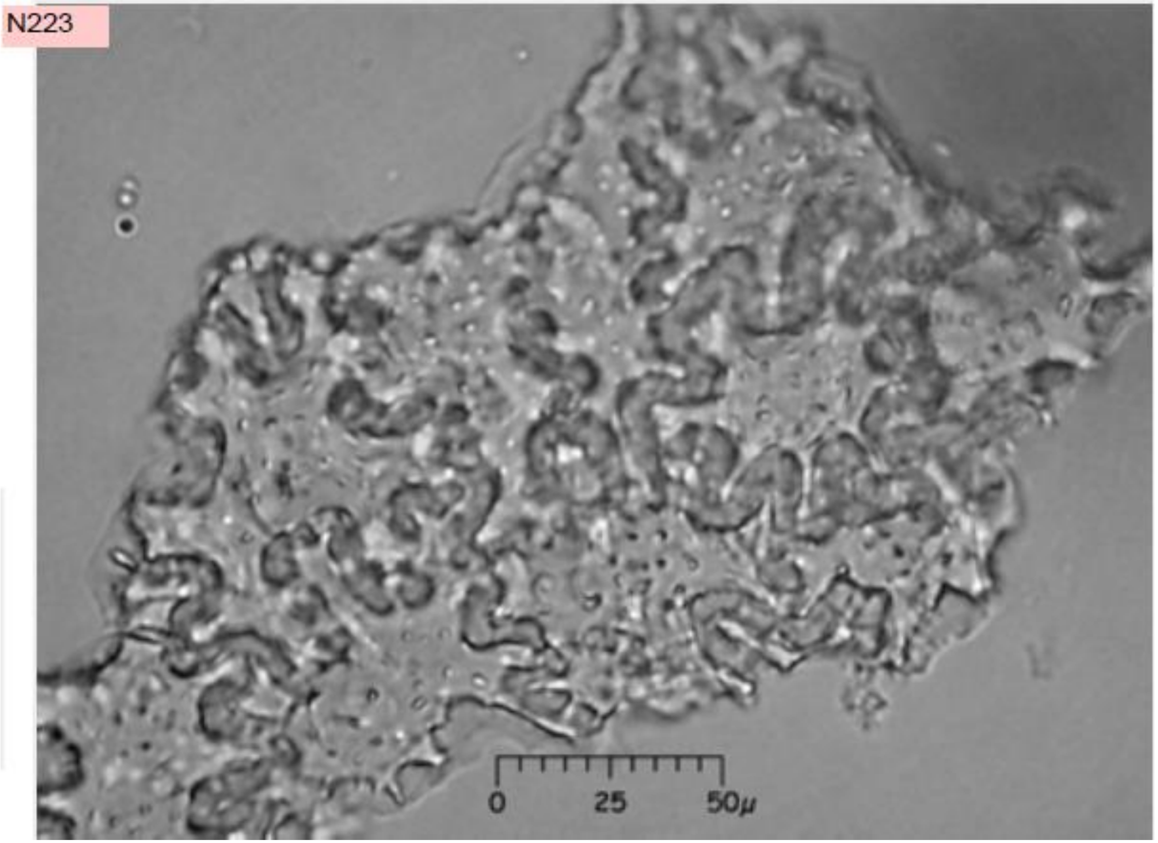


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Hedyosmum goudotianum

Phytolith

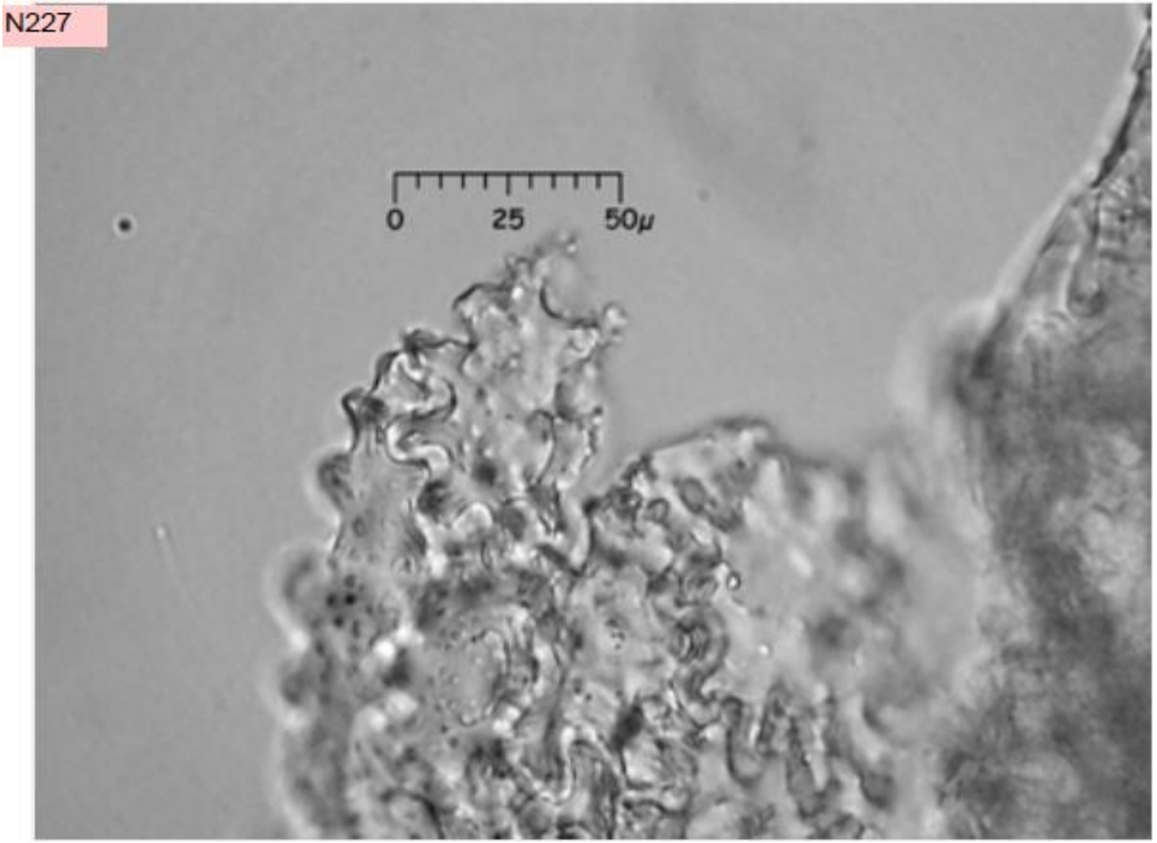
Note how robust and thick bodies are.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Hedyosmum goudotianum

Phytolith



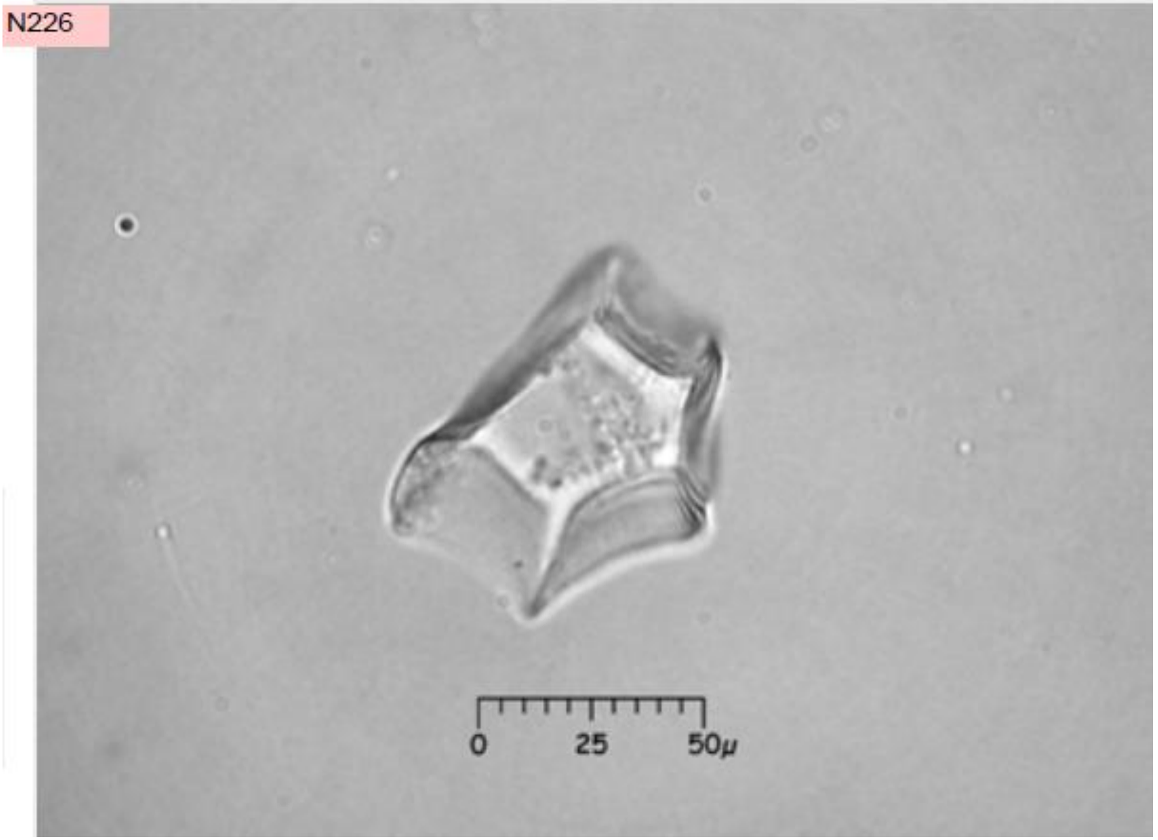
Note that bodies are not flat or smooth in rotation. In this view, they are almost "puffed" and irregularly thick. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Hedyosmum goudotianum

Phytolith

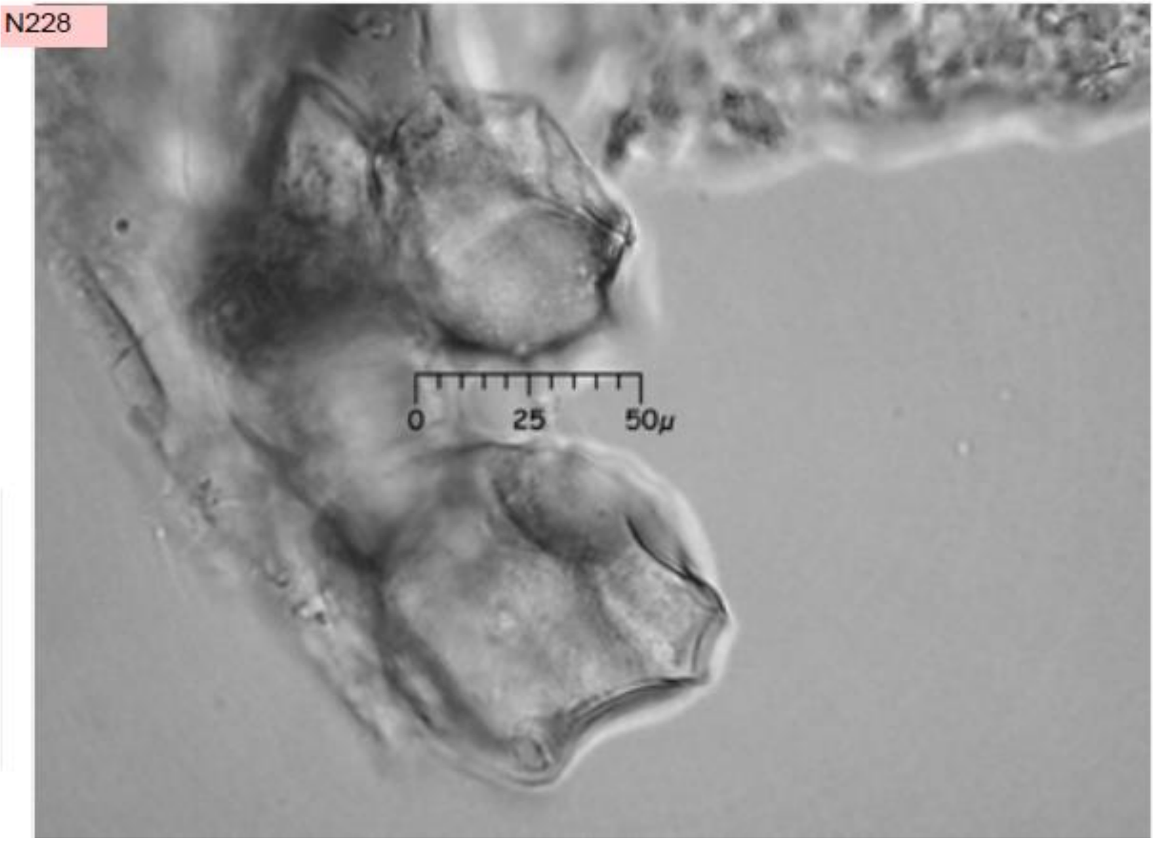
Note large size of these polyhedral bodies.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Hedyosmum goudotianum

Phytolith



Note large size of these polyhedral bodies. See double outline of "plates" or faces on polyhedron. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

CHRYSOBALANACEAE

Chrysobalanus icaco

Phytolith

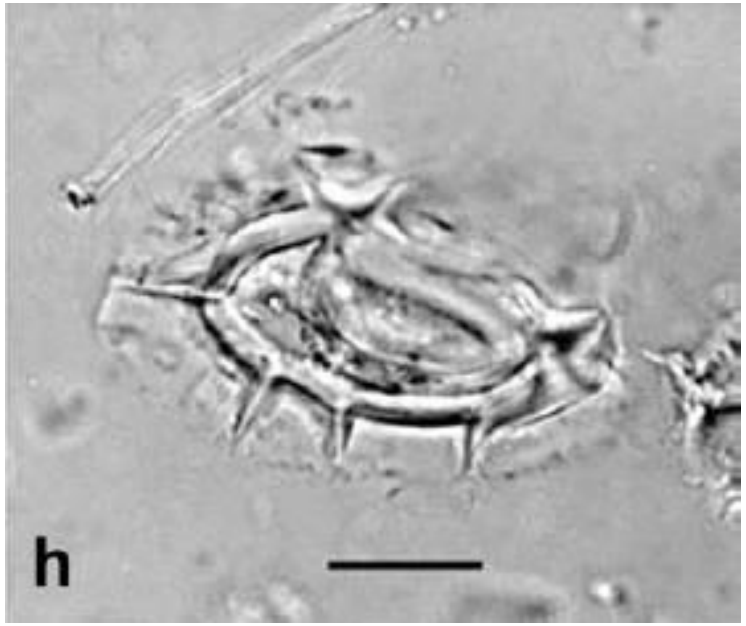
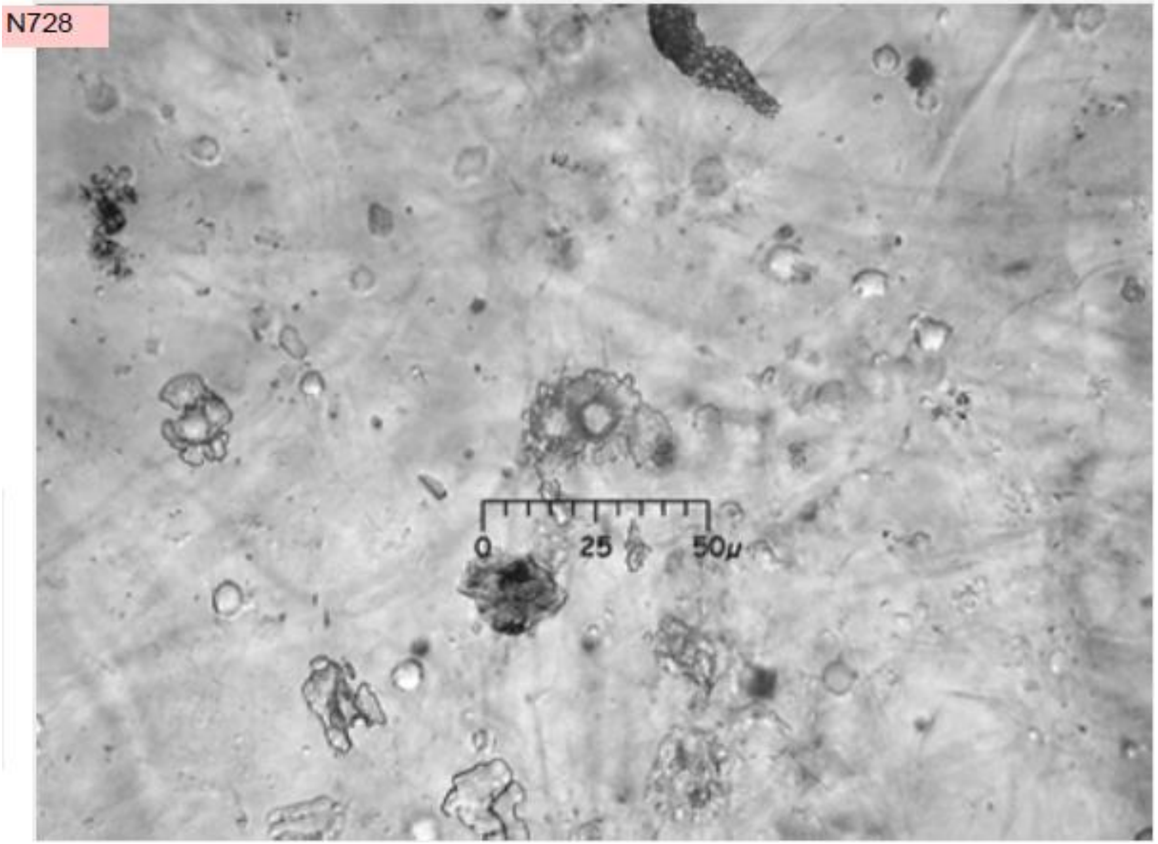


Fig. 2. Phytoliths with little or no taxonomic value. h) Hair base from Chrysobalanus icaco leaf

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Chrysobalanus icaco

Phytolith



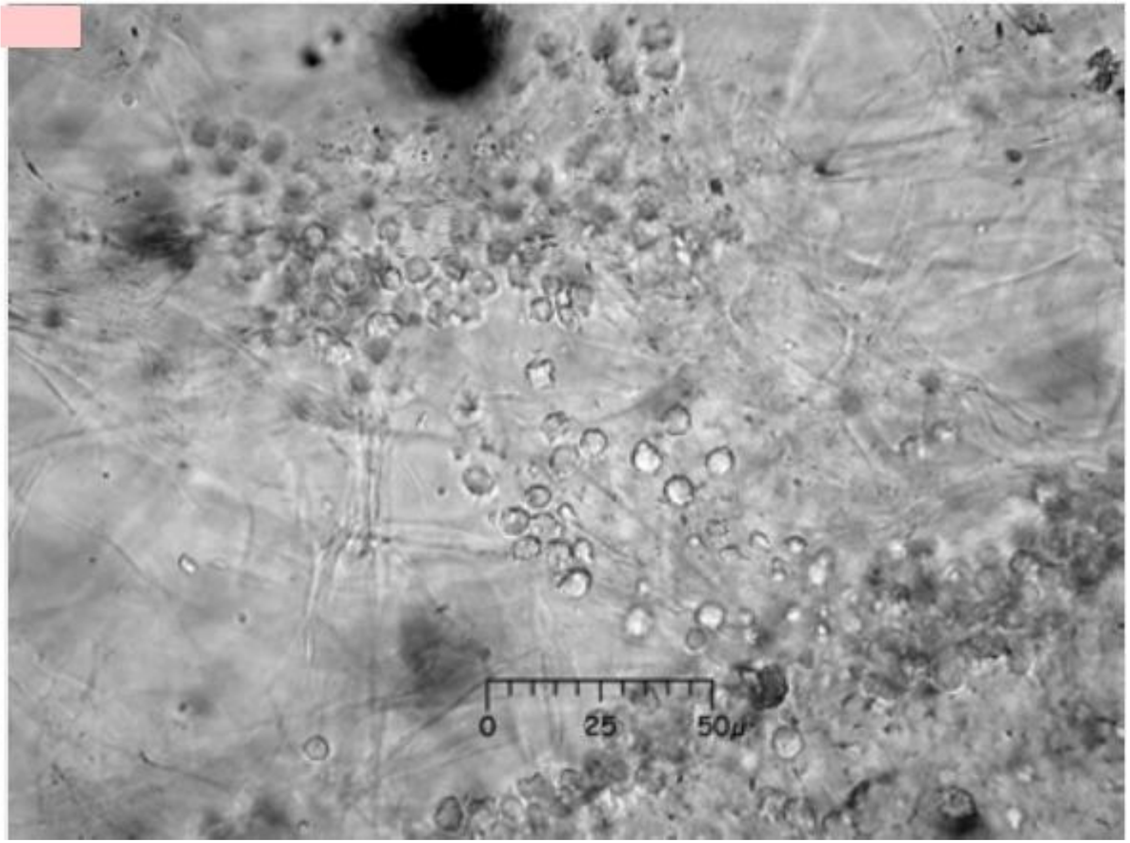
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: not diagnostic
Entered by Updated
Karol Chandler-Ezell 10/7/2002

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Chrysobalanus icaco

Phytolith

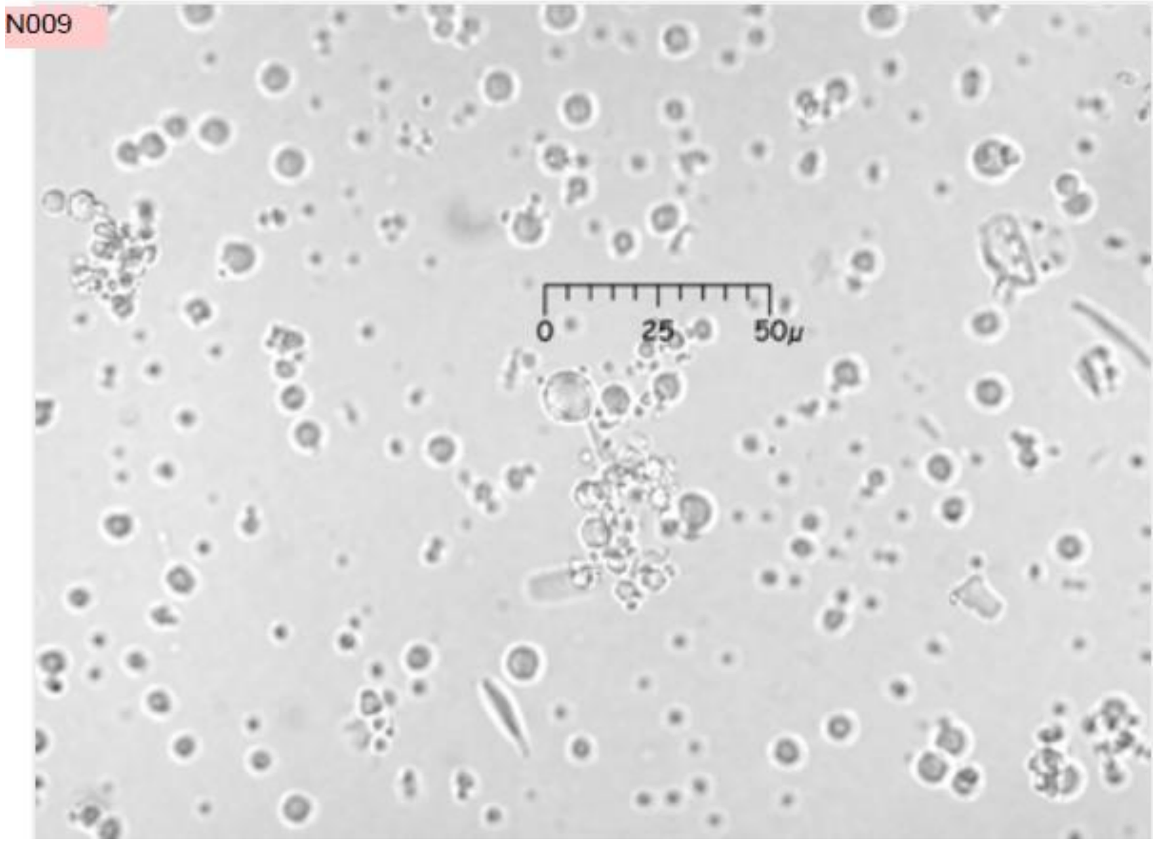
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: fruit/seed



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Hirtella carbonaria

Phytolith



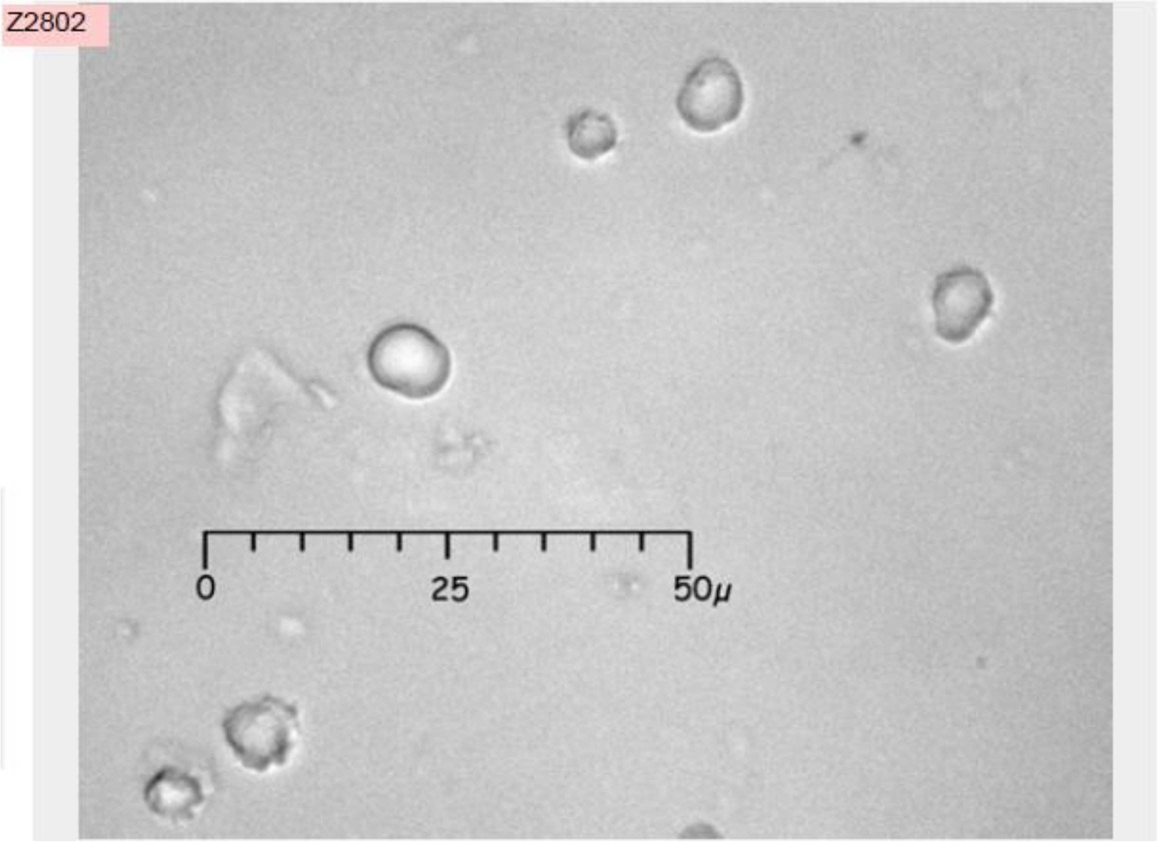
Sphere, small. Often very difficult to notice in archaeological samples. Also produced in Canna, Bixa orellana. Diagnostic level: mixed: Chrysobalanaceae/Cannaceae/Bixa

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Hirtella carbonaria

Phytolith

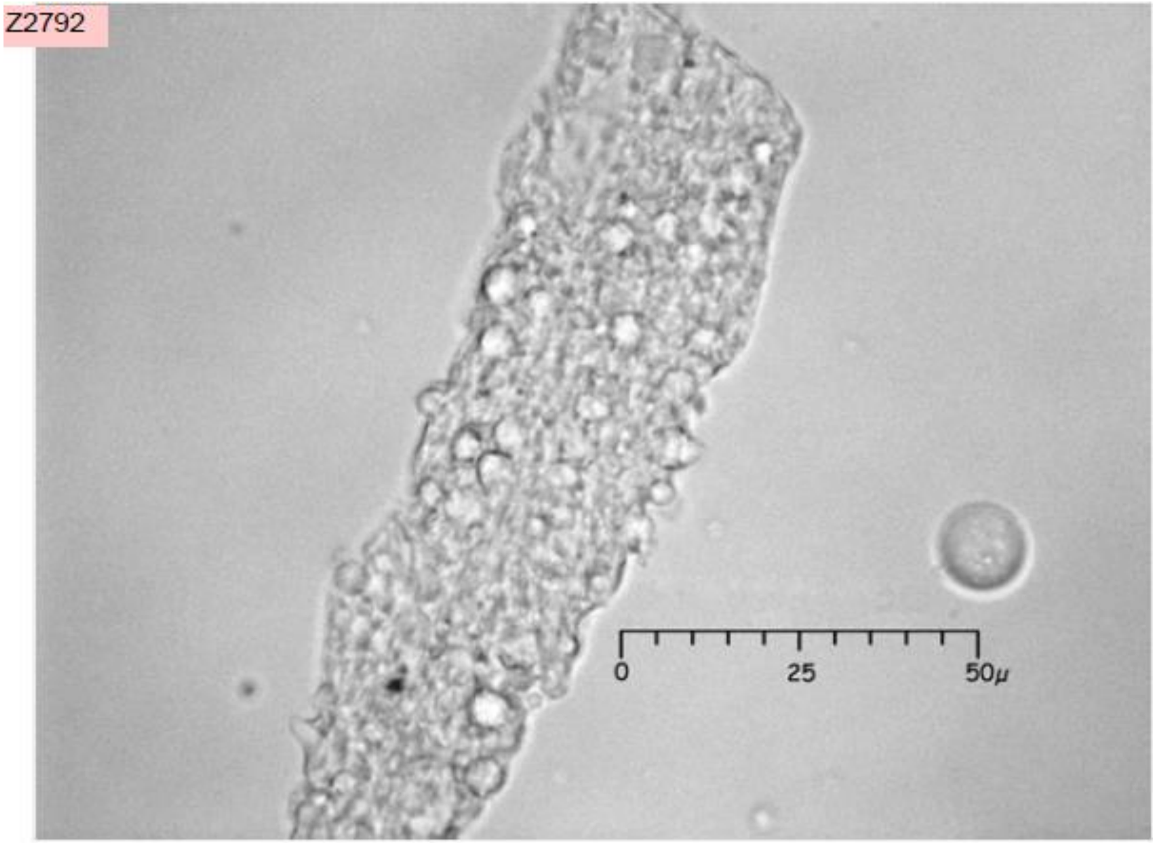
A very smooth example of 80IAa1 that appears to be two conjoined disks, as in the original description of the Chrysobalanaceae type by Piperno. Appear somewhat elongated. Chrysobalanaceae/Cannaceae mixed type



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Licania celiae

Phytolith

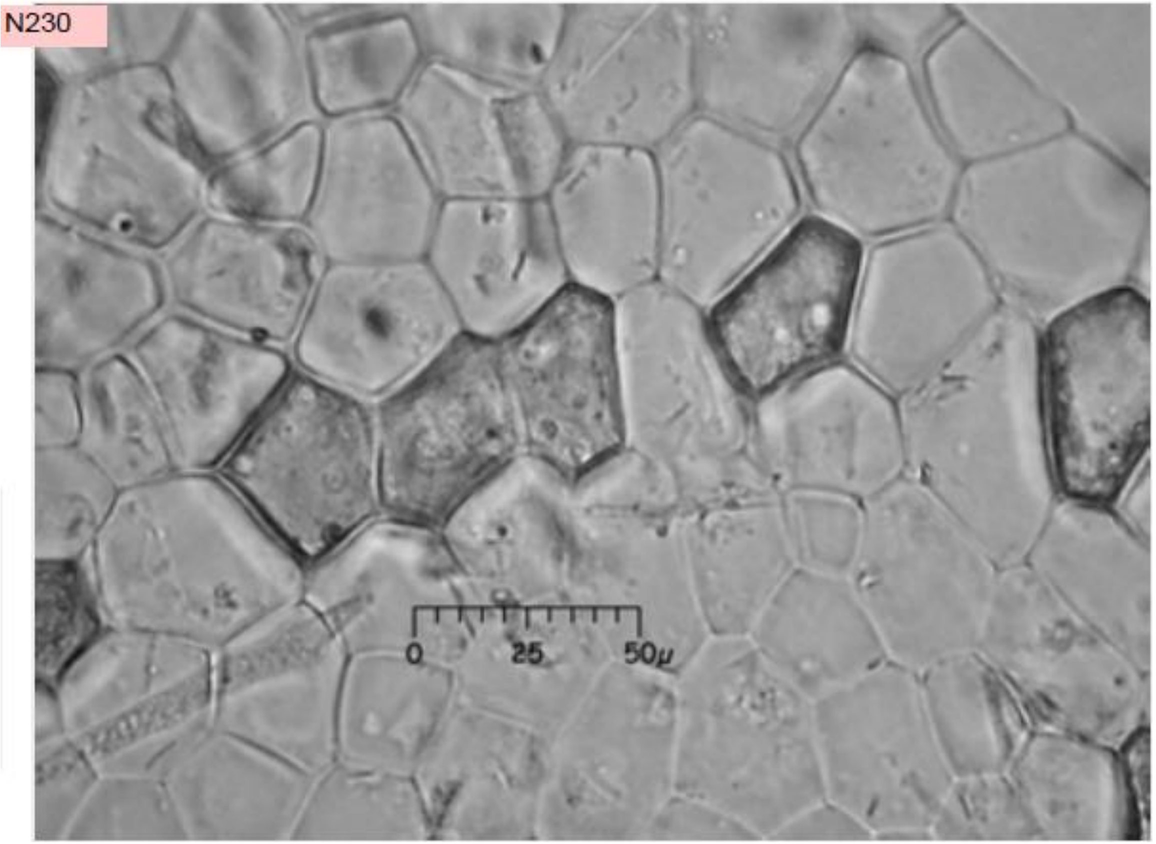


A sheet of 80IAa1. Spheres are not completely smooth. Chrysobalanaceae/Cannaceae mixed type

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Licania longistyla

Phytolith



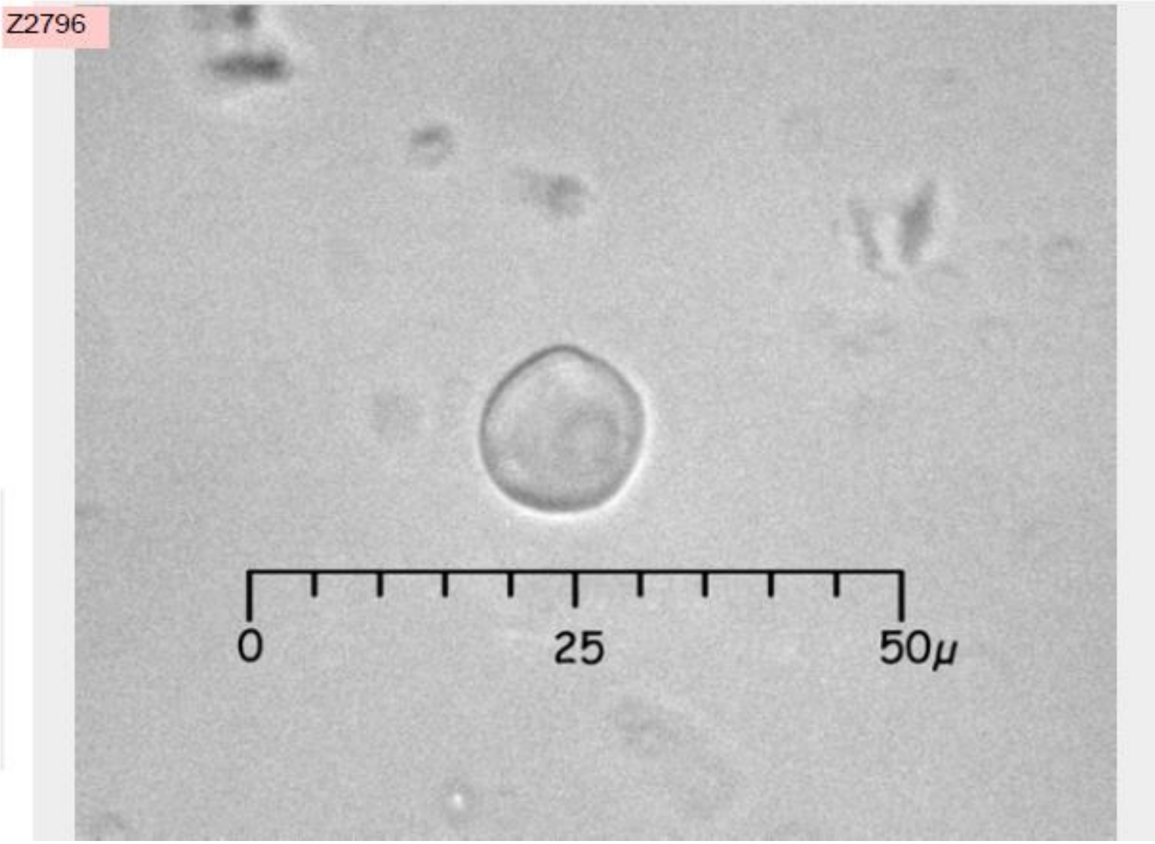
Darkened cells in center of image.
Diagnostic level: dicot epidermis

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Licania longistyla

Phytolith

80IAa1 showing slight irregularity on edge. Slightly flattened in rotation. The irregularity can look like an inclusion until the sphere is rotated.
Chrysobalanaceae/Cannaceae mixed type

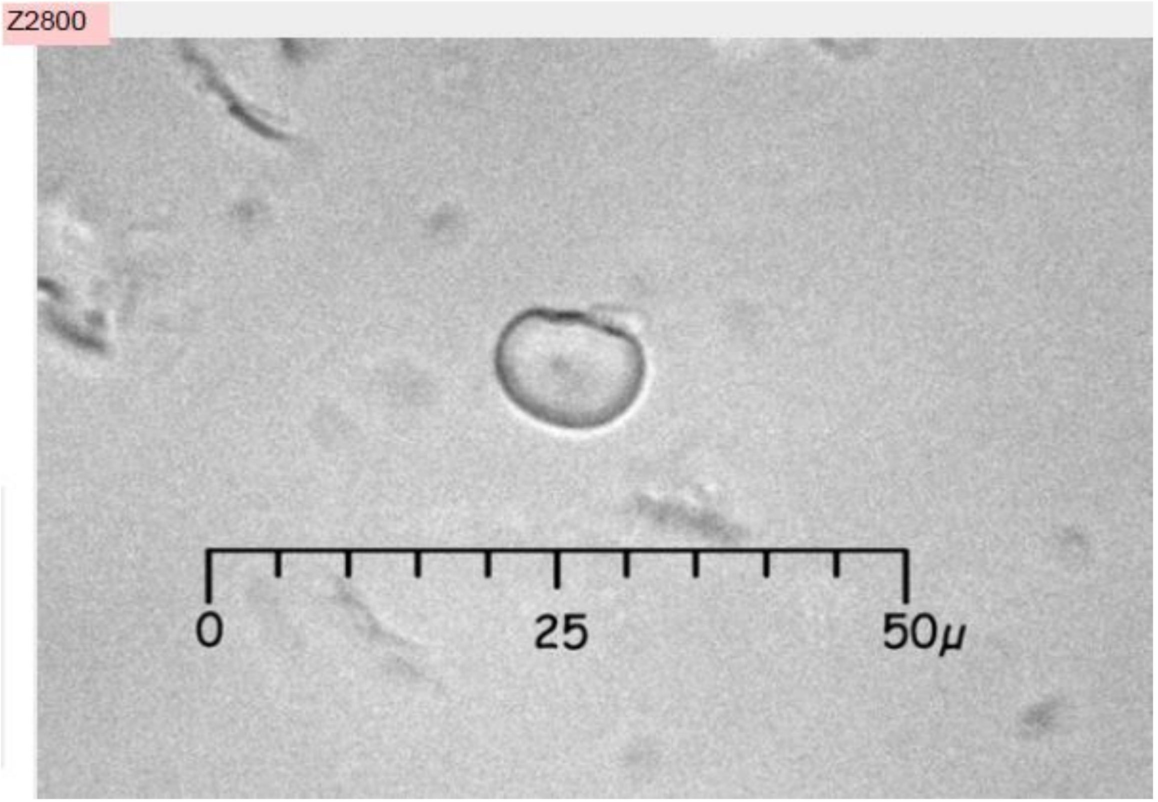


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Licania longistyla

Phytolith

Same 80IAa1 sphere as image Z2796 rotated to show the slight flattening and irregularity. Chrysobalanaceae/Cannaceae mixed type

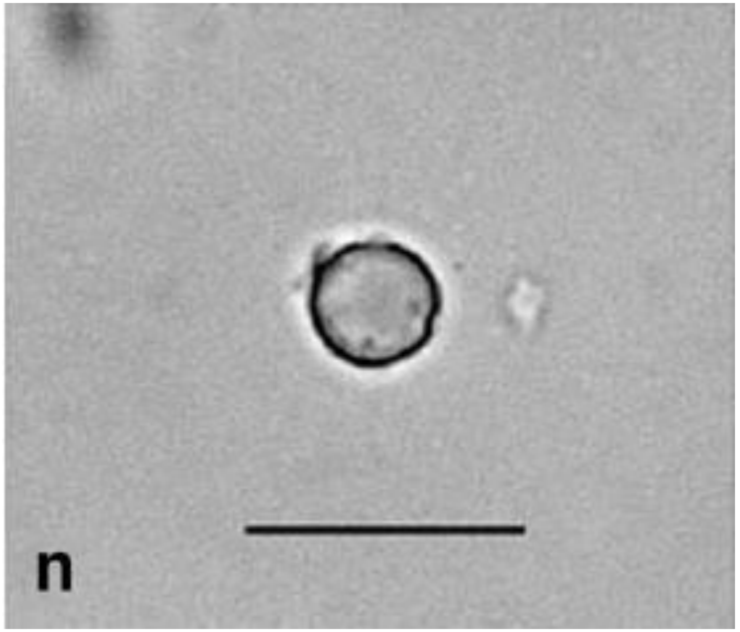


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Licania macrophylla

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. n) Globular psilate phytolith from Licania macrophylla

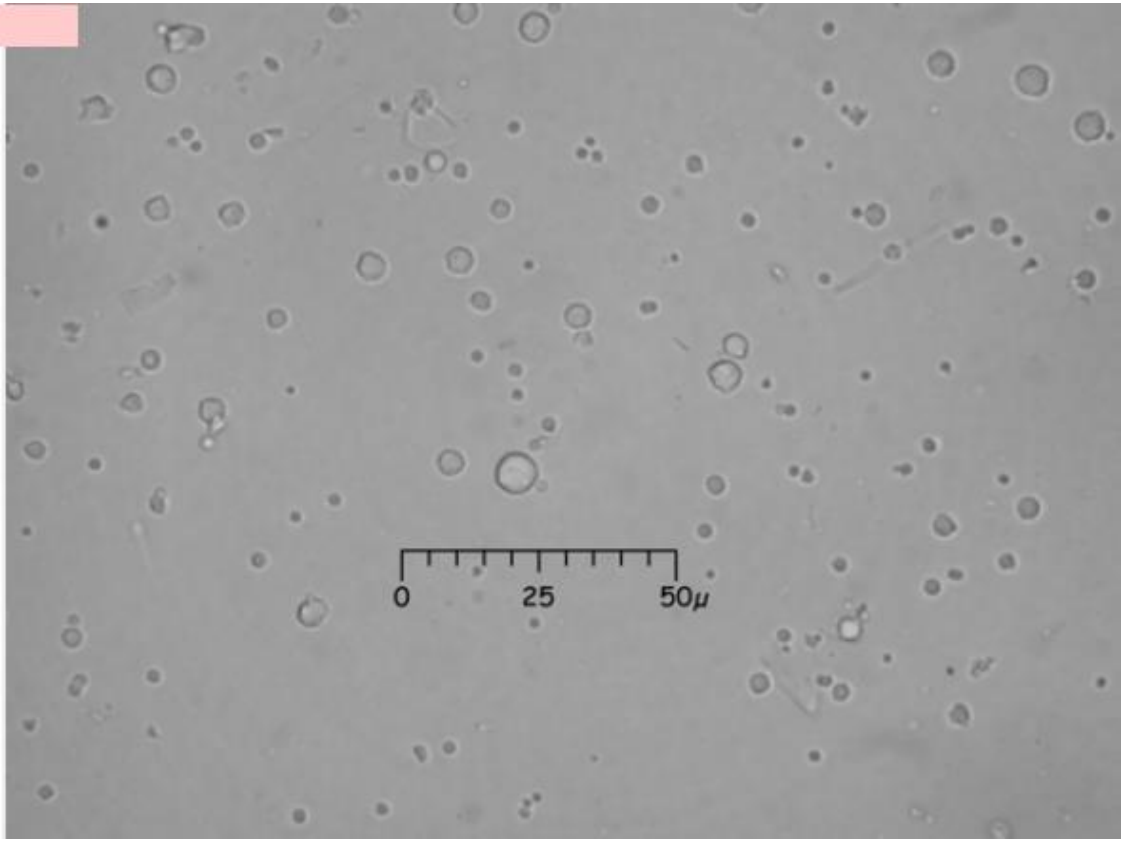


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Licania platypus

Phytolith

Sphere, small. Often very difficult to notice in archaeological samples.
Also produced in Canna, Bixa.
Diagnostic level: mixed, Chrysobalanaceae/Canna/Bixa
Description



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Parinari campestris

Phytolith

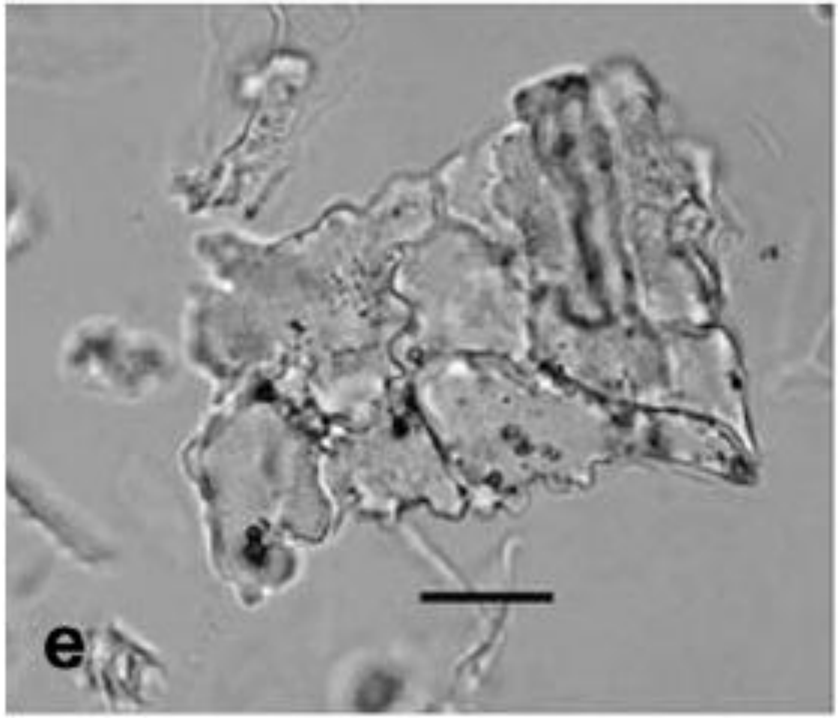


Fig. 2. Phytoliths with little or no taxonomic value. e) Thick, irregular polyhedrals from Parinari campestris

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

CLUSIACEAE

Clusia nemorosa

Phytolith

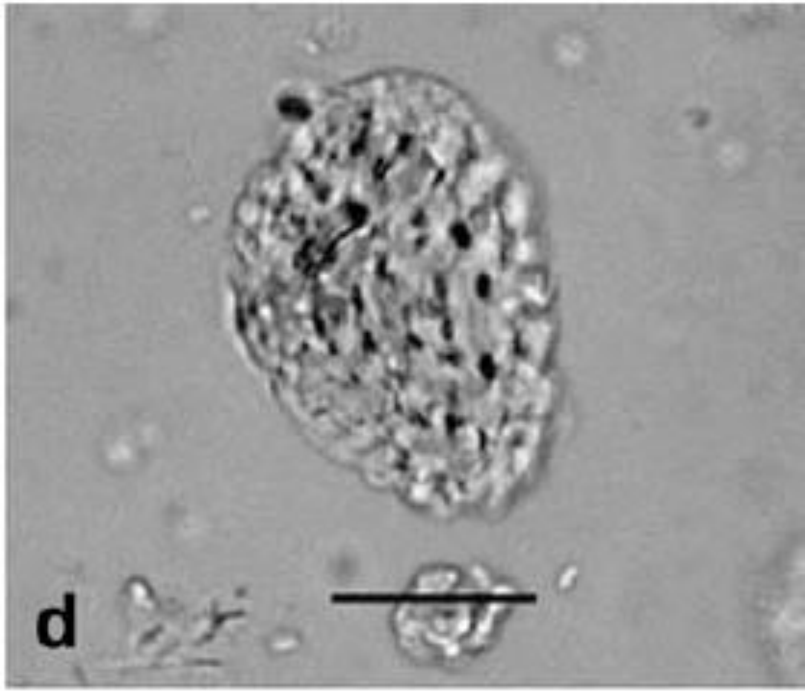


Fig. 2. Phytoliths with little or no taxonomic value. d) Decorated epidermis from Clusia nemorosa

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

COMBRETACEAE

Conocarpus erecta

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. i) Hair base from Conocarpus erecta

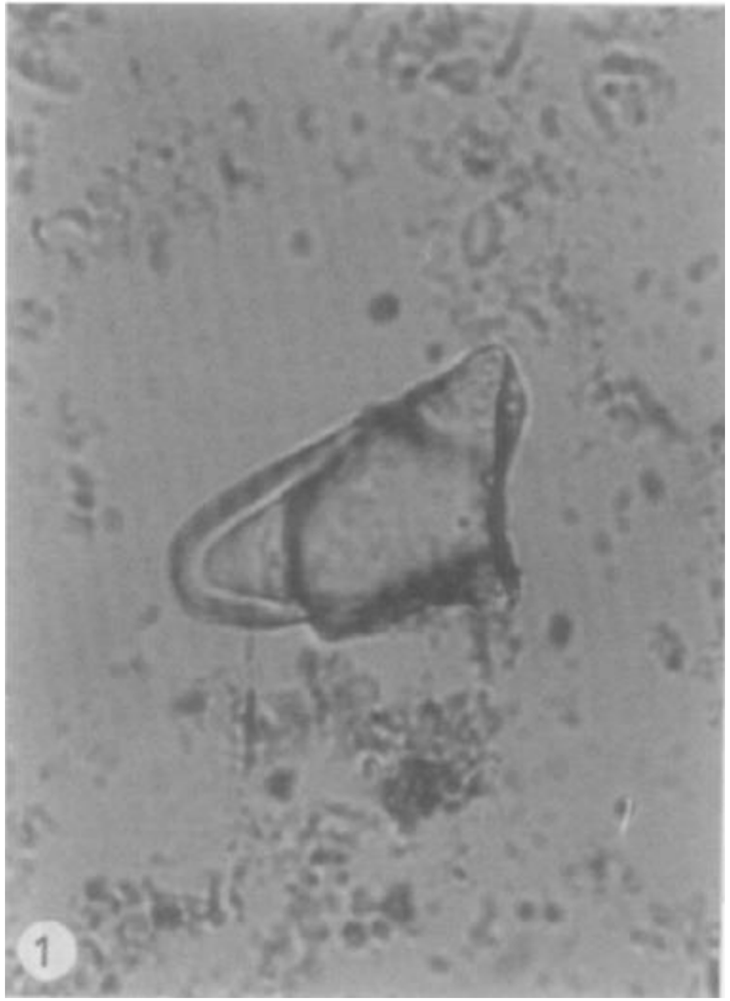
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

COMMELINACEAE

Athyrocarpus peraecariefolium

Phytolith

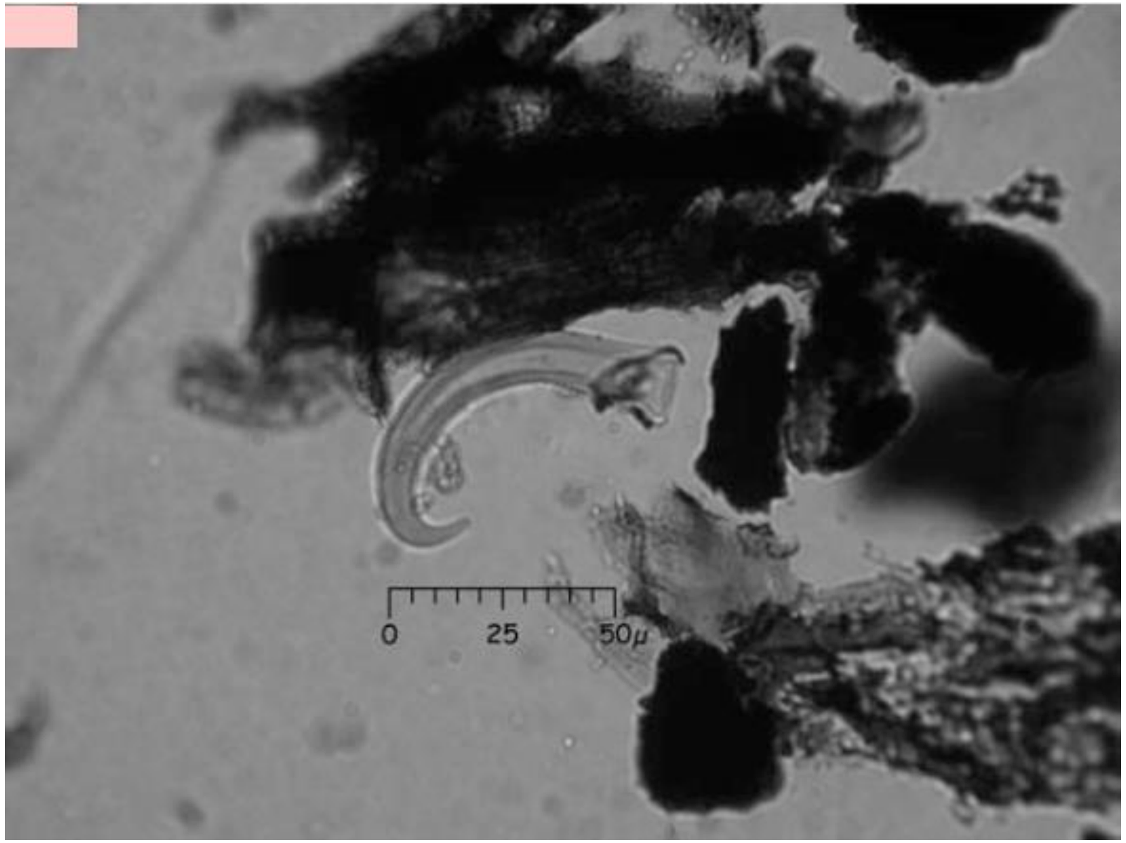
1. A tongue-shaped phytolith from Athyrocarpus peraecariefolium (400 ×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Commelina celestis

Phytolith



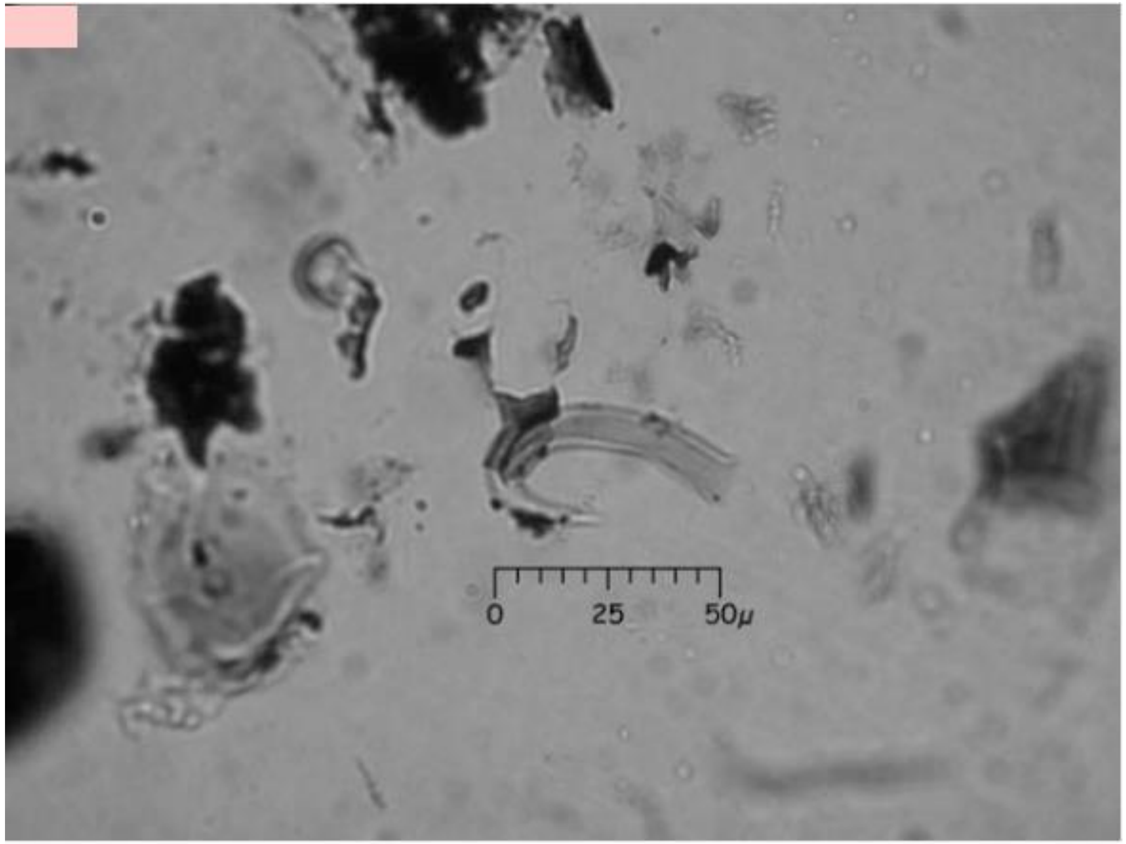
PC3154 leaf
Described by Neil Duncan. Common to abundant in this species and common in C. erecta. Larger and more hooked than similar Phaseolus hairs, but would be confusers where Commelina also grows. Diagnostic level: genus (in absence of Phaseolus)

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina celestis

Phytolith

PC3154 leaf
Described by Neil Duncan. Common to abundant in this species and common in C. erecta. Larger and more hooked than similar Phaseolus hairs, but would be confusers where Commelina also grows. Diagnostic level: genus (in absence of Phaseolus)

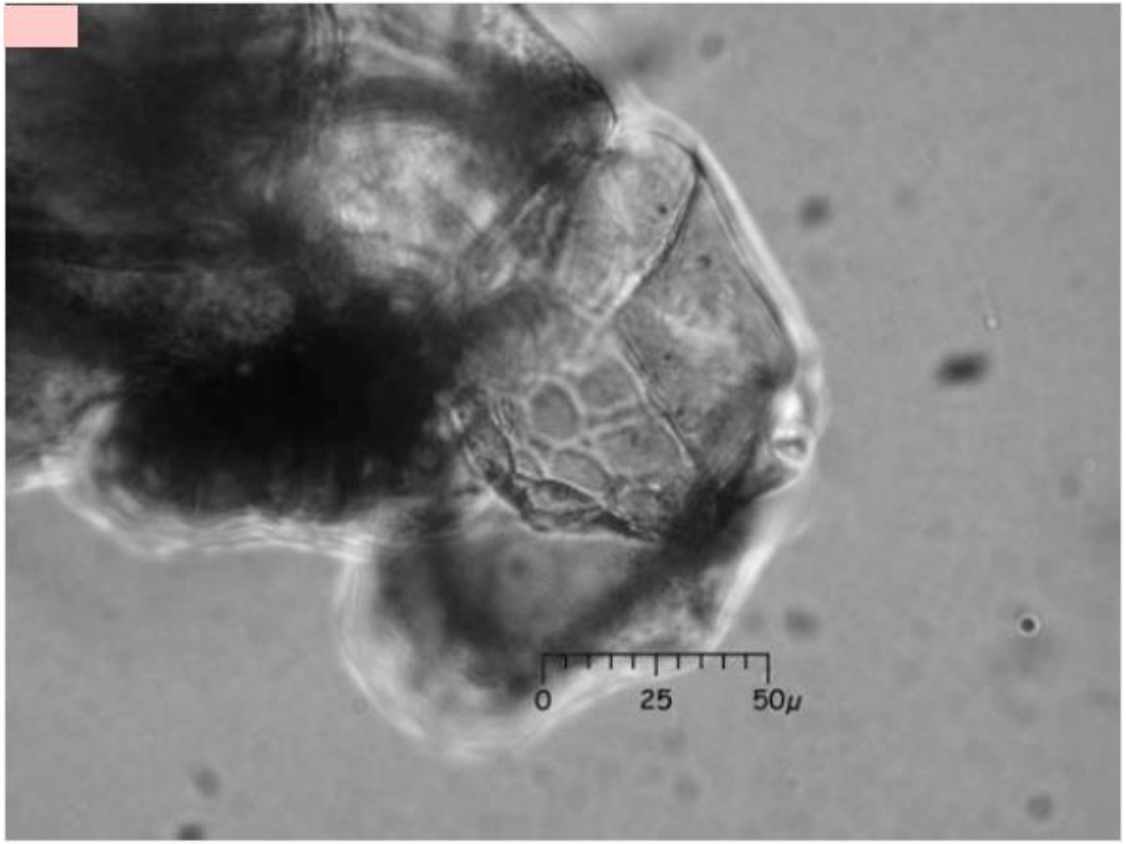


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina dianthafolia

Phytolith

PC3155, leaf
Described by Neil Duncan. The scallops on these schlerids are somewhat similar to those of Cucurbita spheres. The quadrilateral form distinguishes them. Common. Also common in C. robusta.
Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith

Type established by Karol Chandler- Ezell, 2004
C. erecta photos by Neil Duncan, 2011
Side view of flat domed rhizome cylinder, potential Calathea “confuser.” Note small size.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith

Type established by Karol Chandler- Ezell, 2004
C. erecta photos by Neil Duncan, 2011
Side view of flat domed rhizome cylinder, potential Calathea “confuser.” Note smaller size.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith

Type established by Karol Chandler- Ezell, 2004
C. erecta photos by Neil Duncan, 2011
Bottom view (base of ciliate or beaded cylinder) of flat domed rhizome cylinder

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith

Type established by Karol Chandler- Ezell, 2004
C. erecta photos by Neil Duncan, 2011
A group of cylinders in partial rotation; note decoration of base

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

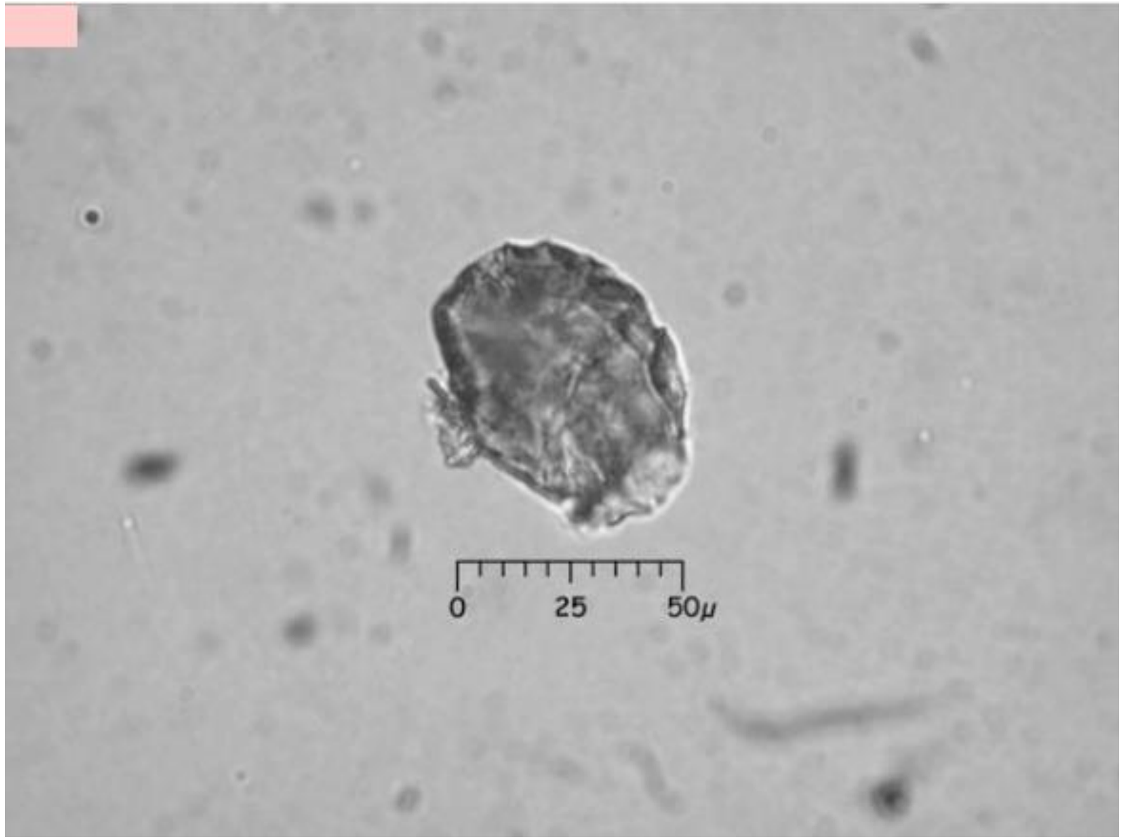
Phytolith

Type established by Karol Chandler- Ezell, 2004
C. erecta photos by Neil Duncan, 2011
A cylinder in partial rotation; note smooth, transparent head

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith



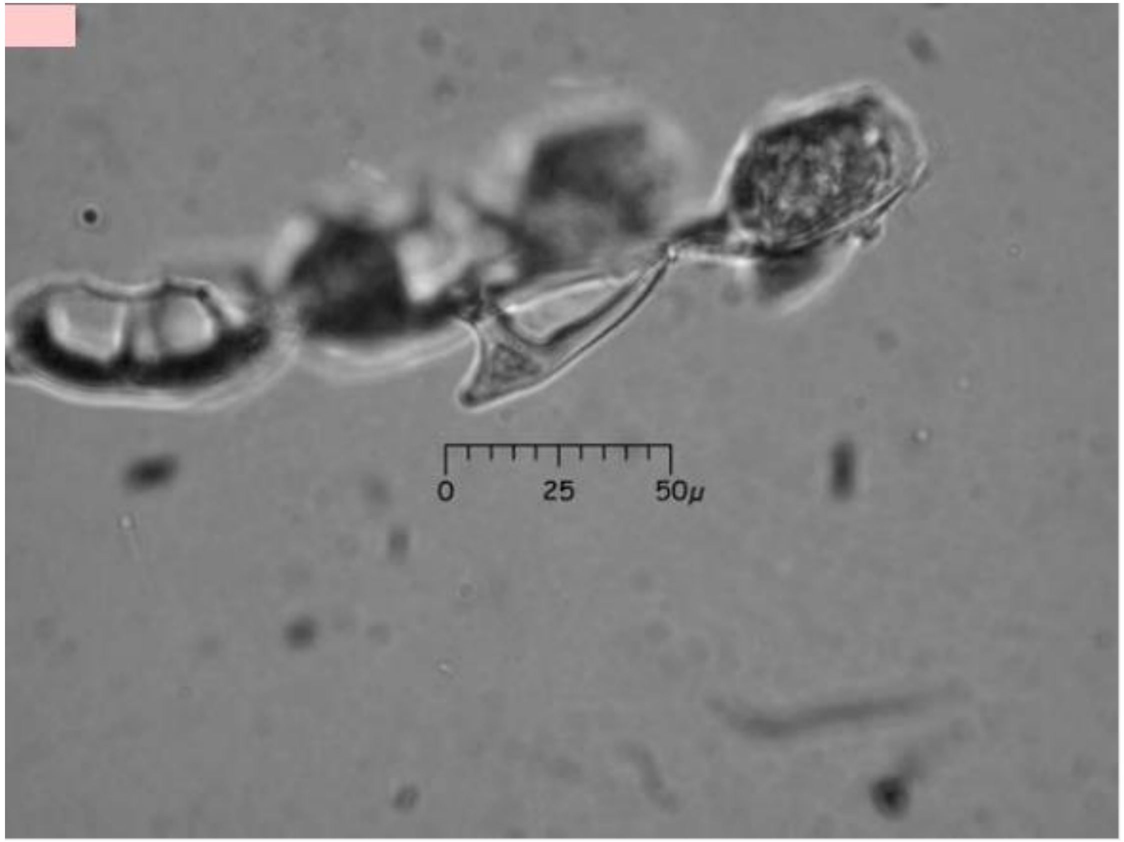
PC3157, leaf
Described by Neil Duncan. The scallops on these schlerids are somewhat similar to those of Cucurbita spheres. The quadrilateral form distinguishes them. Smaller, less robust, and rarer in this species.
Diagnostic level: not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina erecta

Phytolith

PC3157, leaf Described by Neil Duncan. Unicellular hairs. Rare to moderate abundance.
Diagnostic level: not diagnostic

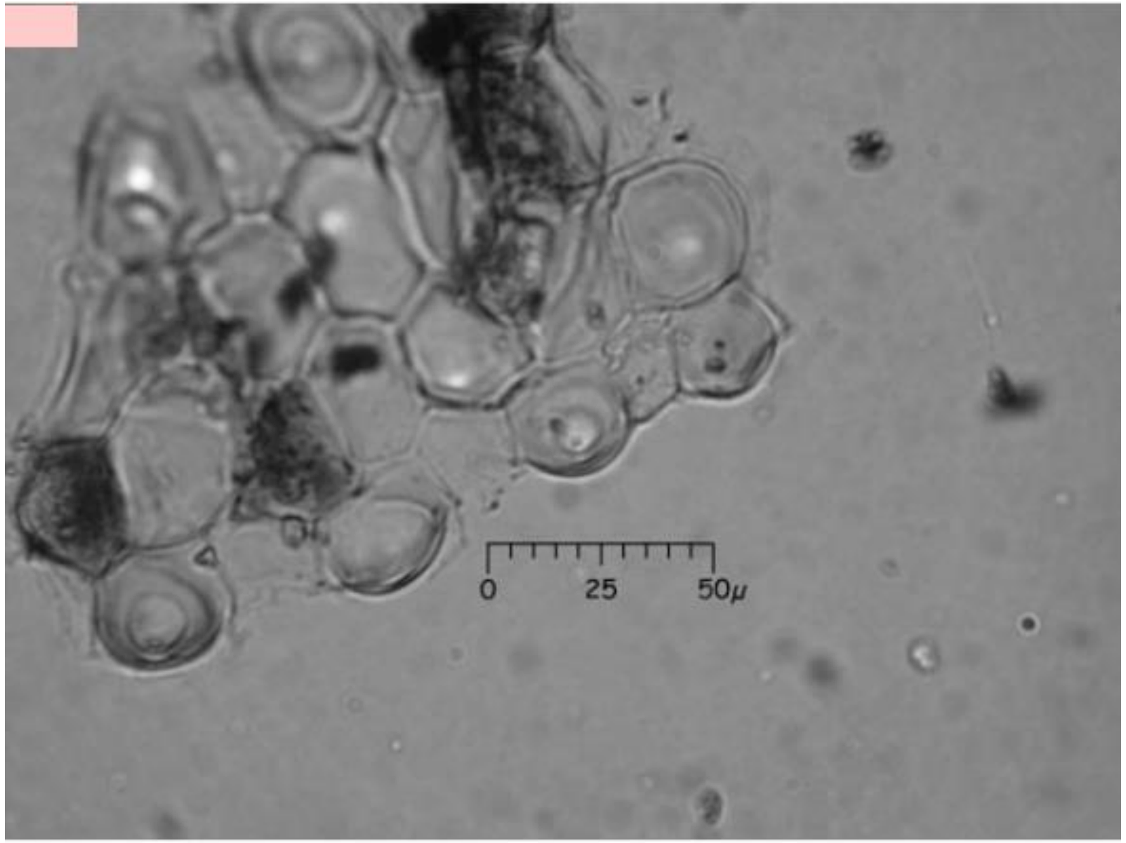


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Commelina scabra

Phytolith

PC3160, leaf Described by Neil Duncan. Unicellular hairs, more “hat-shaped” than the hairs in C. erecta. Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyanotis arachnoidea

Phytolith

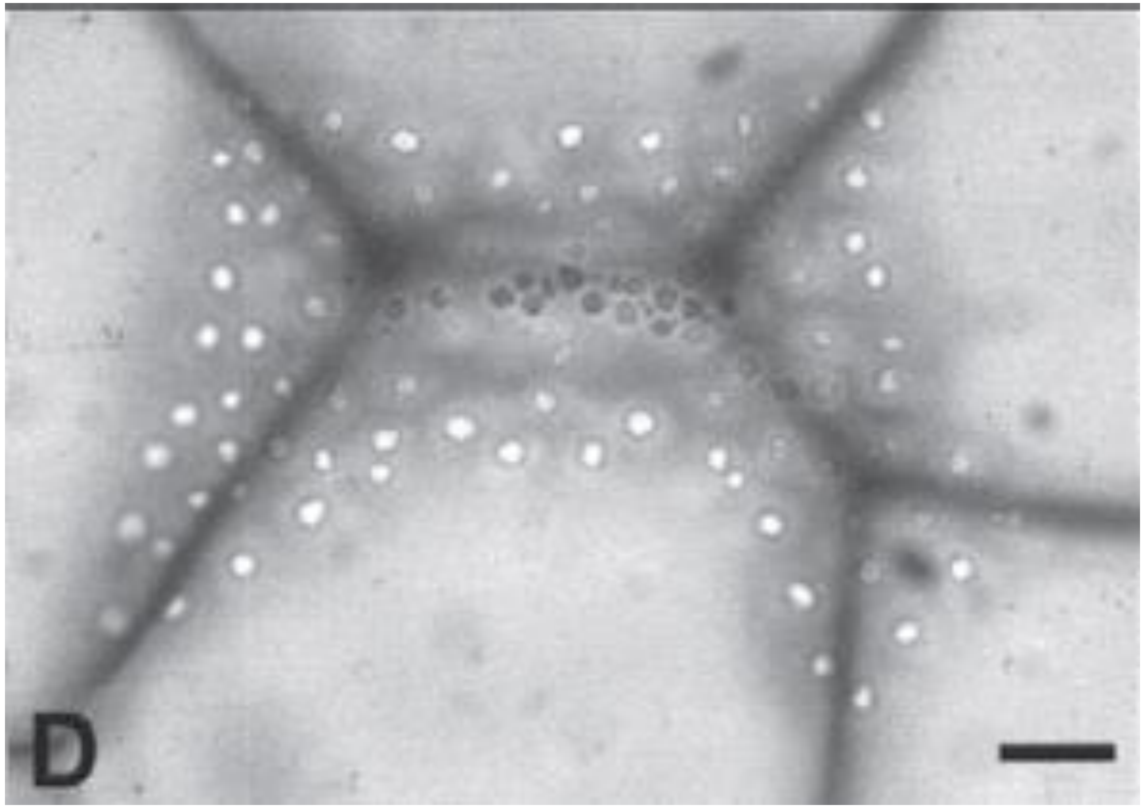


Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. D. Cyanotis arachnoidea (Commelinaceae), small, spherical, spinulose bodies in epidermal cells, apparently following the cell wall (bar = 20 µm).

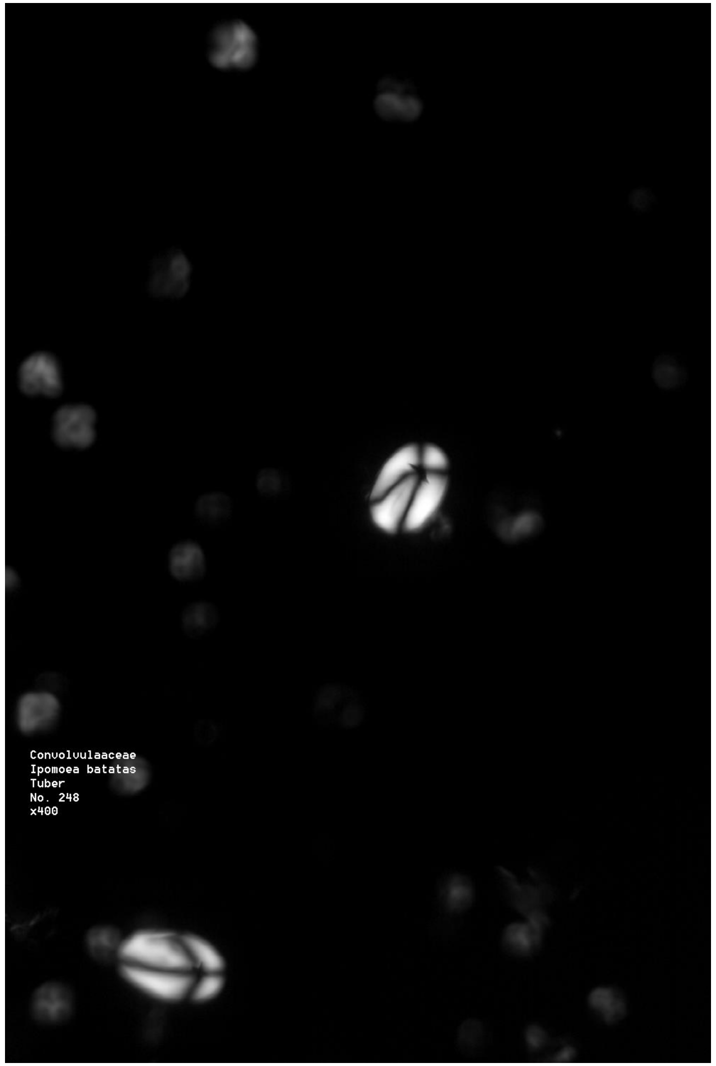
Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

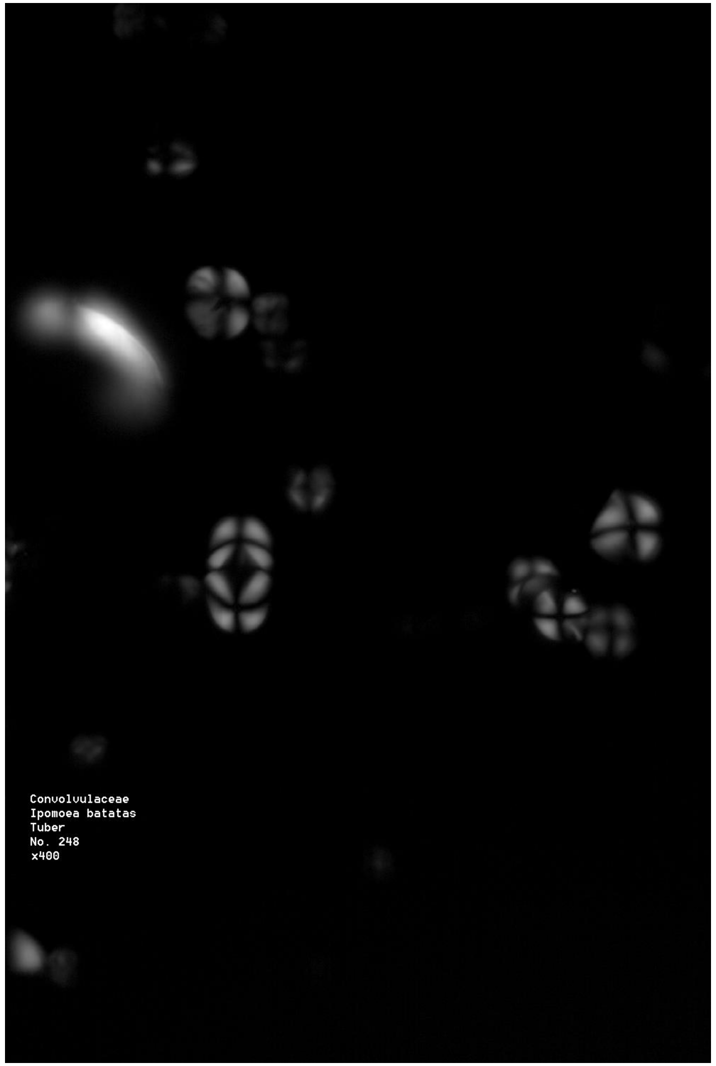
CONVULVULACEAE

Ipomoea batatas

Australian Museum,
McCown Archaeobotany
Laboratory Collection

Starch





Ipomoea batatas

Convolvuleaceae *Ipomoea batatas* "batata"

Phytolith assemblage characterization

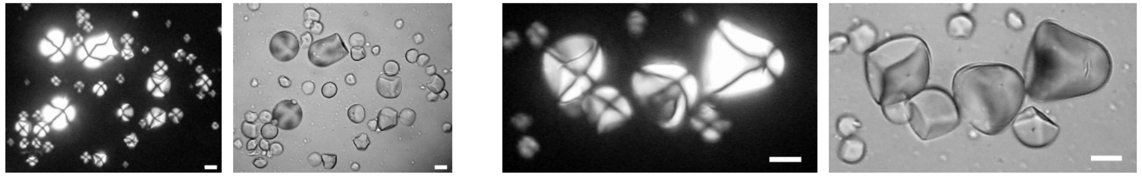
root

References: Reported as not present in leaf and tuber (Piperno 1988:31).
Reported as a family where phytoliths have been found to be not present, rare or not taxonomically significant (Pearsall 2000:371).
Cristaline druses of calcium oxalate with no consistent shape; no raphides (Loy 1994).

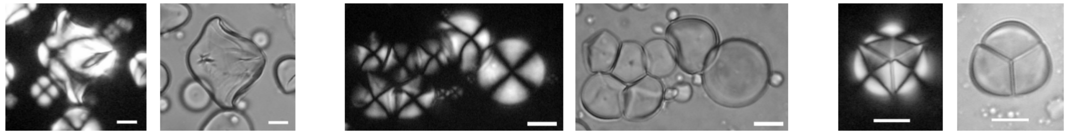
Starch assemblage characterization

root

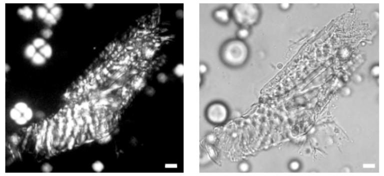
a) Single grains, ovoid, oval, polyhedral, bowl- and bell-shaped, sometimes with two or more facets; variable in size from 2,5µm to 55µm long length; mainly distinct eccentric hilum as a dot or line, usually at rounded or smaller end; distinct lamella; sometimes radiating fissures; very distinct margins; mainly distinct eccentric cross, with four arms visible. May occur in aggregates.



b) Compound grains, compounded by two or more granula, without a single external packing. Granula variable in shape and size, polyhedral, bell- or bowl-shaped, with one or more facets, and plane, wavy or acute truncations; size from 2,5µm to 55µm; mainly distinct eccentric hilum as a dot or line; distinct lamella; sometimes radiating fissures; mainly distinct eccentric cross with four arms visible.



c) Another compound grains, with a single external package variable in shape, size, and number of granula. Granula variable in size to 20µm long length; very distinct hilum as a line or v-shaped; not visible lamella; distinct centric cross, with four arms visible.



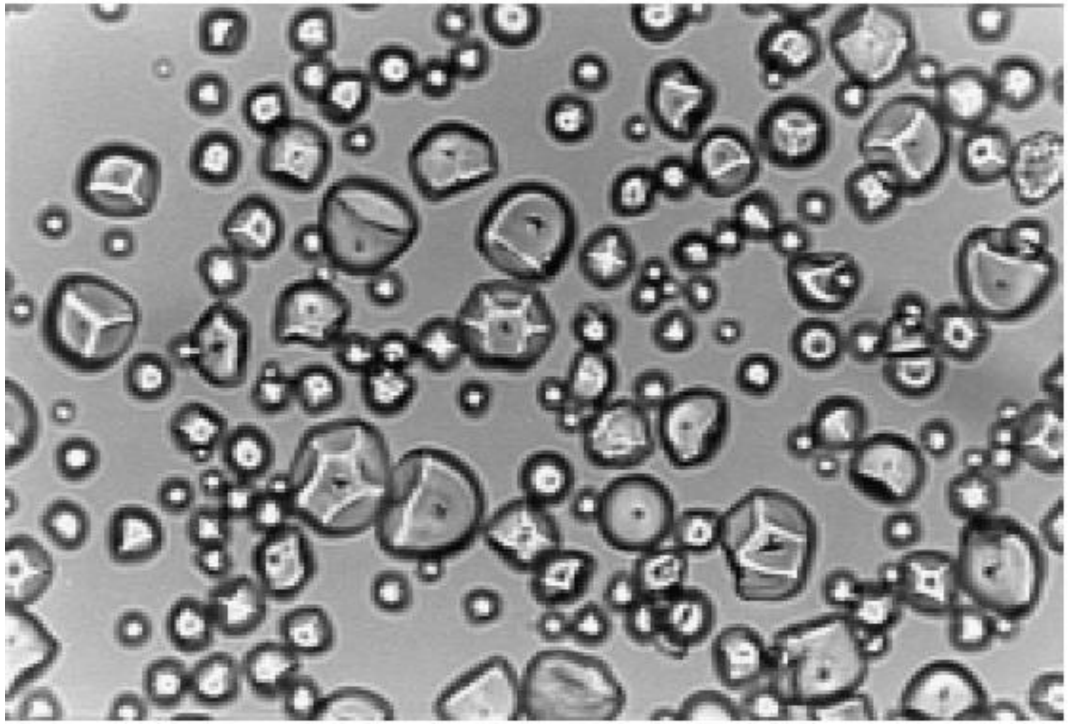
References: Partially based on Loy 1994, Piperno and Holst 1998, Reichert 1913, Shannon and Garwood 1984.

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Ipomoea batatas

Starch



Starch grains from a modern sweet potato tuber. 80x

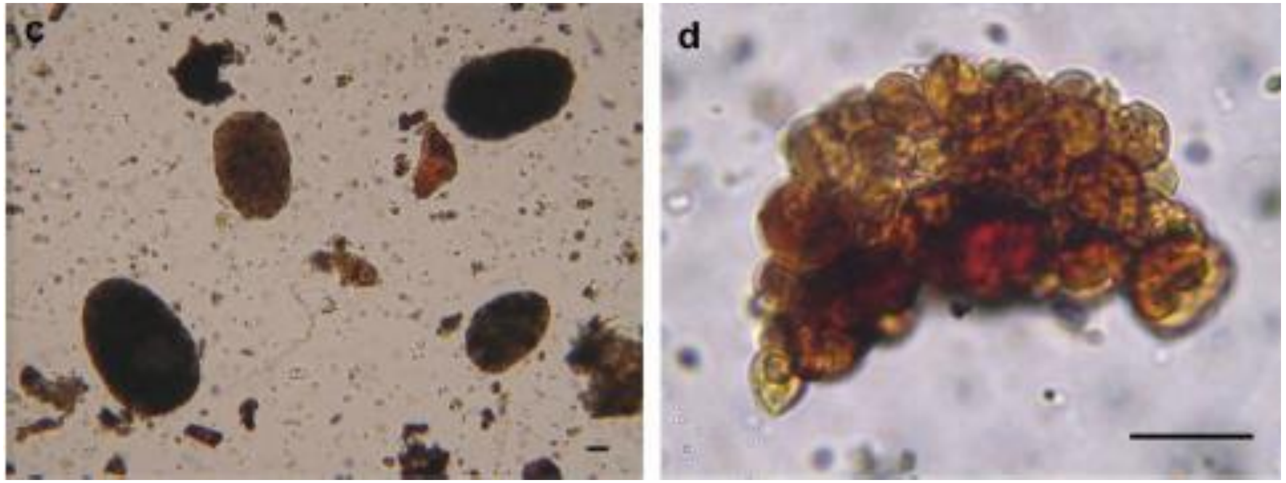
APPENDIX:
Ipomoea batatas (sweet potato) (Figure 2). Mostly compound grains, laminated, often with a diagnostic small and transverse fissure. The pressure facets have very distinct margins. Size: 4–34 microns long

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Ipomoea batatas

Starch

Fig. 7. Plant microfossils from Kona (a, b mounted in Caedax; c–h mounted in glycerol jelly; 100x,400x or 600x; scale bars: 20 mm). (c) Low magnification view of soil-stained dense material within ovate cell membranes (four) (c.f. parenchyma starch storage cells of Ipomoea batatas, Fig. 8c). (d) High magnification view of fragment of ovate cell showing densely packed starch grains (membrane has been lost) (c.f. parenchyma storage cells of I. batatas, Fig. 8c). Individual soil-stained starch grains are more easily seen in cells that are disintegrating than in intact cells because the grains are tightly packed in the latter.



Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Ipomoea batatas

Starch

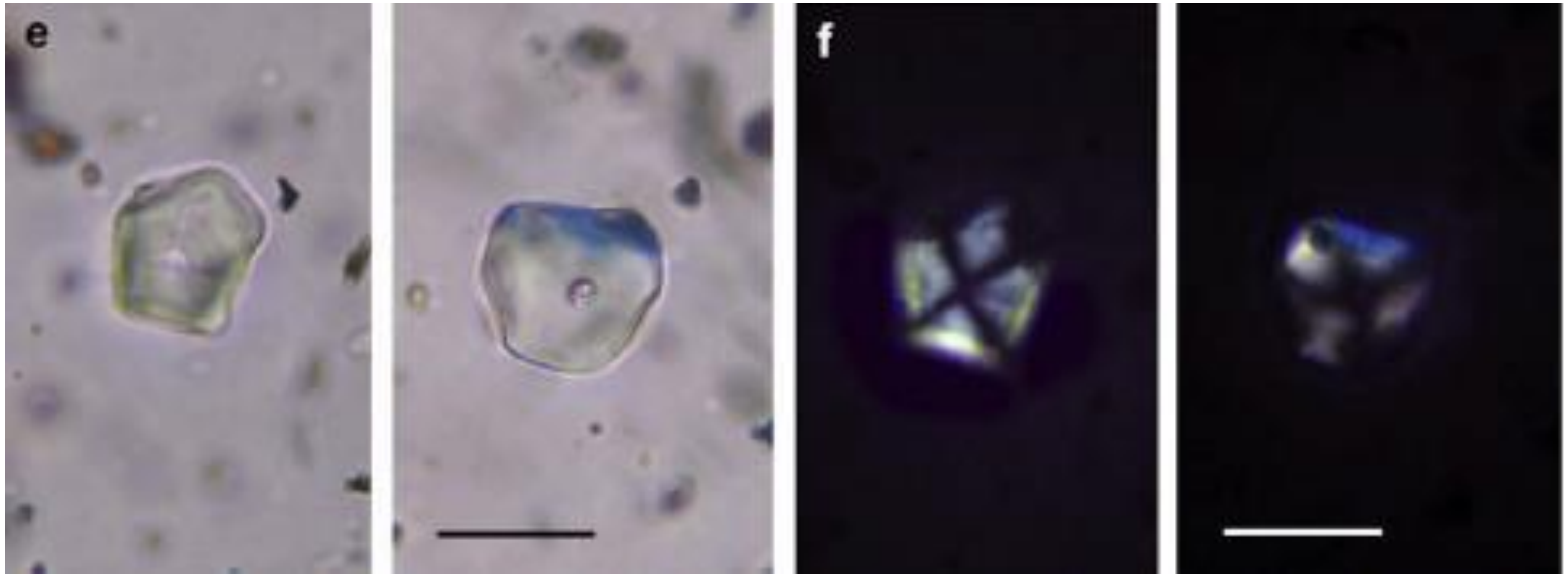


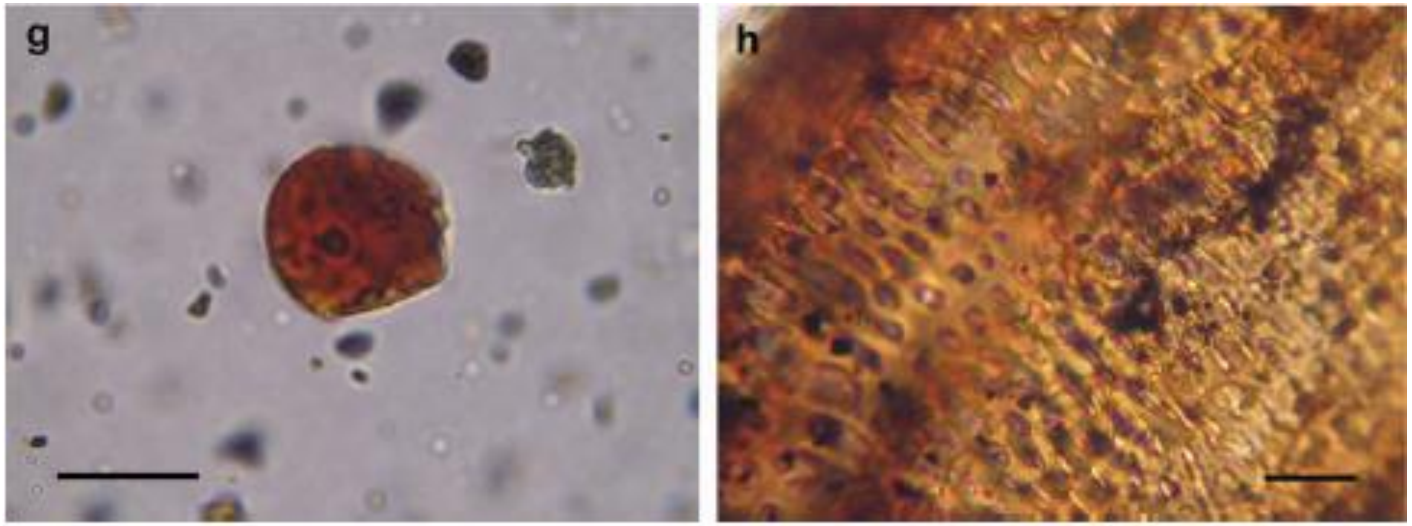
Fig. 7. Plant microfossils from Kona (a, b mounted in Caedax; c–h mounted in glycerol jelly; 100x,400x or 600x; scale bars: 20 mm). (e, f) Faceted starch grains with central vacuole (c.f. starch grains of I. batatas, Fig. 8d, e). (f) Shows the grains in (e) viewed under cross-polarised light, showing central Maltese cross.

Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Ipomoea batatas

Starch

Fig. 7. Plant microfossils from Kona (a, b mounted in Caedax; c–h mounted in glycerol jelly; 100x,400x or 600x; scale bars: 20 mm). (g) Soil-stained starch grain with central vacuole (c.f. starch grains of I. batatas, Fig. 8d). Although facets are not clearly visible, two straight edges of these are. (h) Xylem vessel element with alternate slit-like pits (c.f. xylem vessel element of I. batatas, Fig. 8f).



Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Ipomoea batatas

Starch

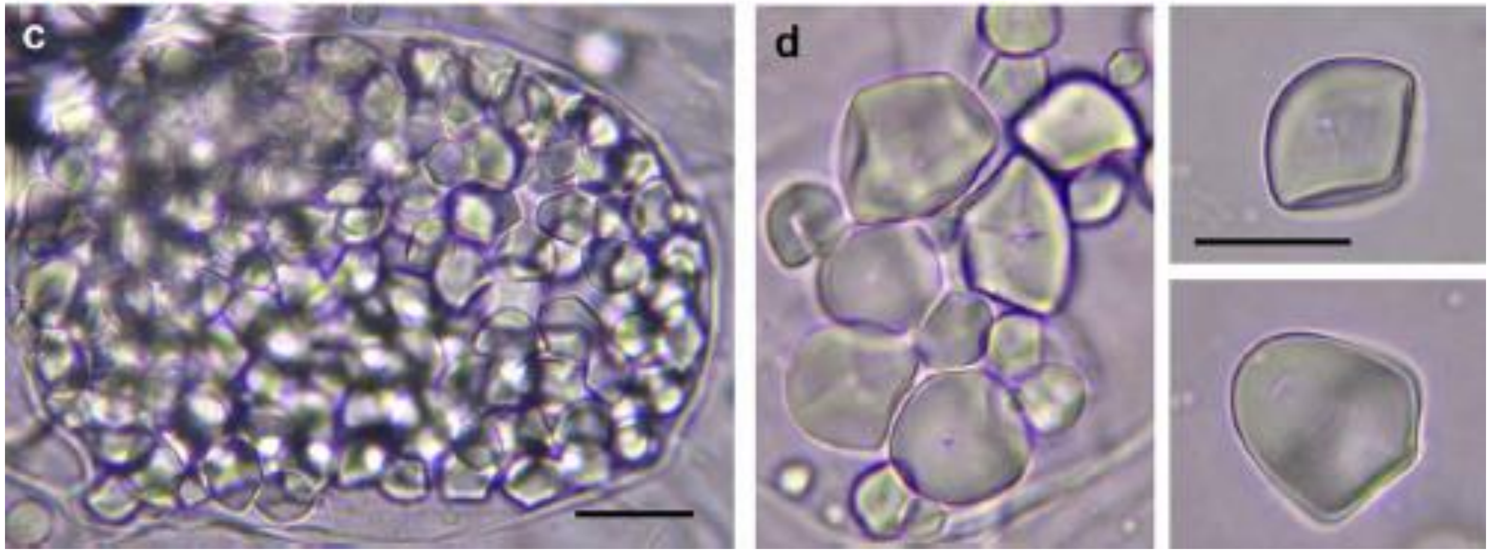


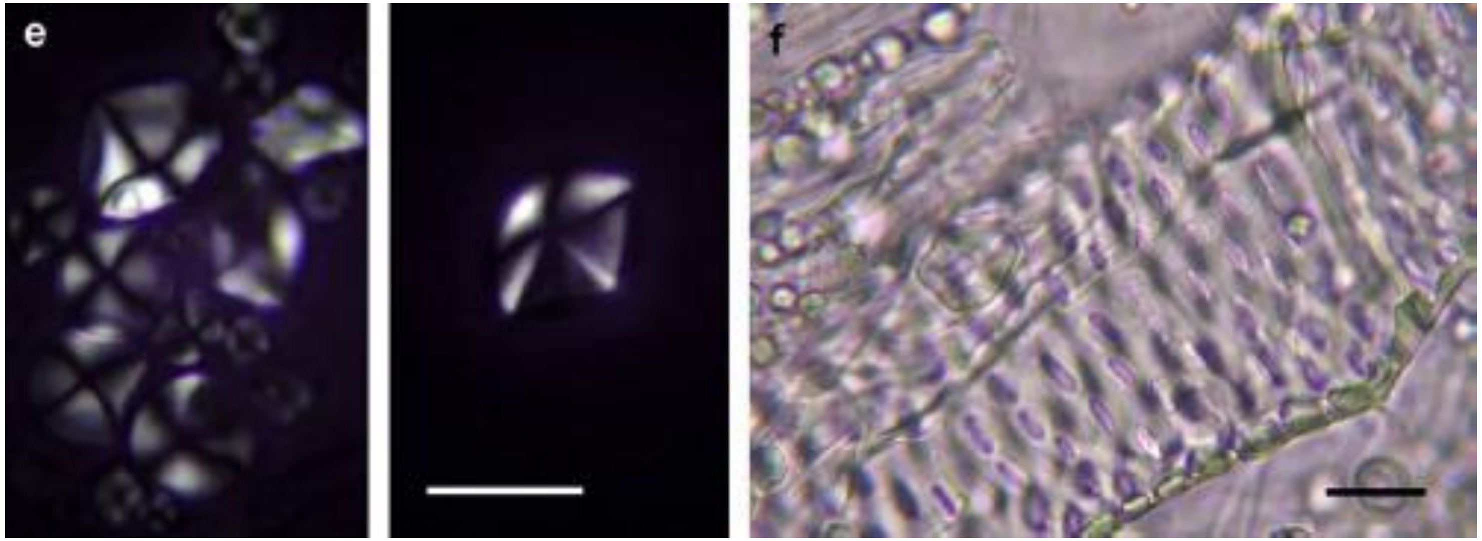
Fig. 8. Modern reference samples ((a, b mounted in Caedax; c–f mounted in glycerol jelly; 400x or 600x; scale bars: 20 mm). (c) Parenchyma storage cell of Ipomoea batatas root, with densely packed, immature starch grains. Storage cells are typically ovate, up to w115 mm diam., with thin walls, <0.5 mm thick. (d) Typical starch grains of I. batatas root. Grains are spherical to sub-spherical, often bell- shaped, up to w26 mm diam., with a vacuole at the central hilum (seen here as a dot) and up to six flattened pressure facets. Reichert (1913) described the hilum as ‘‘eccentrically placed. in or slightly to one side of the median line’’. However, as this appears more or less central, to avoid confusion with the several Pacific starch taxa that have elongated grains with very eccentric hila (i.e. well off the median line, e.g. four of the five Remote Oceanic Dioscorea spp.), we describe the Ipomoea hilum as central, as did Loy et al. (1992). Many of the grains shown here are more mature than those in (c), hence are larger.

Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Ipomoea batatas

Starch

Fig. 8. Modern reference samples ((a, b mounted in Caedax; c–f mounted in glycerol jelly; 400x or 600x; scale bars: 20 mm). (e) Starch grains in left and upper right panels of (d) viewed under cross-polarised light, showing central Maltese crosses. (f) Xylem vessel element of I. batatas root. Vessel elements are up to c. 90 mm across with walls up to 5 mm thick, and alternate slit-like pits up to 20 mm across



Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Ipomoea batatas

Starch

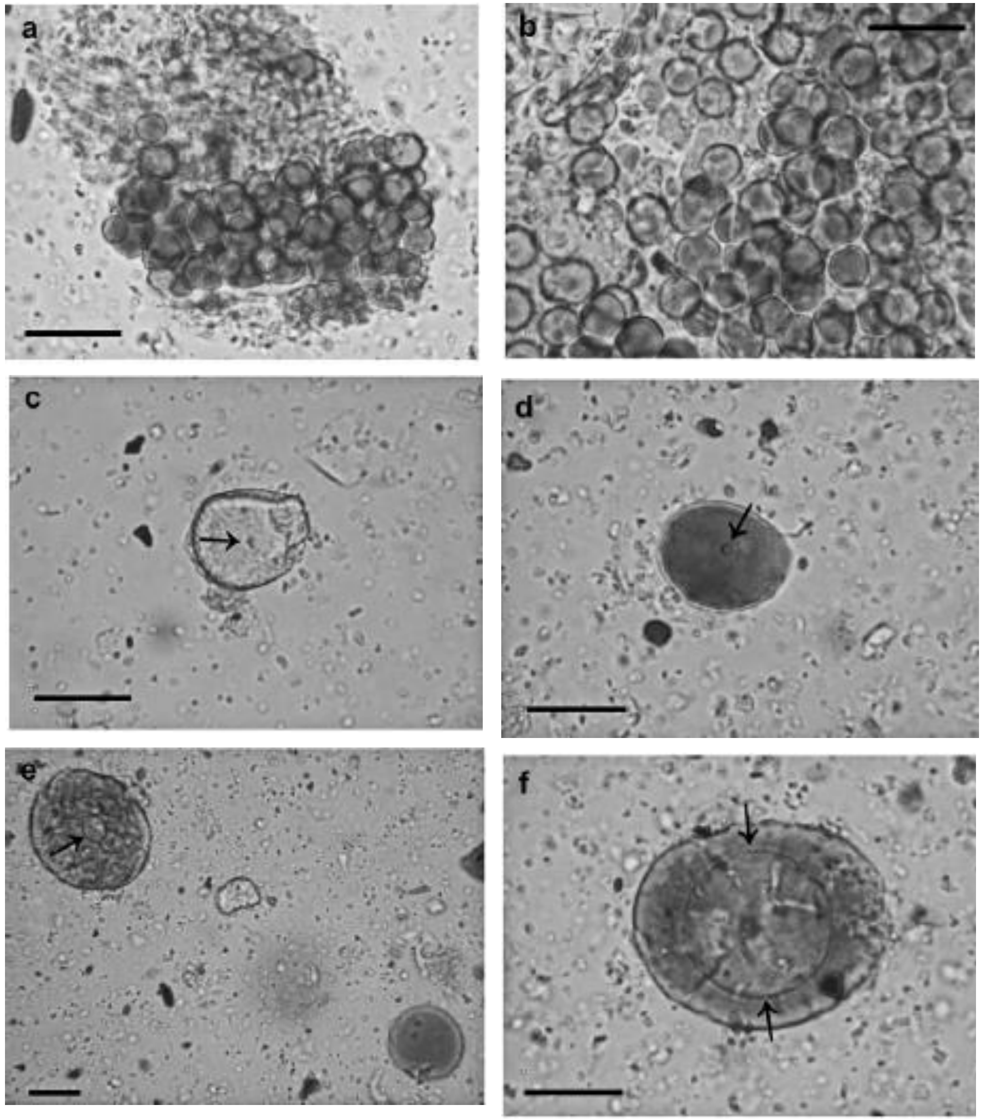


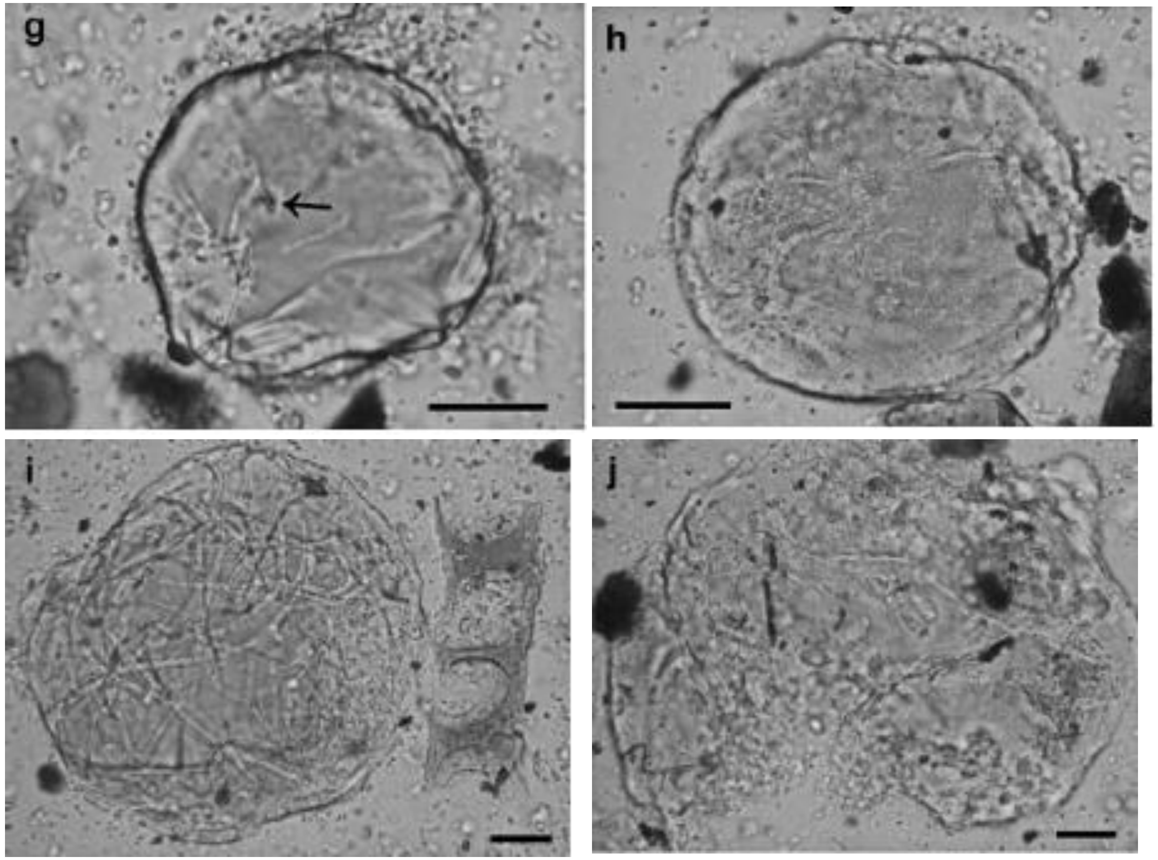
Fig. 2. Microfossils characteristic of introduced Ipomoea batatas root from Hamurana Rd (400? or 600?). (a, b) Clumps of immature, brown-stained starch grains in cellulose material (c.f. starch grains of I. batatas root, Fig. 4a-d). (c, d) Bell-shaped starch grains, one brown-stained, with central vacuole (arrows) (c.f. bell-shaped starch grains of I. batatas root, Fig. 4c). (e) Two brown-stained starch grains. The larger shows signs of corrosion: pitting and expansion of the vacuole (arrow). (f) Brown-stained starch grain showing extreme vacuole expansion (arrows).

Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 2. Microfossils characteristic of introduced Ipomoea batatas root from Hamurana Rd (400? or 600?). (g-j) Starch grains showing extreme swelling, and corrosion with cracking and disintegration. Vacuole (arrow) is visible in (g). A degraded xylem fragment with expanded wall pits (see below) is visible in (i).



Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

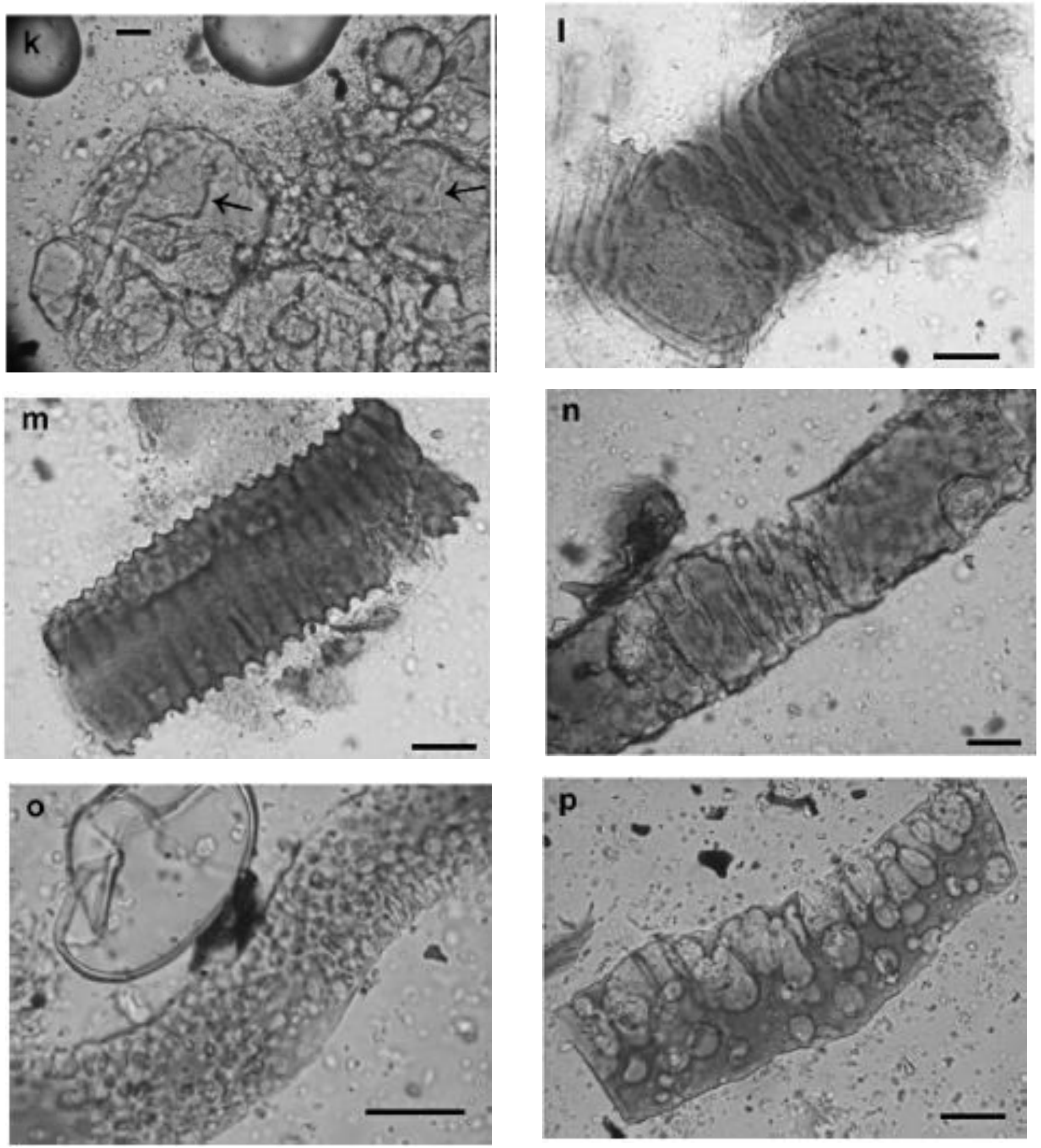


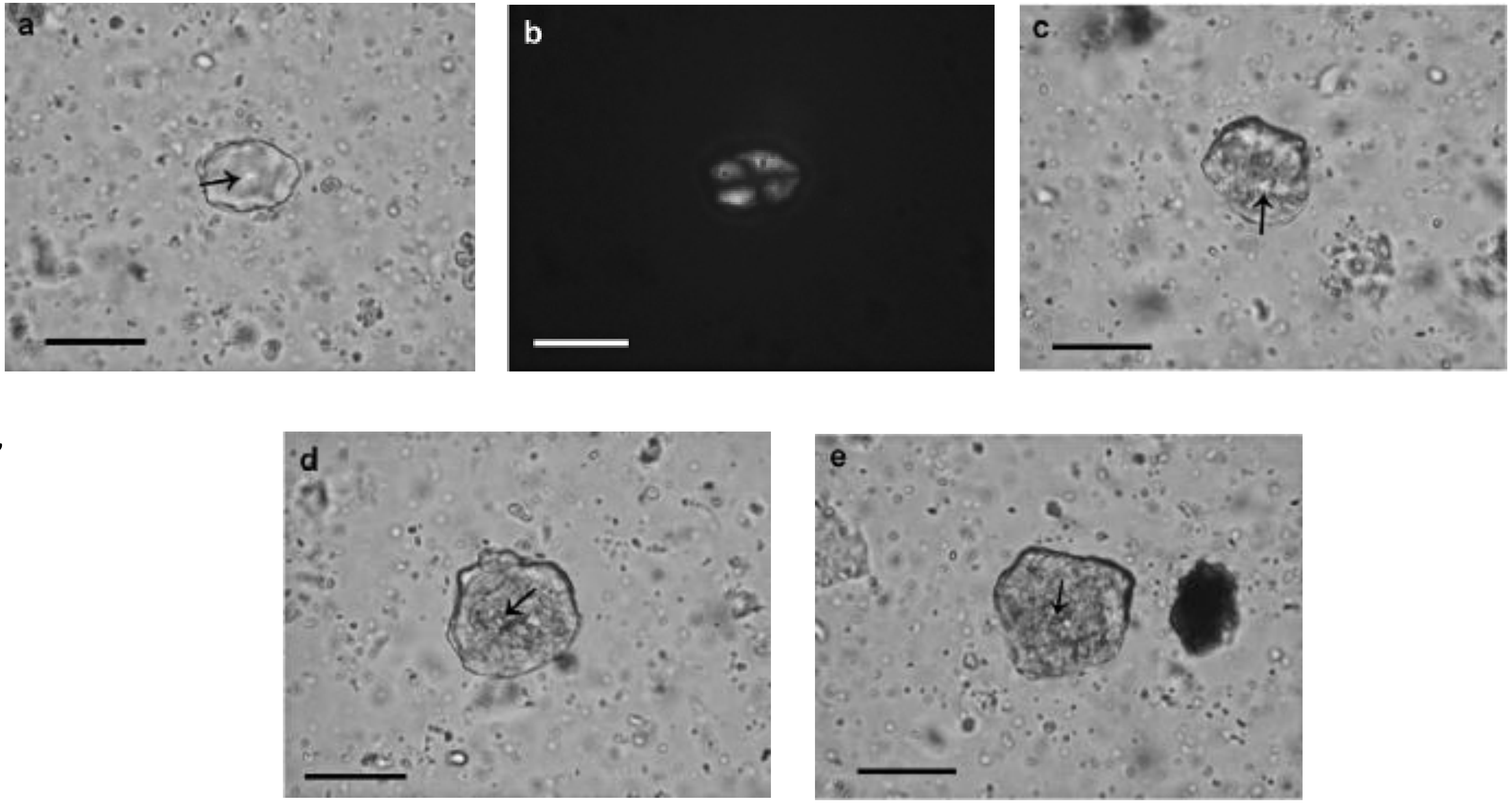
Fig. 2. Microfossils characteristic of introduced Ipomoea batatas root from Hamurana Rd (400? or 600?). (k) Clump of starch grains showing variable swelling and disintegration. Note cracks (arrows). (The two dark-outlined objects top centre and left are air bubbles.) (l-p) Brown-stained xylem tracheary elements with slit-like pits (c.f. xylem vessel elements of I. batatas root, Fig. 4e-h). (n-p) show expansion of wall pits. In (l), the inside of the cell is visible through the large opening, lower end. (The other large object in o is a Cyathea fern spore.) Scale bars, 20 mm.

Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 3. Microfossils characteristic of introduced Ipomoea batatas root from Whangapoua (400? or 600?). (a) Well-preserved, multi-facetted starch grain with central vacuole (arrow) (c.f. multi-facetted starch grain of I. batatas root, Fig. 4d, bottom). (b) Starch grain is viewed under cross-polarised light, showing central Maltese cross, i.e., dark areas of cross-intersect in centre of grain (c.f. Fig. 4b). (c-k) Individual and pairs (f-h, j) of starch grains, showing brown-staining, facetting, central vacuole (arrows) and variable swelling. The vacuole in (f) is distorted length-wise.

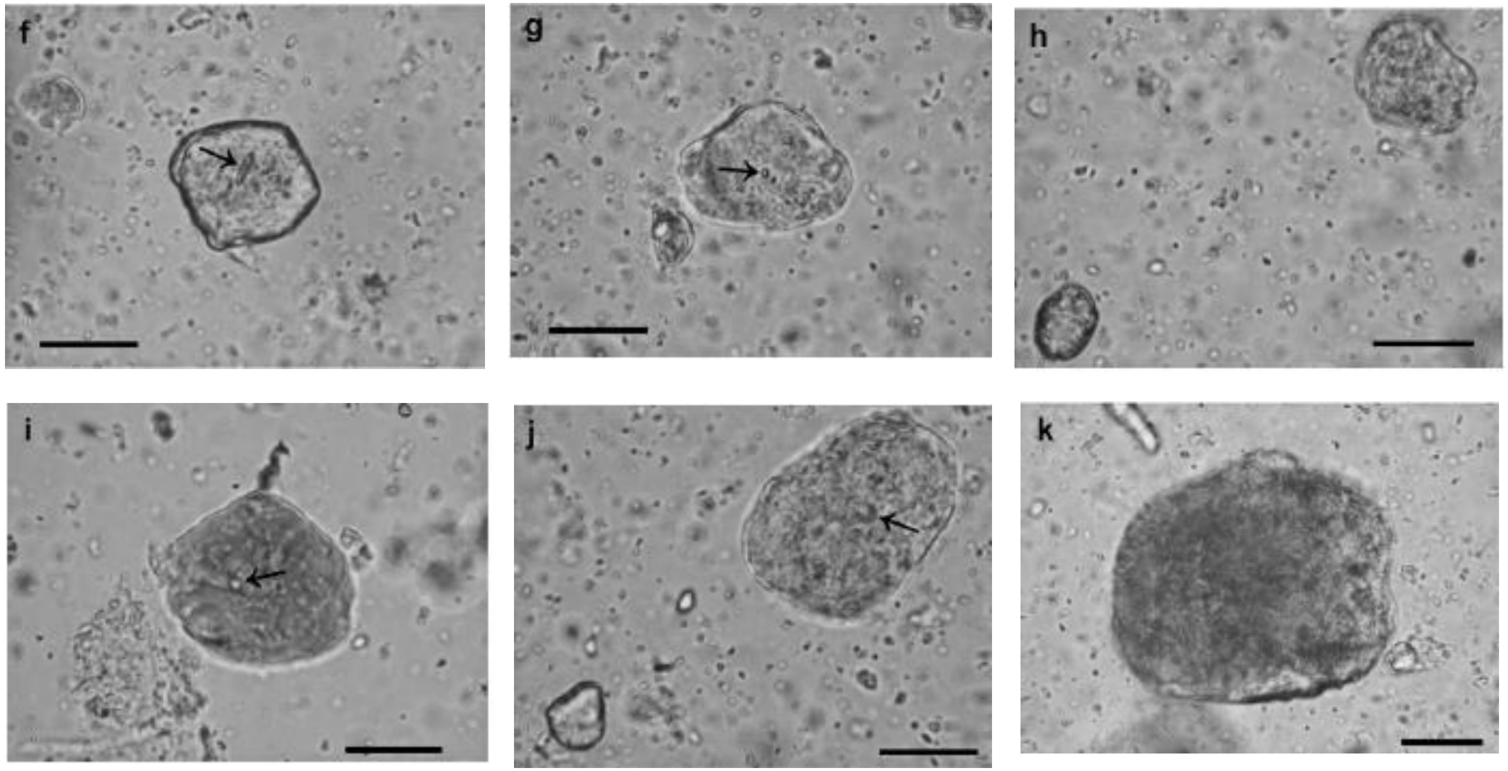


Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 3. Microfossils characteristic of introduced Ipomoea batatas root from Whangapoua (400? or 600?). (a) Well-preserved, multi-facetted starch grain with central vacuole (arrow) (c.f. multi-facetted starch grain of I. batatas root, Fig. 4d, bottom). (b) Starch grain is viewed under cross-polarised light, showing central Maltese cross, i.e., dark areas of cross-intersect in centre of grain (c.f. Fig. 4b). (c-k) Individual and pairs (f-h, j) of starch grains, showing brown-staining, facetting, central vacuole (arrows) and variable swelling. The vacuole in (f) is distorted length-wise.

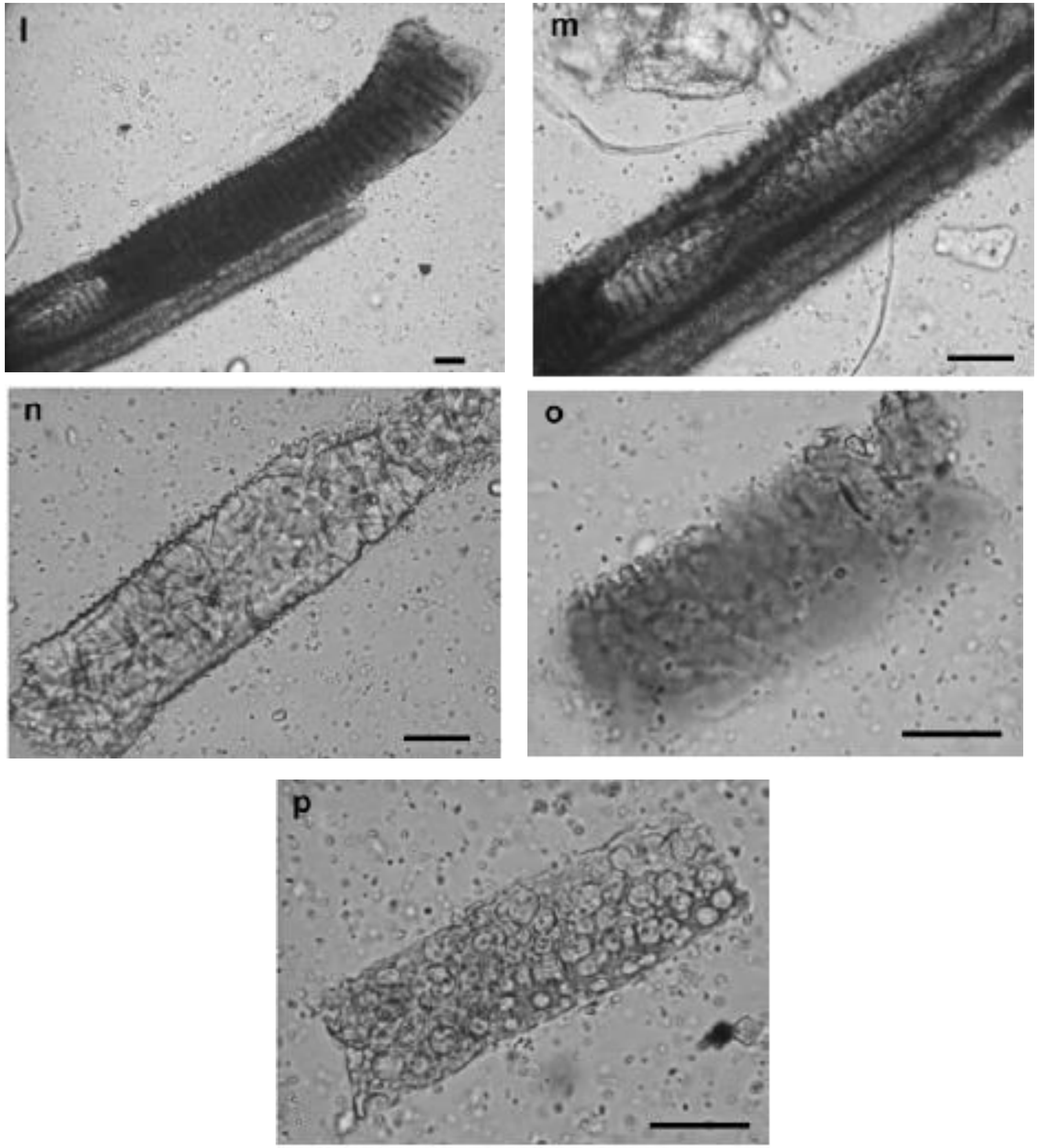


Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 3. Microfossils characteristic of introduced Ipomoea batatas root from Whangapoua (400? or 600?). (l-p) Brown-stained xylem tracheary elements with slit-like pits (c.f. xylem vessel elements of I. batatas, Fig. 4e-h). (l) and (m) are of the same specimen (a pair of elements: one wide and one narrow), photographed at different points and magnifications. (n) and (p) show cracks and pit expansion, respectively. Scale bars, 20 mm

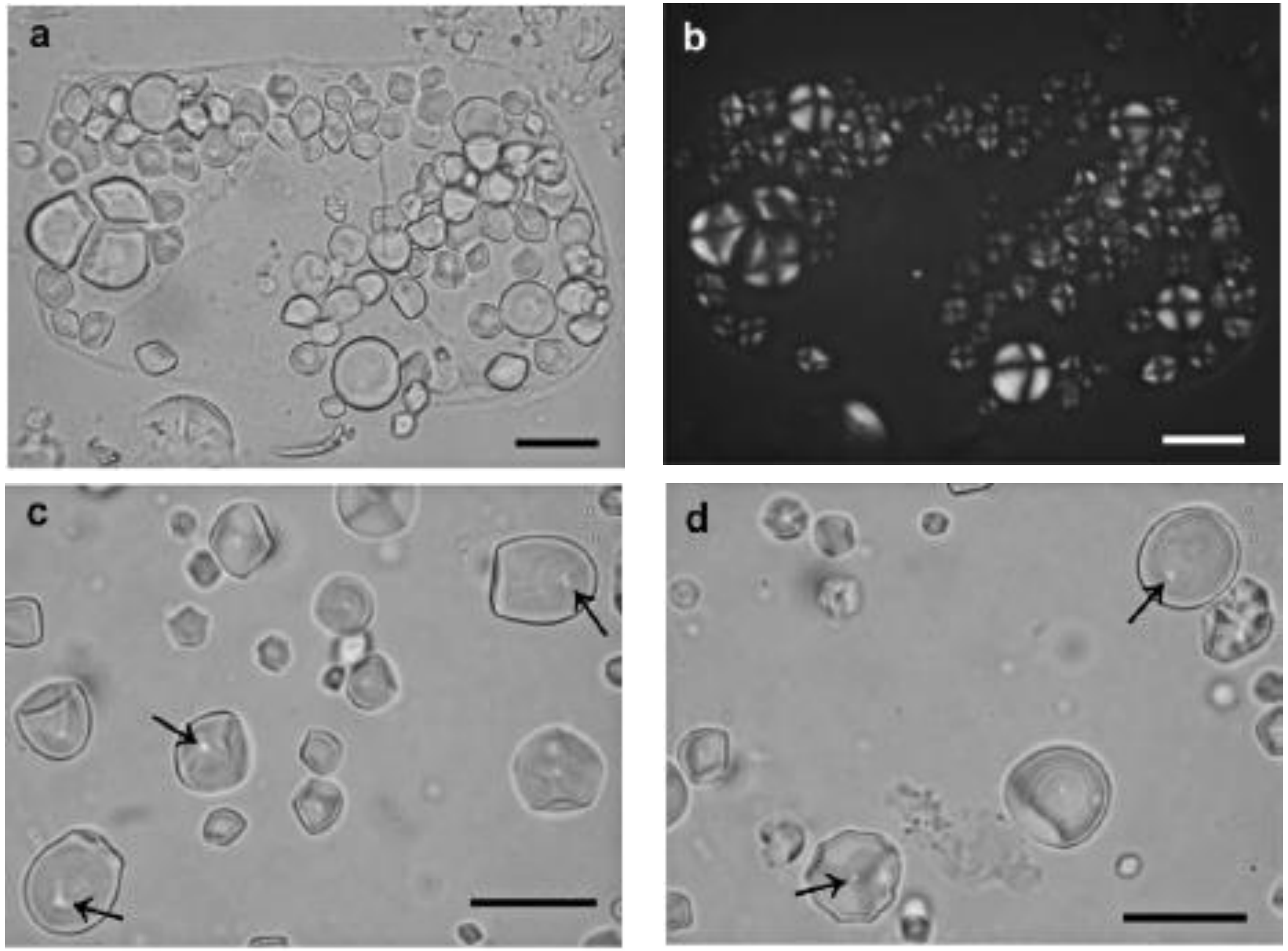


Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 4. Microparts of Ipomoea batatas root from modern reference samples (400? and 600?). (a-d) Starch grains of various ages (mature grains are larger). Grains are colourless, spherical to sub-spherical, often bell-shaped, smooth, up to 26 mm in diameter, with a vacuole at the central hilum (arrows), and nearly all have one
domed surface and up to six (rarely more than three) flattened pressure facets. Viewed from the top facets may be obscured with grains appearing completely round. In (b), grains in (a) are viewed under cross-polarised light, showing central Maltese crosses.

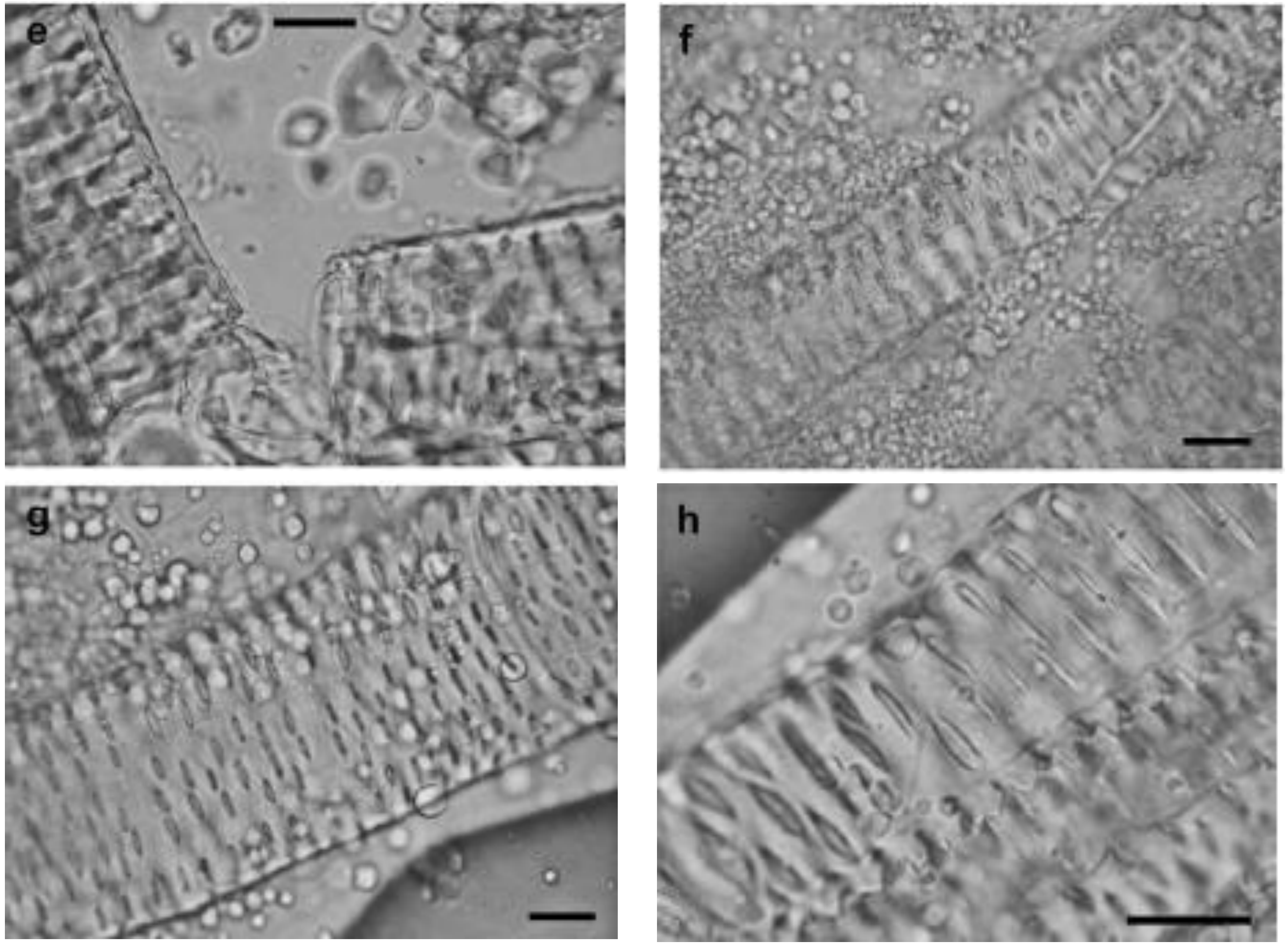


Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

Fig. 4. Microparts of Ipomoea batatas root from modern reference samples (400? and 600?). (e-h) Xylem vessel elements. Elements are up to 90 mm across with walls up to 5 mm thick, and alternate slit-like pits up to 20 mm across. The vessel in (e) has been damaged during slide preparation. Starch grains in various concentrations are also visible. Scale bars, 20 mm

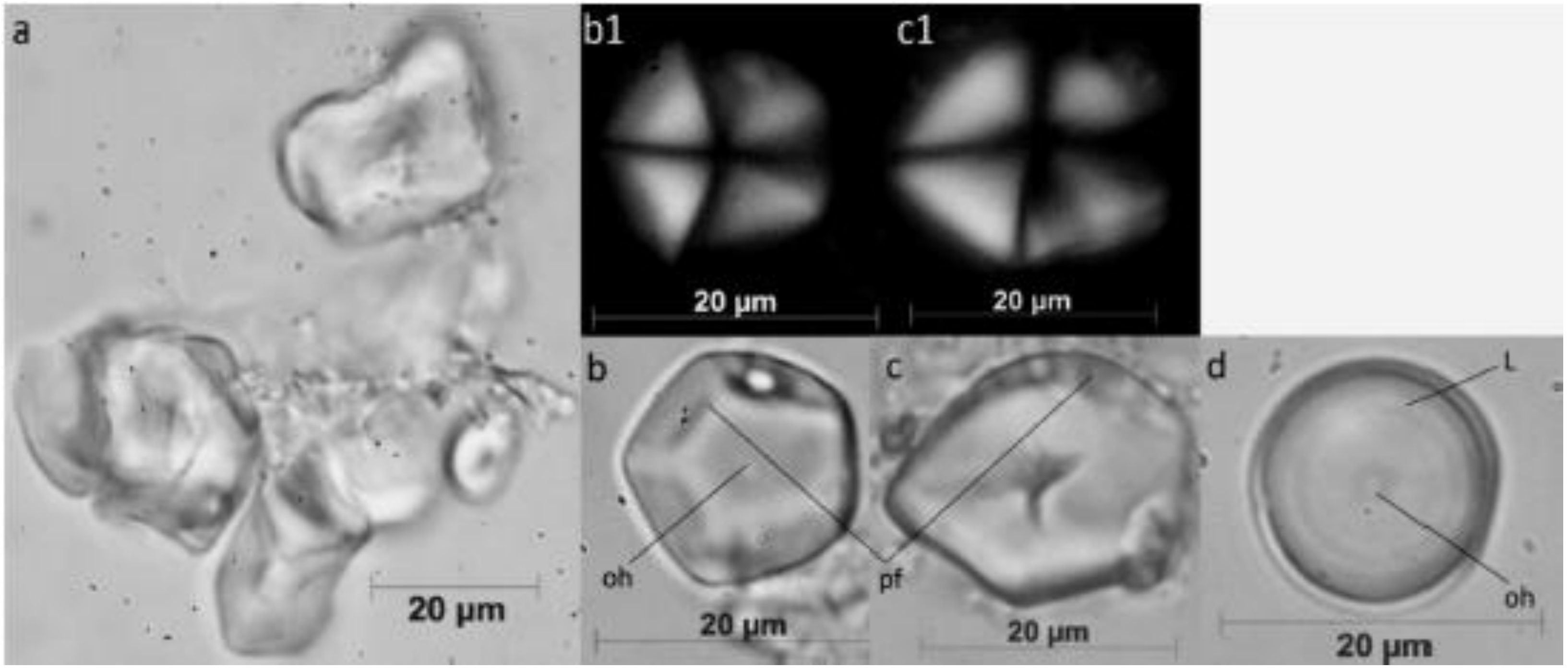


Horrocks, Mark, Matthew Campbell, and Warren Gumbley. 2007. A Short Note on Starch and Xylem of Ipomoea Batatas (Sweet Potato) in Archaeological Deposits from Northern New Zealand. *Journal of Archaeological Science* 34 (9):1441–48.

Ipomoea batatas

Starch

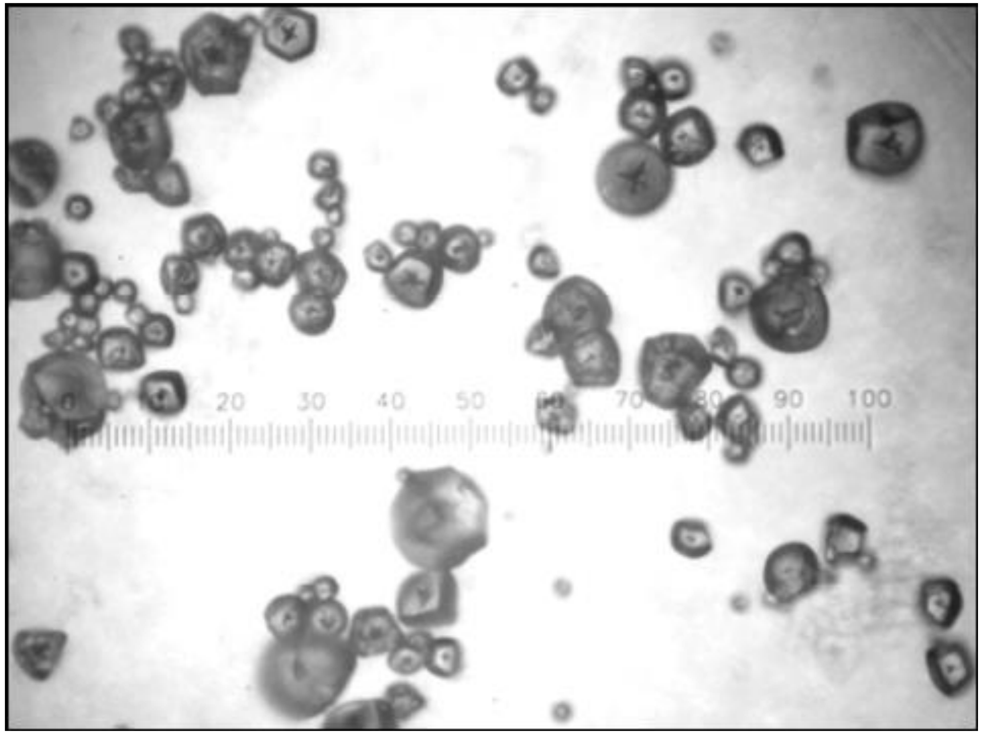
Fig. 6. Sweet potato starch grains from St. John and Eva 2. a, cluster of at least six starches possibly of sweet potato with smooth signatures associated to heat damaging in a low humidity environment; b and c, diagnostic polyhedral shapes with two to five pressure facets (“pf”), and diagnostic extinction crosses (b1, c1) consisting in two or three lightly curved-very thin arms with the fourth arm been wider and triangular; d, spherical starch showing the open hilum (“oh”) and lamellae (“L”) in the form of concentric rings. Provenances: starches a (artifact E-1), b and d (artifact E-2), c (artifact SJ-3)



Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Ipomoea batatas

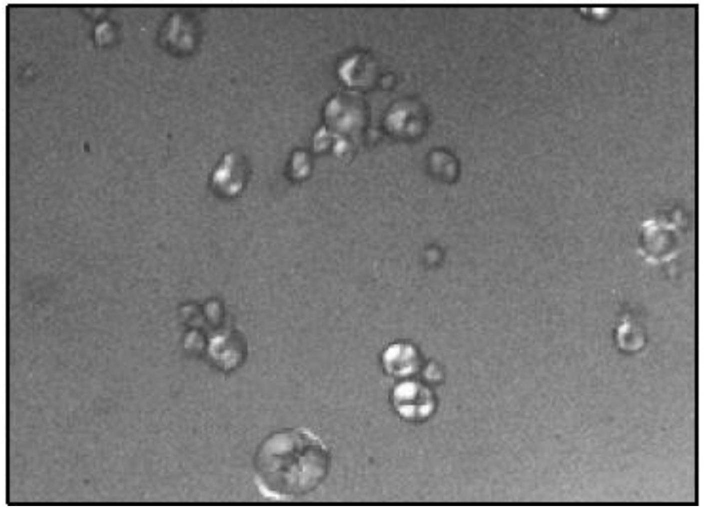
Starch

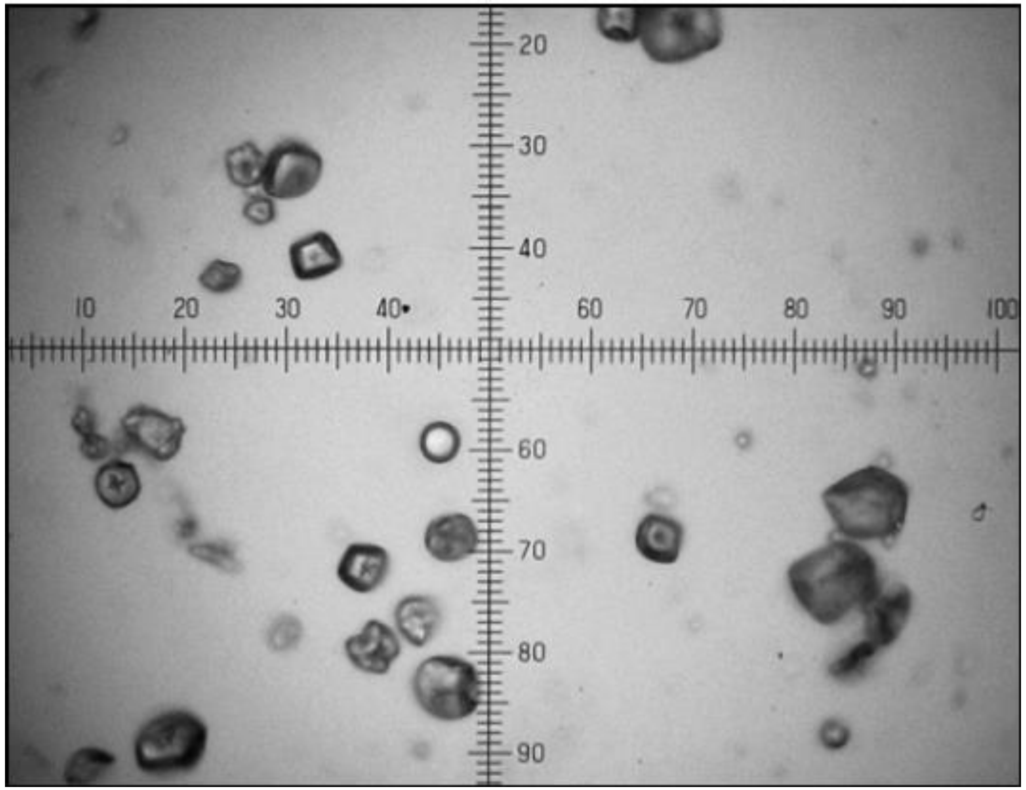


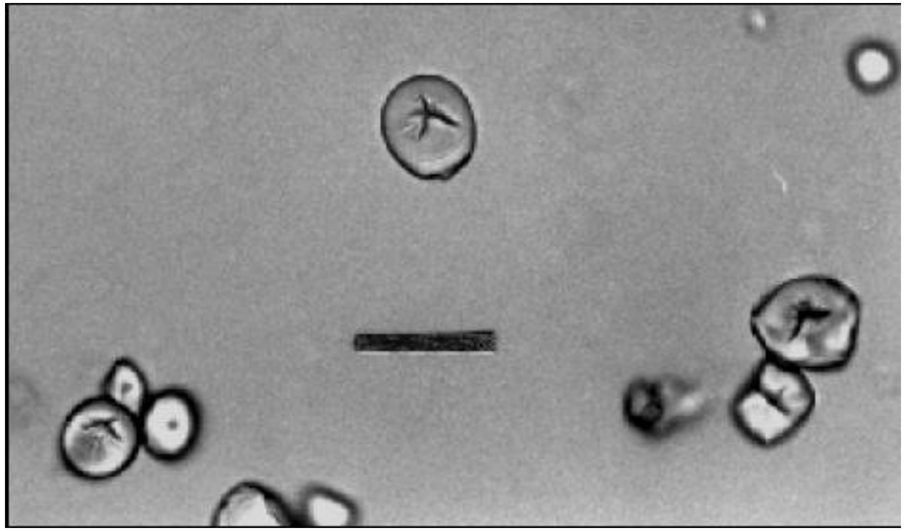
Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Ipomoea cf. repanda

Starch







Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

COSTACEAE

Chamaecostus cuspidatus

Phytolith

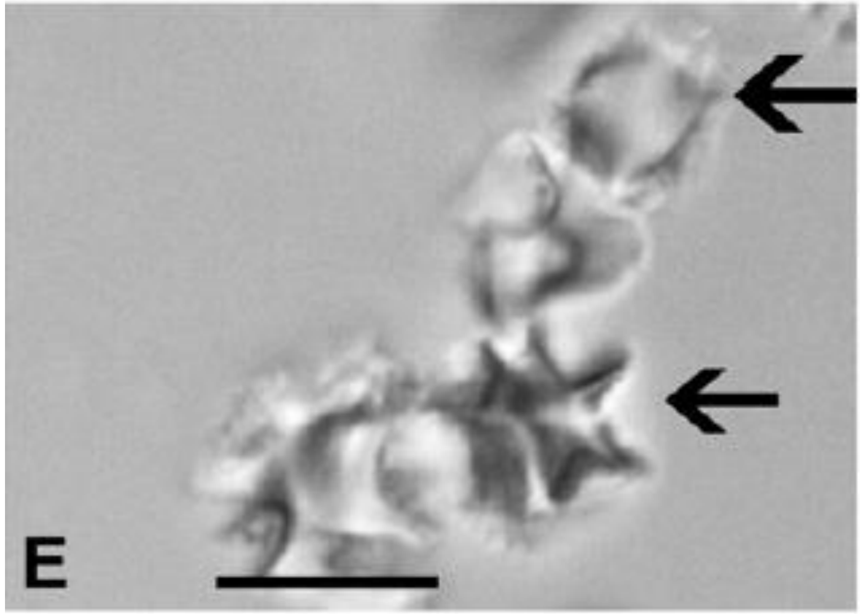


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). E, non-fringed D1 (bottomarrow) and D2 (top arrow) druses from Chamaecostus cuspidatus leaf. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Cheilocostus specious

Phytolith

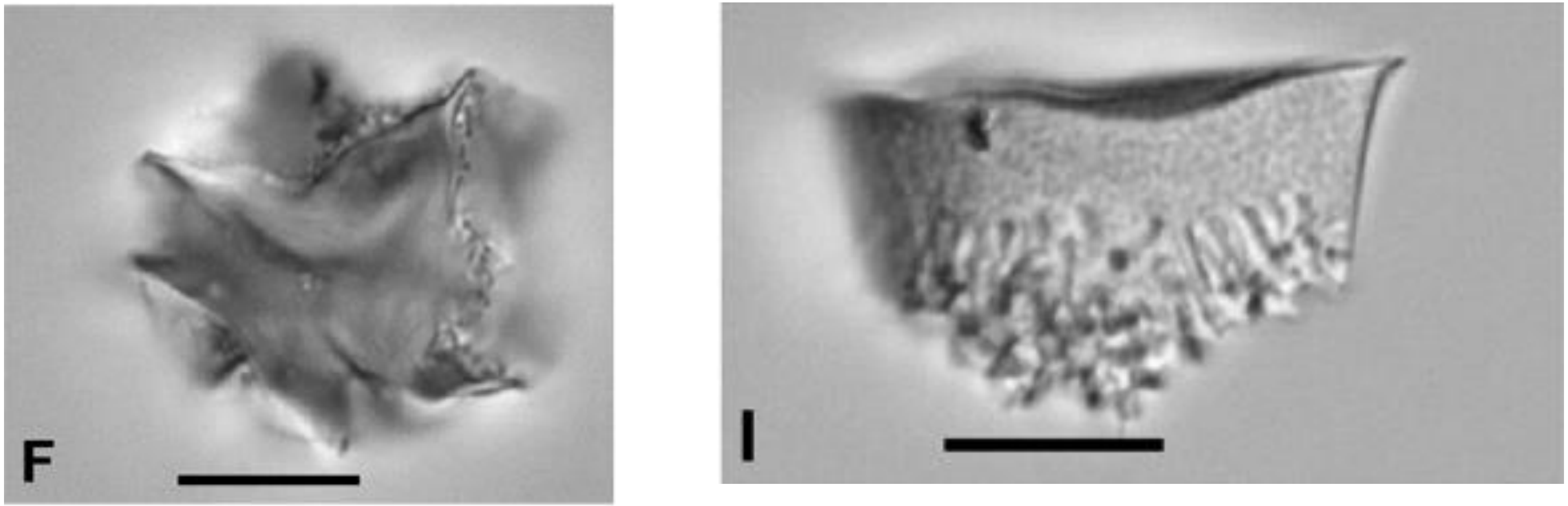


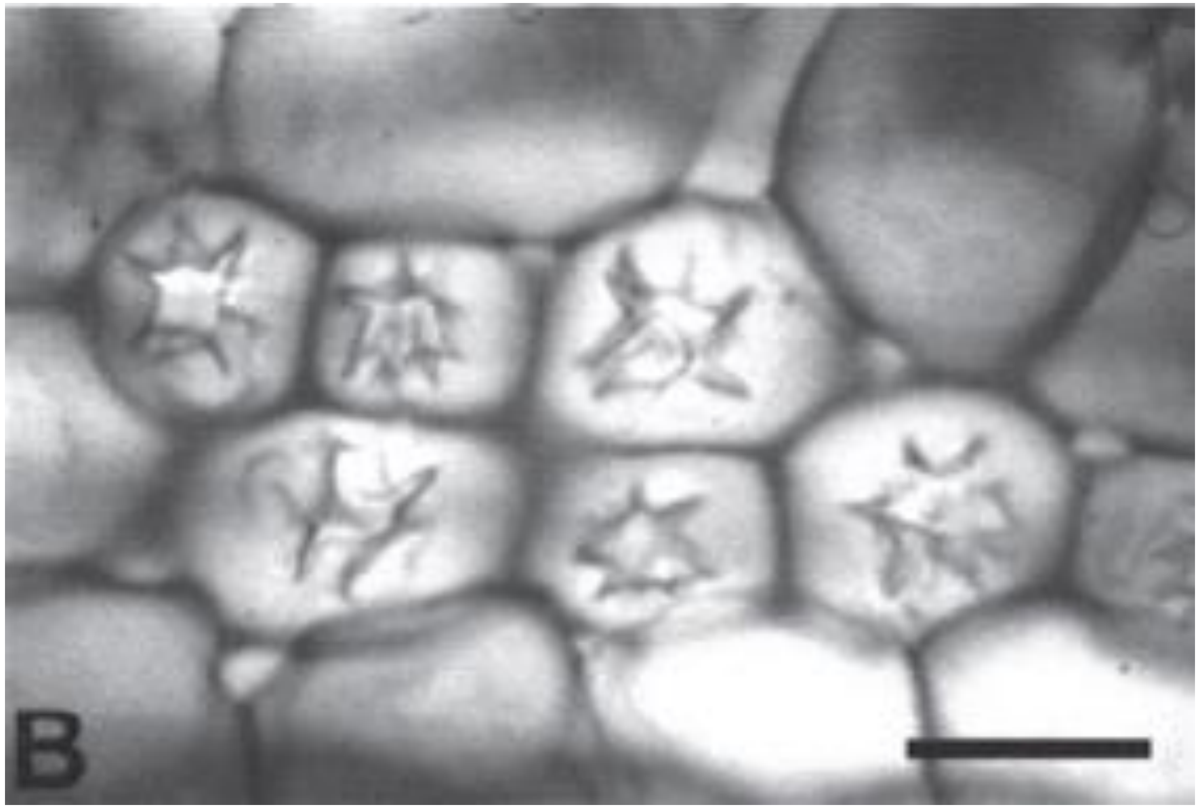
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). F, non-fringed D1 druse from Cheilocostus specious rhizome. I, side-view of Ta1 from Cheilocostus specious seed. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Costus englerianus

Phytolith

Fig. 3. Various silica body morphologies found in the order Zingiberales. B. Costus englerianus (Costaceae), druse-like silica bodies over bundle-sheath cells (bar = 20μm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Costus lacerus

Phytolith

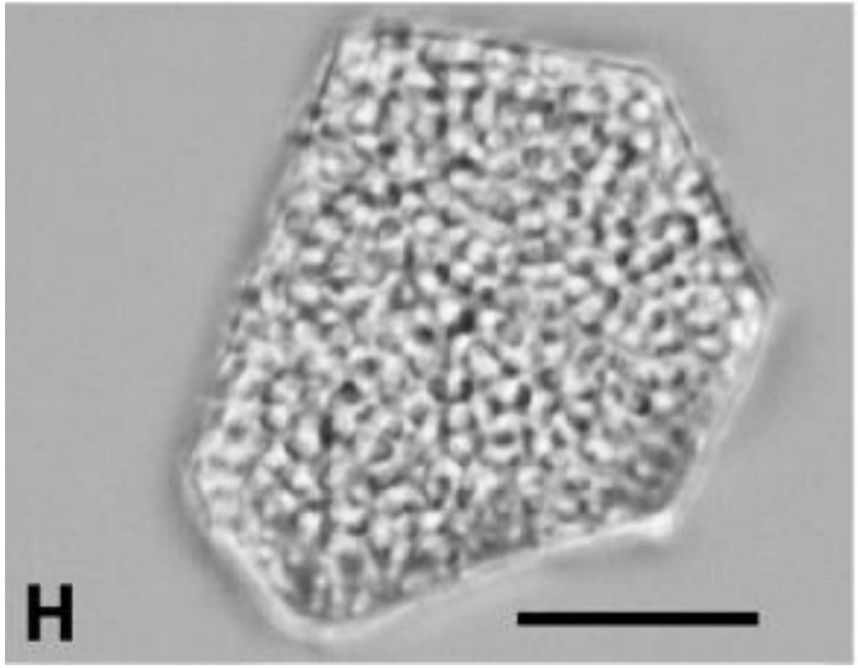


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). H, top-view of Ta1 (tabular-columellate) from Costus lacerus seed. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Costus pulverulentus

Phytolith

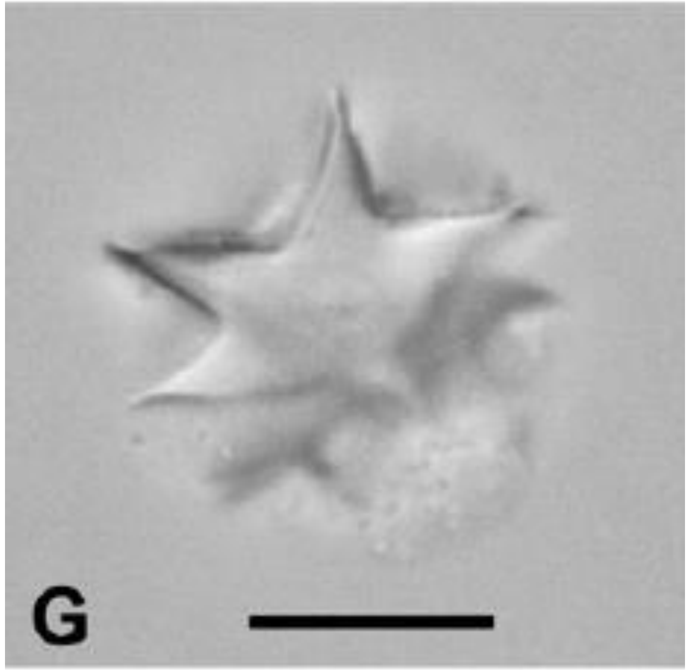


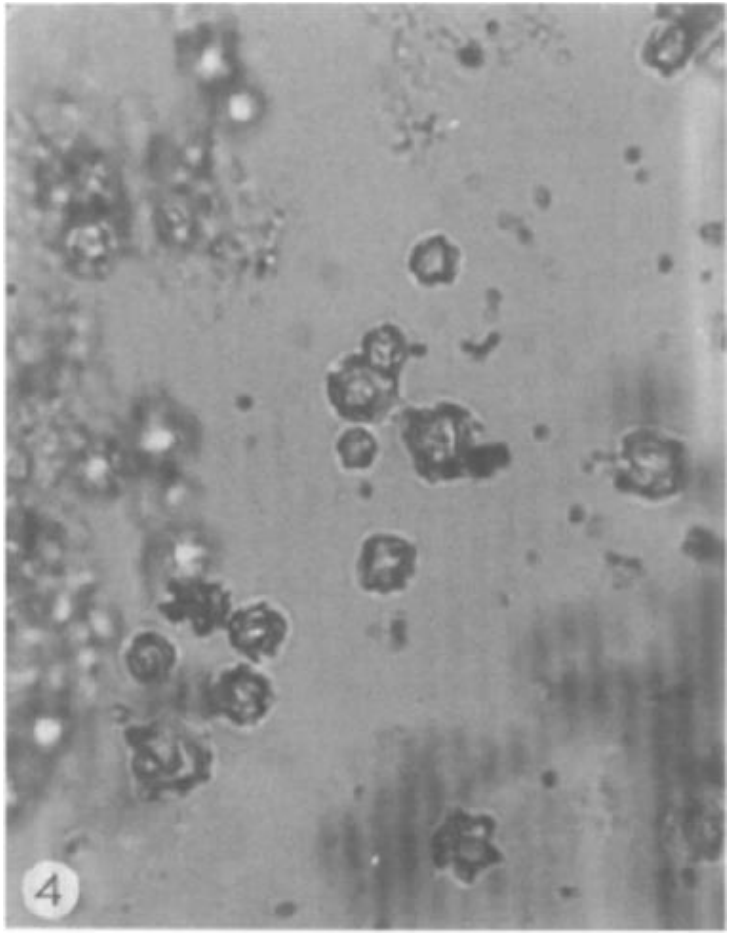
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). G, non-fringedD1 druse from Costus pulverulentus rhizome. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Dimerocostus uniflorus

Phytolith

Phytoliths with irregularly angled or folded surfaces from Dimerocoatus uniflorus (250x).

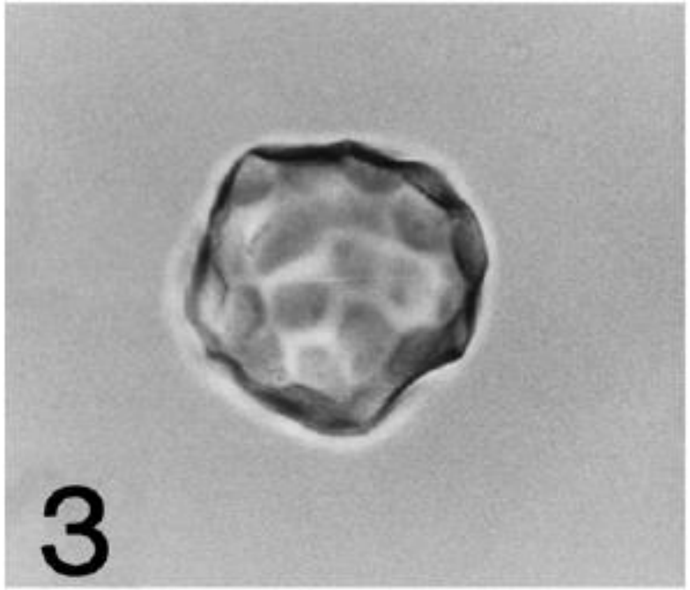


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

CUCURBITACEAE

Calycophysum pedunculatum

Phytolith

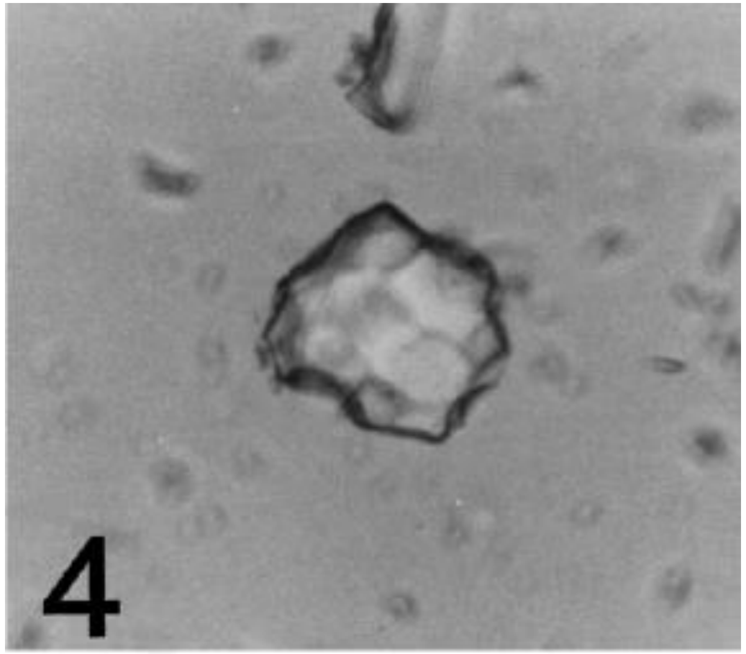


3. A scalloped phytolith from *Calycophysum pedunculatum*. In contrast to *Cucurbita* it has irregular borders, shallow scallops, and usually only one decorated hemisphere.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cionosicys macrantha

Phytolith



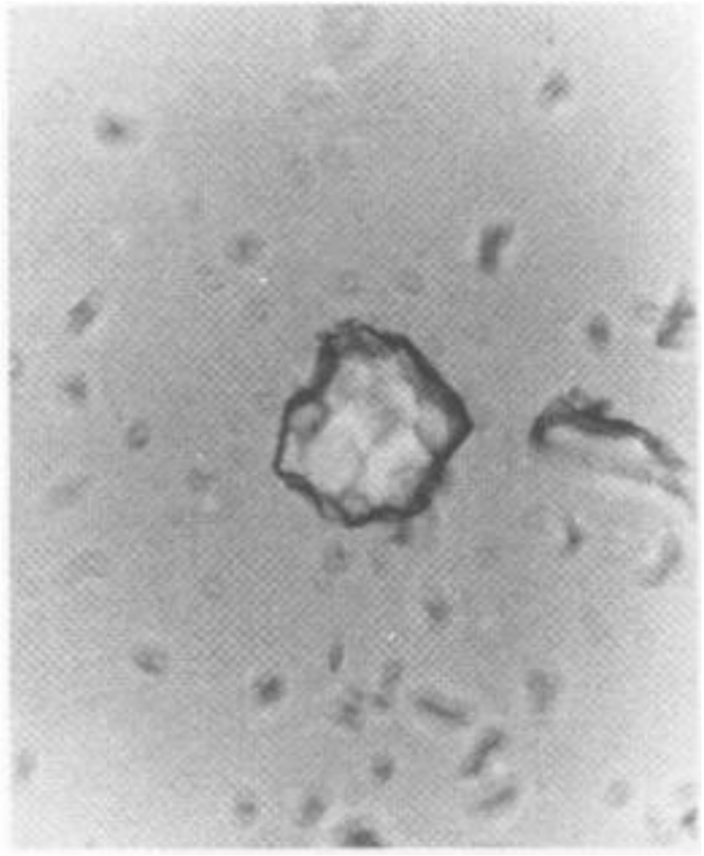
4. An irregular, scalloped phytolith from *Cionosicys macrantha*. Its longest dimension is 44 m. Most of these phytoliths are flat, and they do not possess hemispheres with different scallop sizes.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cionosicys macrantha

Phytolith

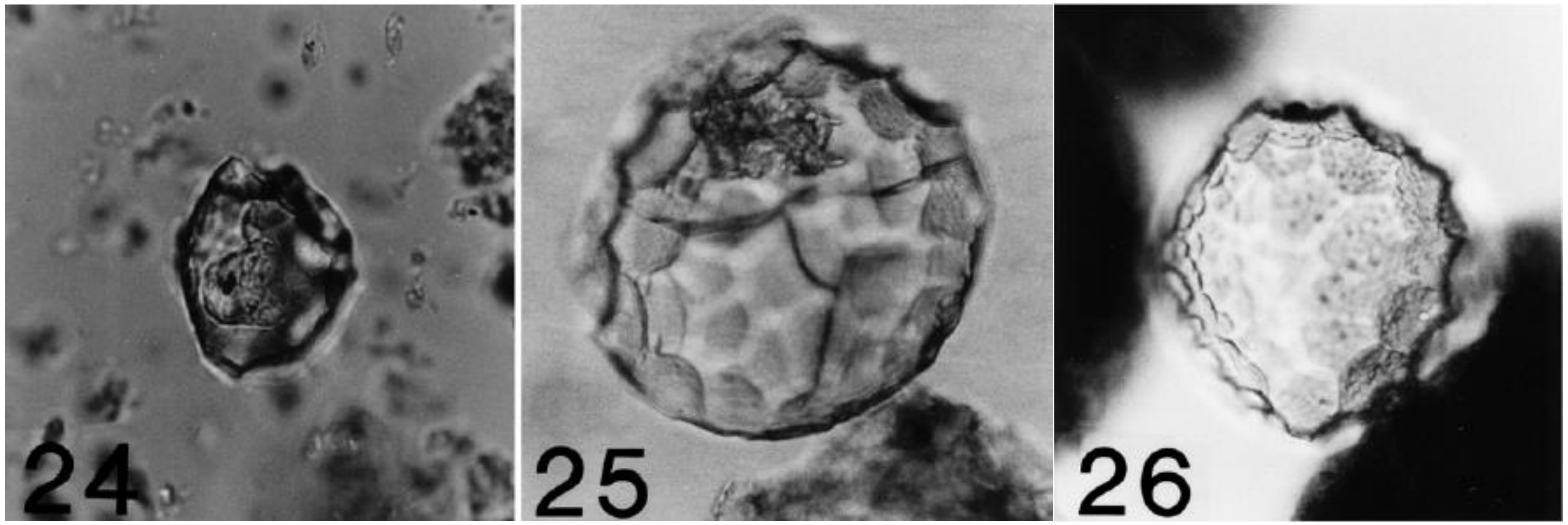
Fig. 16. Scalloped phytolith from a wild species in the Cucurbitaceae, Cionosicys macrantha (see caption for Fig. 15).



Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Cucurbita sp.

Phytolith



24. A *Cucurbita* phytolith from the pre-10,000 occupation at Vegas. It is 53 m long.
25. A *Cucurbita* phytolith from the assemblage directly dated to 9060 (Unit E 8–9, 110–120 cm below surface). It is 104 m long.
26. A *Cucurbita* phytolith from Vegas, same context as above. It is partially turned, revealing the hemisphere with smaller scallops. It is 80 m long.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cucurbita sp.

Phytolith

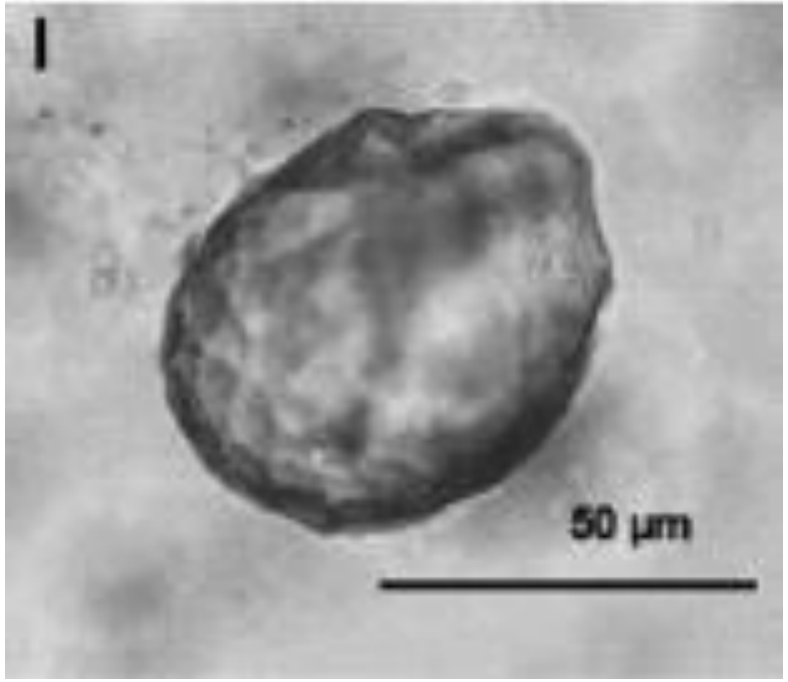


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. l) Cucurbita scalloped sphere (P Ridged Field 2, 10-20 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Cucurbita sp.

Phytolith

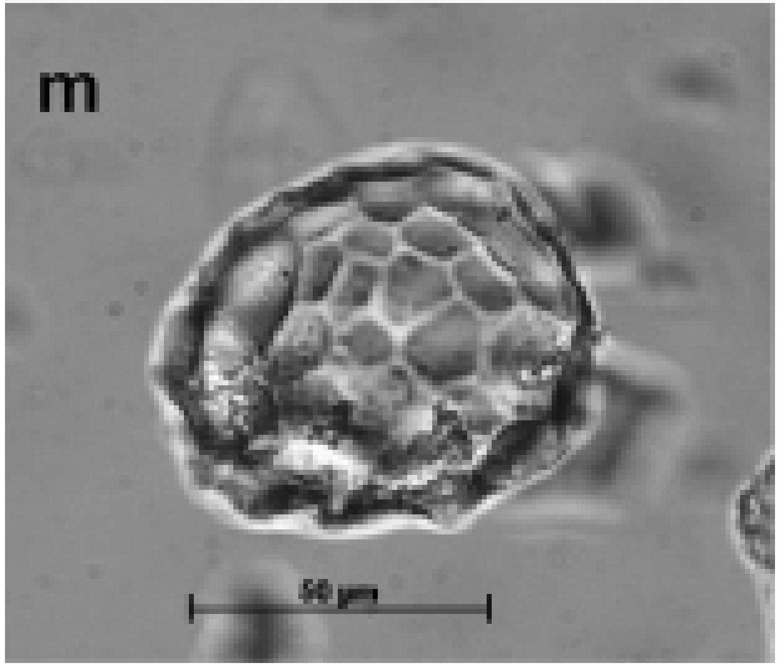


Fig. 5. Selected microbotanical remains. Phytoliths: m) Cucurbita sp. rind scalloped sphere (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Cucurbita sp.

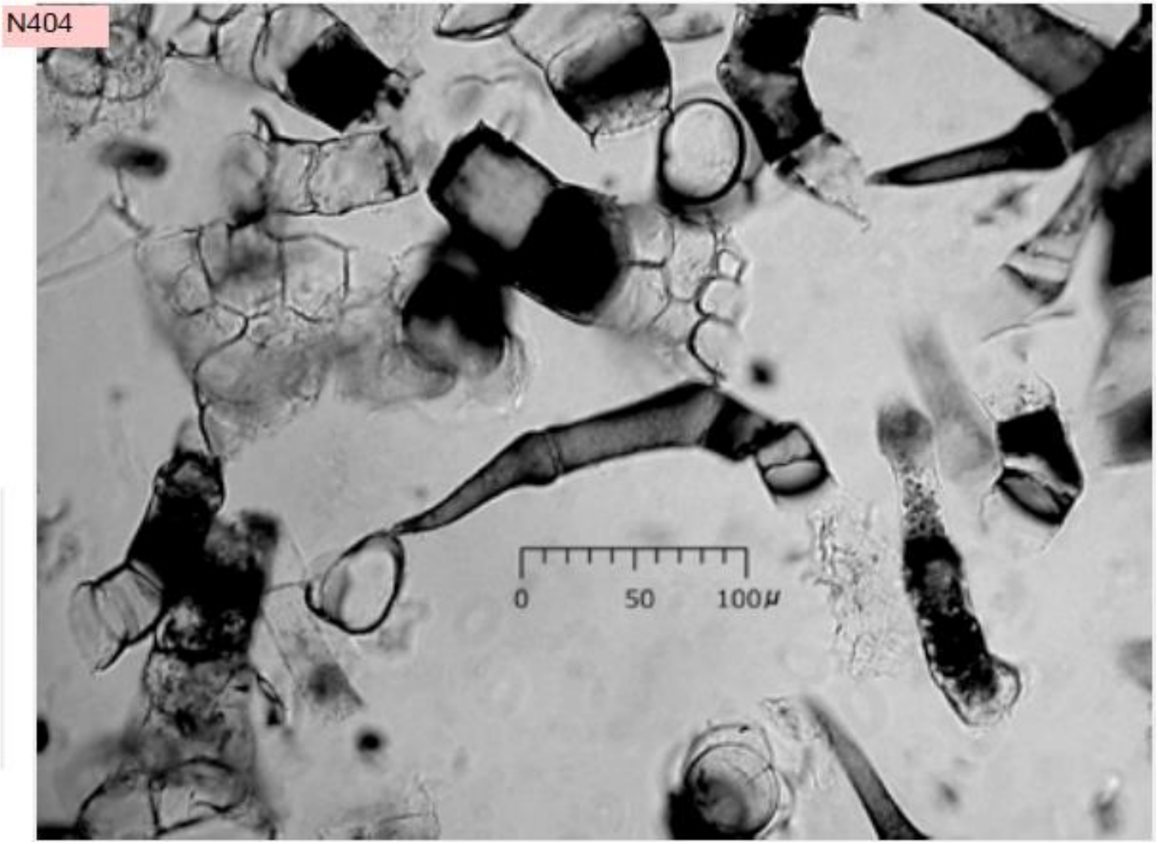
Phytolith

Hair base. Central cell often not obvious unless phytolith is rotated. Cells are transparent, allowing you to look down or through the base. Diagnostic level: Asteraceae/Cucurbitaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cucurbita sp.

Phytolith



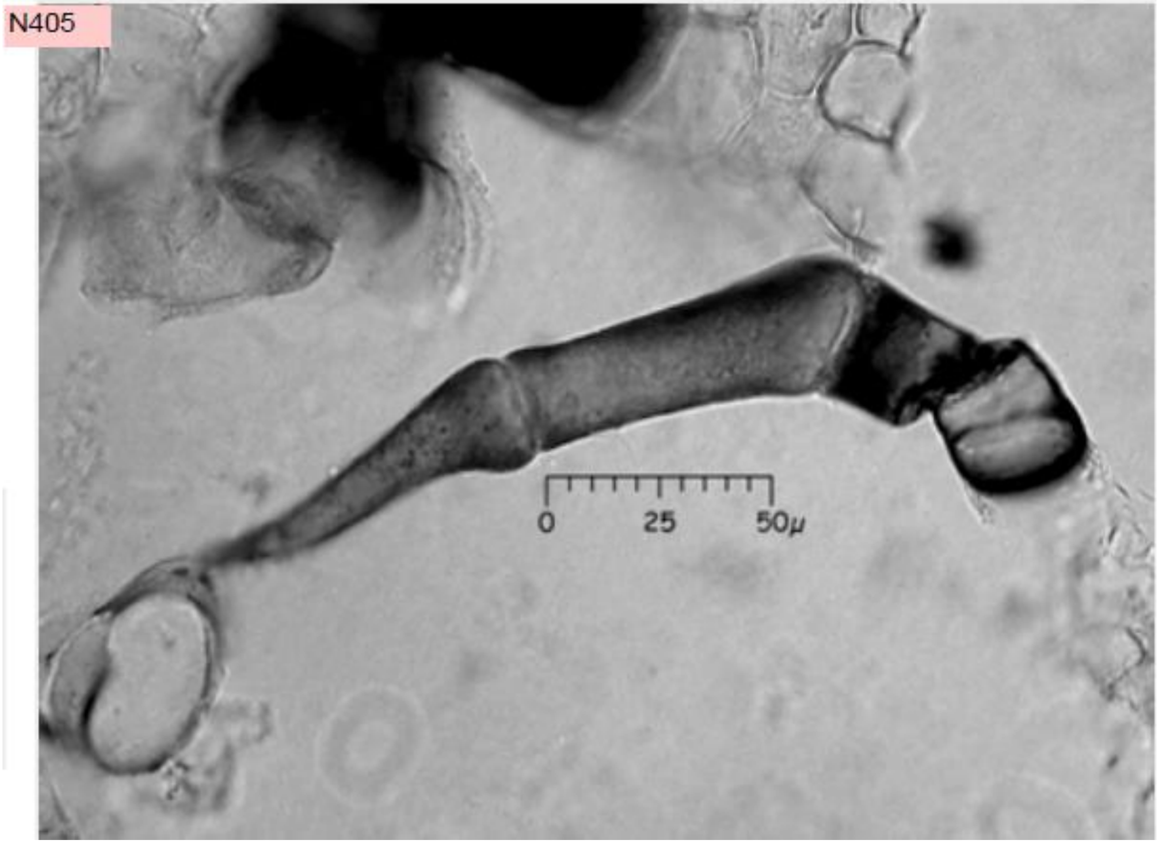
In some cases, base of hair is still inserted, making central cell very dark and obvious Diagnostic level: Asteraceae/Cucurbitaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cucurbita sp.

Phytolith

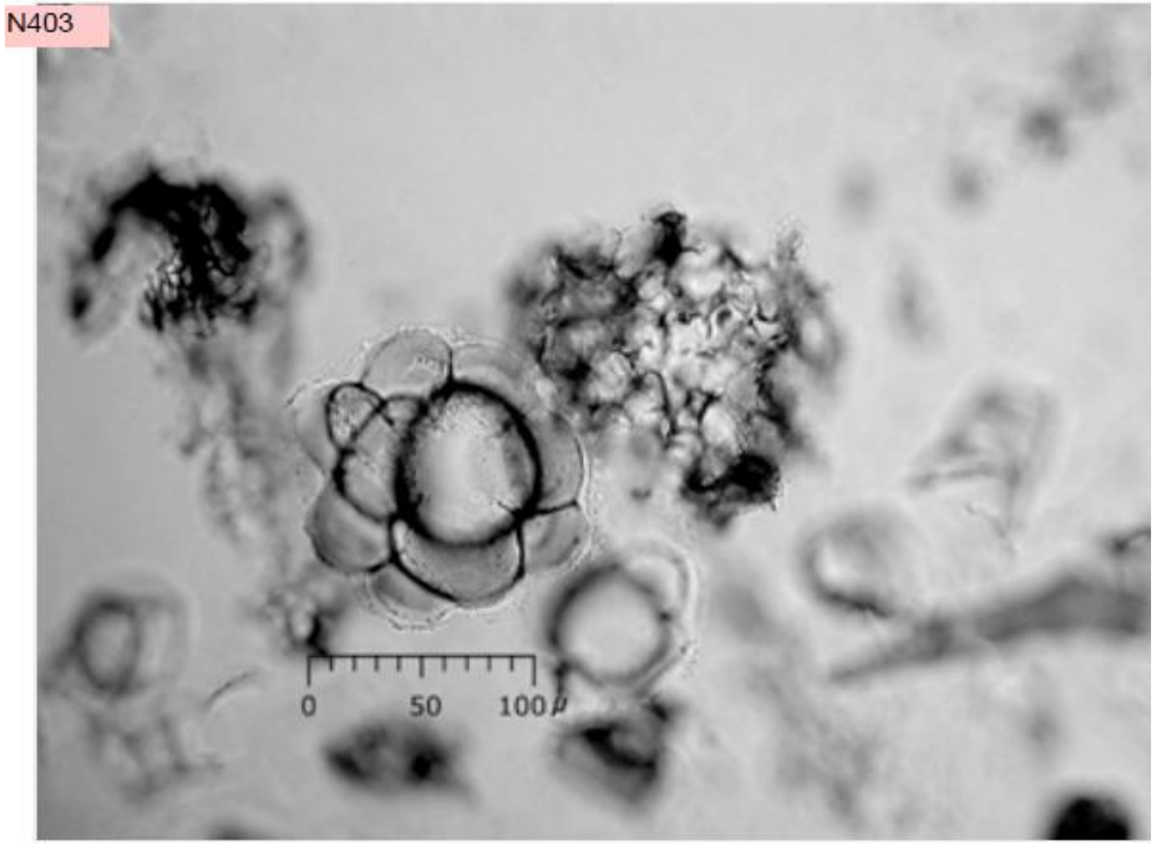
Number of joints varies. Diagnostic level: Cucurbitaceae/Asteraceae



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cucurbita sp.

Phytolith

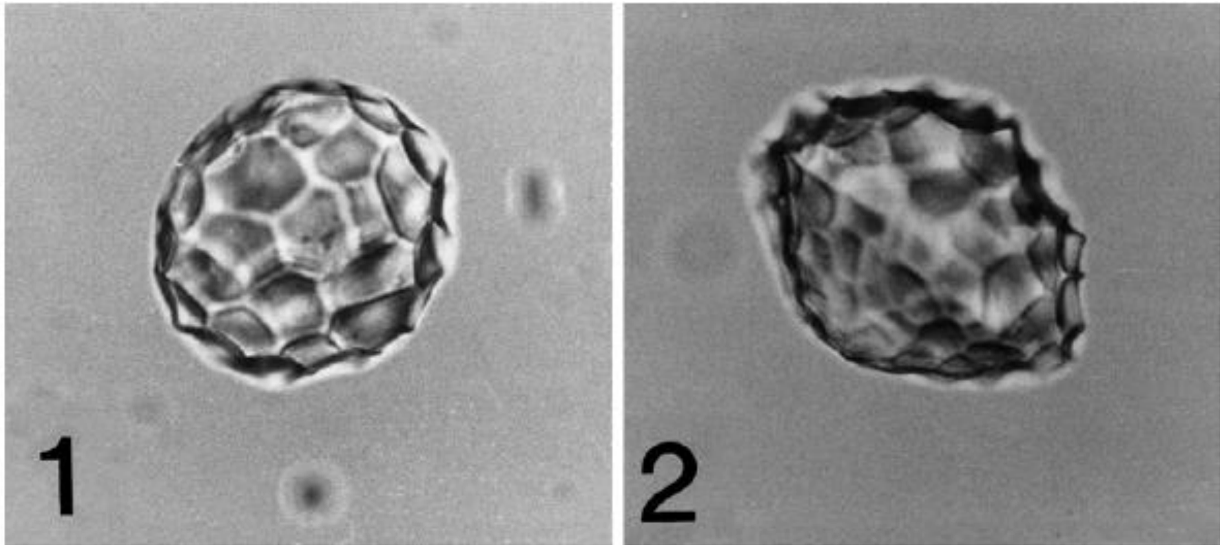


Hairbase and attached cells form a large sphere. This particular base is darkened/occluded. Also visible in image: A rotated, partial hairbase.
Diagnostic level: Cucurbitaceae/Asteraceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cucurbita argyosperma ssp. sororia

Phytolith



1. A spherical, deeply scalloped phytolith from *Cucurbita argyrosperma* ssp. *sororia* from Panama. Its longest dimension is 64 m.
2. A phytolith like the one in Figure 1 rotated so that the two different hemispheres can be seen.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cucurbita ficifolia

Phytolith

Figure 12. A phytolith from *Cucurbita ficifolia*. One hemisphere has a grainy type of decoration (compare with Figures 2 & 13–16). It is 99 m long.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cucurbita ficifolia

Phytolith

Fig. 1. Scalloped phytoliths from the fruit rind of the domesticated species Cucurbita ficifolia, native to Andean South America. The phytolith on the bottom is 125mm long.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

Cucurbita ficifolia

Phytolith

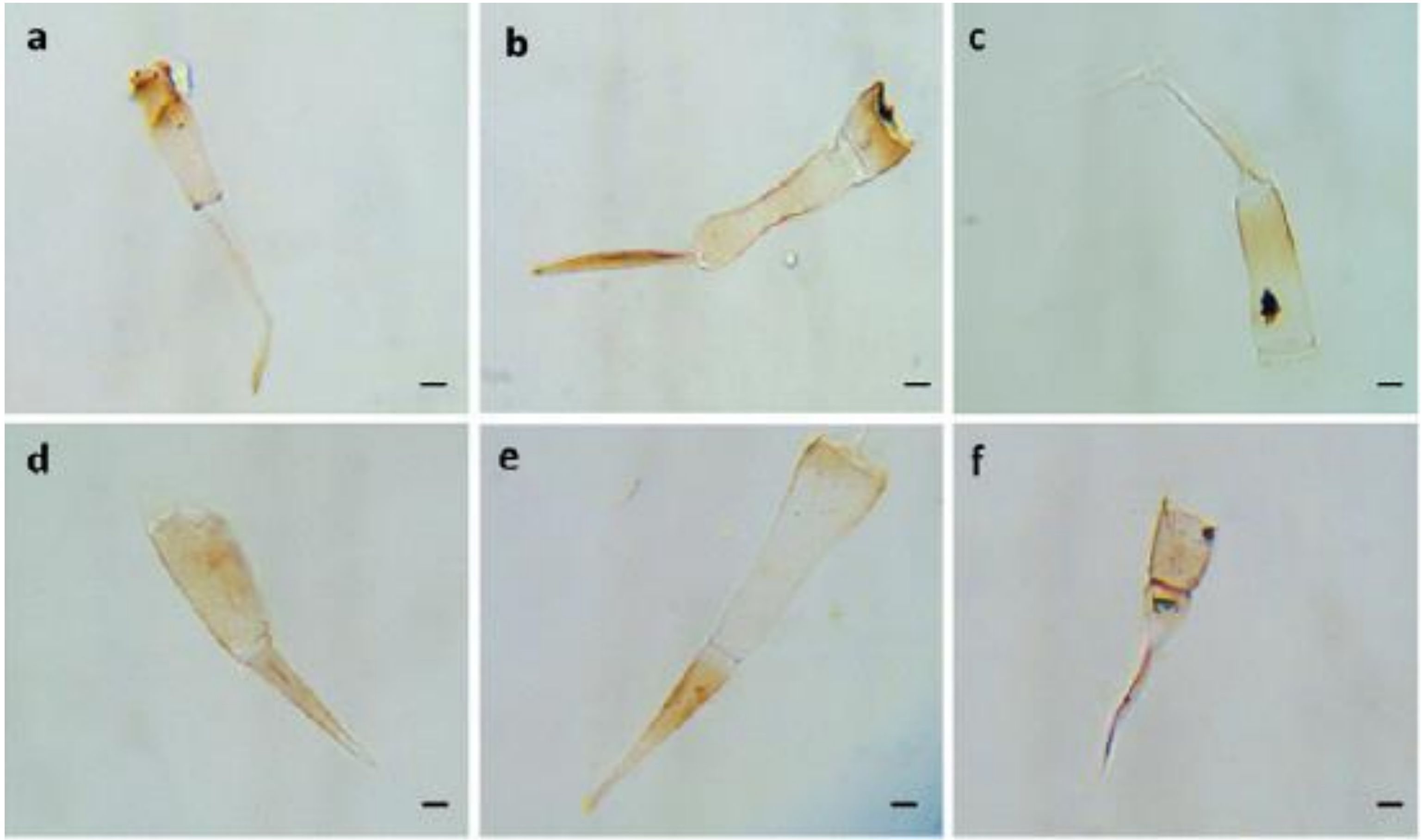


Figure 3. Squash leaf phytoliths (Cucurbita ficifolia Bouché. a) 137.97µm, 20.58µm; b) 88.23µm, 16.3µm; c) 123.78µm, 23.78µm; d) 100.7µm, 21.48µm; e) 93.6µm, 18.54µm; f) 53.32µm, 13.64µm. Scale: 10 µm by 40X

Poveda-Díaz, Nataly, Maria Eugenia Morales-Puentes, and Gregory Vaughan. 2016. Phytoliths Produced by Common Bean (Phaseolus Vulgaris L.), Achira (Canna Indica L.), and Squash (Cucurbita Ficifolia Bouché), Crop Species from Boyacá, Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 40 (154):137–46.

Cucurbita ficifolia

Phytolith

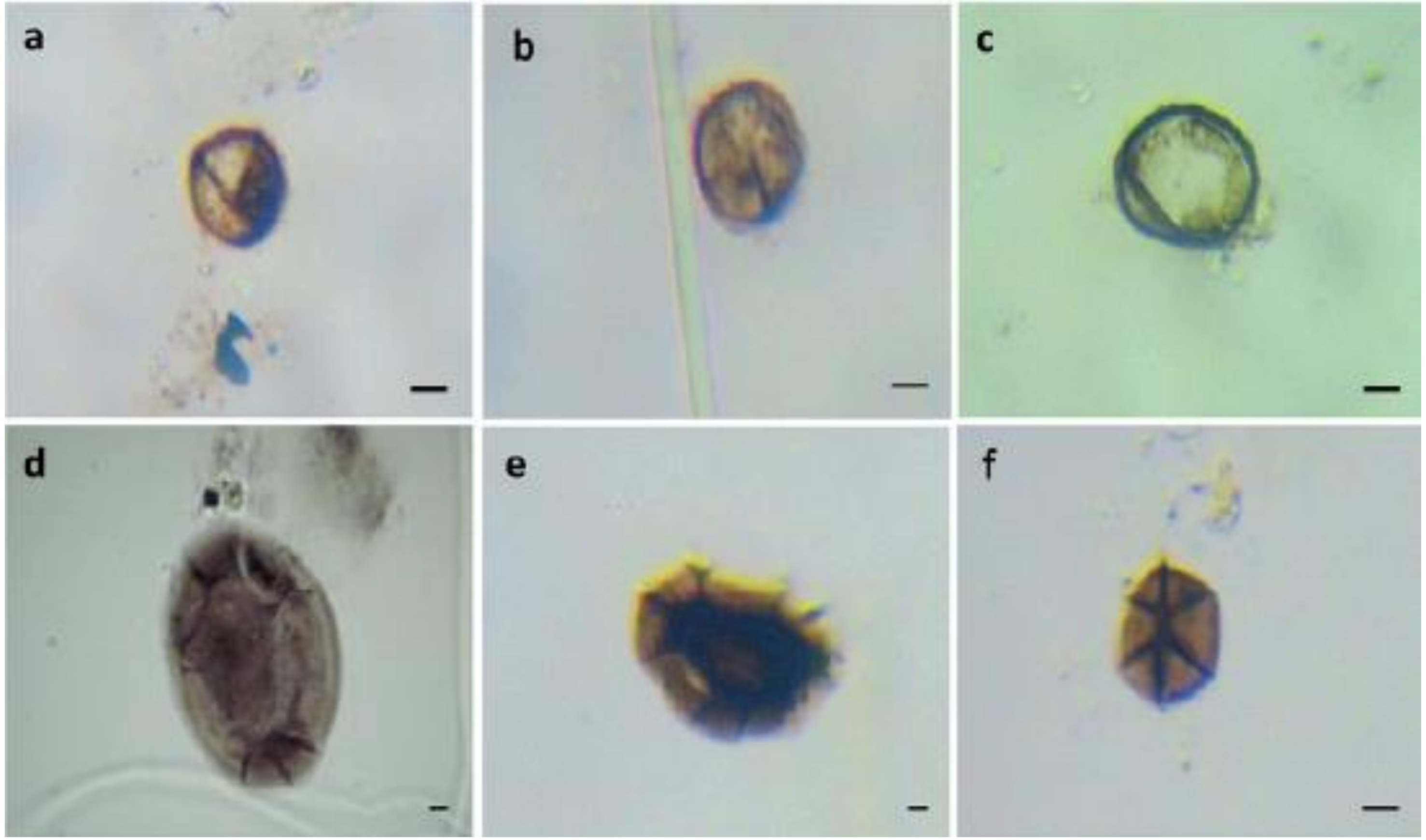
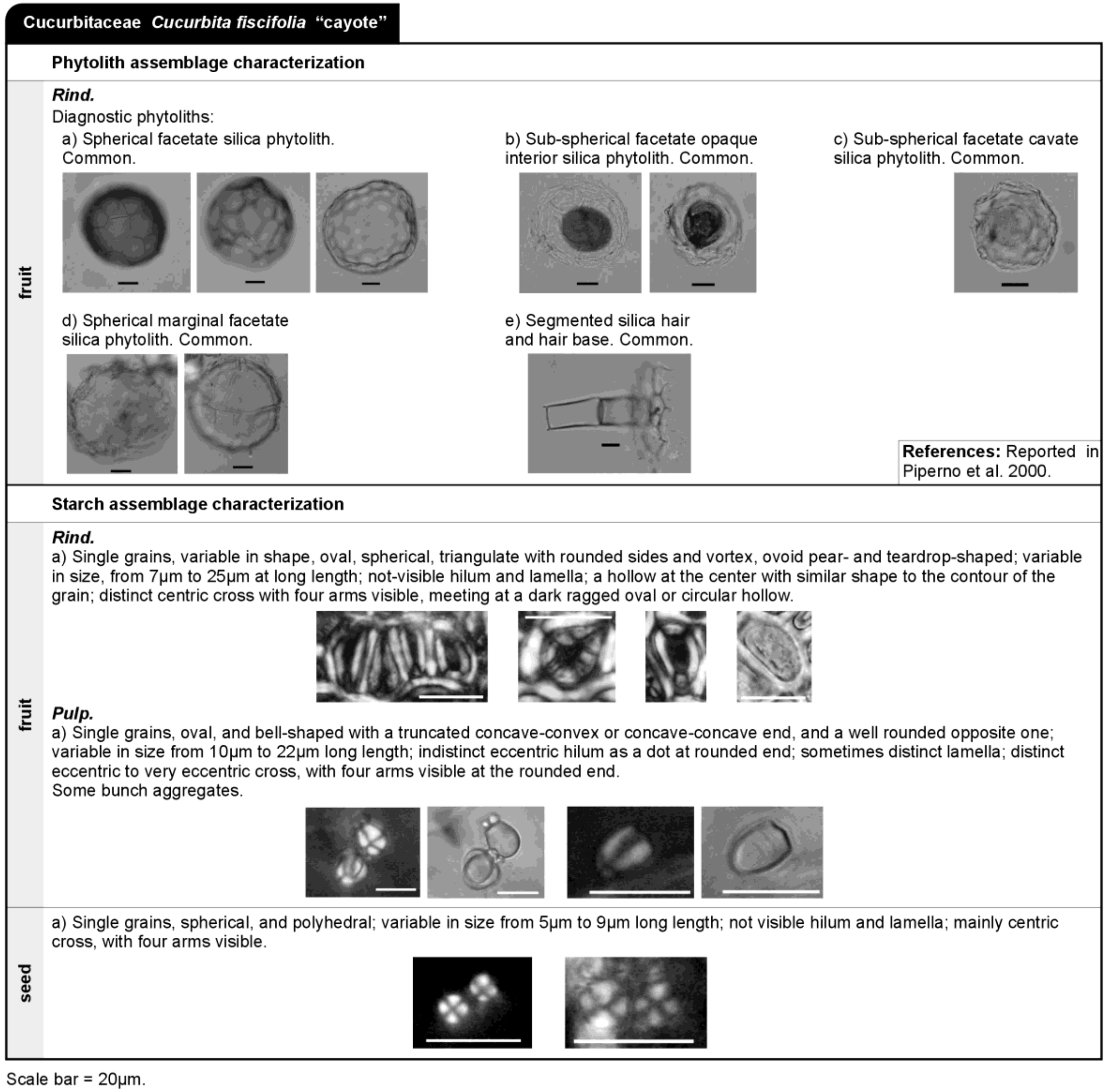


Figure 4. Phytoliths from the epidermis of squash fruit (Cucurbita ficifolia Bouché). a) 23.25µm, 21.63µm; b) 47.97µm, 28.62 µm; c) 38.7µm, 23.86µm; d) 21.63 µm, 16.88 µm; e) 22.24µm, 21.26µm; f) 32.93 µm, 21.14 µm. Scale: 10 µm by 40X.

Poveda-Díaz, Nataly, Maria Eugenia Morales-Puentes, and Gregory Vaughan. 2016. Phytoliths Produced by Common Bean (Phaseolus Vulgaris L.), Achira (Canna Indica L.), and Squash (Cucurbita Ficifolia Bouché), Crop Species from Boyacá, Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 40 (154):137–46.

Cucurbita fiscifolia



Cucurbitaceae *Cucurbita fiscifolia* "cayote"

Phytolith assemblage characterization

fruit

Rind.

Diagnostic phytoliths:

a) Spherical facetate silica phytolith. Common.

b) Sub-spherical facetate opaque interior silica phytolith. Common.

c) Sub-spherical facetate cavate silica phytolith. Common.

d) Spherical marginal facetate silica phytolith. Common.

e) Segmented silica hair and hair base. Common.

References: Reported in Piperno et al. 2000.

Starch assemblage characterization

fruit

Rind.

a) Single grains, variable in shape, oval, spherical, triangulate with rounded sides and vortex, ovoid pear- and teardrop-shaped; variable in size, from 7μm to 25μm at long length; not-visible hilum and lamella; a hollow at the center with similar shape to the contour of the grain; distinct centric cross with four arms visible, meeting at a dark ragged oval or circular hollow.

Pulp.

a) Single grains, oval, and bell-shaped with a truncated concave-convex or concave-concave end, and a well rounded opposite one; variable in size from 10μm to 22μm long length; indistinct eccentric hilum as a dot at rounded end; sometimes distinct lamella; distinct eccentric to very eccentric cross, with four arms visible at the rounded end.

Some bunch aggregates.

seed

a) Single grains, spherical, and polyhedral; variable in size from 5μm to 9μm long length; not visible hilum and lamella; mainly centric cross, with four arms visible.

Scale bar = 20μm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Cucurbita lundelliana

Phytolith

Fig. 12. A phytolith from Cucurbita lundelliana like the one in Fig. 11, turned on its side to reveal the different pattern of scallop shape and size on the hemispheres of Cucurbita phytoliths.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

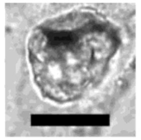
Cucurbita maxima

Cucurbitaceae *Cucurbita maxima* "zapallo"

Phytolith assemblage characterization

fruit

Rind.
Diagnostic phytoliths:
a) Sub-round facetate silica phytolith. Common.



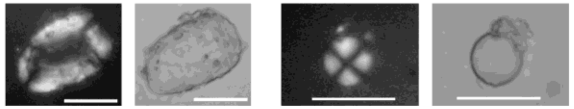
References: Reported in Bozarth 1987 and Piperno et al 2000.

Starch assemblage characterization

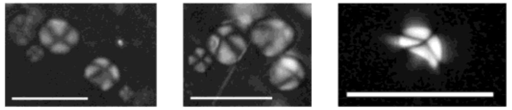
fruit

Rind.
a) Single grains, variable in shape, oval, spherical, triangulate with rounded sides and vortex, ovoid pear- and teardrop-shaped; variable in size, to 40µm long length; non visible hilum and lamella; a centric hollow with similar shape to the contour of the grain; rough surface; distinct centric cross with four arms visible, meeting at dark oval or circular, sometimes ragged, hollow.

b) Also common spherical grains, to 12µm long length.

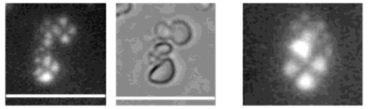


Pulp.
a) Single grains, spherical to oval, bowl- and sausage-shaped, sometimes truncated; variable in size from 2µm to 12µm long length; not visible hilum and lamella; distinct centric or lightly eccentric cross, with four arms visible.

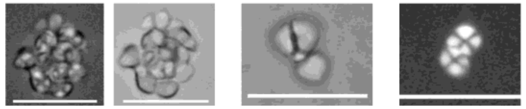


seed

a) Mainly single grains, spherical to oval, and bowl-shaped, with a truncated wavy concave-convex or convex end; variable in size from 2µm to 8µm long length; not visible hilum and lamella; distinct centric cross, with four arms visible.



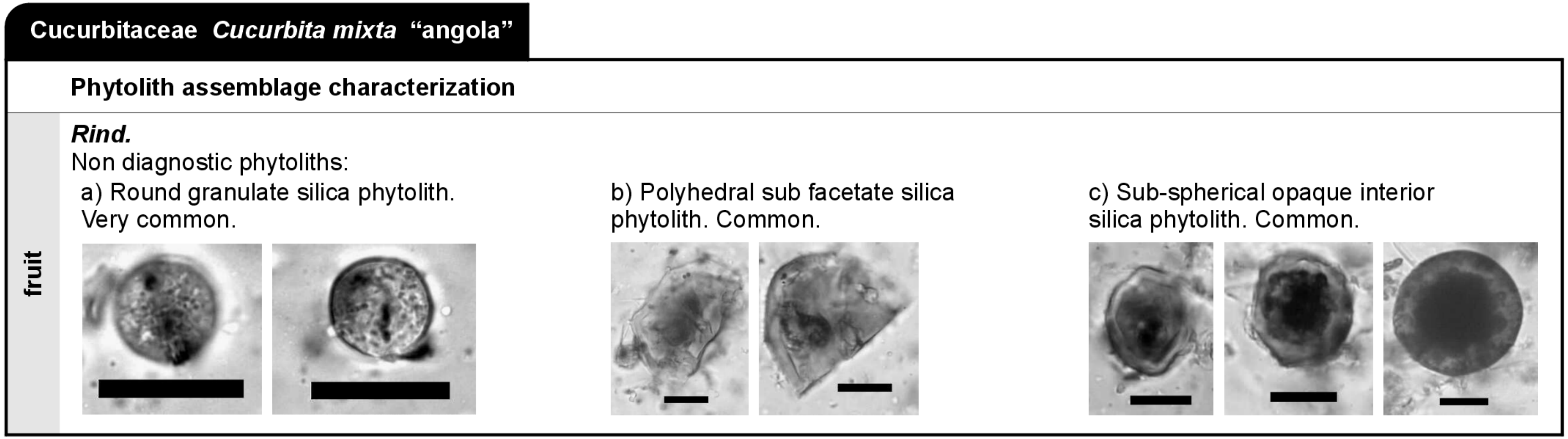
b) Some compound grains, oval and teardrop-shaped, compounded by three or four granula, and compound grains, irregular in shape, compounded by variable number of granula. Granula different in size and shape, with one or two oblique truncations. Aggregates.



Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

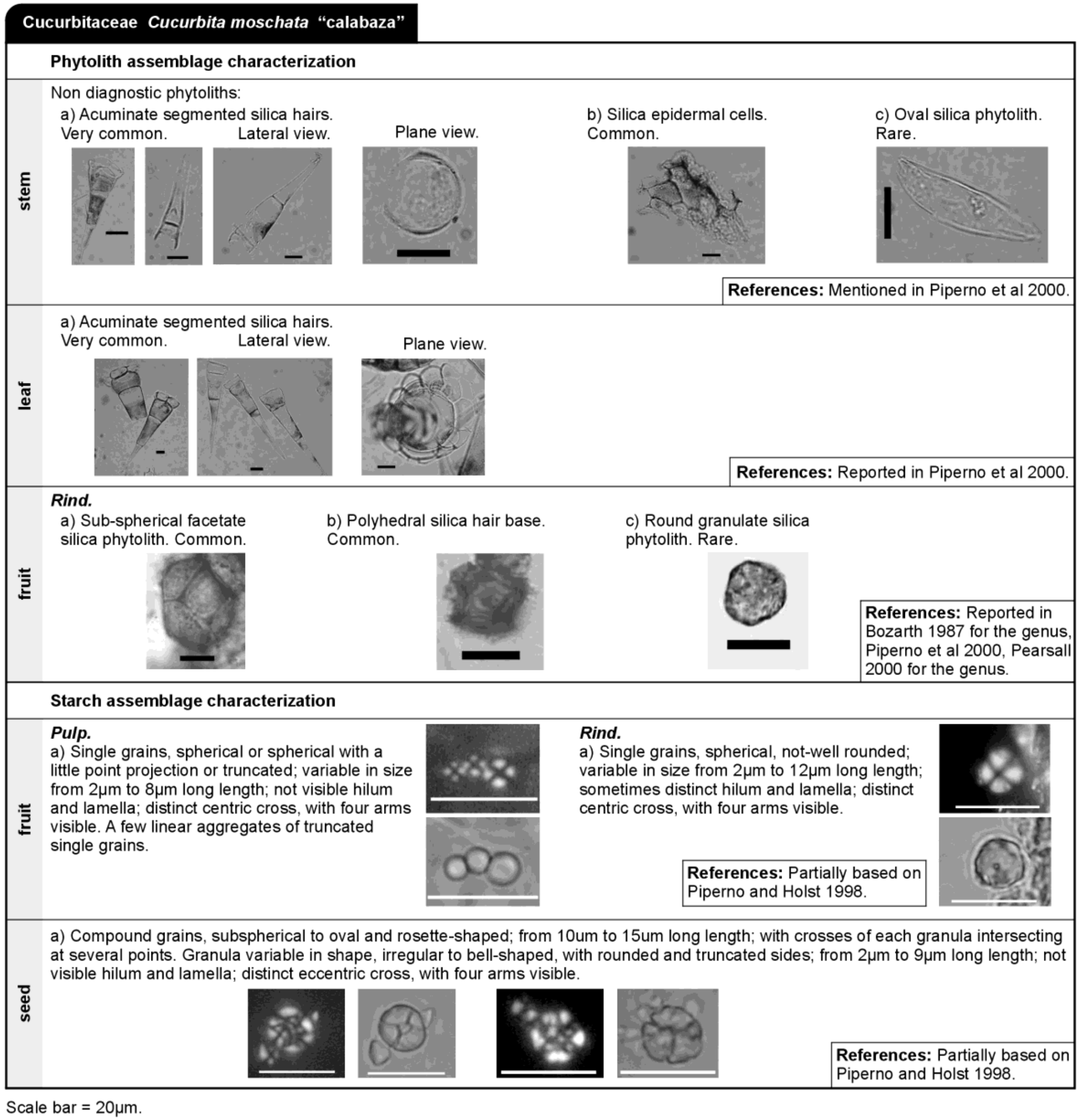
Cucurbita mixta



Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Cucurbita moschata



Korstanje and Babot,
McCown Archaeobotany Laboratory Collection

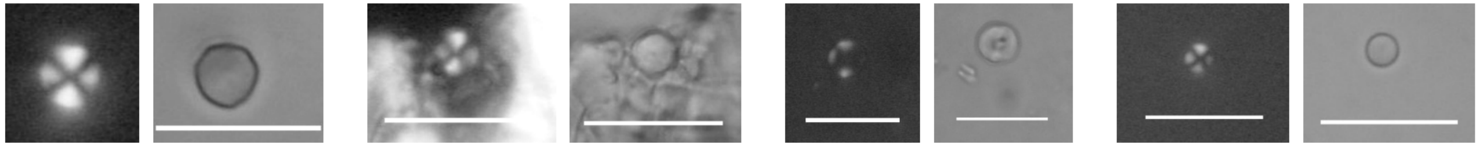
Cucurbita moschata

Cucurbitaceae ***Cucurbita moschata*** **“anco”**

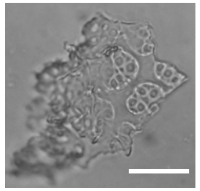
Starch assemblage characterization

seed

a) Single grains, spherical and polyhedral; variable in size from 3µm to 10µm long length; indistinct or distinct centric hilum as a dot or circle; not-visible lamella; distinct centric cross, with four arms visible.



b) Compound grains, compounded by six or more granula. Granula are similar in size, ranging as single grains do.



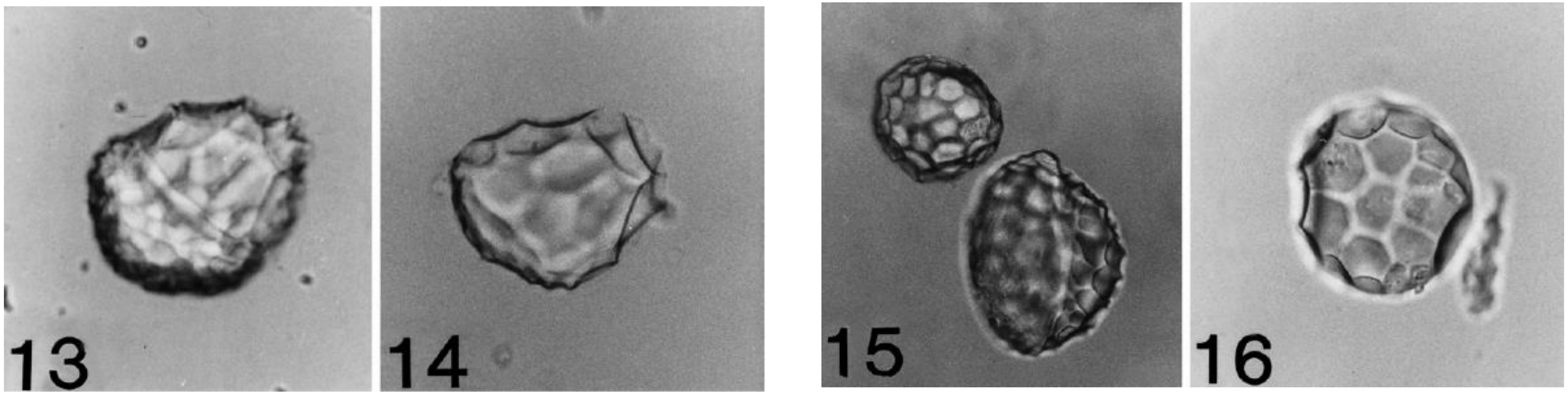
References: Partially based on Piperno and Holst 1998.

Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Cucurbita moschata

Phytolith



13. A phytolith from a Venezuelan population of *C. moschata*. It is thicker (72 m) than it is long (58 m) and possesses a clear demarcation between the two hemispheres. It also has elongated scallops on one hemisphere.
14. A scalloped phytolith from a Venezuelan population of *C. moschata*, in which the hemisphere with the smallest scallops is greatly reduced or truncated. These have only been observed thus far in *C. moschata*. It is 56 m long.
15. Scalloped phytoliths from *C. moschata* from western Ecuador. They differ from those in the Venezuelan land race of *C. moschata* (compare with Figures 13 & 14). The largest phytolith is 102 m long.
16. A scalloped phytolith from *C. moschata* from Vera Cruz, Mexico. It is 60 m long.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cucurbita moschata

Phytolith

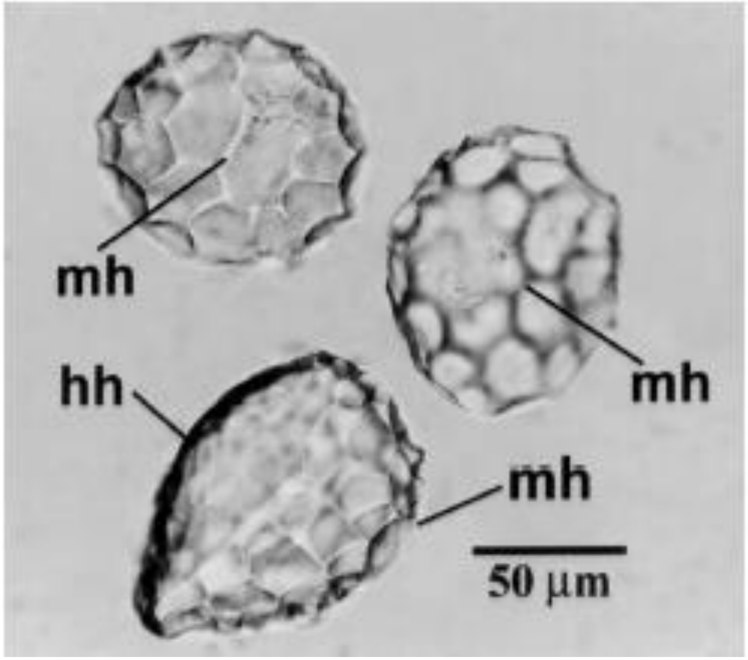


Fig. 5. Scalloped phytoliths from the domesticated species Cucurbita moschata. Wild squash phytoliths have the same morphology but are often much smaller than in domesticates. From Piperno, 2006

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Cucurbita moschata

Phytolith

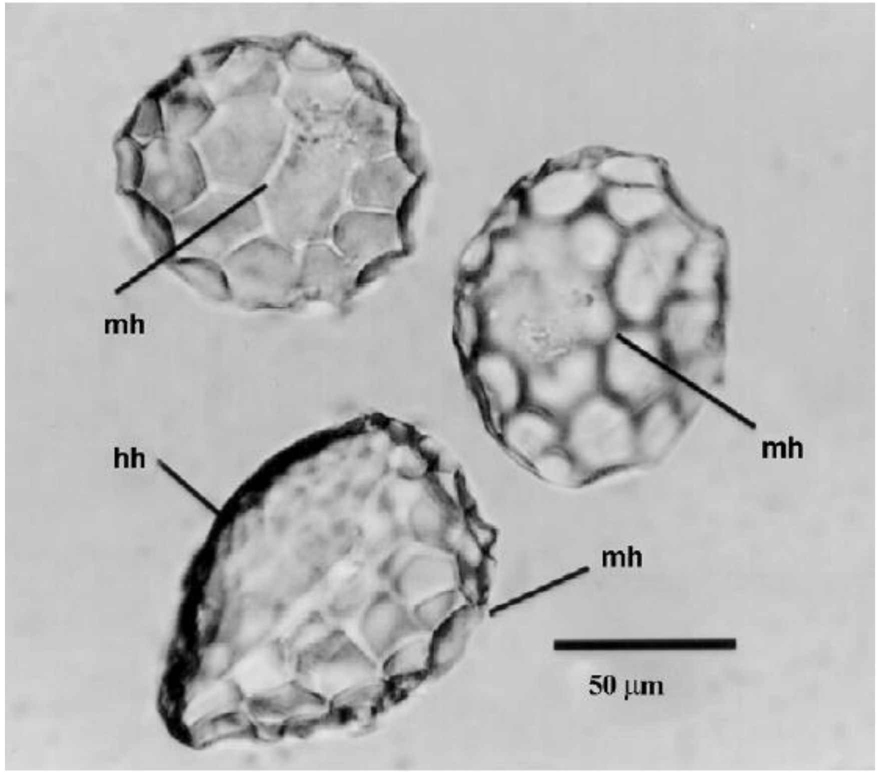
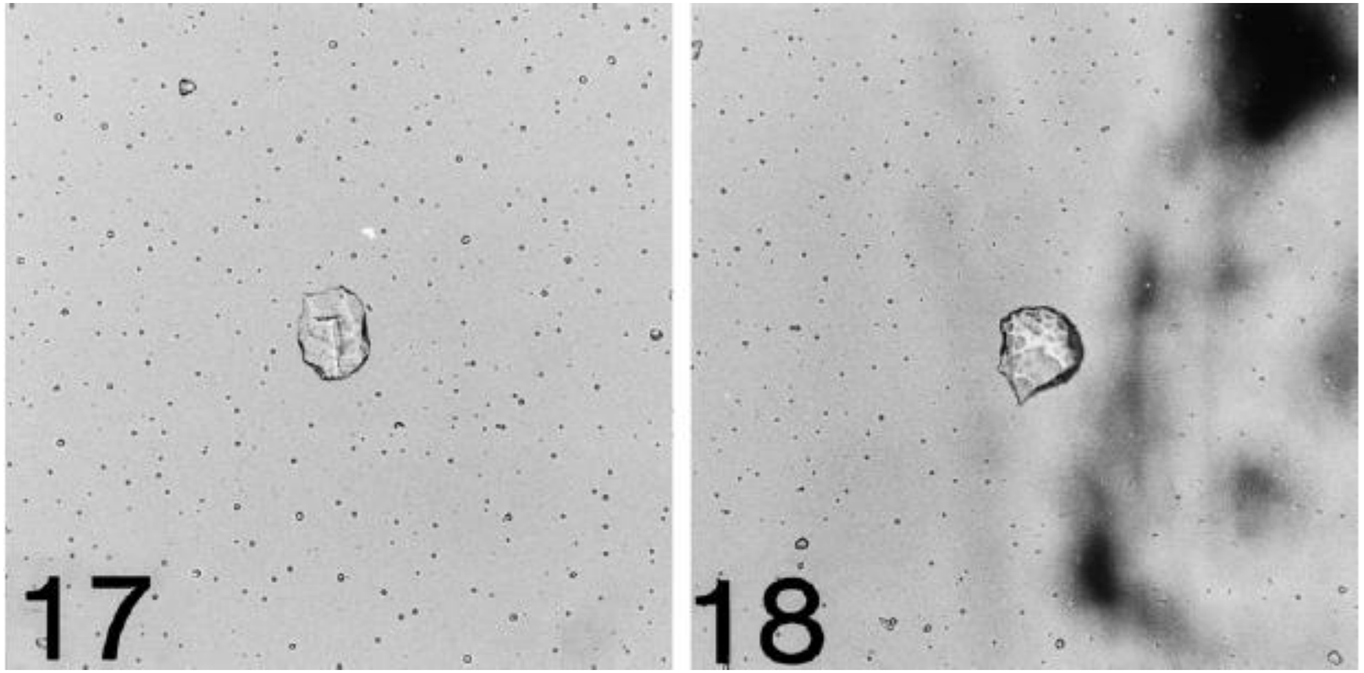


Fig. 2. Scalloped phytoliths from the domesticated species Cucurbita moschata. They have the same morphology as those in Fig. 1, but are larger than in C. sororia and other wild species. hh: hypodermal hemisphere, mh: mesocarpal hemisphere. Reprinted from Piperno et al. (2002), Copyright National Academy of Sciences USA.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

Cucurbita moschata

Phytolith



Figures 17 and 18. Irregular scalloped phytoliths from the bitter *C. moschata* from Panama. Both are about 40 m long.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Cucurbita moschata

Phytolith

Fig. 11. A spherical, scalloped phytolith from the rind of Cucurbita moschata. The scallops are round, deep, and regularly distributed.

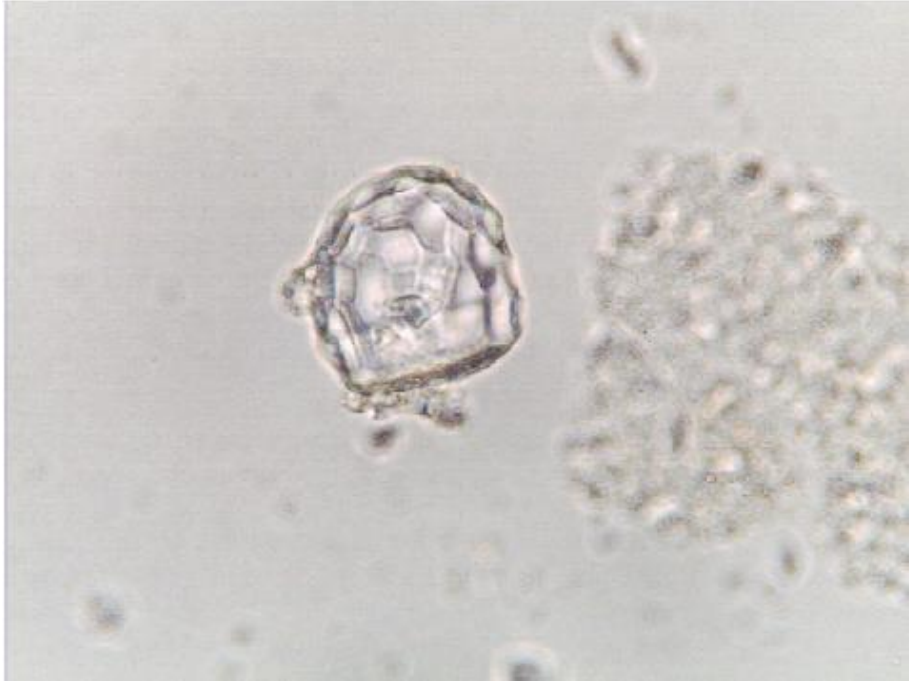
Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Cucurbita moschata

Phytolith

Fig. 9. A phytolith from a fruit rind of Cucurbita moschata recovered from Huaca Prieta, Peru. It is like those found in modern fruits of the crop. The longest dimension of the phytolith measures 66 mm.

Fig. 10. A phytolith from a fruit rind of Cucurbita moschata from Huaca Prieta, Peru. It has attributes unlike in phytoliths from modern fruits. The longest dimension is 54mm.



Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Cucurbita moschata

Starch

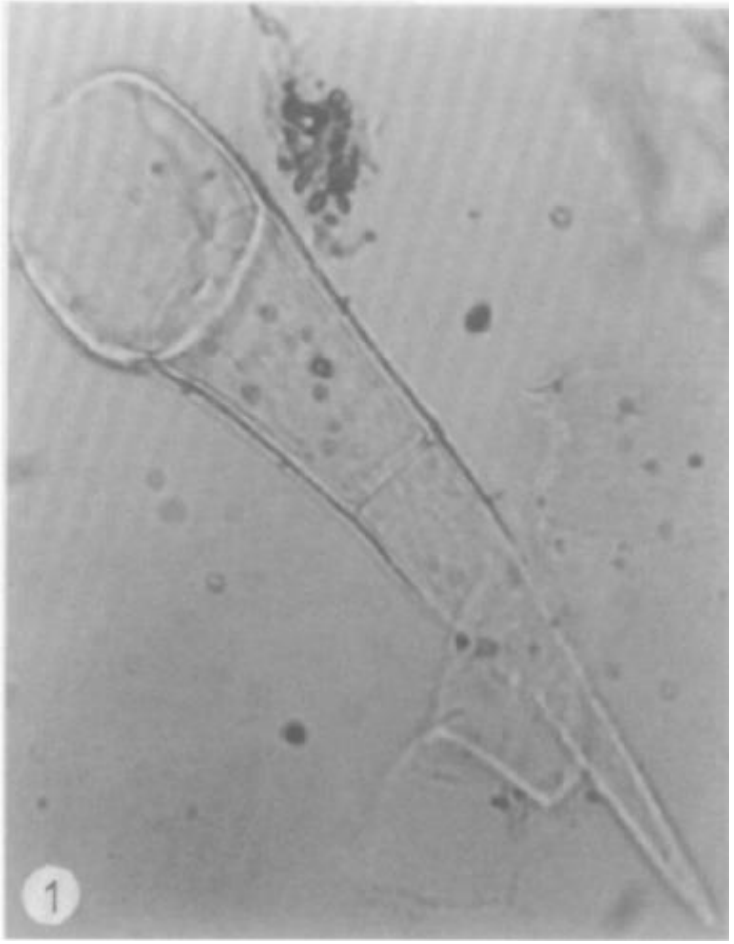
APPENDIX:
Cucurbita moschata (squash). Mostly simple grains, round to bell-shaped. When turned they may have the appearance of a hollow cone. The hilum is a closed point and is frequently surrounded by very prominent lamella. The distal end of the grains tends to be pleated. Size: 8–24 microns long.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Cucurbita palmata

Phytolith

1. A segmented hair from Cucurbita palmata (200 x).



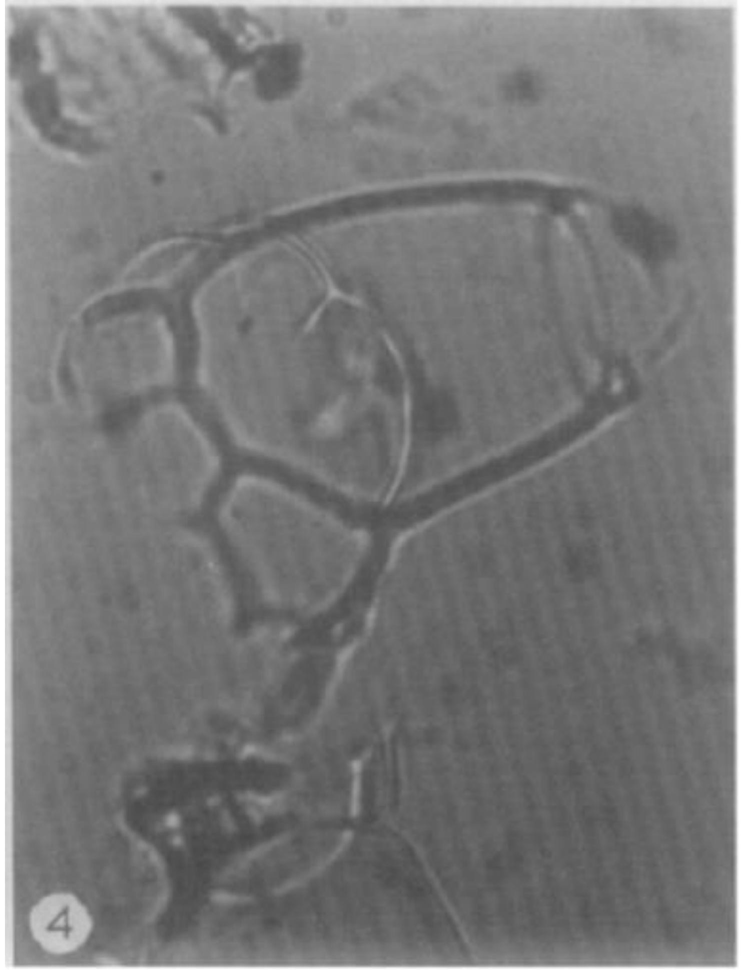
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

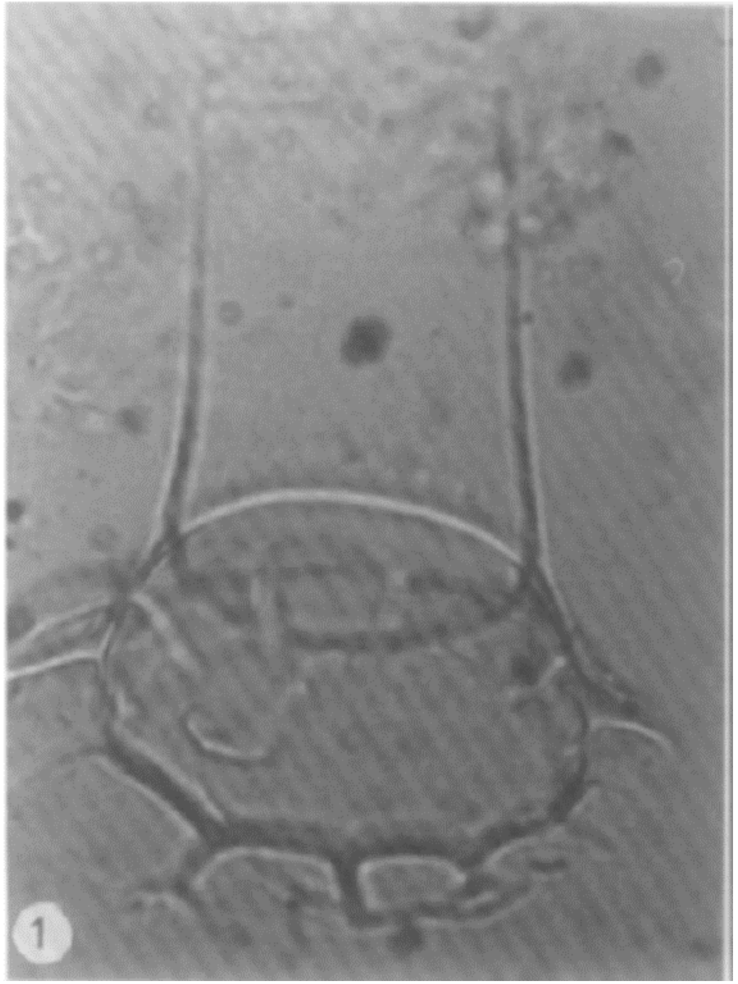
Cucurbita pepo

Phytolith

4. Segmented hair from Cucurbita pepo with two segments and a small, round apical segment (250x).

1. Segmented hair from Cucurbita pepo with a somewhat tapered basal and intermediate segment and a small, rounded apical segment (250 x). Many hairs of this type have less tapered basal and intermediate segments.



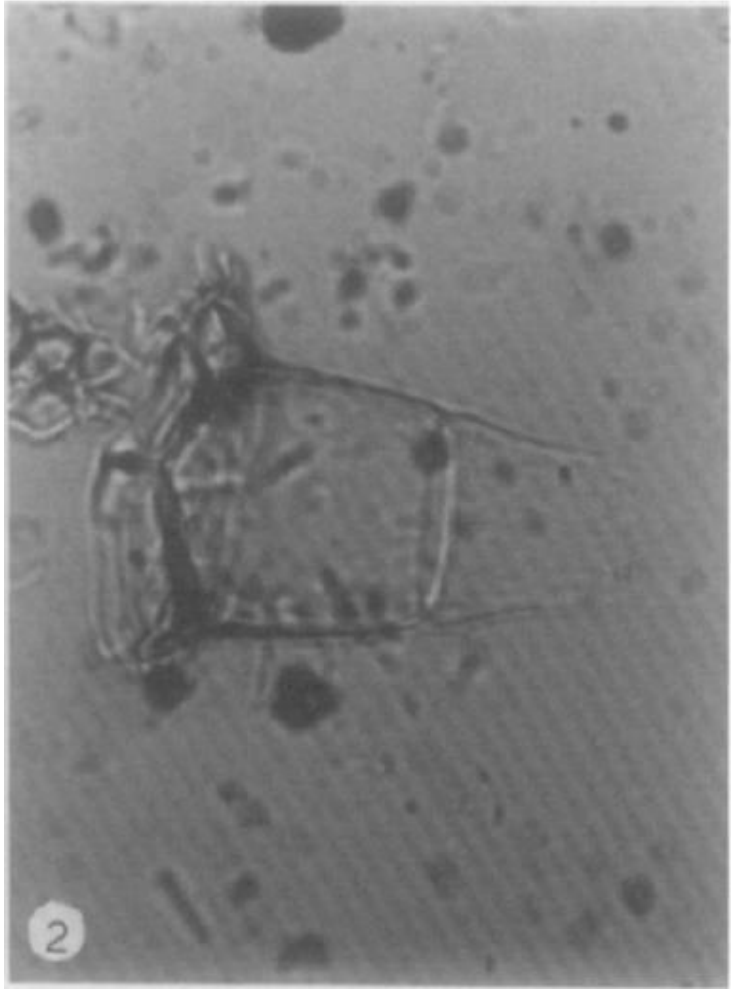


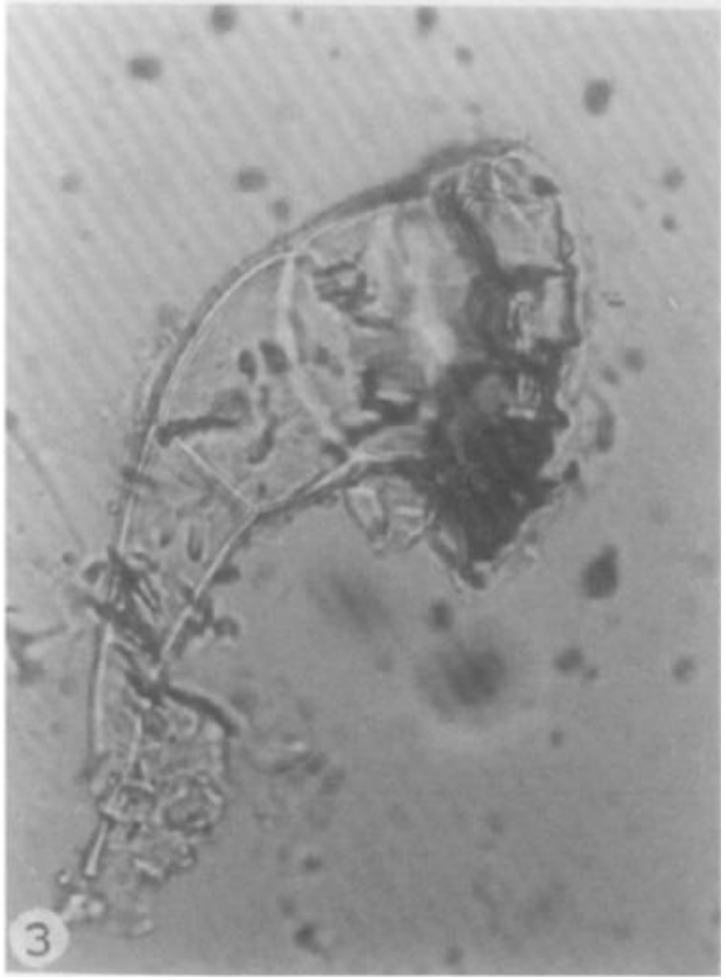
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Cucurbita pepo

Phytolith

2. A broken segmented hair from Cucurbita pepo (250 ×).
3. A segmented hair from Cucurbita pepo (156 x).

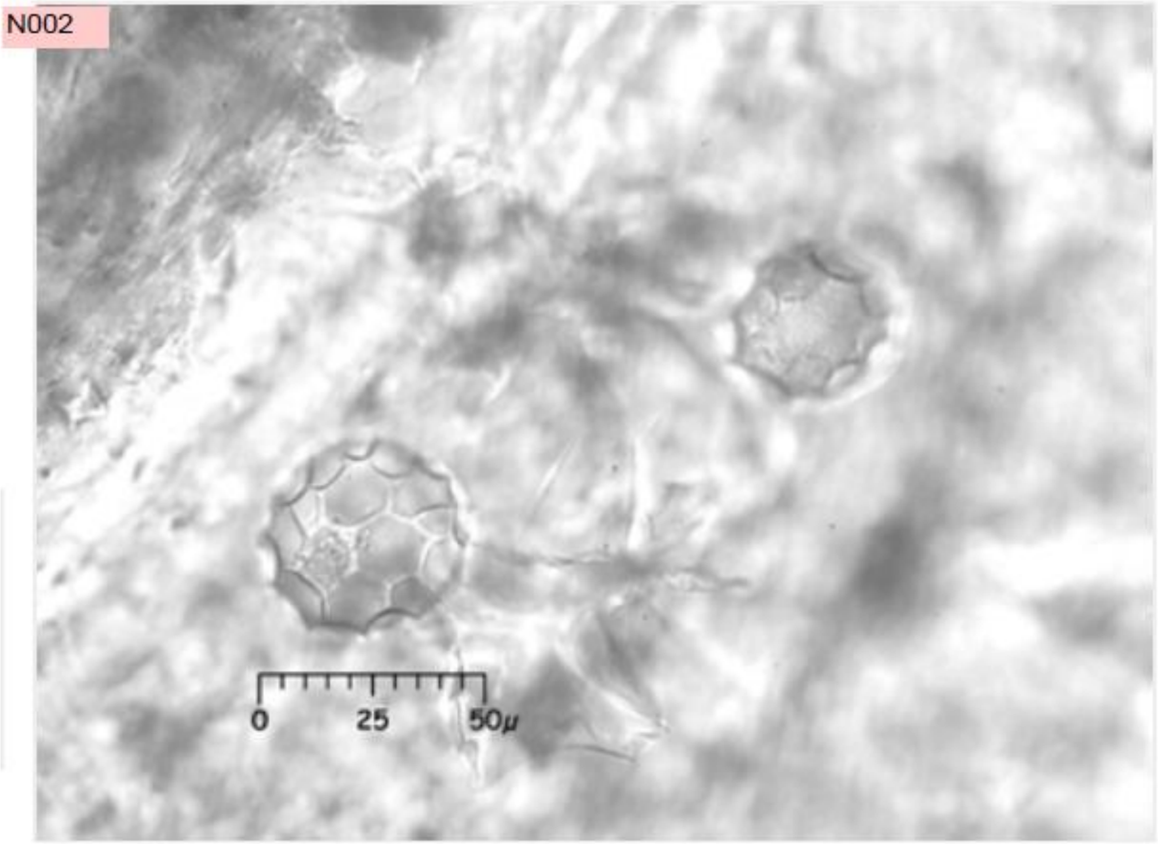




Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Cucurbita pepo var. ozarkana

Phytolith

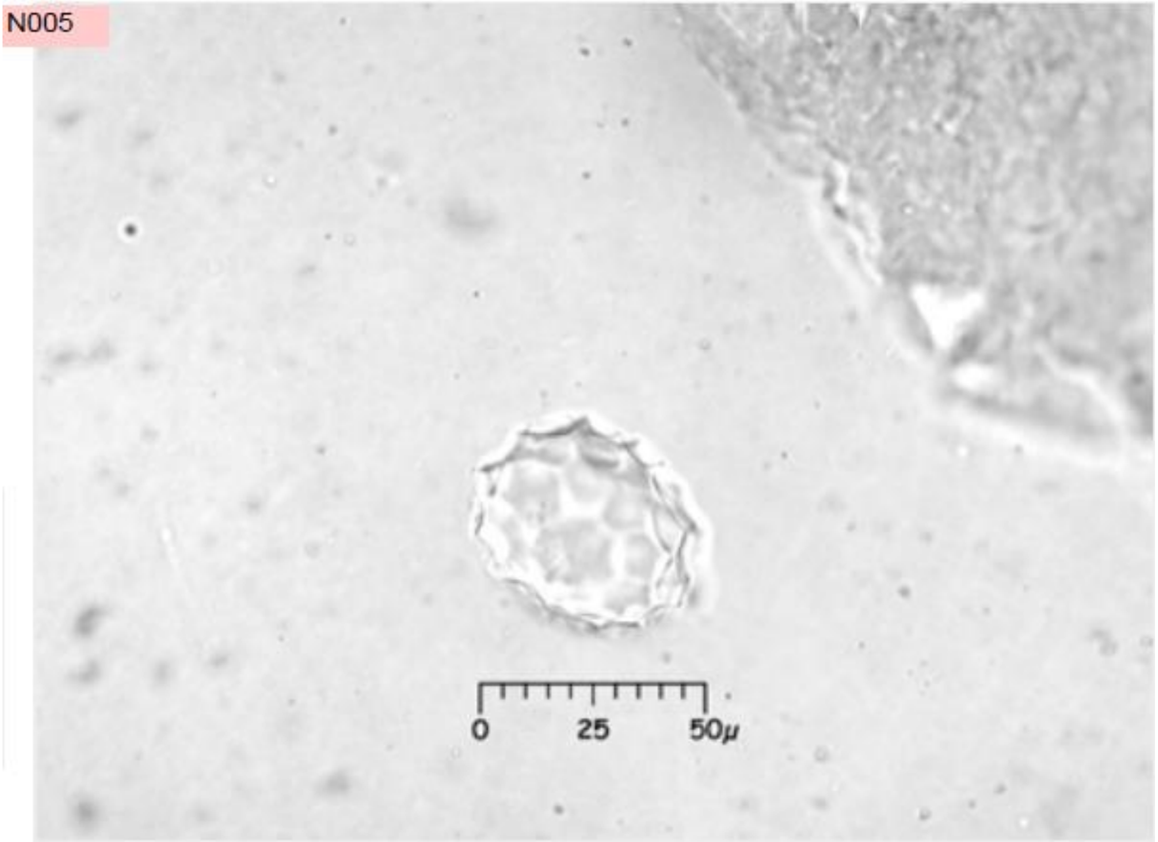


Diagnostic level: genus, domesticated
Larger hemisphere of spheres is visible in this view.
See Piperno's 2000 Journal Archaeological Science article: "Phytoliths in Cucurbita and other neotropical Cucurbitaceae ....." for extensive discussion of the spheres produced by this family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cucurbita pepo var. ozarkana

Phytolith



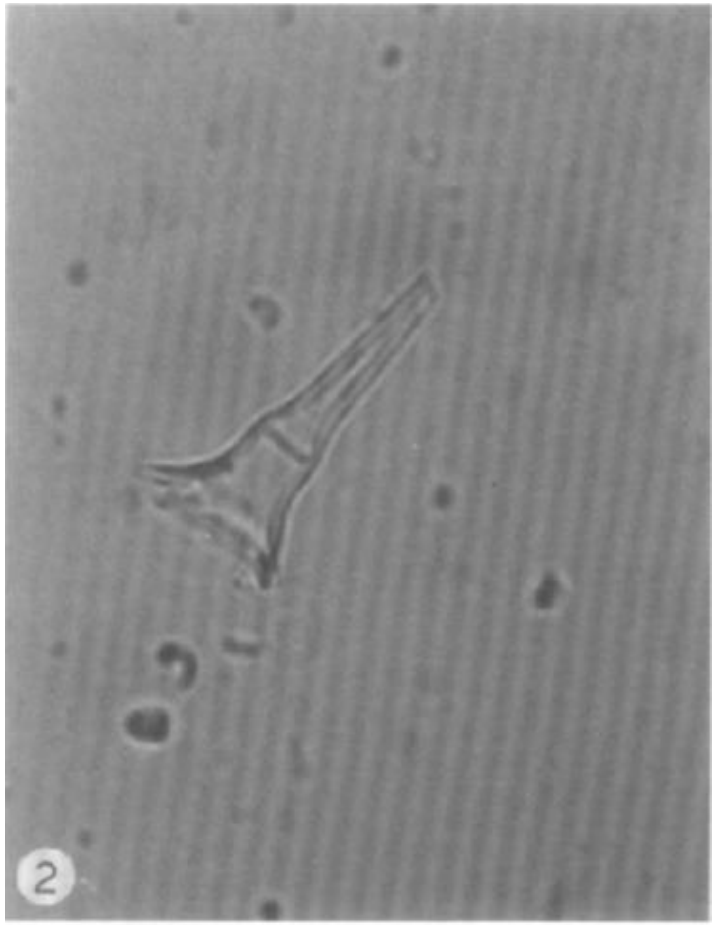
Diagnostic level: genus, domesticated In this view, you can see the difference between “large” and “small” hemispheres
See Piperno’s 2000 Journal Archaeological Science article: “Phytoliths in Cucurbita and other neotropical Cucurbitaceae .....” for extensive discussion of the spheres produced by this family

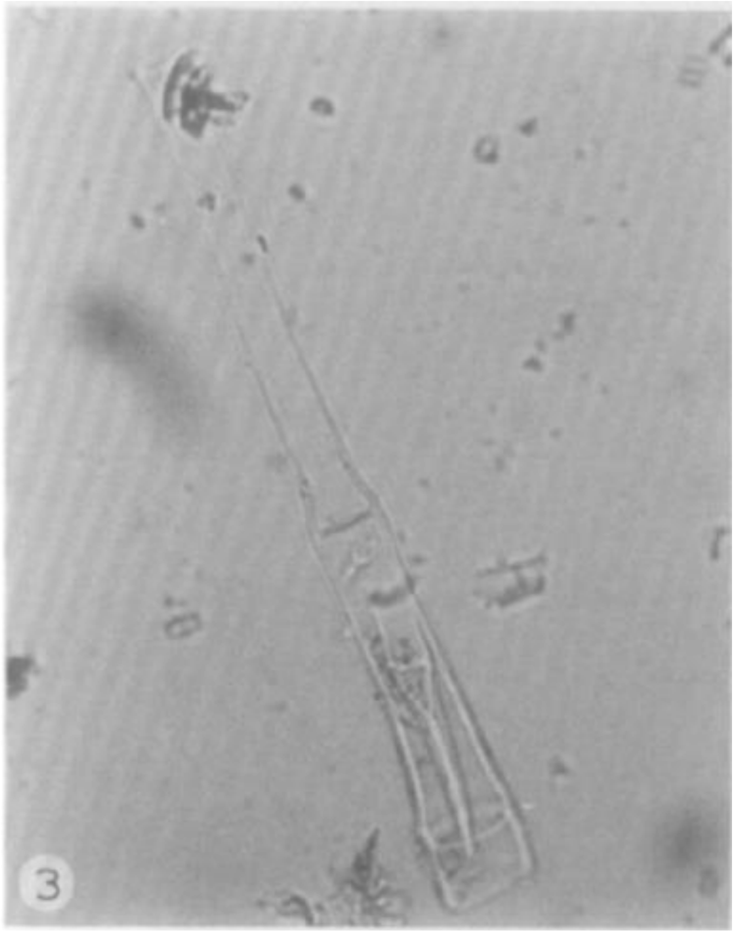
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gurania makoyana

Phytolith

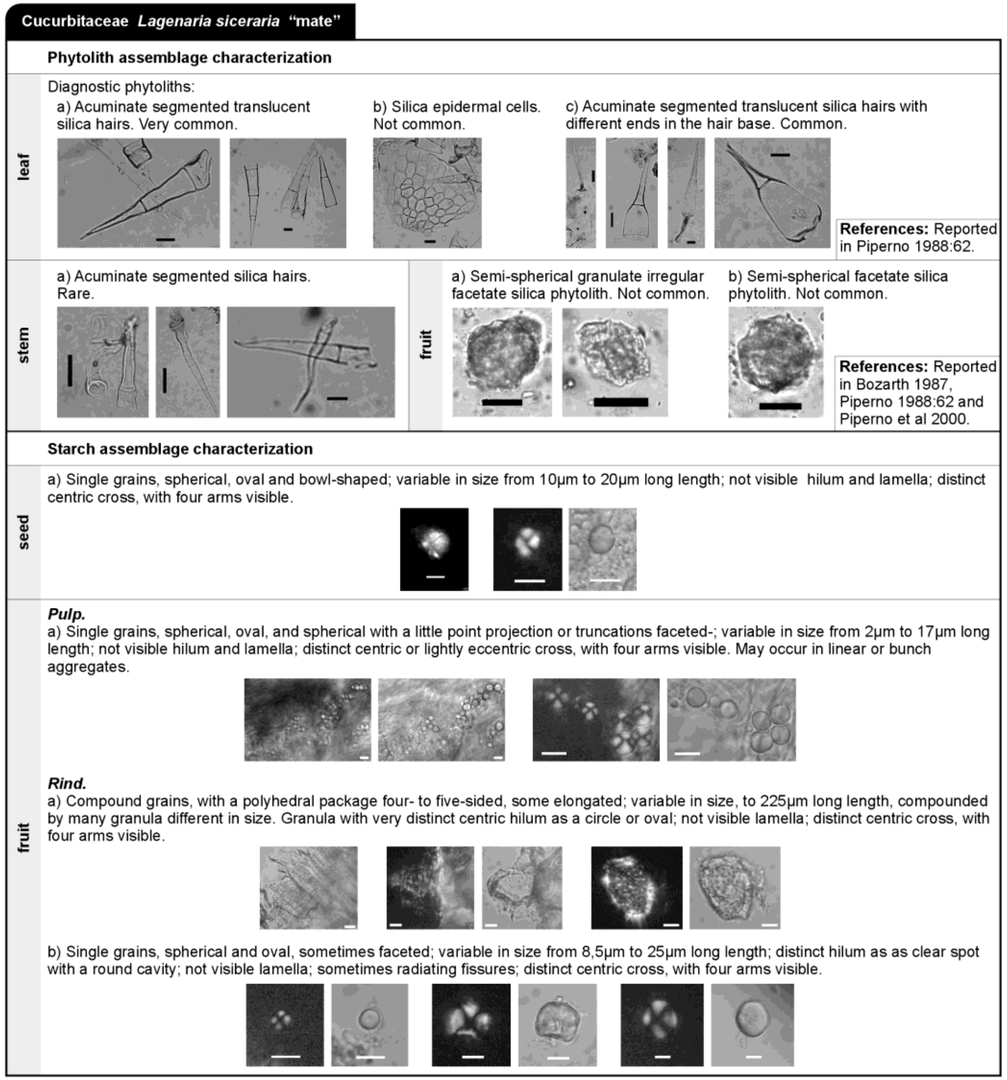
2. A segmented hair from Gurania makoyana (250 x).
3. A segmented hair with long segments and a non-tapered shaft from Gurania makoyana (250 X).





Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Lagenaria siceraria



Cucurbitaceae *Lagenaria siceraria* "mate"

Phytolith assemblage characterization

leaf

Diagnostic phytoliths:

a) Acuminate segmented translucent silica hairs. Very common.

b) Silica epidermal cells. Not common.

c) Acuminate segmented translucent silica hairs with different ends in the hair base. Common.

References: Reported in Piperno 1988:62.

stem

a) Acuminate segmented silica hairs. Rare.

fruit

a) Semi-spherical granulate irregular facetate silica phytolith. Not common.

b) Semi-spherical facetate silica phytolith. Not common.

References: Reported in Bozarth 1987, Piperno 1988:62 and Piperno et al 2000.

Starch assemblage characterization

seed

a) Single grains, spherical, oval and bowl-shaped; variable in size from 10µm to 20µm long length; not visible hilum and lamella; distinct centric cross, with four arms visible.

fruit

Pulp.

a) Single grains, spherical, oval, and spherical with a little point projection or truncations faceted-; variable in size from 2µm to 17µm long length; not visible hilum and lamella; distinct centric or lightly eccentric cross, with four arms visible. May occur in linear or bunch aggregates.

Rind.

a) Compound grains, with a polyhedral package four- to five-sided, some elongated; variable in size, to 225µm long length, compounded by many granula different in size. Granula with very distinct centric hilum as a circle or oval; not visible lamella; distinct centric cross, with four arms visible.

b) Single grains, spherical and oval, sometimes faceted; variable in size from 8,5µm to 25µm long length; distinct hilum as as clear spot with a round cavity; not visible lamella; sometimes radiating fissures; distinct centric cross, with four arms visible.

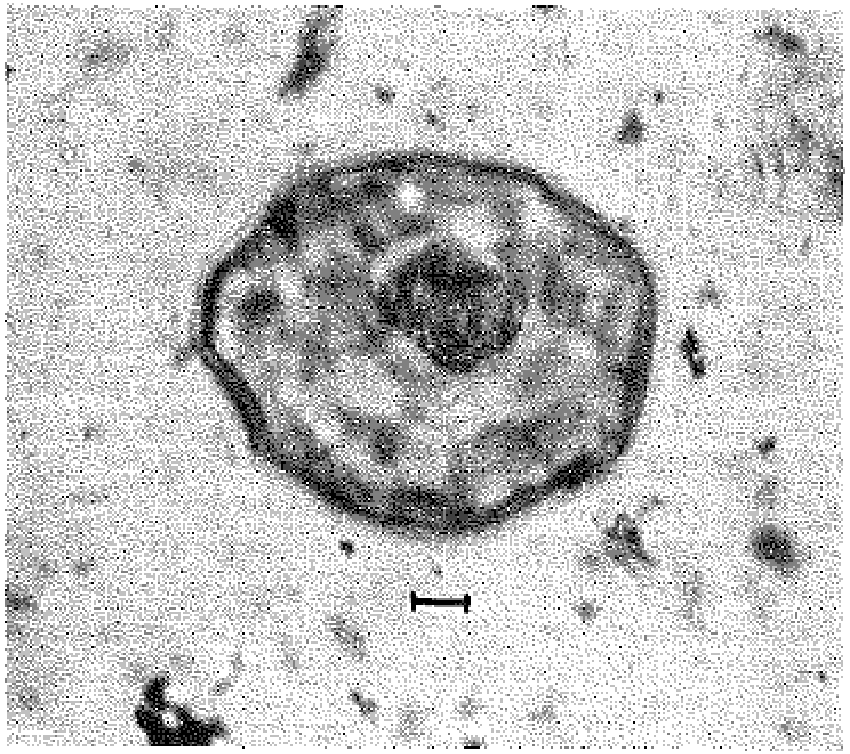
Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Lagenaria siceraria

Phytolith

d

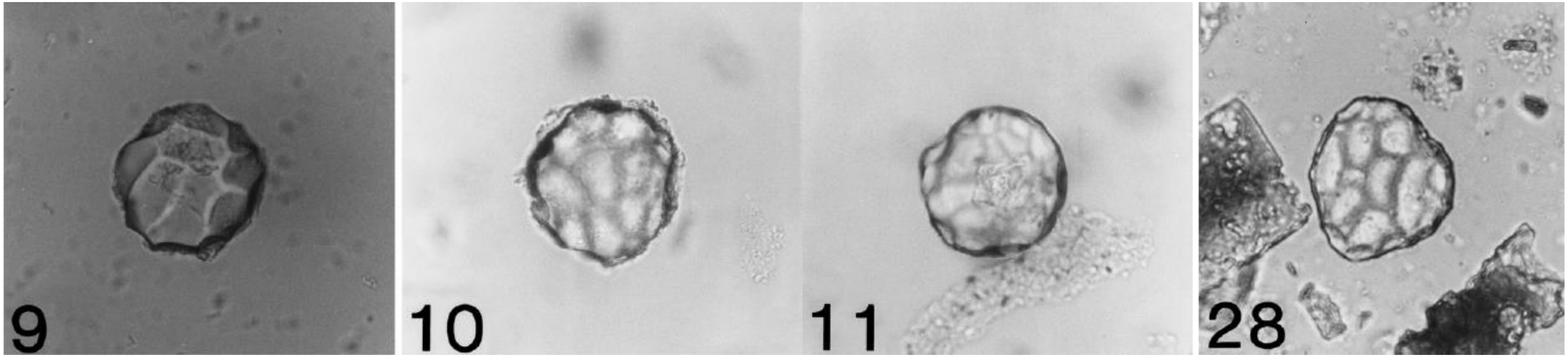


d. Scalloped sphere from Lagenaria siceraria.

Pearsall, Deborah Marie. 1993. Contributions of Phytolith Analysis for Reconstructing Subsistence: Examples from Research in Ecuador. *Current Research in Phytolith Analysis: Applications in Archaeology and Paleoecology*. MASCA.

Lagenaria siceraria

Phytolith



9. A phytolith from bottle gourd. It is hemispherical with elongated scallops.
10. A hemispherical phytolith from bottle gourd, with its undecorated flat side laying face up. The scallops are irregularly shaped.
11. A hemispherical phytolith from bottle gourd, with irregularly shaped and elongated scallops.
28. A bottle gourd phytolith from pre-7000 ▯▯ contexts at the Aguadulce rock shelter. It is hemispherical and has irregular, elongated scallops (compare with Figure 10).

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Lagenaria siceraria

Phytolith

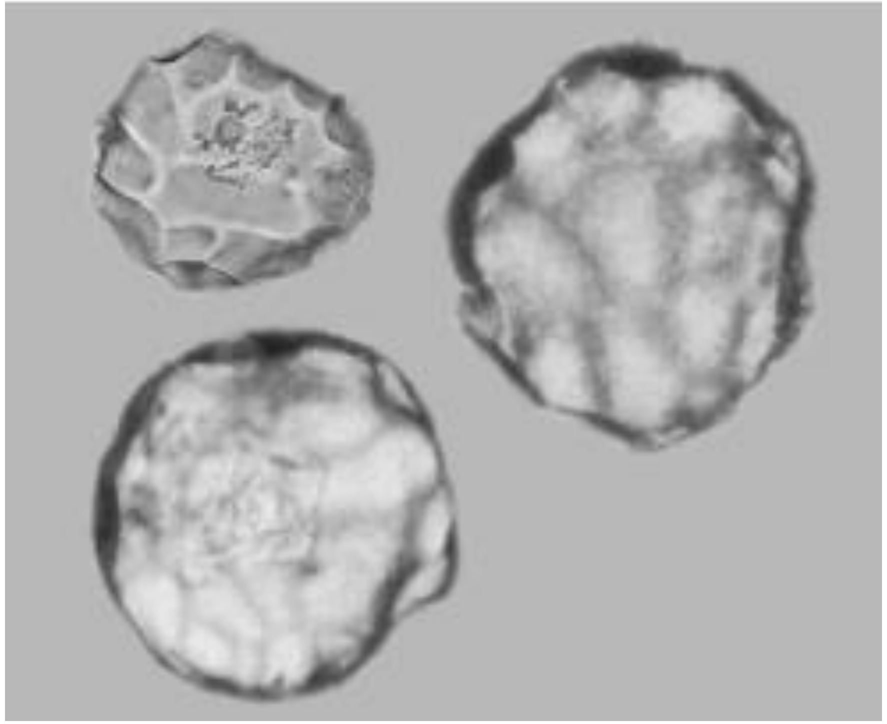


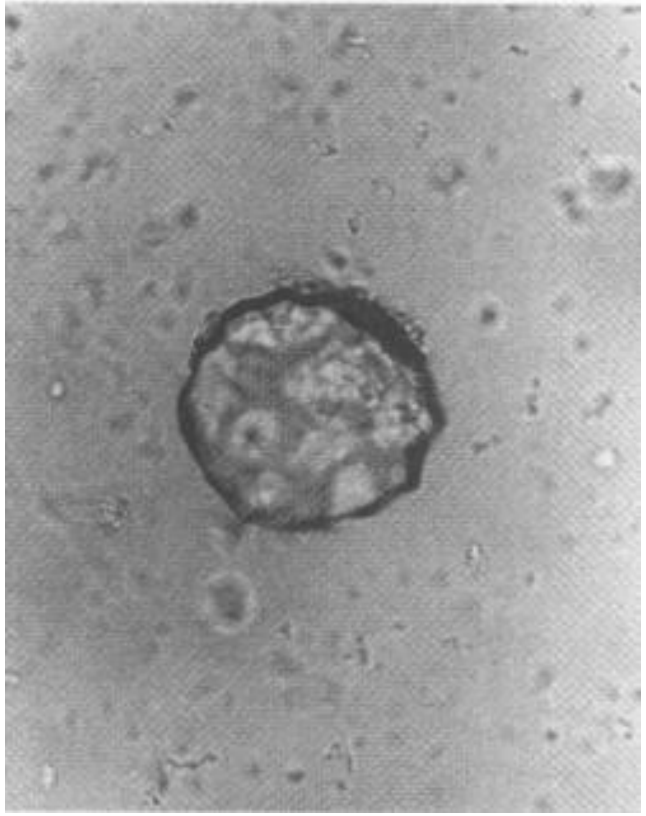
Fig. 6. Scalloped phytoliths from bottle gourd. Unlike in Cucurbita, scallops are irregularly-shaped and one hemisphere of the phytolith is flat and undecorated. Size ranges from 64 to 112 mM. From Piperno, 2006

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Lagenaria siceraria

Phytolith

Fig. 13. A phytolith from Lagenaria siceraria (bottle gourd). It is distinctive because it has large, often elongated, and irregularly distributed scallops on one side of the phytolith, and is hemispherical.



Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Lagenaria siceraria

Phytolith

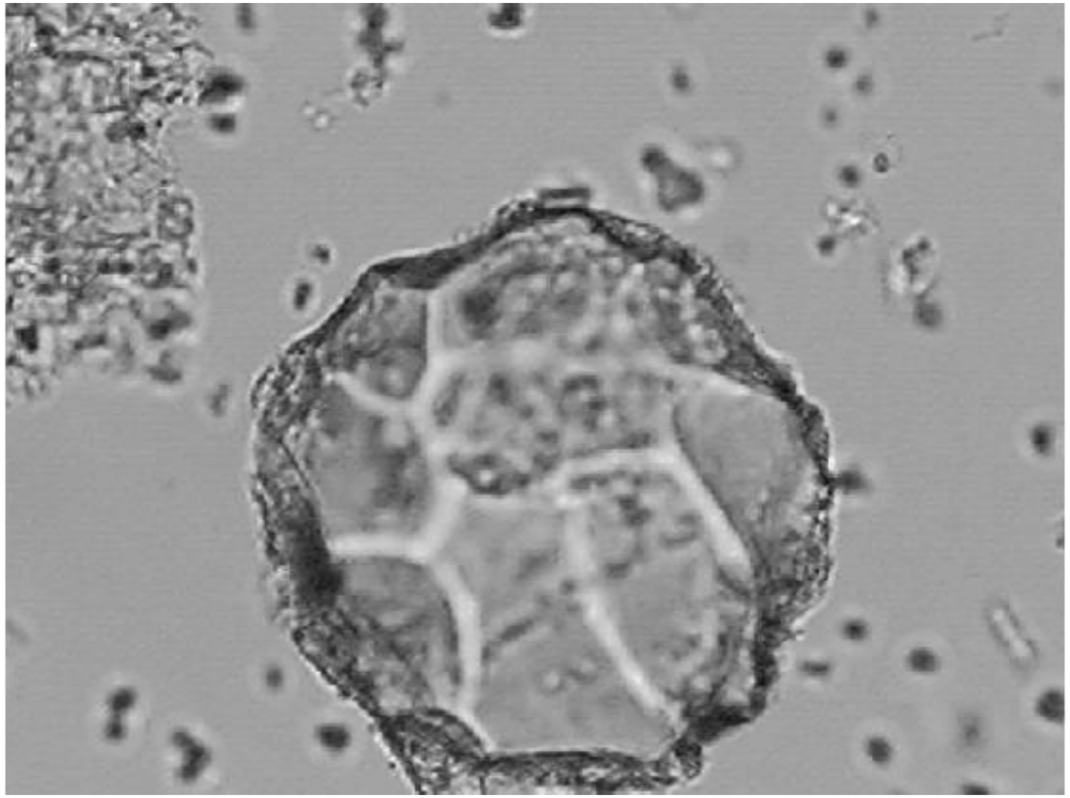


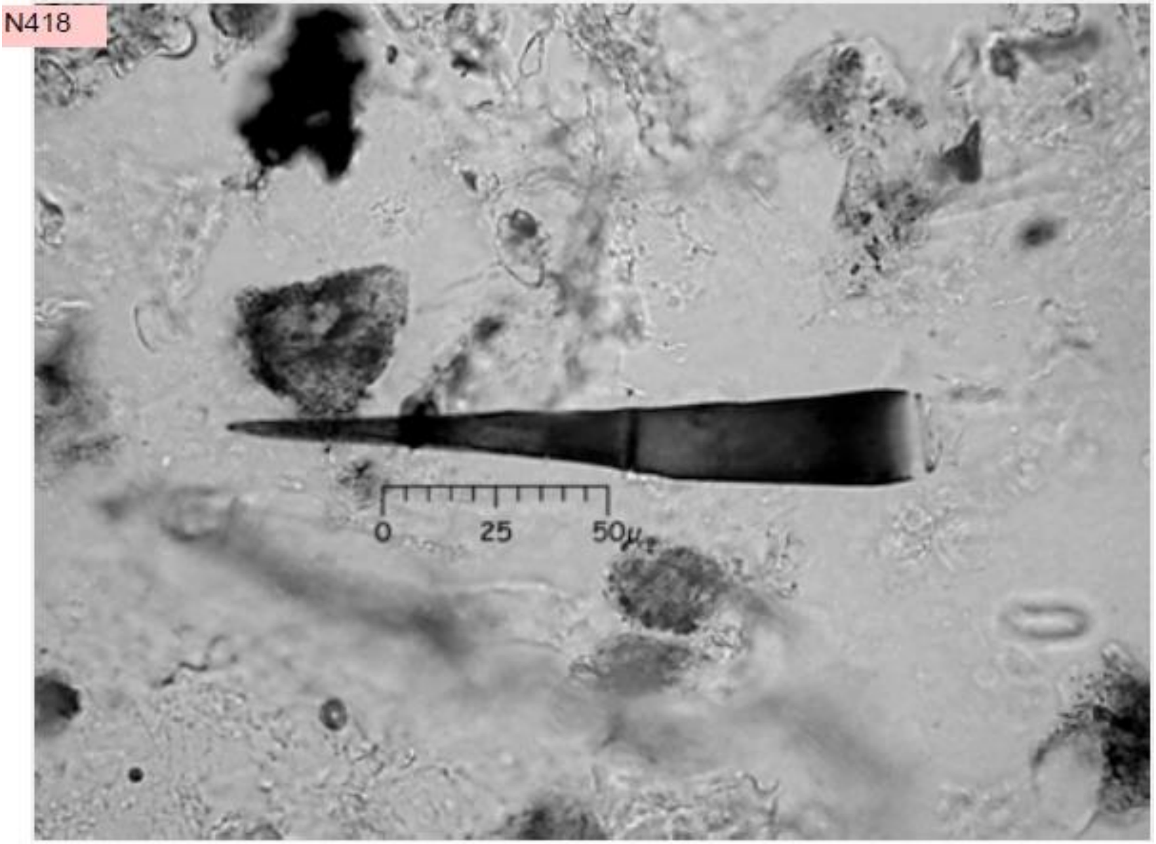
Fig. 4. A phytolith from bottle gourd showing how the irregular pattern of the stone cells is discernible on the phytolith surface

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Lagenaria siceraria

Phytolith

Diagnostic level:
Cucurbitaceae/Asteraceae

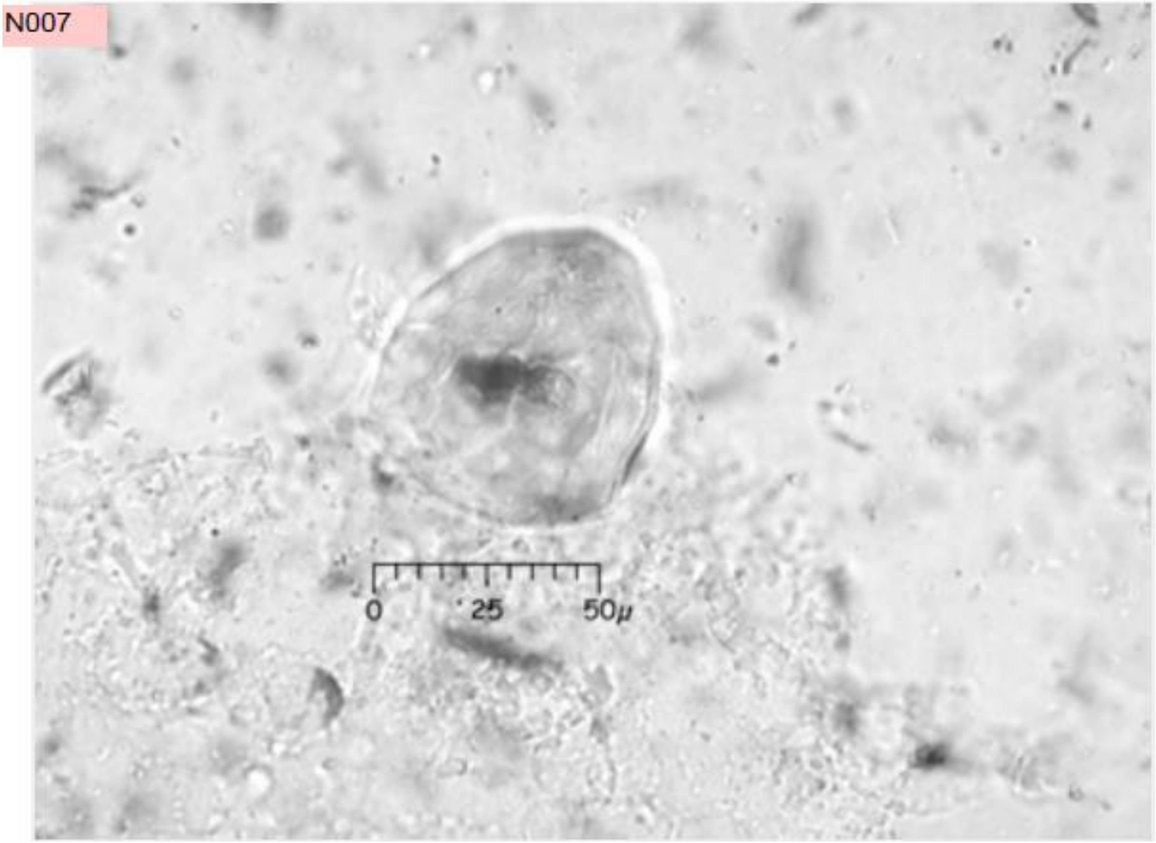


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lagenaria siceraria

Phytolith

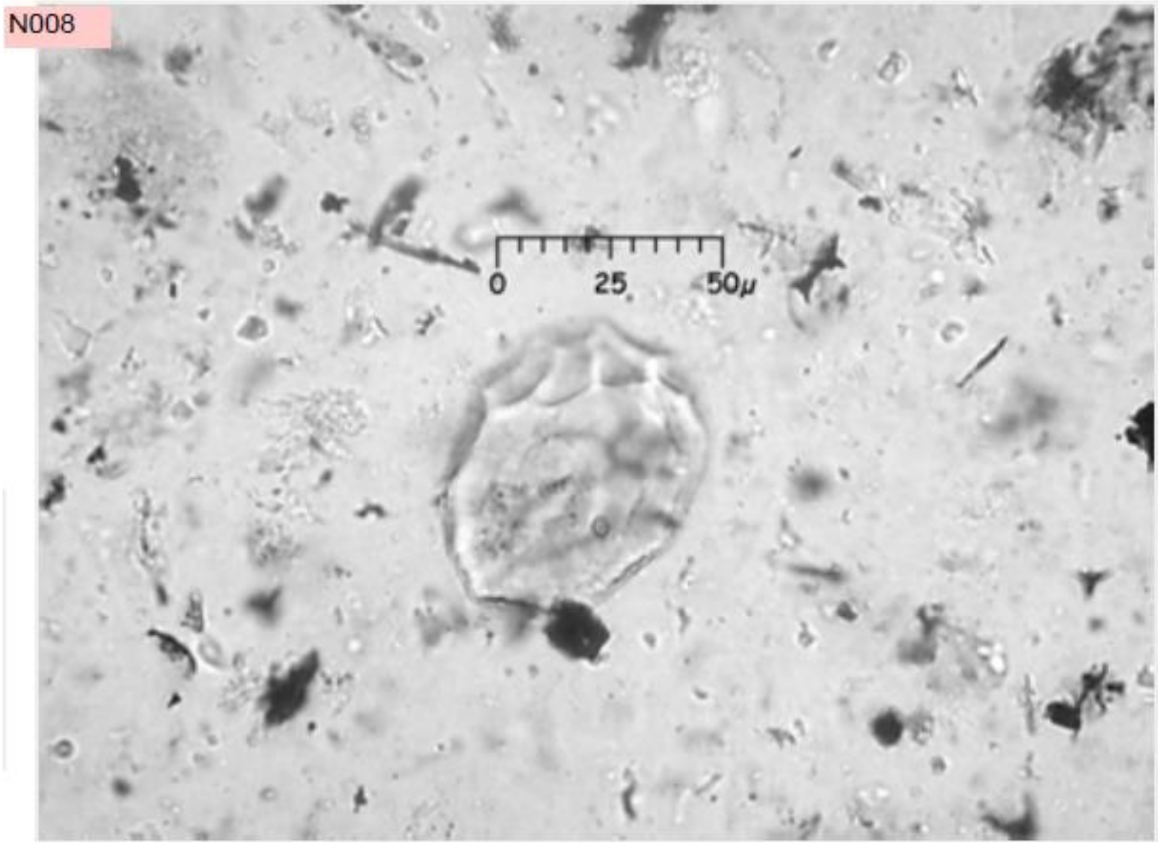
The presence of elongated facets/scallops, that are irregularly distributed,are the diagnostic features of gourd. See Piperno et al. 2000. Diagnostic level: species



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lagenaria siceraria

Phytolith



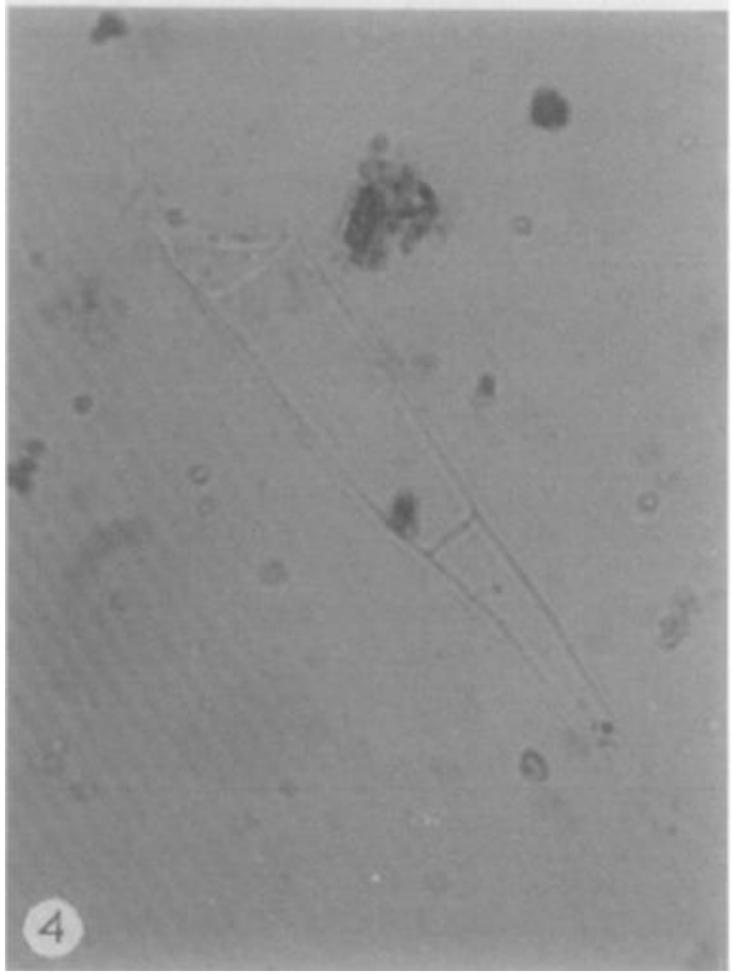
The presence of elongated facets/scallops, that are irregularly distributed,are the diagnostic features of gourd. See Piperno et al. 2000. Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lagenaria siceraria

Phytolith

4. A segmented hair from Lagenaria siceraria (200x).

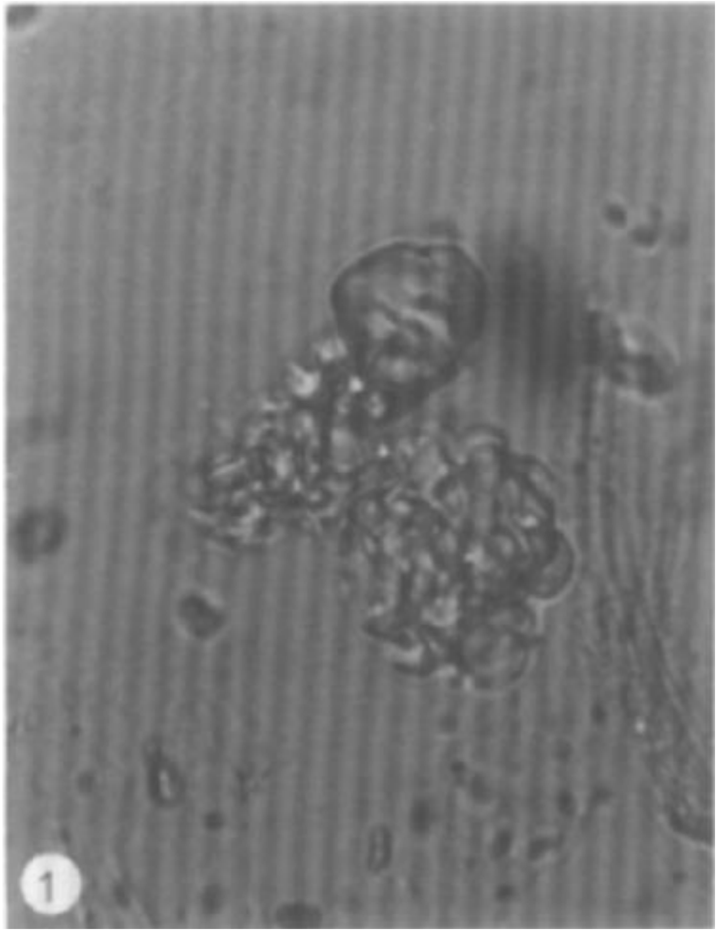


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Luffa astori

Phytolith

1. Irregular, lumpy pieces of silica from Luffa astori (250 ×).

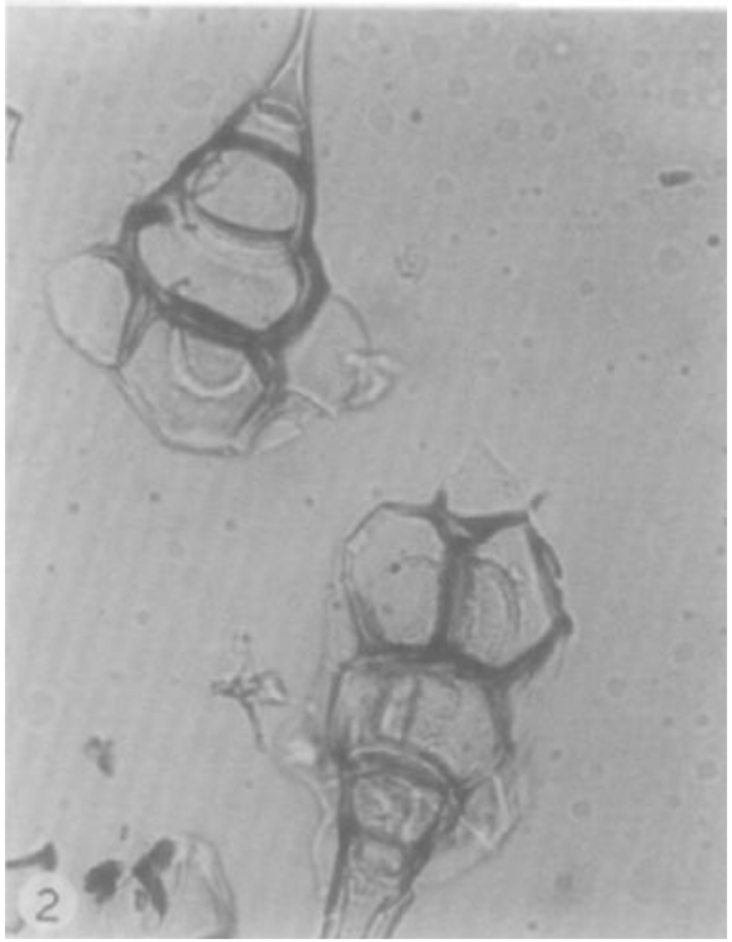


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Melothria guadalupensis

Phytolith

2. Segmented hairs with circular segments and tapered apexes from Melothria guadalupensis (156 x).

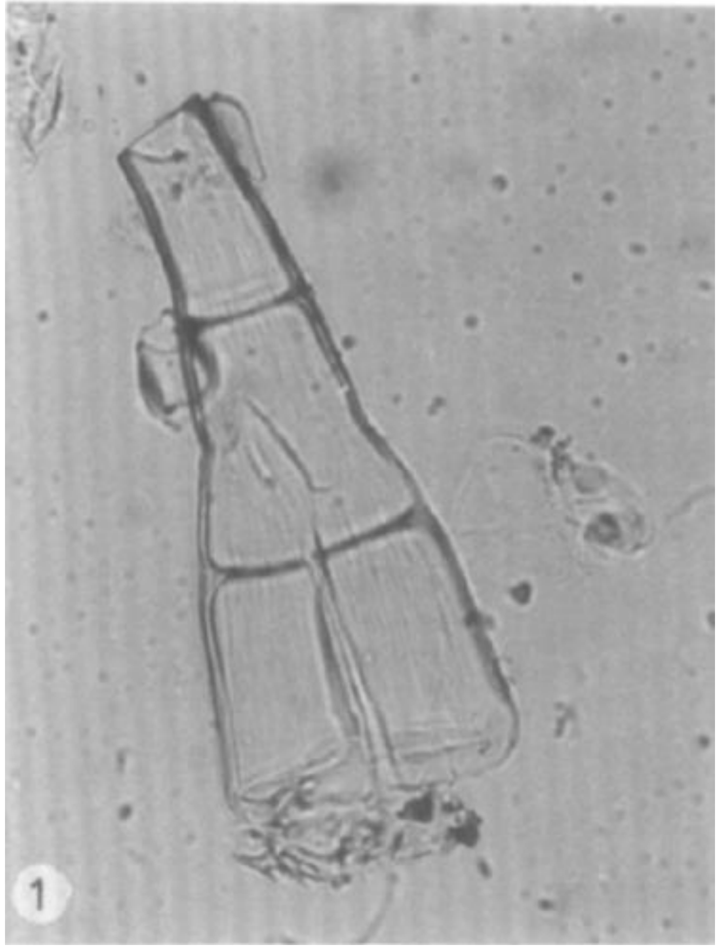


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Melothria guadalupensis

Phytolith

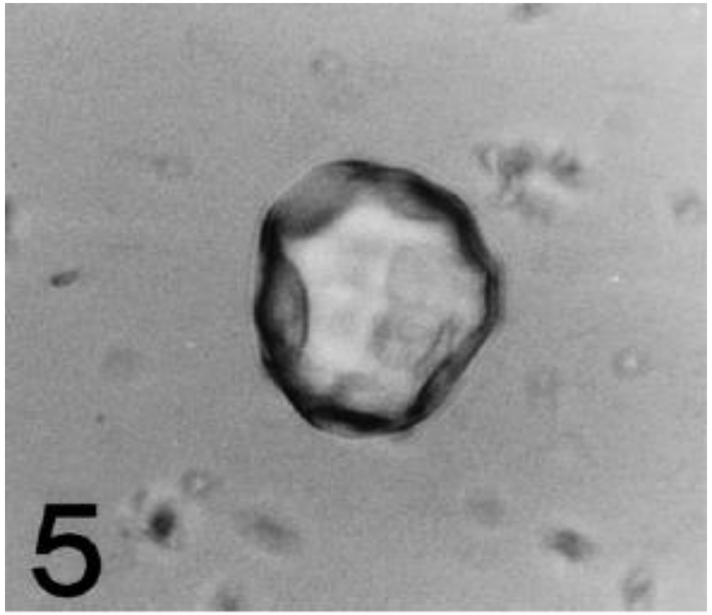
1. Segmented hairs with the surface decoration of long, fine striations from Melothria guadalupensis (156 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Peponopsis adhaerens

Phytolith



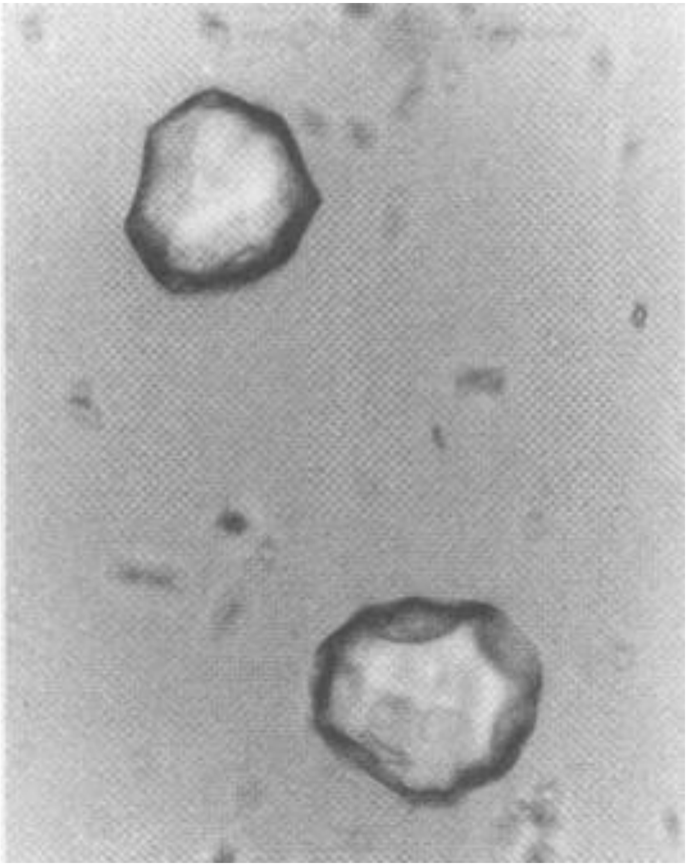
5. A scalloped phytolith from *Peponopsis adhaerens*. It has shallow scallops and possesses only one decorated hemisphere. It is 44 m long.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Peponopsis adhaerens

Phytolith

Fig. 15. Scalloped phytoliths from a wild species in the Cucurbitaceae, Peponopsis adhaerens. They differ from domesticated Cucurbitaceae in having small and indistinct scallops, little difference in the decoration of the hemispheres, and in overall size. Also, they often are not spherical, but are flattish (see also Fig. 16).

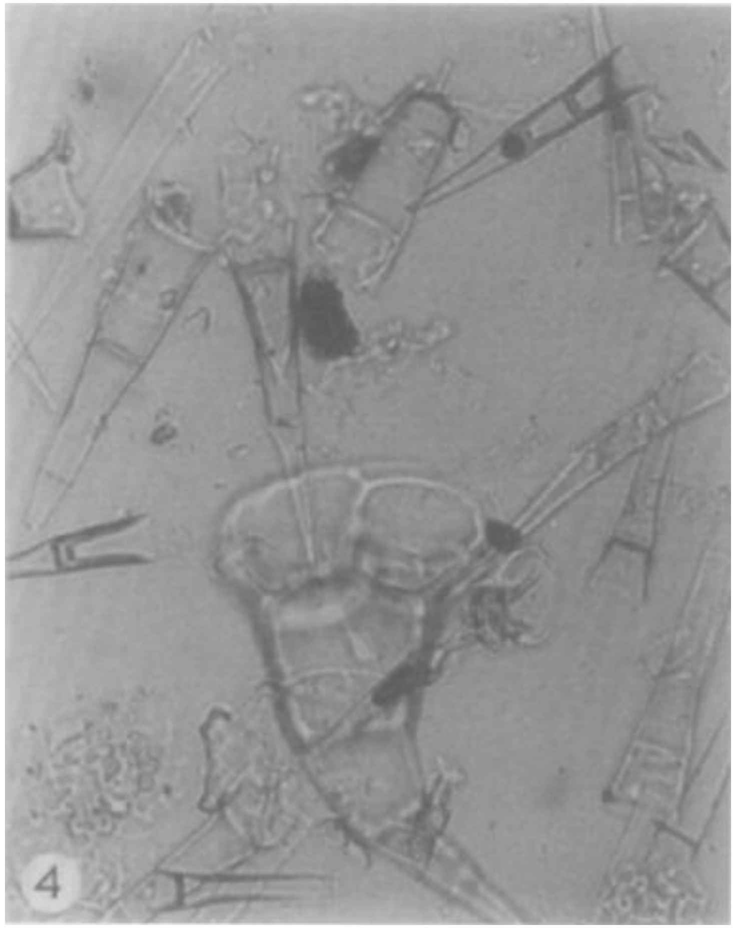


Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Pittiera grandiflora

Phytolith

4. Segmented hairs from Pittiera grandiflora. Some have blackish silica inclusions (156 x).

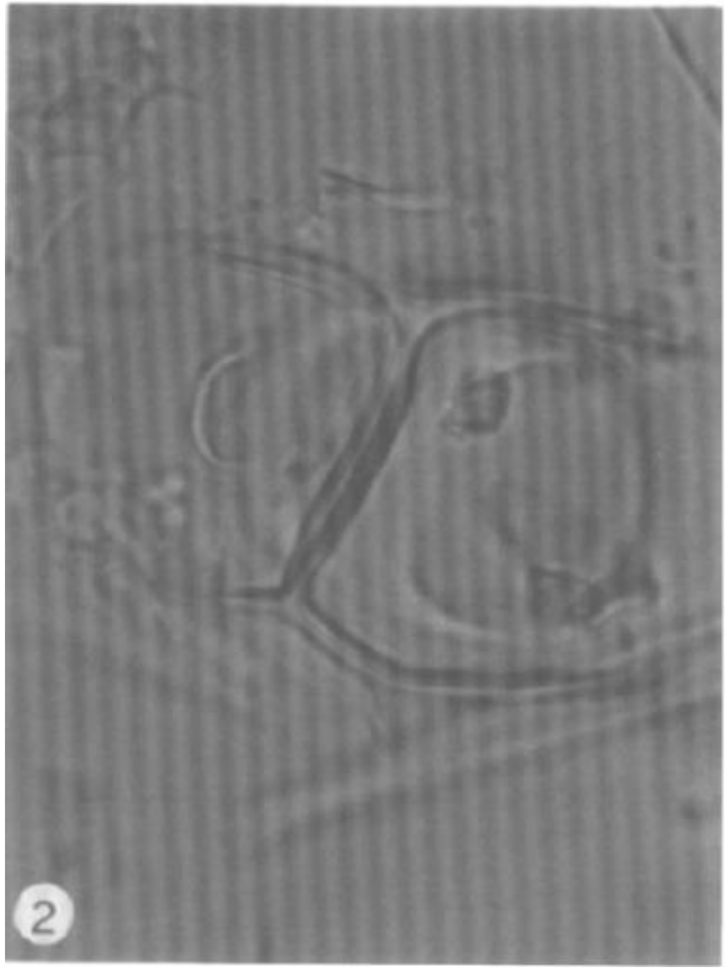


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Pittiera grandiflora

Phytolith

2. A hair base from Pittiera grandiflora consisting of two half-spheres joined together (400 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Sechium edule

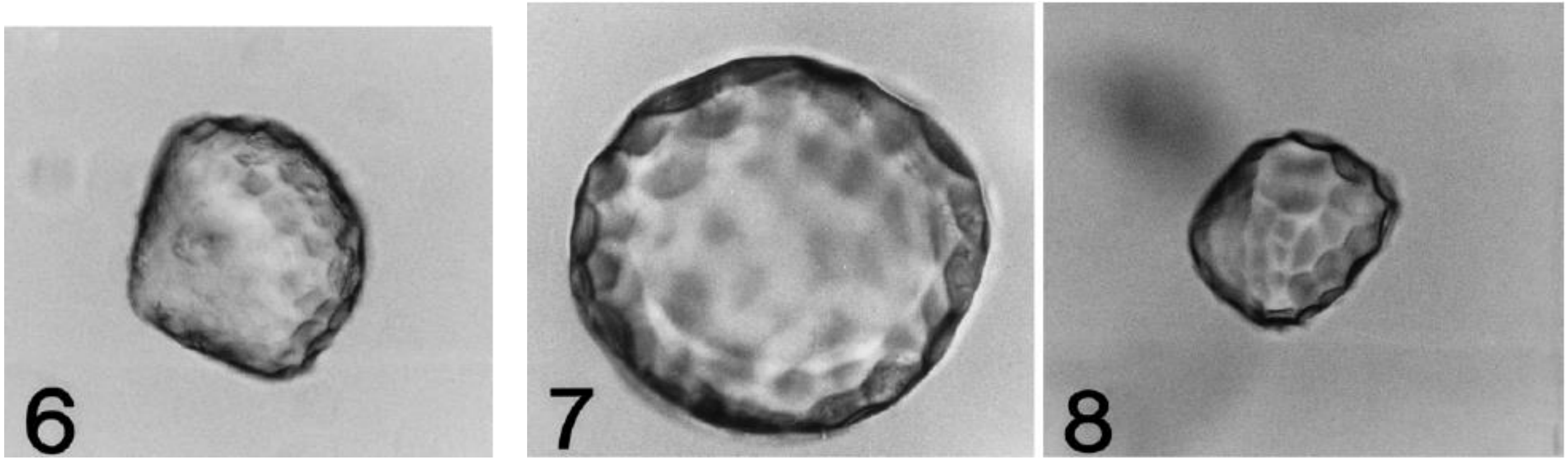
Starch

APPENDIX:
Sechium edule (chayote). Compound and simple grains, laminated, with few distinguishing features. Size: 4–16 microns.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Sicana odorifera

Phytolith



6. A phytolith from *Sicana odorifera* rotated so that the differences in the shapes and decorations of the two hemispheres can be observed. The hemisphere on the left forms a cone and it also has a different surface decoration than that of *Cucurbita* (compare with Figures 1 & 2).
7. A phytolith from *Sicana odorifera*. The undecorated hemisphere is laying face up. Notice the dark margin of the phytolith (compare with Figure 1).
8. A phytolith from *Sicana odorifera* showing how the hemispheres are asymmetrical.

Piperno, Dolores R., Thomas C. Andres, and Karen E. Stothert. 2000. Phytoliths in Cucurbita and Other Neotropical Cucurbitaceae and Their Occurrence in Early Archaeological Sites from the Lowland American Tropics. *Journal of Archaeological Science* 27:193–208.

Sicana odorifera

Phytolith

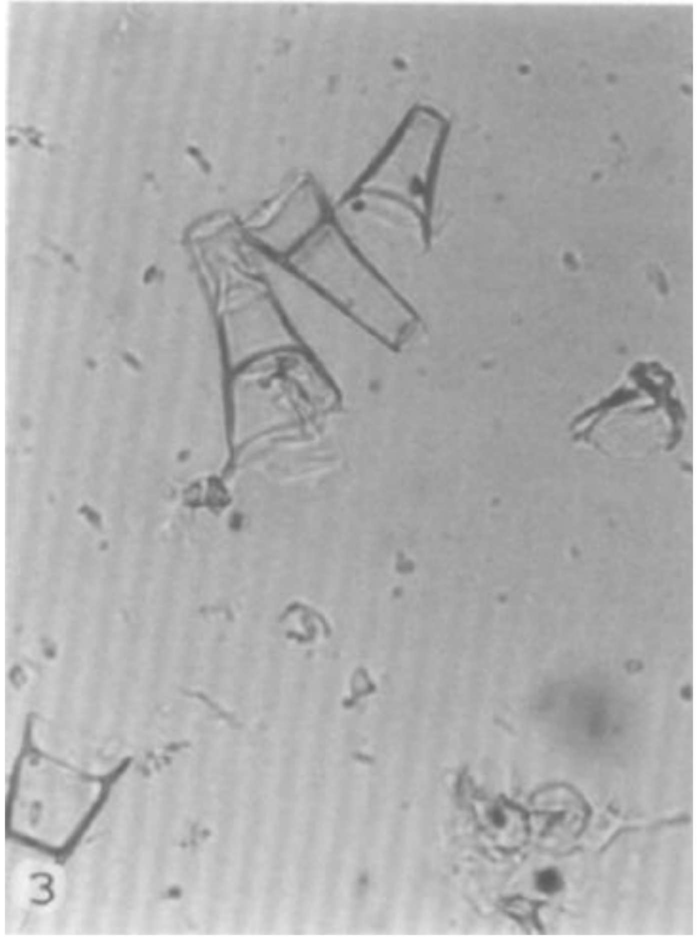
Fig. 14. A phytolith from Sicana odorifera. It has one hemisphere that is markedly conical and faintly decorated (compare with Cucurbita and Lagenaria).

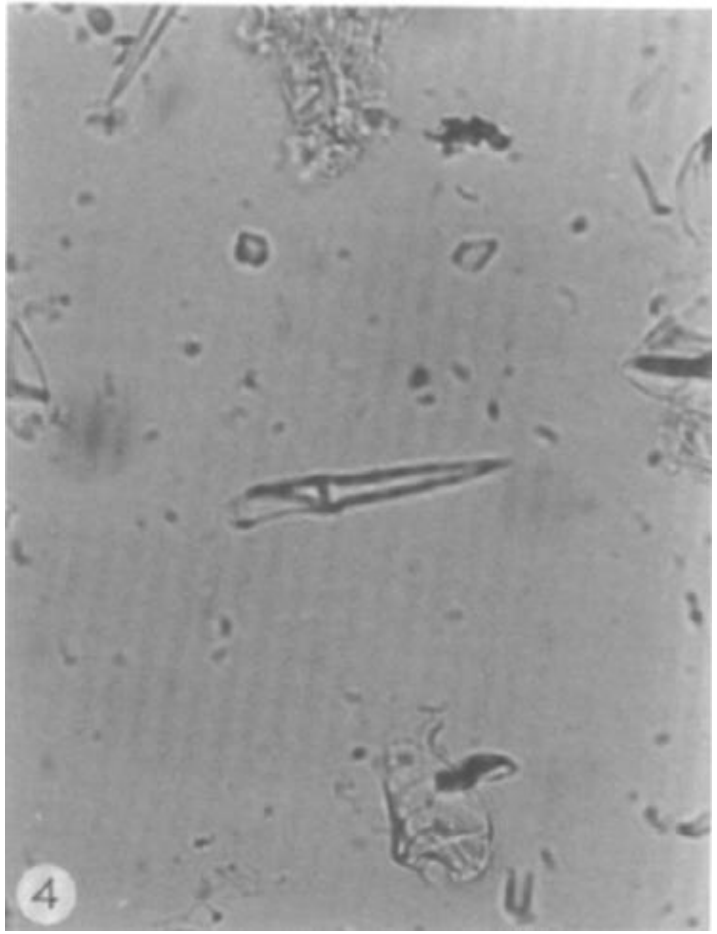
Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Sicyos echinocystoides

Phytolith

3. Segmented hairs from Sicyos echinocystoides (156 ×).
4. A segmented hair from Sicyos echinocystoides (156 x).





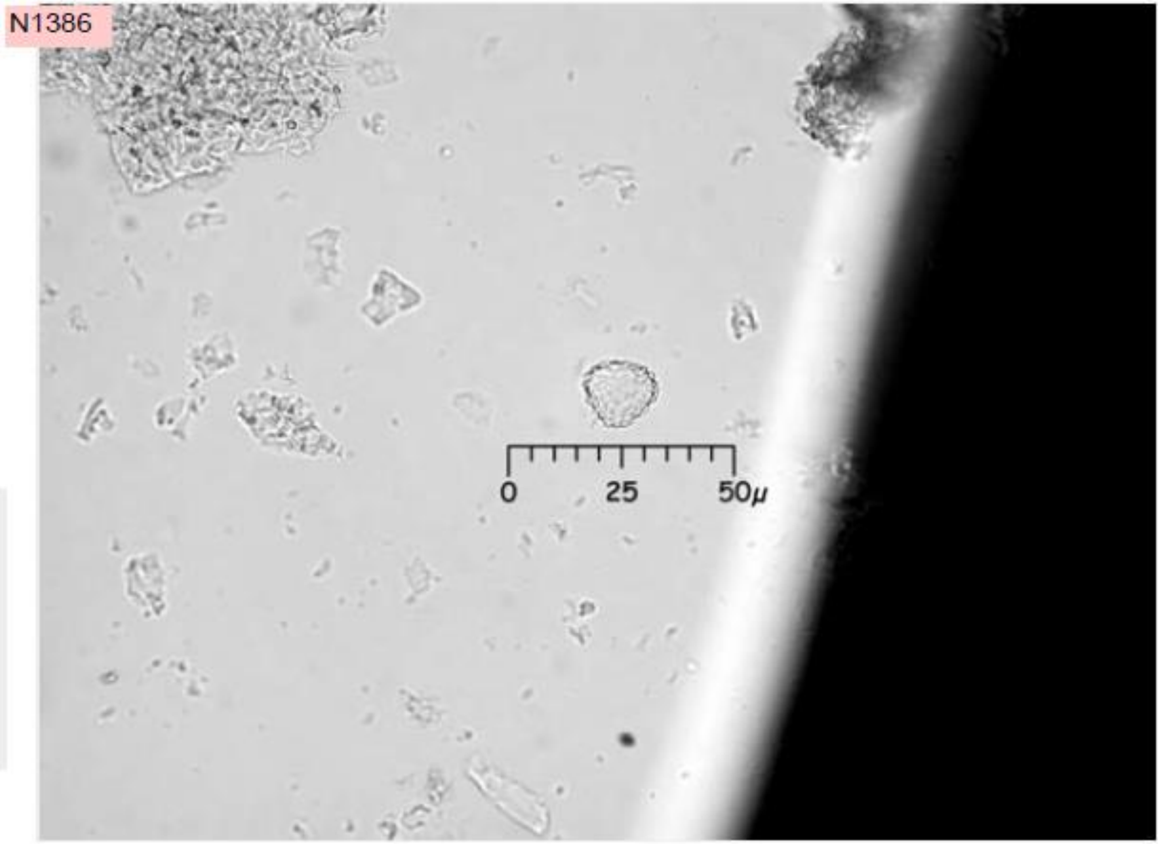
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

CYATHEACEAE

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

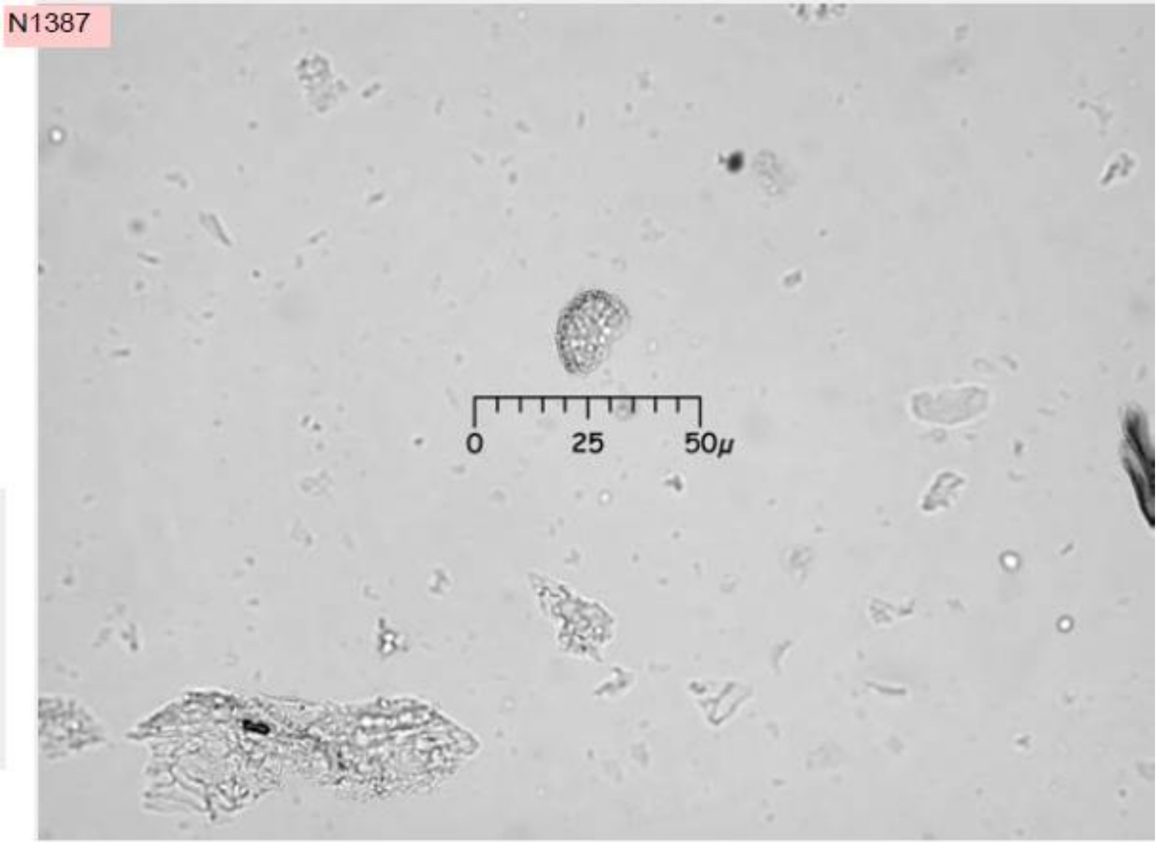


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

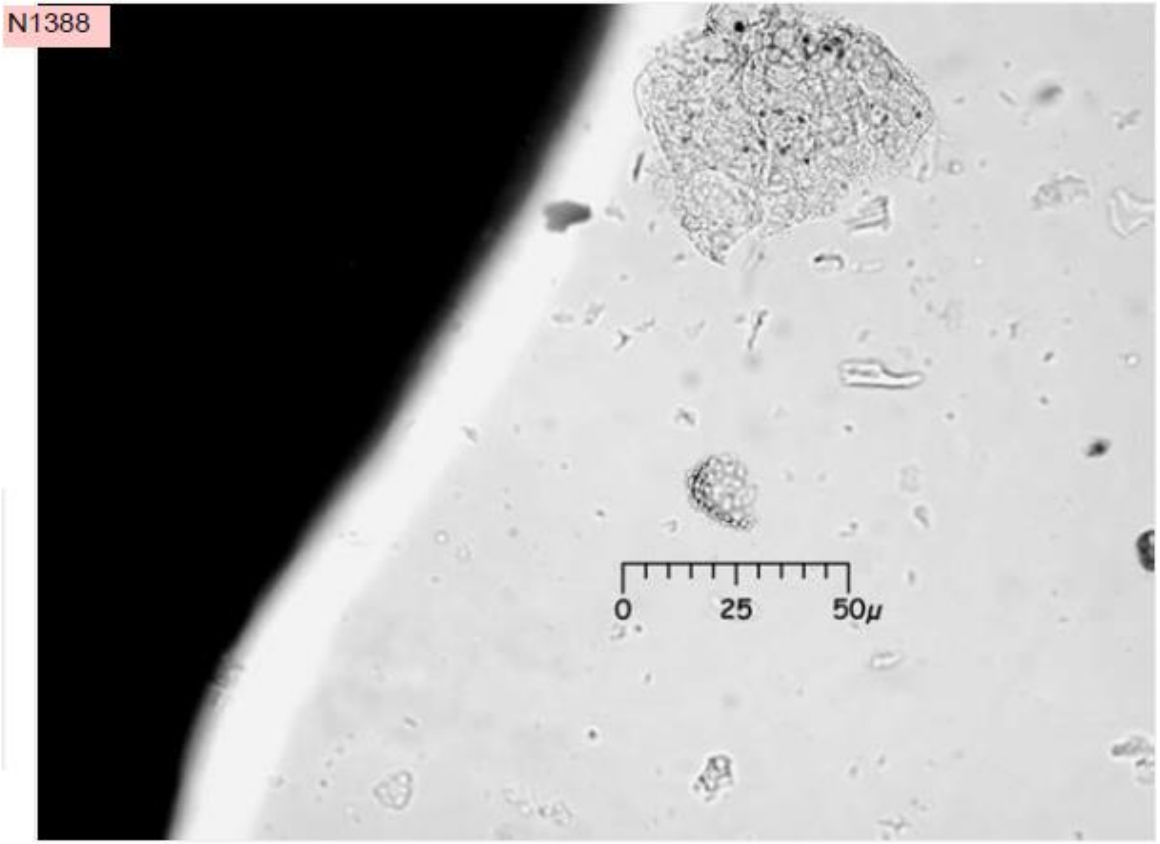


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

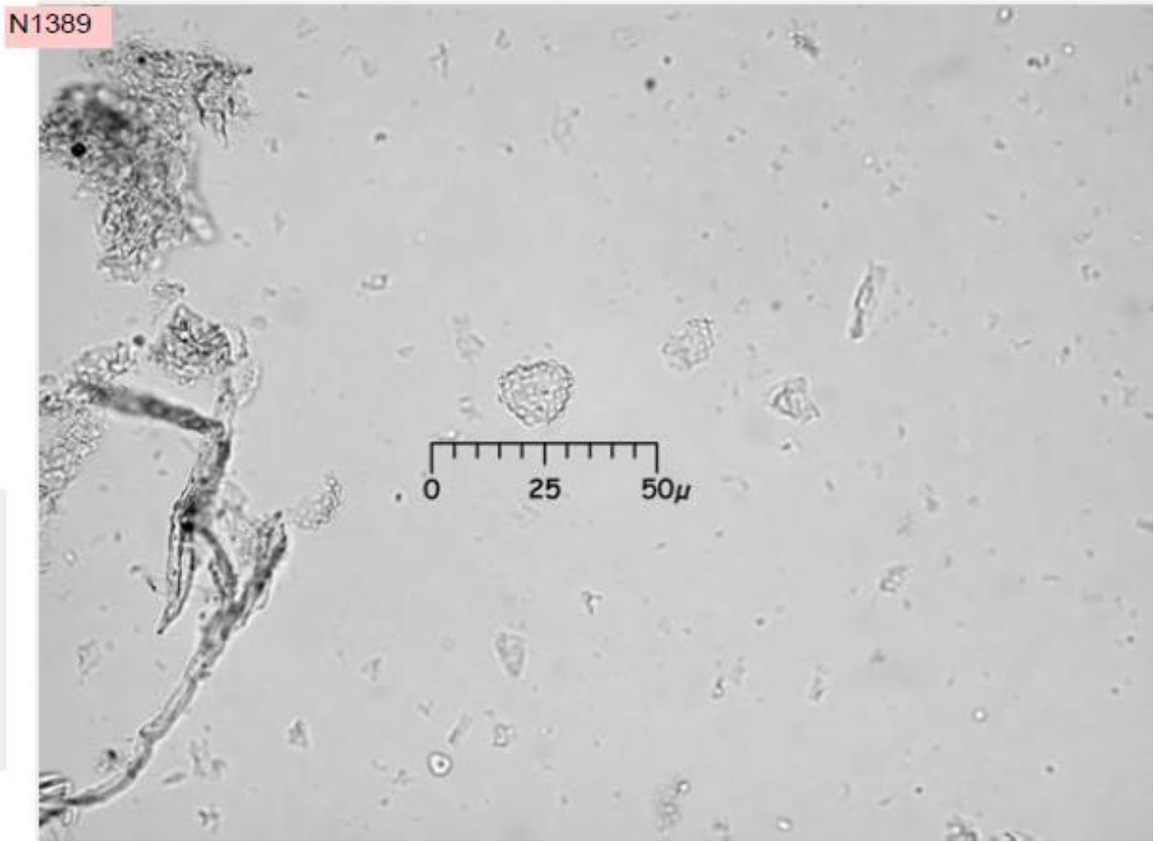


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

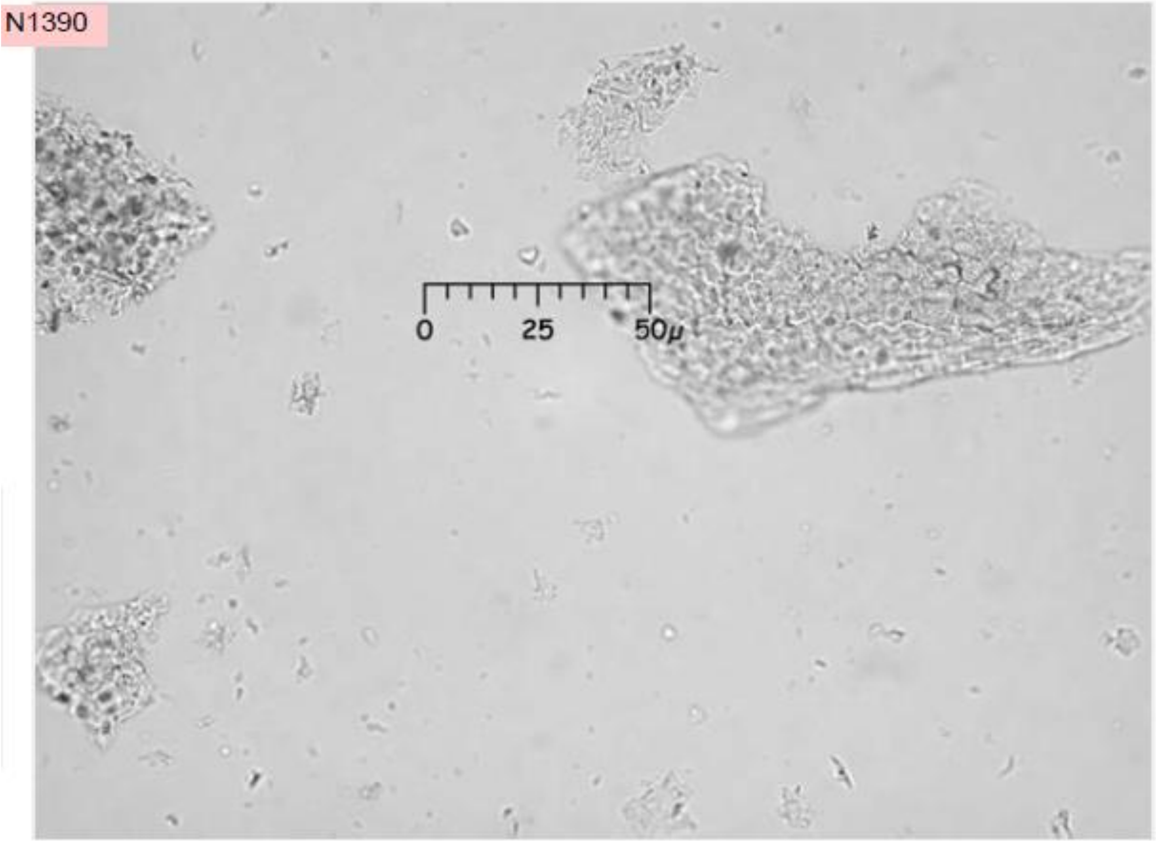


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

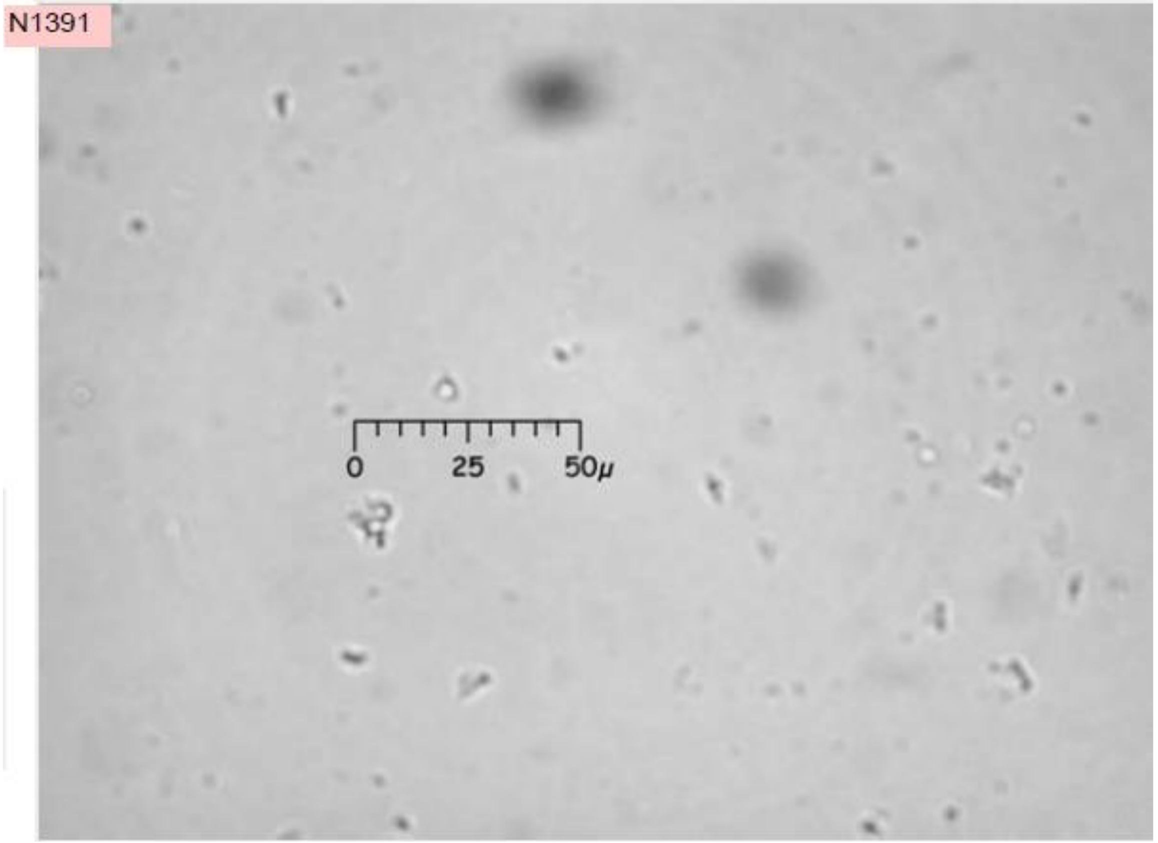


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

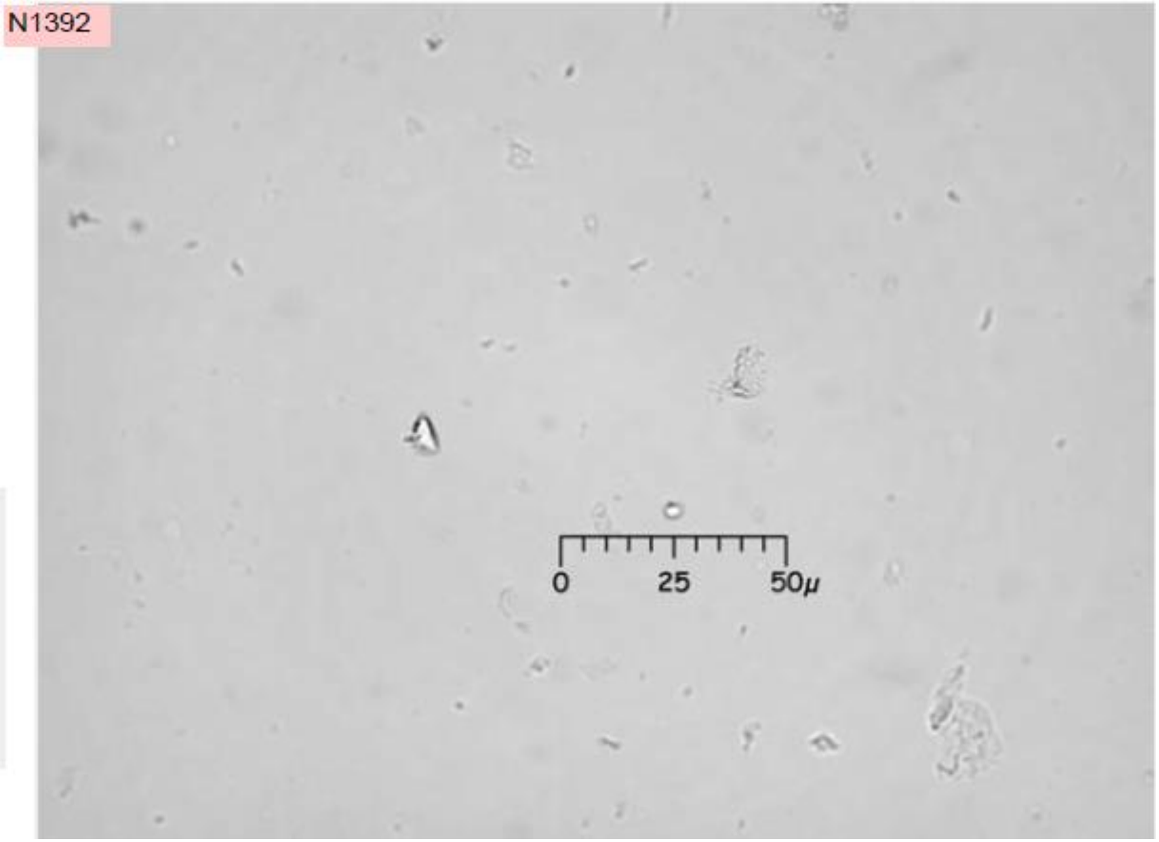


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

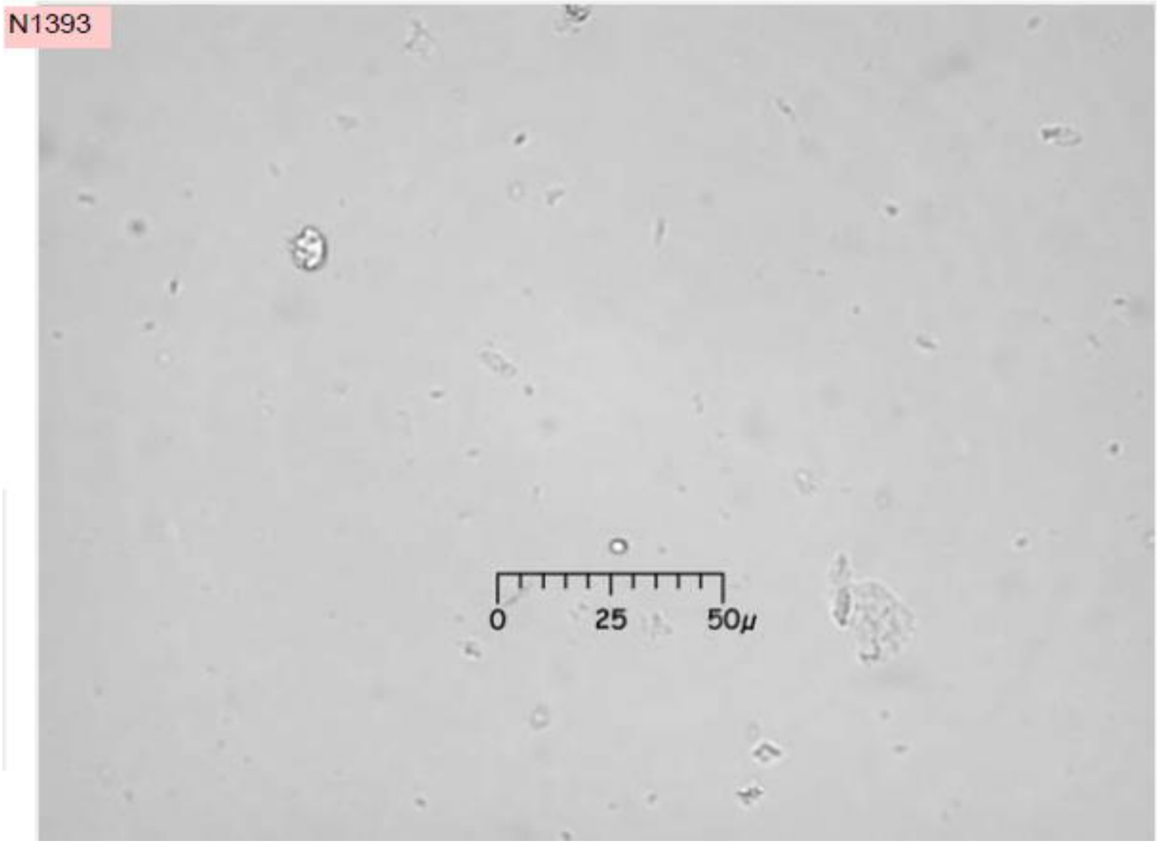


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyathea pallescens

Phytolith

Slide 2229a. Leaf

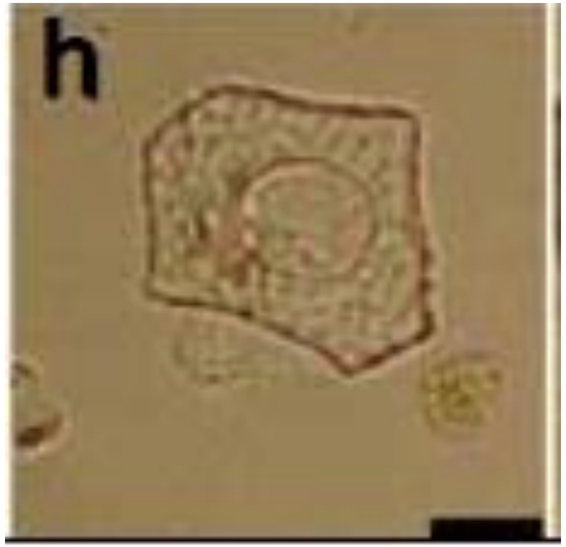


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

CYPERACEAE

Cyperaceae

Phytolith



h. Achene phytolith highly distinctive, and possibly diagnostic of the Cyperaceae genera *Kyllinga* and *Cyperus*.

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Cyperaceae

Phytolith

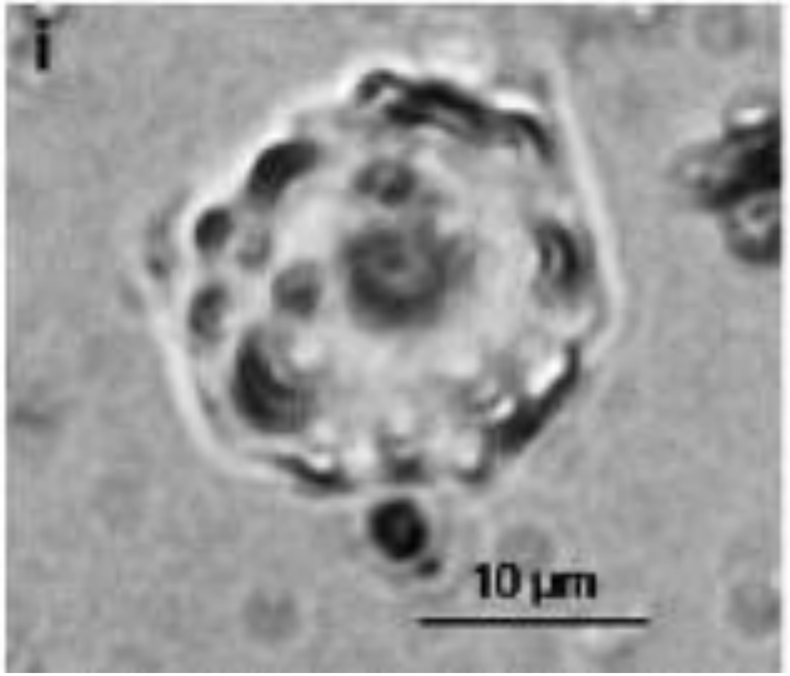


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. i) Cyperaceae hat-shaped phytolith with satellites (BD M1, 20-30 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Abildgaardia monostachya

Phytolith

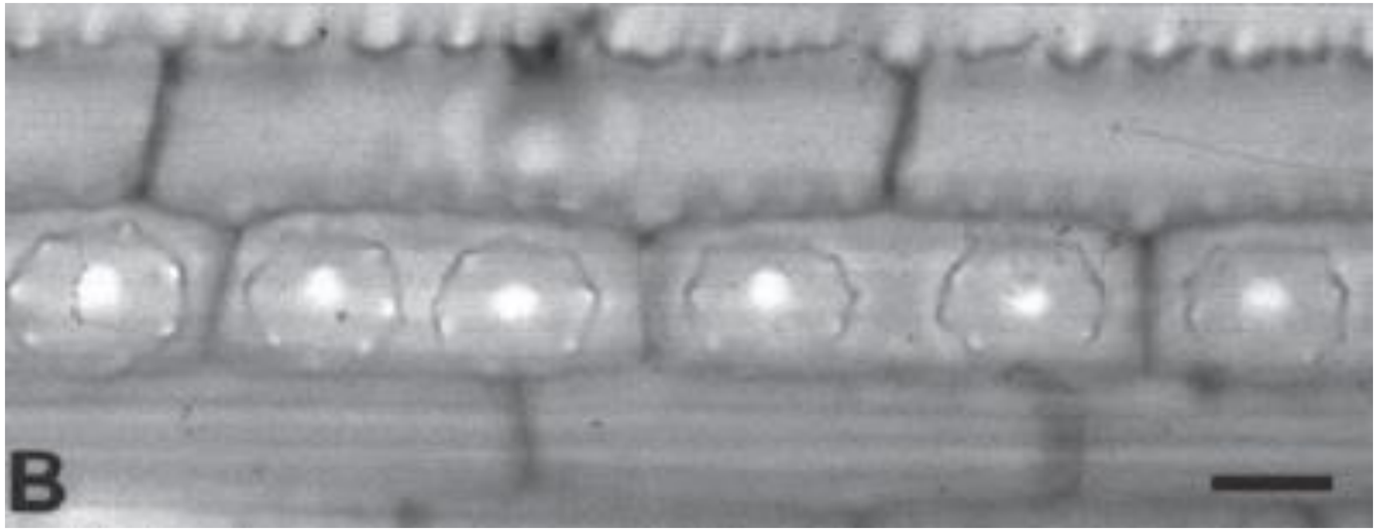


Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. B. Abildgaardia monostachya (Cyperaceae), conical bodies with satellites in epidermis
(bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Carex intermedia

Phytolith

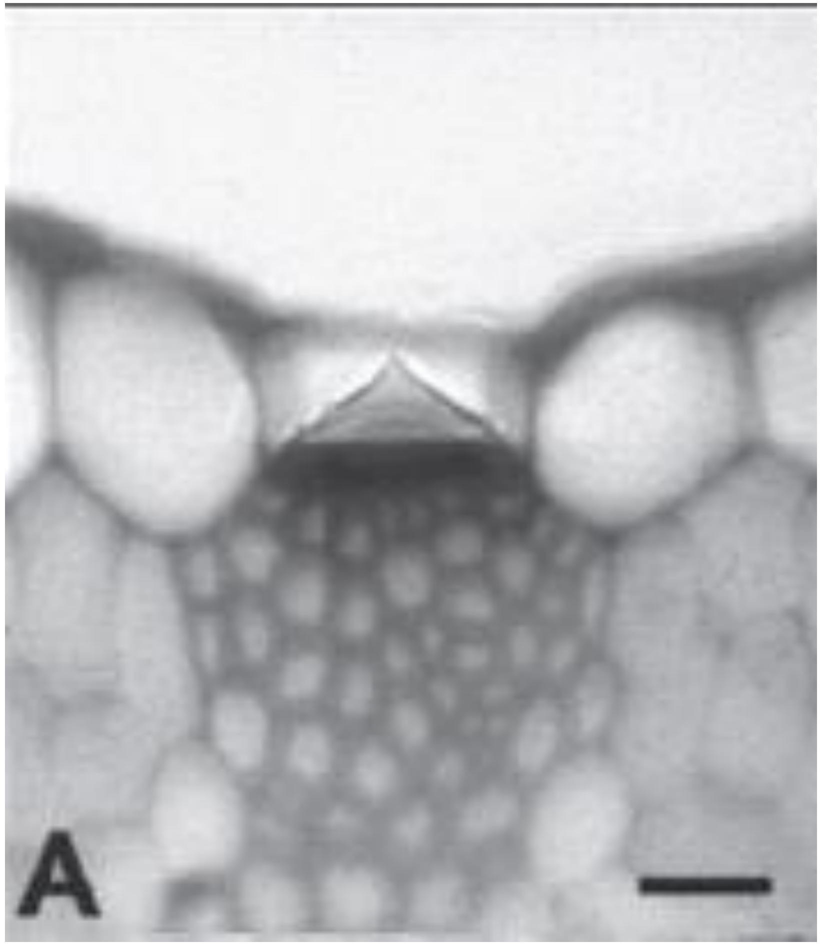


Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. A. Carex intermedia (Cyperaceae), lateral view of a conical silica body with tiny spines projecting near the base (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Cyperus articulatus

Phytolith

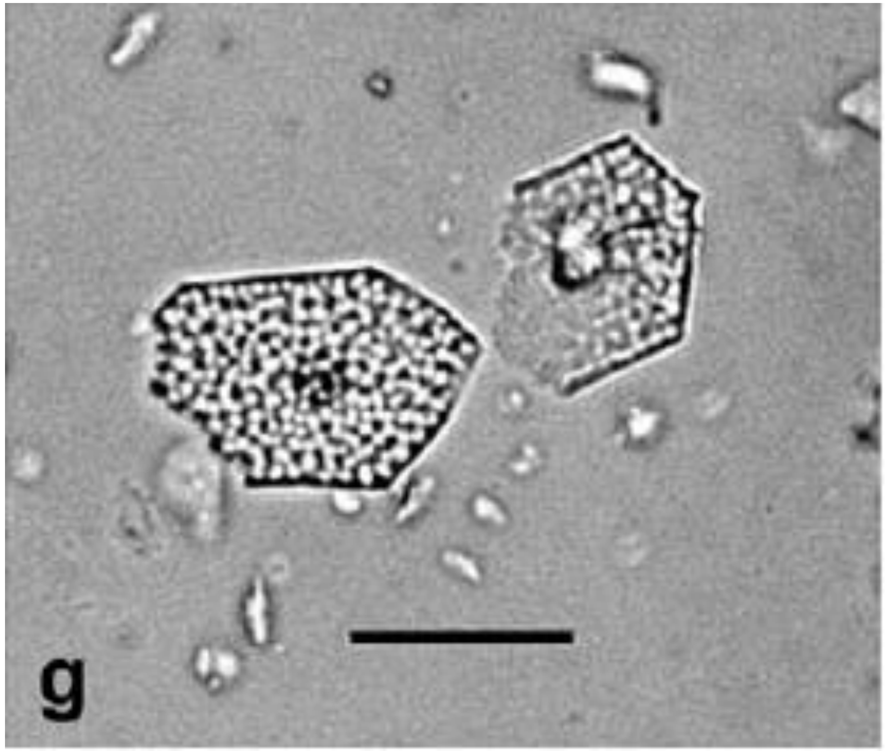


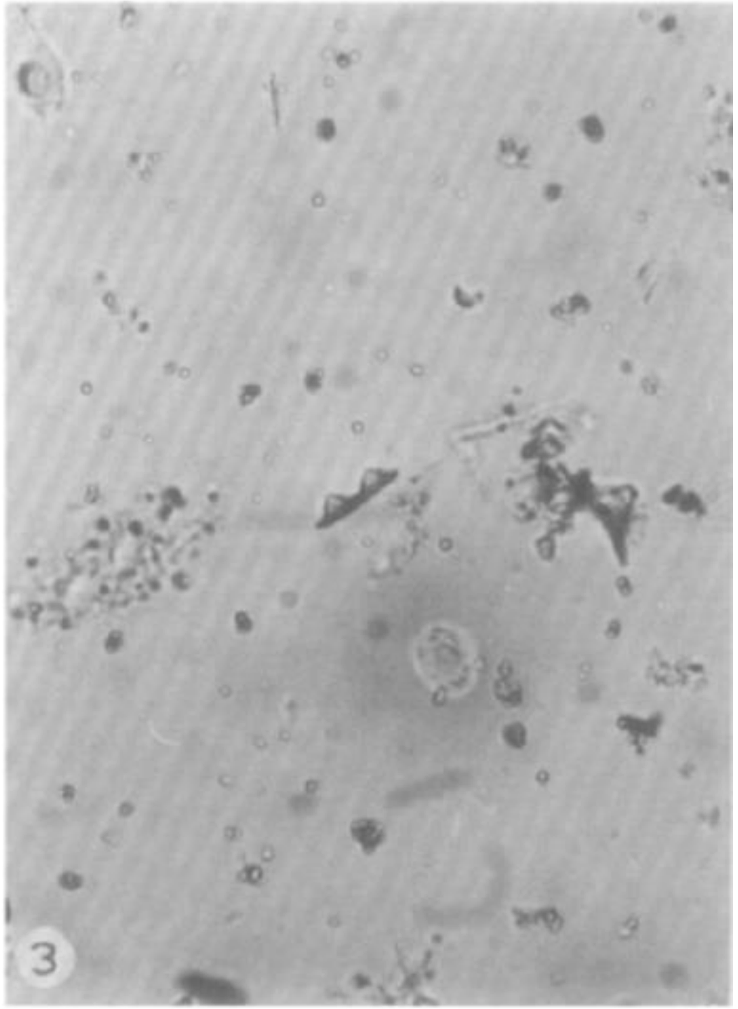
Fig. 3. Phytoliths from non-grass monocots. g) Polygonal cone from Cyperus articulatus achene

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Cyperus chorizanthus

Phytolith

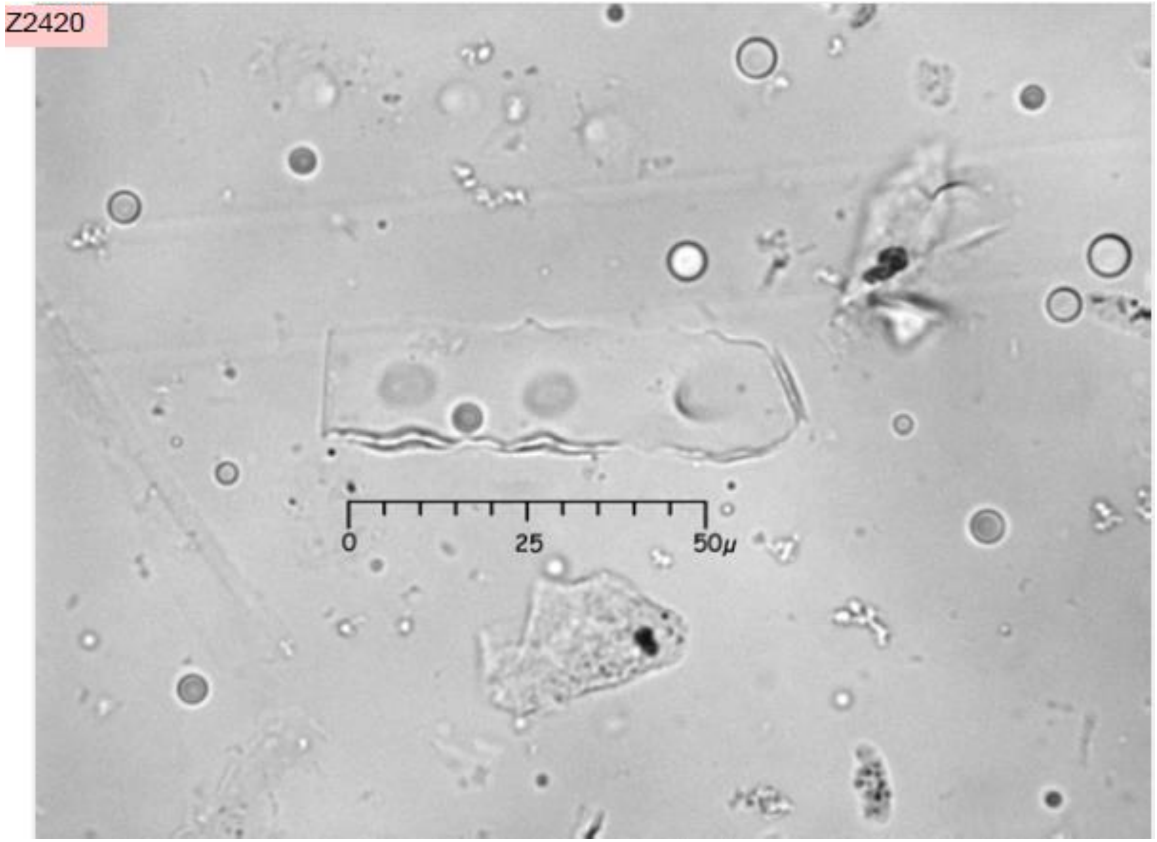
3. Conical-shaped phytoliths from Cyperus chorizanthus (400×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Cyperus esculentus

Phytolith



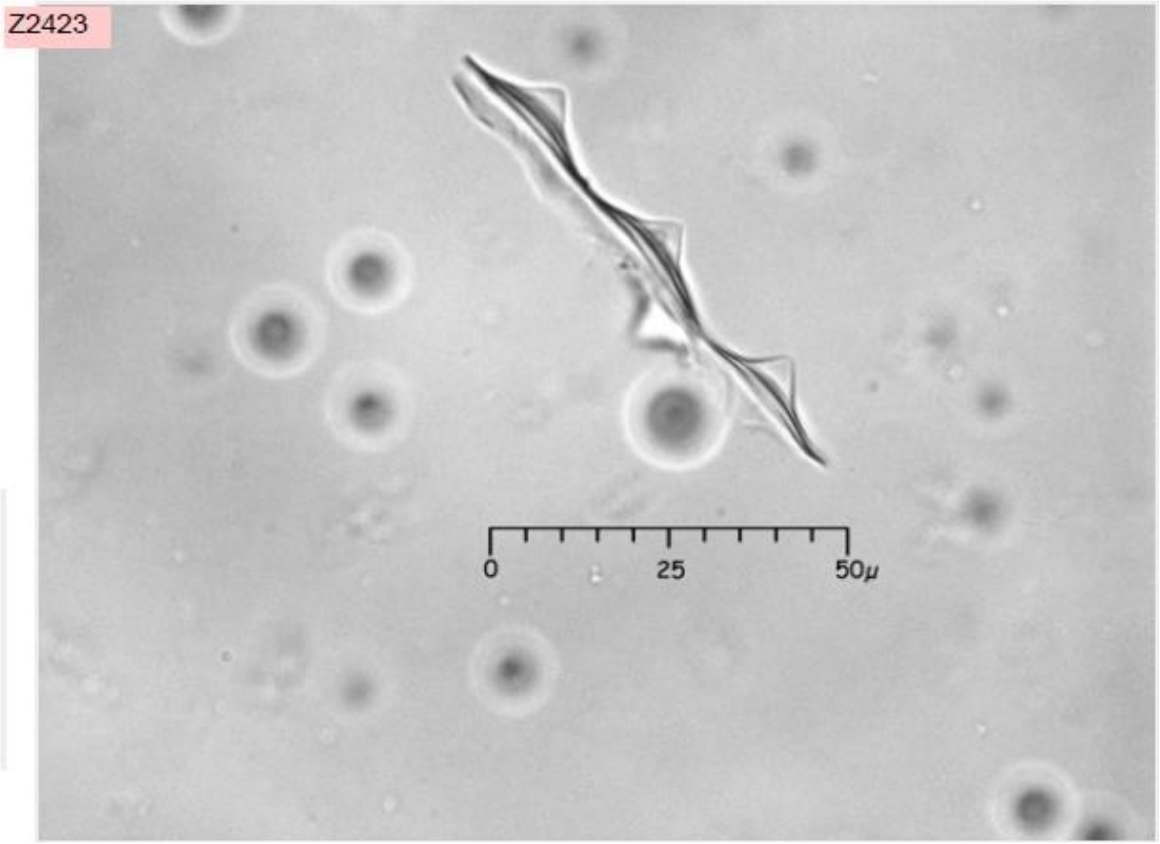
PC628, leaf
Often occur in lines or ranks. Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

PC628, leaf
Often occur in lines or ranks. Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

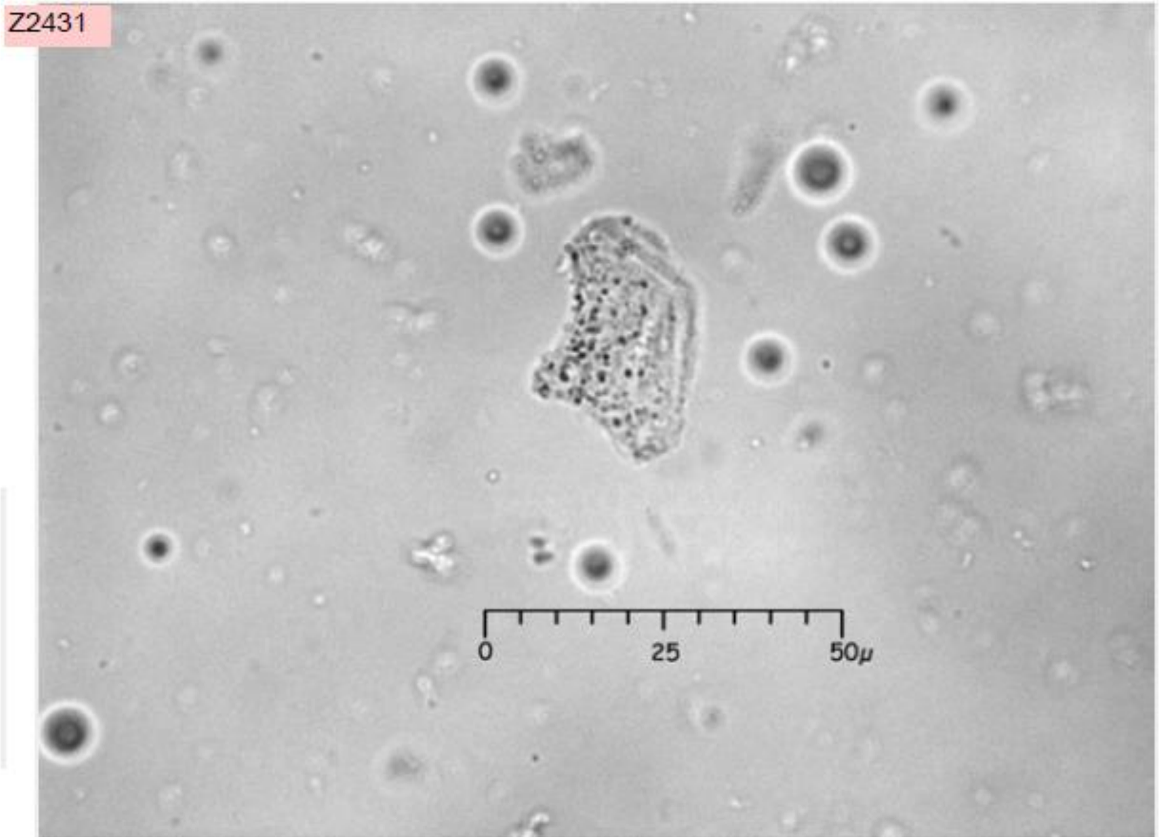


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

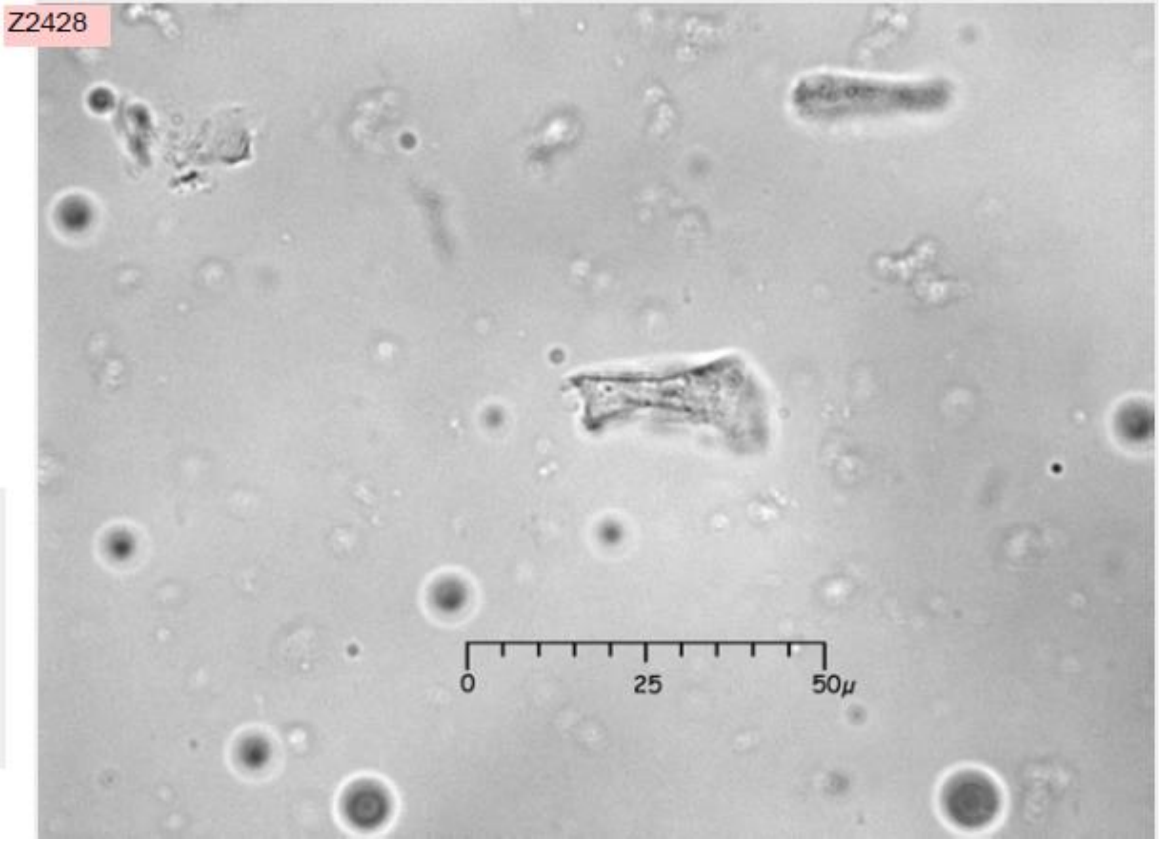
PC629 inflorescence
Some examples have edge projections Diagnotic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith



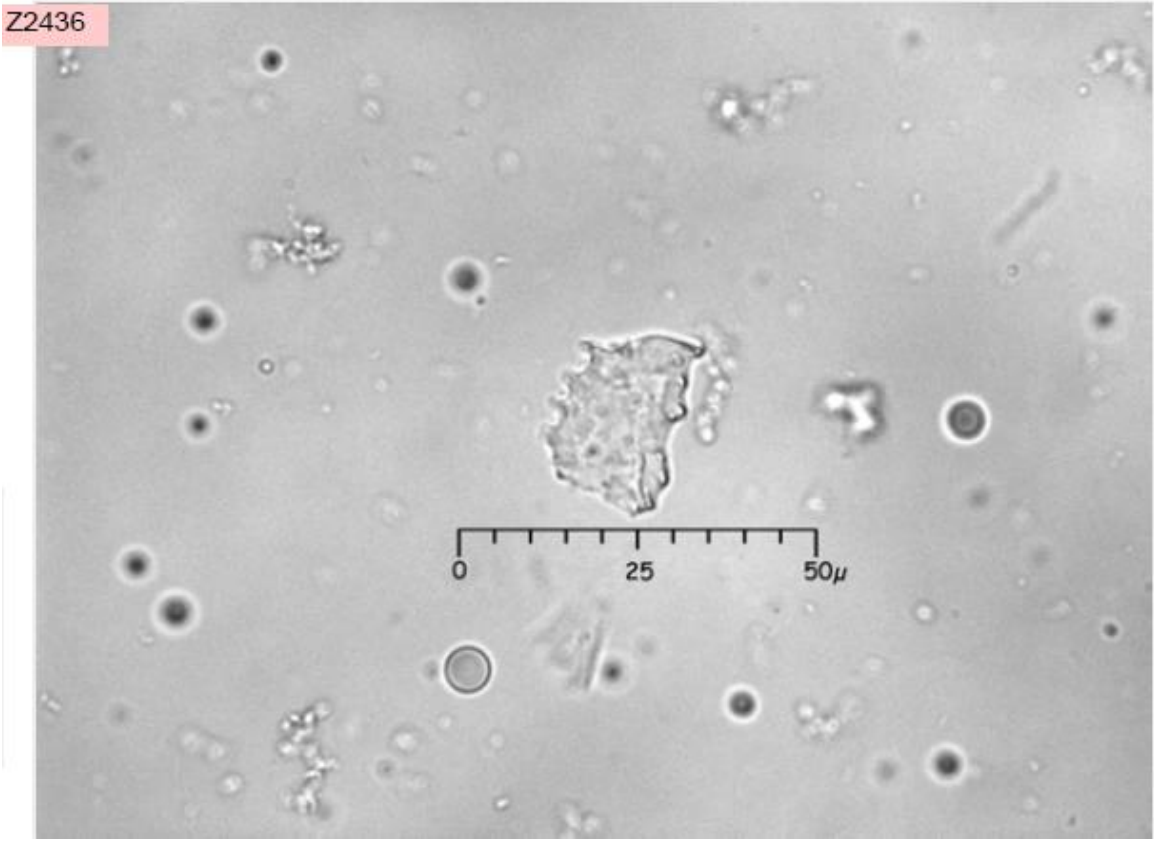
PC629 inflorescence
Some examples have edge projections This photo shows a side view
Diagnotic level: under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

PC629 inflorescence
Some examples have edge projections This photo shows edge projections.
Diagnotic level: under study

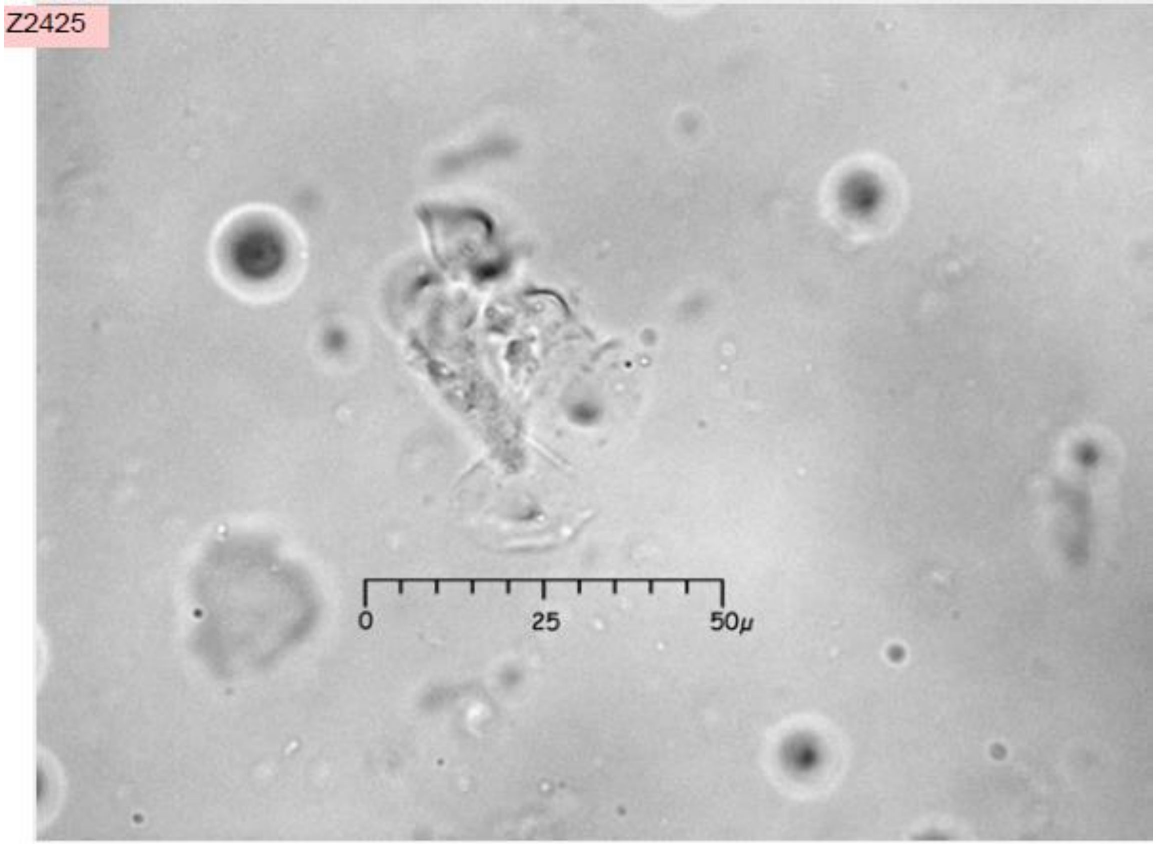


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

PC629 inflorescence Diagnostic level: under study

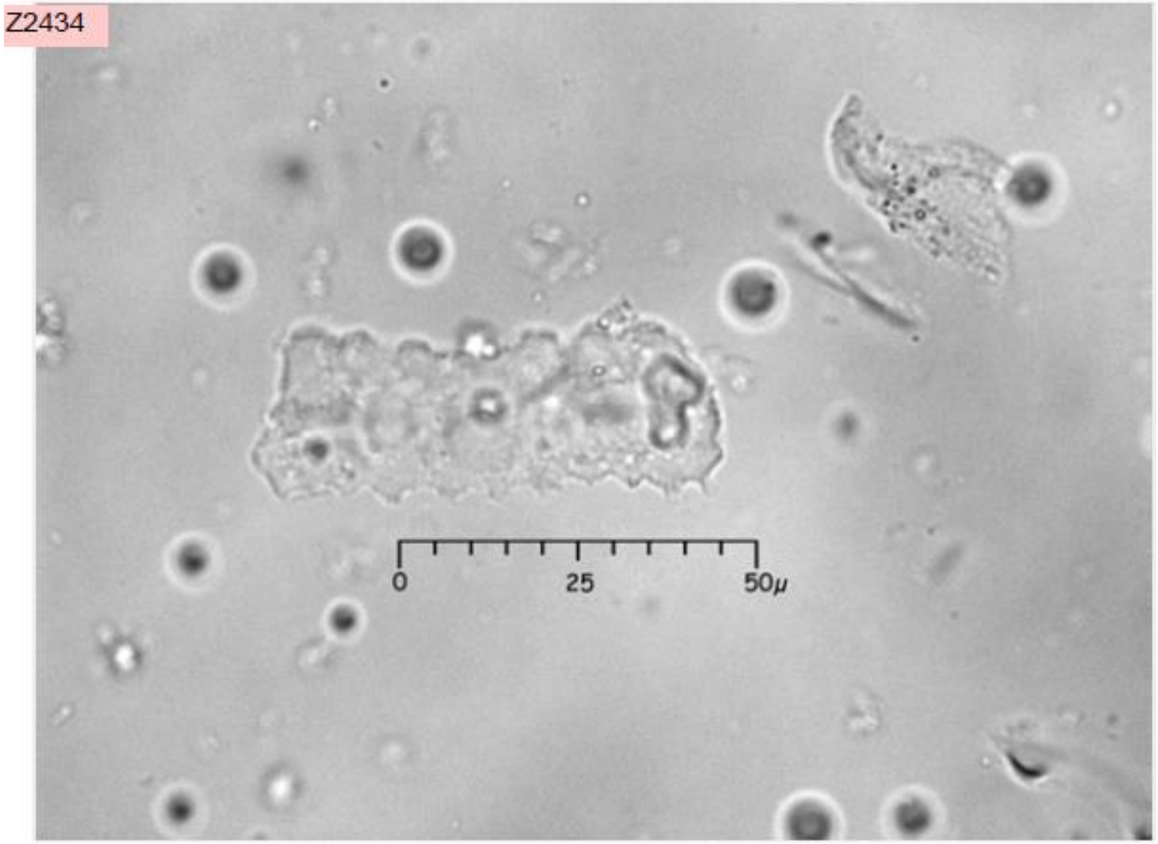


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

PC629 inflorescence
This example (viewed from the bottom) has edge decoration/projections
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

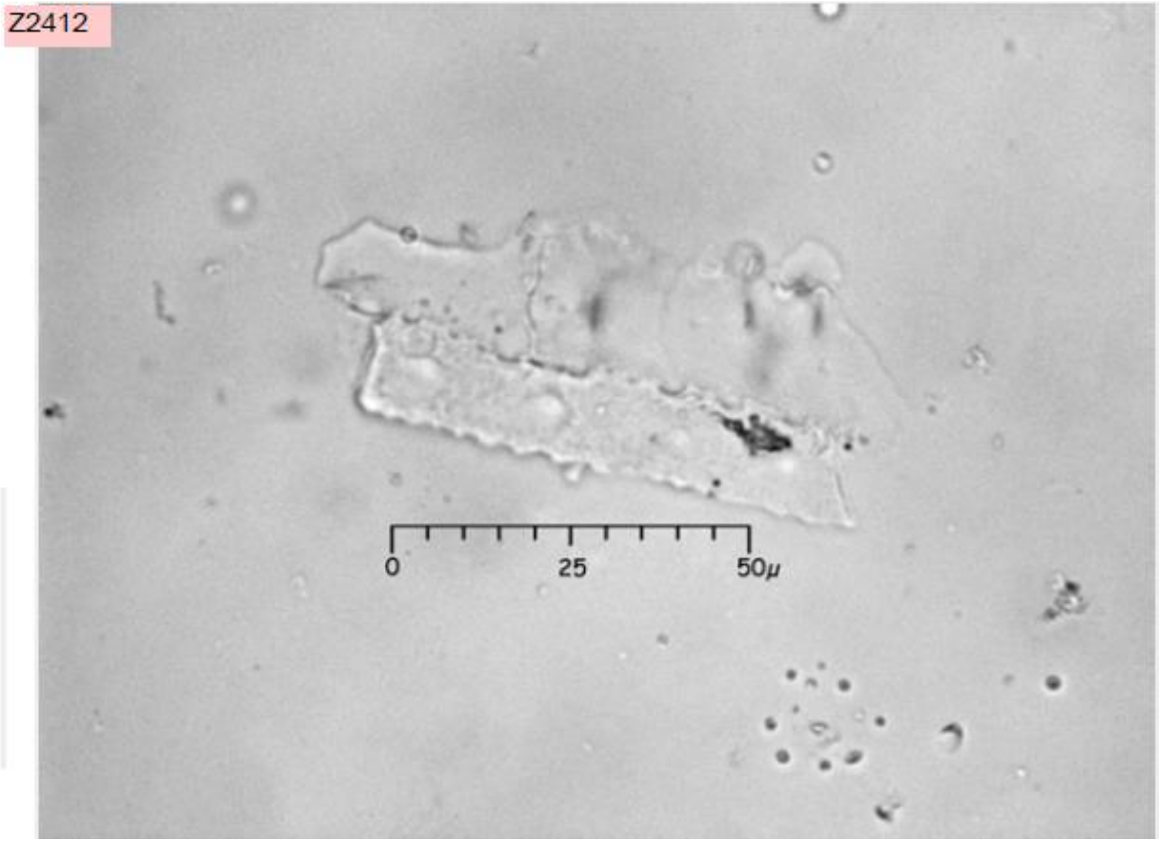
PC626, leaf
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

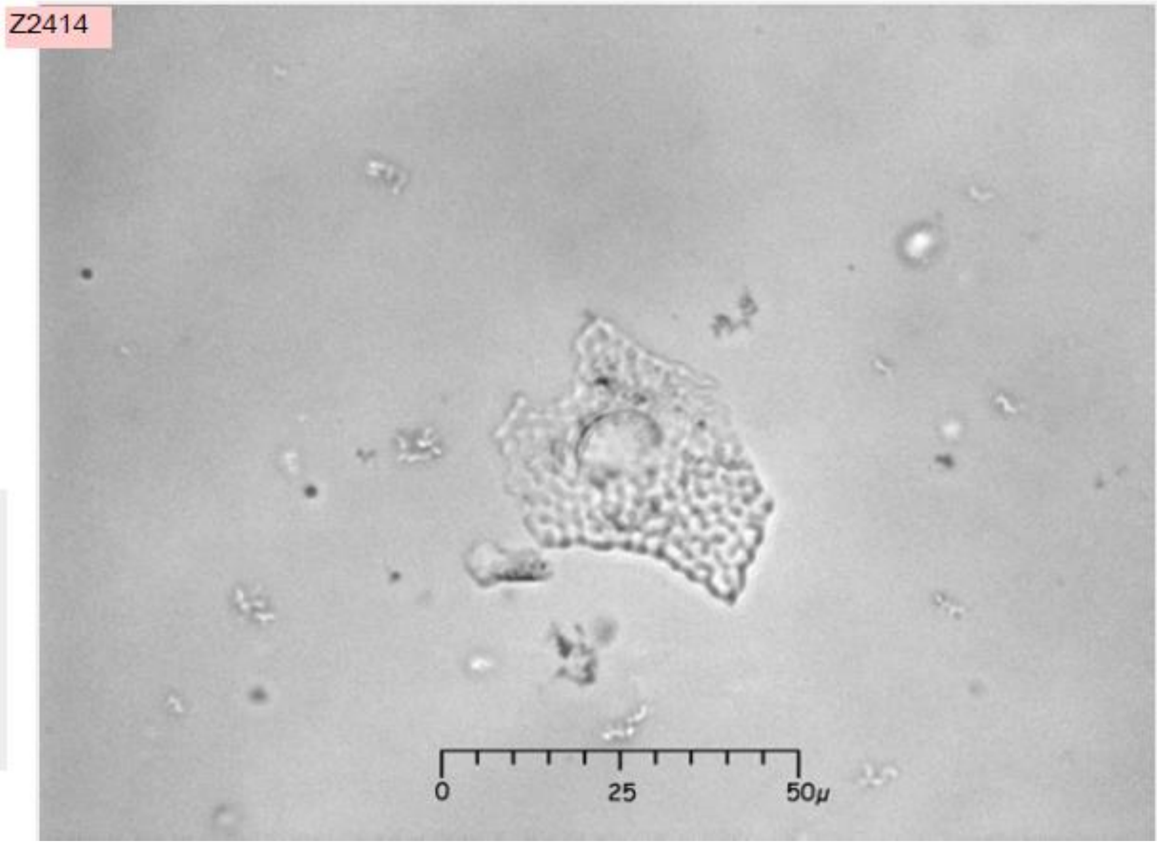
PC626, leaf
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith



PC627 inflorescence
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

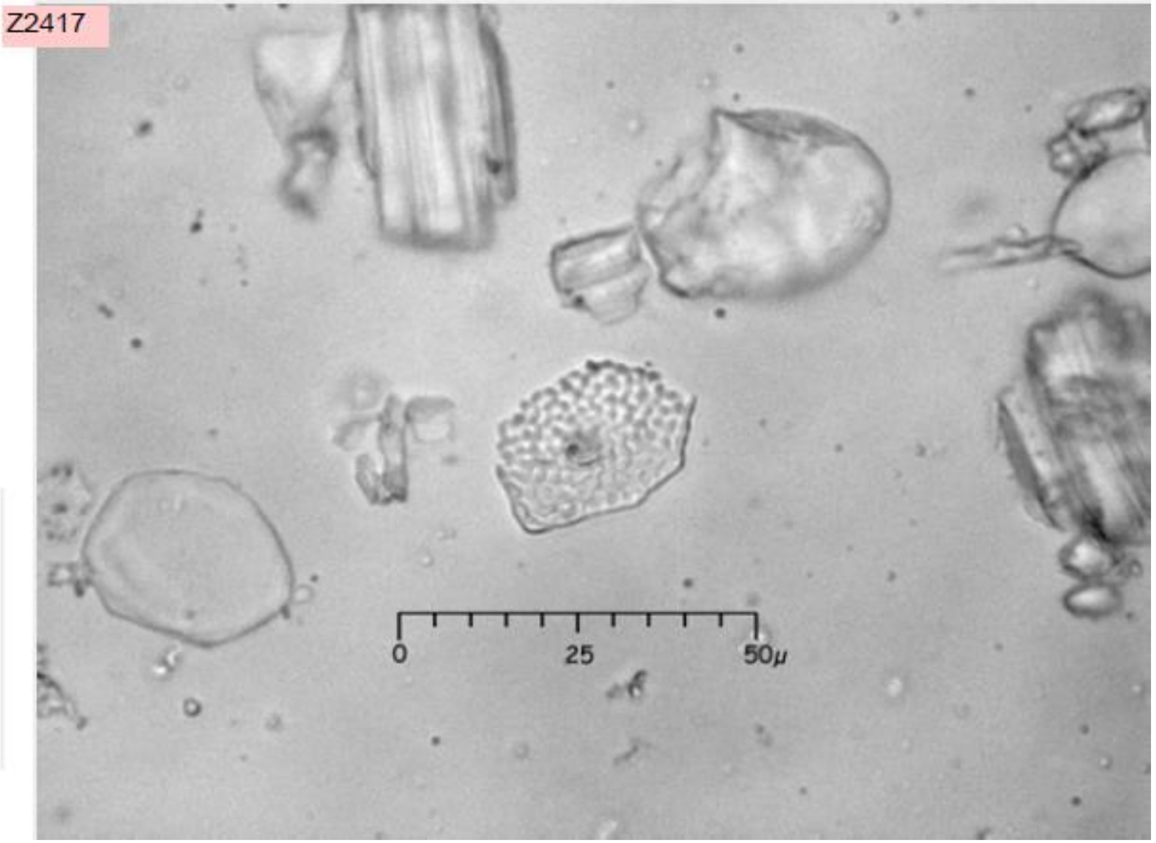
PC627 inflorescence
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus esculentus

Phytolith

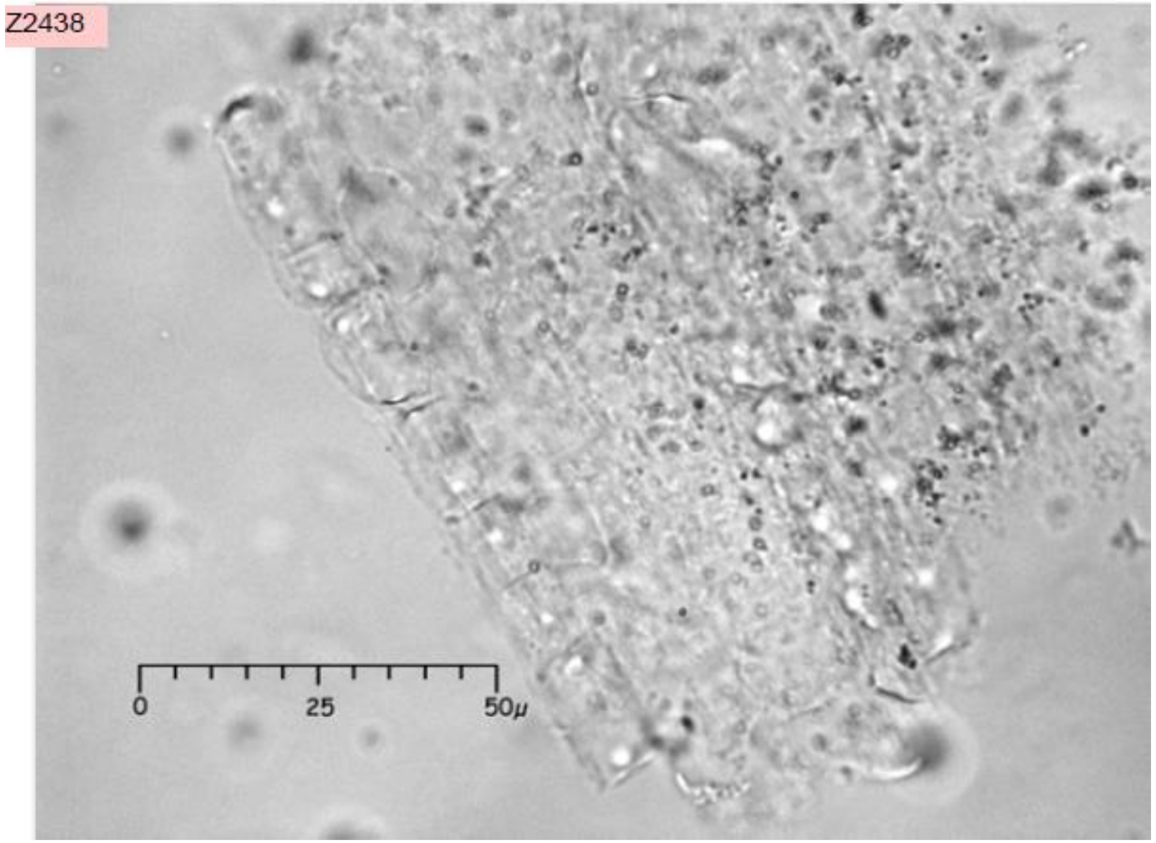
PC627 inflorescence
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith



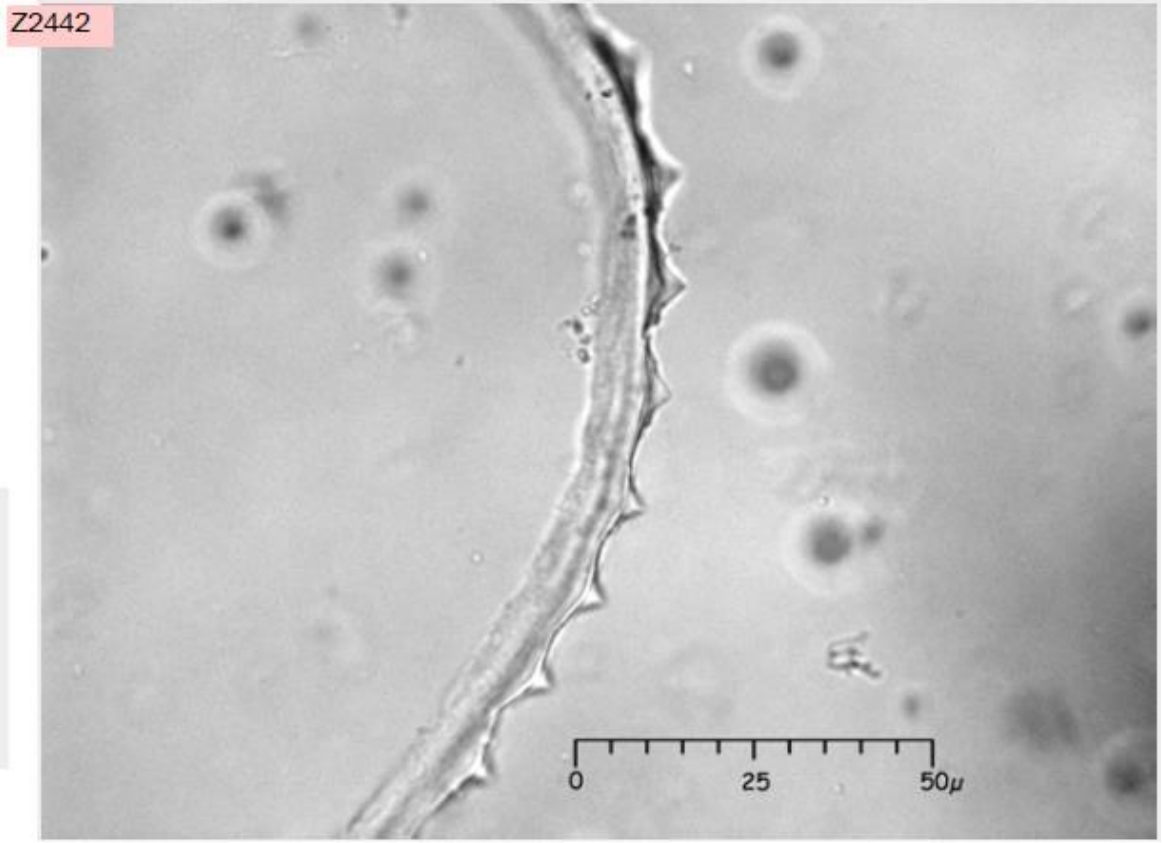
PC2996 leaf
Epidermal sheet with 20VA in situ
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith

PC2996 leaf
Side view of group of 20VA
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

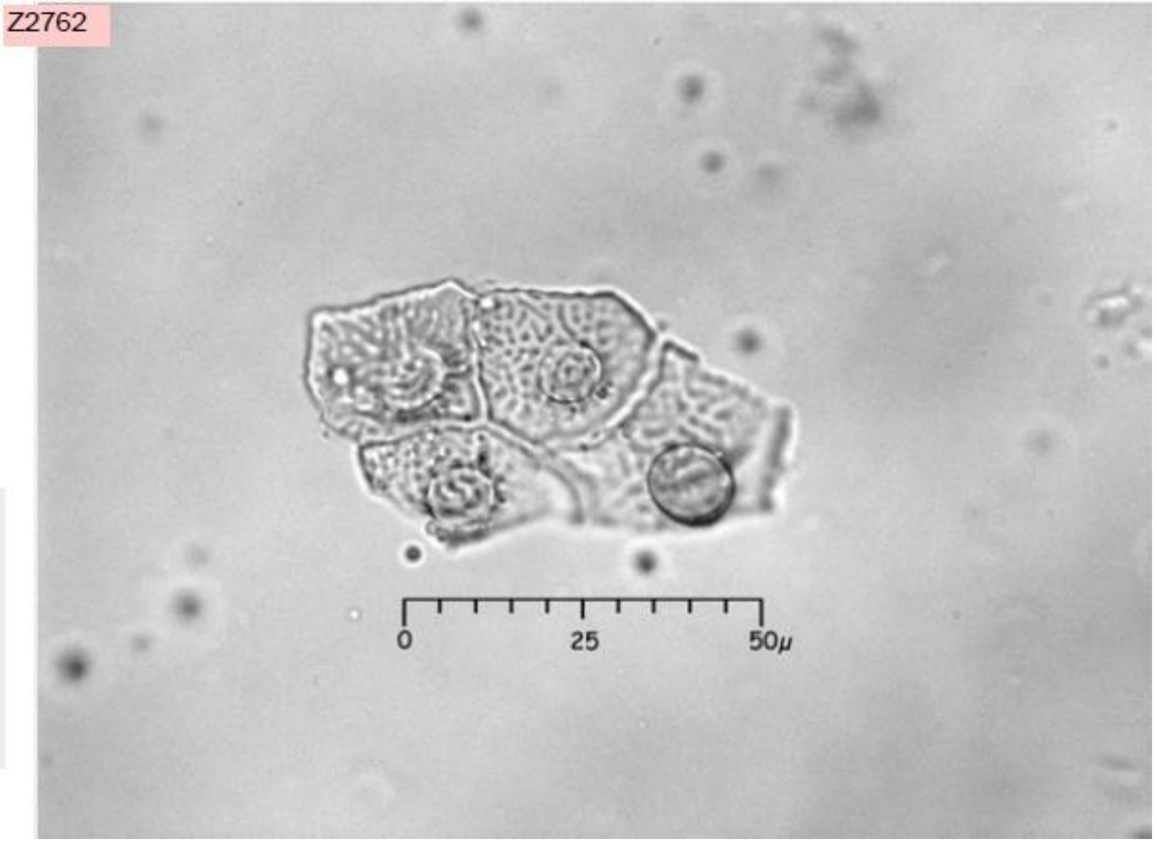


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith

PC2997
This variant has flat-topped rather than conical projections. Both flat and conical are present in the specimen; flat tend to occur in epidermal sheets
Diagnostic level: genus

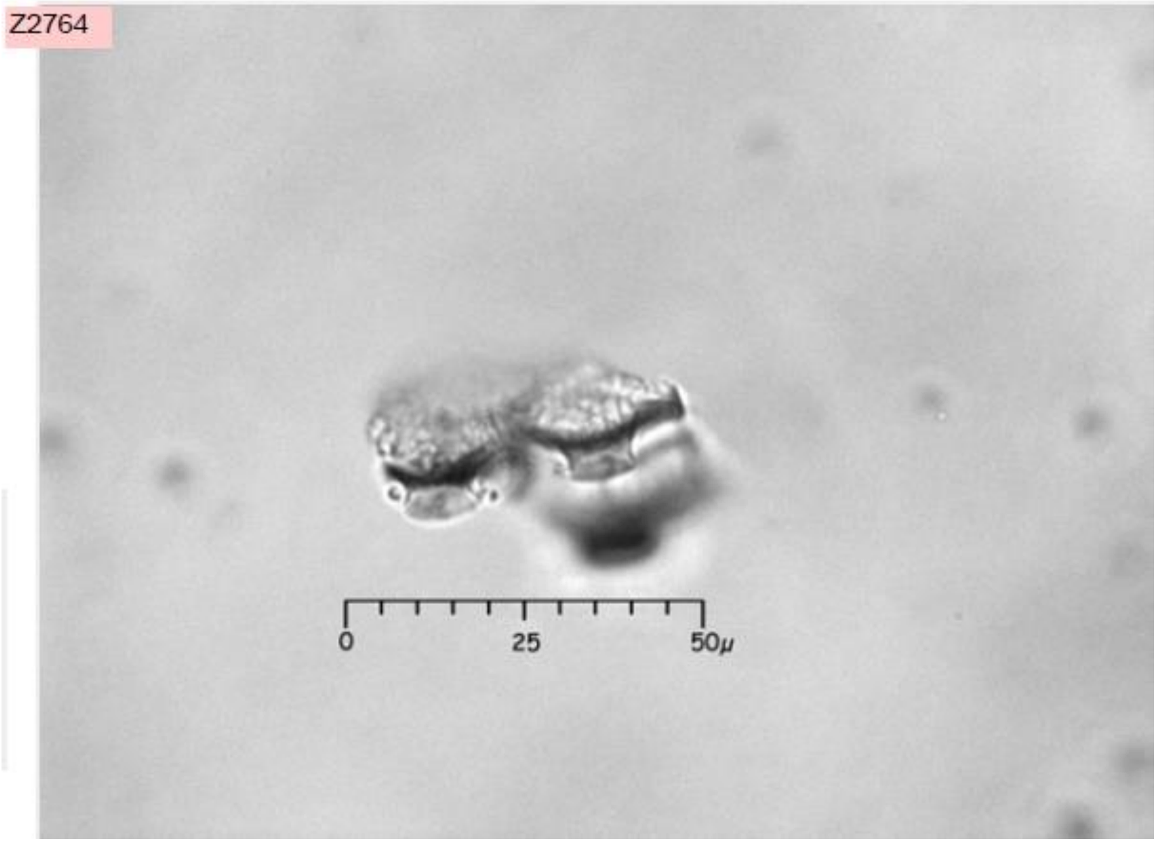


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith

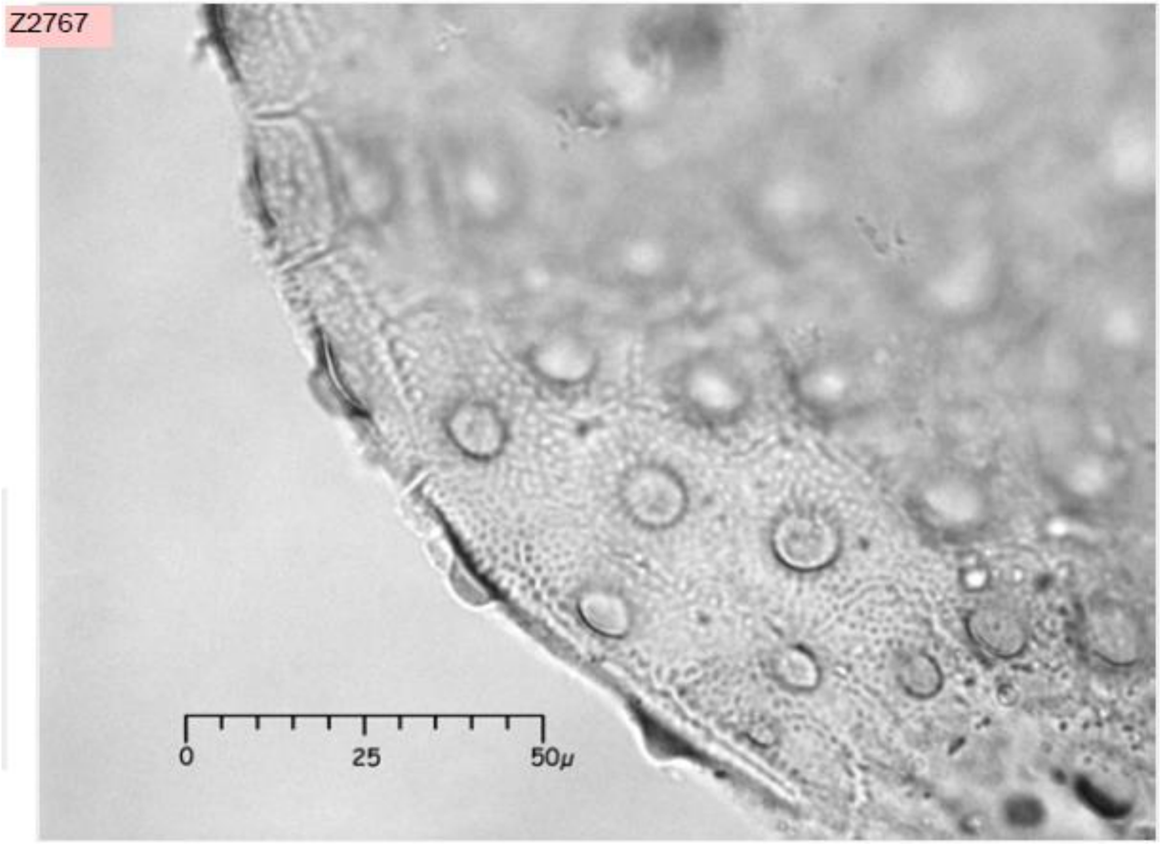
PC2997
This variant has flat-topped rather than conical projections. Both flat and conical are present in the specimen; flat tend to occur in epidermal sheets
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith



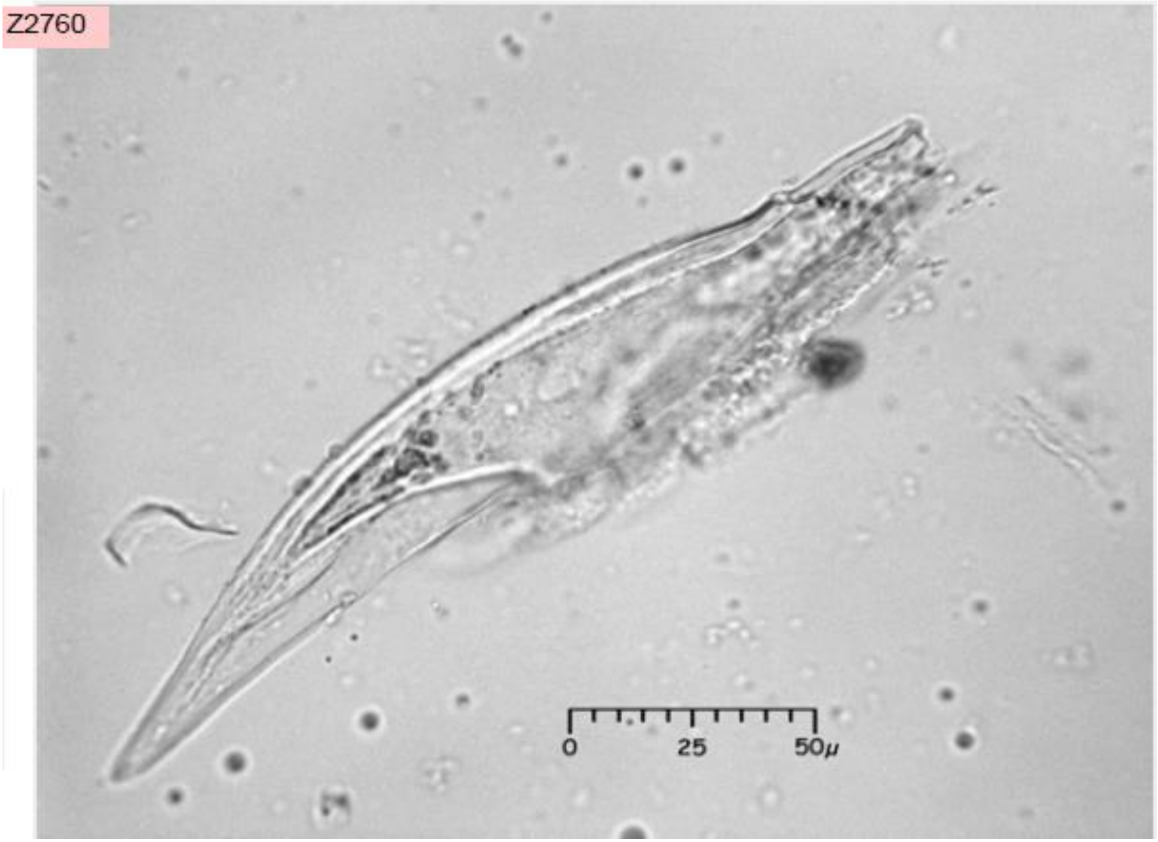
PC2997
This variant has flat-topped rather than conical projections. Both flat and conical are present in the specimen; flat tend to occur in epidermal sheets
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith

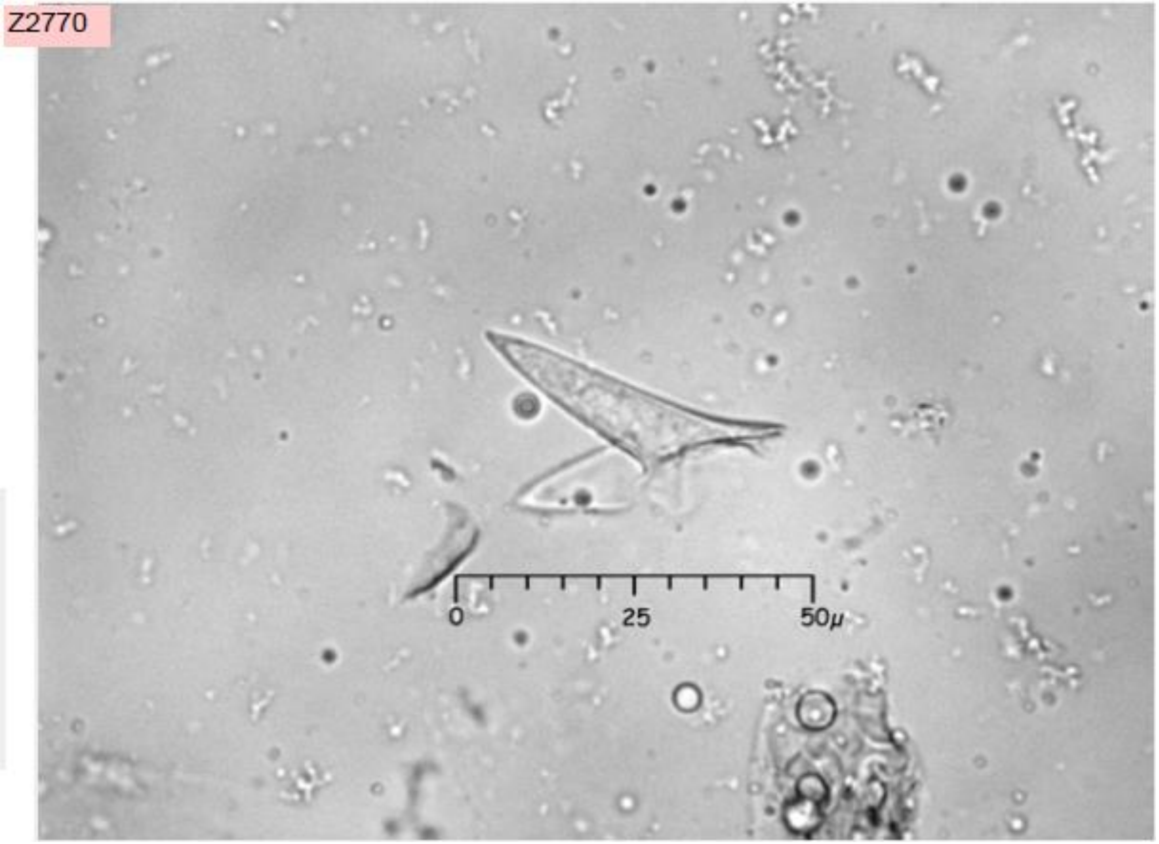
PC2996, leaf
double-outline trichome
Not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus hermaphroditus

Phytolith



PC2997, inflorescence
double-outline trichome
Not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Cyperus/Kyllinga sp.

Phytolith

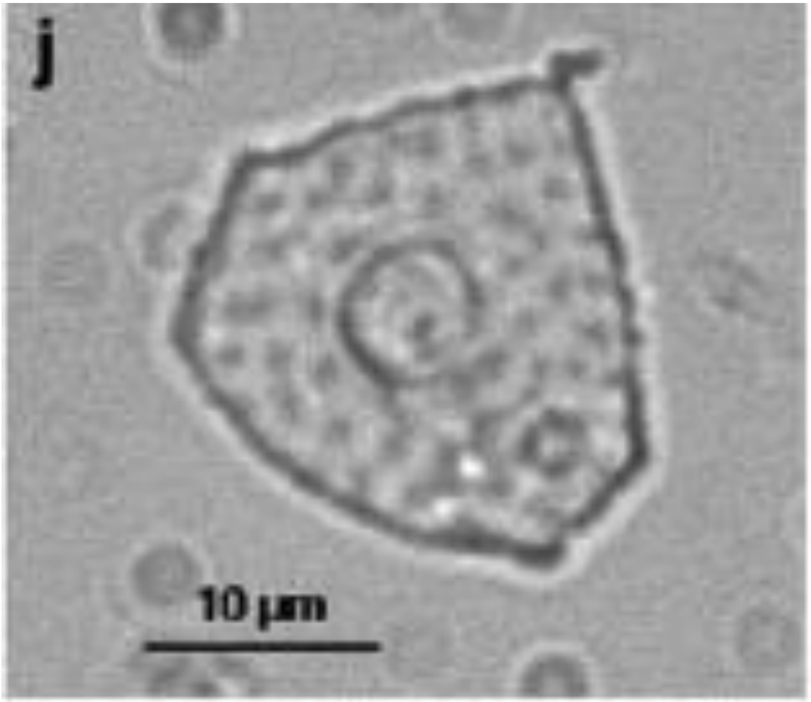


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. j) Cyperus/Kyllinga achene body (BD M1, 10-20 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Cyperus/Kyllinga sp.

Phytolith

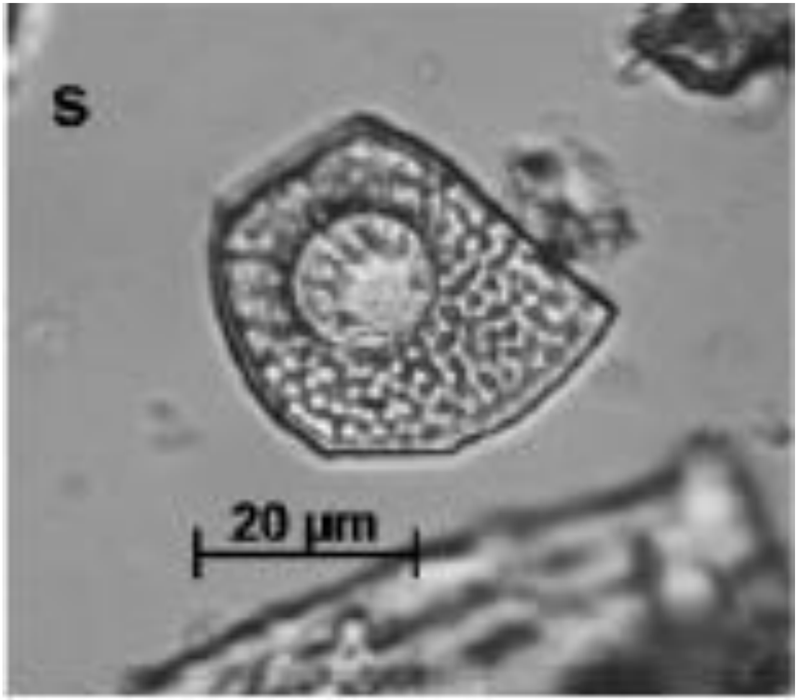


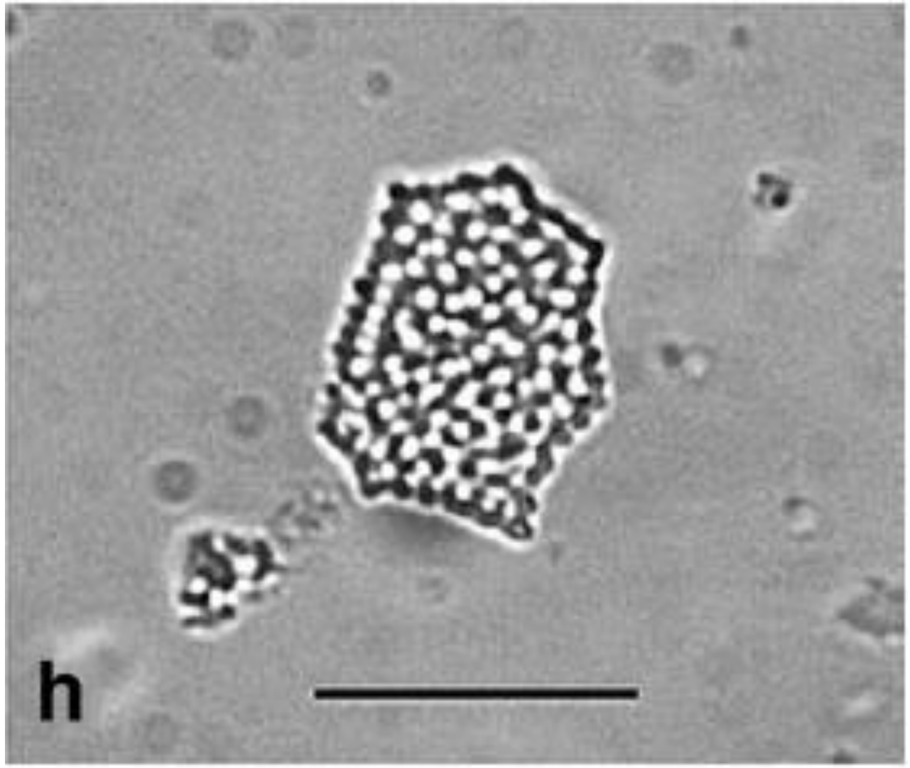
Fig. 5. Selected microbotanical remains. Phytoliths: s) Cyperus/Kyllinga achene (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Kyllinga brevifolia

Phytolith

Fig. 3. Phytoliths from non-grass monocots. h) Polygonal cone from Kyllinga brevifolia achene

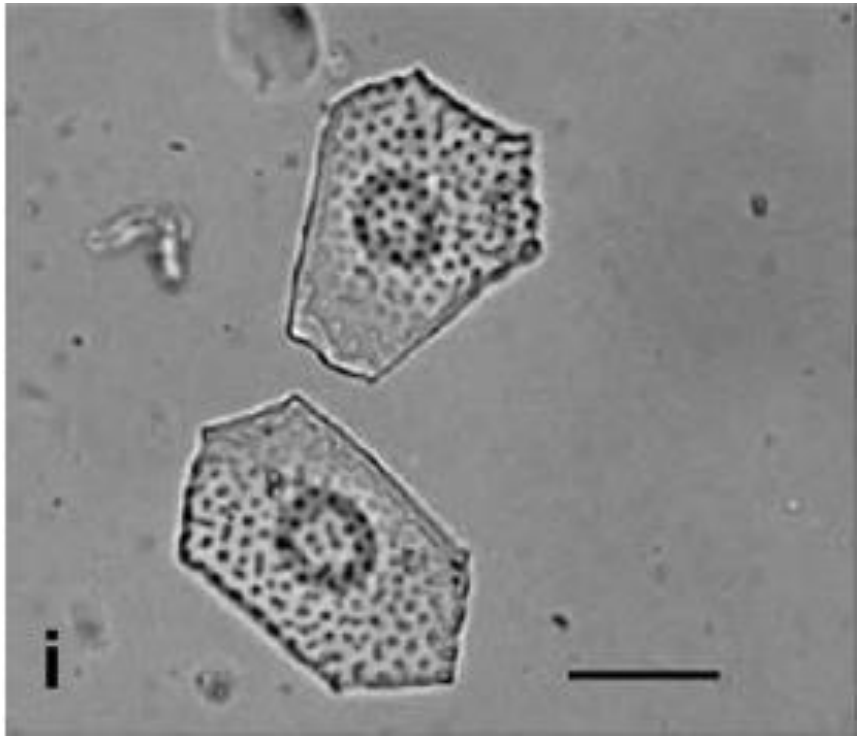


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Remirea maritima

Phytolith

Fig. 3. Phytoliths from non-grass monocots. i) Polygonal cone from Remirea maritima achene



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Rhynchospora gigantea

Phytolith

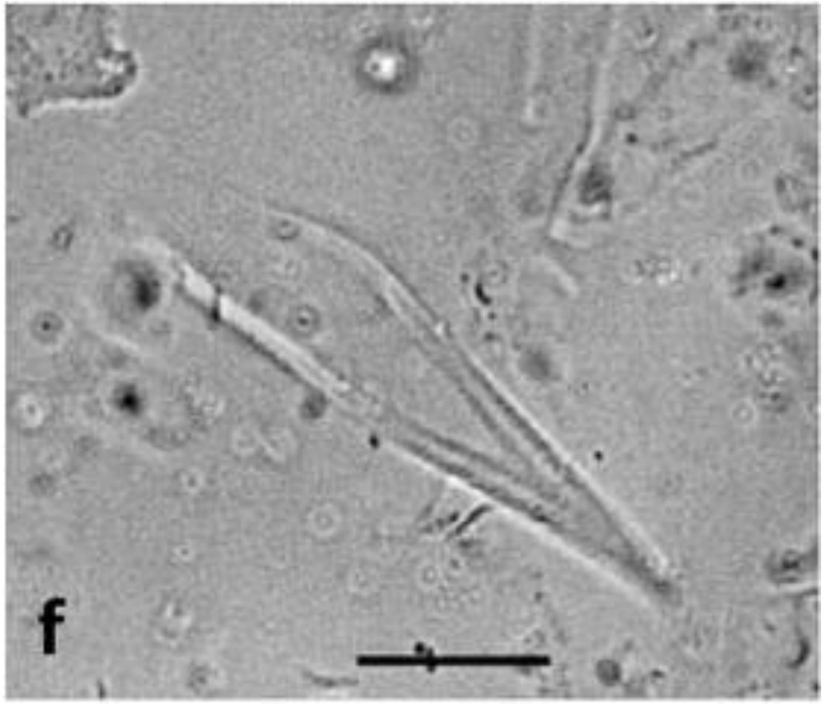


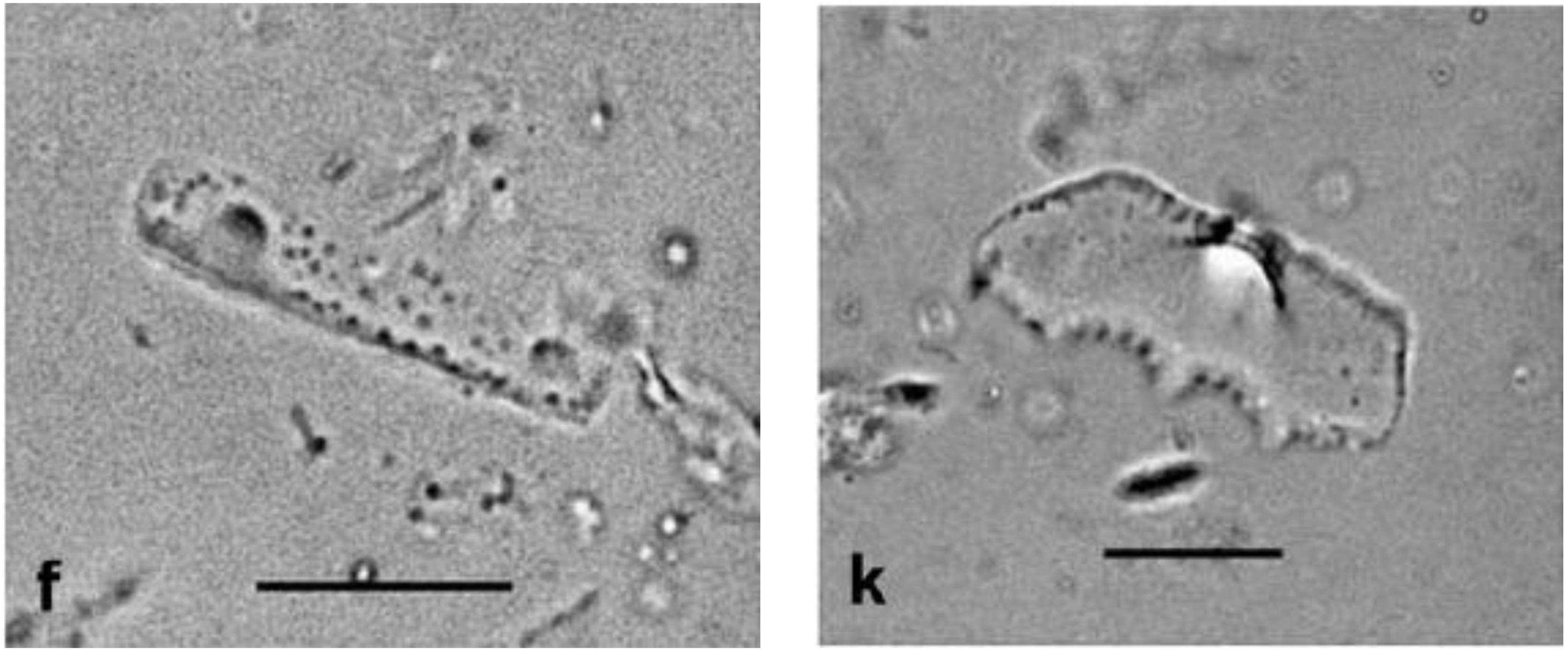
Fig. 2. Phytoliths with little or no taxonomic value. f) Trichome from Rhynchospora gigantea inflo

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Rhynchospora gigantea

Phytolith

Fig. 3. Phytoliths from non-grass monocots. f) Cones from Rhynchospora gigantea inflo, k) Polygonal cone from R. gigantea achene



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Scirpus sp.

Phytolith

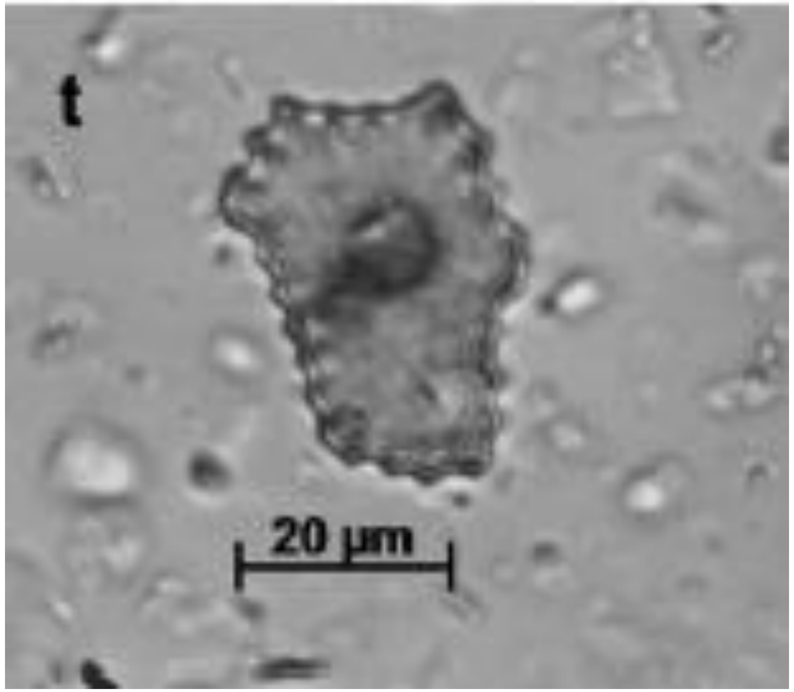
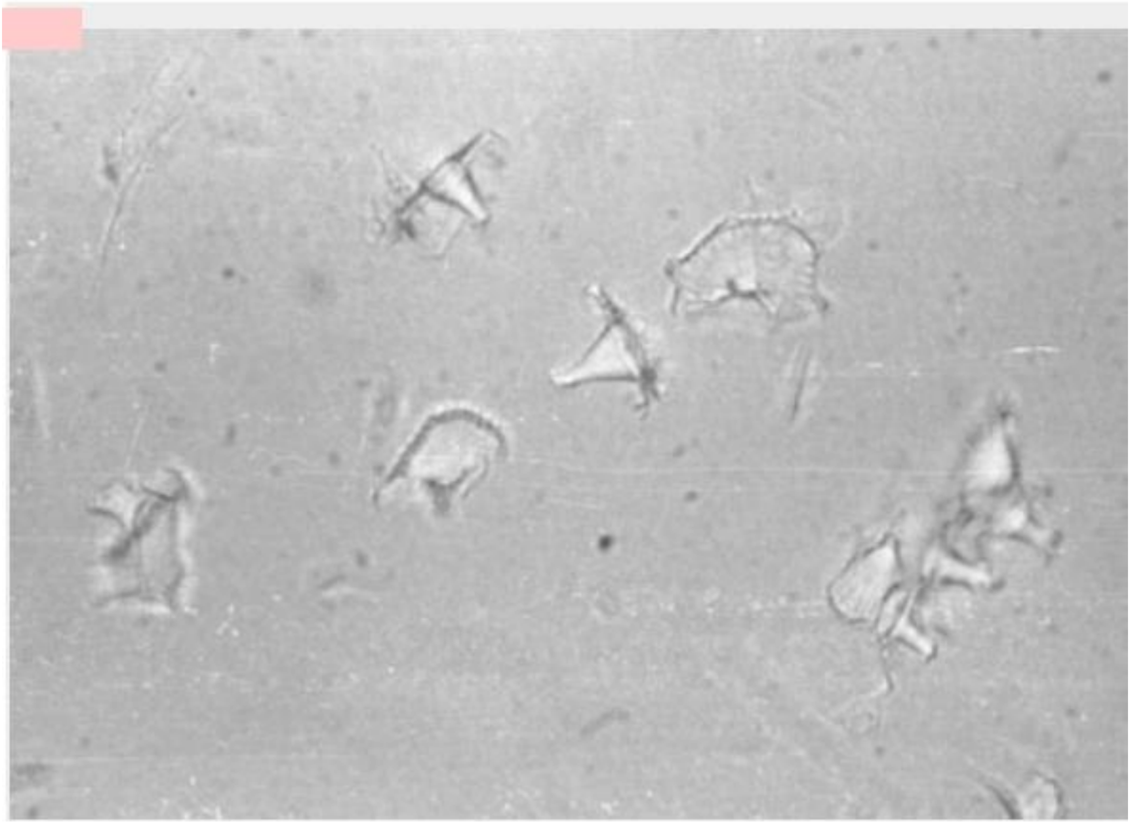


Fig. 5. Selected microbotanical remains. Phytoliths: t) Scirpus achene (LM 99-1864).

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Scirpus sp.

Phytolith

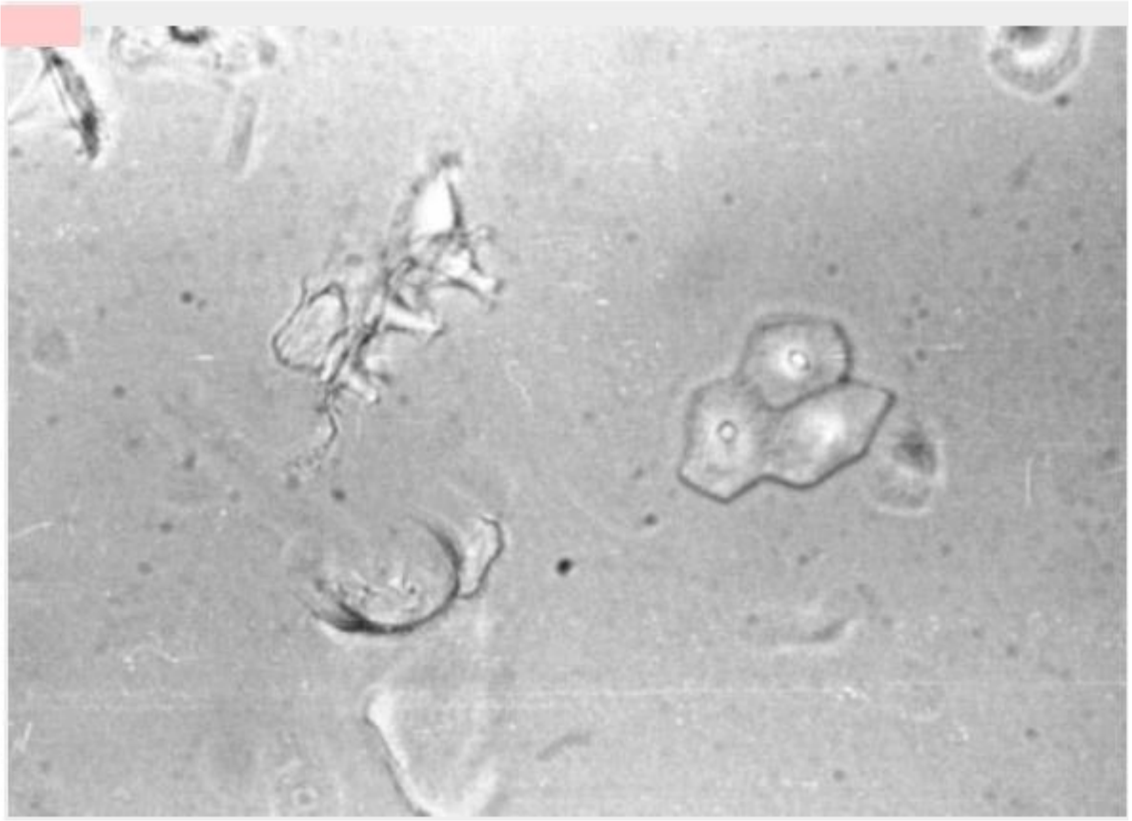


Epidermal seed phytolith
The genus Scirpus is distinct for its very tall conical projection and tall, pointed “sombrero” apperance.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Scirpus sp.

Phytolith



The genus Scirpus is distinct for its very tall conical projection and tall, pointed “sombrero” apperance.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Scirpus-type sp.

Phytolith

Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. k) Scirpus-type achene body (BD M1, 0-10 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Scirpus asper

Phytolith

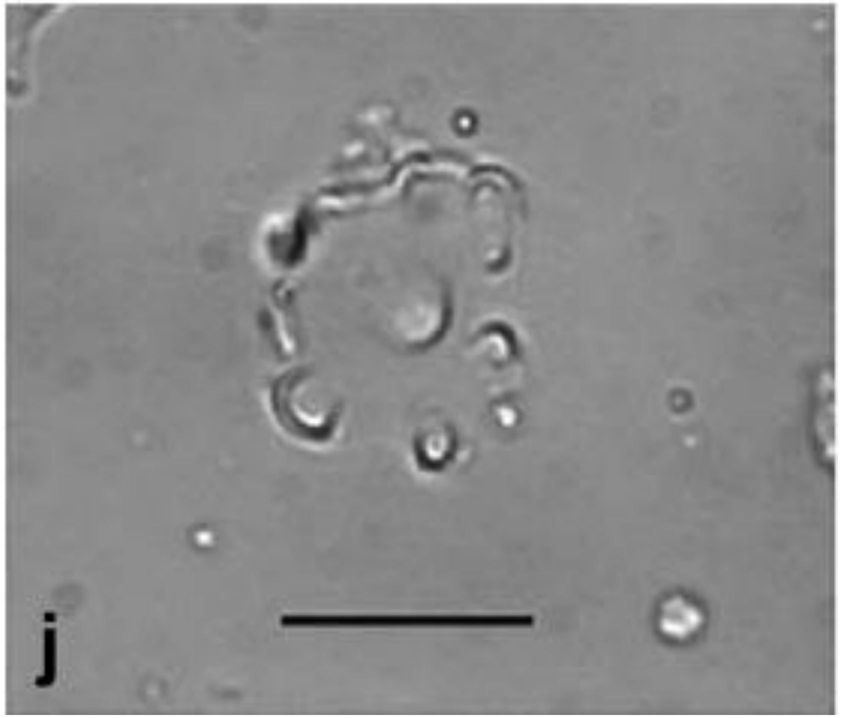


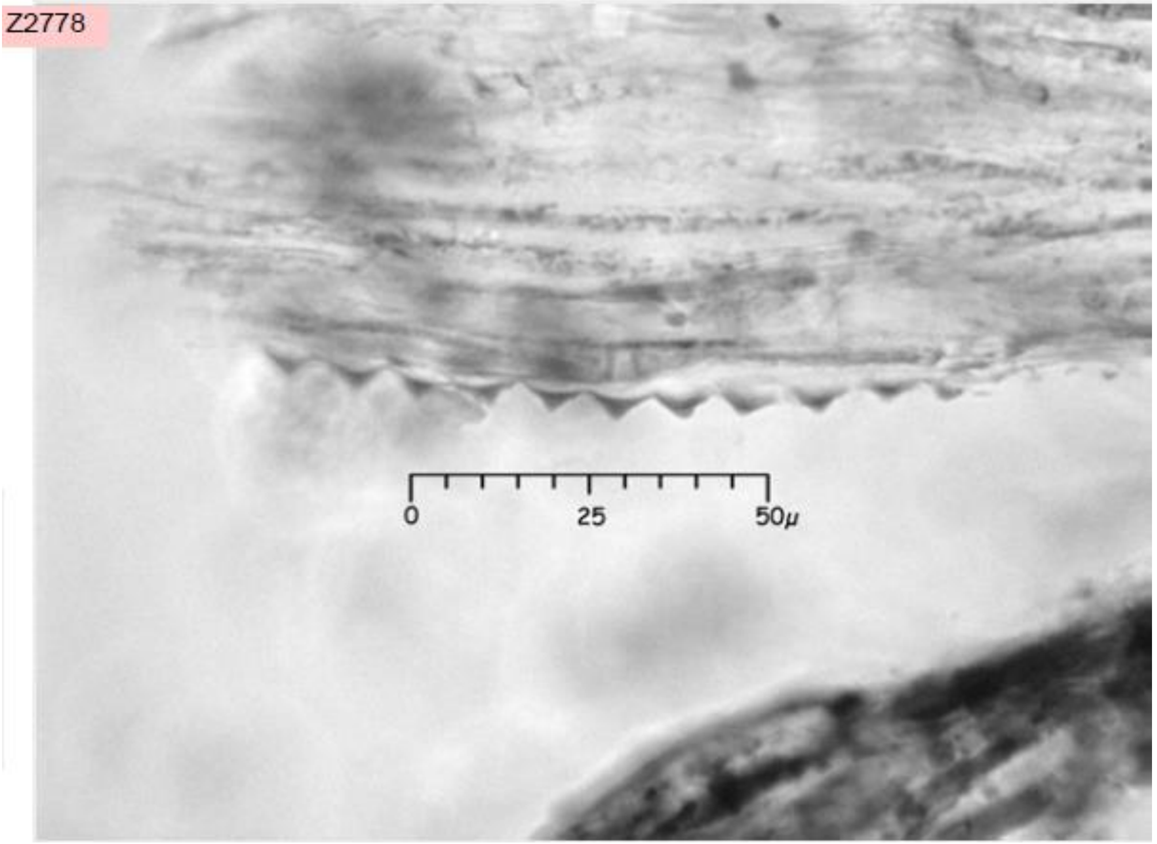
Fig. 3. Phytoliths from non-grass monocots. j) Polygonal cone from Scirpus asper achene

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Scirpus totora

Phytolith

PC644 leaf
Epidermal sheet with 20VA in situ
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Scleria eggersiana

Phytolith

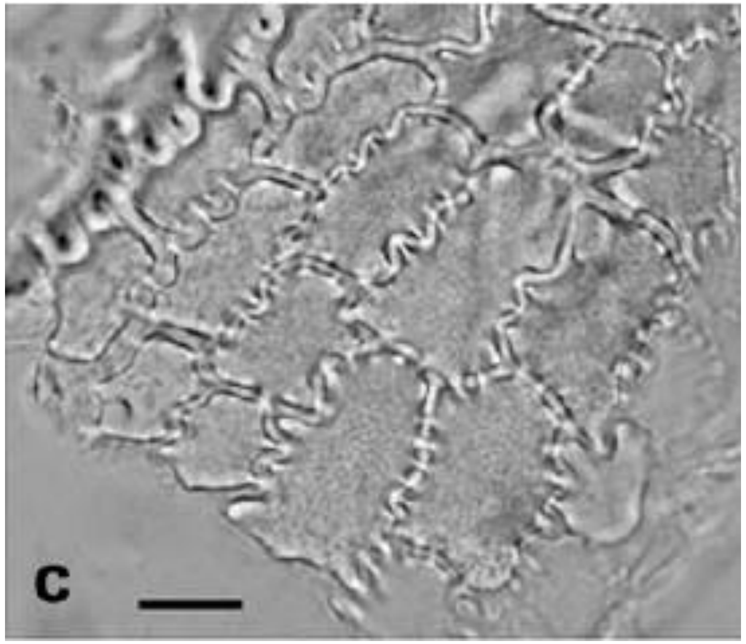
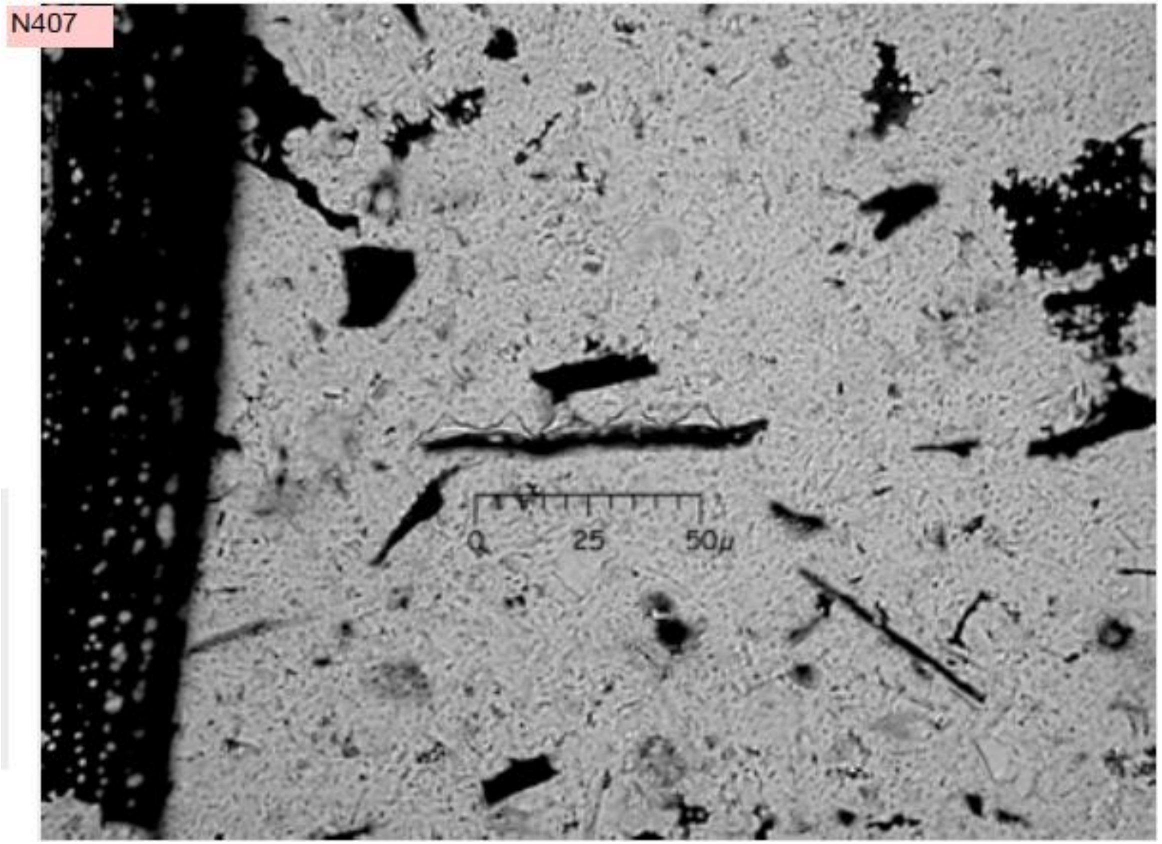


Fig. 2. Phytoliths with little or no taxonomic value. c) Anticlinal epidermis from Scleria eggersiana inflo

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Torulinium odoratum

Phytolith



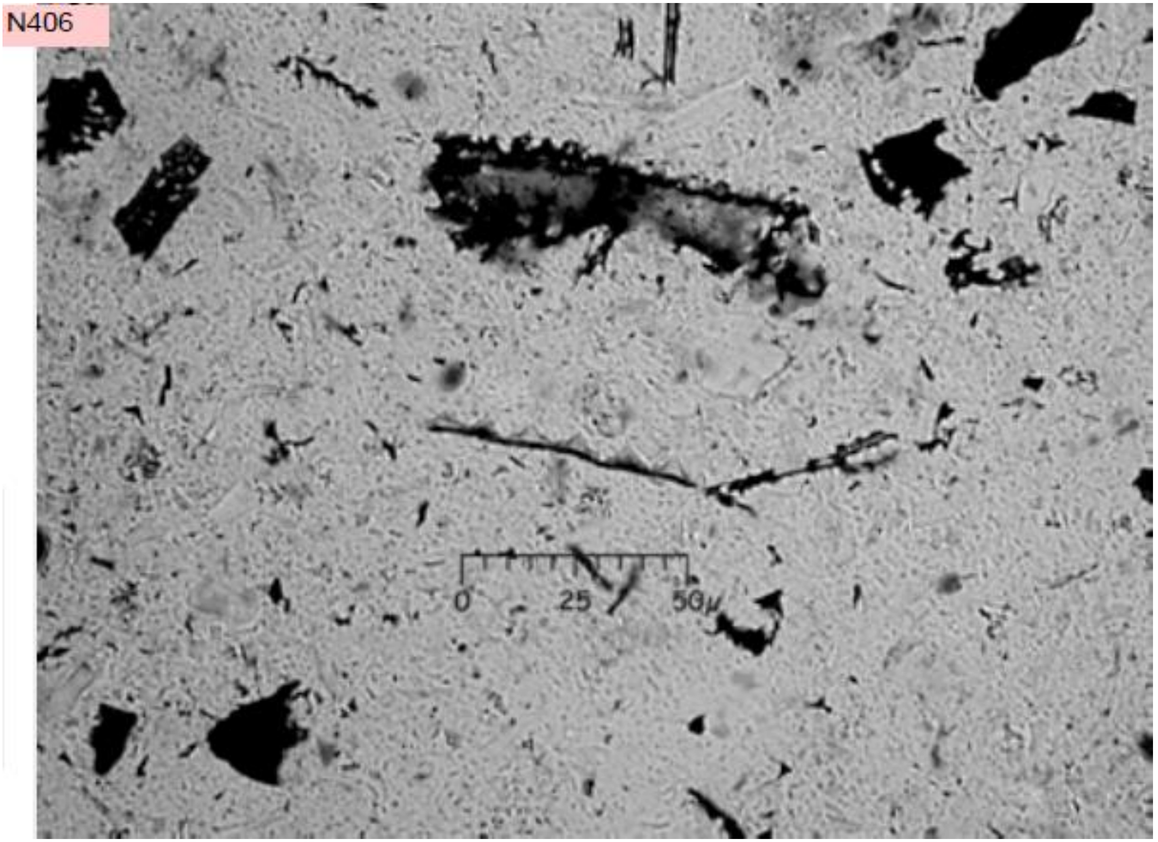
Often occur in lines or ranks.
Often conical in top view, but non-quadrilateral in side view.
In side view, conical projections with "shoulders".
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Torulinium odoratum

Phytolith

Often occur in lines or ranks.
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

DASYPOGONACEAE

Dasypogon bromeliifolius

Phytolith

Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. J. Dasypogon bromeliifolius (Dasypogonaceae), epidermal silica sand (bar = 20 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Kingia australis

Phytolith

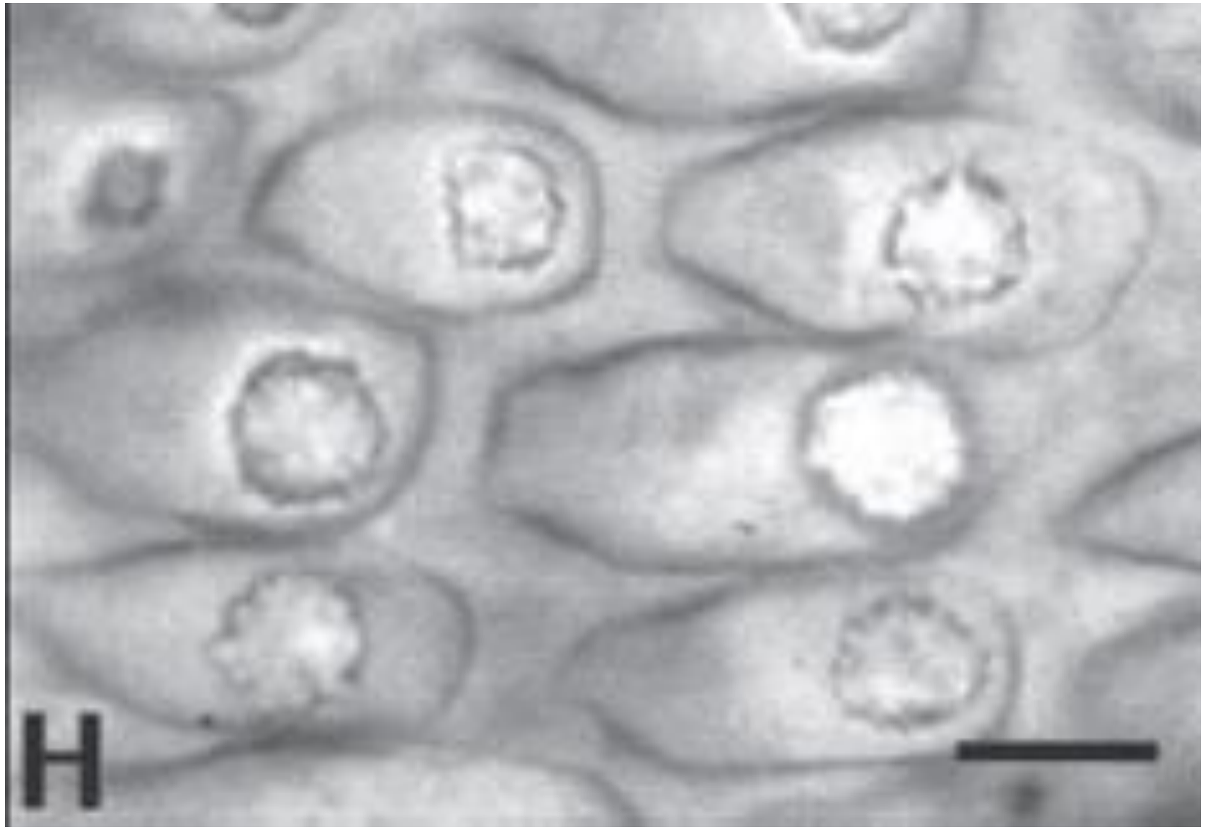


Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. H. Kingia australis (Dasypogonaceae), spherical silica bodies
with a rugose surface in epidermal cells (bar = 10 μm).

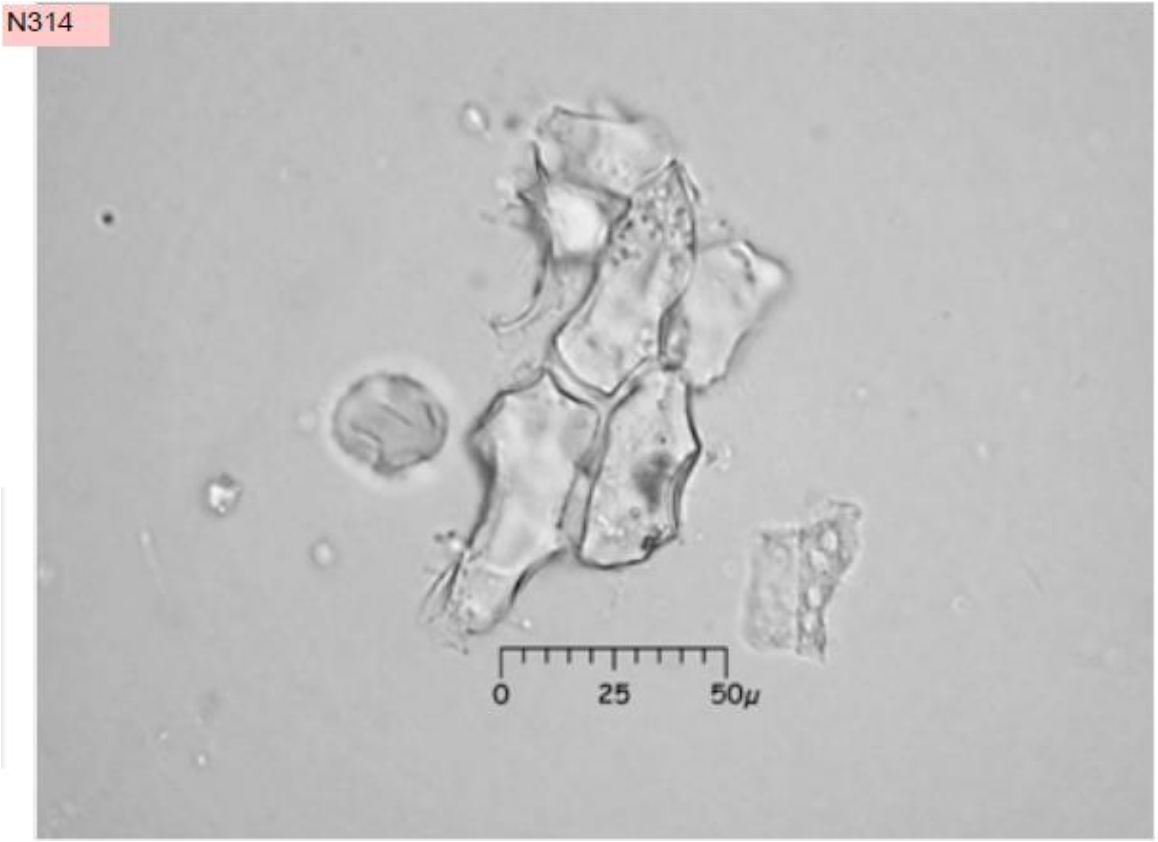
Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

DICHAPETALACEAE

Stephanopodium longipedicellatum

Phytolith

Very variable in appearance, recognizable by the twisted appearance with smooth concave curves next to angular plate junctions.
Diagnostic level: family

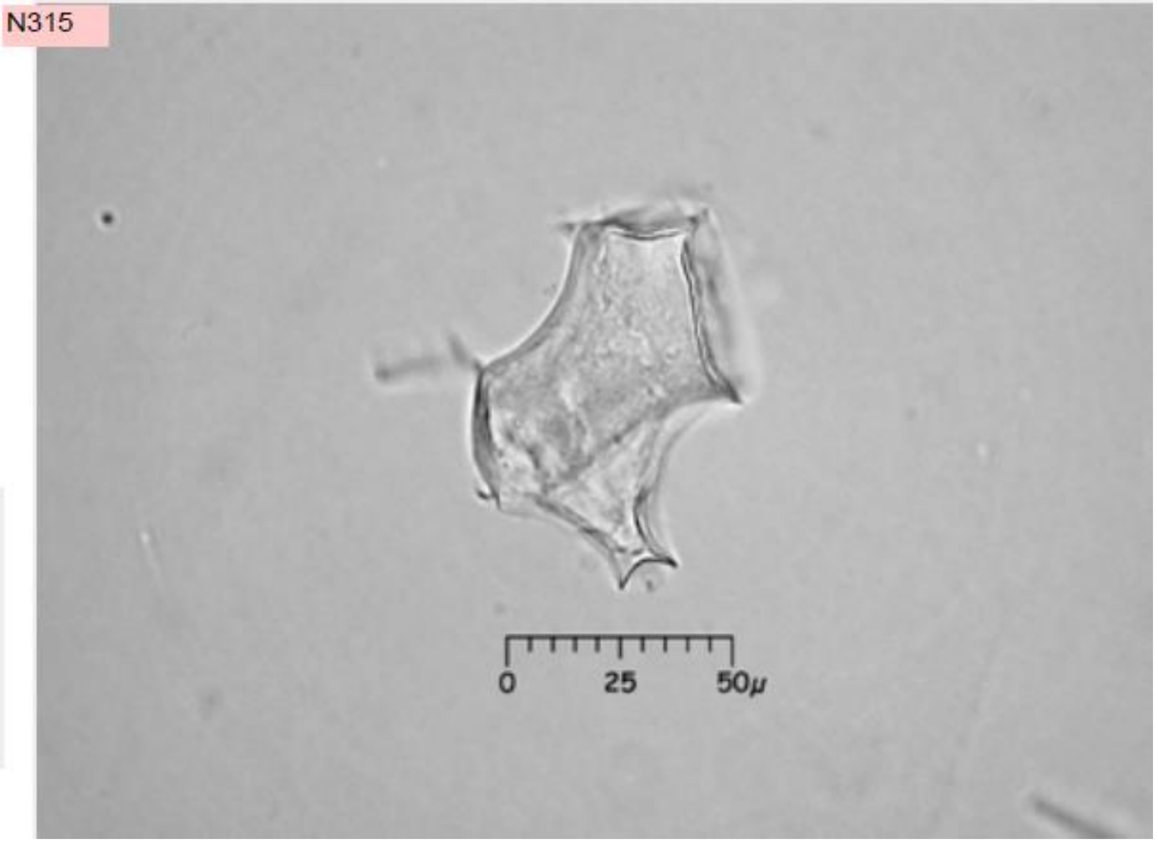


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stephanopodium longipedicellatum

Phytolith

Dichapetalaceae family diagnostic type. Surfaces angled, platelike, yet curving. Dichapetalaceae type has 3 broad branches, surface grainy while other types have thin or pointed branches. Diagnostic level: family

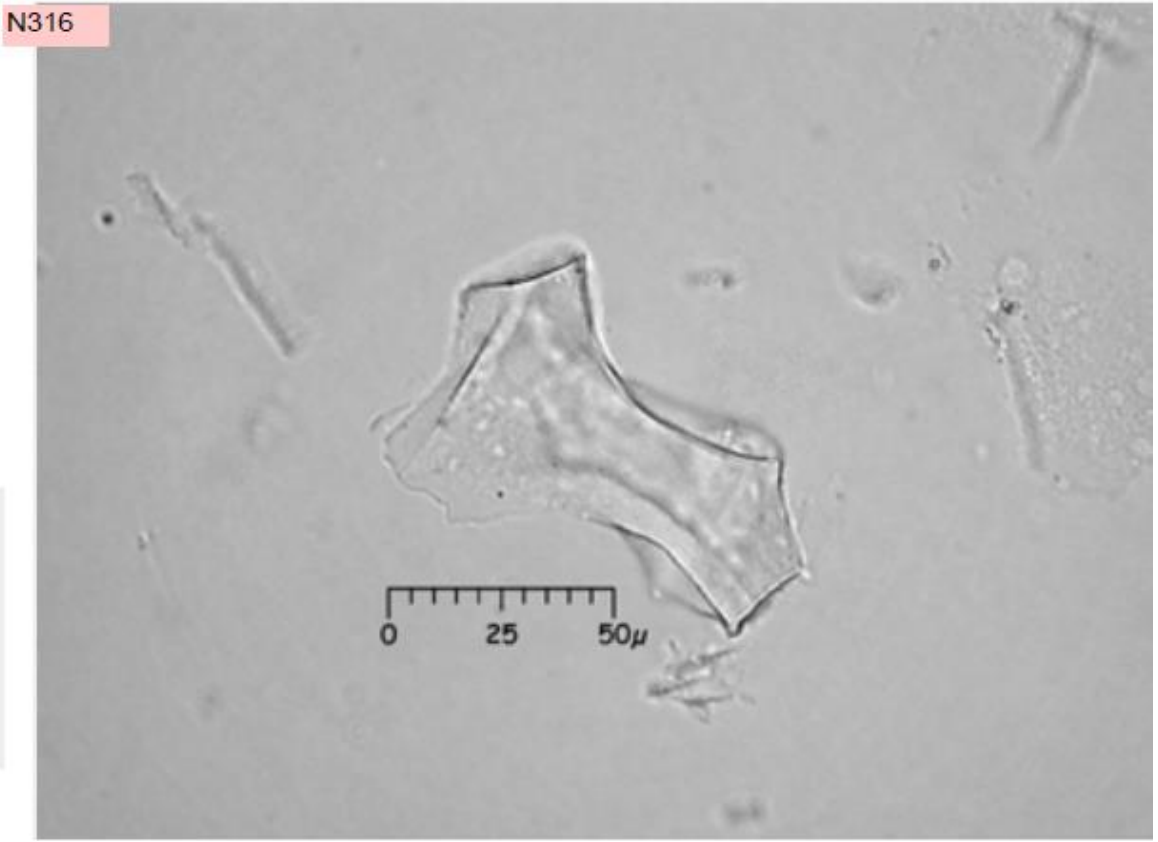


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stephanopodium longipedicellatum

Phytolith

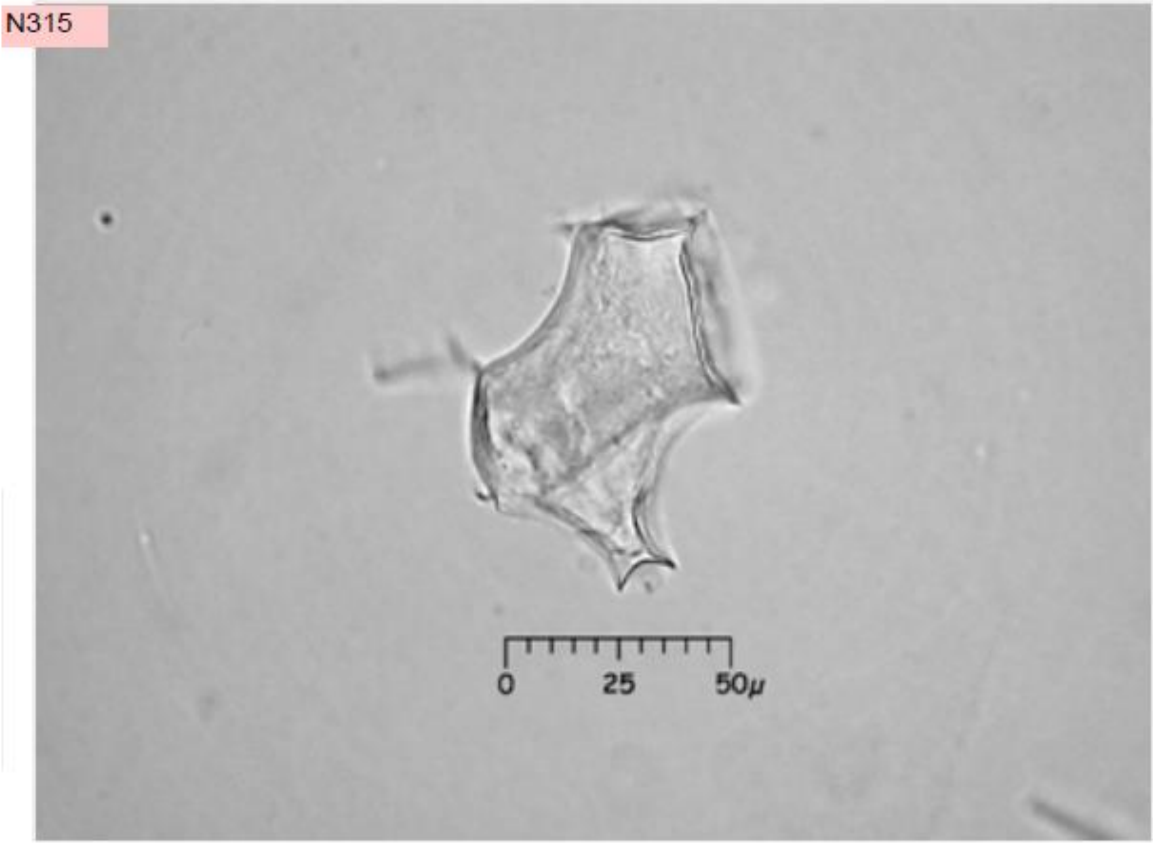
Dichapetalaceae family diagnostic type. Surfaces angled, platelike, yet curving. Dichapetalaceae type has 3 broad branches, surface grainy while other types have thin or pointed branches. Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stephanopodium peruvianum

Phytolith

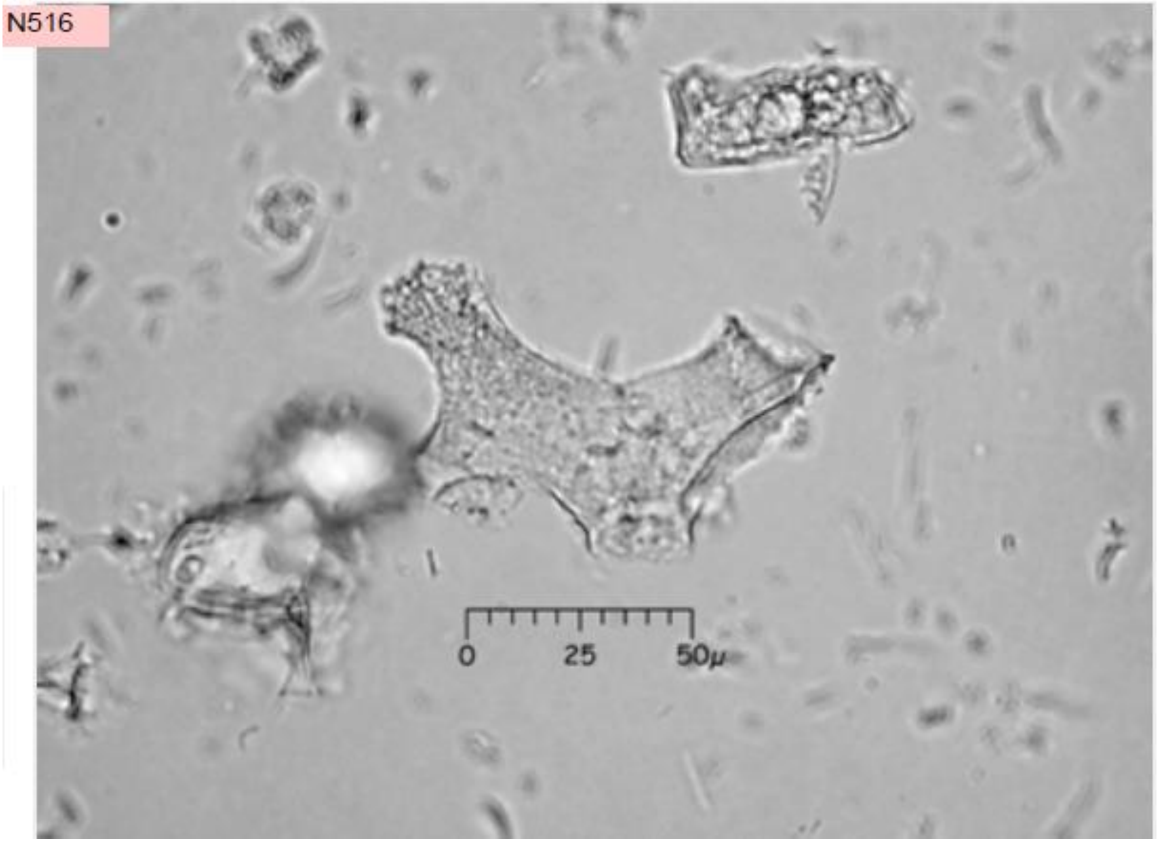


Very variable in appearance, recognizable by the twisted appearance with smooth concave curves next to angular plate junctions.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Tapura peruviana

Phytolith

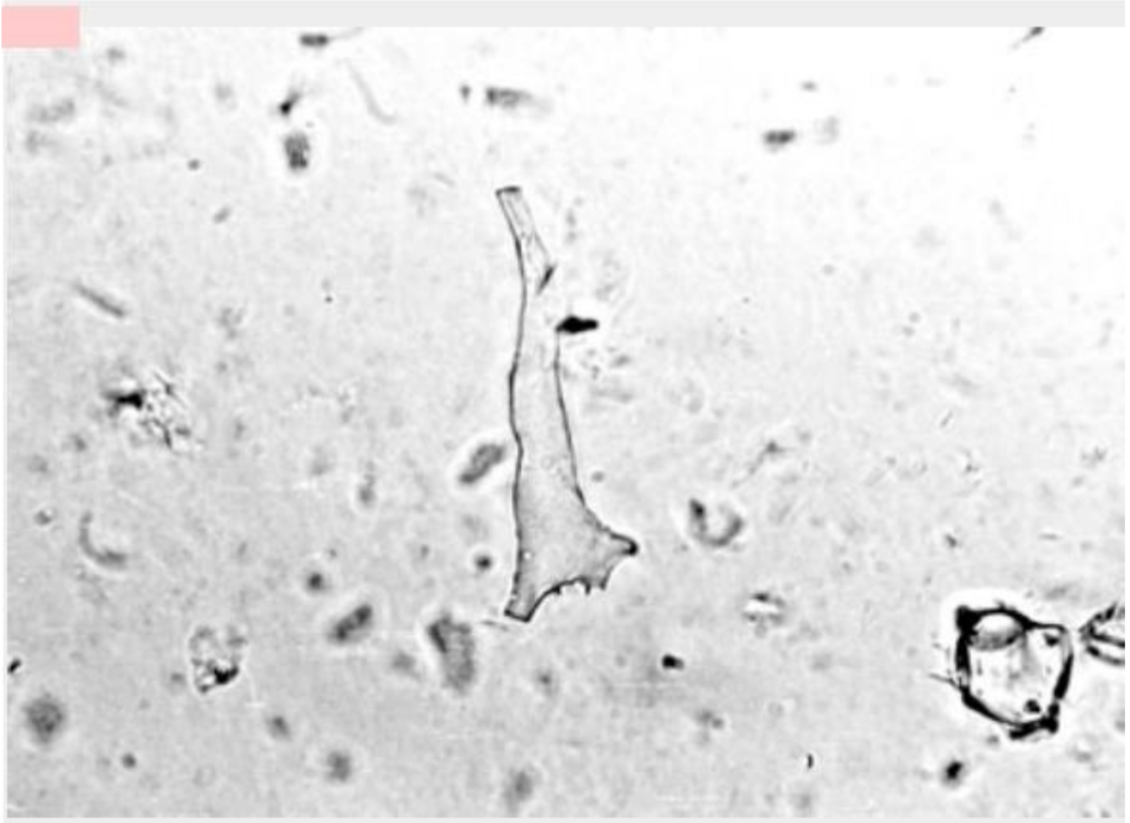


Very variable in appearance, recognizable by the twisted appearance with smooth concave curves next to angular plate junctions.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Tapura peruviana

Phytolith



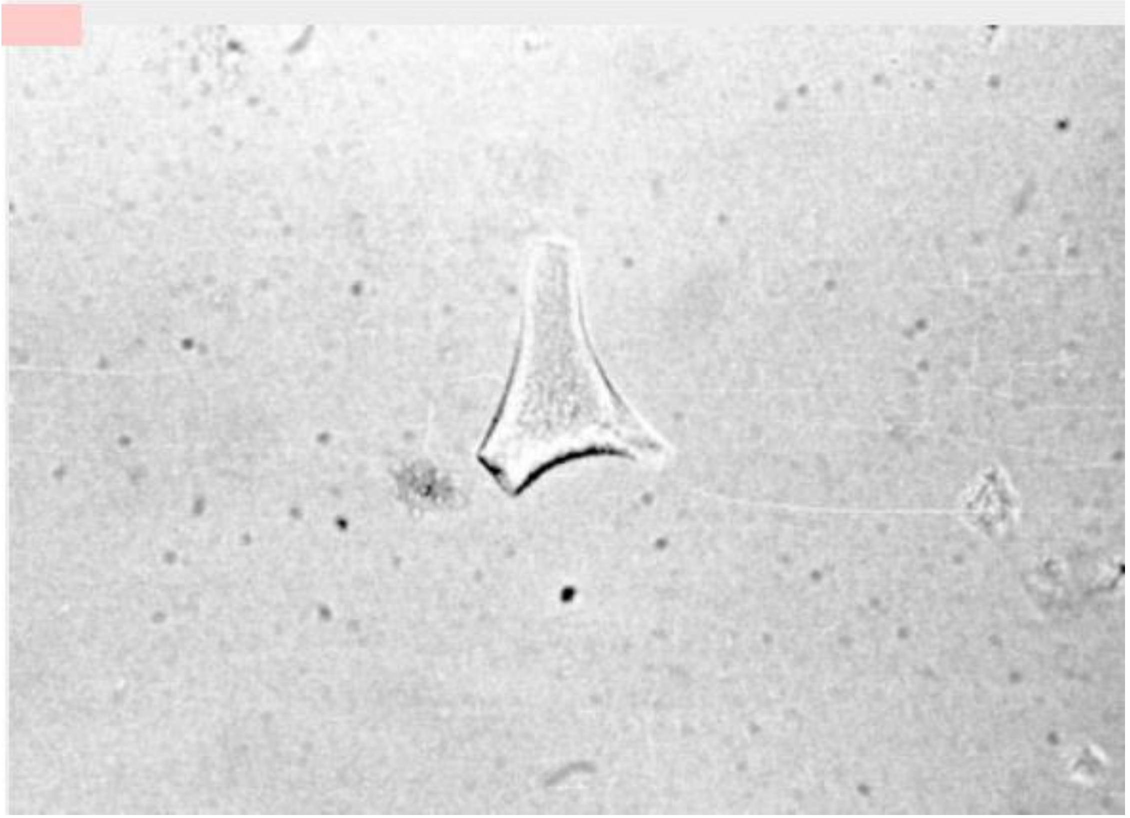
schlerid
This shows a typical elongate schlerid.
Diagnostic level: generalized arboreal

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Tapura peruviana

Phytolith

schlerid
This shows a very short, broad, curved example.
Diagnostic level: generalized arboreal



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

DILLENIACEAE

Dilleniaceae

Phytolith

Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. r) Dilleniaceae-type hair base phytoliths (GM RP, 0-15 cm)

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Curatella americana

Phytolith

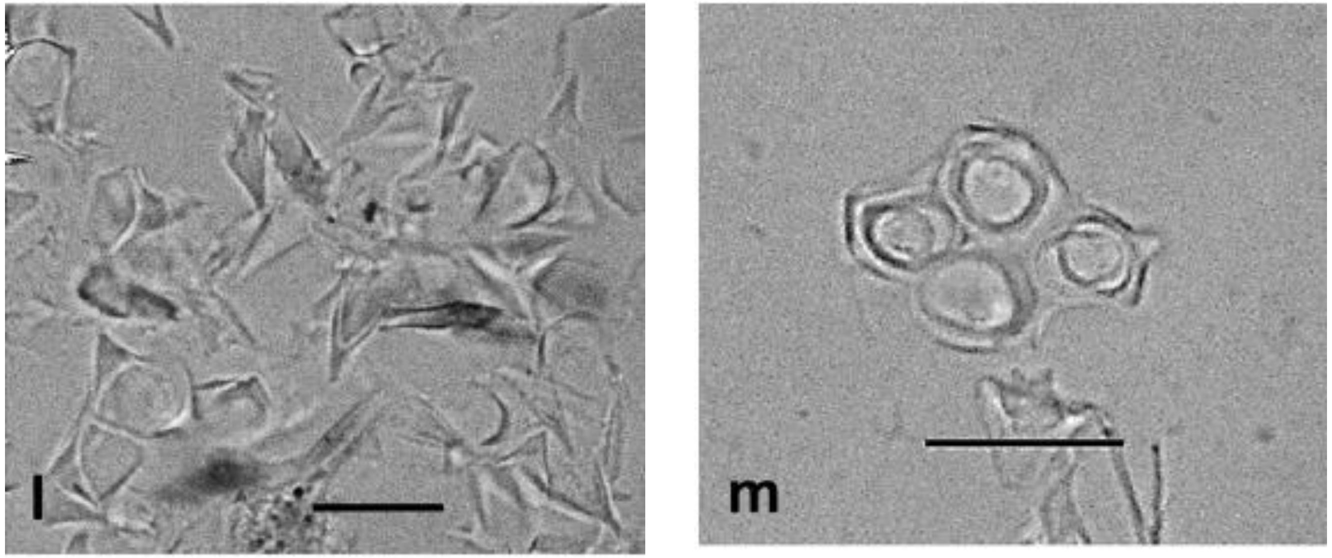


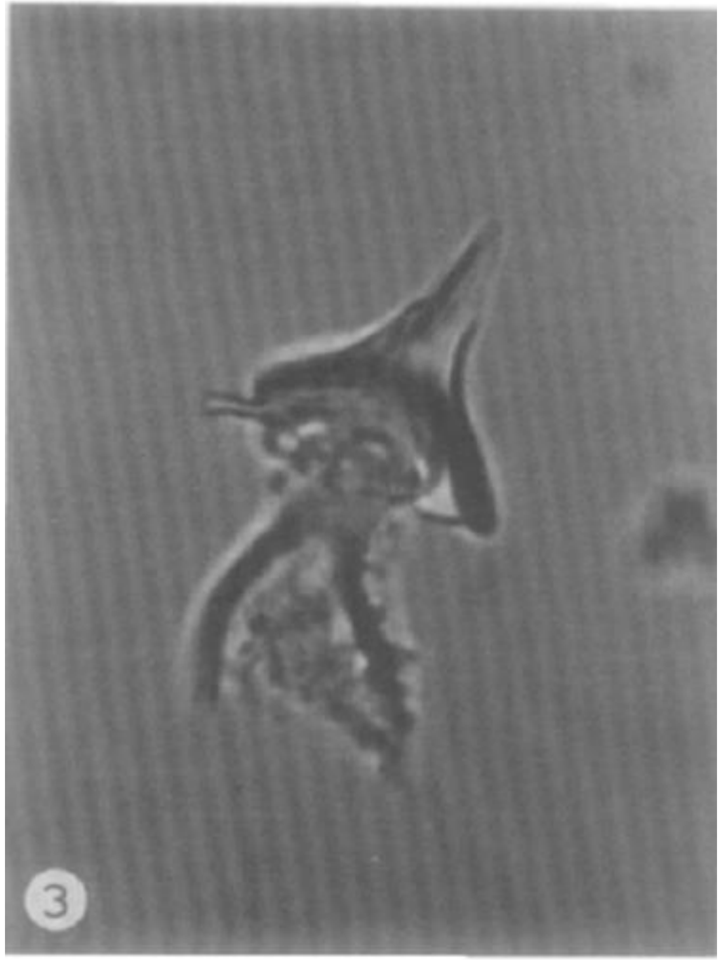
Fig. 5. Phytoliths from dicotyledons. l) Trichomes from Curatella americana, m) Hair base from C. americana

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Curatella americana

Phytolith

3. A short, deltoid hair cell phytolith with prongs from Curatella americana (400 x)

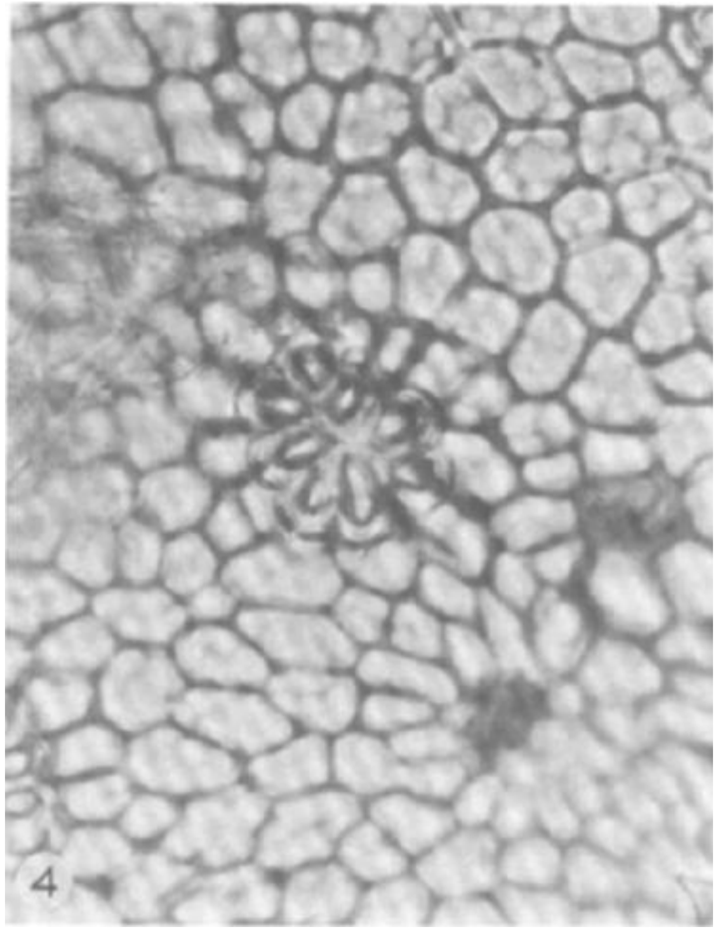


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Curatella americana

Phytolith

4. Silicified multicelled hair bases from Curatella americana. They are attached to silicified polyhedral epidermis (250 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Davilla alata

Phytolith

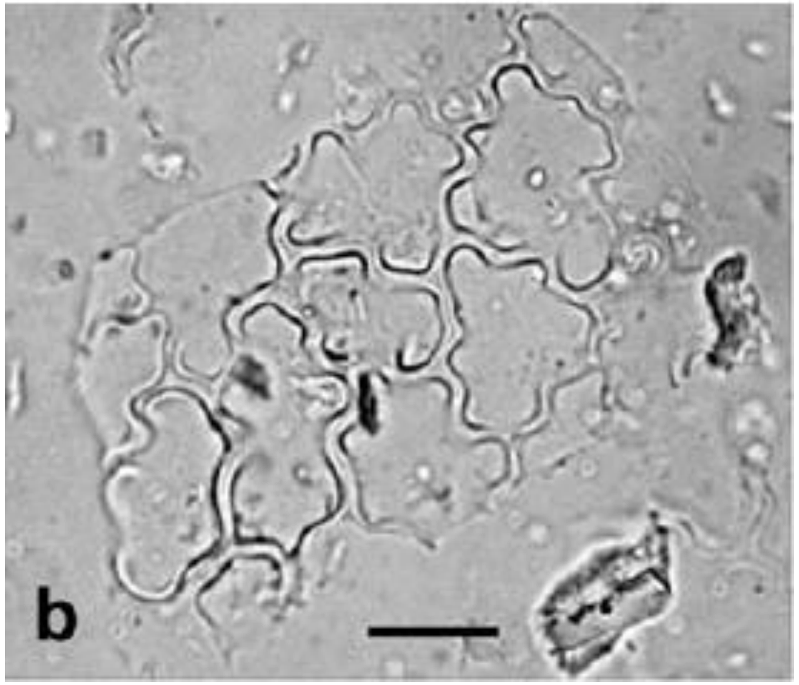


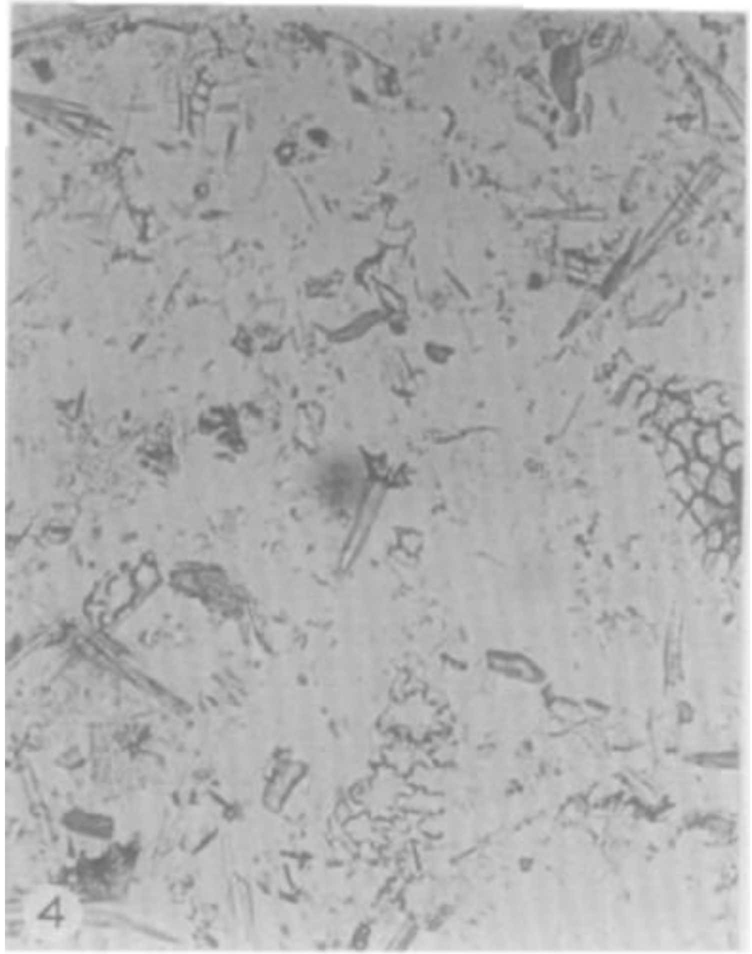
Fig. 2. Phytoliths with little or no taxonomic value. b) Anticlinal epidermis from Davilla alata leaf

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Davilla aspera

Phytolith

4. Non-segmented hair cell phytoliths from Davilla aspera. The hair in the center has prongs and lateral projections at the base (125 x).

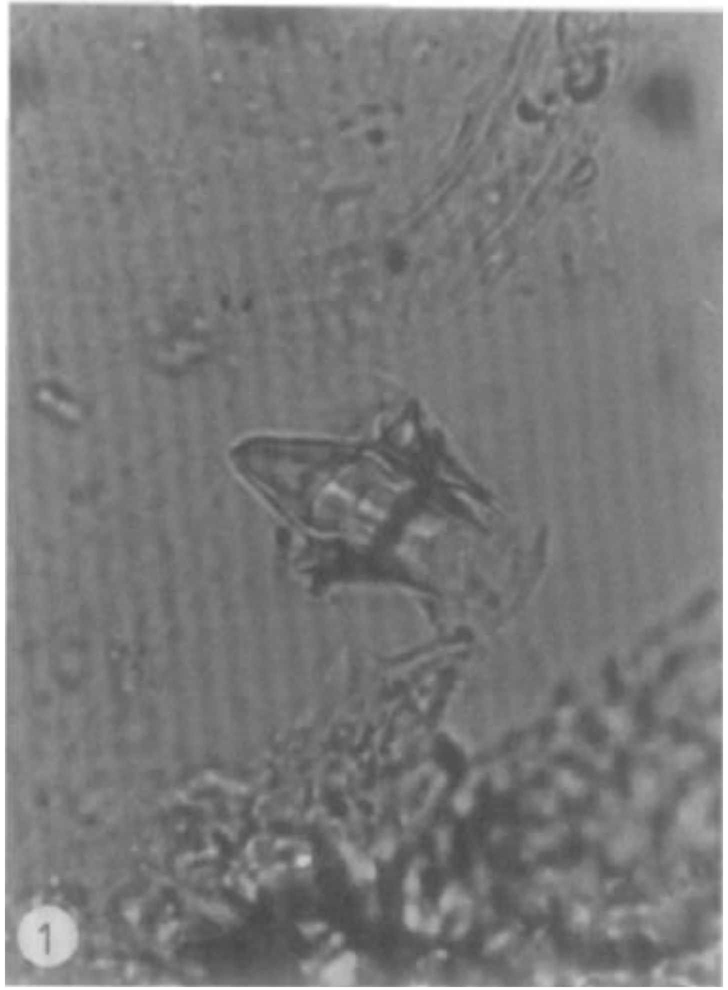


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Davilla rugosa

Phytolith

1. Non-segmented hair cell phytolith with prongs and lateral projections from Davilla rugosa (250 X).

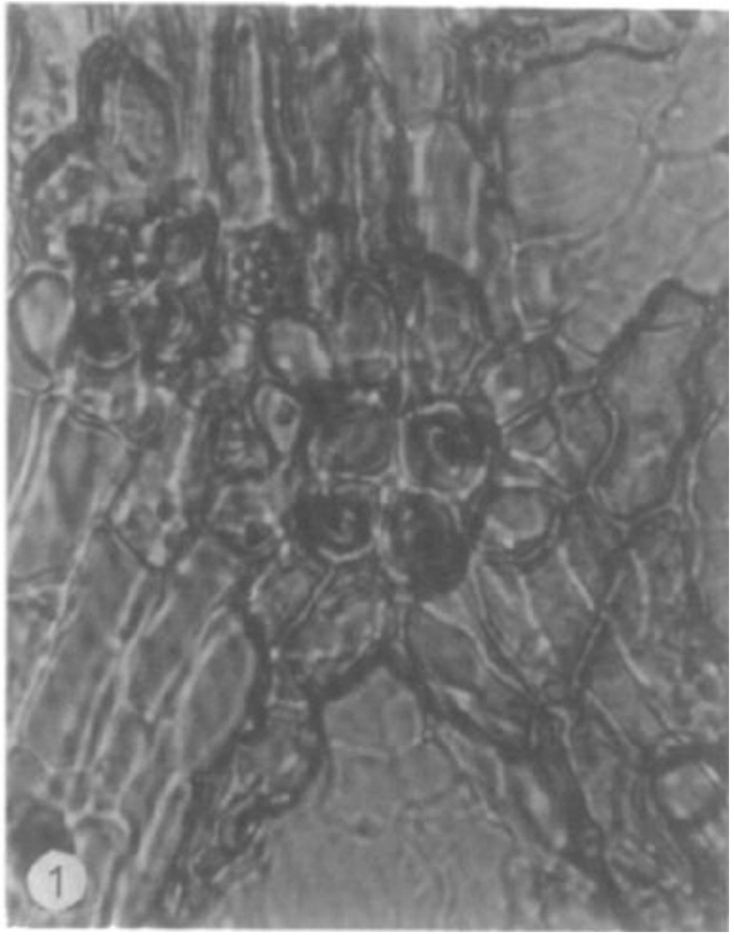


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Tetracera volubilis

Phytolith

1. Silicified multicelled hair base with 4 cells from Tetracera volubilis (250 ×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

DIOSCOREACEAE

Dioscoreaceae cf.

Starch

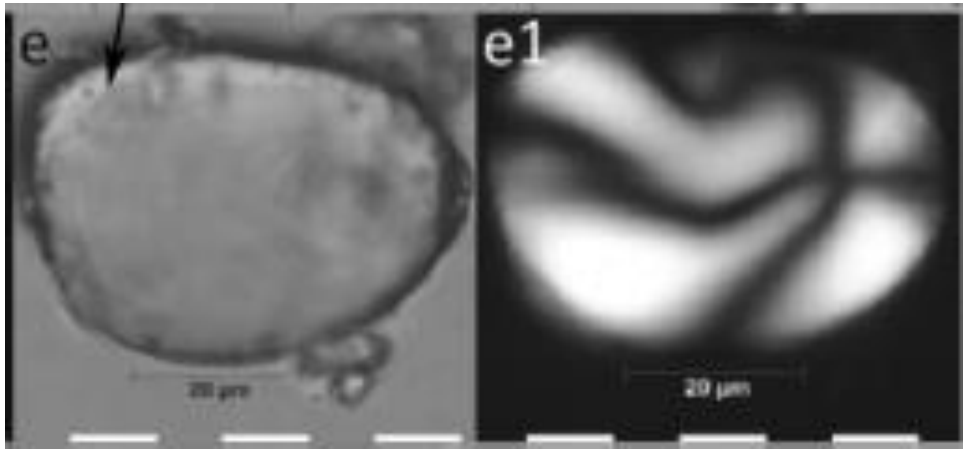
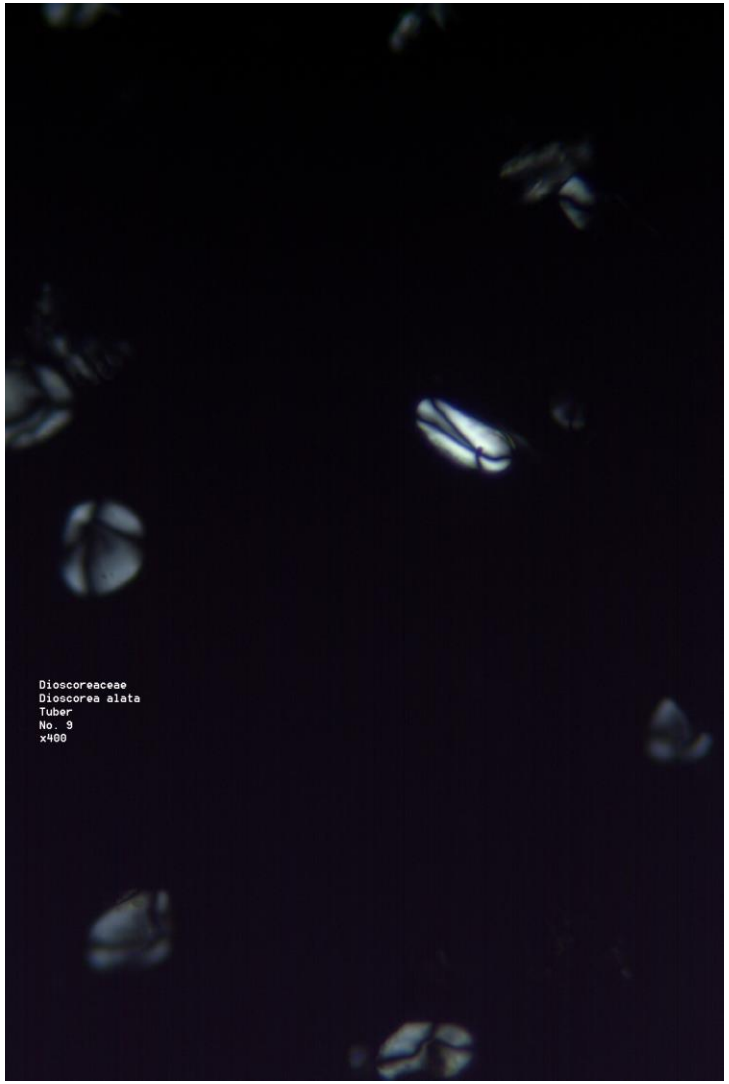


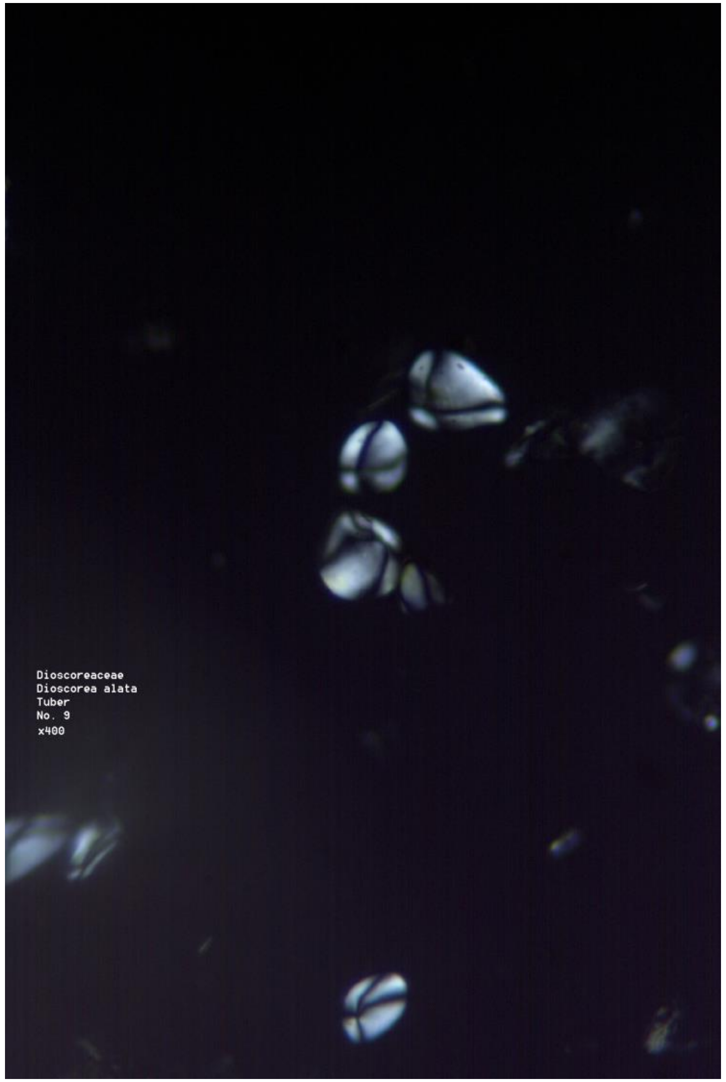
Fig. 9. Other ancient starch grains (a-g) recovered at St. John and Eva 2. e, cf. Dioscoreaceae starch with various concentric rings or lamellae around the hilum and with concentric layers or lamellae (“L”) going down to the distal end; e1, the same starch showing its extinction cross.

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Dioscorea alata

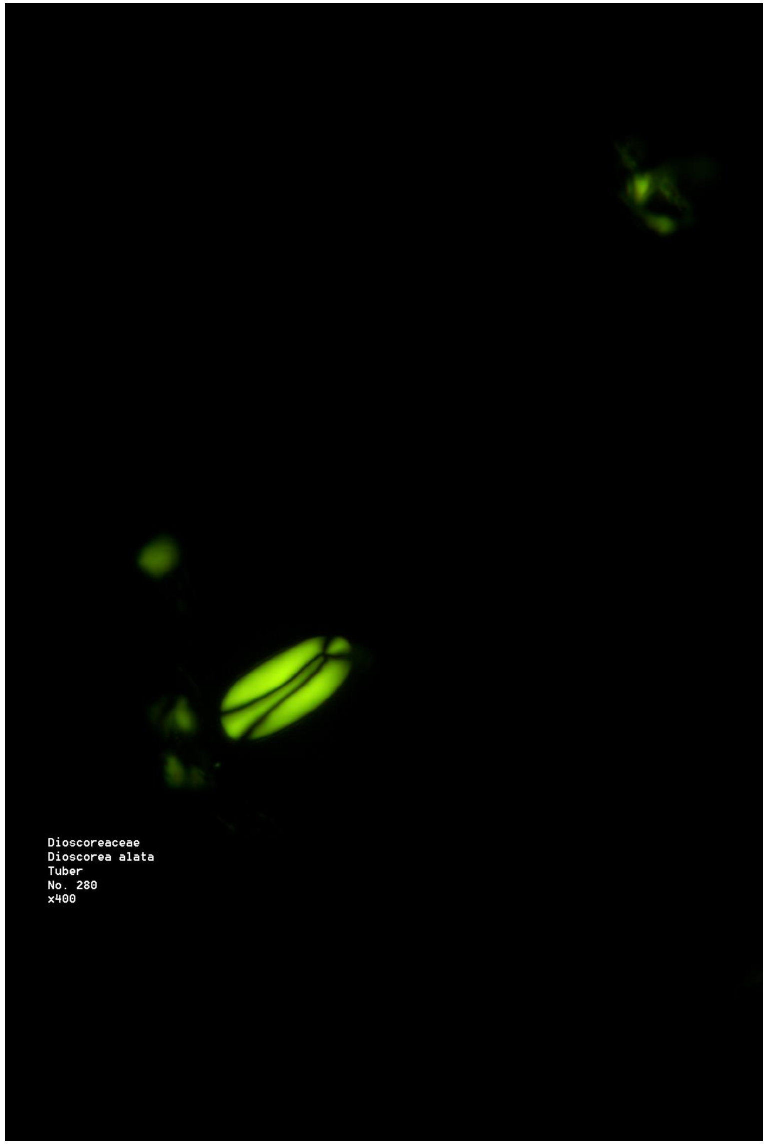
Australian Museum,
McCown Archaeobotany
Laboratory Collection

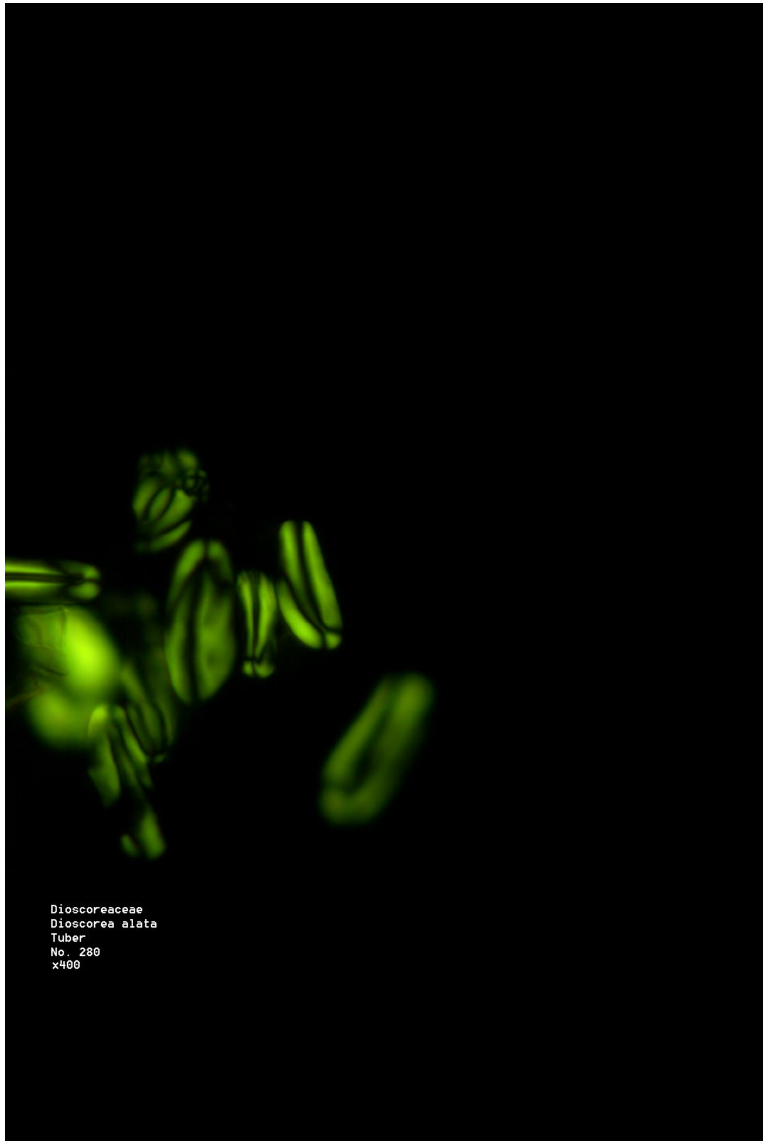




Dioscorea alata

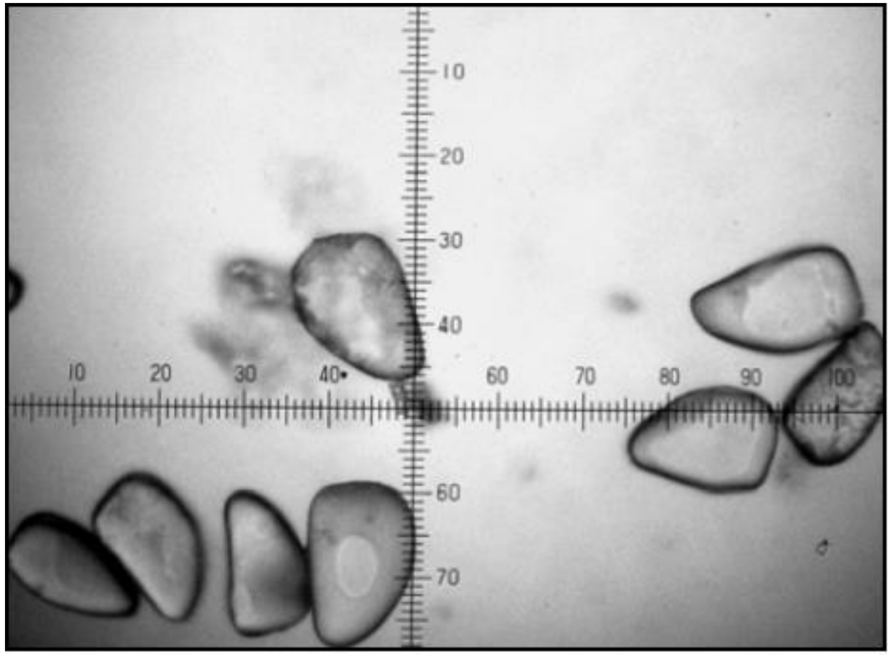
Australian Museum,
McCown Archaeobotany
Laboratory Collection

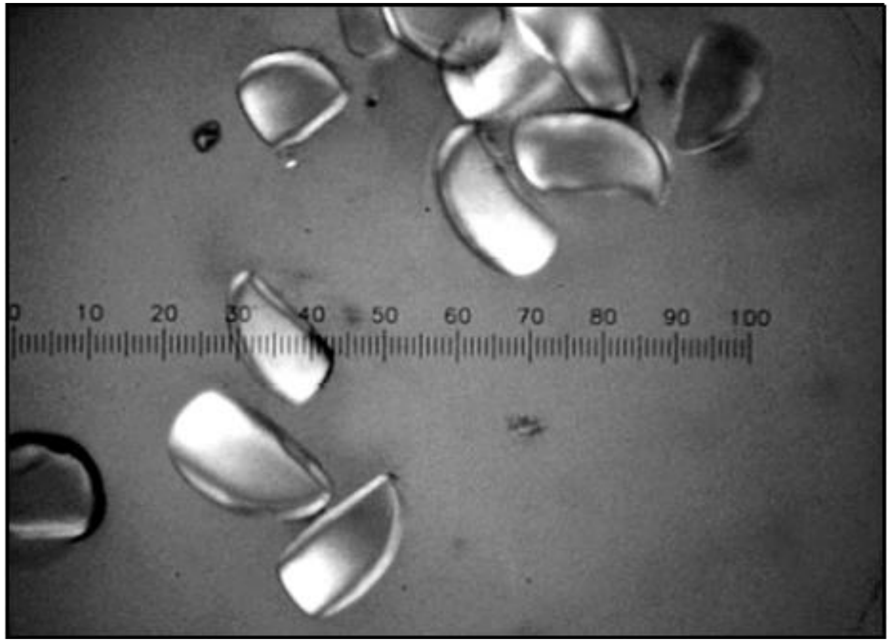




Dioscorea alata

Starch

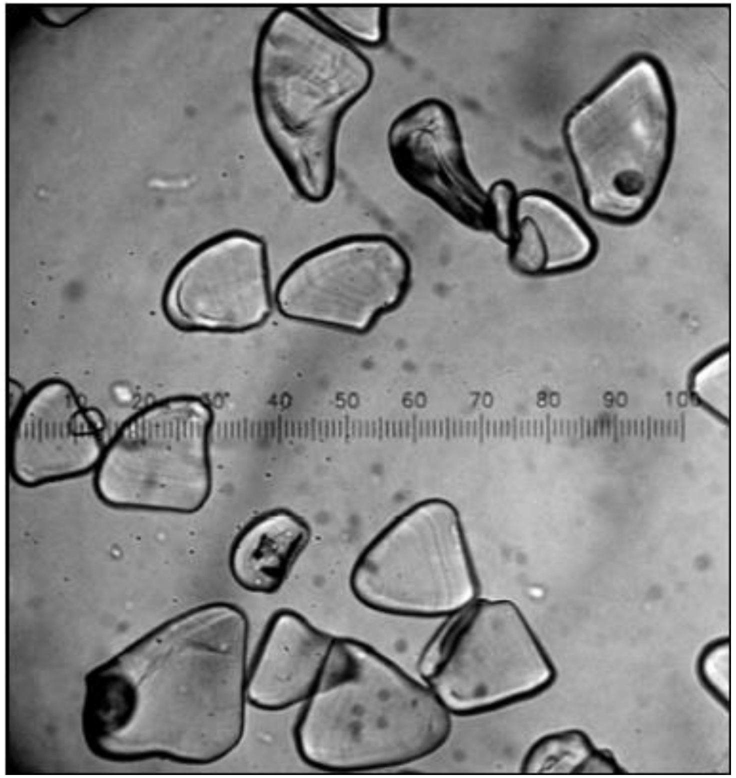


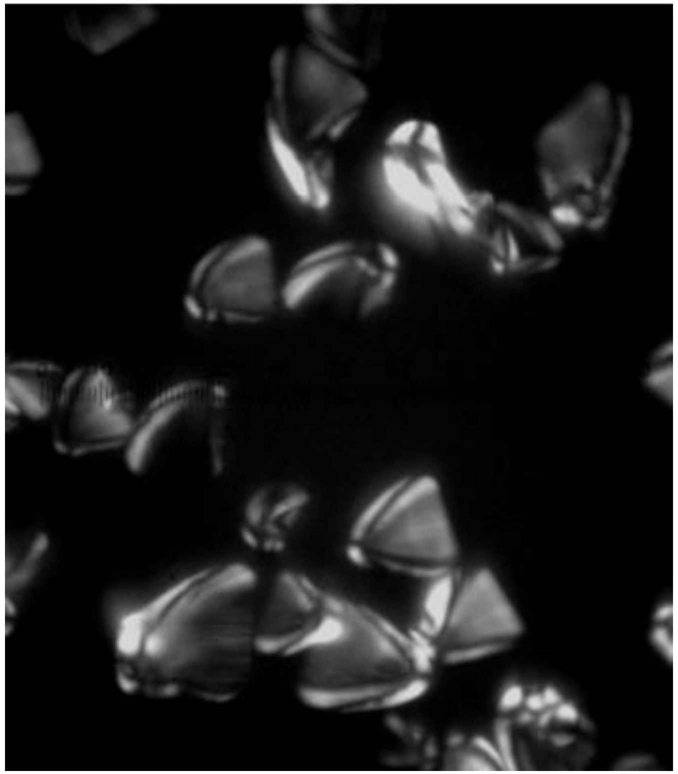


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Dioscorea altissima

Starch

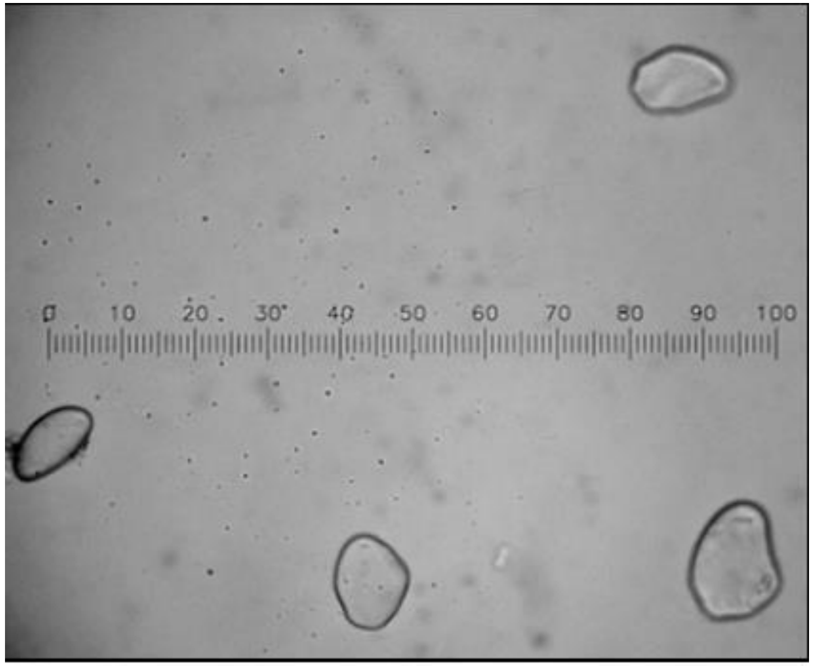


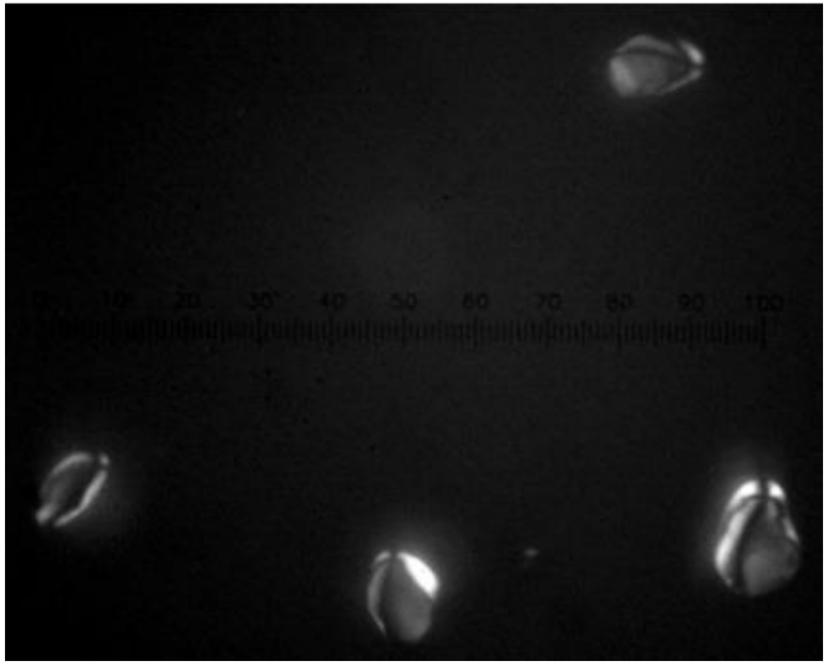


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Dioscorea altissima

Starch

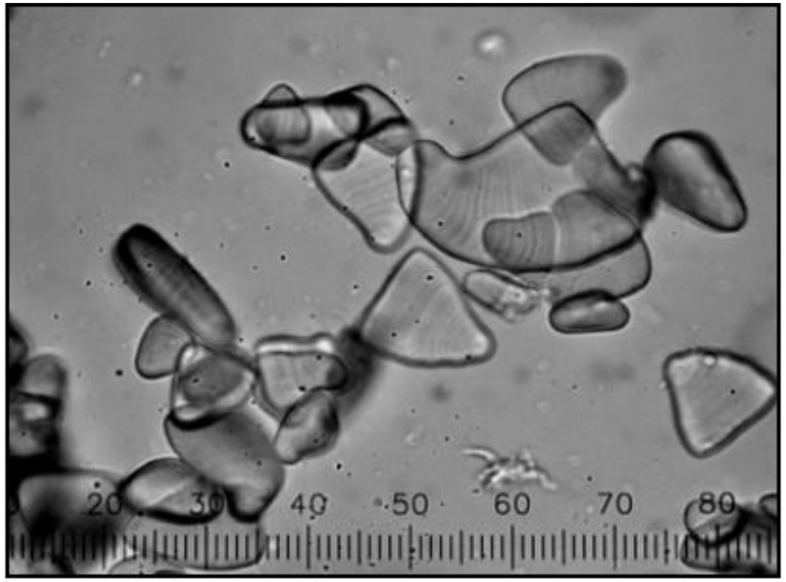


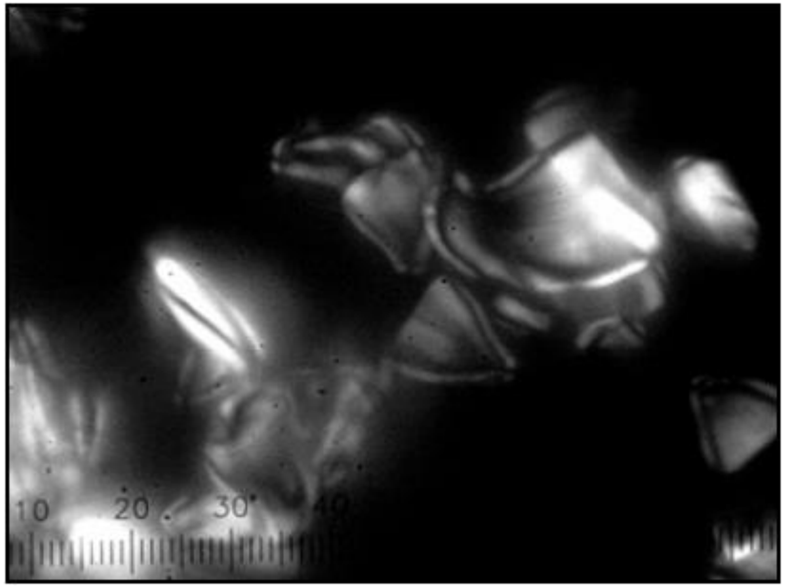


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Dioscorea bulbifera

Starch

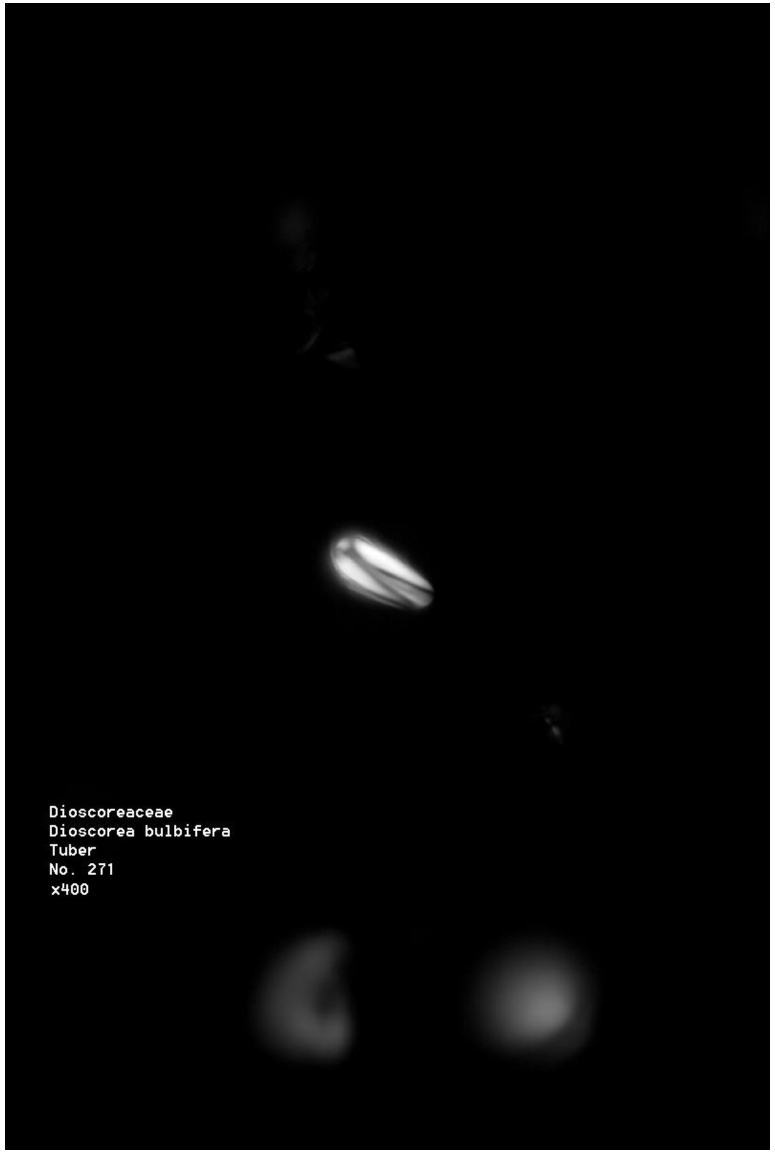


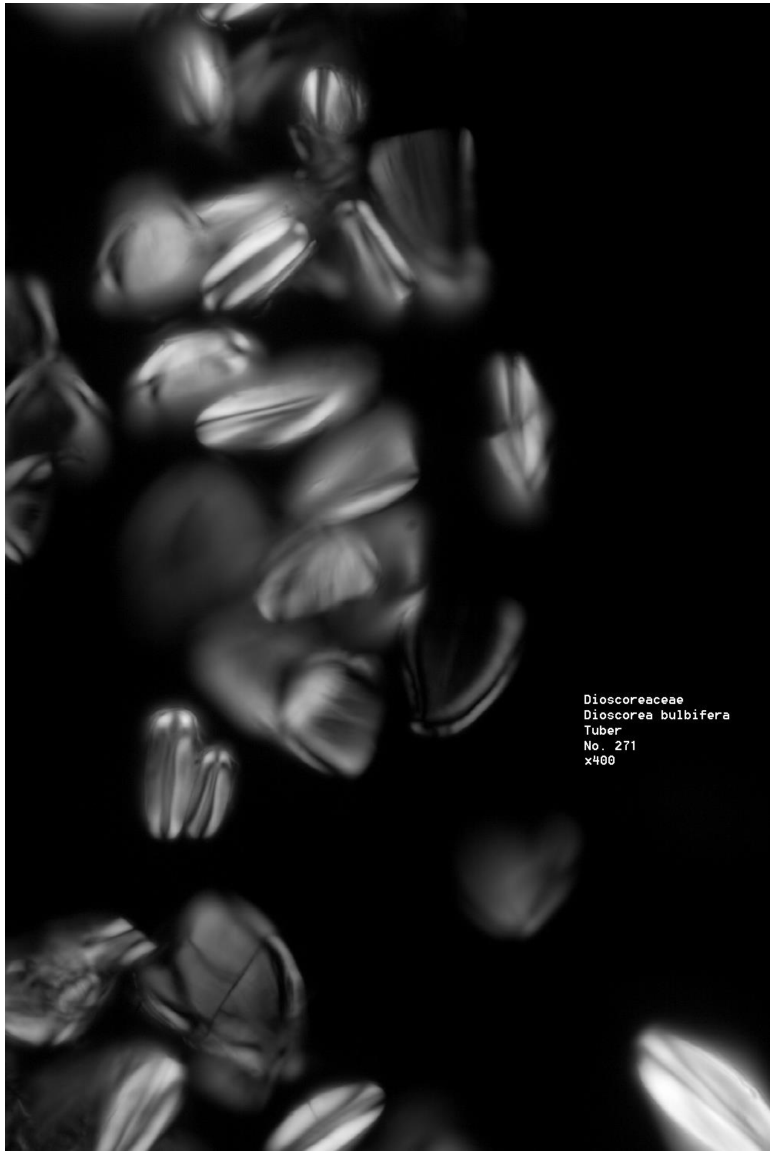


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Dioscorea bulbifera

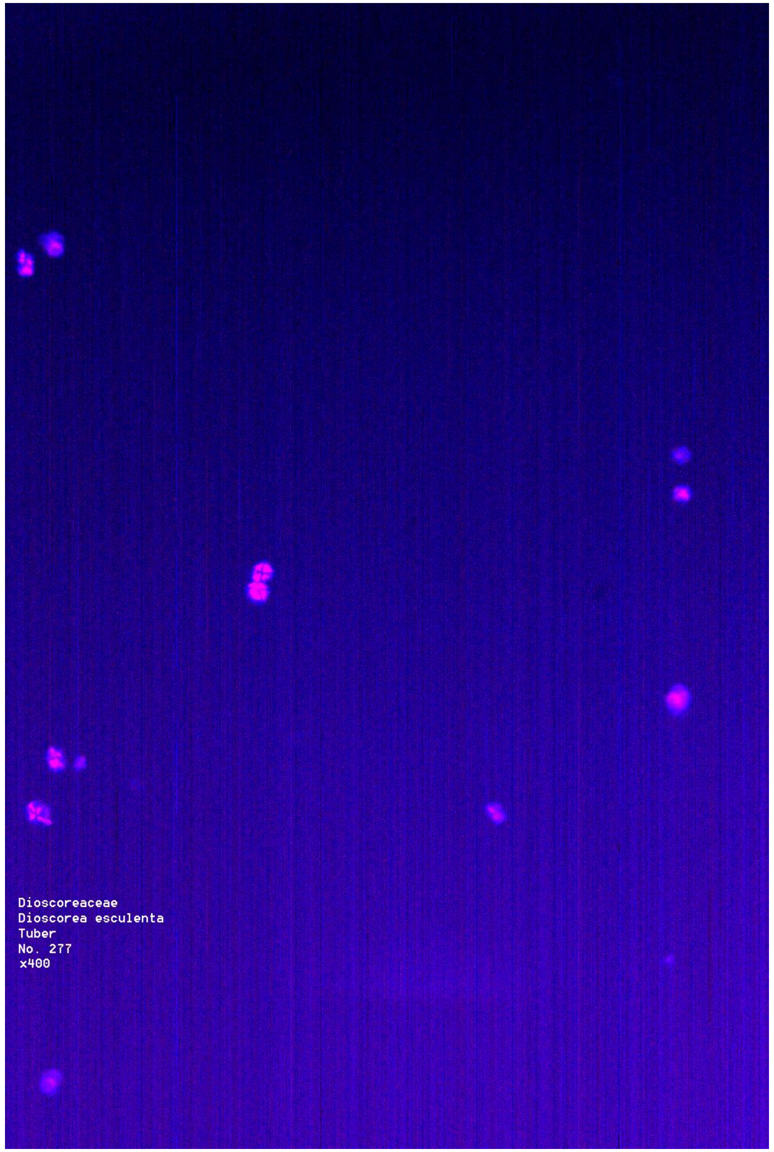
Australian Museum,
McCown Archaeobotany
Laboratory Collection

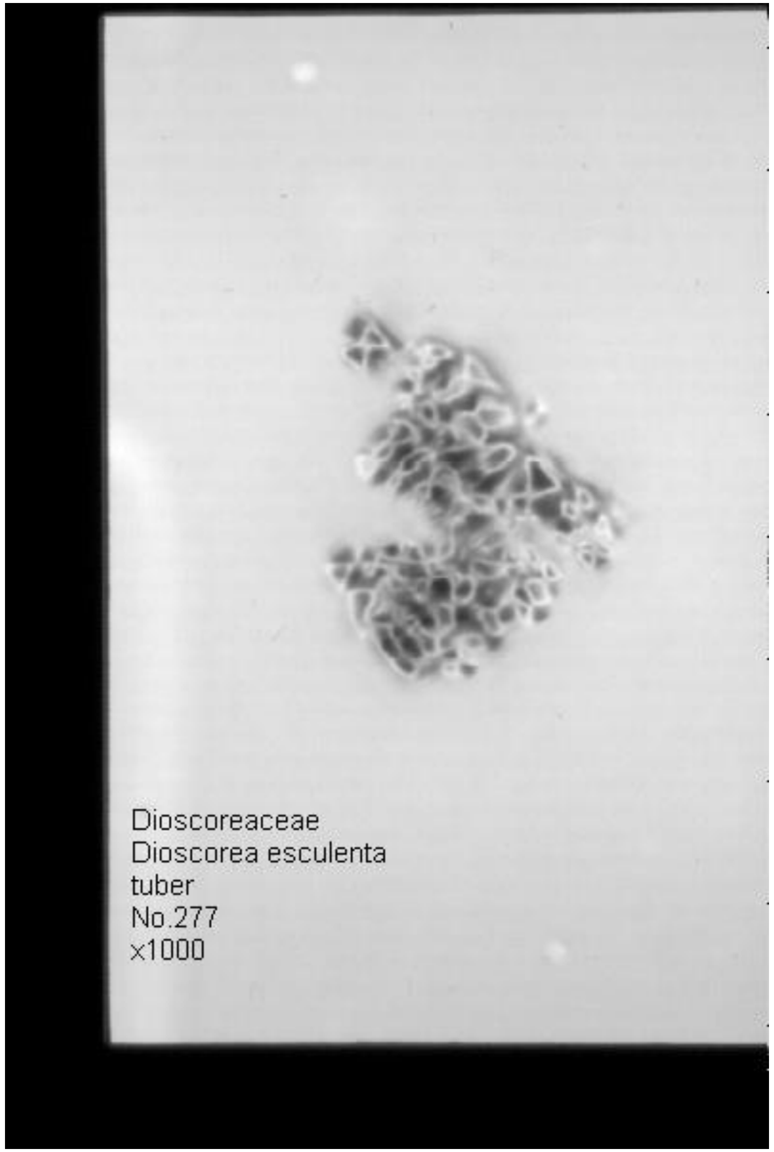




Dioscorea esculenta

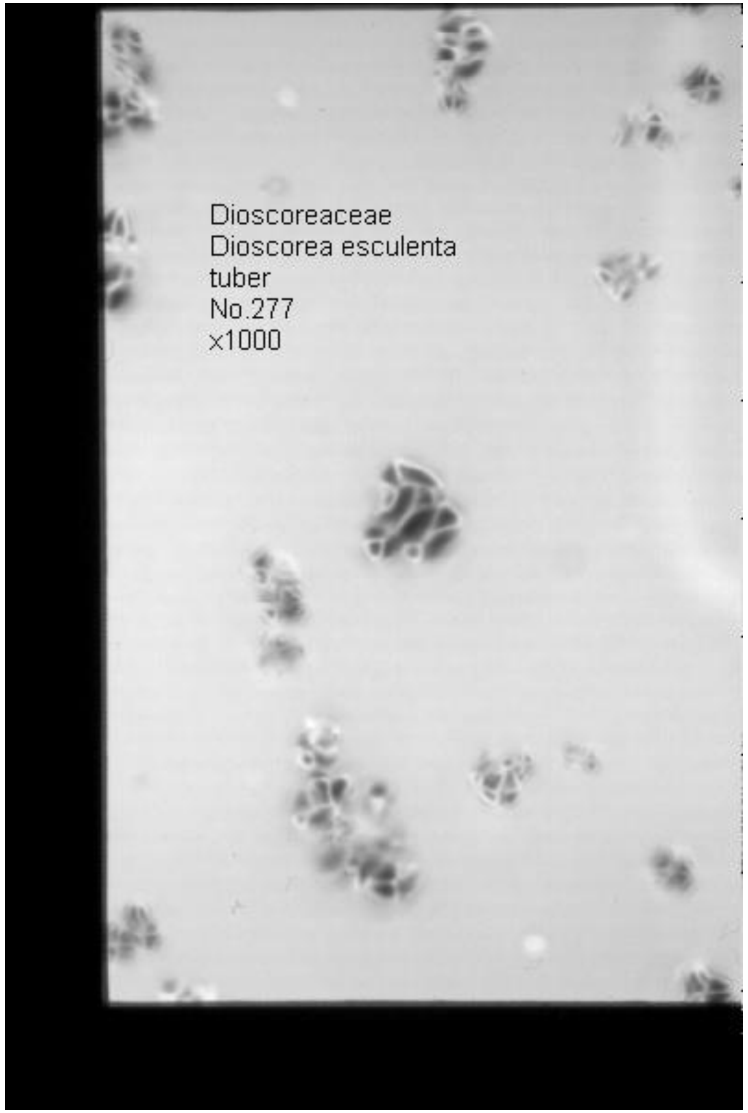
Australian Museum,
McCown Archaeobotany
Laboratory Collection

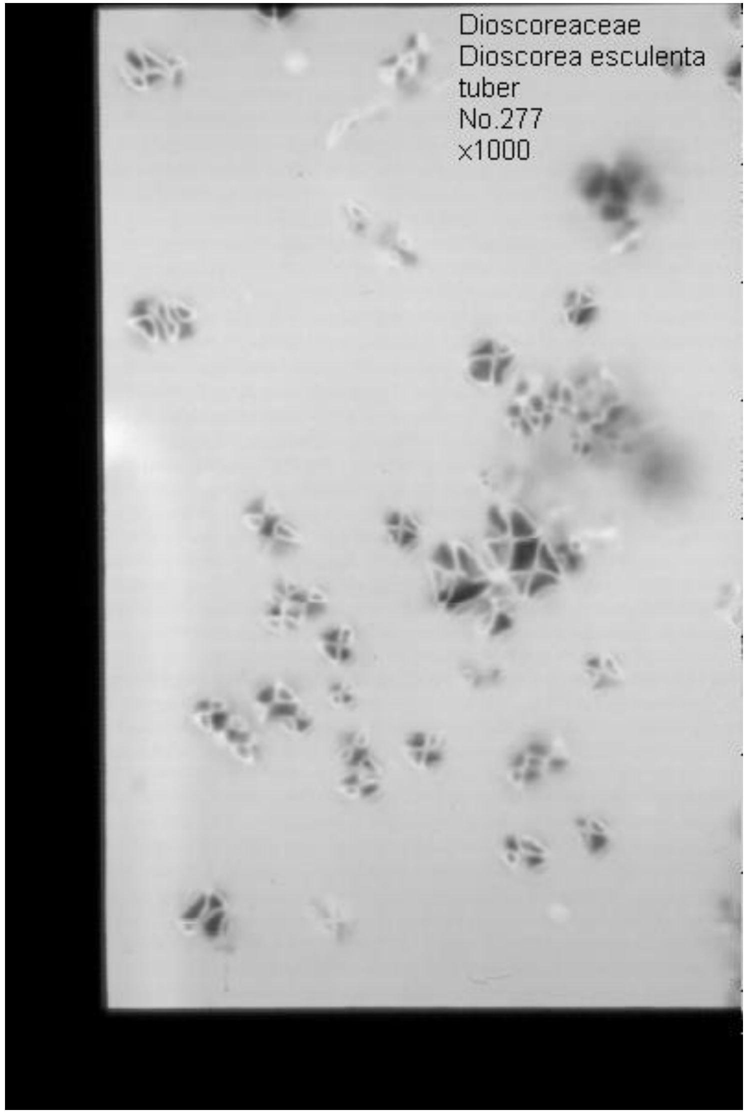




Dioscorea esculenta

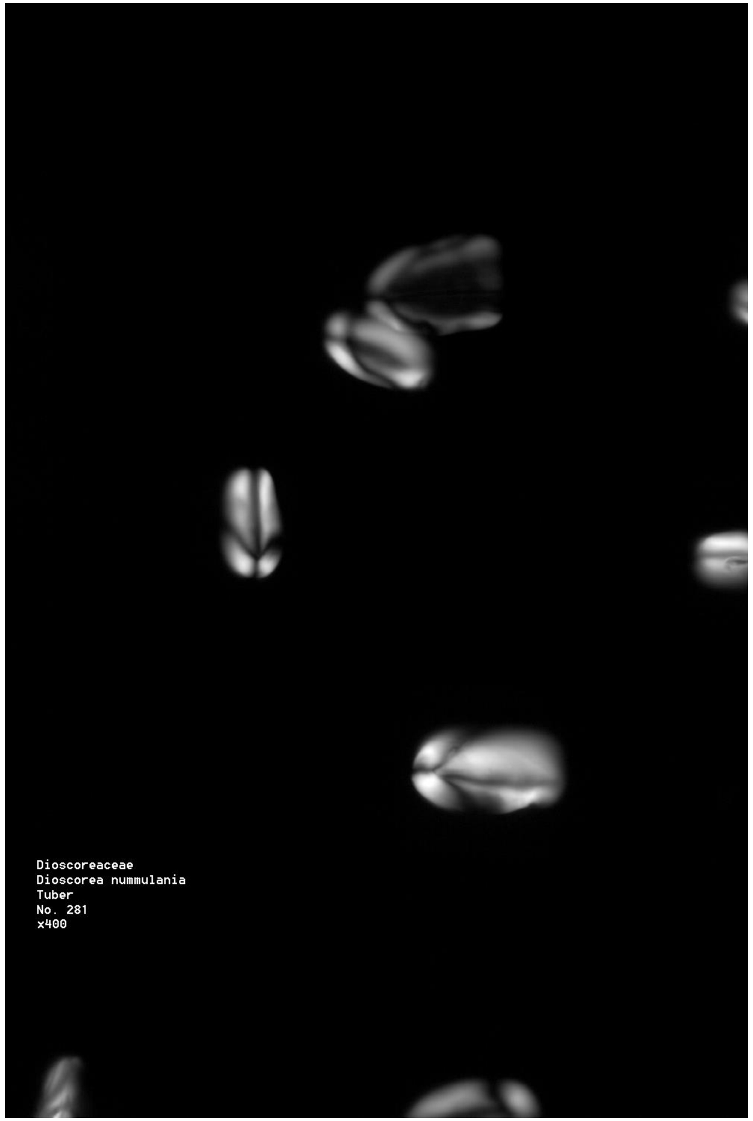
Australian Museum, McCown Archaeobotany Laboratory Collection

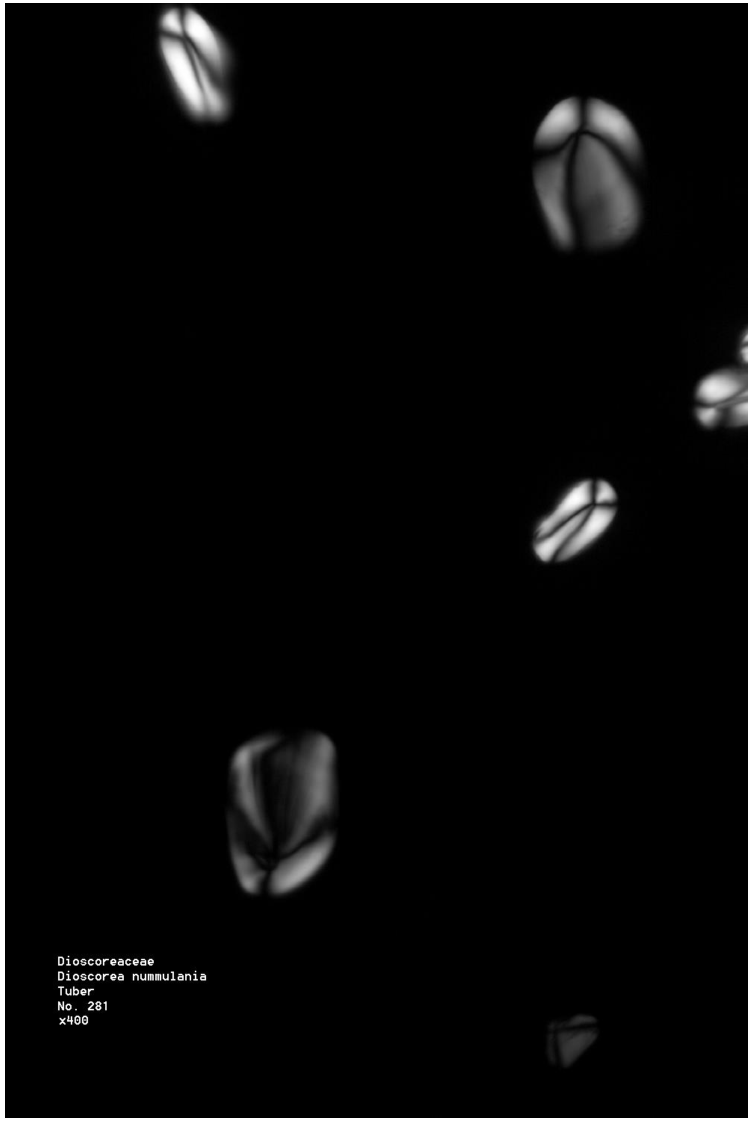


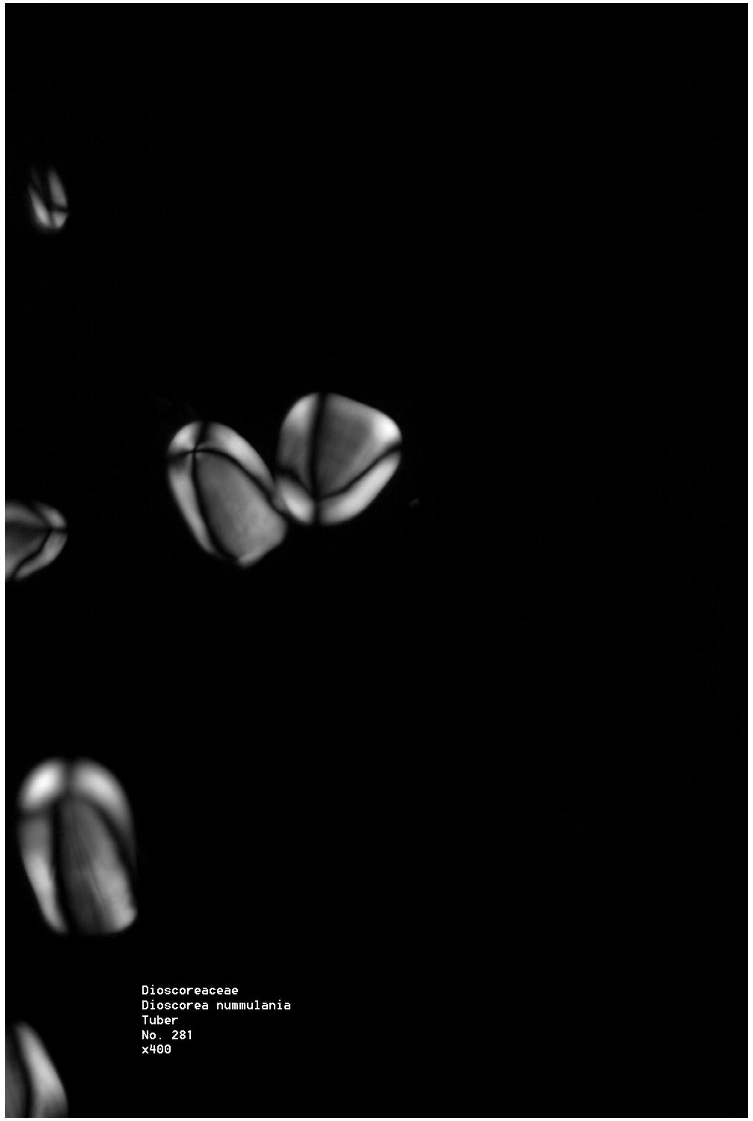


Dioscorea nummulania

Australian Museum,
McCown Archaeobotany
Laboratory Collection

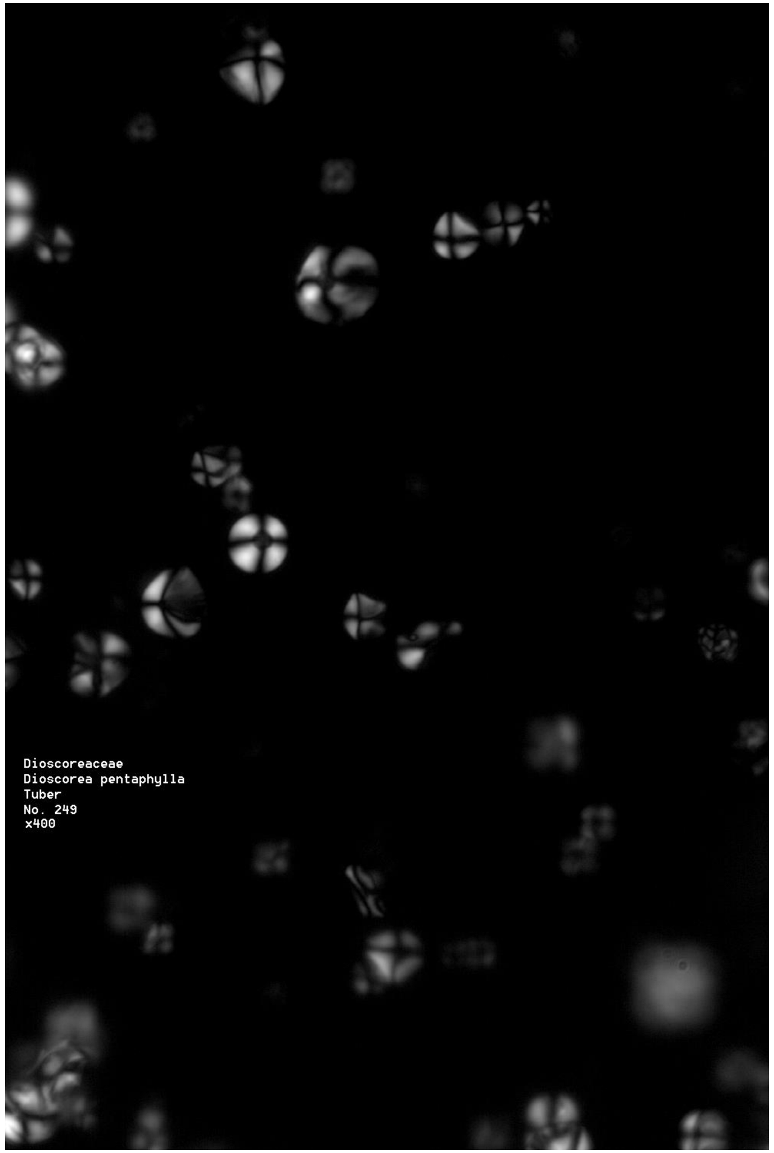


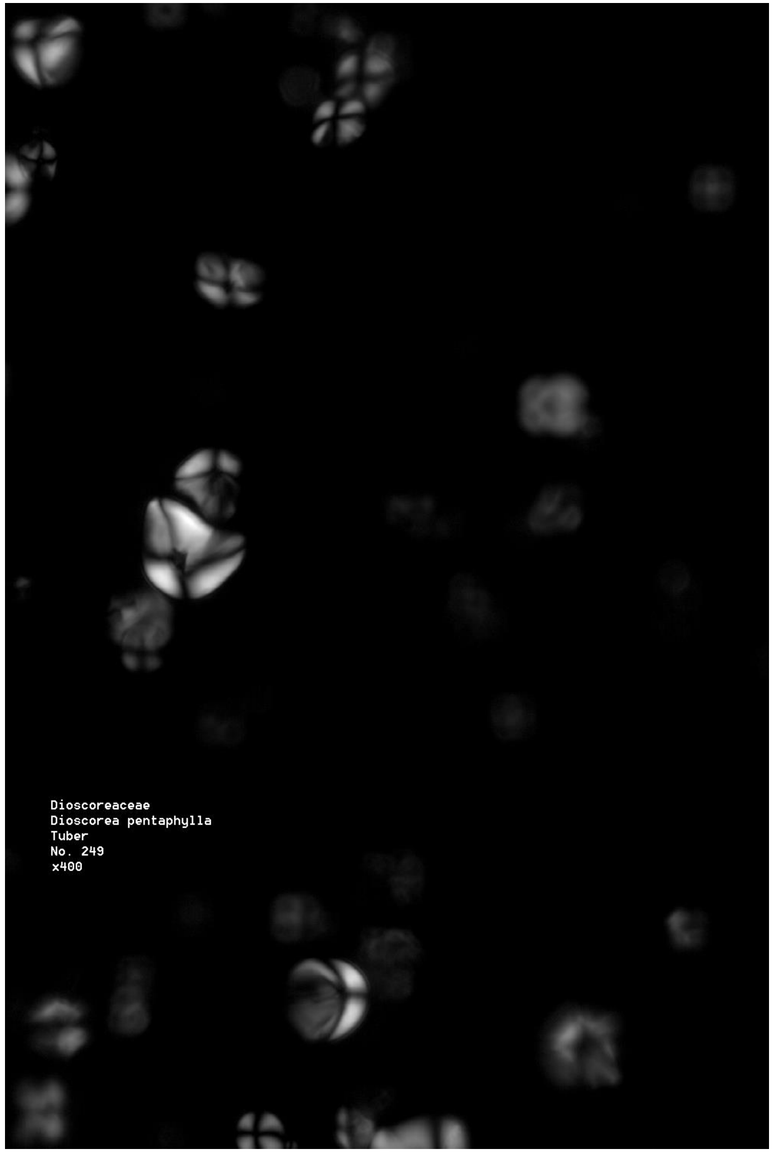




Dioscorea pentaphylla

Australian Museum,
McCown Archaeobotany
Laboratory Collection



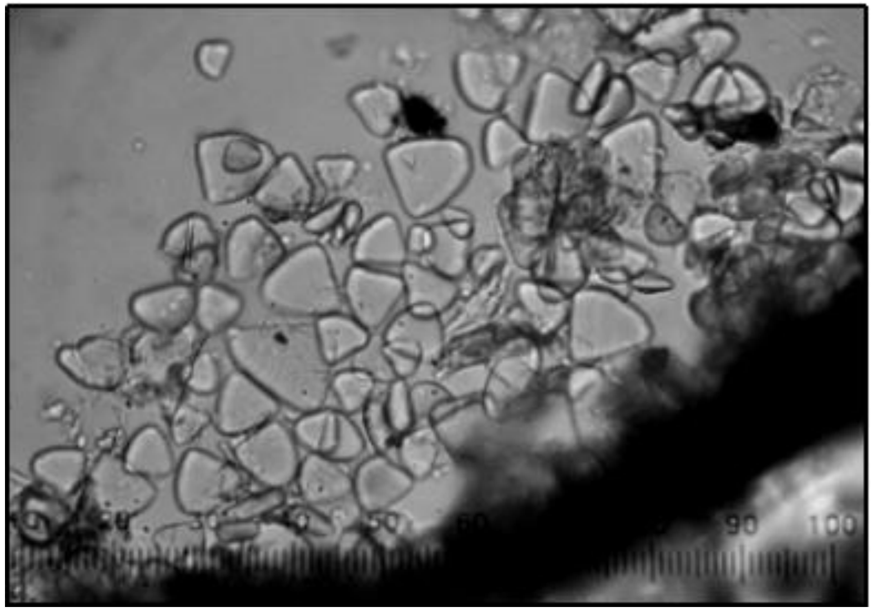


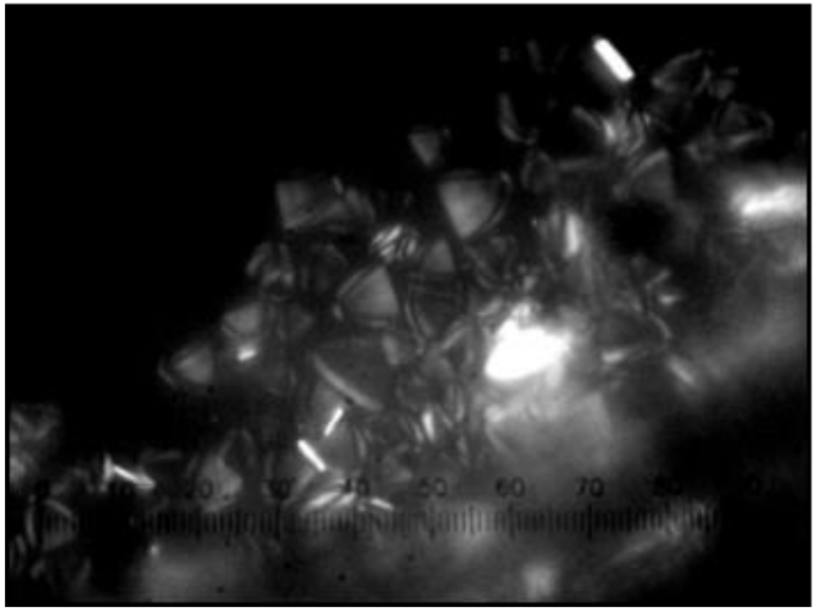
Dioscorea pentaphylla

Australian Museum,
McCown Archaeobotany
Laboratory Collection

Dioscorea polygonoides

Starch

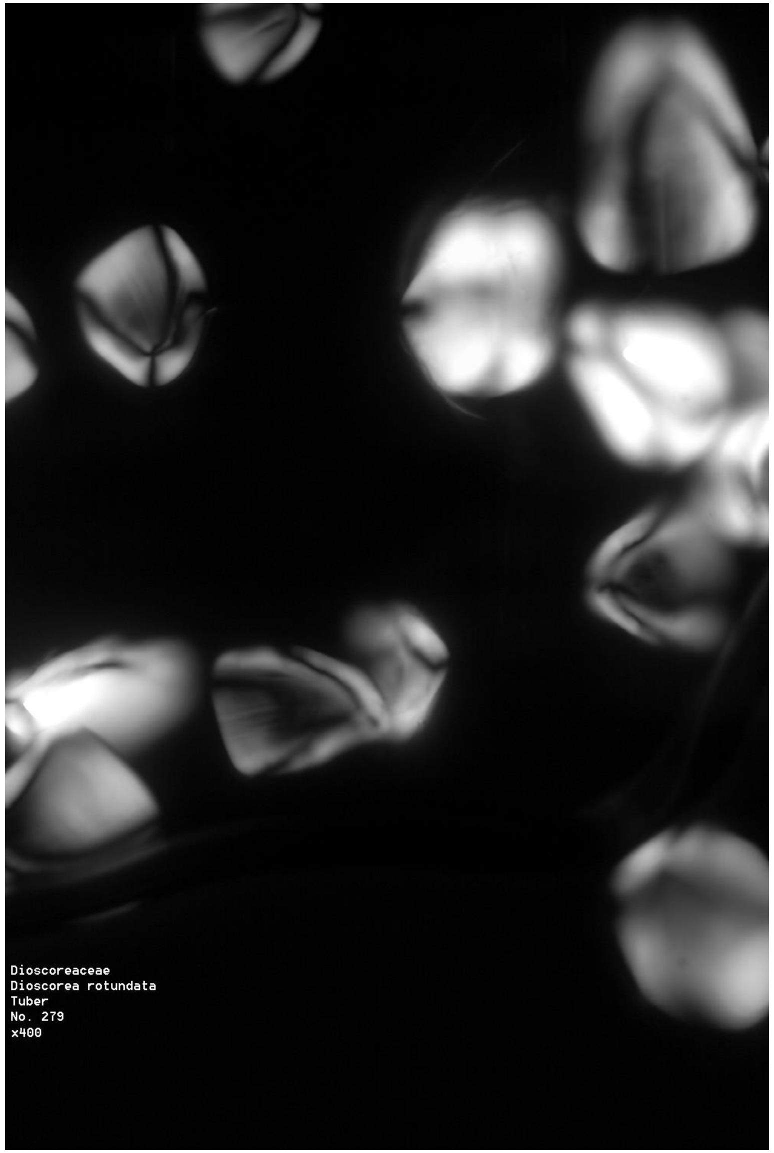




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

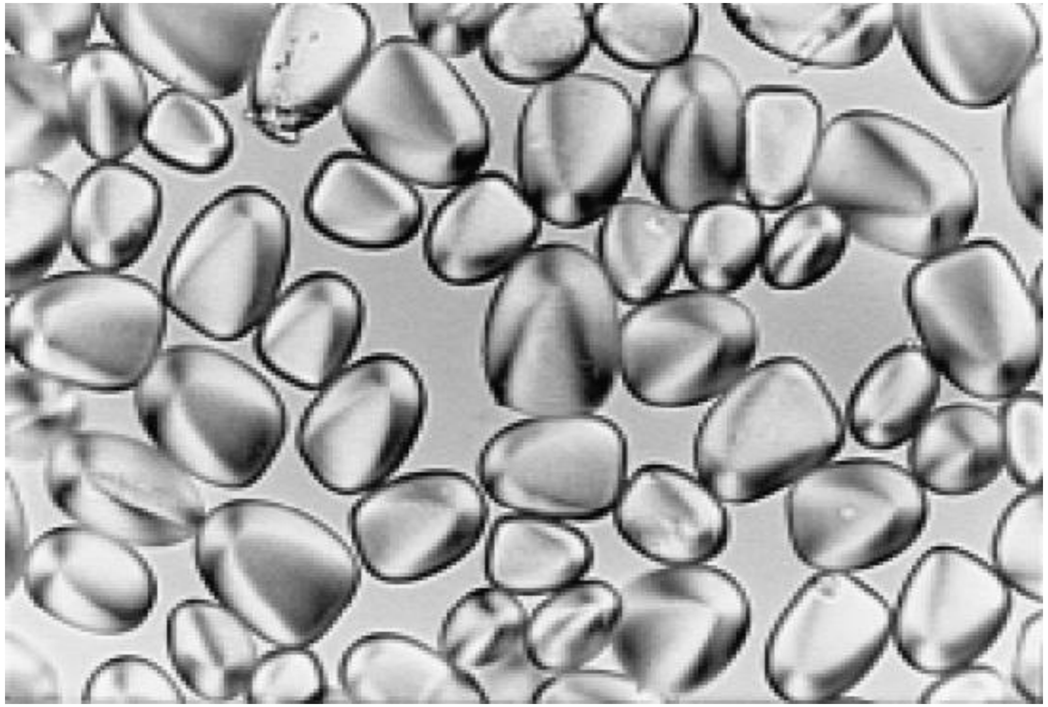
Dioscorea rotundata

Australian Museum,
McCown Archaeobotany
Laboratory Collection



Dioscorea trifida

Starch



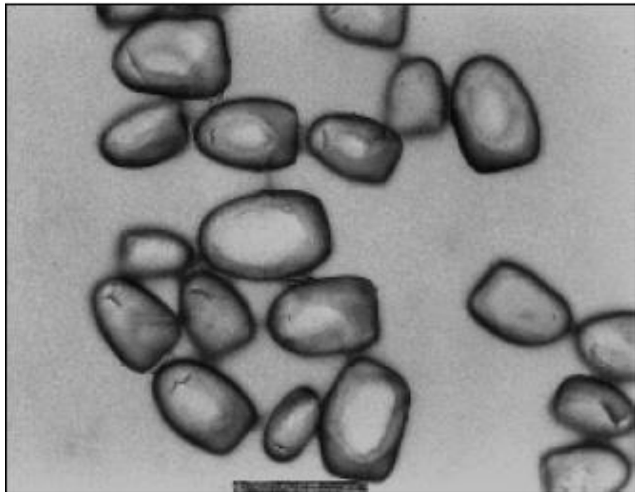
Starch grains from a modern tuber of Dioscorea trifida.
80x

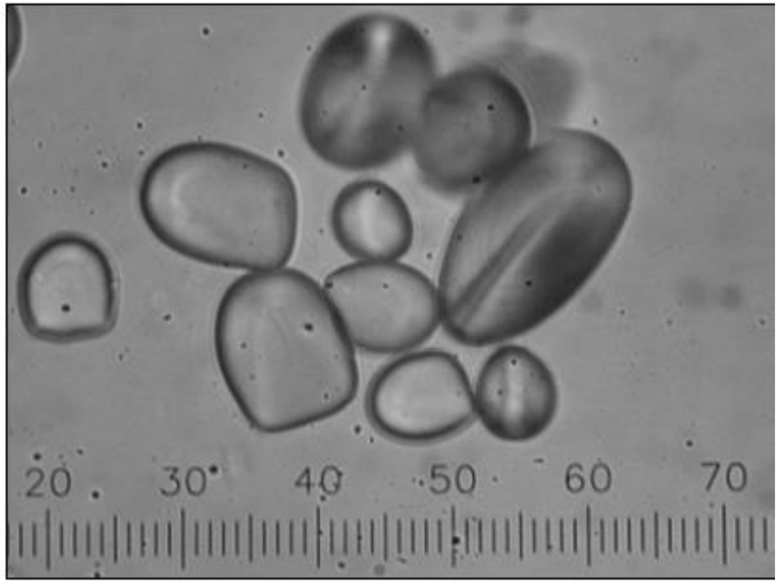
APPENDIX:
Dioscorea trifida (yampı ´) (Figure 3). Simple grains, laminated, with a more or less distinct point where the hilum is located. They possess a cuneiform-shaped depression extending from the hilum to the bottom of the grain, and a straight distal edge. Size: 24– 84 microns long

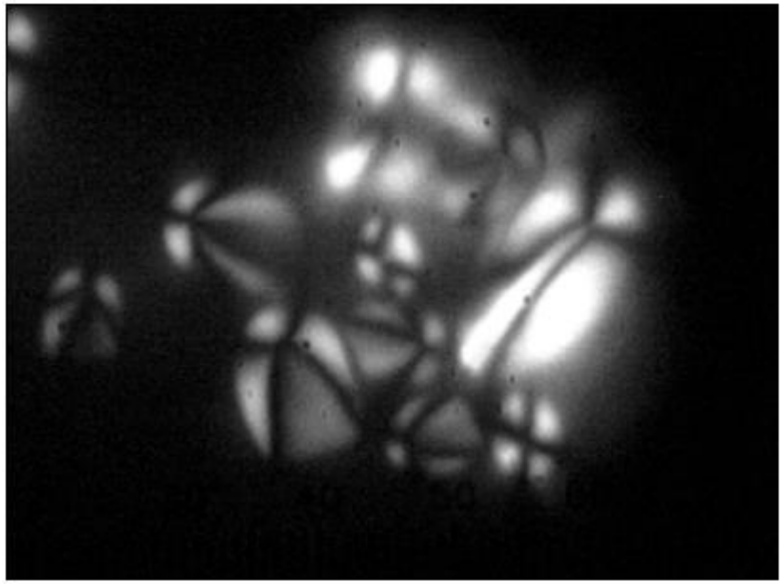
Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Dioscorea trifida

Starch



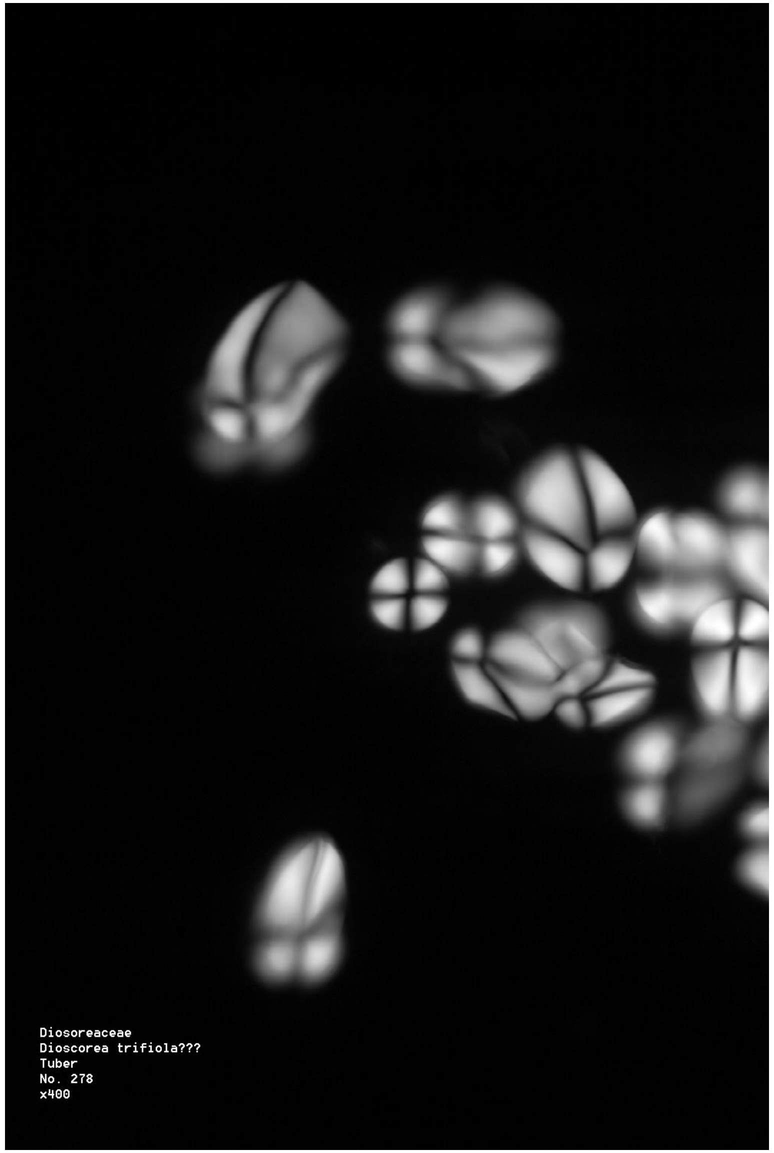


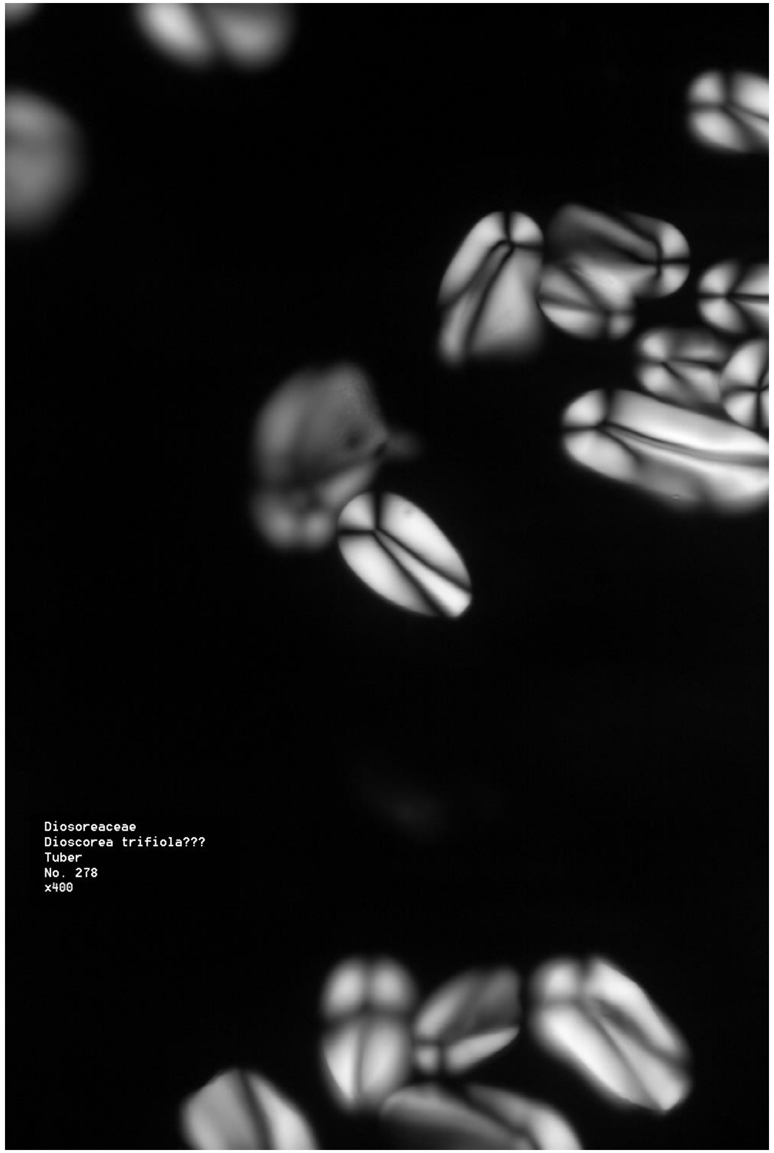


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Dioscorea trifiola?

Australian Museum,
McCown Archaeobotany
Laboratory Collection





Dioscorea sp.

Starch

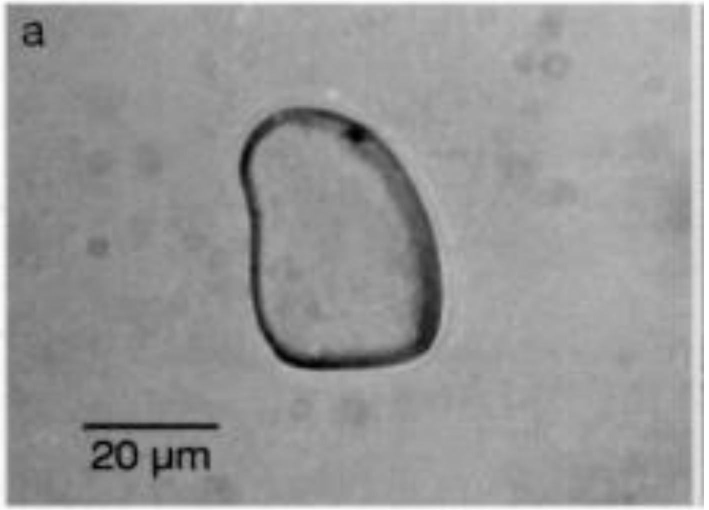


Figure 3. Light micrographs of archaeological starch granules representative of the recovered assemblage. a: Starch granule of Dioscorea sp. recovered from flake 3.

Perry, Linda. 2002. Starch Analyses Reveal Multiple Functions of quartz "manioc" Grater Flakes from the Orinoco Basin, Venezuela. *Interciencia* 27 (11):635–39.

Dioscorea sp.

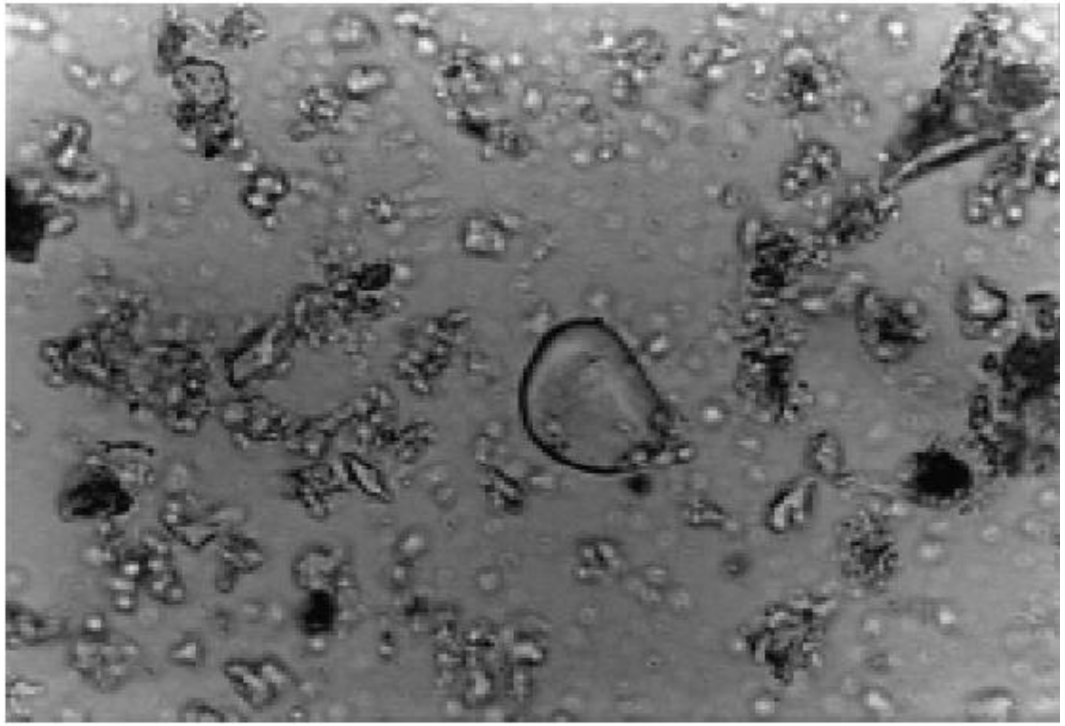
Starch

Starch grains from the tuber of a wild Dioscorea species from Panama. 80x

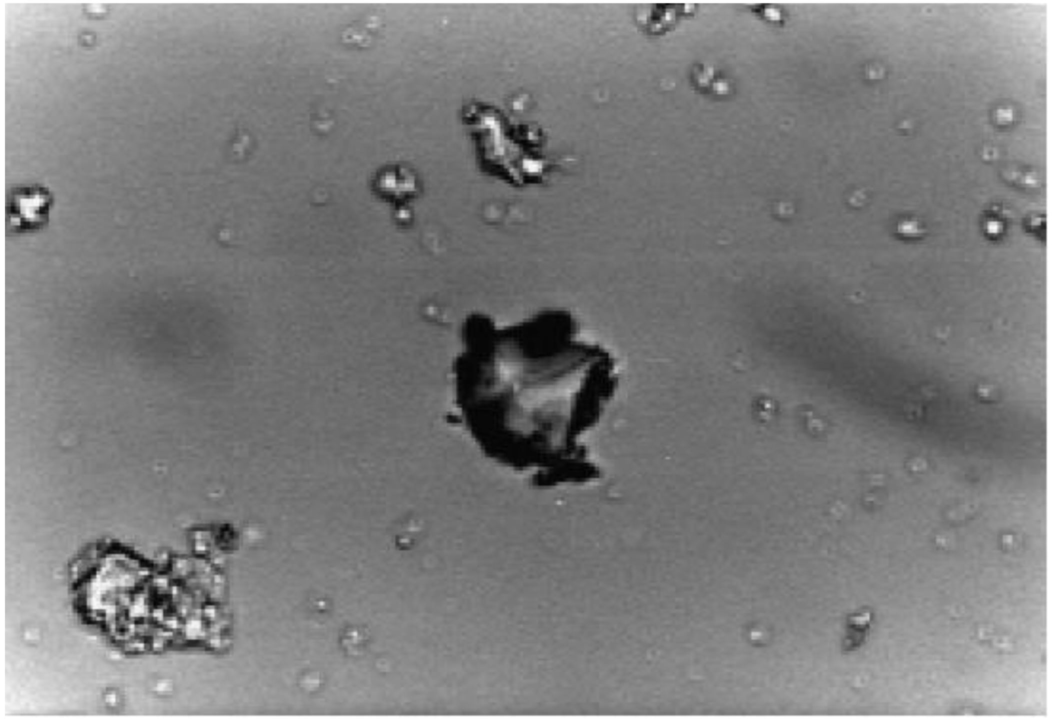
Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Dioscorea sp.

Starch



A Dioscorea sp. starch grain from La Mula. 160x. The grain measures 20 microns by 16 microns.



A Dioscorea sp. starch grain from the Aguadulce shelter. 320x. The grain measures 16 microns by 16 microns

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Dioscorea sp.

Starch

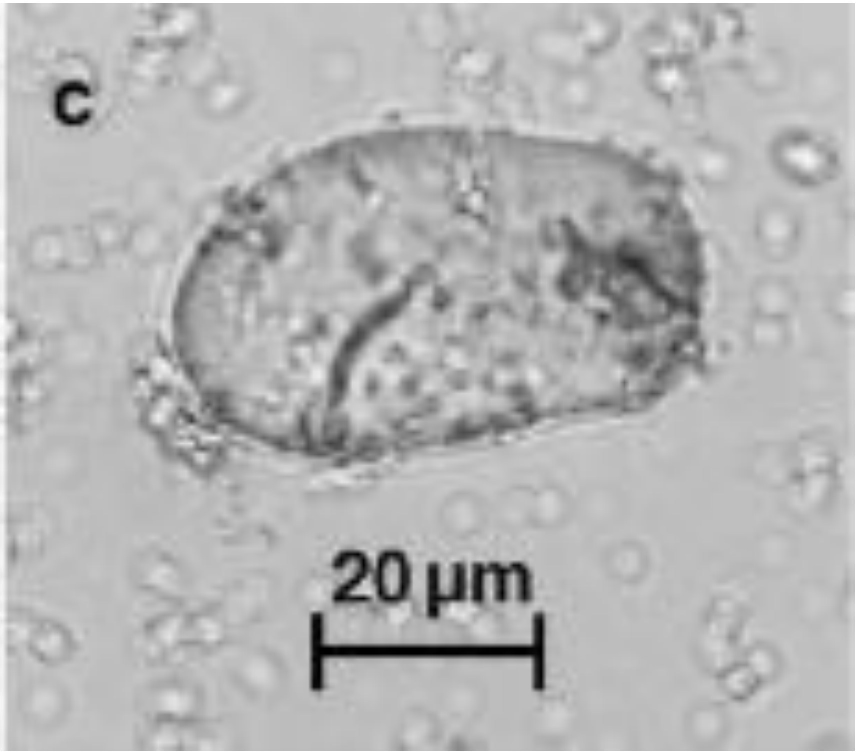


Fig. 5. Selected microbotanical remains. Starch grains: c) Dioscorea sp. (SAL 04-2-7447)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Dioscorea sp.

Starch

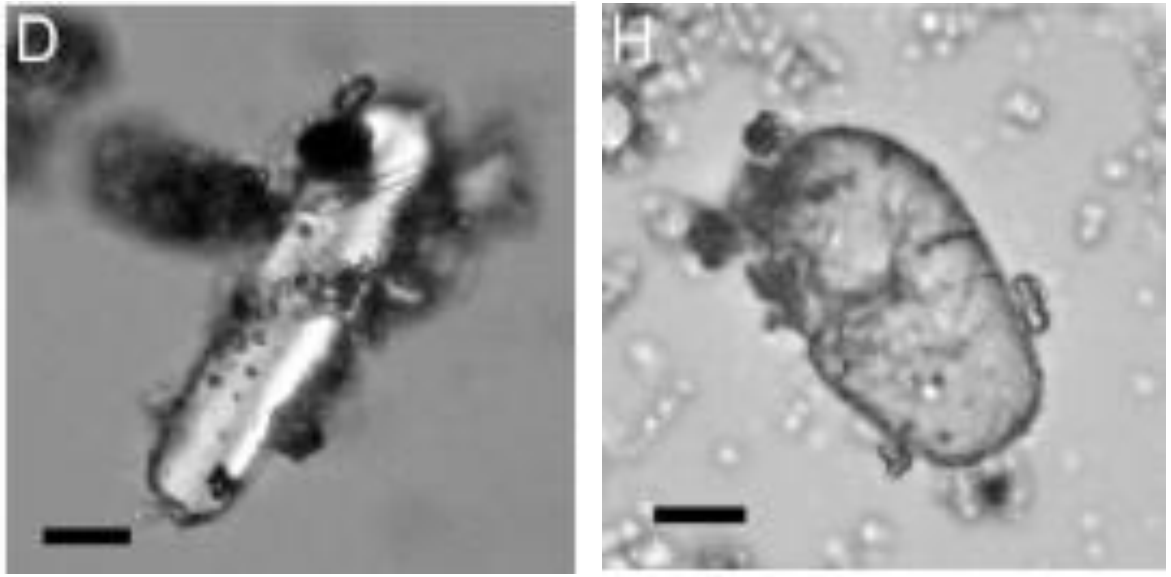
Figure 1. Various starch grains. c, A starch grain from a species of Dioscorea recovered from milling stone 350. Scale bar 10 µm

Piperno, Dolores R., Anthony J. Ranere, Irene Holst, and Patricia Hansell. 2000. Starch Grains Reveal Early Root Crop Horticulture in the Panamanian Tropical Forest. *Nature* 407:894–97.

Dioscorea sp.

Starch

Fig. 2. Selected archaeological starch grains. (D) Dioscorea cf. urophylla starch from Trapiche, chopper 147/10,?4300 cal BP (under cross-polarized light). (H) Dioscorea sp. starch from Ladrones, handstone CL-68/1, ?7500 cal BP. (Scale bar: 10 µm.) Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8

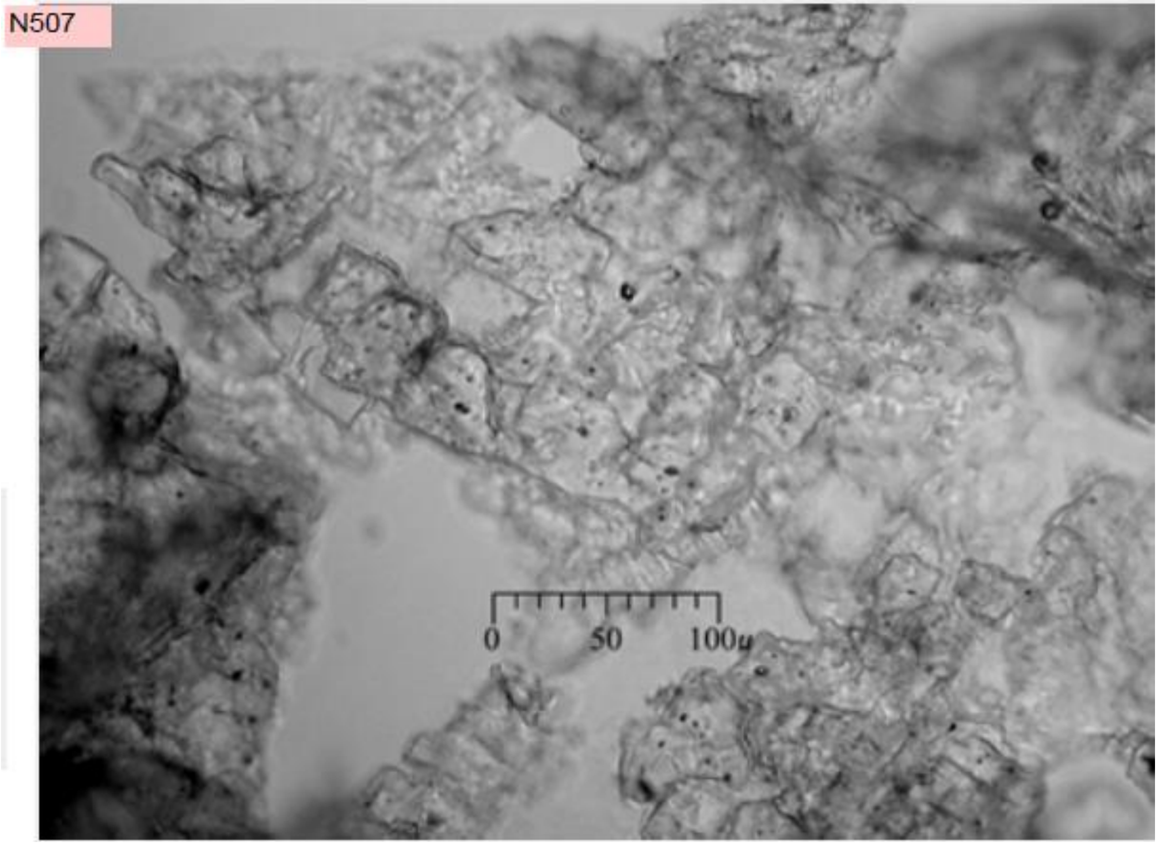


Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Dioscorea sp.

Phytolith

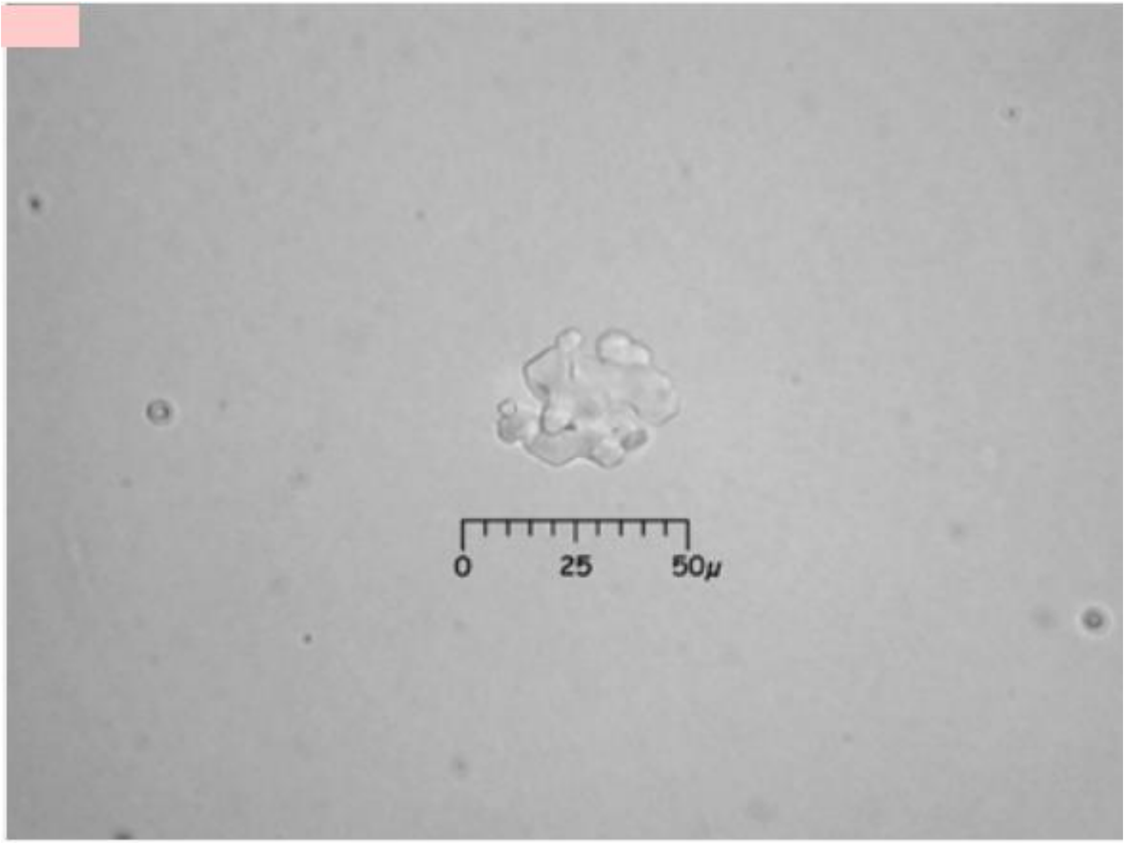
Type established by Karol Chandler-Ezell, 2004. Cultivated tuber.
Diagnostic level: root/tuber



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dioscorea sp.

Phytolith



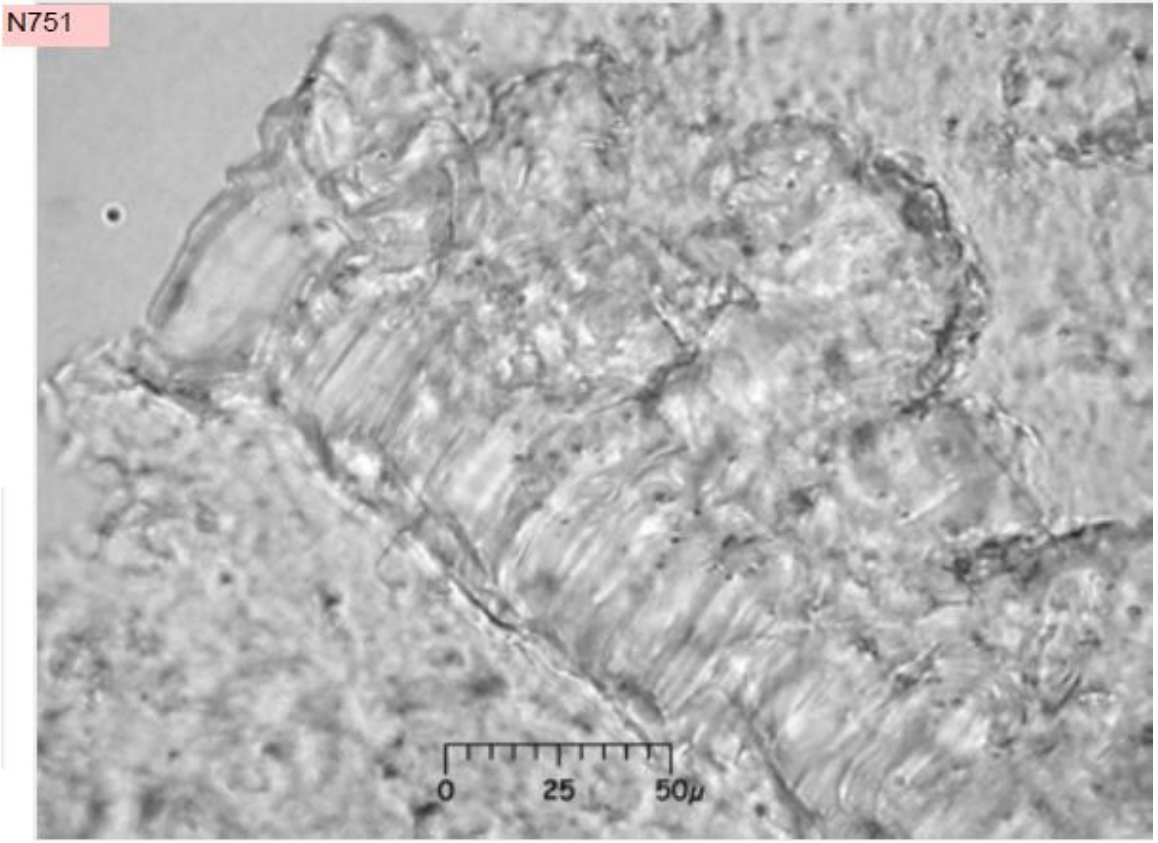
Type established by Karol Chandler-Ezell, 2004. Cultivated tuber.
Diagnostic level: root/tuber

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dioscorea sp.

Phytolith

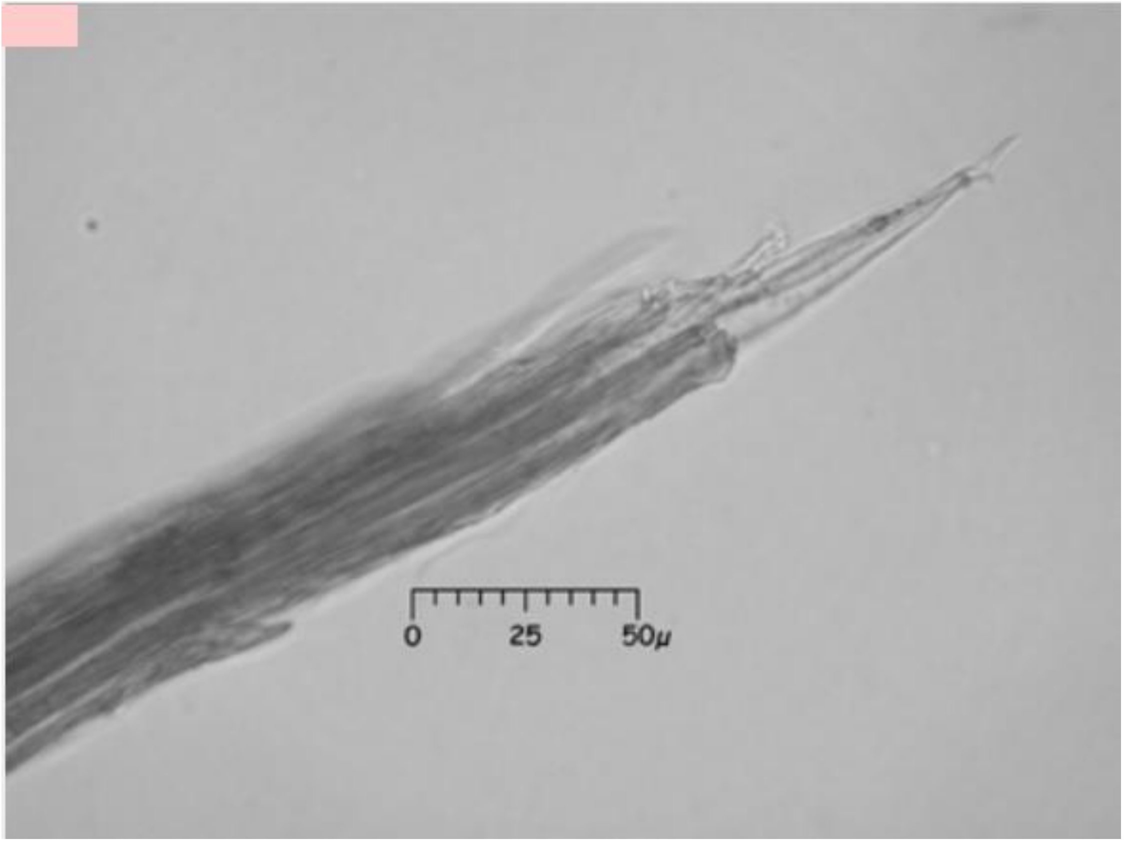
Type established by Karol Chandler-Ezell, 2004. Cultivated tuber.
Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dioscorea sp.

Phytolith



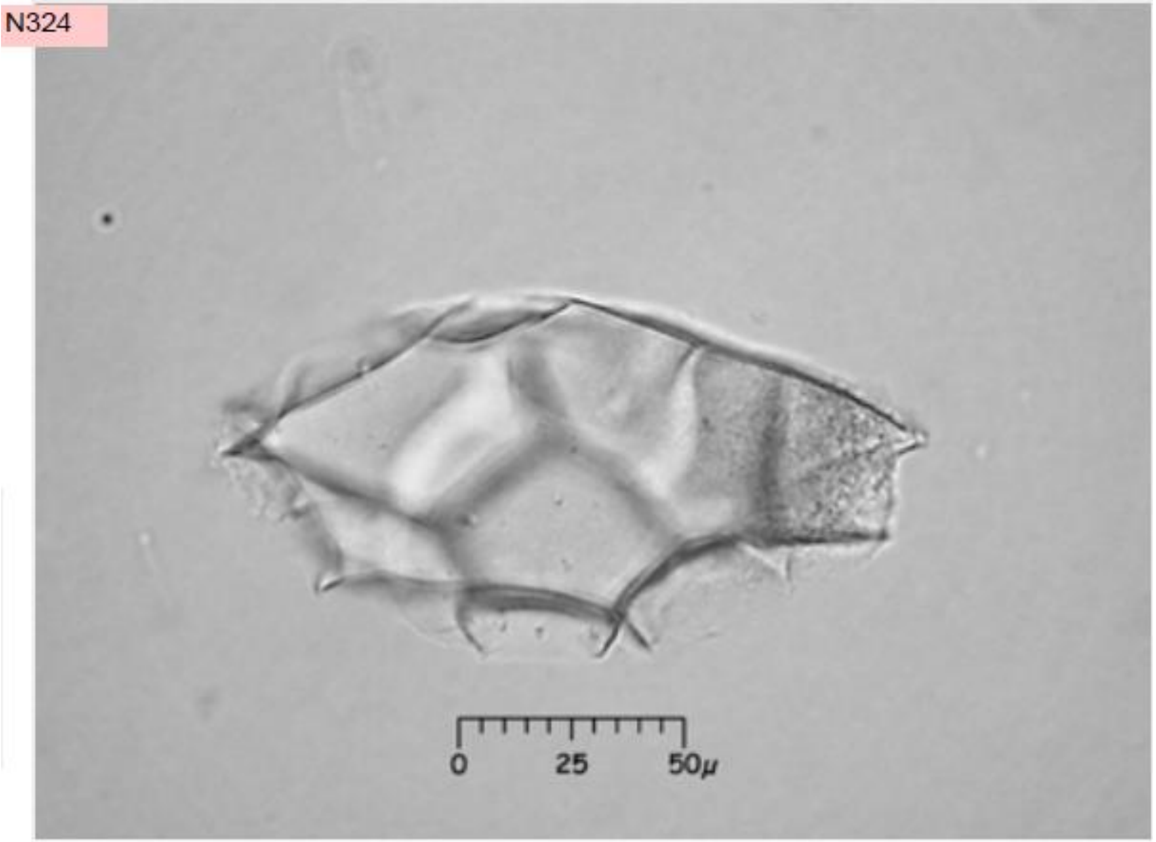
Type established by Karol Chandler-Ezell, 2004. Cultivated tuber.
Diagnostic level: root/tuber

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

EBENACEAE

Diospyros virginiana

Phytolith



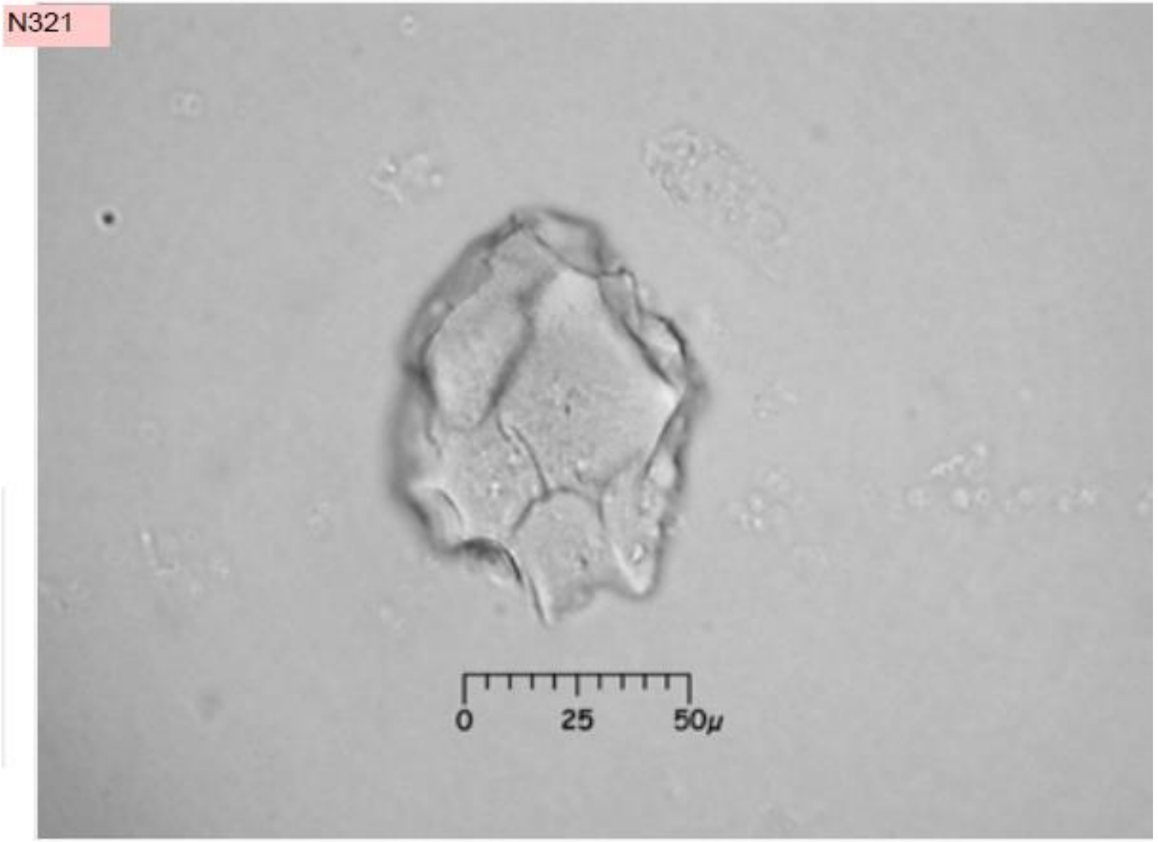
Faceted hemisphere, side view (see Record #177 for top view).
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Diospyros virginiana

Phytolith

Faceted hemisphere, top view (see Record #176 for side view).
Diagnostic level: family

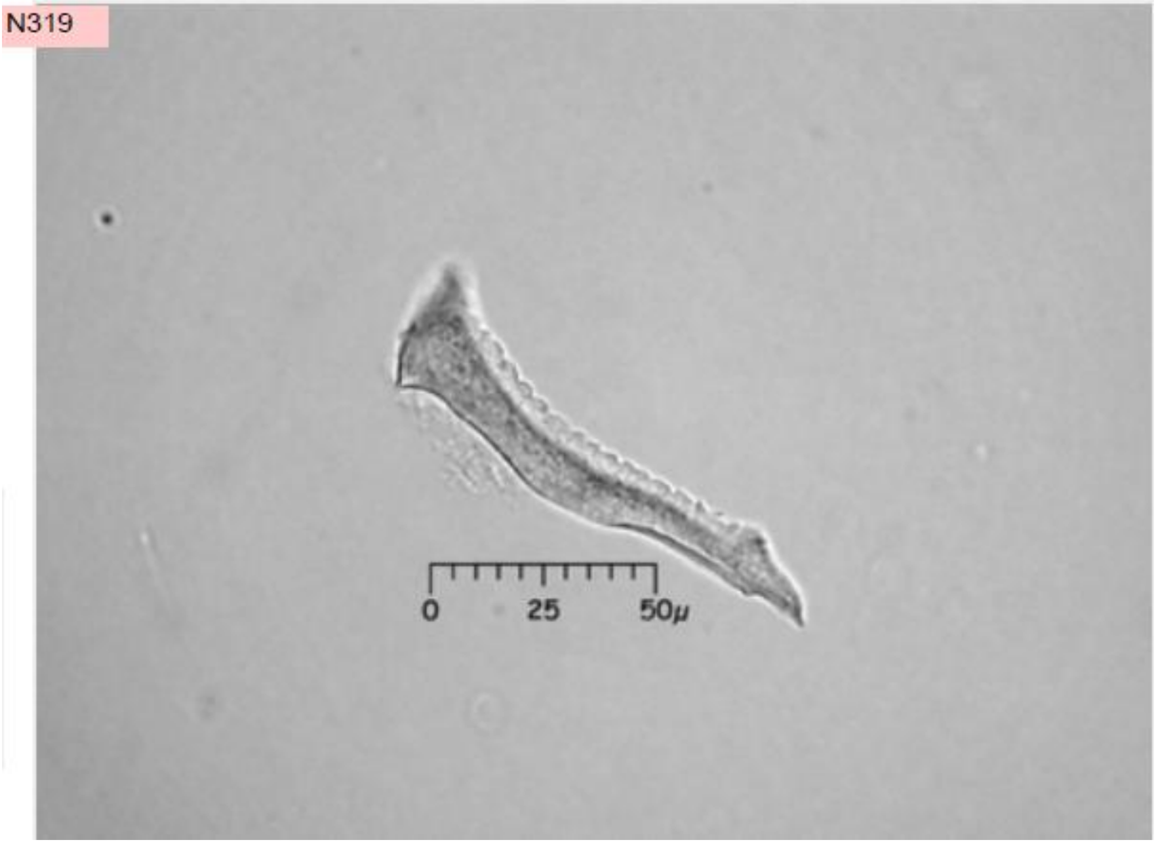


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Diospyros virginiana

Phytolith

Note interesting “ridge” of bumps gives it a scalloped appearance on the dorsal ridge.
Diagnostic level: generalized arboreal



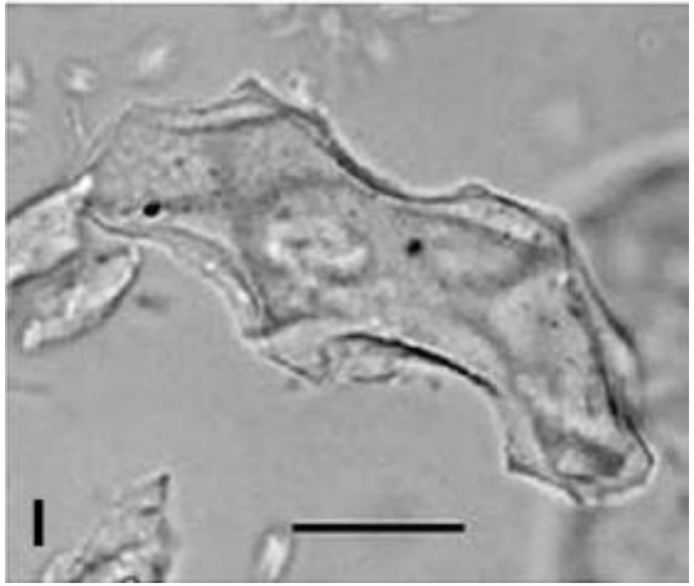
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

ELAEOCARPACEAE

Sloanea grandiflora

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. l) MFB from Sloanea grandiflora leaf



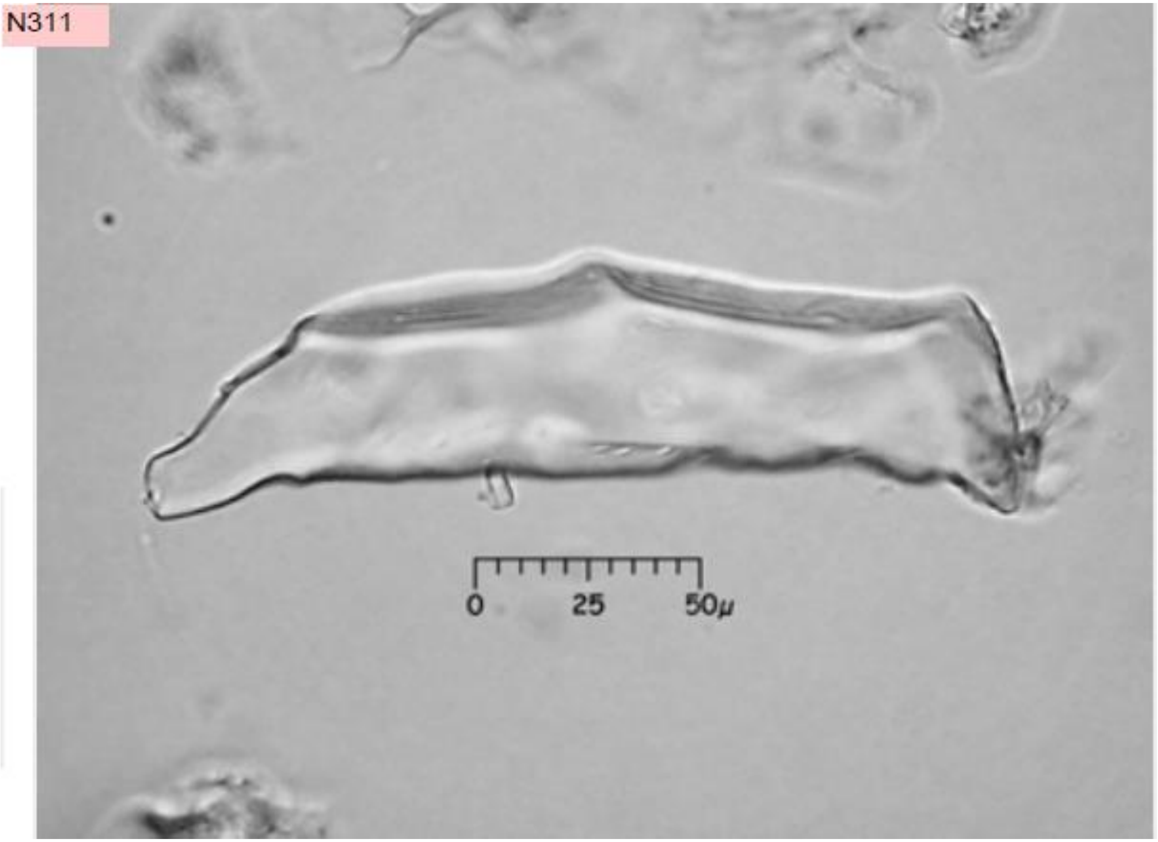
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

ERICACEAE

Macleania sp.

Phytolith

Very large schlerid.
Diagnostic level: generalized arboreal

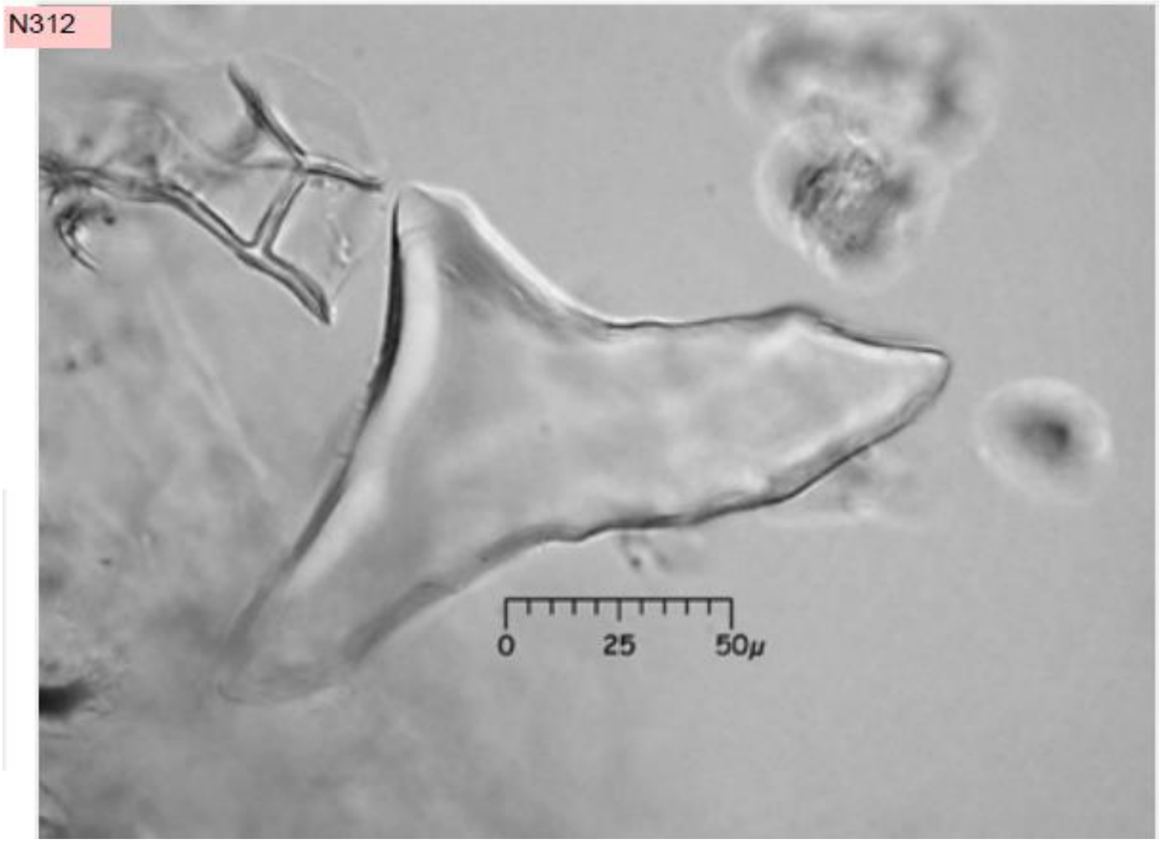


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Macleania sp.

Phytolith

Very large schlerid.
Diagnostic level: generalized arboreal



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

ERITHROXELACEAE

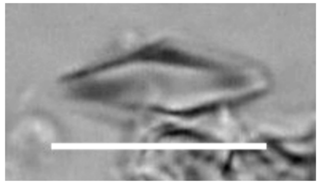
Erythroxylum coca

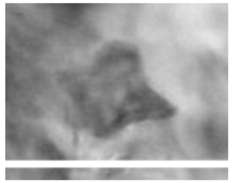
Erithroxelaceae *Erythroxylum coca* "coca"

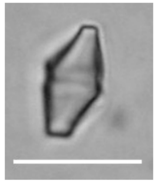
Phytolith assemblage characterization

leaf

a) Tetracuneiform calcium oxalates phytoliths. Very common.



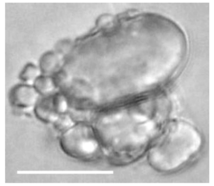




Starch assemblage characterization

leaf

a) Single grains, oval to spherical, well rounded; variable in size from 10μm to 30μm long length; not-visible hilum and lamella. Some bunch aggregates.



Scale bar = 20μm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Erythroxylum mucronatum

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. k) Sclereid from Erythroxylum mucronatum

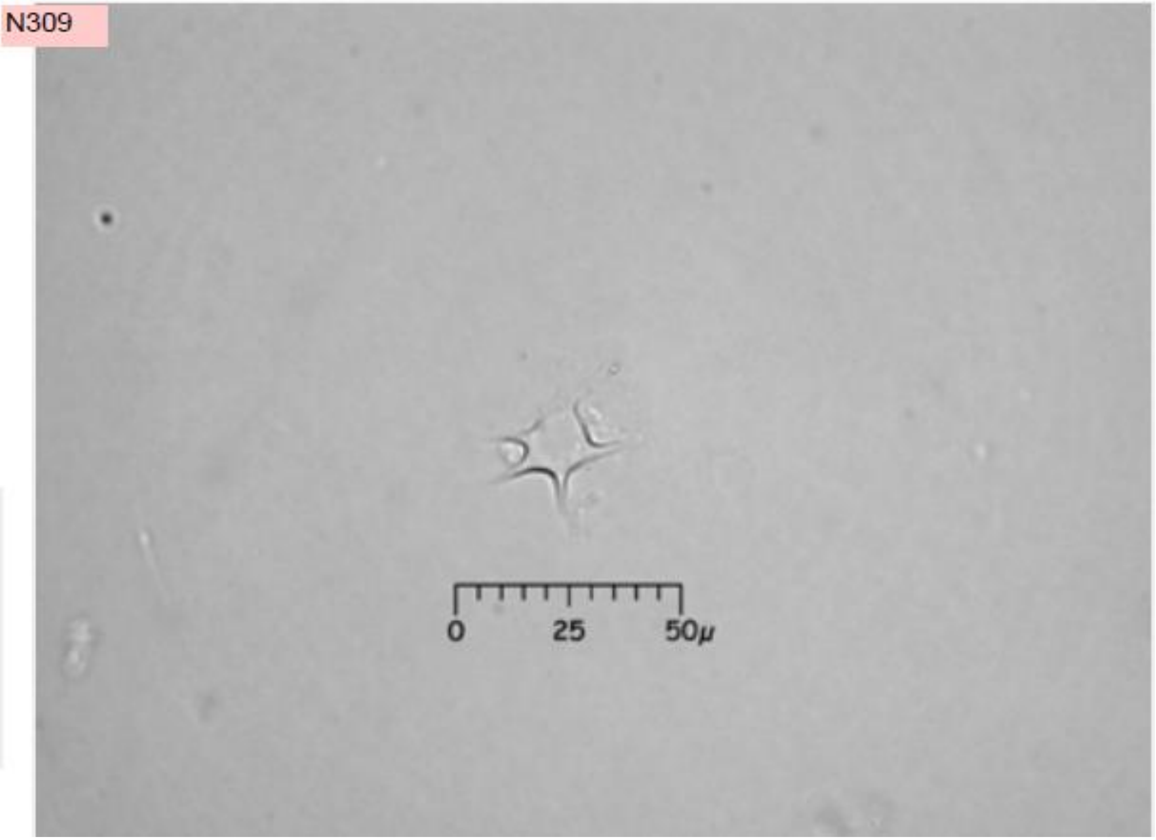
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

EUPHORBIACEAE

Acalypha diversifolia

Phytolith

Diagnostic level: not diagnostic

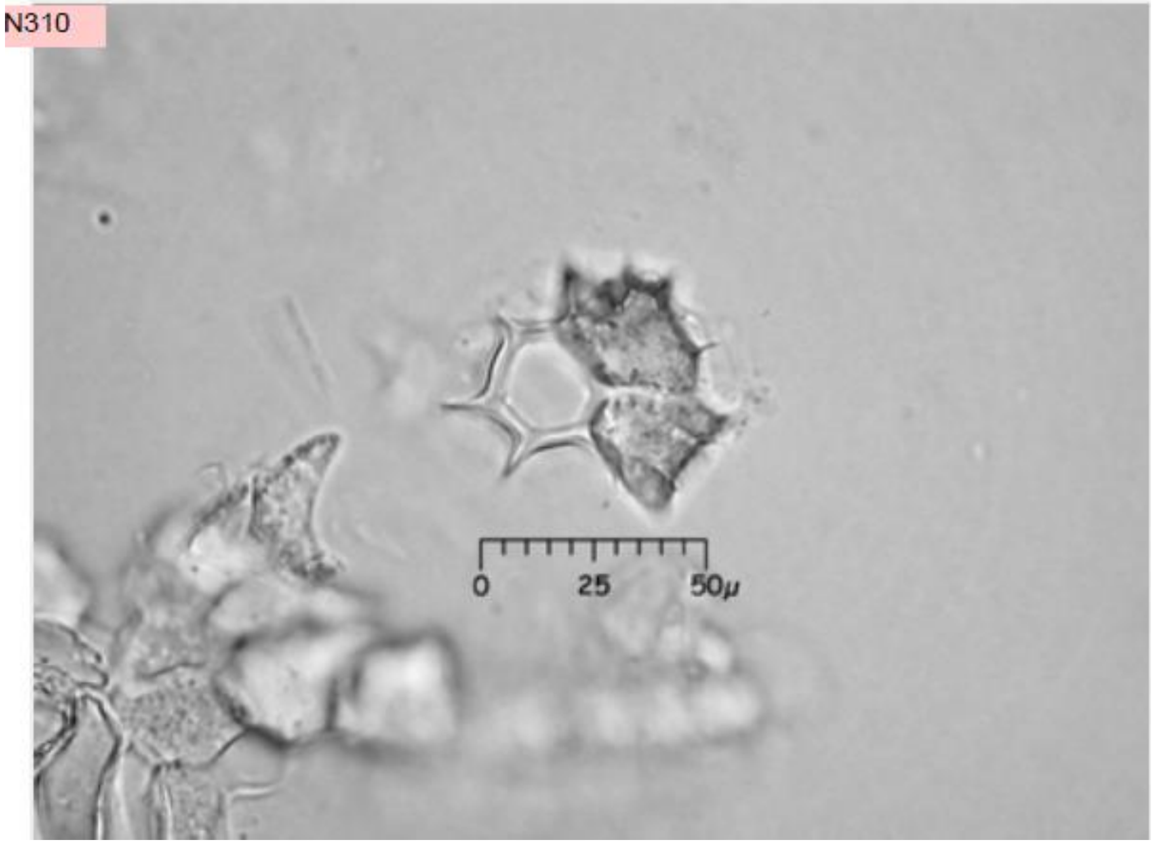


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Acalypha diversifolia

Phytolith

Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Amanoa anomala

Phytolith

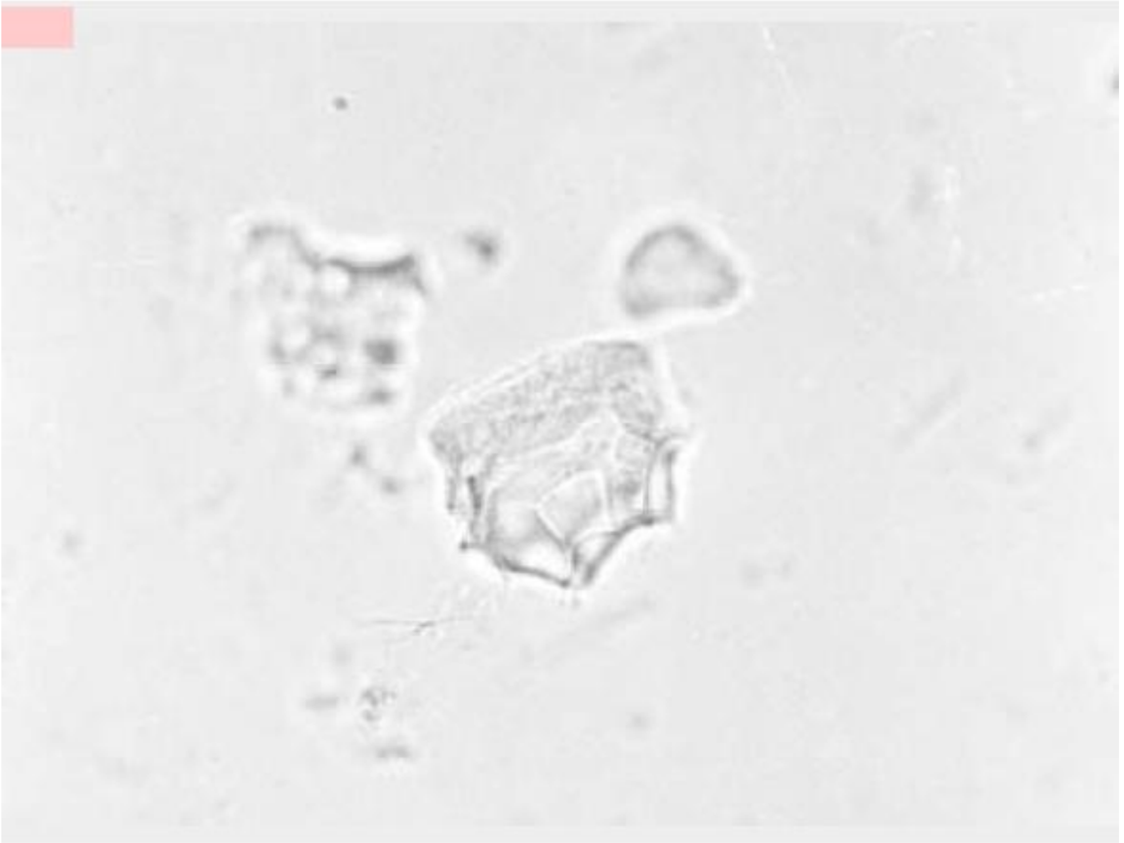
Be sure to rotate blocky quadrilaterals to see the distinct nature of the projections in this type.
See other Euphorbiaceae taxa to see range of variation of this type across the family.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Amanoa anomala

Phytolith

Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Amanoa anomala

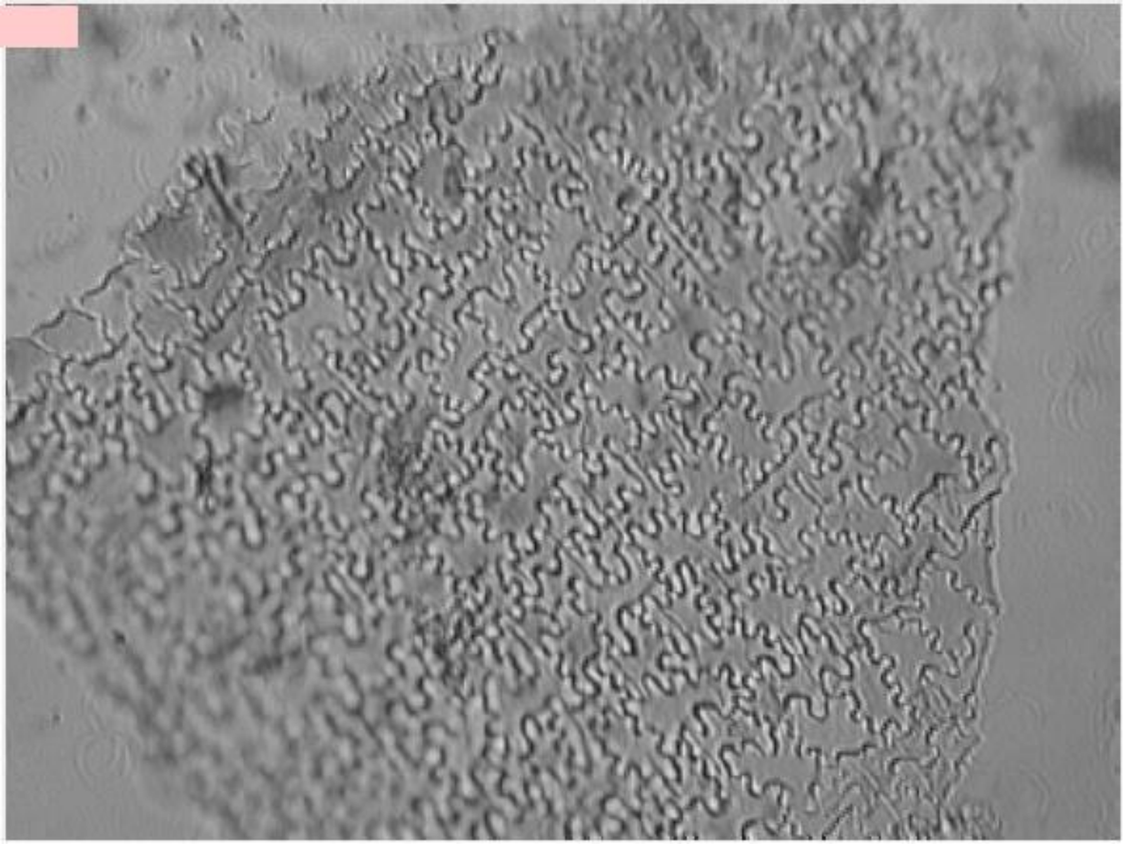
Phytolith

View of rounded side... projections not visible, facets not distinct in this view. Be sure to rotate to see both views.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Croton fraseri

Phytolith

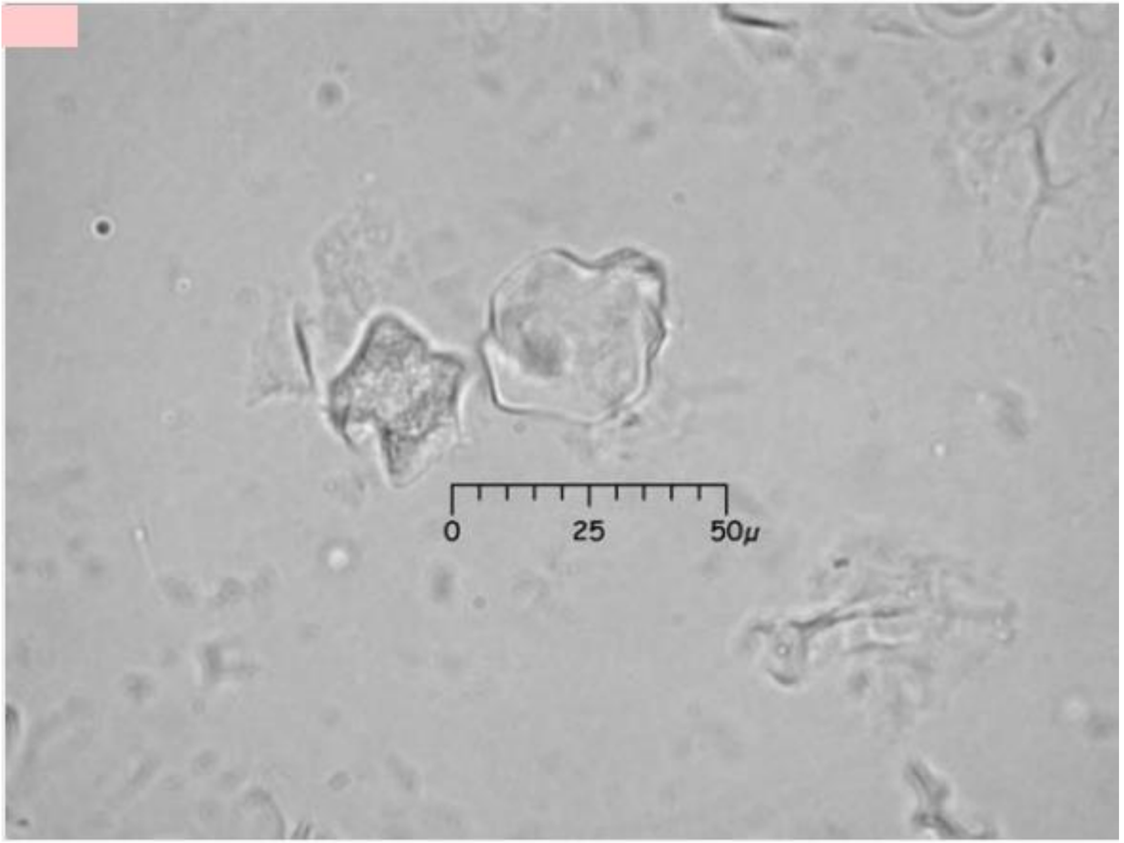


This type is not diagnostic of Euphorbiaceae. It is produced in a number of dicots.
May occur singly or in sheets of different sizes. This is a particularly large sheet.
May be occluded.
Diagnostic level: not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Croton fraseri

Phytolith

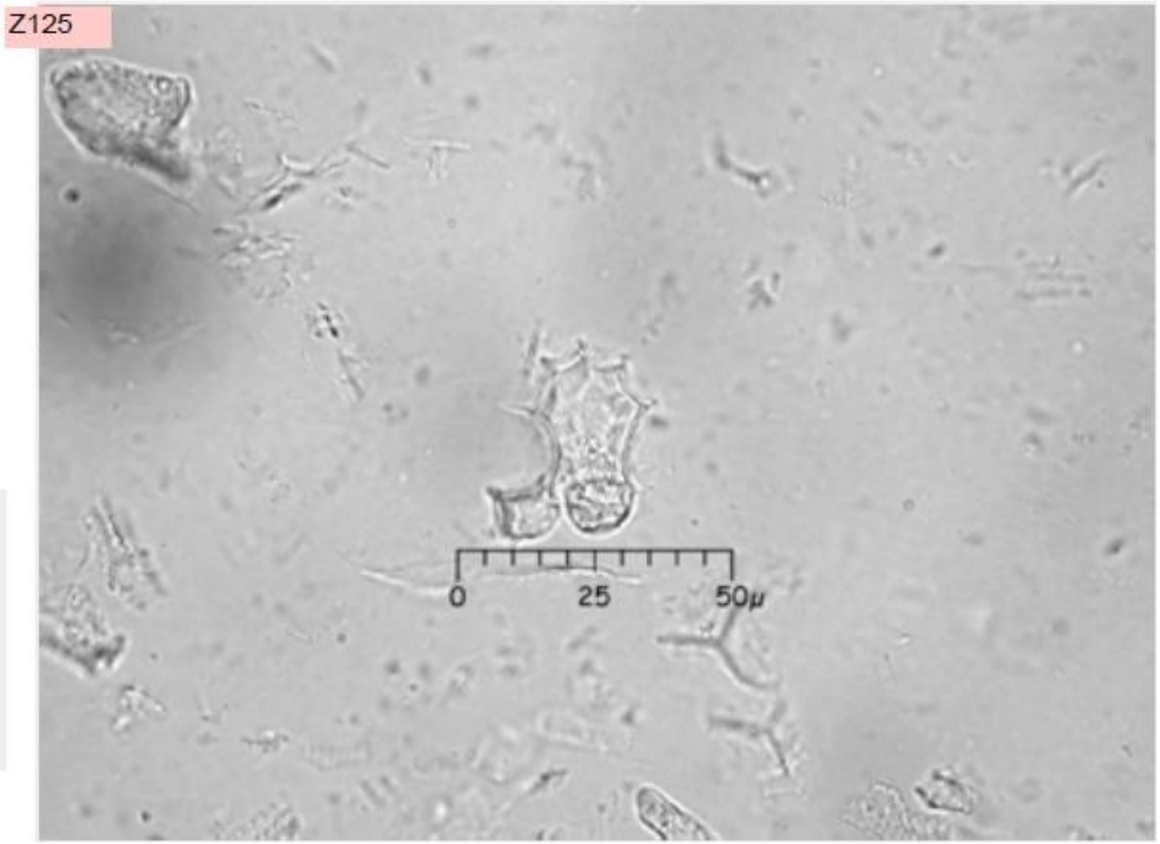


Blocky quadrilateral epidermal tissue. In profile, projections and facets on multifaceted face give crown-like appearance. Rotate to spot multifaceted space and distinguish from non-diagnostic 3D epidermal blocks.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Croton fraseri

Phytolith



Blocky quadrilateral. This example is more flattened than usual, showing range of the type.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Croton fraseri

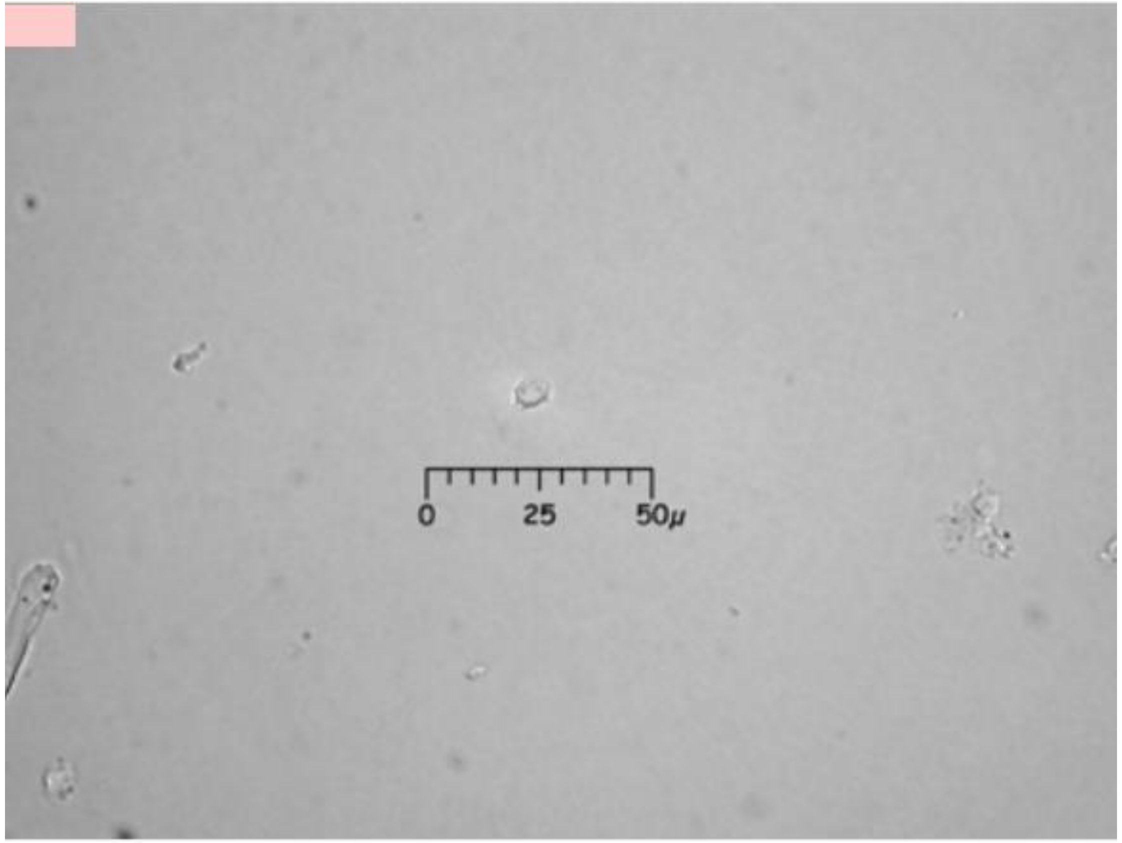
Phytolith

Can have roughened edges, but many examples are smooth.
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Manihot esculenta

Phytolith



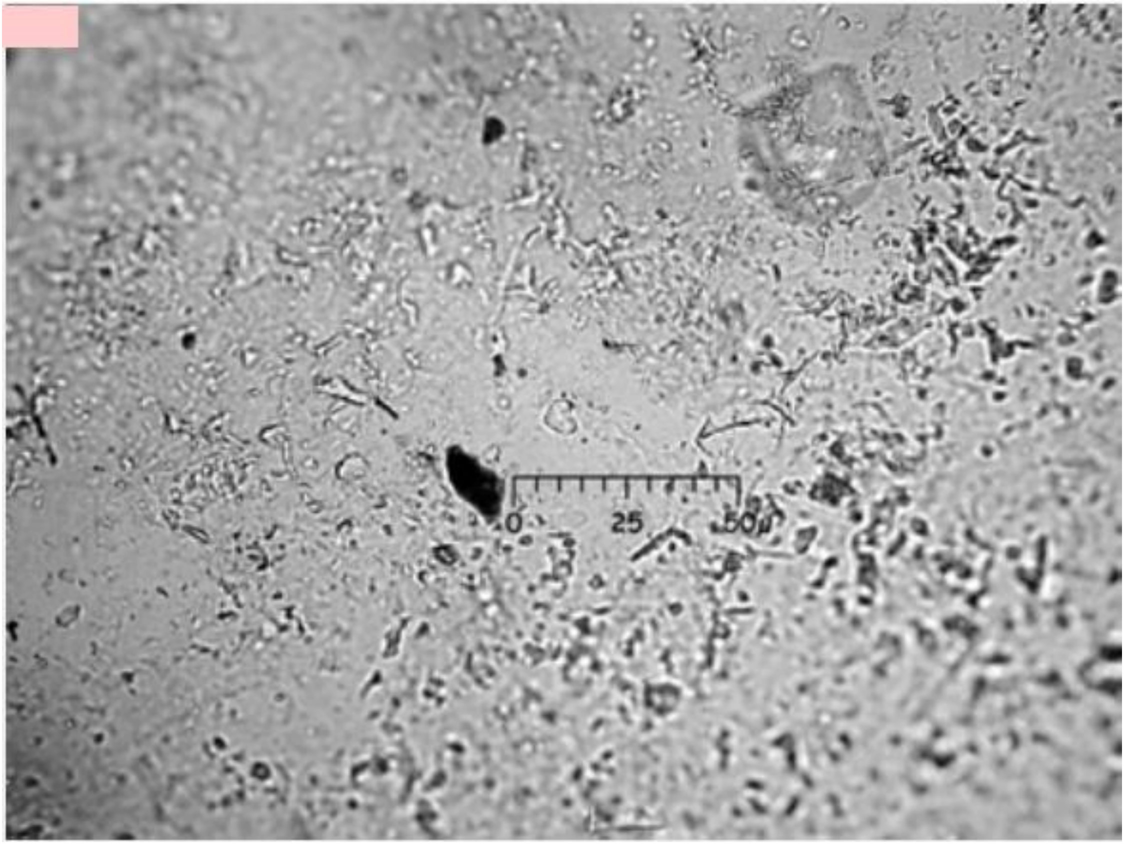
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Manihot esculenta

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: genus

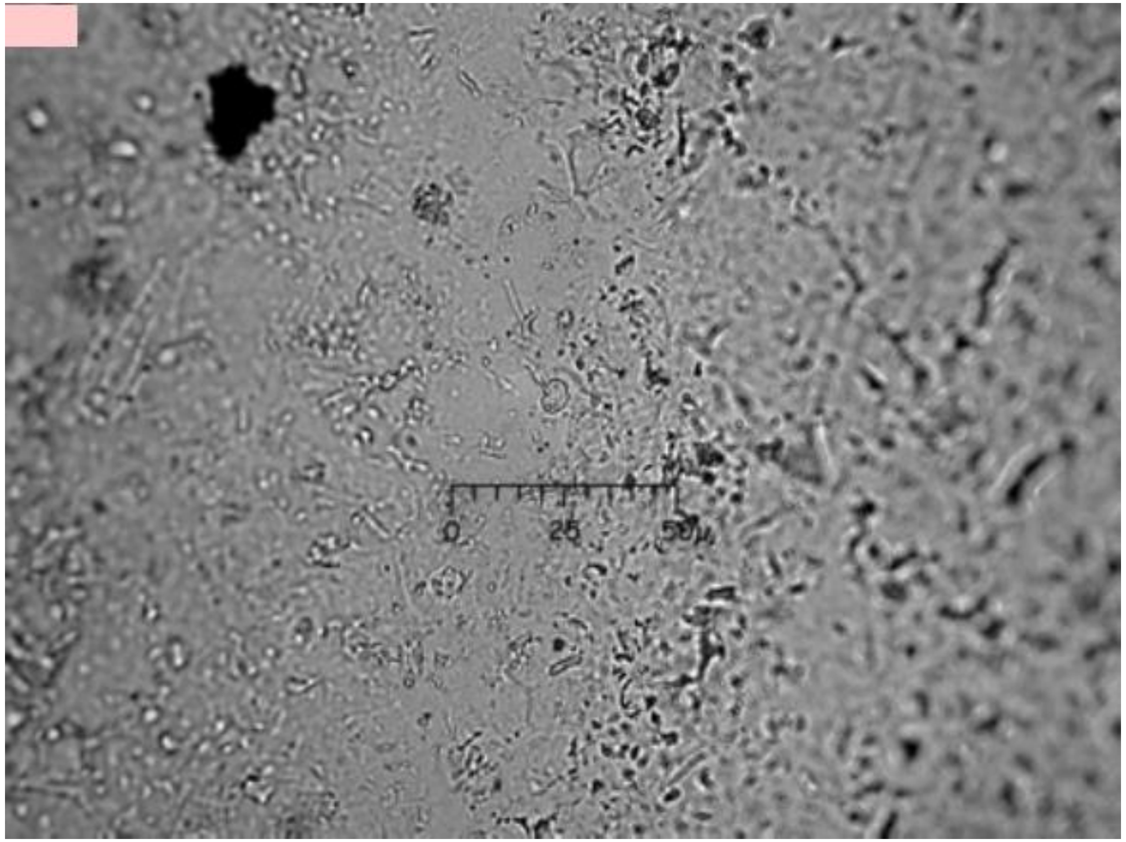


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Manihot esculenta

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: genus

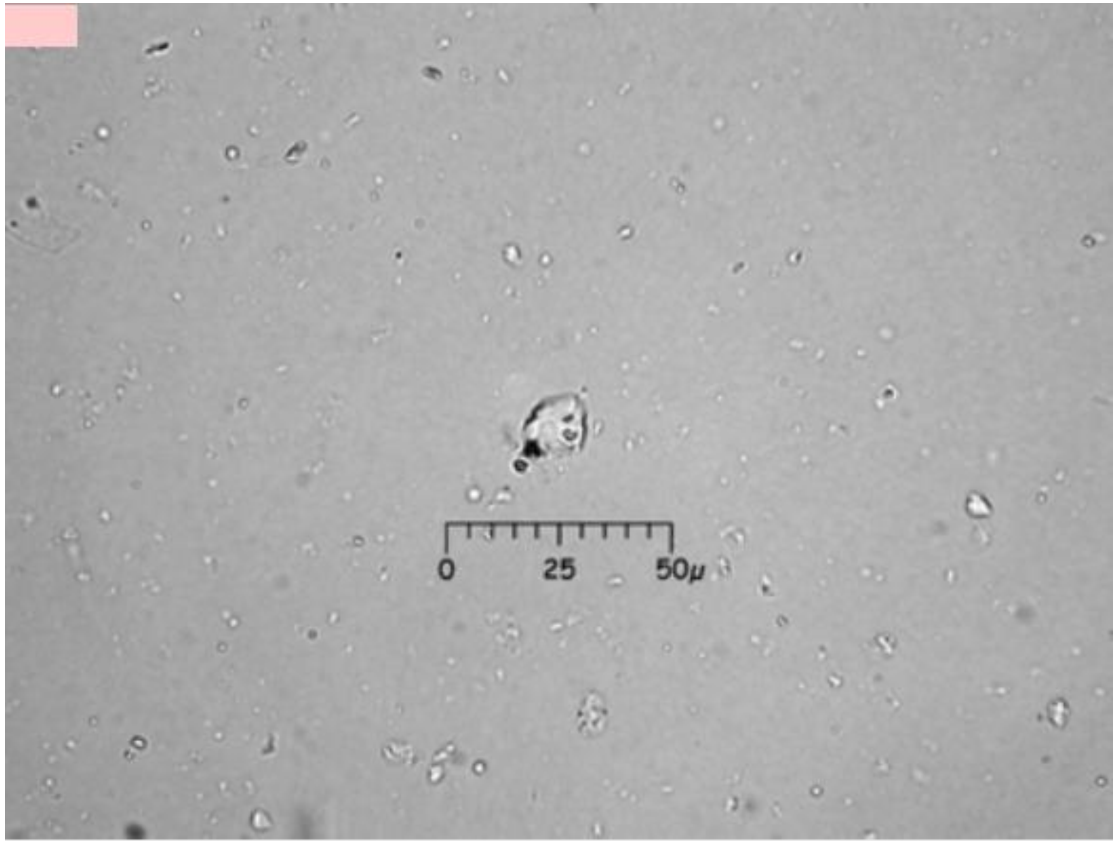


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Manihot esculenta

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: genus

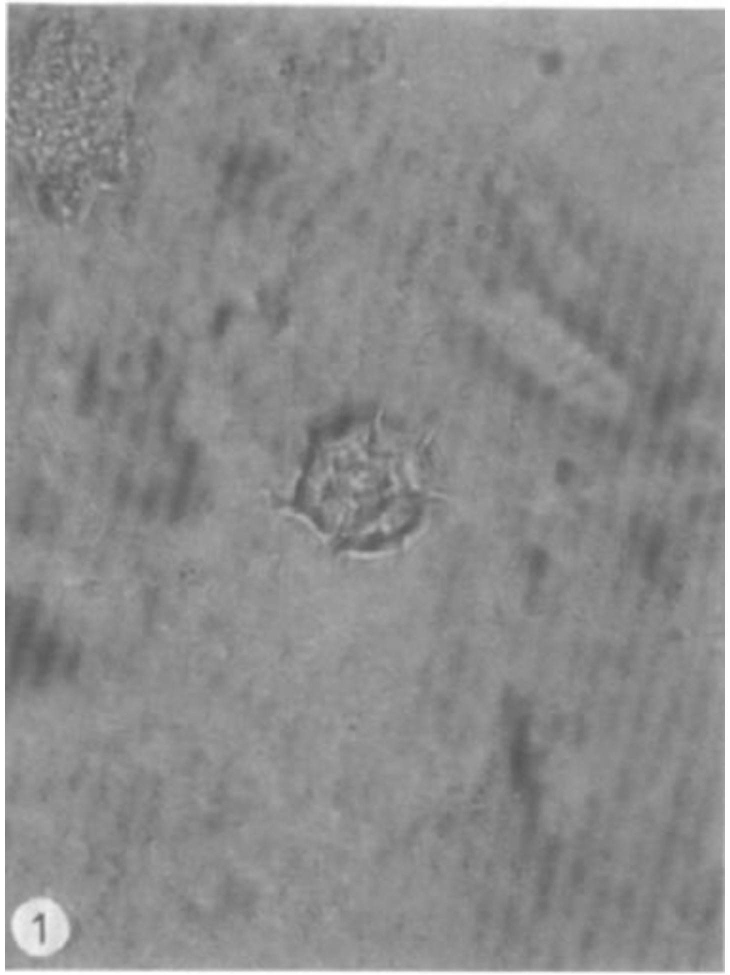


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Manihot esculenta

Phytolith

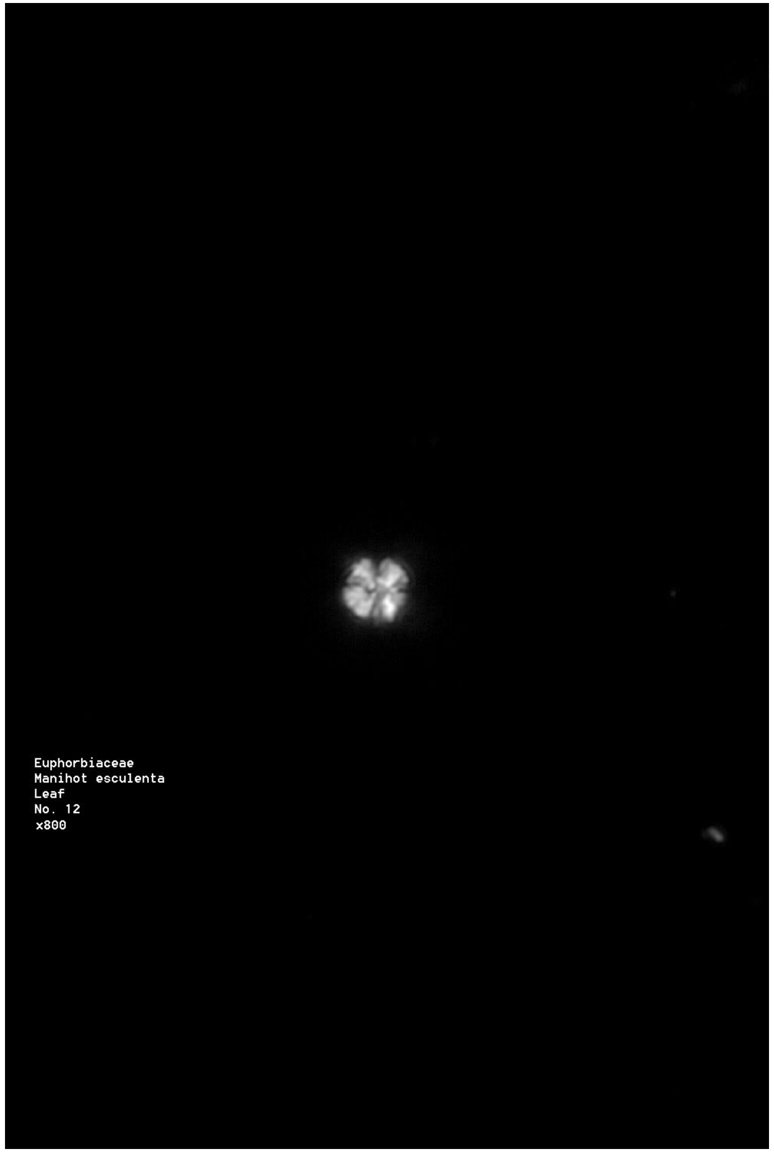
1. A stellate hair cell from Manihot esculenta (250 x).

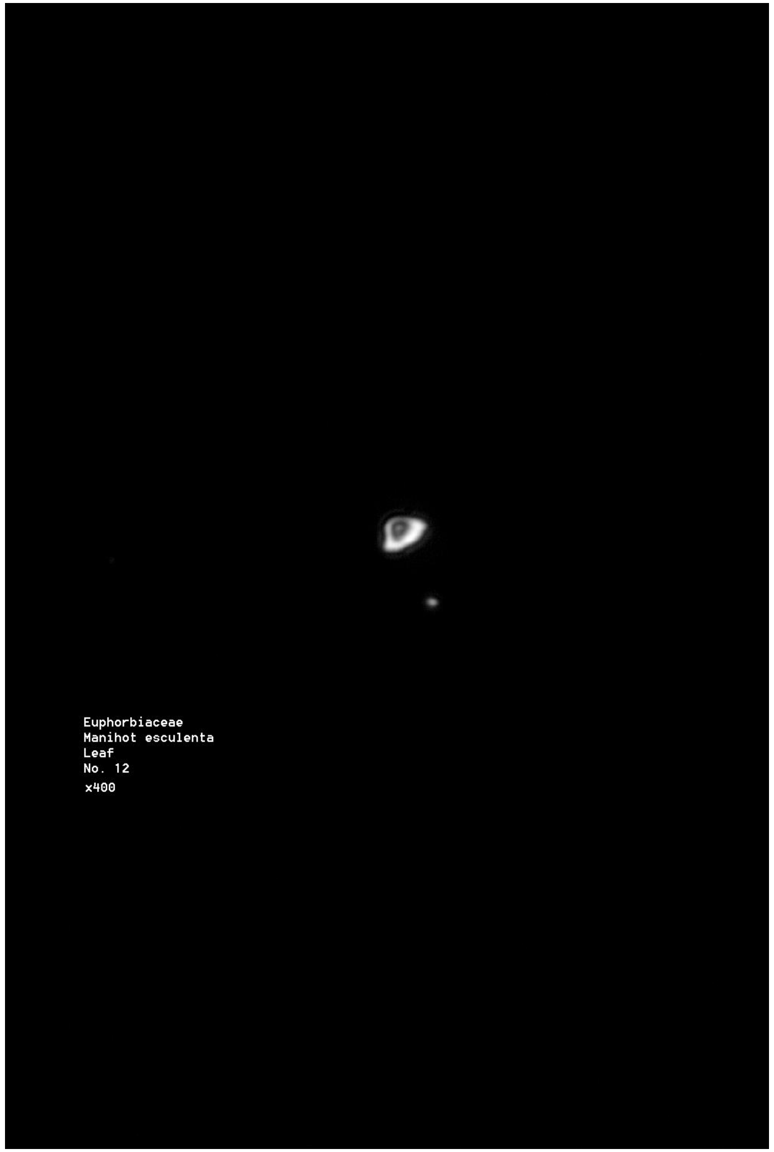


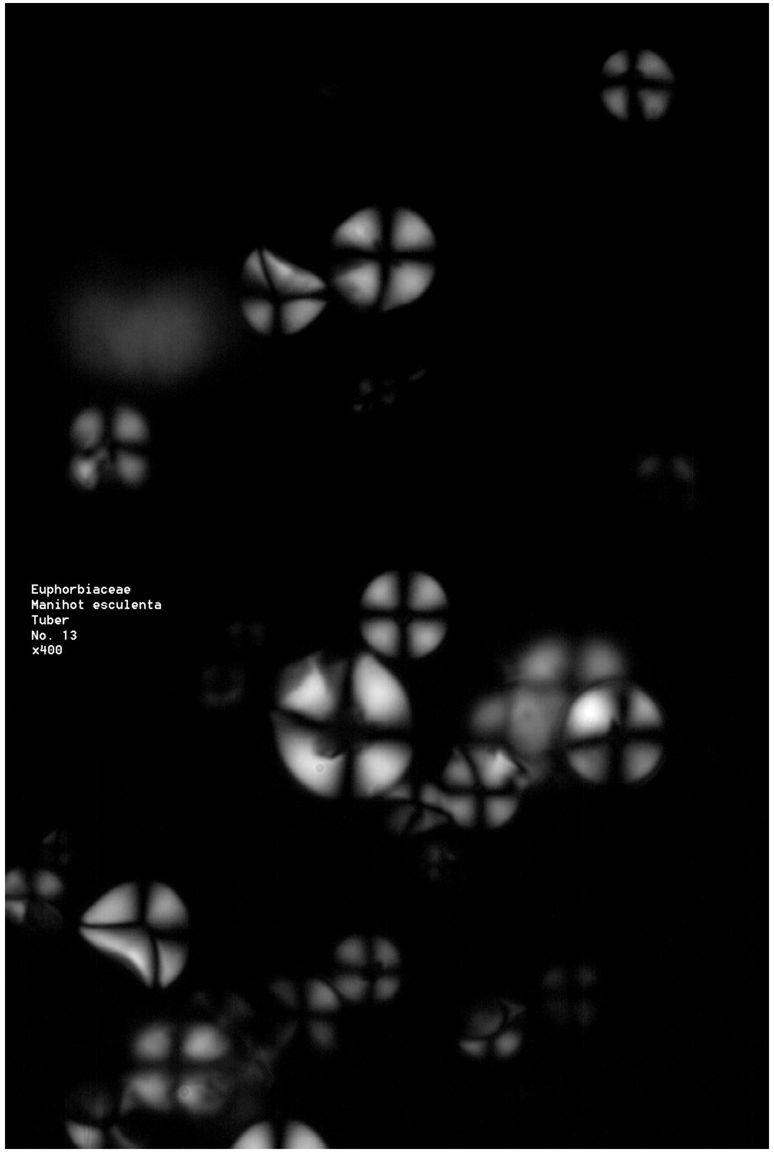
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Manihot esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection

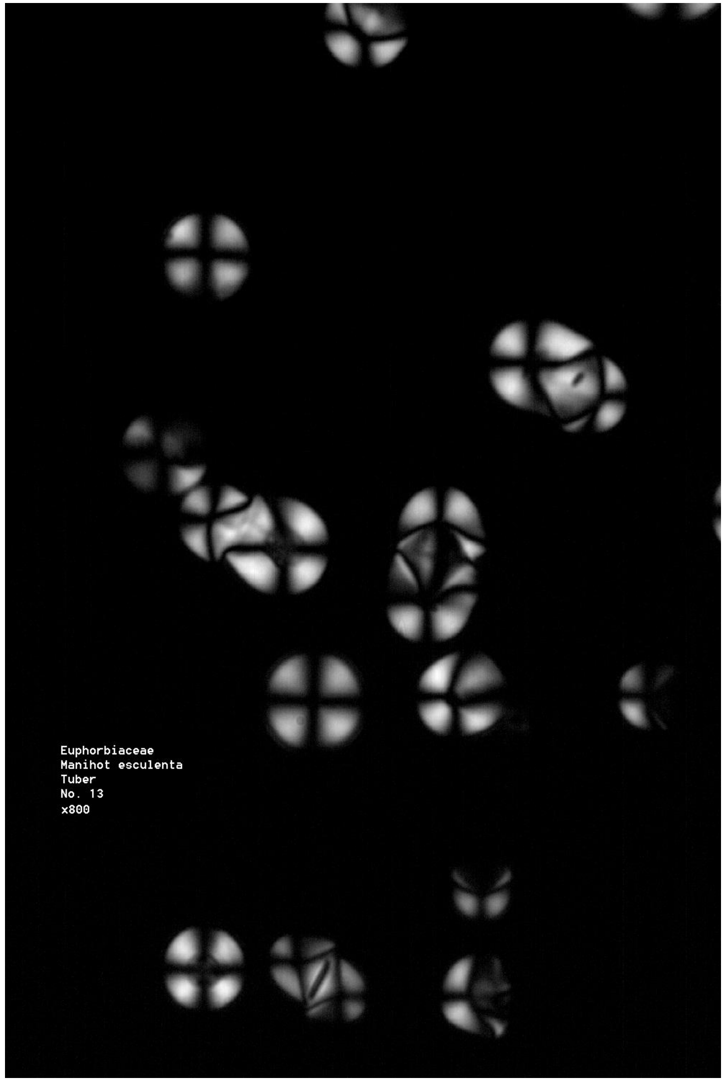


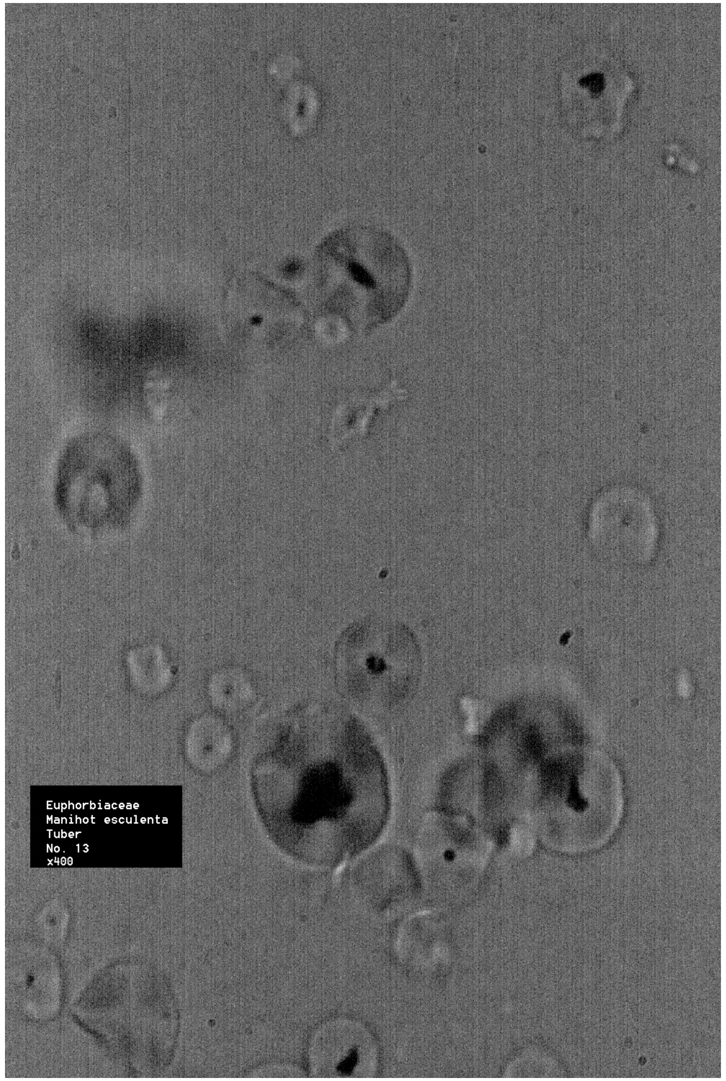




Manihot esculenta

Australian Museum,
McCown Archaeobotany
Laboratory Collection





Manihot esculenta

Starch

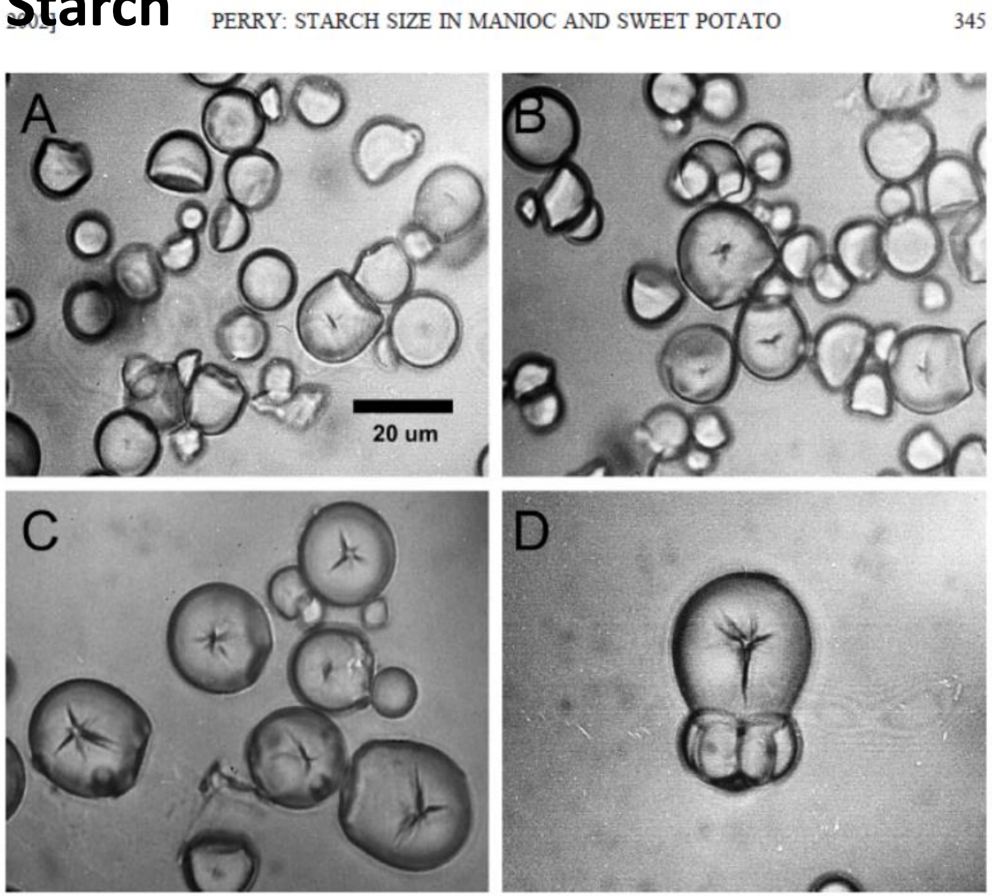
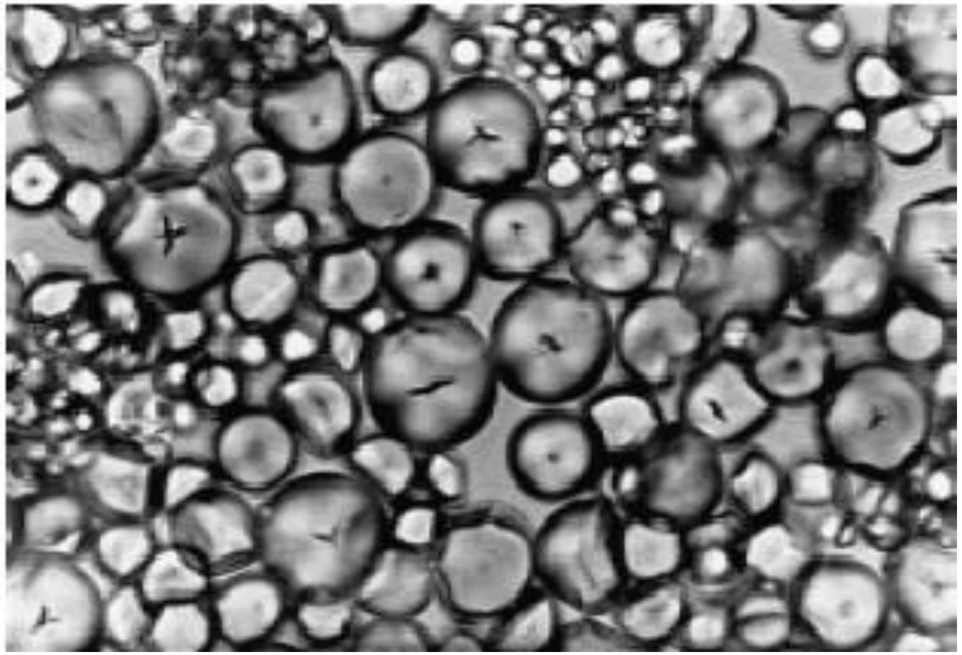


Fig. 1. Light micrographs of coastal Peruvian (**A, B**) and lowland (**C, D**) types of manioc starch granules
showing distinctive and diagnostic features of each. All photographs are at the same magnification.
A. Starch granules of manioc roots from Chimu Sur. Note the typical hemispherical forms with linear central
fissuring.
B. Coastal Peruvian starch granules from modern manioc roots with typical Peruvian form. Note the smaller
overall size and less ''inflated'' quality of hemispherical granules compared to lowland types.
C. Modern manioc starch granules from roots from the Upper Rio Negro region of Venezuela. Note the large,
central stellate fissure and hollow hilum.
D. Compound starch grain of lowland manioc showing how basal faceting occurs during development as small
granules form with the larger granule. Note the inflated quality of the large, diagnostic granule.

Perry, Linda. 2002. Starch Granule Size and the Domestication of Manioc (Manihot Esculenta)
and Sweet Potato (Ipomoea Batatas). *Economic Botany* 56 (4):335–49.

Manihot esculenta

Starch



Starch grains from a modern manioc tuber. 80x.

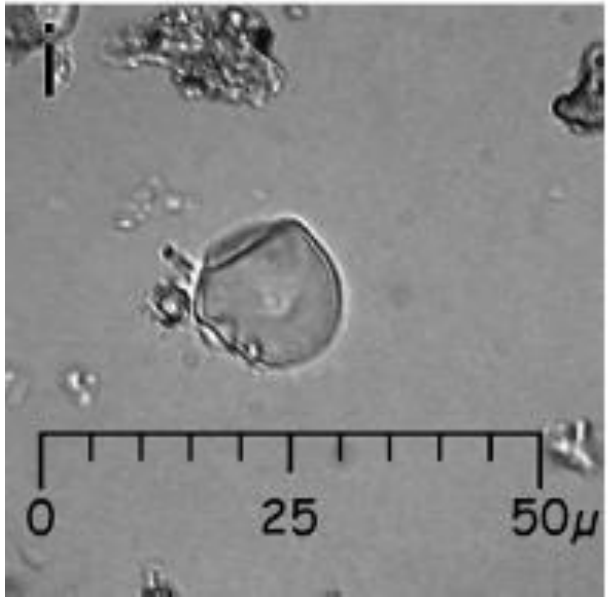
APPENDIX:
Manihot esculenta (manioc, yuca). Mostly compound grains, with very characteristic bell shapes and smooth surfaces. They are not demonstrably laminated. They often possess a diagnostic central fissure that is deep and stellate.
Size: 5–20 microns long

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Manihot esculenta

Starch

Fig. 5. Selected phytoliths and starch granules recovered from tools. See MU Phytolith website (http://www. missouri.edu/~phyto) for other photographs. i. Manihot esculenta starch granule, SS42 FS3294-B.



Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

Manihot esculenta

Starch

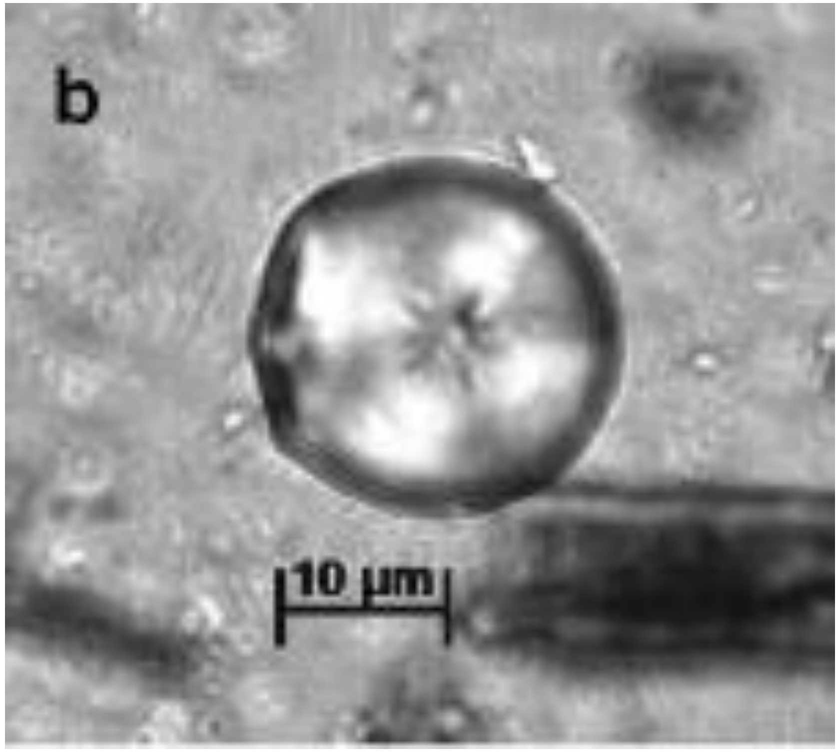


Fig. 5. Selected microbotanical remains. Starch grains: b) Manihot esculenta (SAL 04-4-3597)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Manihot esculenta

Starch

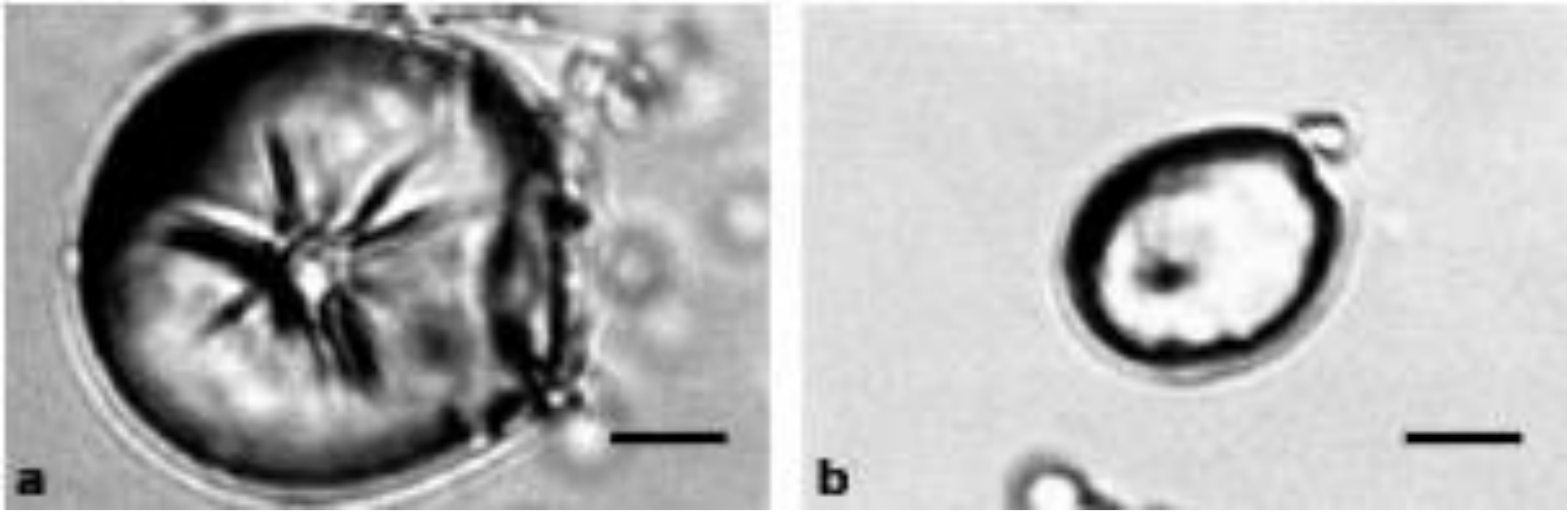


Figure 1. Various starch grains. a, A starch grain from manioc recovered from milling stone 42. b, A starch grain from the putative wild ancestor of manioc, Manihot esculenta spp. flabellifolia. Scale bar 5 µm

Piperno, Dolores R., Anthony J. Ranere, Irene Holst, and Patricia Hansell. 2000. Starch Grains Reveal Early Root Crop Horticulture in the Panamanian Tropical Forest. *Nature* 407:894–97.

Manihot esculenta

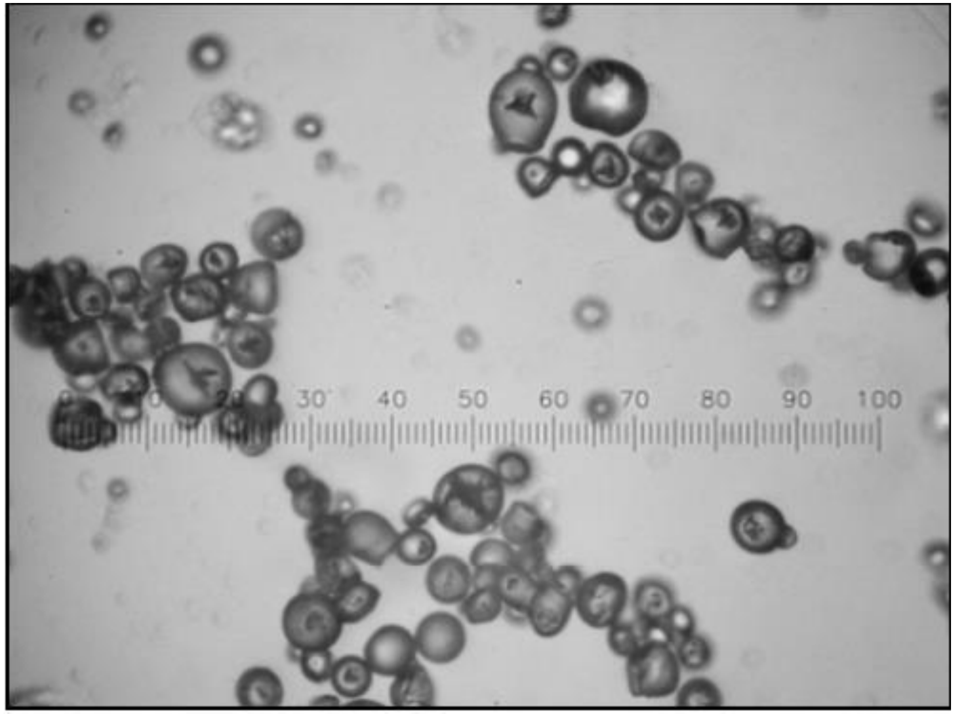
Starch

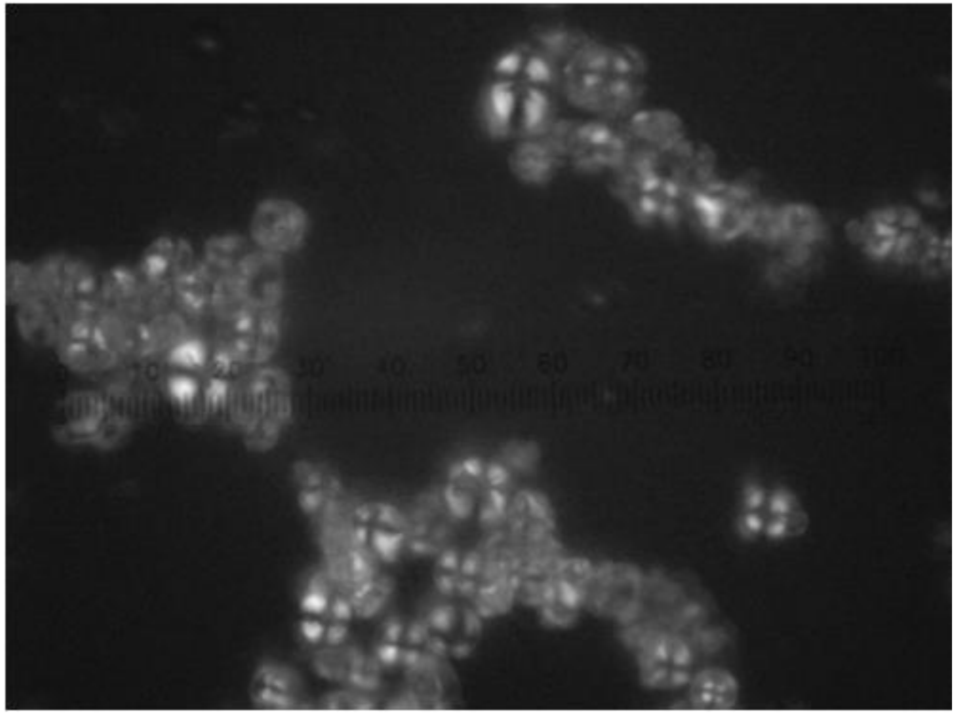
Fig. 2. Selected archaeological starch grains. (B) Manioc (Manihot esculenta) starch from Casita de Piedra, grinding-stone base 69/18, ?3600 cal BP. (Scale bar: 10 µm) Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8.

Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Manihot esculenta

Starch

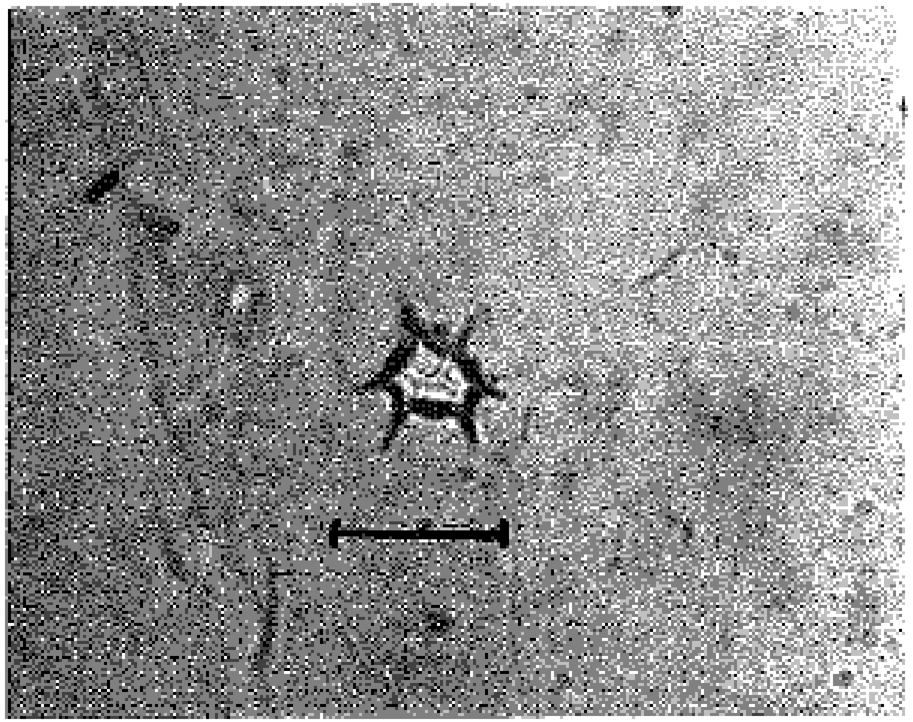




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Manihot esculenta

Phytolith

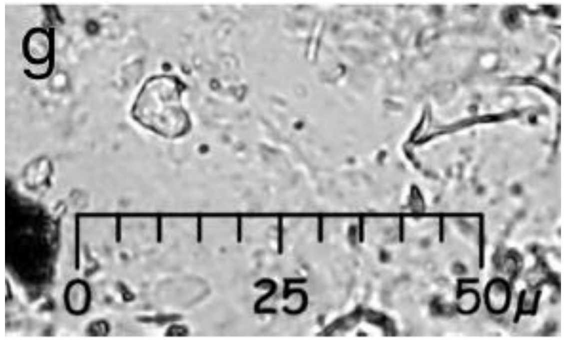
c 

c. Hair cell base from manioc, Manihot esculenta

Pearsall, Deborah Marie. 1993. Contributions of Phytolith Analysis for Reconstructing Subsistence: Examples from Research in Ecuador. *Current Research in Phytolith Analysis: Applications in Archaeology and Paleoecology*. MASCA.

Manihot sp.

Phytolith



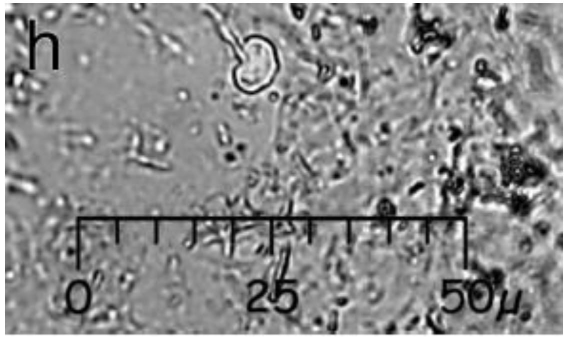


Fig. 1. Selected new diagnostic phytoliths. See MU Phytolith website (http://www.missouri.edu/~phyto) for photographs of all types. g, h. 160I Manihot (Euphorbiacae) secretory cell

Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

Manihot sp.

Phytolith

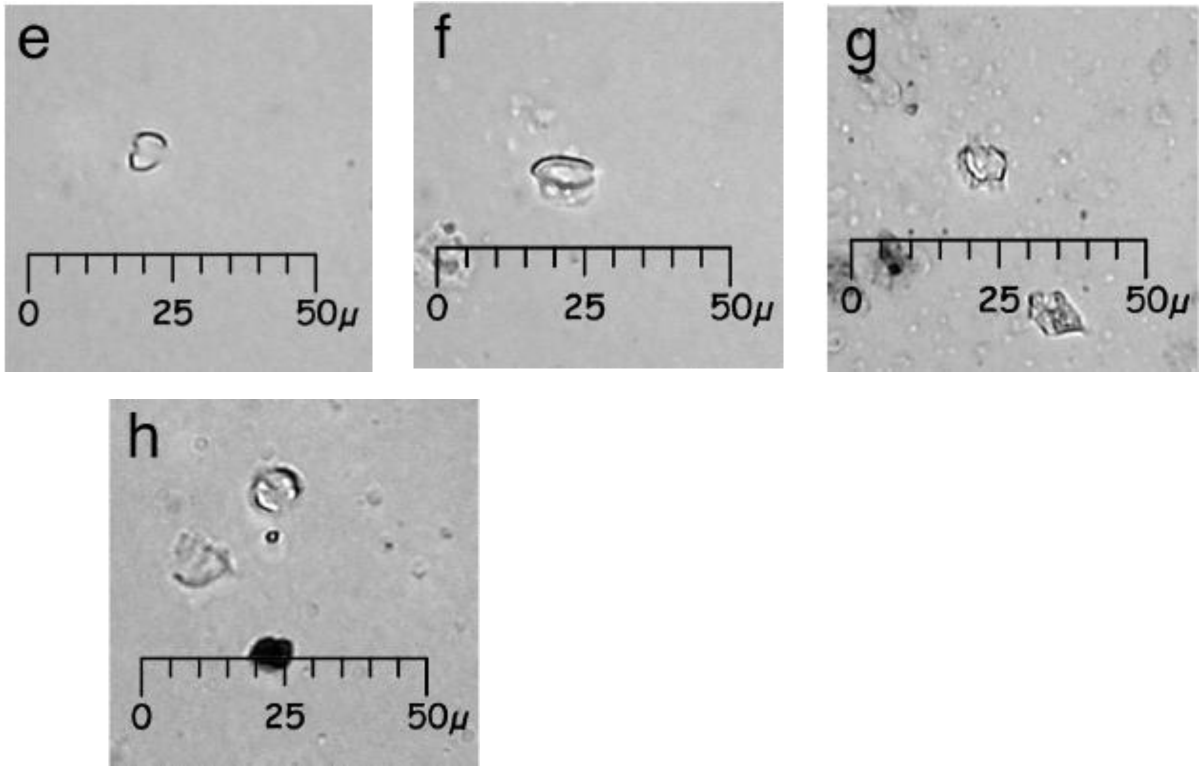


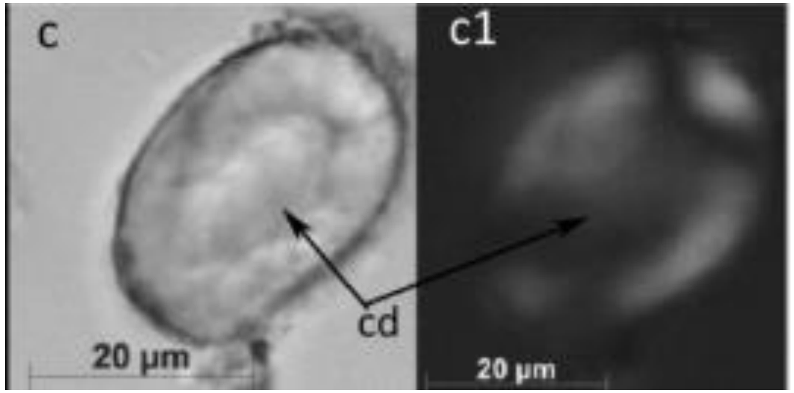
Fig. 5. Selected phytoliths and starch granules recovered from tools. See MU Phytolith website (http://www. missouri.edu/~phyto) for other photographs e. 160I Manihot secretory cell, PS1804FS 3294-B. f. 160I Manihot secretory cell, PS1804FS 3294-B. g. 160I Manihot secretory cell, PS3, Structure 20 floor sediment. h. 160I Manihot secretory cell, PS1804 FS3294-B.

Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

FABACEAE

Fabaceae

Starch



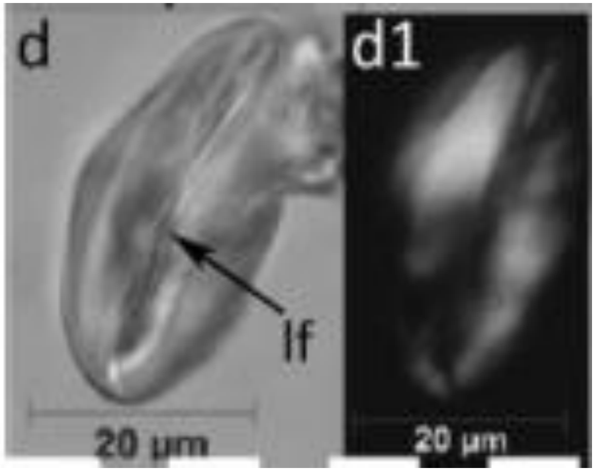


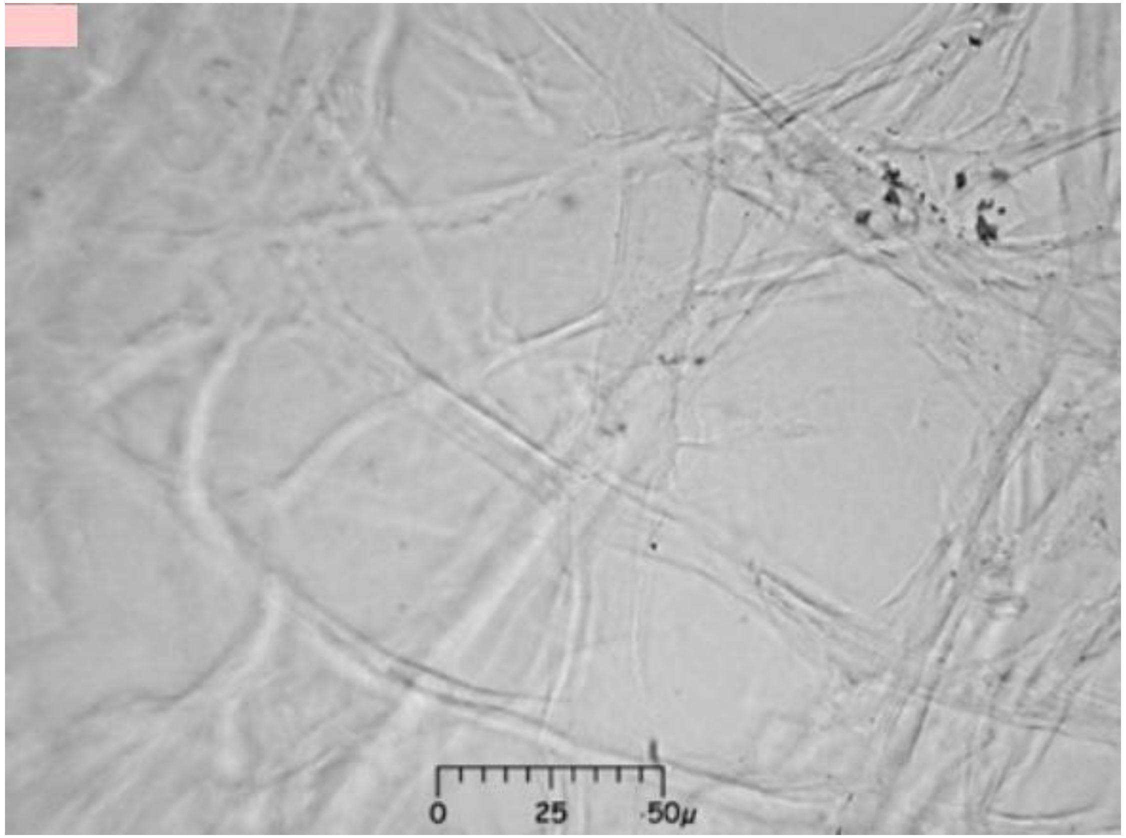
Fig. 9. Other ancient starch grains (a-g) recovered at St. John and Eva 2. c, Fabaceae starch with central depression ("cd"), c1, the same starch reflecting damaging signs at the center as noted by the extinction cross; d, Fabaceae starch in lateral (eccentric) view with a longitudinal fissure ("lf"); d1, the same starch projecting the extinction cross.

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Acacia macrocantha

Phytolith

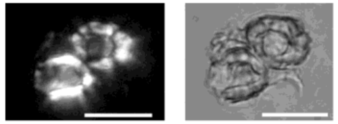
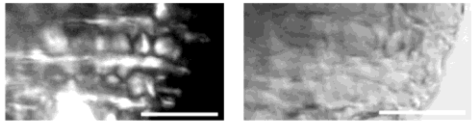
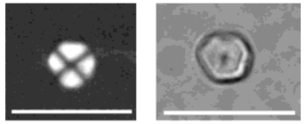
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: family, seeds/pods



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Acacia visco

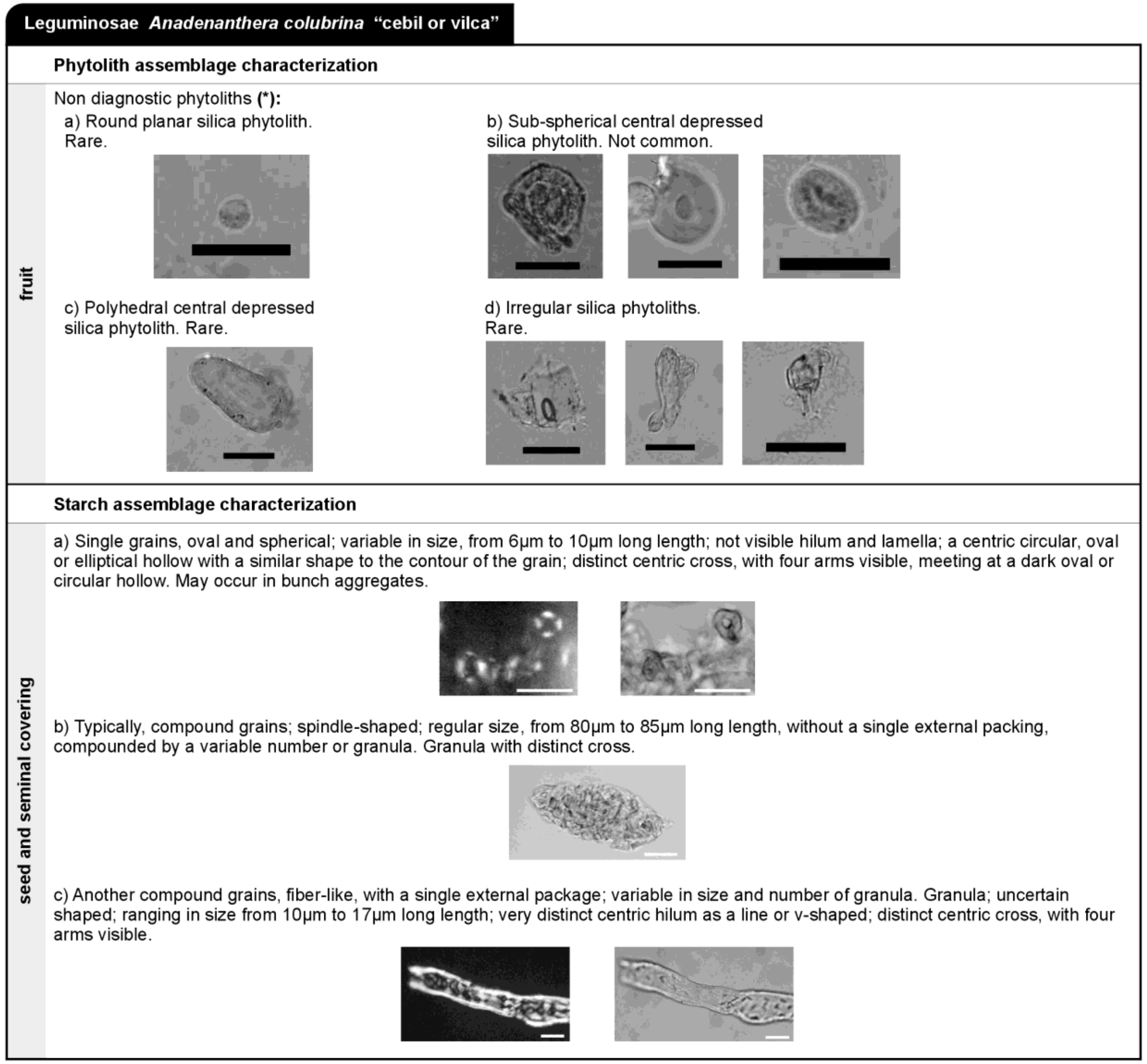
Leguminosae *Acacia visco* "visco"

	Phytolith assemblage characterization
pod	**References:** Reported as rare in Piperno 1988:37 for *Acacia farnesiana* epidermis.
seed and seminal coverig	No diagnostic phytoliths **(*).** **References:** Reported as rare in Piperno 1988:37 for *Acacia farnesiana* epidermis.
	Starch assemblage characterization
pod	a) Single grains, oval to spherical; variable in size, from 18µm to 25µm long length; not visible hilum and lamella; a centric hollow with a similar shape to the contour of the grain; distinct centric cross, with four arms visible, meeting at a dark oval or circular hollow.  b) Compound grains, with a single external package elongated, variable in shape, size, and number of granula. Granula; uncertain shaped; *ca.* 10µm; not-visible hilum and lamella; distinct centric cross, with four arms visible, intersecting at a line or a dark center. 
seed and seminal coverig	a) Single grains, polyhedral, six-sided; *ca.* 8µm long length; distinct centric hilum as a dot; not visible lamella; distinct centric cross, with four arms visible. 

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Anadenanthera colubrina



Leguminosae *Anadenanthera colubrina* "cebil or vilca"

Phytolith assemblage characterization

fruit

Non diagnostic phytoliths **(*)**:

a) Round planar silica phytolith. Rare.

b) Sub-spherical central depressed silica phytolith. Not common.

c) Polyhedral central depressed silica phytolith. Rare.

d) Irregular silica phytoliths. Rare.

Starch assemblage characterization

seed and seminal covering

a) Single grains, oval and spherical; variable in size, from 6µm to 10µm long length; not visible hilum and lamella; a centric circular, oval or elliptical hollow with a similar shape to the contour of the grain; distinct centric cross, with four arms visible, meeting at a dark oval or circular hollow. May occur in bunch aggregates.

b) Typically, compound grains; spindle-shaped; regular size, from 80µm to 85µm long length, without a single external packing, compounded by a variable number or granula. Granula with distinct cross.

c) Another compound grains, fiber-like, with a single external package; variable in size and number of granula. Granula; uncertain shaped; ranging in size from 10µm to 17µm long length; very distinct centric hilum as a line or v-shaped; distinct centric cross, with four arms visible.

Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Anadenanthera peregrina

Starch

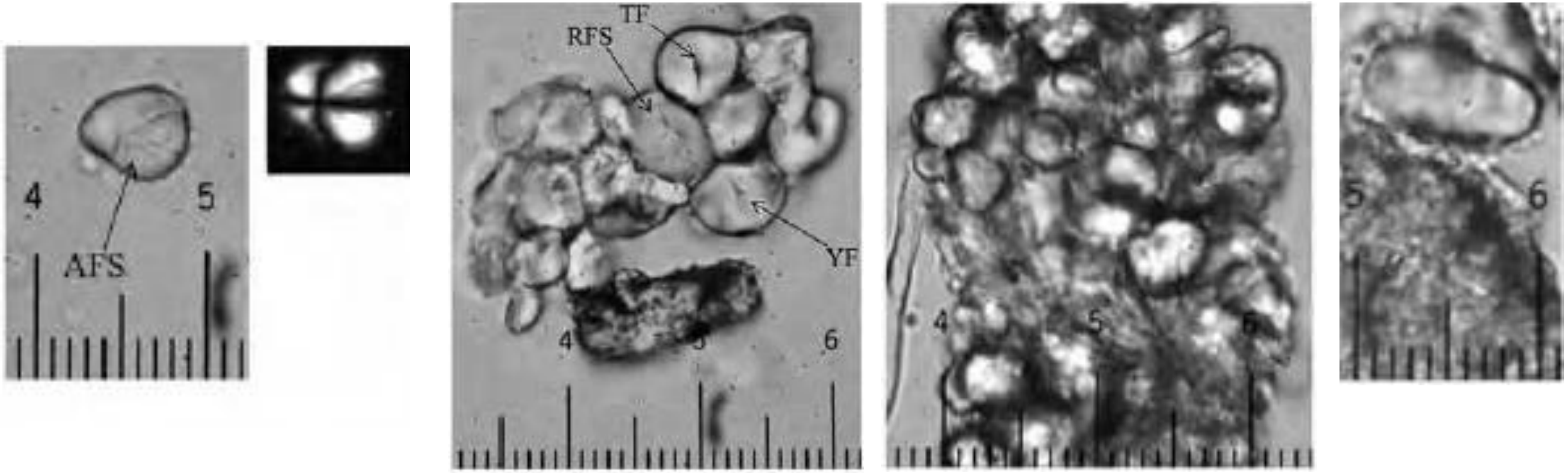


Figure 6. Modern starch grains from Anadenanthera peregrina. Starch grain from mature seeds and starch grain cluster showing shapes, dimensions, and types of fissures that are common in A. peregrina. AFS = asymmetrical fissures and stri- ations; RFS = radial fissure and striations; TF = transversal fissure; YF = “Y” shaped fissure. Note: oval starch grain at the extreme right; transovate-obtuse starch grain at the extreme left. Scale for all microphotographs: space between major units (numbers) = 37.5 µm.

Pagán-Jiménez, Jaime R., and Lisabeth A. Carlson. 2014. Recent Archaeobotanical Findings of the Hallucinogenic Snuff Cojoba (Anadenanthera Peregrina (L.) Speg.) in Precolonial Puerto Rico. *Latin American Antiquity* 25 (1):101–16.

Anadenanthera peregrina

Starch

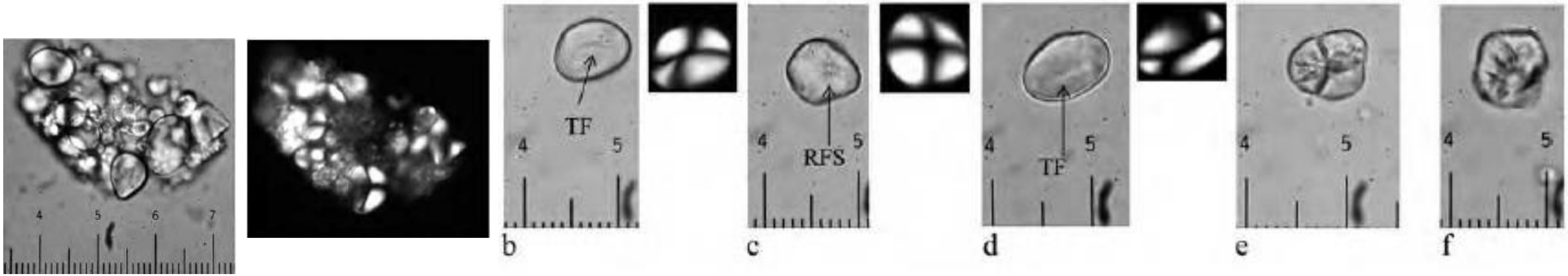


Figure 7. Starch grains recovered from the coral milling base from CE-11: (a) starch grain cluster from cojoba or A. pere- grina (to the right is the same cluster cross-polarized in dark field); (b) oval starch grain with a transversal fissure (the same cross-polarized); (c) transovate-obtuse starch grain with thin striations and radial fissure that are typical of A. pere- grina (the same cross-polarized); (d) oval starch grain (the same cross-polarized); (e) and (f) broken starch grains, prob- ably broken by the grinding process. TF = transversal fissure; RFS = radial fissure and striations. Scale for all microphotographs: space between major units (numbers) = 37.5 µm

Pagán-Jiménez, Jaime R., and Lisabeth A. Carlson. 2014. Recent Archaeobotanical Findings of the Hallucinogenic Snuff Cojoba (Anadenanthera Peregrina (L.) Speg.) in Precolonial Puerto Rico. *Latin American Antiquity* 25 (1):101–16.

Anadenanthera peregrina

Starch

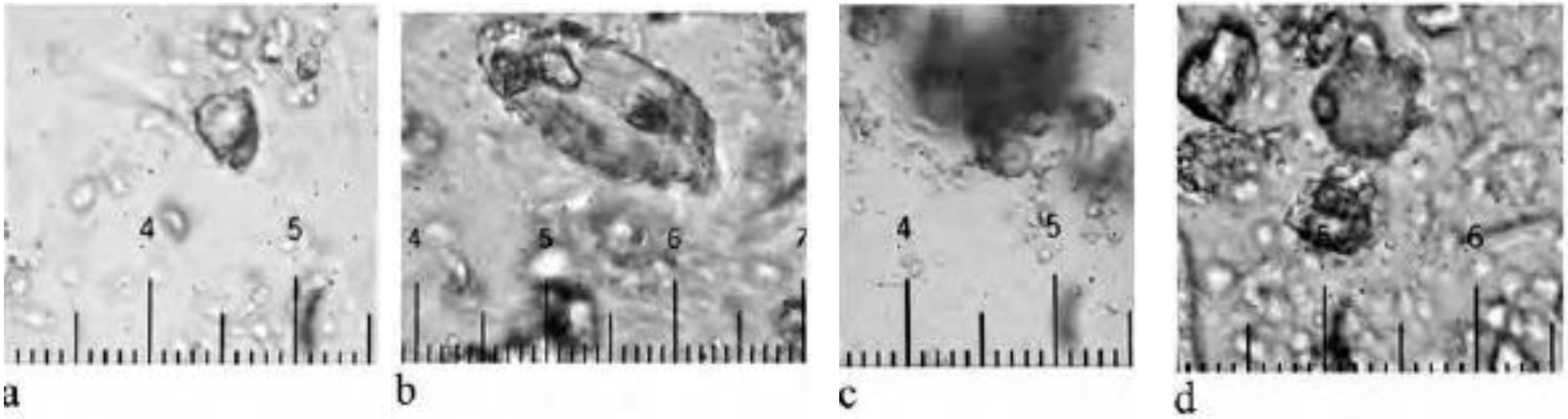


Figure 8. Modified and/or damaged starch grains from modern Anadenanthera peregrina (cojoba) seeds after parching (toasting). All the starches lost their extinction crosses, some of them (b) quadrupled their size due to the gelatinization process, and others (c) revealed a small circumscribed central depression ("scoop"). Scale for all microphotographs: space between major units (numbers) = 37.5 µm.

Pagán-Jiménez, Jaime R., and Lisabeth A. Carlson. 2014. Recent Archaeobotanical Findings of the Hallucinogenic Snuff Cojoba (Anadenanthera Peregrina (L.) Speg.) in Precolonial Puerto Rico. *Latin American Antiquity* 25 (1):101–16.

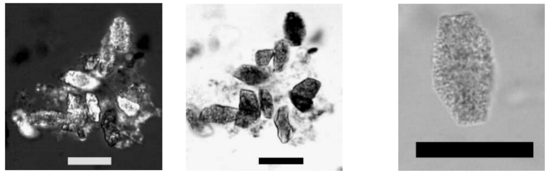
Arachis hypogaea

Leguminosae *Arachis hypogaea* "maní"

Phytolith assemblage characterization

fruit

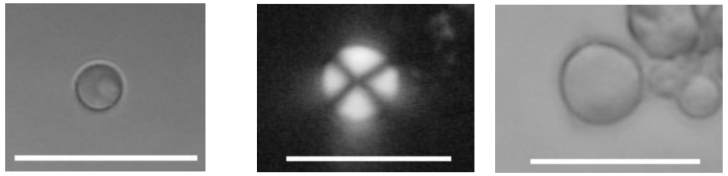
Pod and seed.
Non diagnostic phytoliths **(*):**
a) Polyhedral calcium oxalate phytolith.
Common.



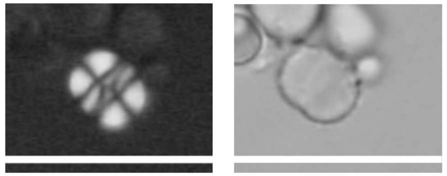
Starch assemblage characterization

seed

a) Single grains, spherical and subspherical; variable in size, from 4µm to10µm long length; distinct centric hilum as clear spot with a round cavity; distinct fine lamella; generally an elongated central cleft with short radiating fissures extends the length of the grain; distinct centric cross, with four arms visible, intersecting at a dark oval or line.



b) Some compound grains, without a single external package, compounded by two granula. Granula similar in size and shape; bowl-shaped with wavy truncation; *ca.* 7µm long length; distinct eccentric cross, to the truncate end, with four arms visible.



References: Partially based on Cortella and Pochettino 1994, Piperno and Holst 1998, Reichert 1913.

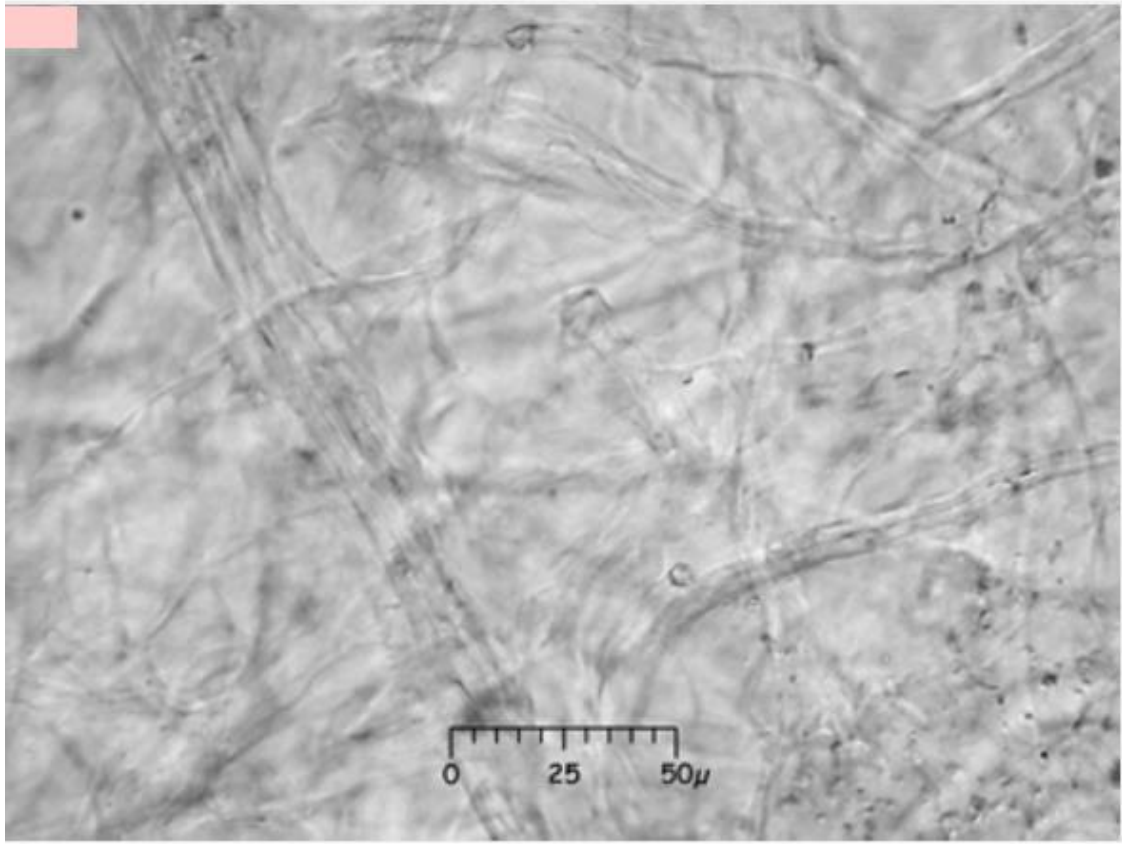
Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Arachis hypogaea

Phytolith

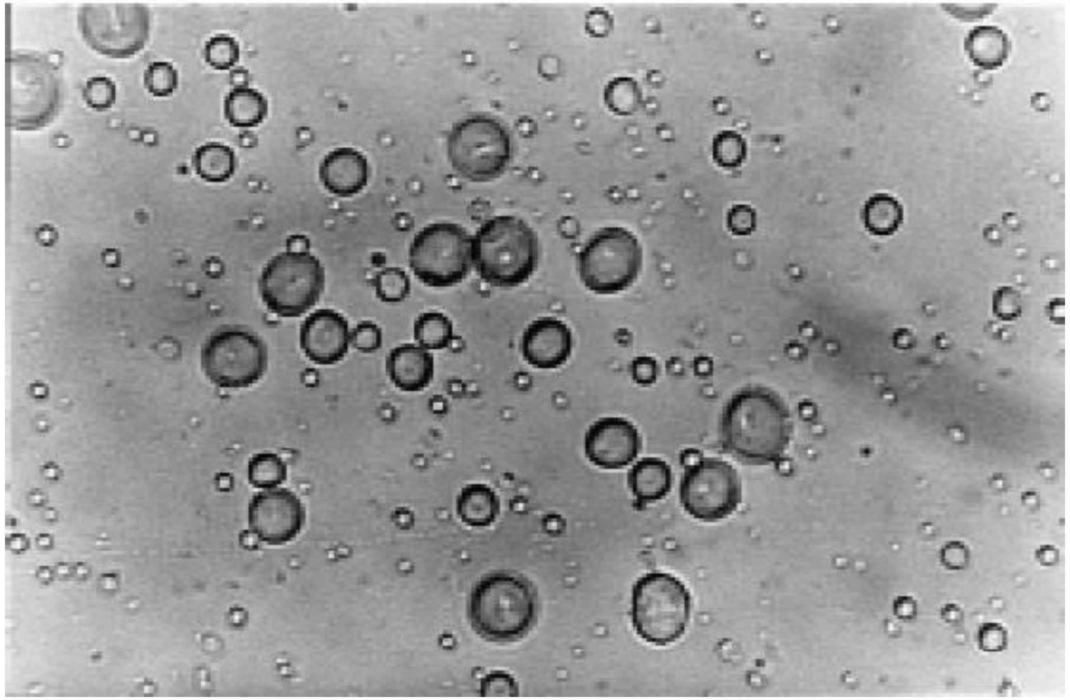
Type established by Karol Chandler- Ezell, 2004
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Arachis hypogaea

Starch



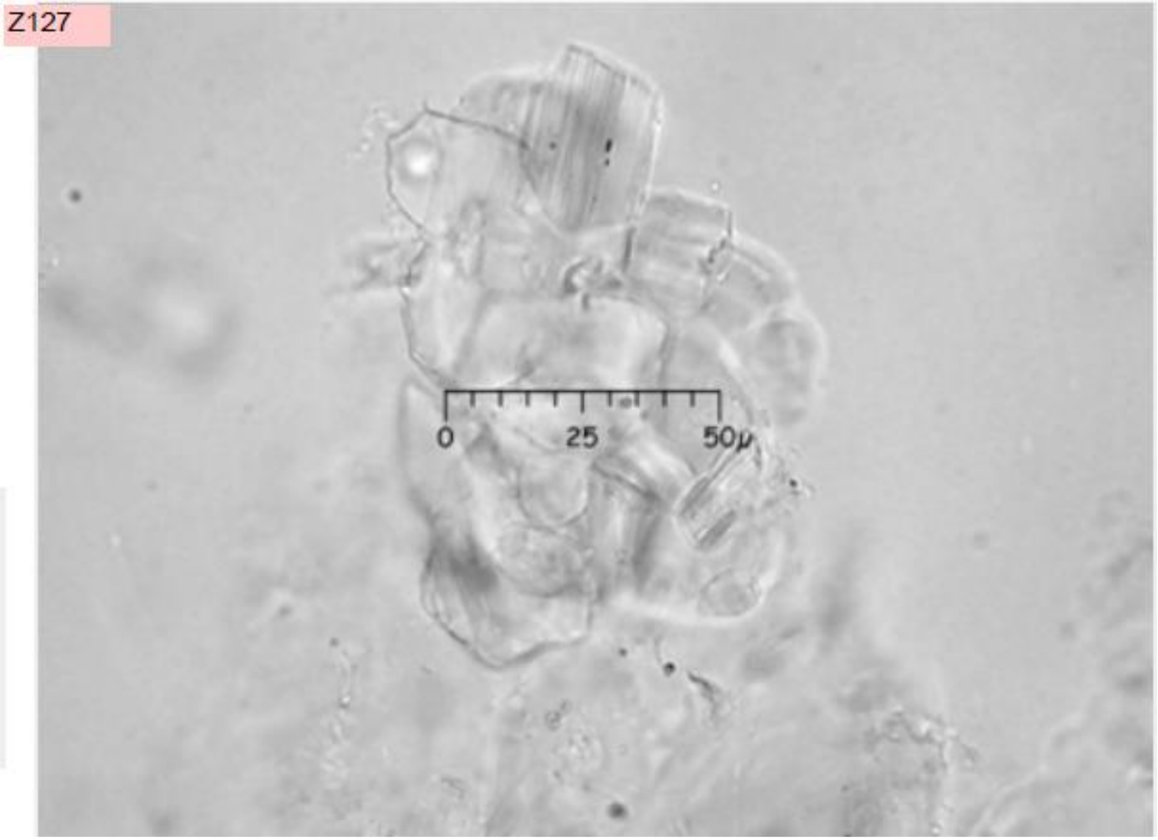
Starch grains from modern peanuts. 160x

APPENDIX:
Arachis hypogaea (peanut) (Figure 7). Simple grains with fine laminations. The hilum appears as a clear spot with a round cavity. An elongated central cleft with short radiating fissures extends the length of the grain. Size: 4–10 microns long

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Brownea grandiceps

Phytolith



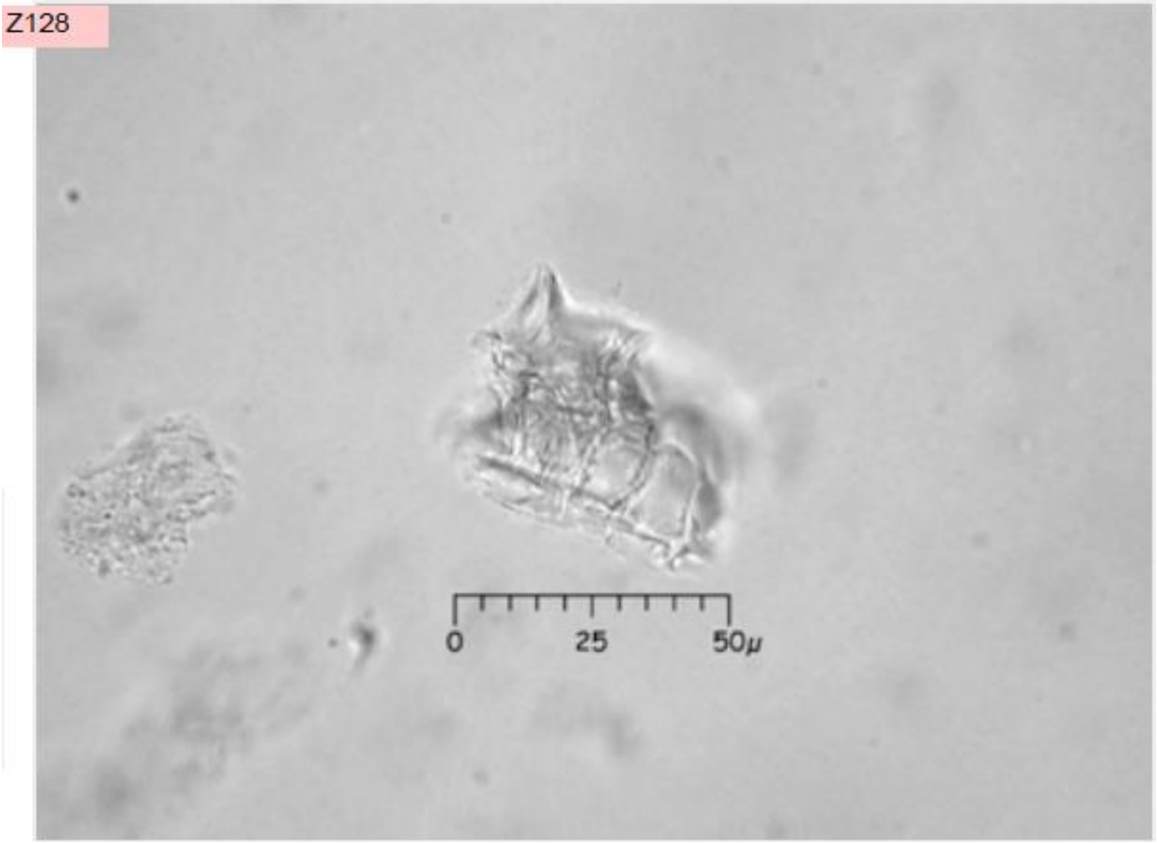
probably calcium carbonate ($CaCO_3$) crystals.
Appear in many of the genera of the Fabaceae, but also present in Musaceae, Flacourtiaceae and Bombacaceae.
Diagnostic level: not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Brownea ucayalina

Phytolith

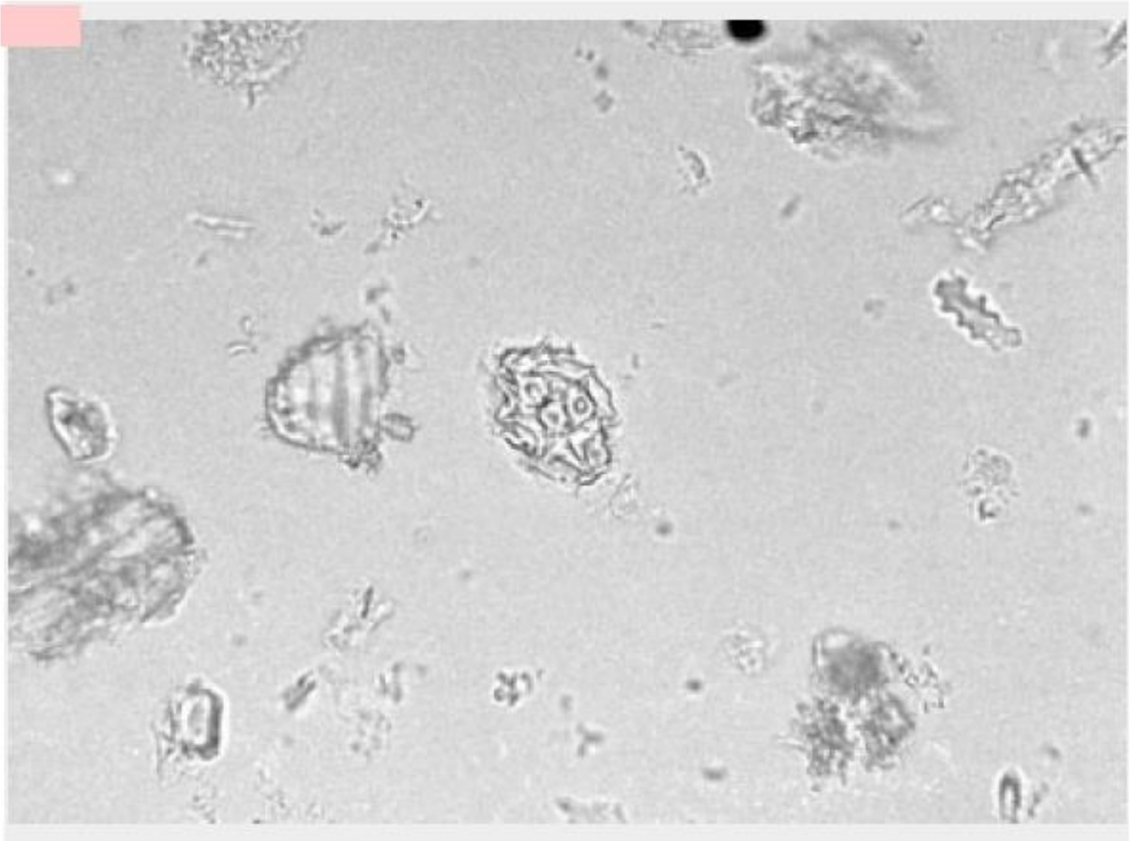
From the top, this hair base may be confused with a diagnostic produced by Dalium guianense (also of the Fabaceae family). Rotate to see the thickness of the hair base. Slide 1772a leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Brownea ucayalina

Phytolith



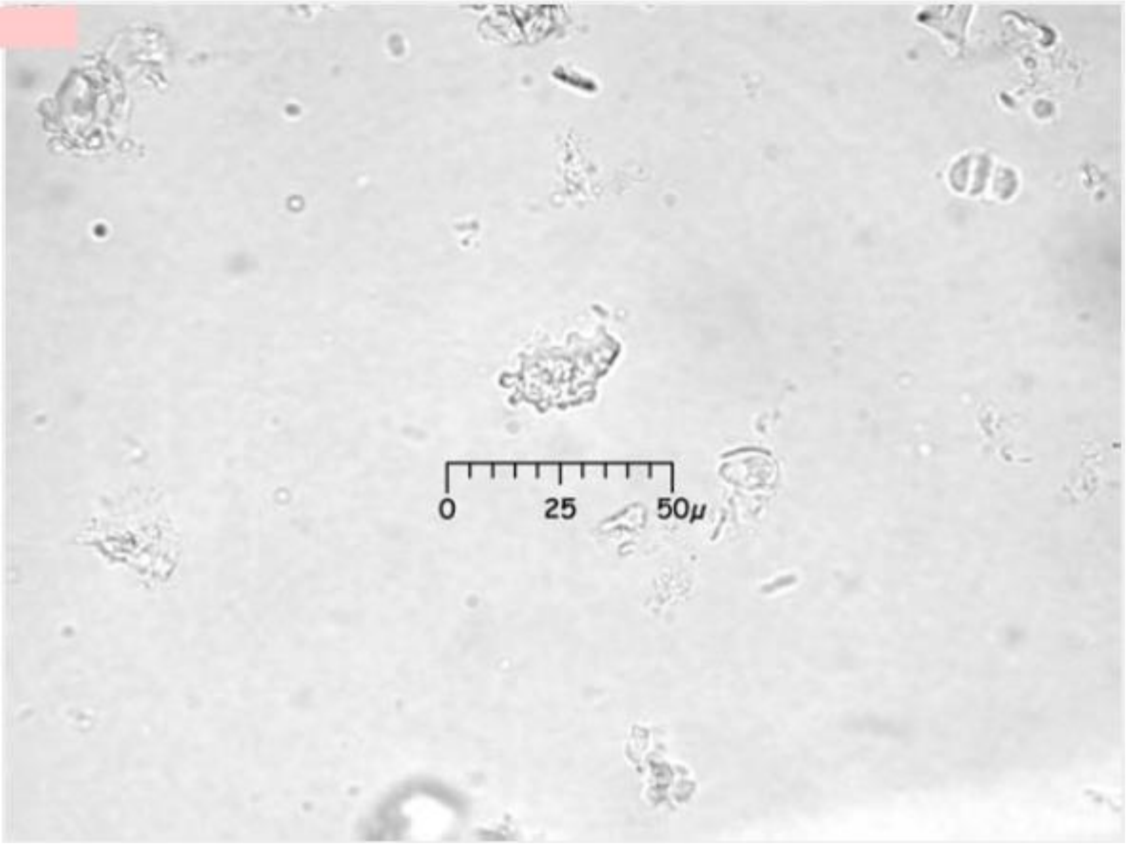
Slide 1772a leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Brownea ucayalina

Phytolith

Slide 1772a leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Canavalia spp.

Starch

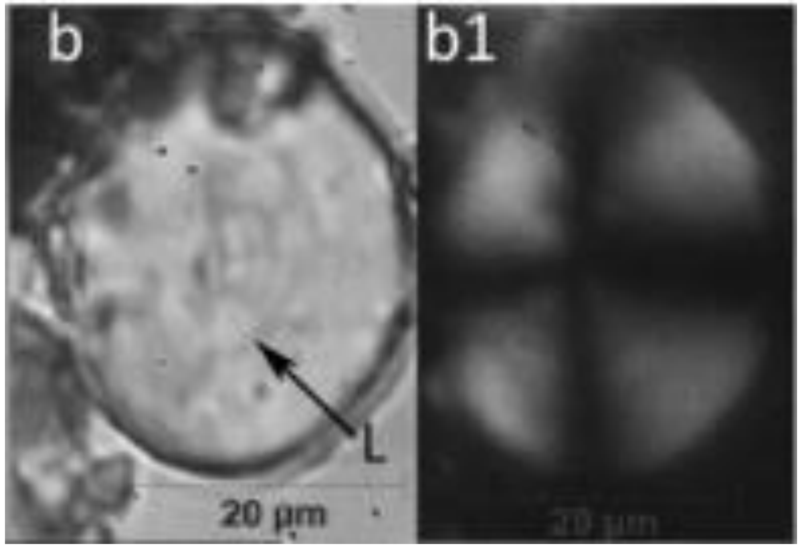
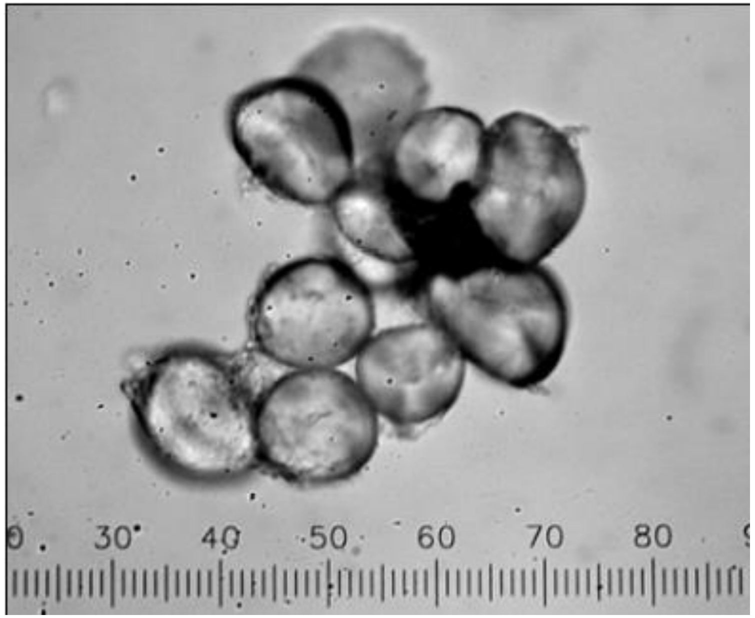


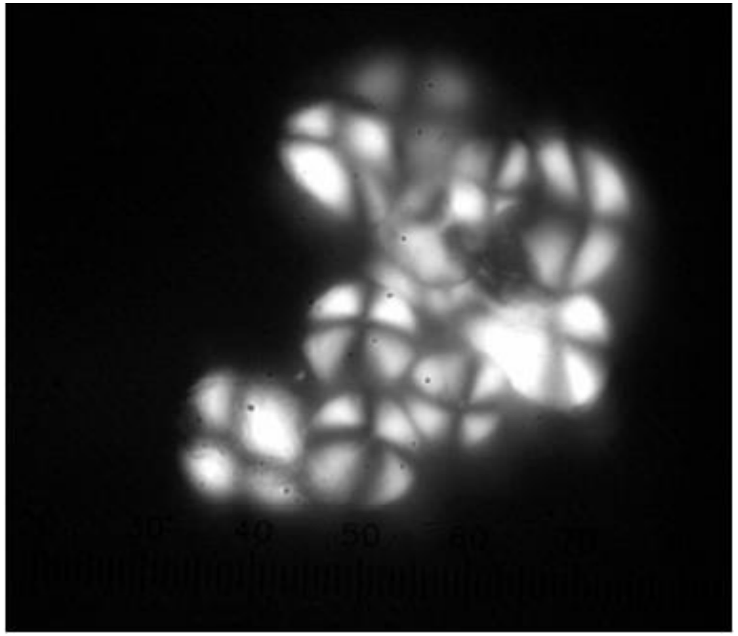
Fig. 9. Other ancient starch grains (a-g) recovered at St. John and Eva 2. b, Canavalia spp. oval starch showing partial lamellae (“L”); b1, the same starch with extinction cross

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Canavalia rosea

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Cicer arietinum

Starch

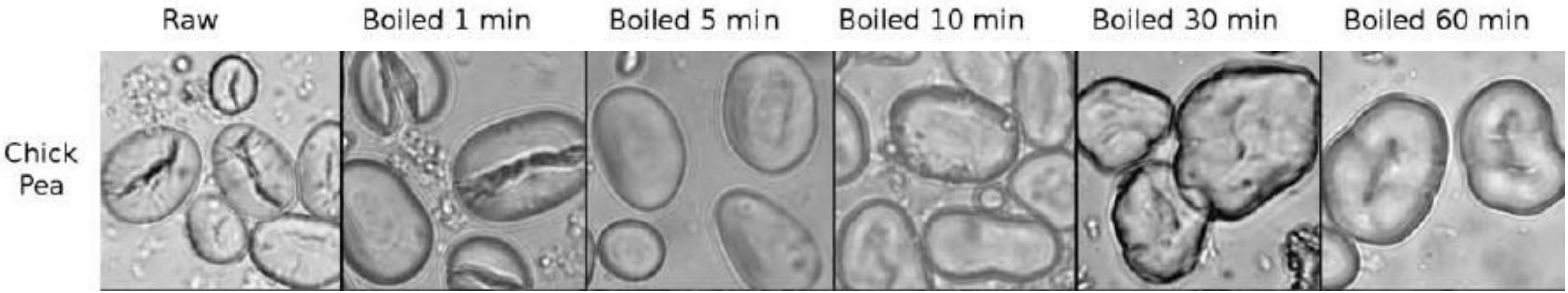


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Cicer arietinum

Starch

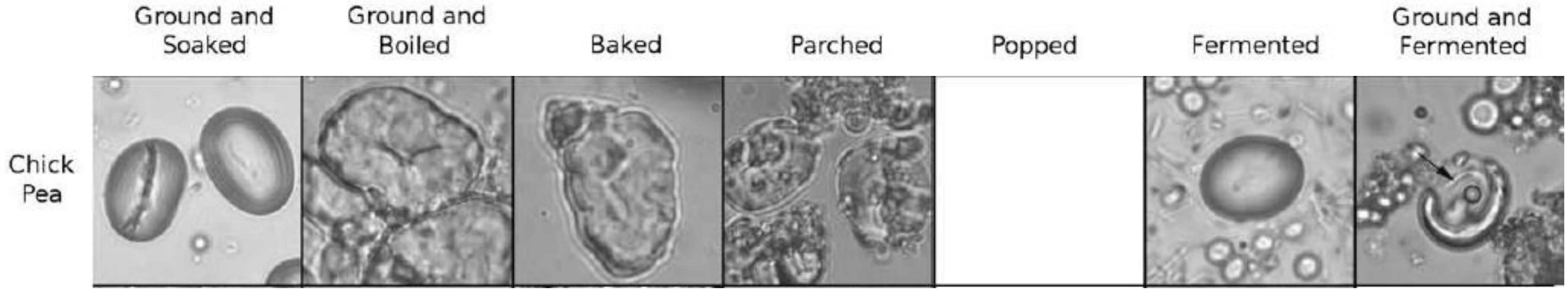


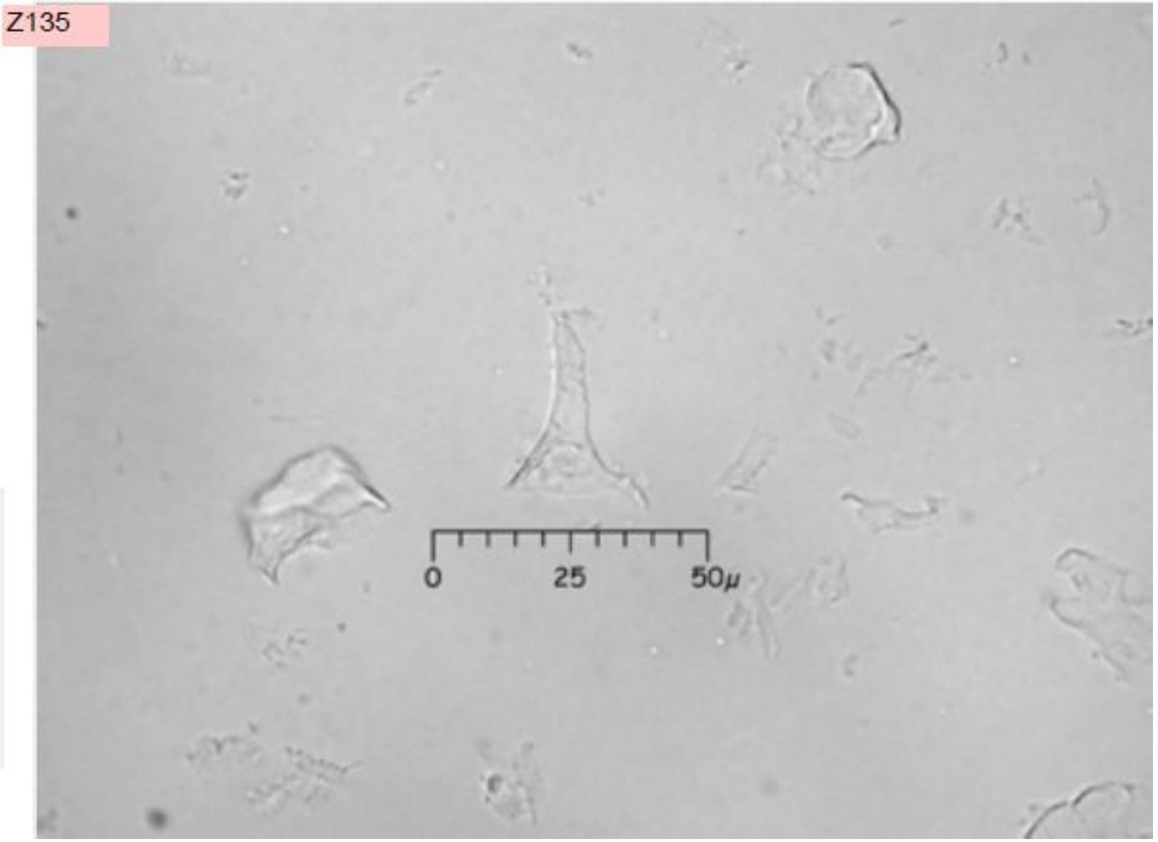
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Dalium guianense

Phytolith

Slide 1766e leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus

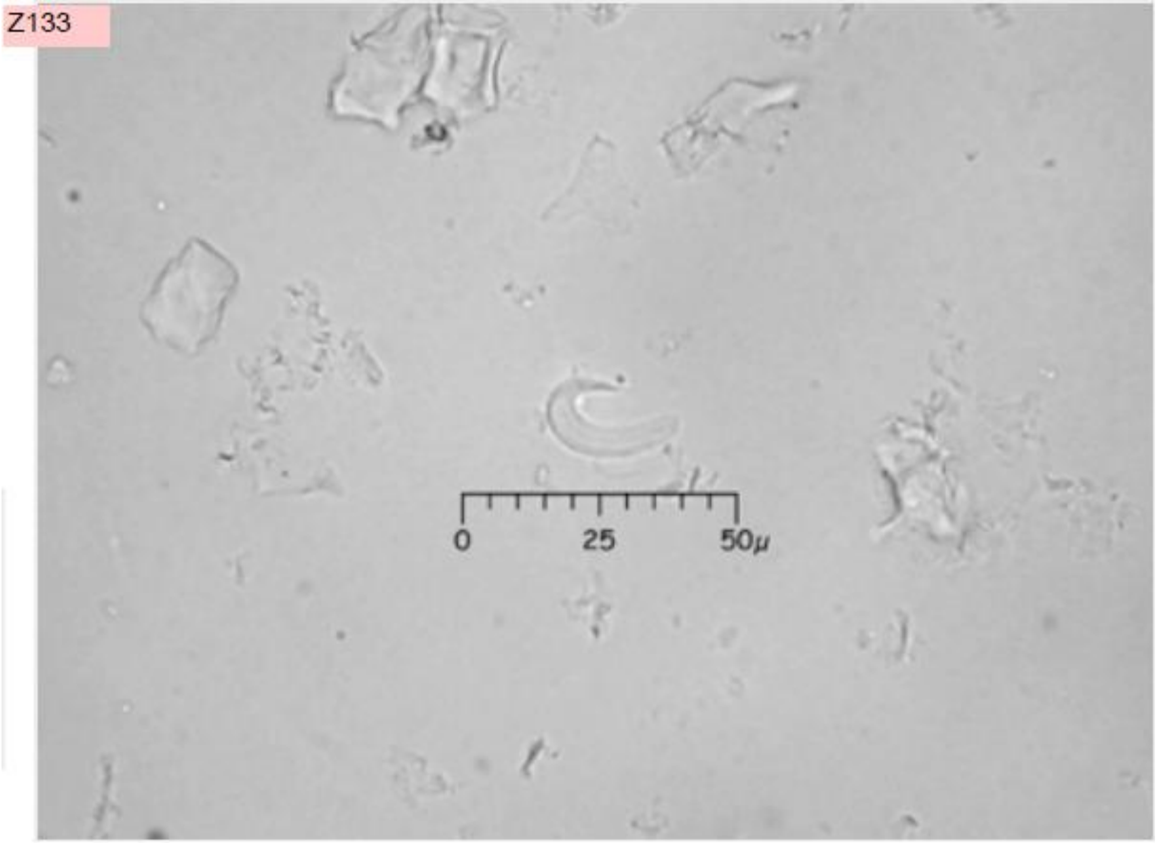


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dalium guianense

Phytolith

Slide 1766e leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus

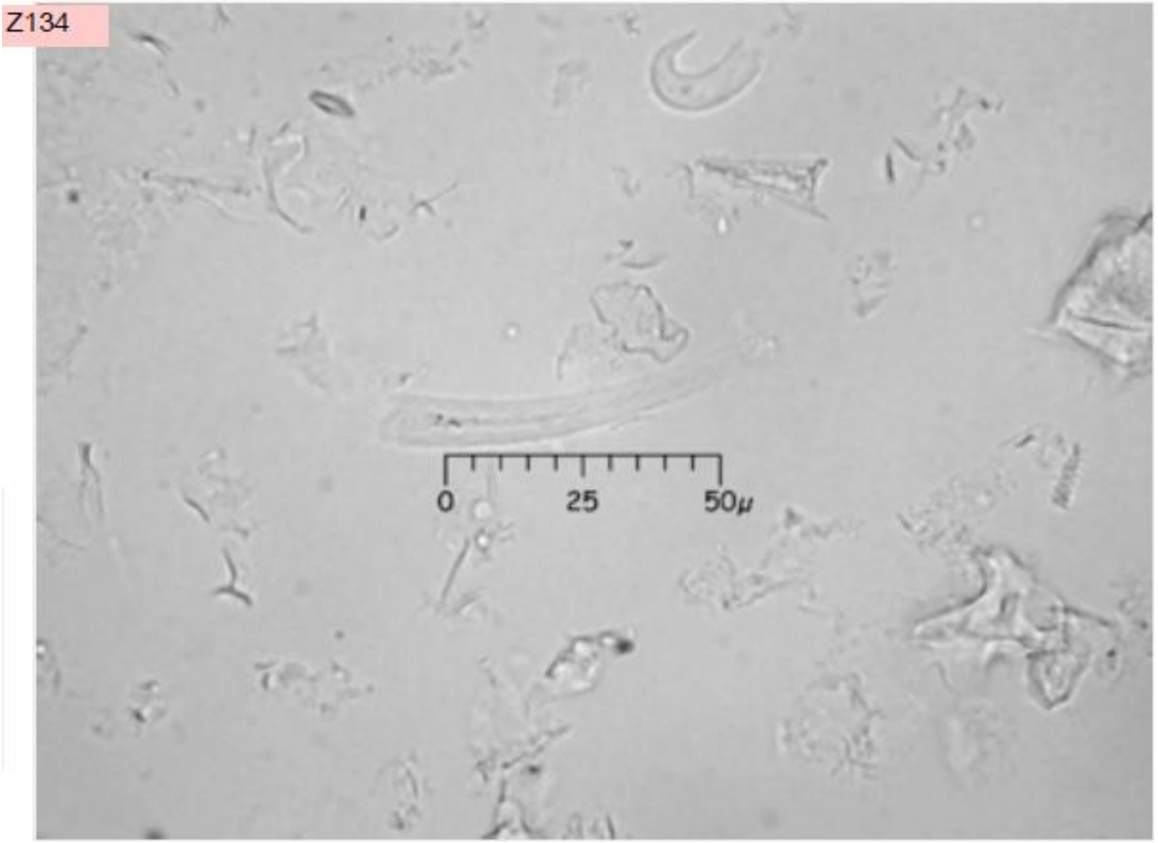


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dalium guianense

Phytolith

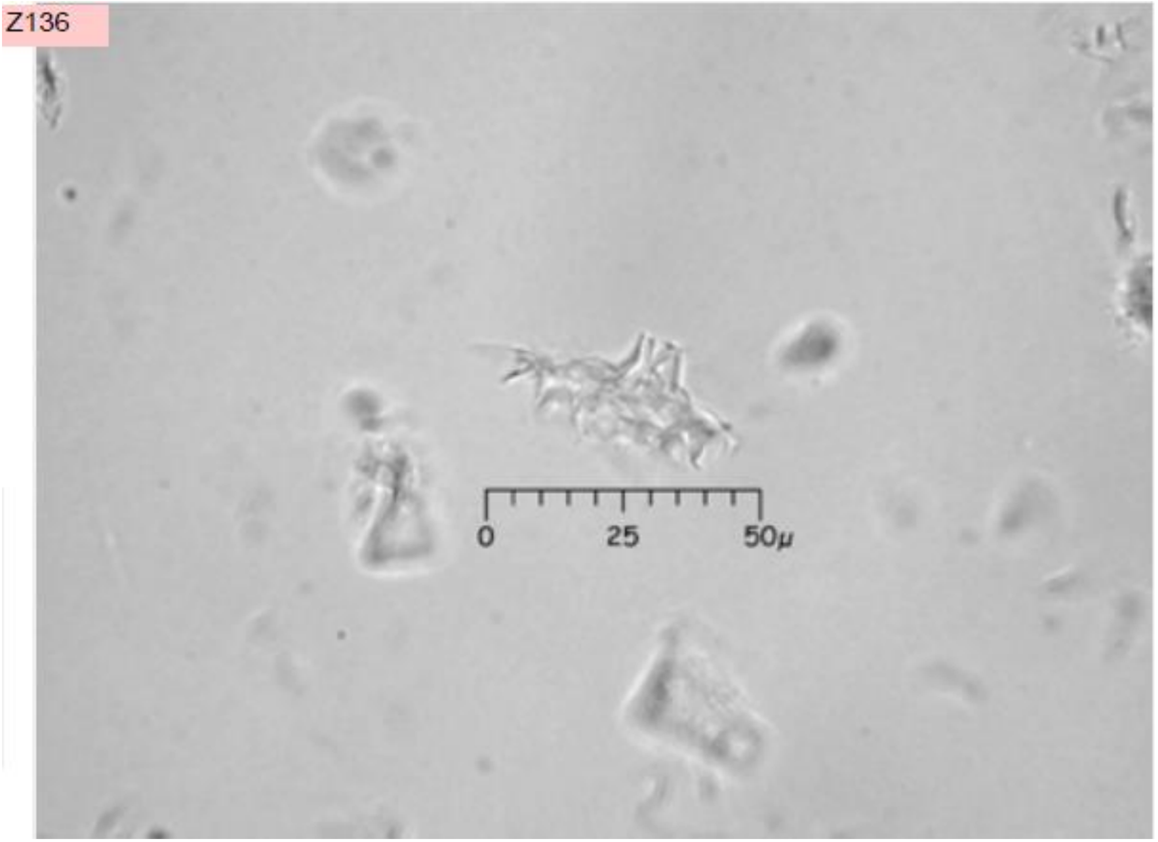
Slide 1766e leaf. Type defined by Shawn Collins 01/1999. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Dalium guianense

Phytolith



Ornamental Indigo.
From the top, this may be confused with Brownea ucayalina, rotate to see the thickness of the hair base. Slide 1766e leaf. Typed defined by Shawn Collins 01/1999.
Diagnostic level: genus Description

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Enterolobium cyclocarpum

Starch

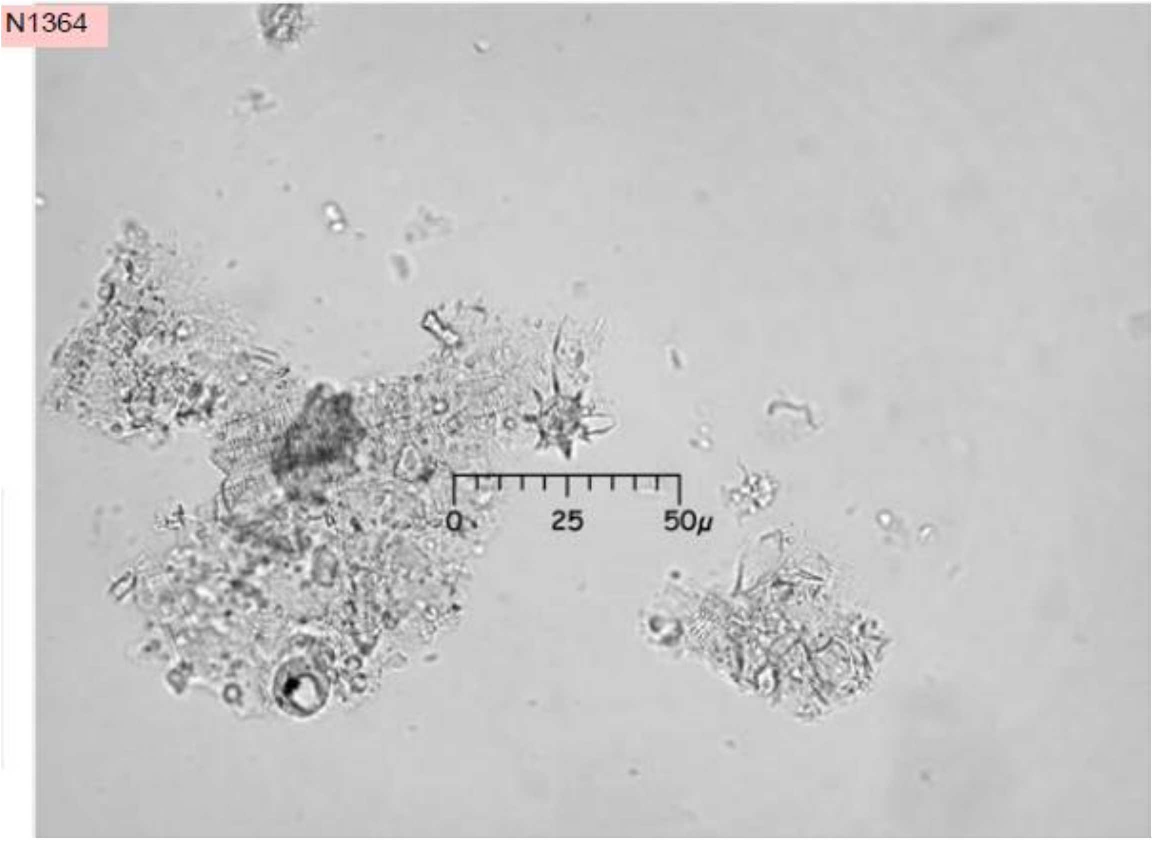
APPENDIX:
Enterolobium cyclocarpum. Simple grains, very irregular in shape, with a rough surface. When turned to the side a long fissure can be seen.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Erythrina amazonica

Phytolith

Slide 1811. Leaf.
Diagnostic level: mixed Guazuma, Erythrina, Lithospermum



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Geoffroea decorticans

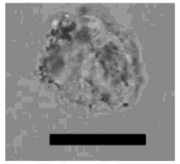
Leguminosae *Geoffroea decorticans* "chañar"

Phytolith assemblage characterization

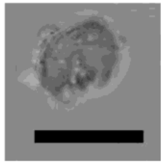
fruit

Endocarp and seed).
Non diagnostic phytoliths **(±):**

a) Semi-spherical facetate silica phytolith. Rare.



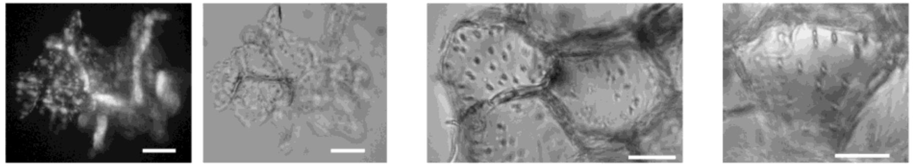
b) Sub-round silica phytolith. Rare.



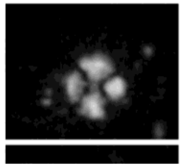
Starch assemblage characterization

fruit

Endocarp.
a) Compound grains, with a polyhedral package five- to six- sided; variable in size, to 60μm long length, compounded by at least 24-26 granula different in size. Granula range in size from 3μm to 9μm; very distinct centric hilum as a circle; not visible lamella; distinct centric cross, with four arms visible.



Pulp.
a) Single grains, spherical; to 8μm long length; not visible hilum and lamella; distinct centric cross, with four arms visible.



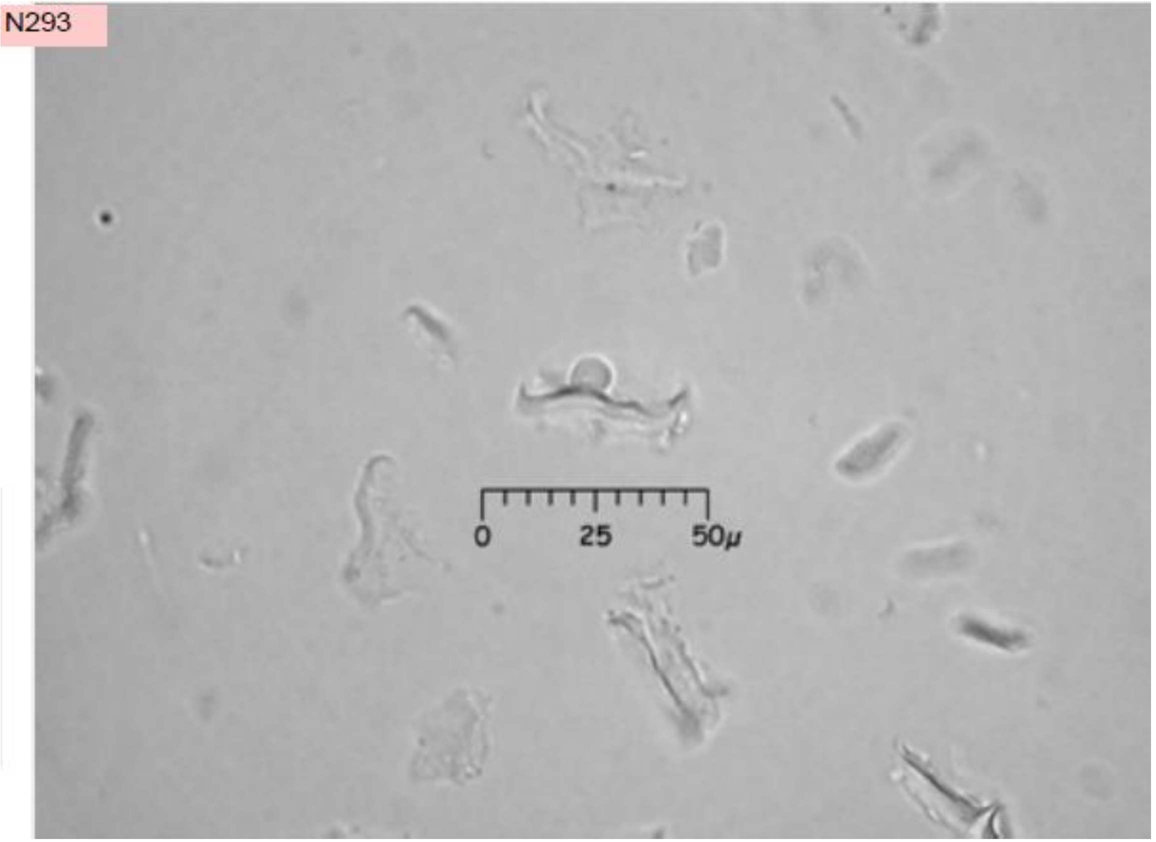
Scale bar = 20μm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Inga densiflora

Phytolith

Diagnostic level: genus

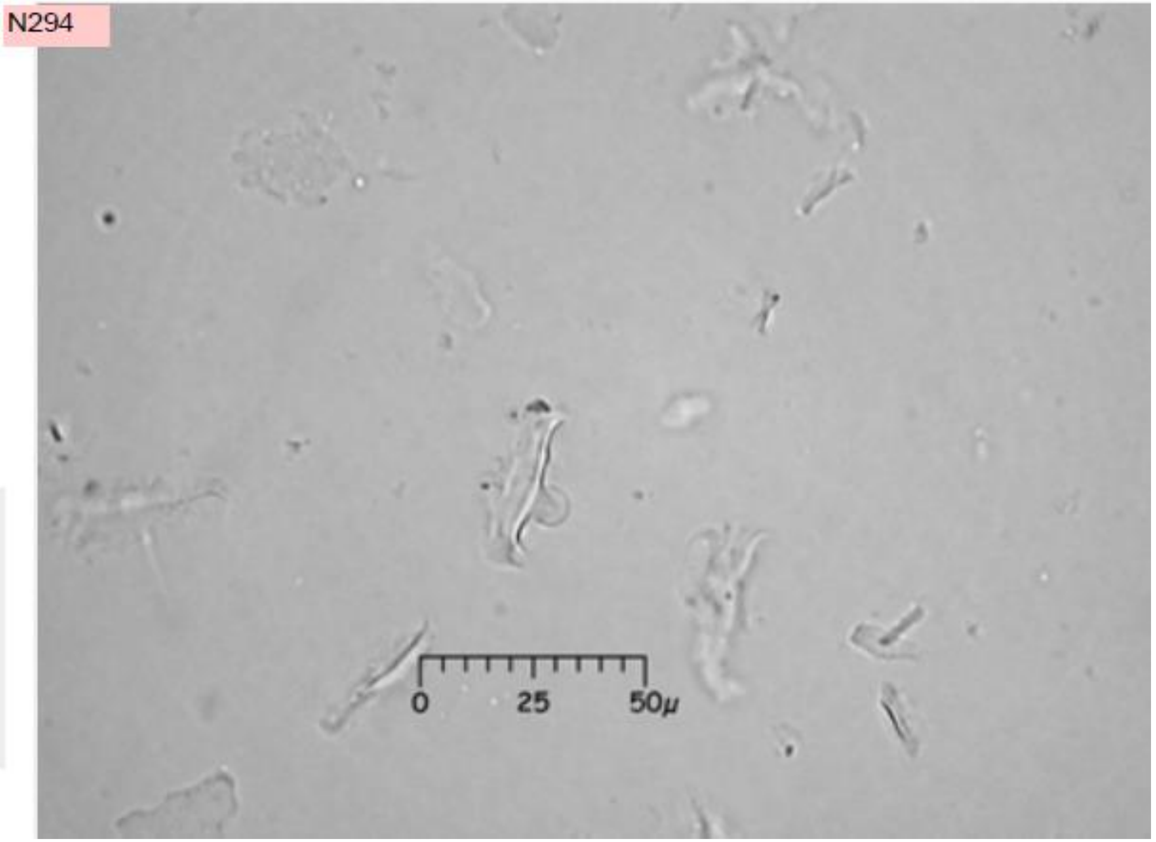


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga densiflora

Phytolith

Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga densiflora

Phytolith

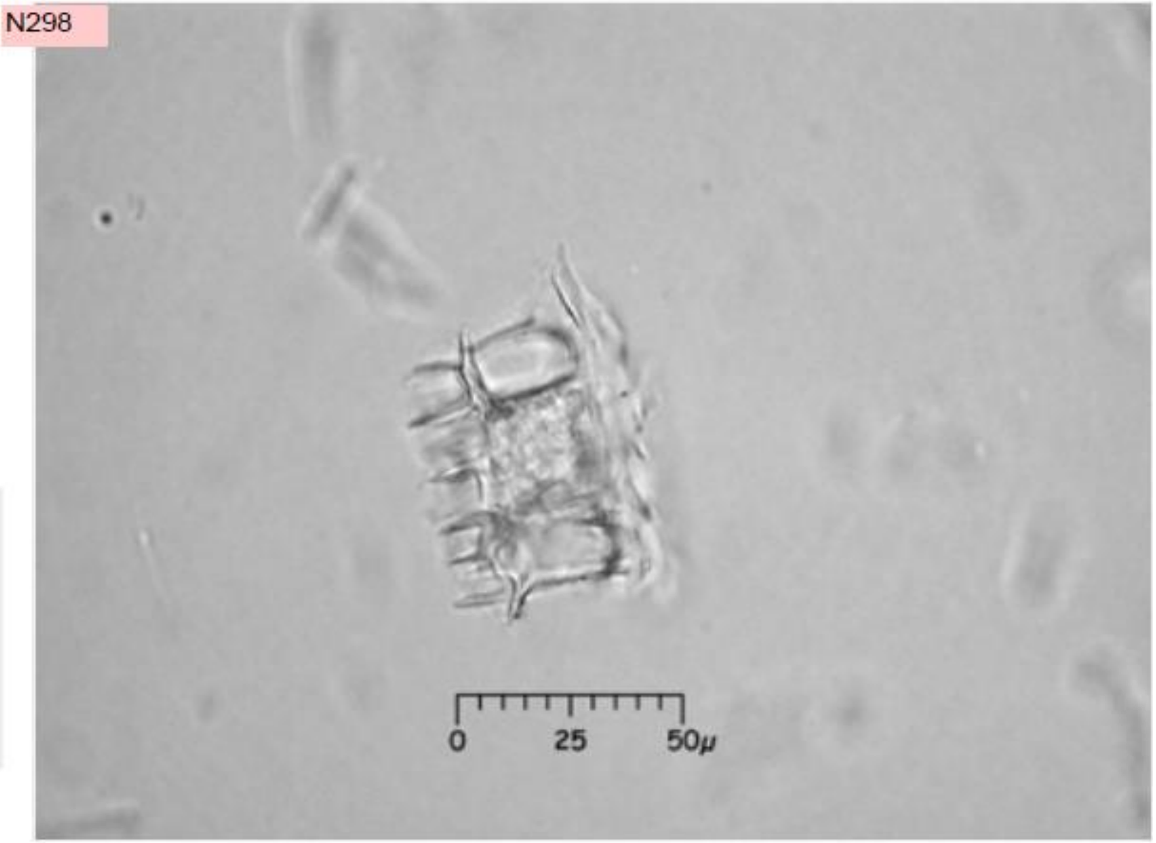
Diagnostic level: not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga densiflora

Phytolith

Side view. See Record #187 for top view.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga densiflora

Phytolith

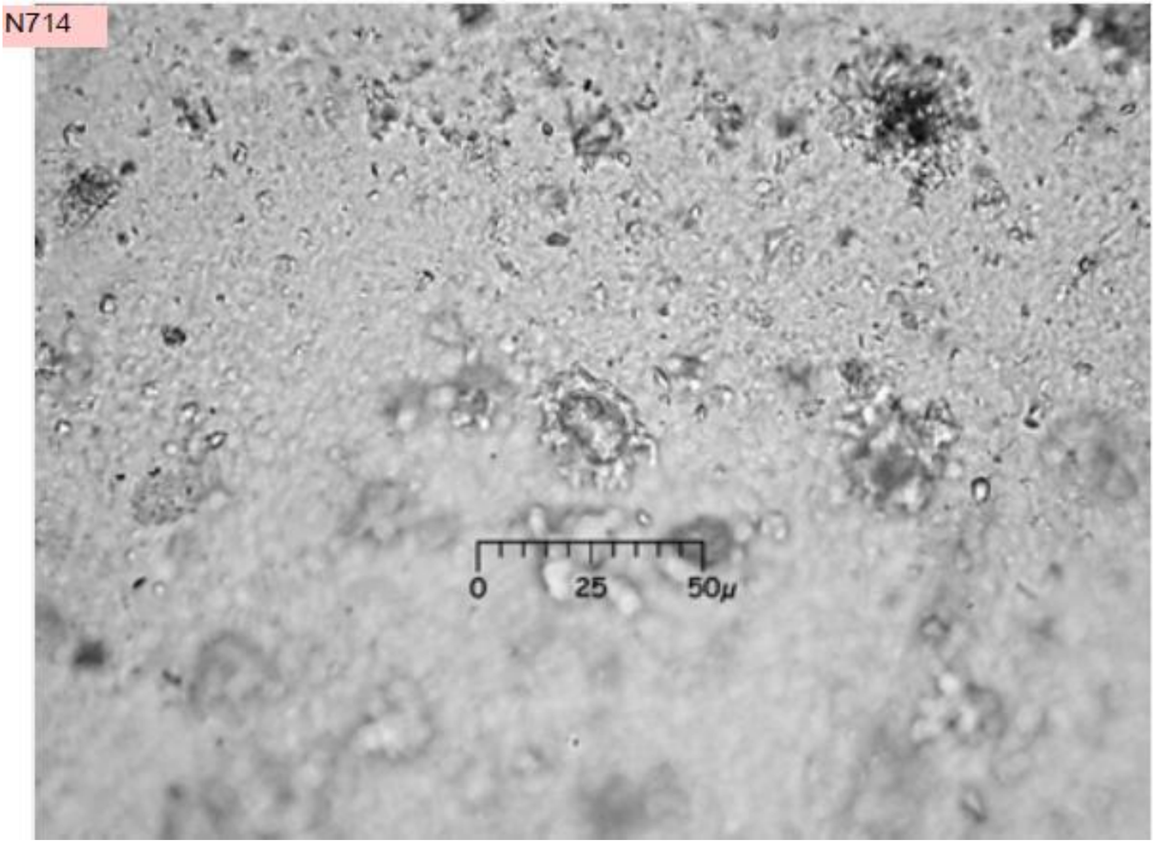
Top - 3/4 view.
See side view (Record #186) to see two layers of surrounding cells. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga spectabilis

Phytolith

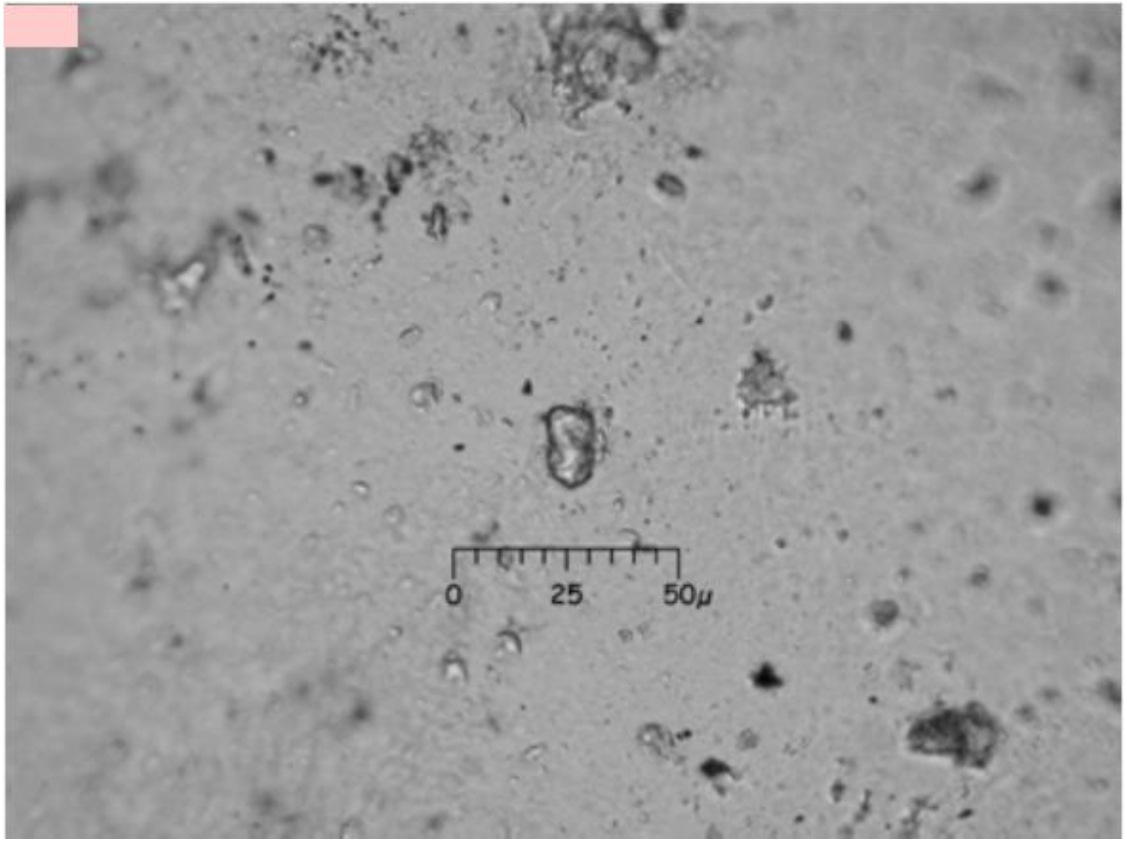
Type established by Karol Chandler- Ezell, 2004
Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Inga spectabilis

Phytolith

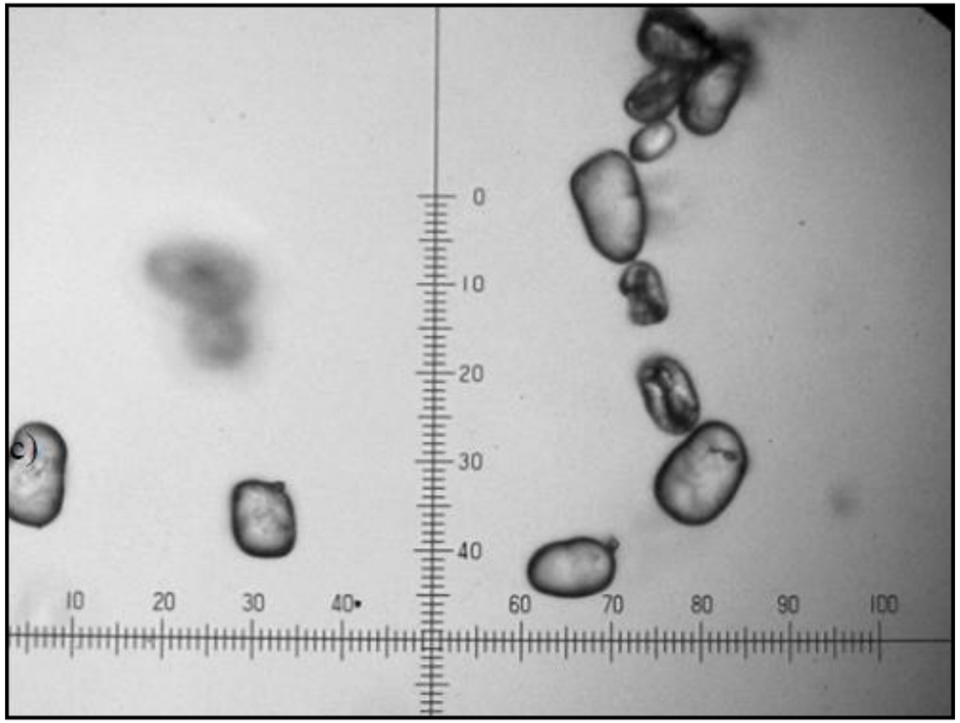


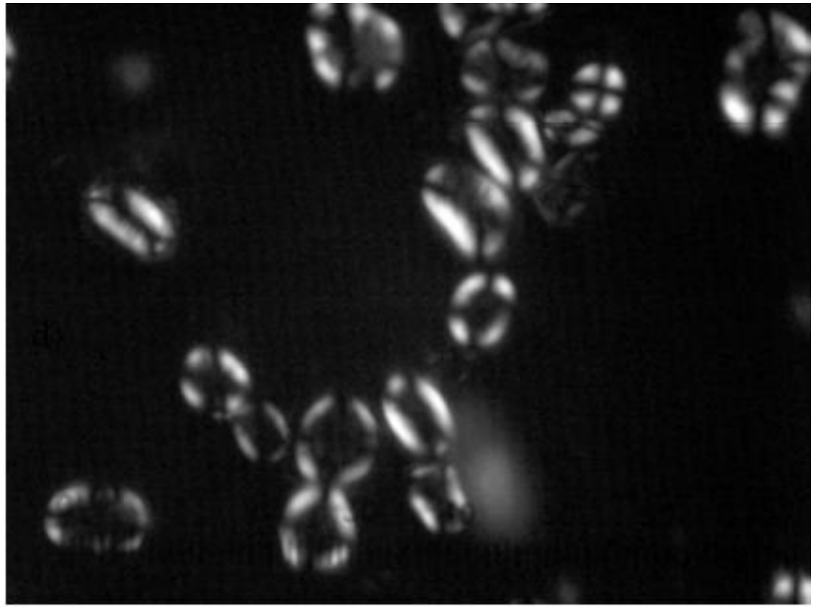
Type established by Karol Chandler- Ezell, 2004
Diagnostic level: undetermined

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Lablab purpureus

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Lens culinaris

Starch

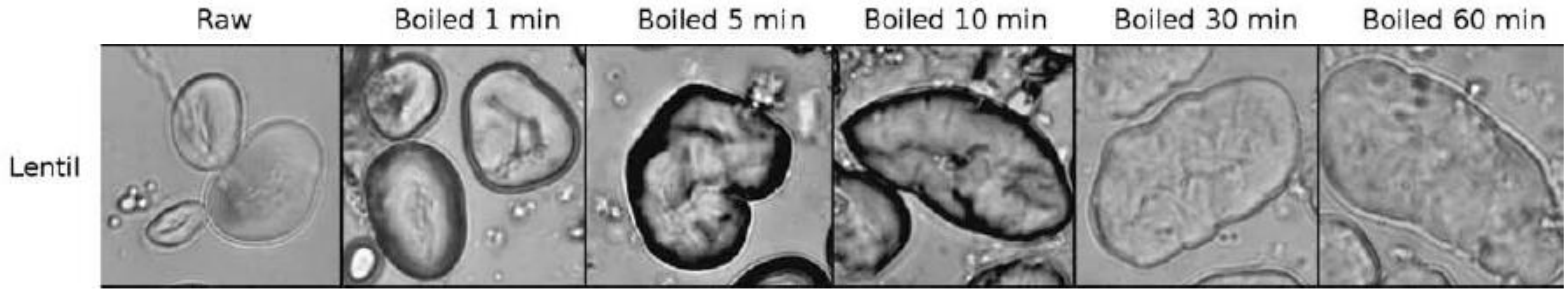


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Lens culinaris

Starch

Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Lupinus mutabilis

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Leguminosae *Lupinus mutabilis* "tarwi"

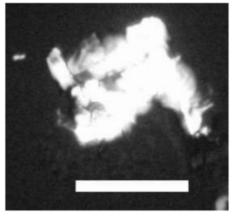
Phytolith assemblage characterization

seed

Non diagnostic phytoliths **(*):**

a) Irregular silica phytolith. Rare.

b) Irregular calcium oxalate phytoliths. Common.



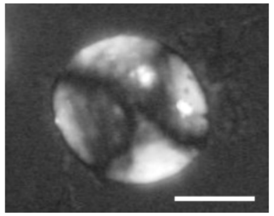
pod

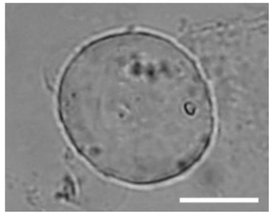
No phytoliths **(*).**

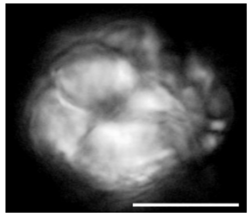
Starch assemblage characterization

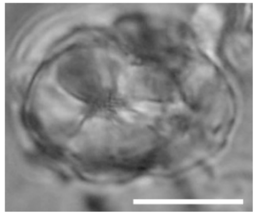
seed

a) Single grains, spherical to oval, well rounded; variable in size from 8µm to 40µm long length; indistinct centric hilum; not-visible lamella; sometimes irregular radiating or regular line fissures and a hollow at the center; distinct, centric or lightly eccentric cross, with four arms visible; distinct border.





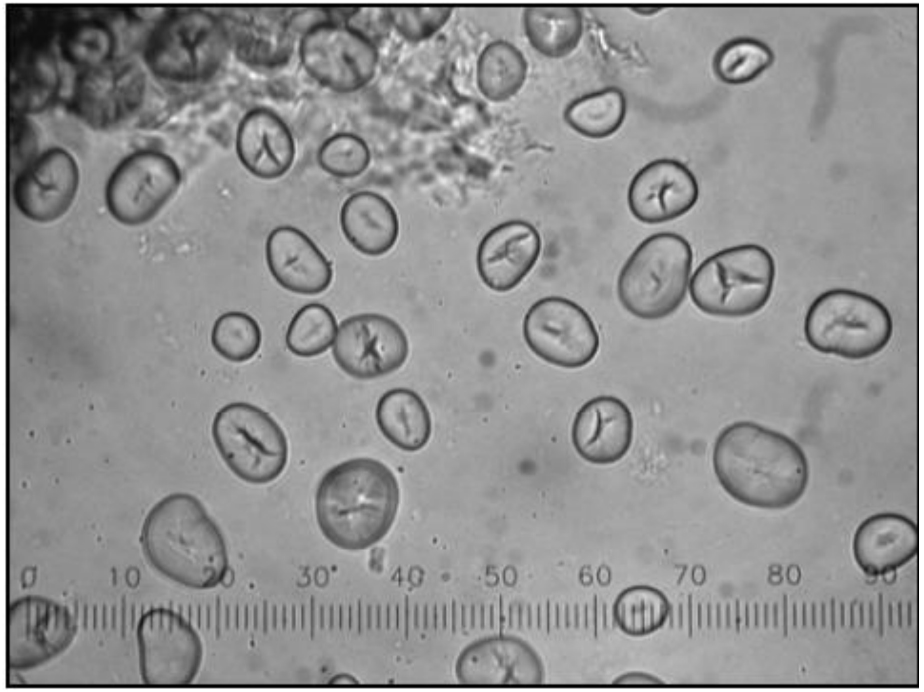


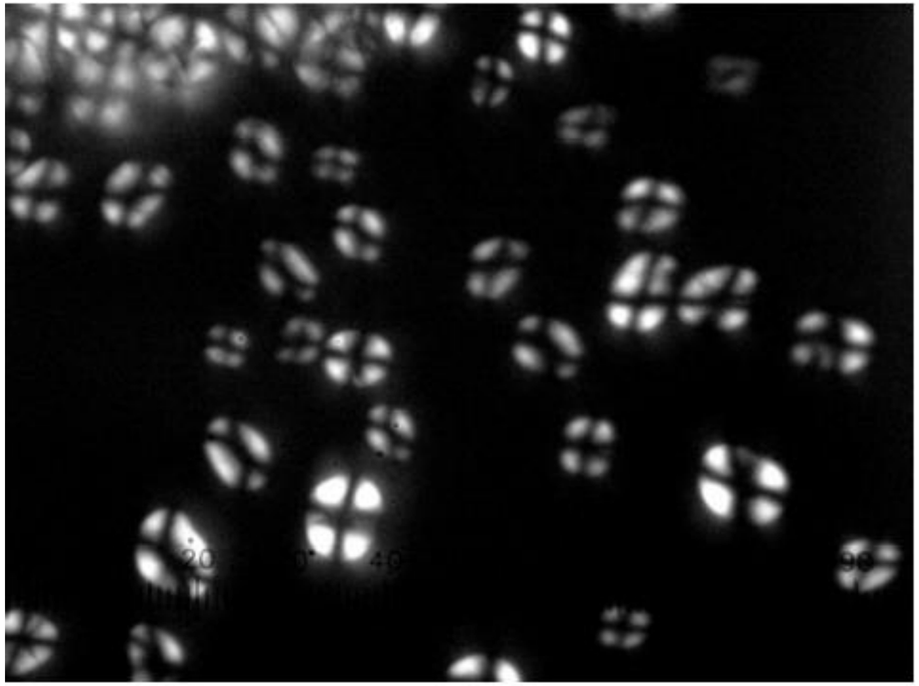


Scale bar = 20µm.

Macroptilium lathyroides

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Pachyrhyzus ahipa

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Leguminosae ***Pachyrizus ahijpa*** **"ajipa"**

Phytolith assemblage characterization

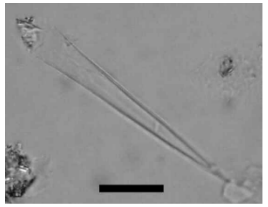
tuber

No phytoliths **(*).**

leaf

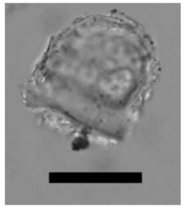
Non diagnostic phytoliths **(*):**

a) Acicular silica hair. Common.

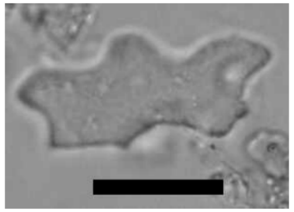


b) Roundel asymmetrical cavated silica phytolith. Common.

c) Semi-roundel gibbous silica phytolith. Rare.

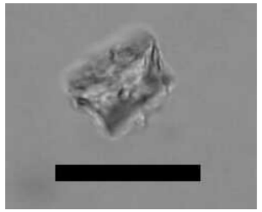


d) Irregular castelate silica phytolith.

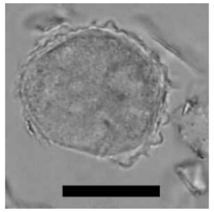


e) Roundel wrinkled silica phytolith. Not common.

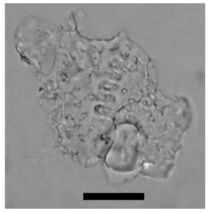
Lateral view.



Plane view.



f) Continuous crenate silica phytolith. Rare.

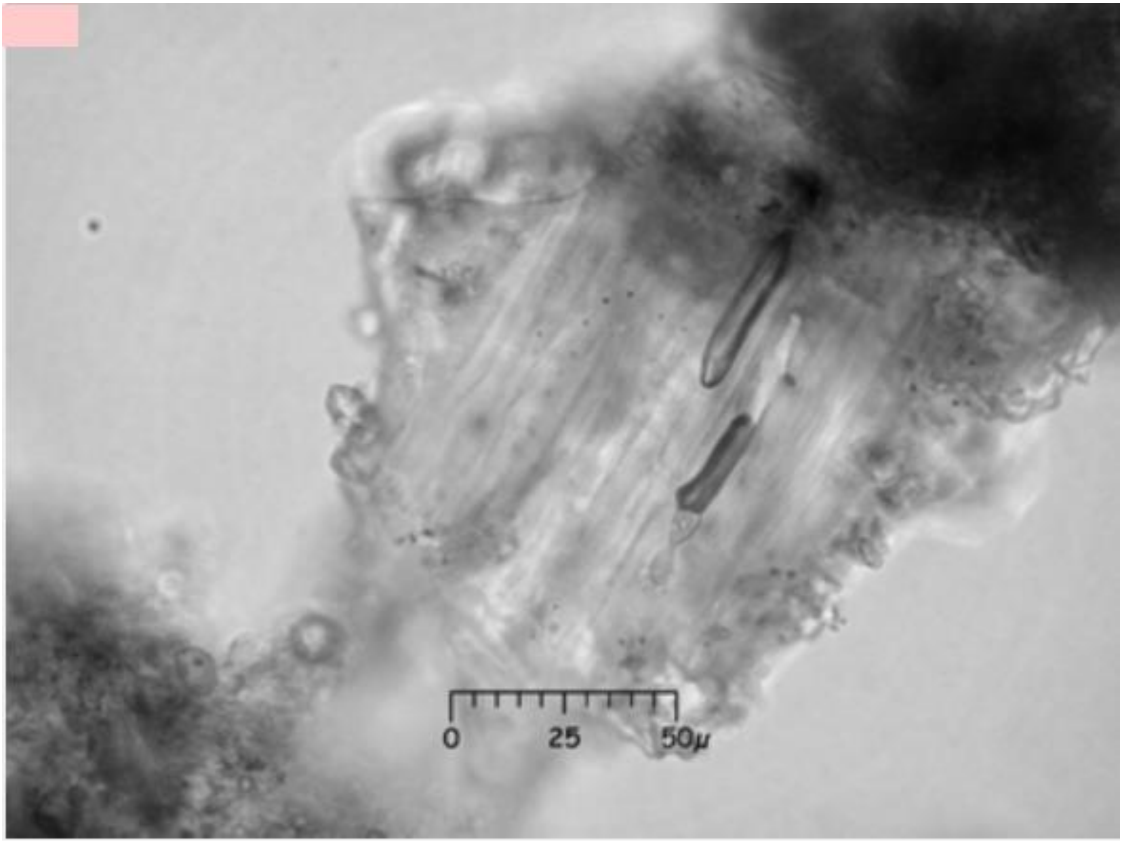


Scale bar = 20μm.

Pachyrhizus erosus

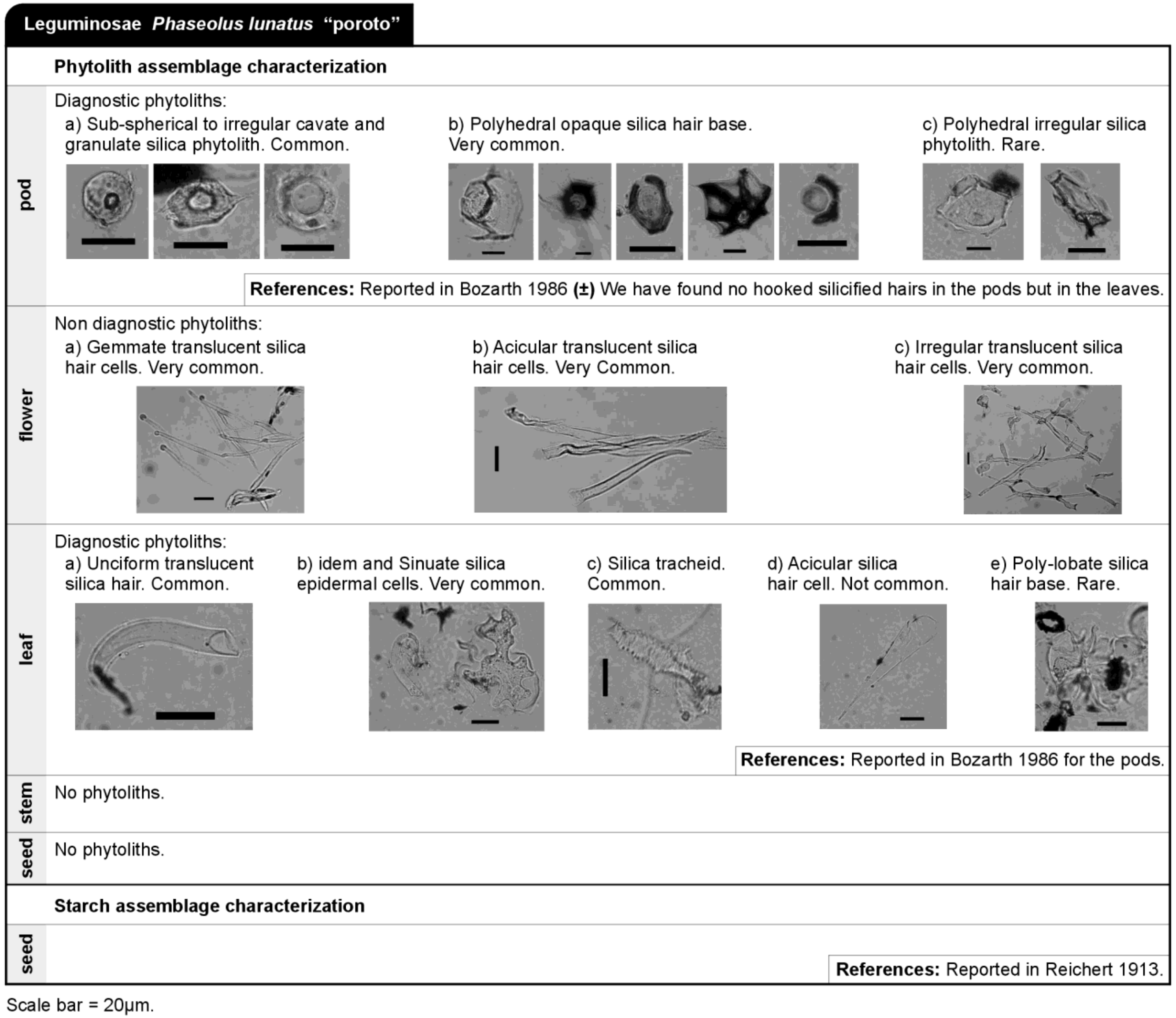
Phytolith

Type established by Karol Chandler- Ezell, 2004
Diagnostic level: root/tuber



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Phaseolus lunatus



Leguminosae *Phaseolus lunatus* “poroto”

Phytolith assemblage characterization

pod

Diagnostic phytoliths:
a) Sub-spherical to irregular cavate and granulate silica phytolith. Common.
b) Polyhedral opaque silica hair base. Very common.
c) Polyhedral irregular silica phytolith. Rare.

References: Reported in Bozarth 1986 **(±)** We have found no hooked silicified hairs in the pods but in the leaves.

flower

Non diagnostic phytoliths:
a) Gemmate translucent silica hair cells. Very common.
b) Acicular translucent silica hair cells. Very Common.
c) Irregular translucent silica hair cells. Very common.

leaf

Diagnostic phytoliths:
a) Unciform translucent silica hair. Common.
b) idem and Sinuate silica epidermal cells. Very common.
c) Silica tracheid. Common.
d) Acicular silica hair cell. Not common.
e) Poly-lobate silica hair base. Rare.

References: Reported in Bozarth 1986 for the pods.

stem

No phytoliths.

seed

No phytoliths.

Starch assemblage characterization

seed

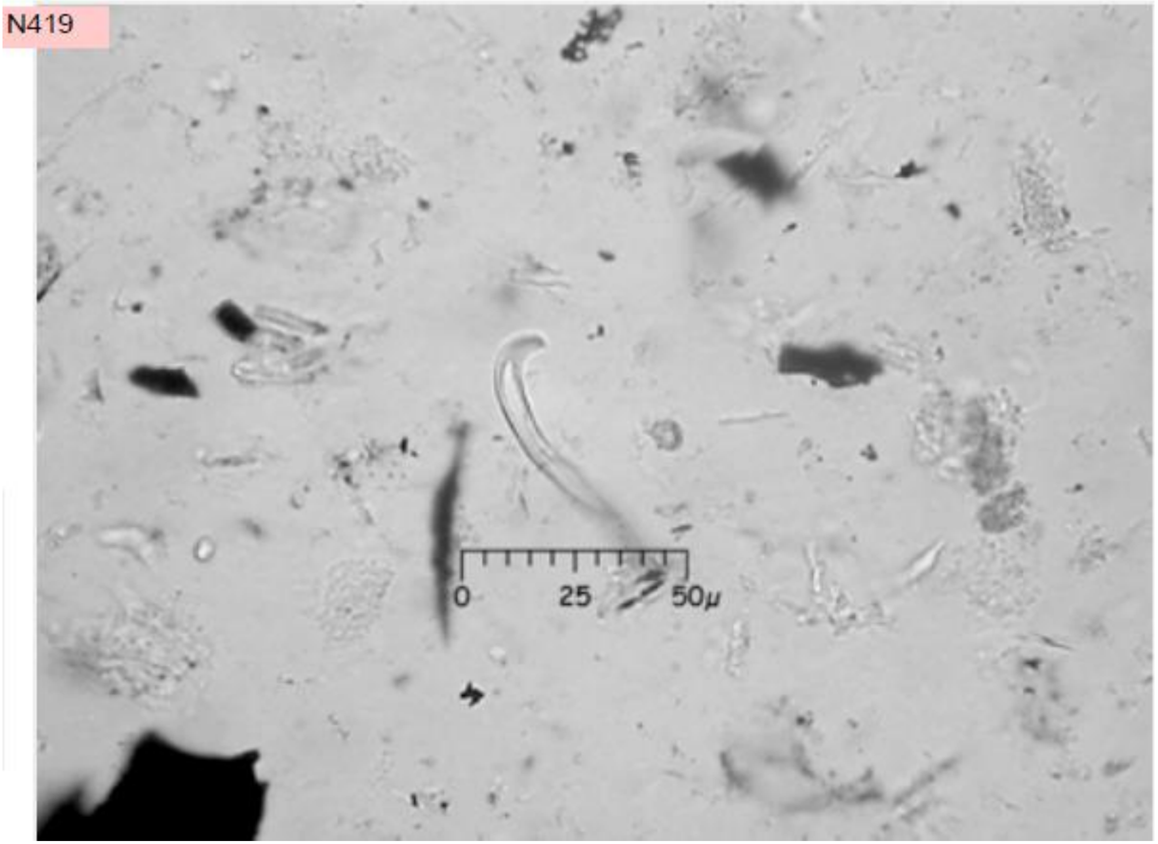
References: Reported in Reichert 1913.

Scale bar = 20μm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Phaseolus lunatus

Phytolith



Phaseolus hair, small when compared to 40IIIAa301.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Phaseolus lunatus

Phytolith

Phaseolus hair, small when compared to 40IIIAa301.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Phaseolus vulgaris

Leguminosae *Phaseolus vulgaris* - var. vulgaris "poroto"

Phytolith assemblage characterization

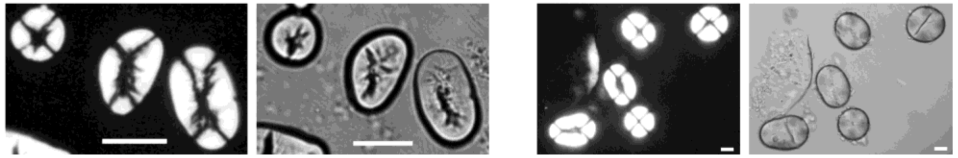
seed

References: Reported in Bozarth 1990.

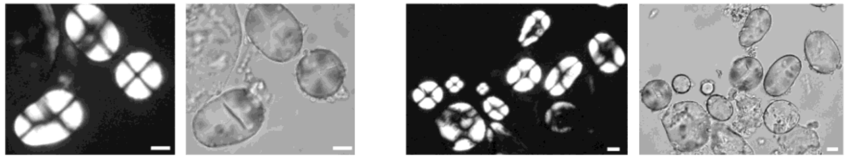
Starch assemblage characterization

seed

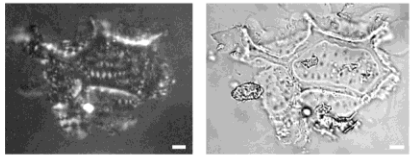
a) Single grains, oval, ovoid, spherical, kidney-shaped, irregularly lobated, polyhedral, ellipsoidal, irregular; variable in size from 2µm to more than 60µm long length; distinct centric hilum, elongated; distinct lamella; a ragged mesial fissure, and radiating lines from the hilum; distinct centric cross, with four irregular arms visible, intersecting at a central ragged line or dot, or meeting two by two.



b) Compound grains, compounded by two or more granula with a single external package. Granula variably in shape, size and orientation; same type of simple ones; distinct centric cross, with visible arms intersecting at different points.



c) Compound grains, with a fiber-like or polyhedral package; variable in size, to 60µm long length, compounded by granula different in size. Granula range in size from 3µm to 5µm; very distinct centric hilum circle-, v- or x-shaped; not visible lamella; distinct centric cross, with four arms visible.



References: Partially based on Piperno and Holst 1998, Reichert 1913, Yañez et al. 1997.

Scale bar = 20µm.

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Phaseolus vulgaris

Phytolith

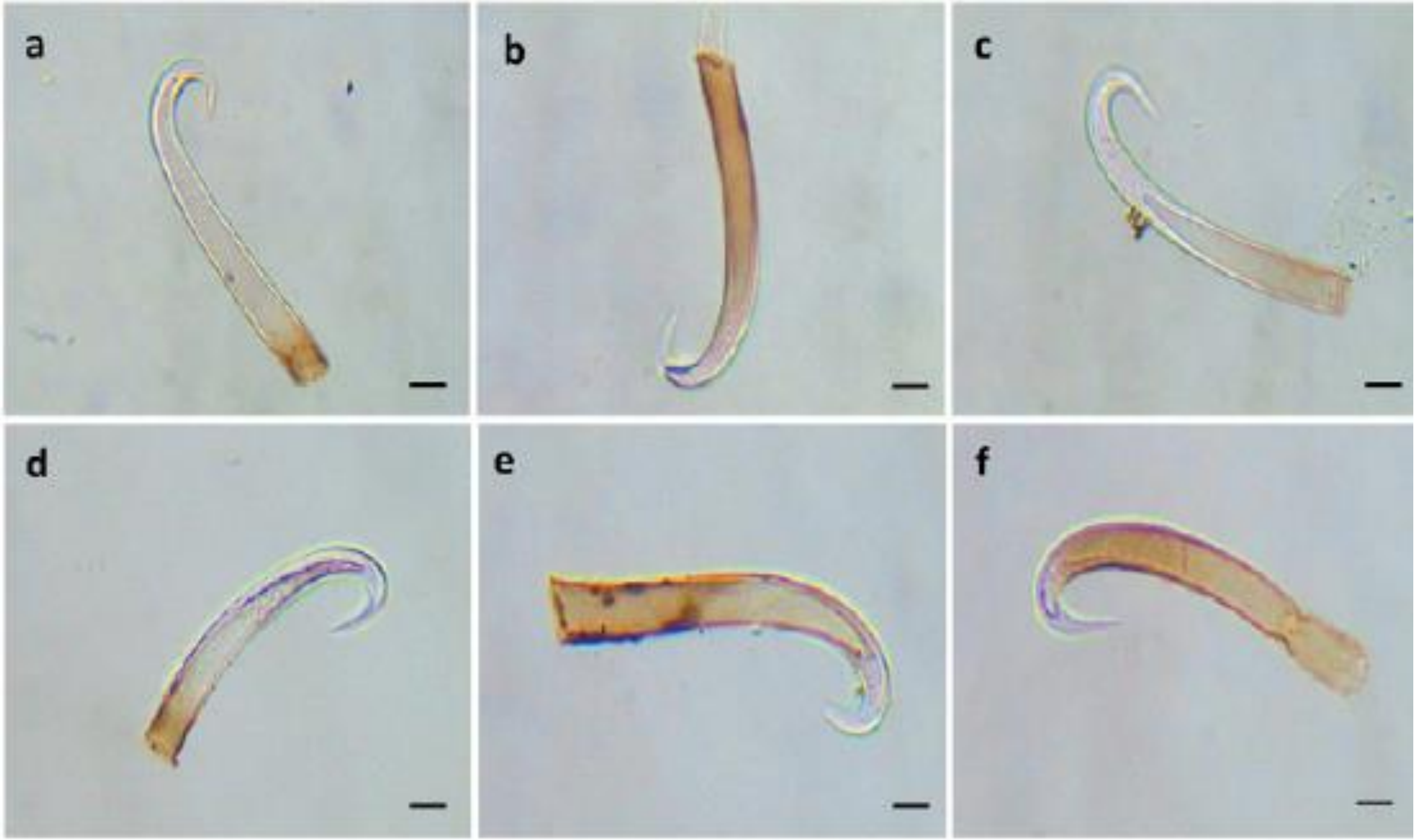


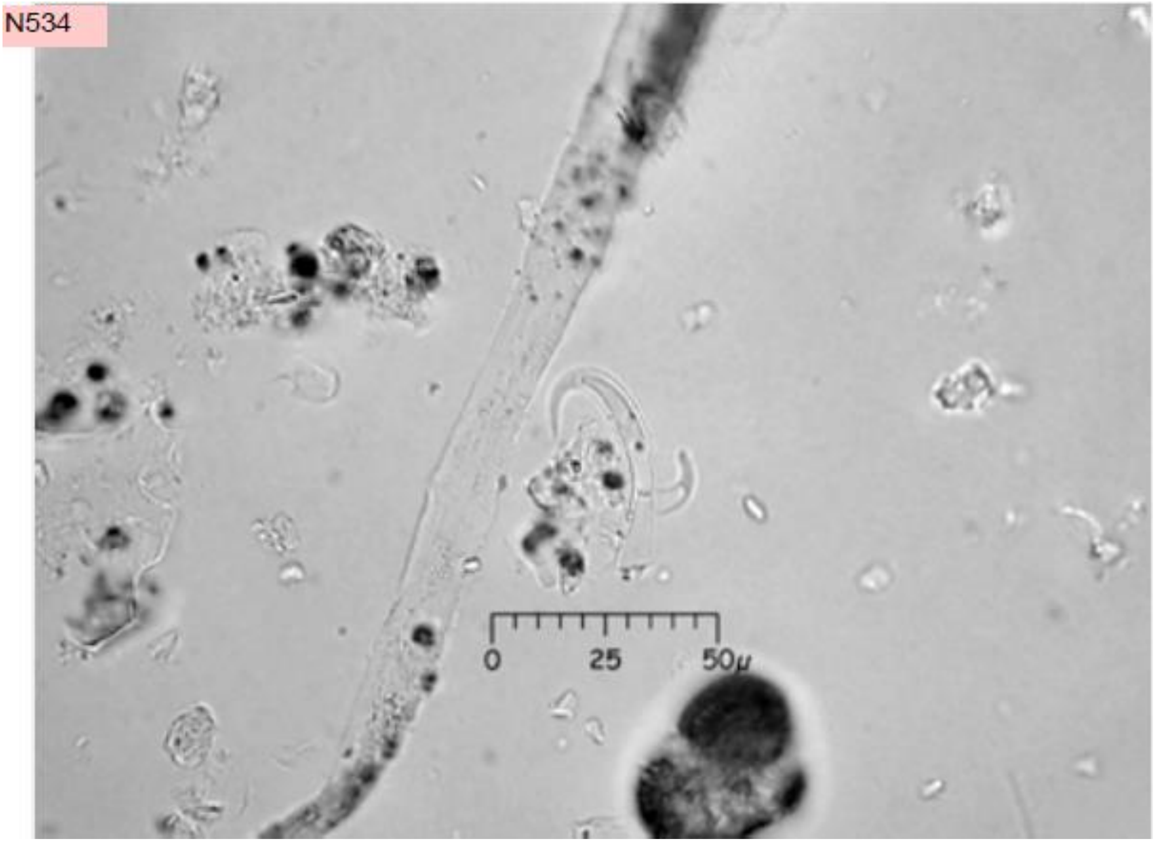
Figure 5. Phytoliths from leaves of common bean Phaseolus vulgaris L.; a) 92.4µm, 12.26µm; b) 78.2µm, 9µm; c) 88.64µm, 10,32µm; d) 102.96µm, 9.94µm; e) 57.37µm, 8.51µm; f) 93.5µm,11.9µm. Scale: 10 µm by 40X

Poveda-Díaz, Nataly, Maria Eugenia Morales-Puentes, and Gregory Vaughan. 2016. Phytoliths Produced by Common Bean (Phaseolus Vulgaris L.), Achira (Canna Indica L.), and Squash (Cucurbita Ficifolia Bouché), Crop Species from Boyacá, Colombia. *Revista de La Academia Colombiana de Ciencias Exactas, Físicas y Naturales* 40 (154):137–46.

Phaseolus vulgaris

Phytolith

Phaseolus hair, small when compared to 40IIIAa301.
Diagnostic level: genus

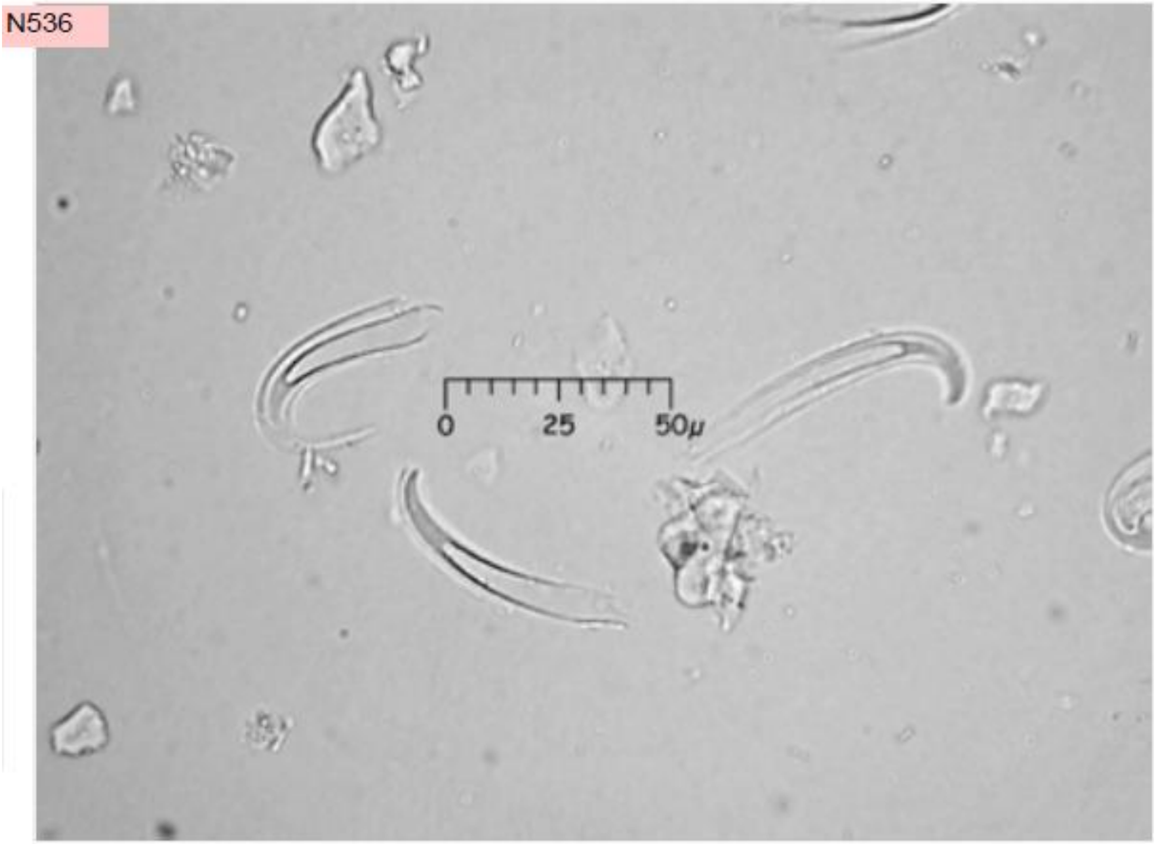


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Phaseolus vulgaris

Phytolith

Phaseolus hair, small when compared to 40IIIAa301.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Phaseolus vulgaris

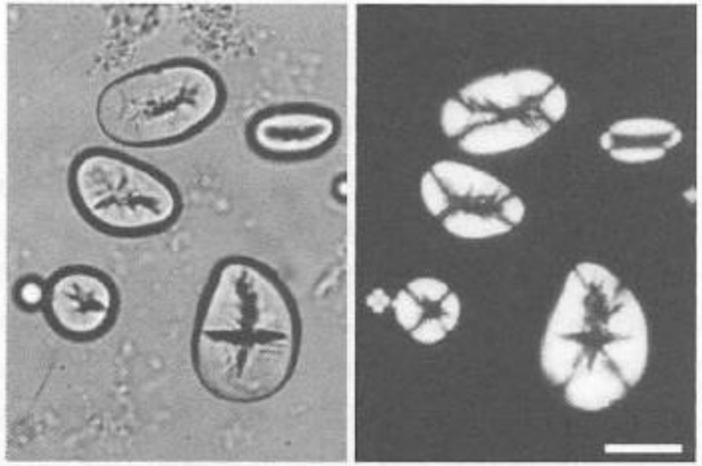


Figure 5. Common bean non-processed starch grains. Views with normal (left) and polarised light (right). Scale bar = 20μm.

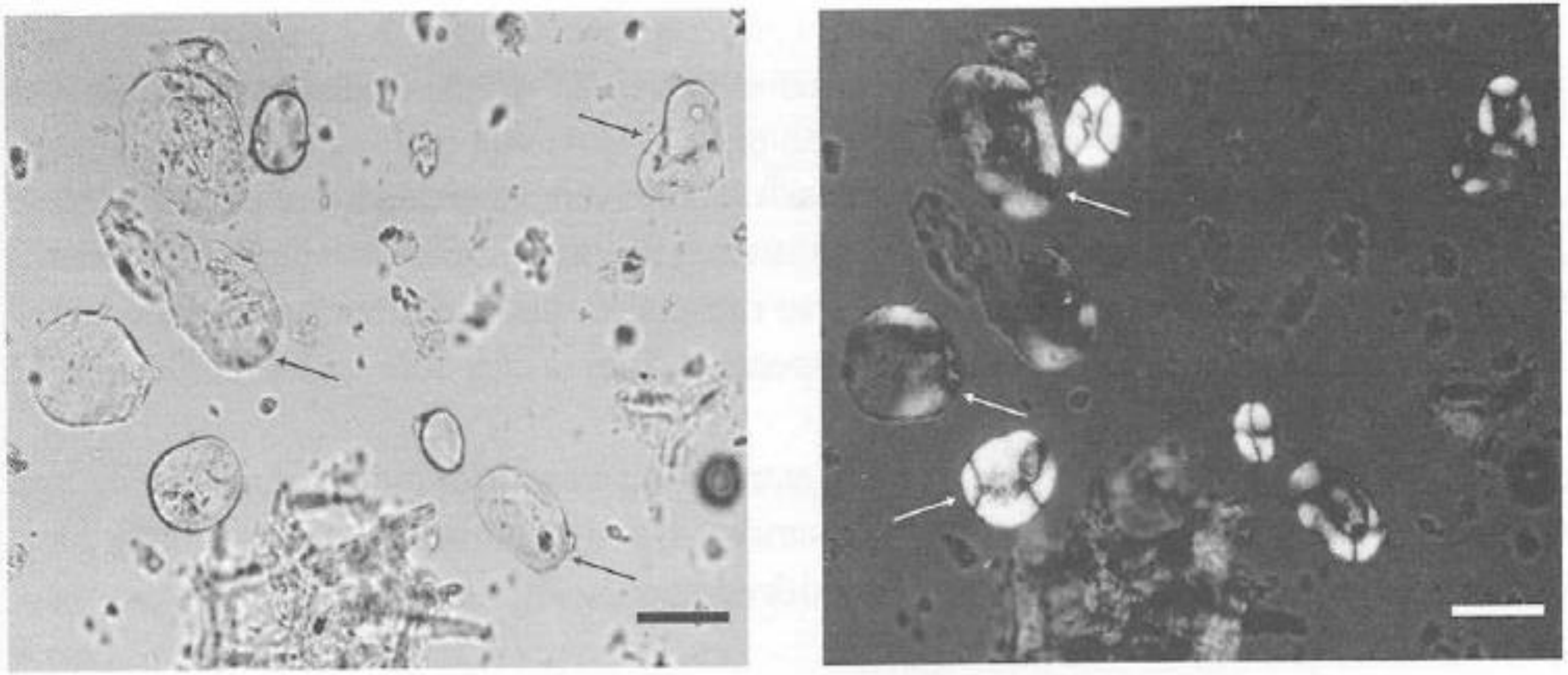
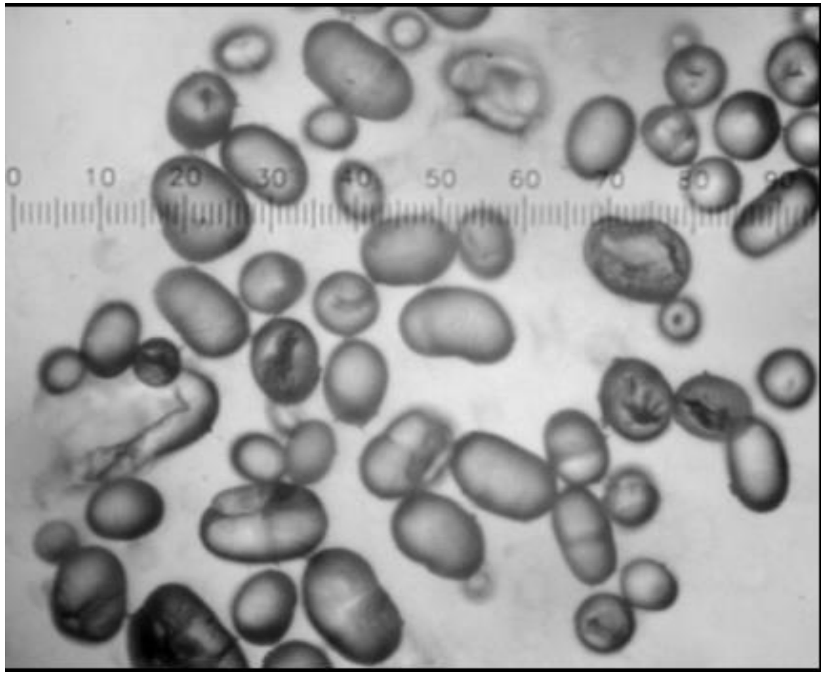


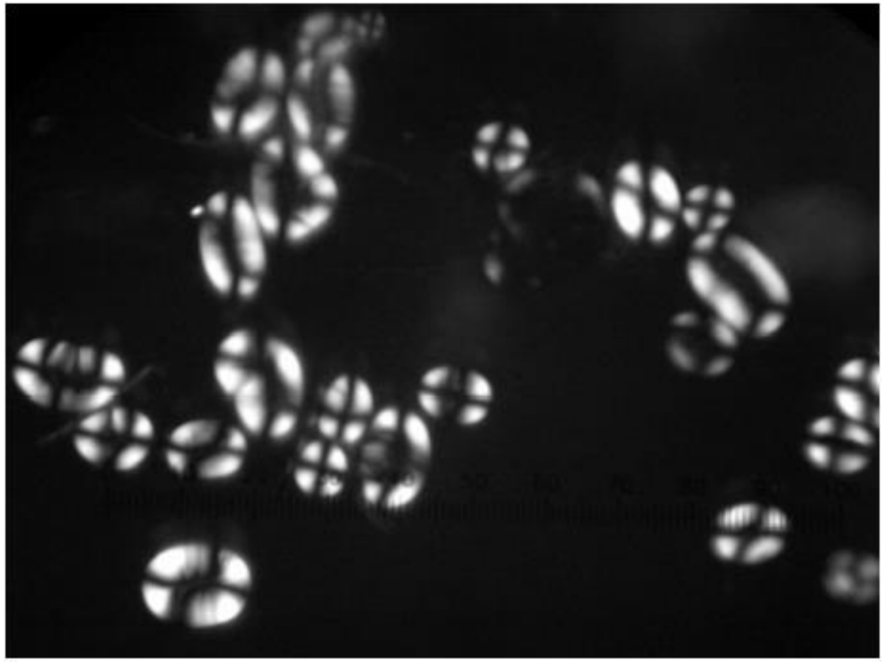
Figure 11. Starch of common bean flour showing milling effects. (a) Highly damaged granules which appear incomplete, fractured and collapsed with damaged surfaces and contours and a grain with a hole at the hilum are marked with arrows. View with normal light (left). (b) Partially obscure grains with low intensity of birefringence and defects in the shape and integrity of the extinction cross are marked with arrows. View with polarised light (right). Scale bar = 40μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Phaseolus vulgaris

Starch

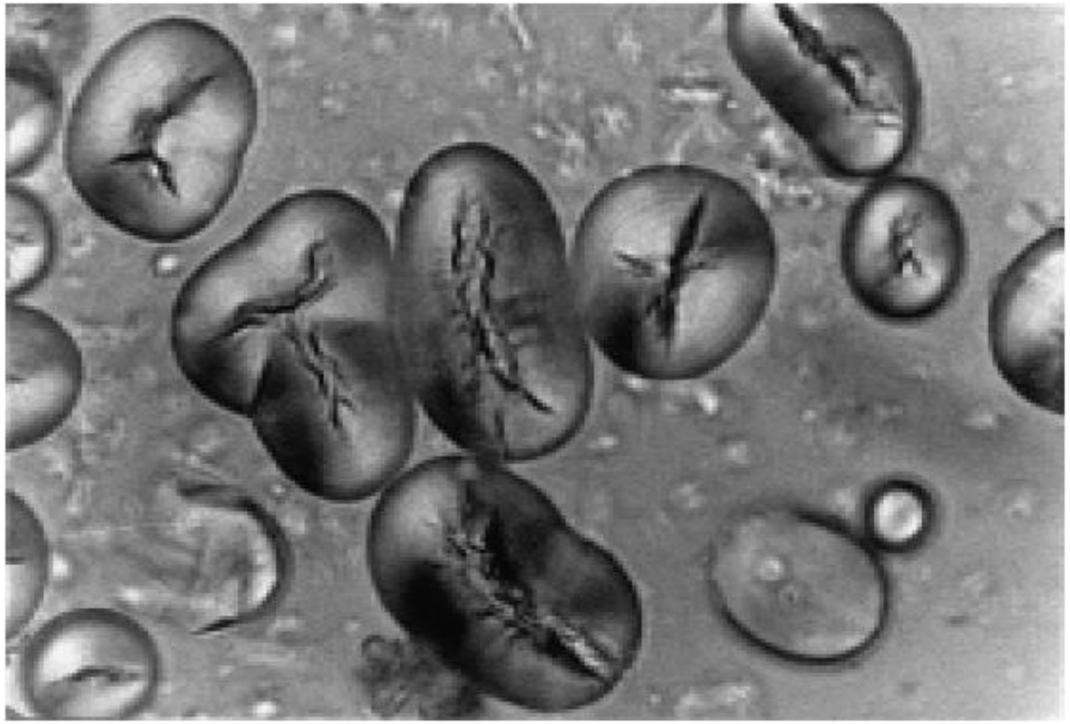




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Phaseolus vulgaris

Starch



Starch grains from modern Phaseolus vulgaris beans. 160x

APPENDIX:
Phaseolus vulgaris (common bean) (Figure 6). Simple grains, oval and laminated, with a large, ragged mesial fissure that extends the length of the grain. Size: 14– 6 microns long.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Pisum sativum

Starch

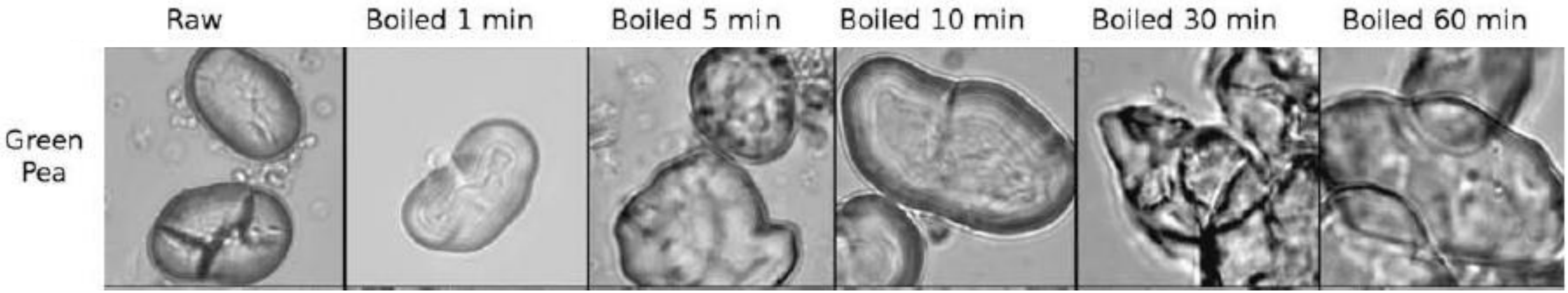


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Pisum sativum

Starch

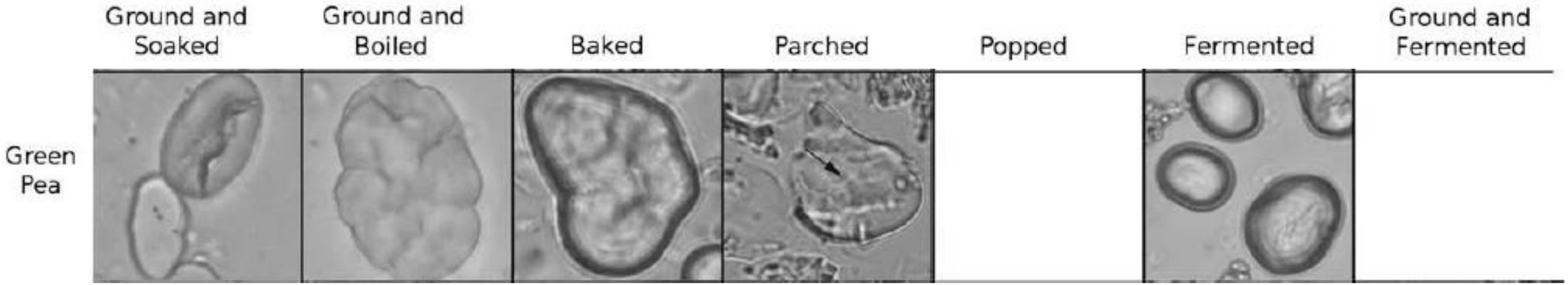


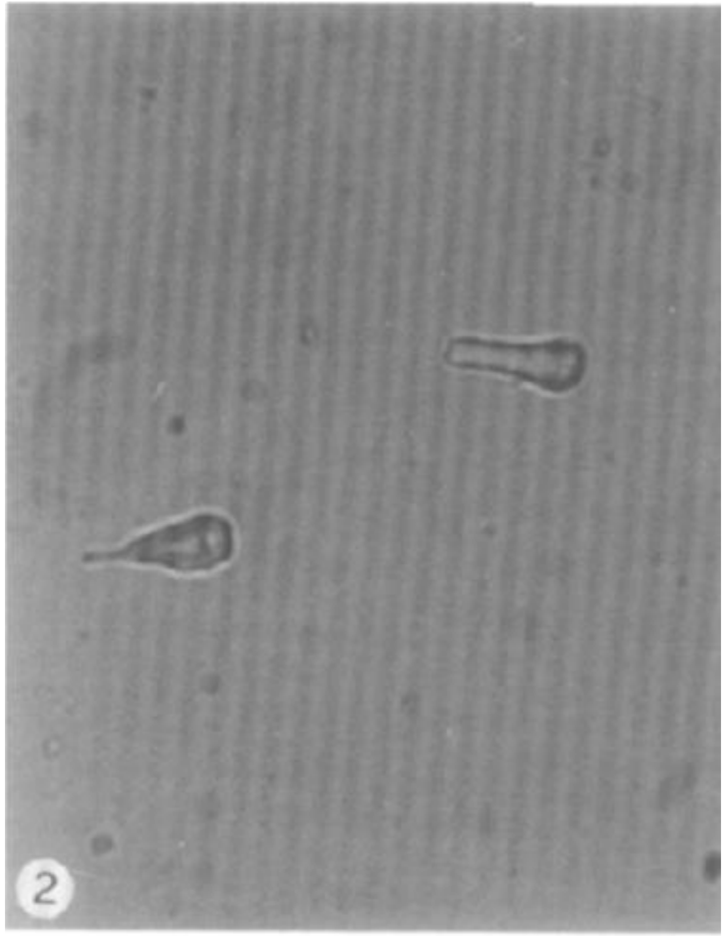
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

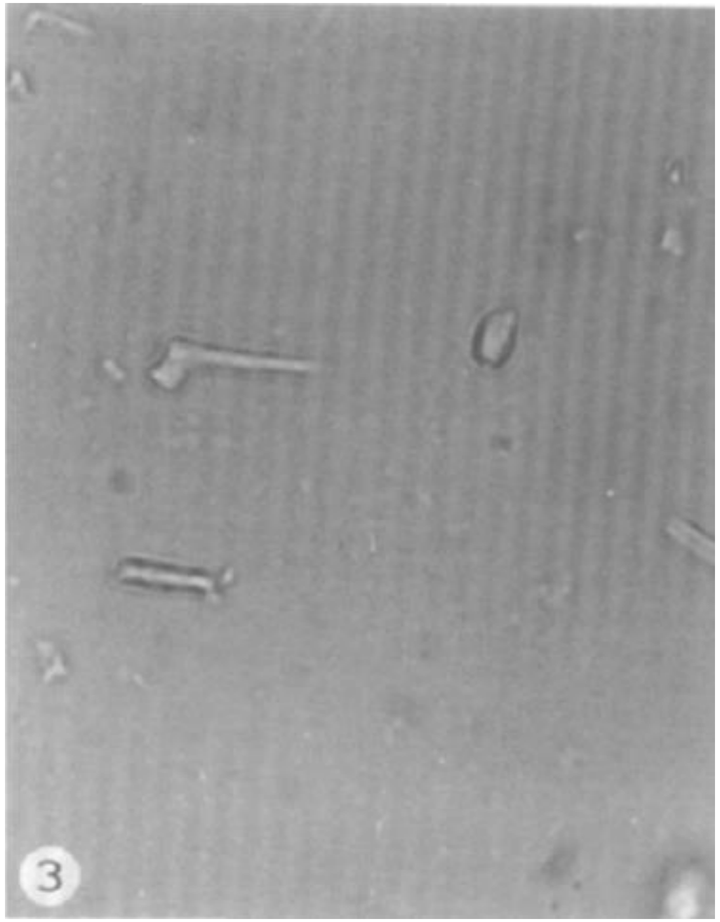
Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Pithecolobium latifolium

Phytolith

2. Silicified sclereids from Pithecolobium latifolium (250x).
3. Silicified sclereids from Pithecolobium latifolium (250x).





Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Prosopis nigra et alba

Leguminoseae *Prosopis nigra et alba* "algarrobo"

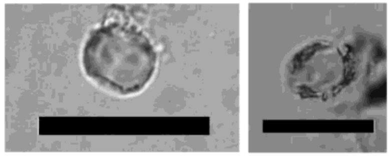
Phytolith assemblage characterization

fruit

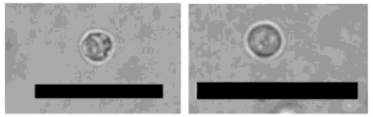
Pod and seed.

Non diagnostic phytoliths:

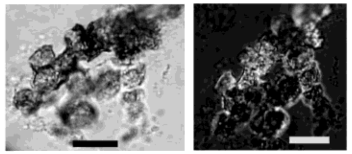
a) Round dorsal irregular faceted silica phytolith. Rare.



b) Round psilate silica phytolith. Rare.



c) Polyhedral calcium oxalate phytolith.

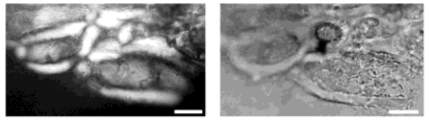


References: Reported as not present in Piperno 1988 for *Prosopis juliflora*. Reported as typical legume crystals in Cummings 1992.

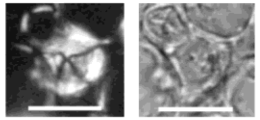
Starch assemblage characterization

pod

a) Single grains, variable in shape, oval and spherical, elongated; variable in size, to 80µm long length; sometimes distinct hilum as a line or circle; not visible lamella; a circular, oval or elliptical hollow at the center with a similar shape to the contour of the grain; distinct centric cross, with four arms visible, meeting at dark oval or circular hollow.

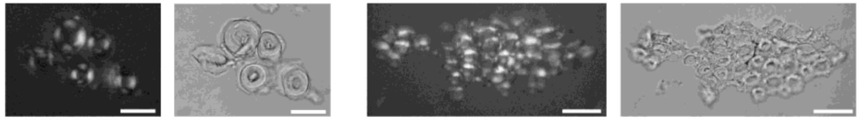


b) Also common spherical grains; distinct centric cross, with four arms visible.



seed

a) Single grains, variable in shape, oval, spherical; variable in size, from 5µm to 30µm long length; sometimes distinct centric hilum as a line or circle; not visible lamella; a circular, oval or elliptical hollow at the center with a similar shape to the contour of the grain; distinct centric cross, with four arms visible, meeting at a dark oval or circular hollow. May occur in bunch aggregates.



b) Also common spherical grains; distinct cross, with four arms visible, intersecting at a vertical line or circle.

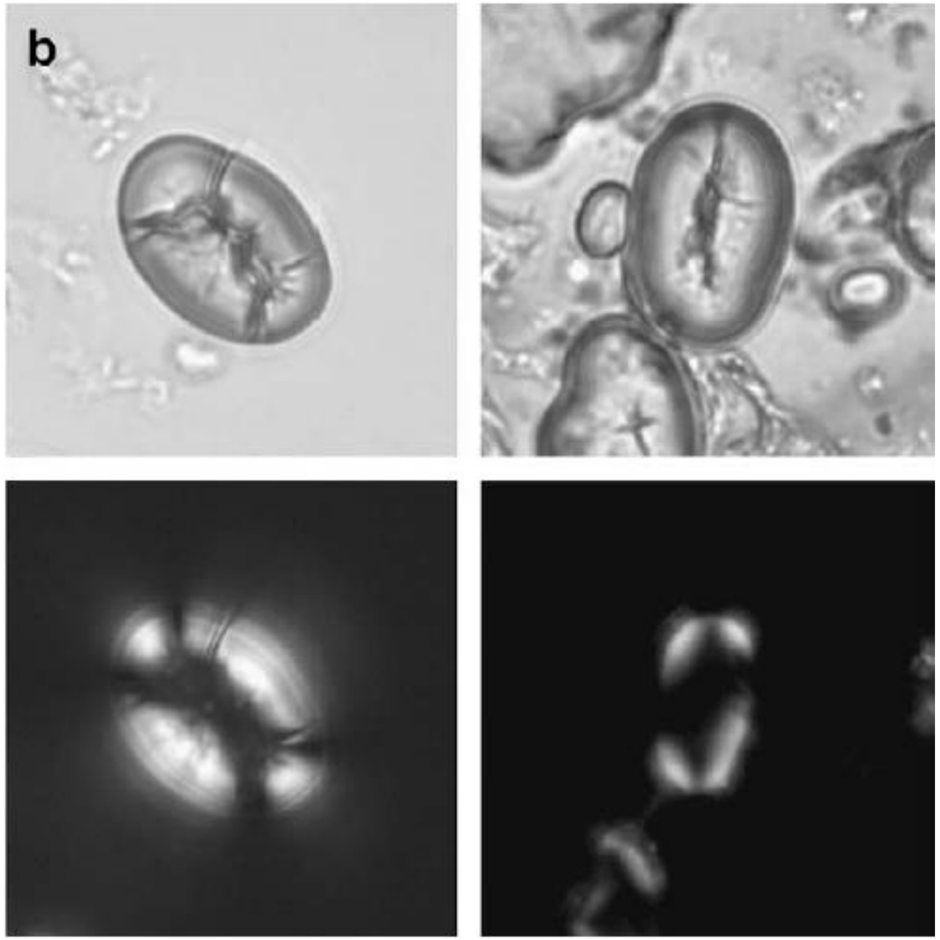
Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Vigna radiata

Starch

Fig. 1. Comparisons of raw and boiled starch grains showing damage to extinction crosses. (b) Mung bean starch grains. Left side, raw mung bean starch grains; right side, mung bean starch grains boiled for 10 min. Once again the cross is faded around the outside and less distinct, though there is very little change visible under regular light. Each image is 50 mm wide.



Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Vigna radiata

Starch

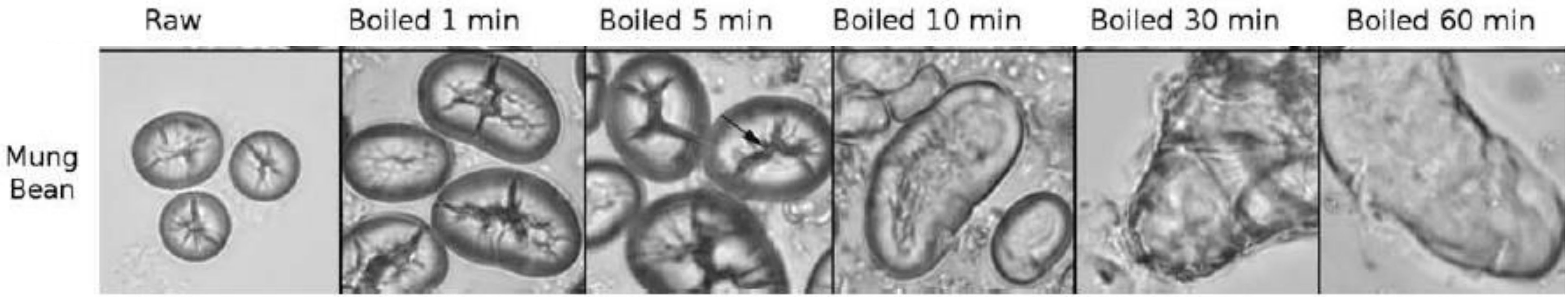


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Vigna radiata

Starch

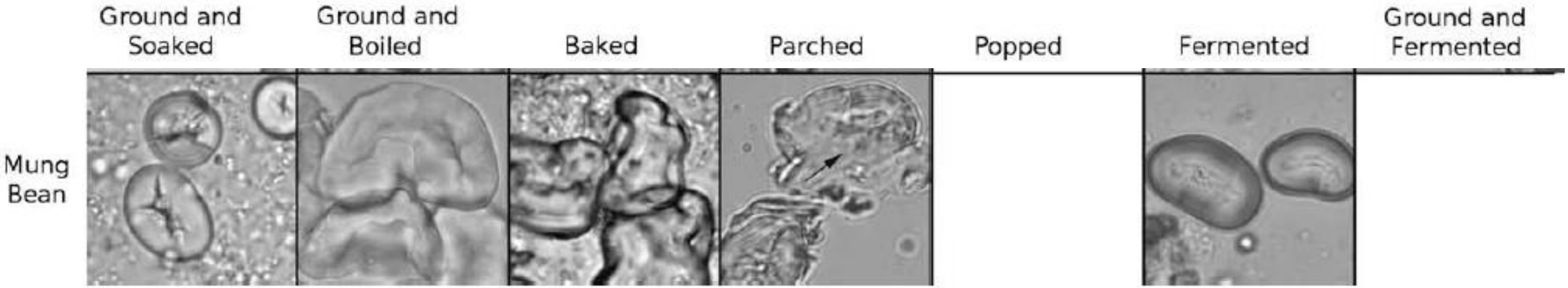


Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

FAGACEAE

Lithocarpus acuminatissima

Phytolith

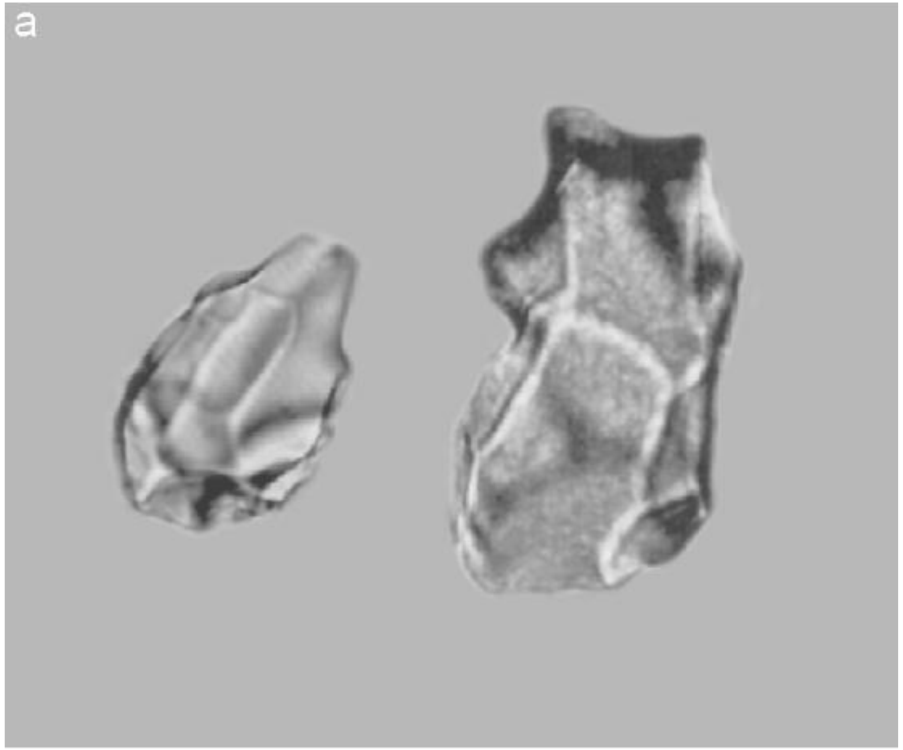


Fig. 3. (a) Facetate phytoliths from Asian Fagaceae (Lithocarpus acuminatissima), left, and Annonaceae (Goniothalamus marcani), right. Reprinted from Kealhofer and Piperno, 1998. Reprinted from Piperno (2006a), Copyright AltaMira Press.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. Quaternary International 193 (1–2):146–59.

FLACOURTIACEAE

Caesaria sylvestris

Phytolith

See Record #140 for a variation of the same body. Occurs in the leaf. Small, tall hair cell base.
Note the decorated schlerids in background-- these are common in the sample.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Caesaria sylvestris

Phytolith

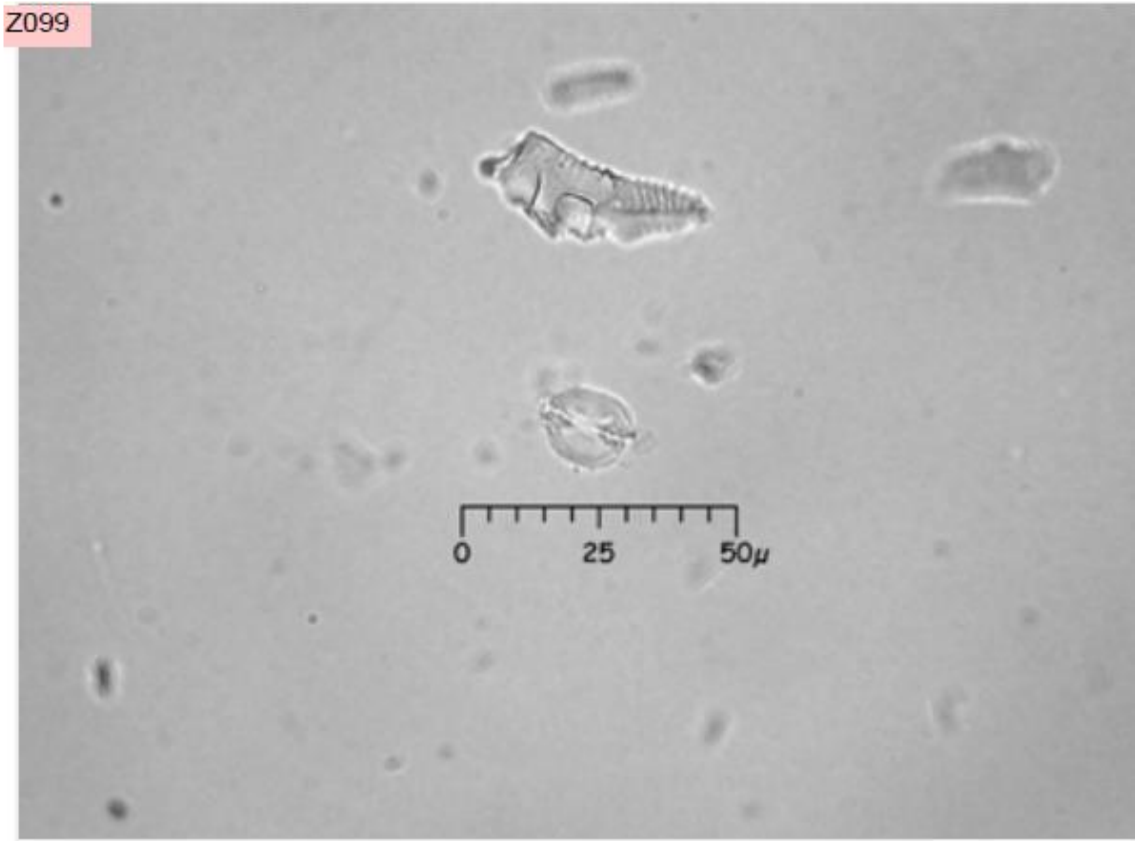
Side view (see also Record #139); tall hair base, small. Occurs in the leaf. Note the decorated schlerids in background--these are common in the sample.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Caesaria sylvestris

Phytolith

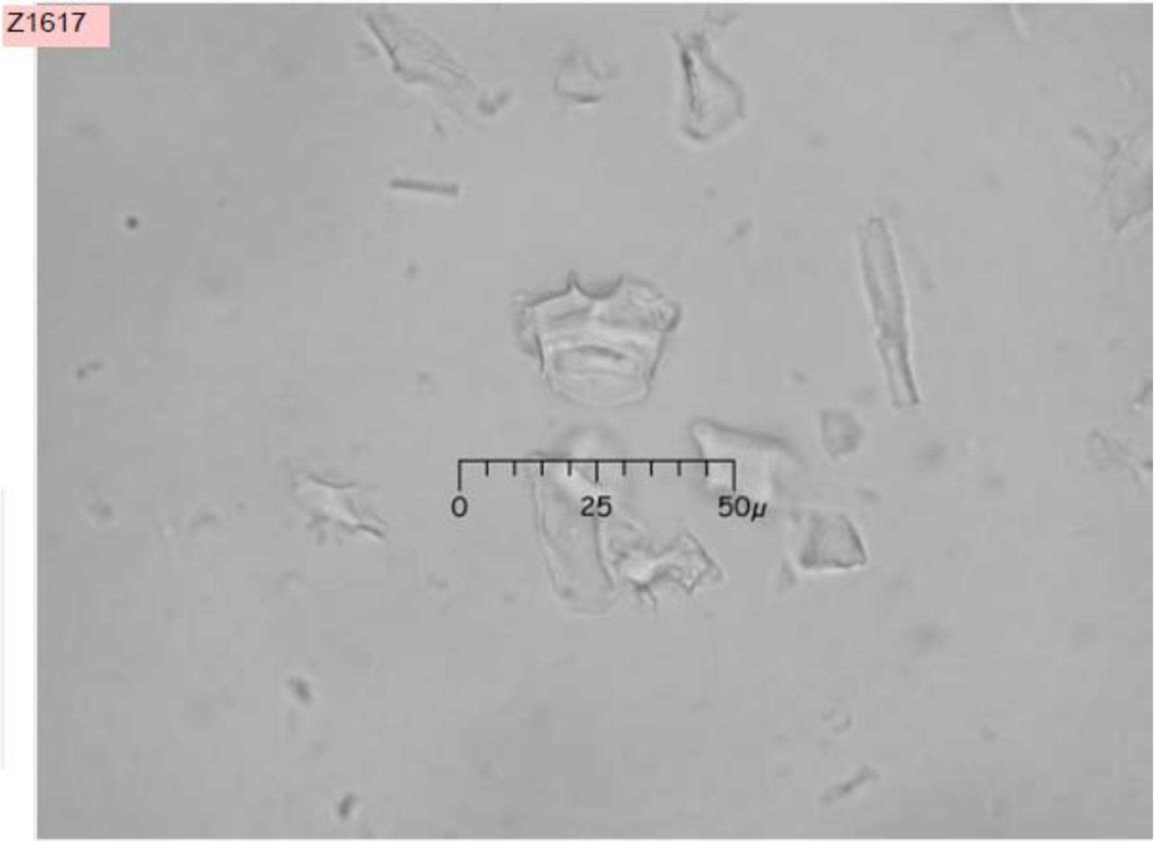
Stomate with two subsidiary cells.
Diagnostic level: not diagnostic



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Caesaria sylvestris

Phytolith



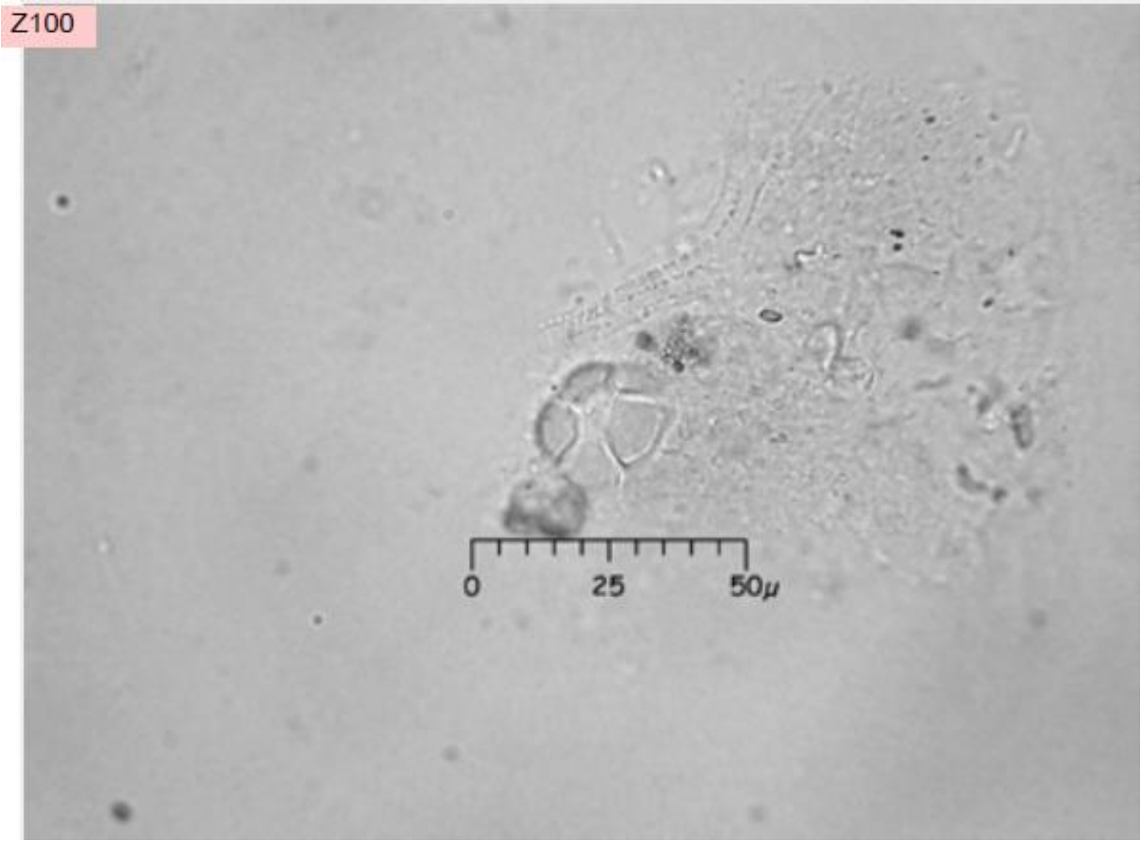
Top view. See Records #140,139 for a variation of the same body. Occurs in the leaf. Small, tall hair cell base. Note the decorated schlerids in background--these are common in the sample. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleuranthodendron lindenii

Phytolith

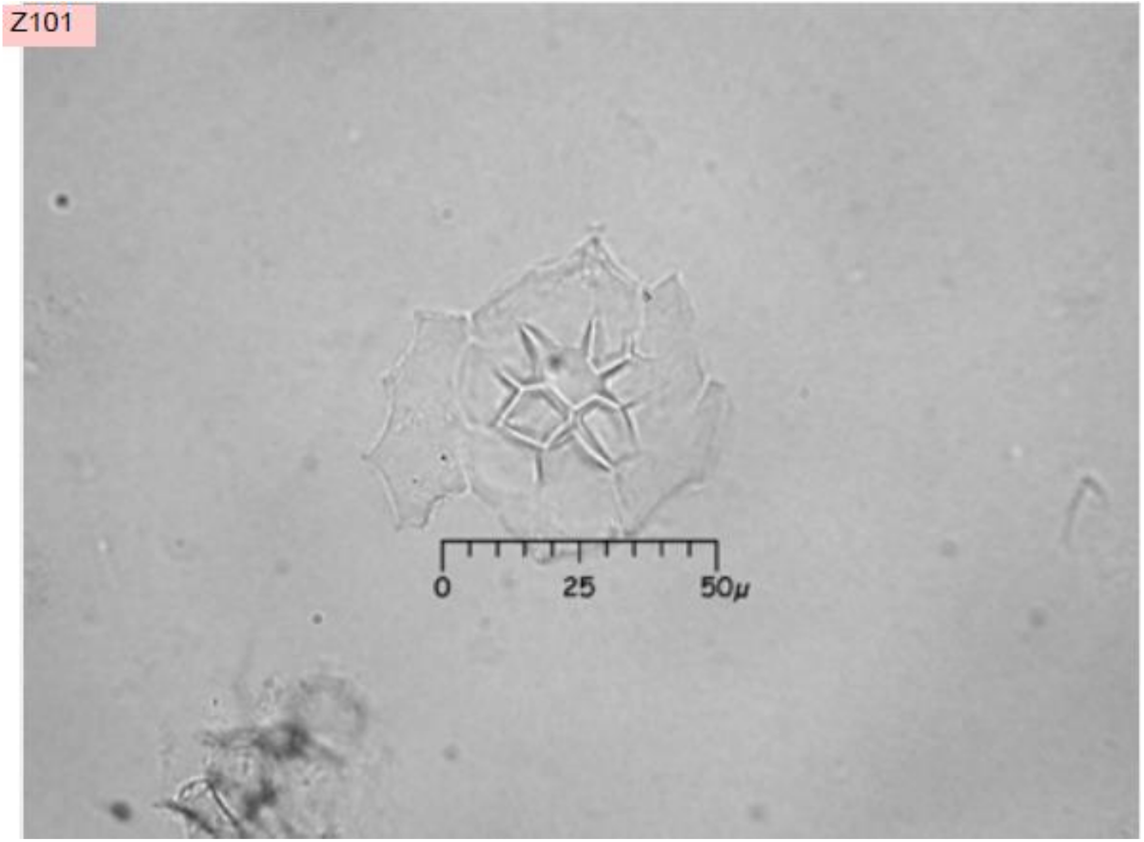
Occurs in the leaf. Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleuranthodendron lindenii

Phytolith



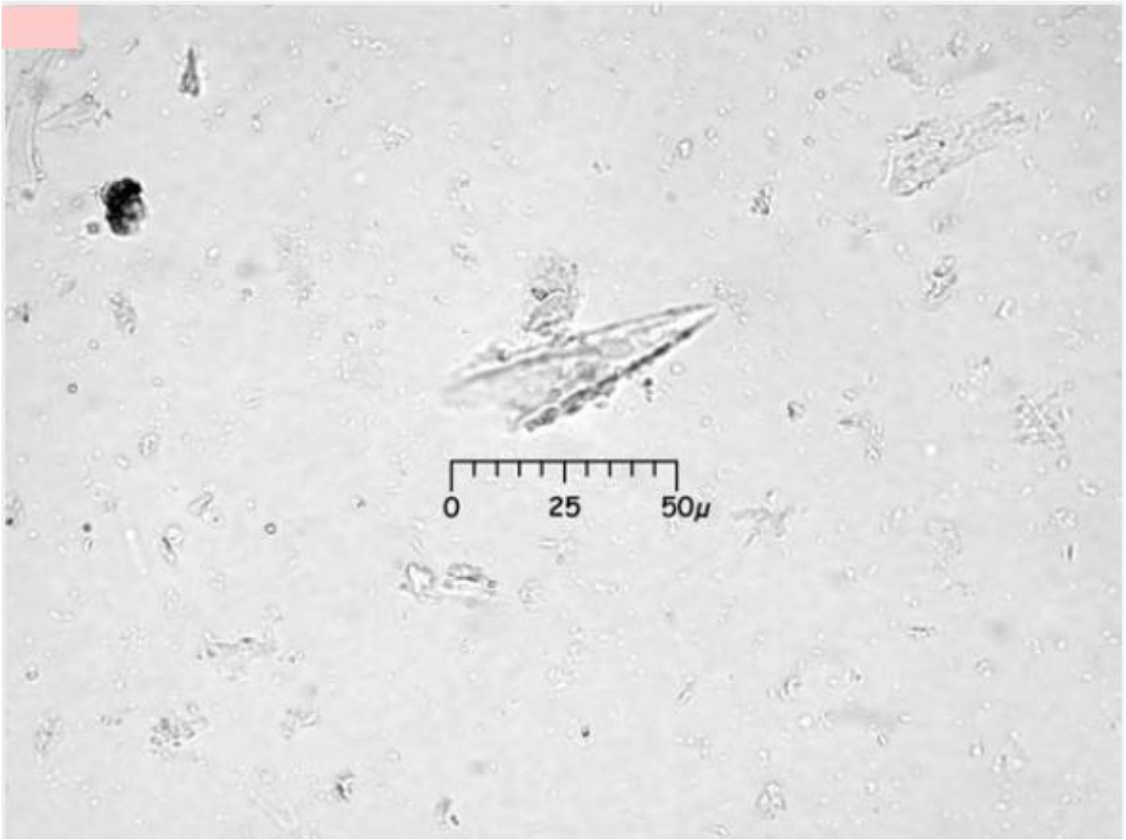
Occurs in the leaf. In this example, the surrounding disk is not completely developed.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleuranthodendron lindenii

Phytolith

Slide 1377 leaf.
Diagnostic level: family

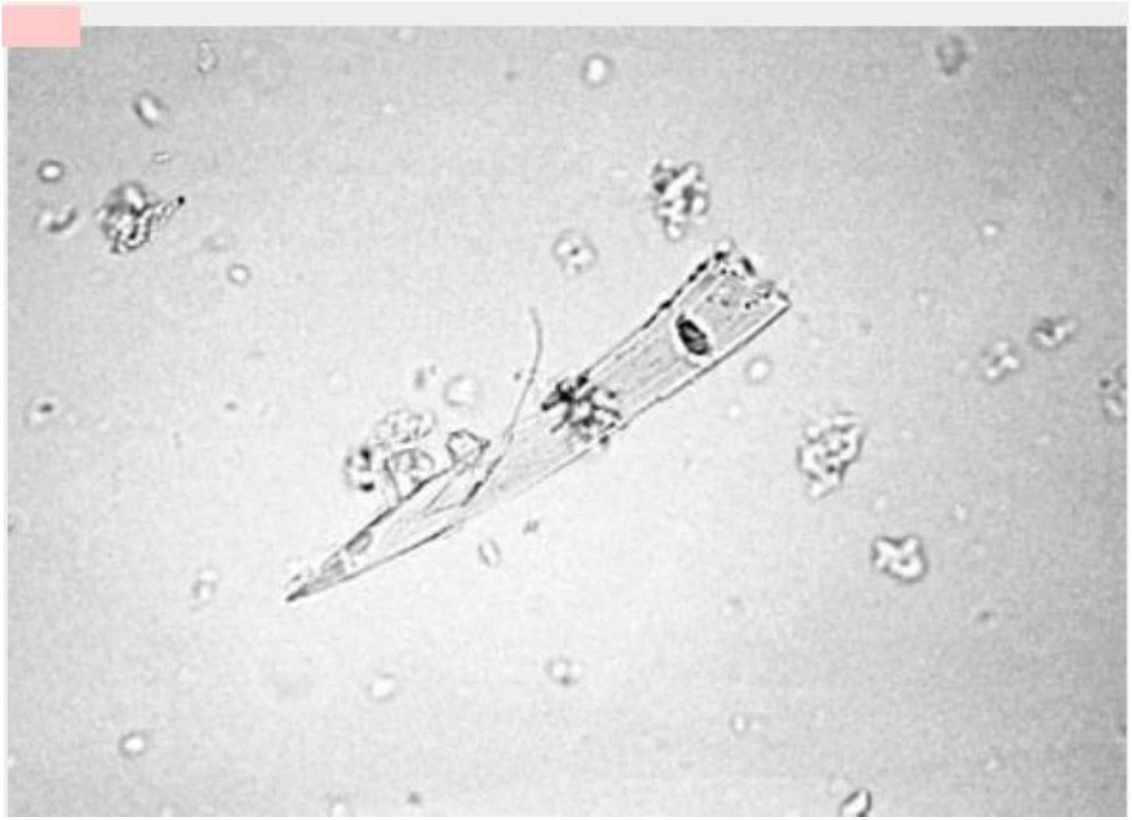


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pueraria phaseoloides

Phytolith

Moderate to common in abundance.
Diagnostic level: family

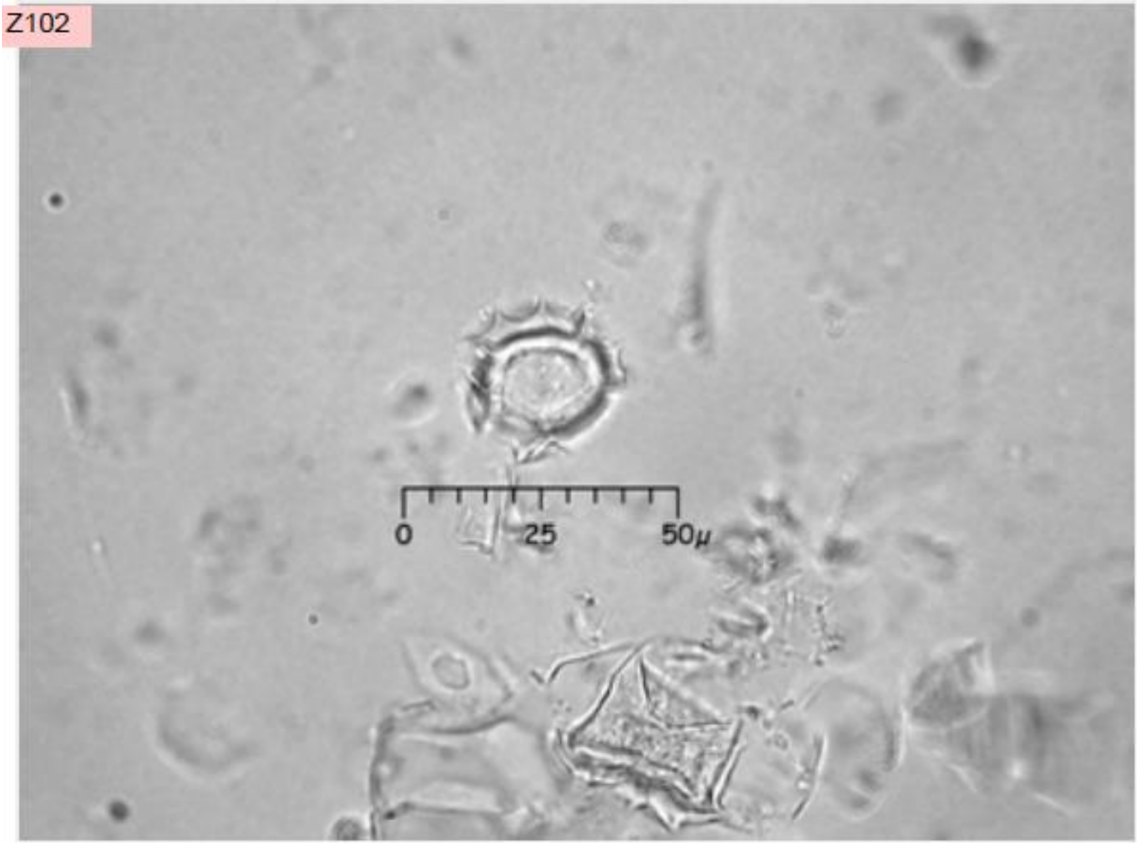


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Tetrathylacium macrophyllum

Phytolith

Occurs in the leaf. Diagnostic level: family



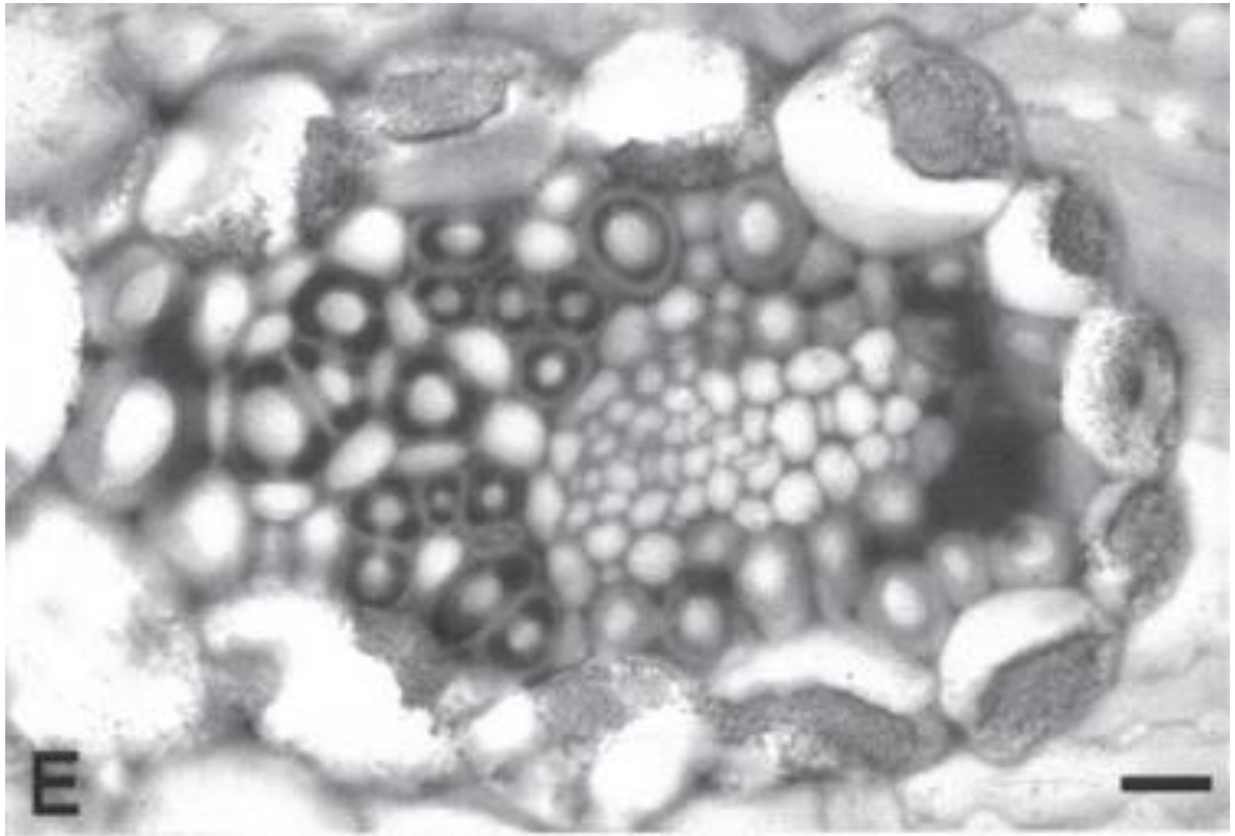
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

HAEMODORACEAE

Conostylis bracteata

Phytolith

Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. E. Conostylis bracteata (Haemodoraceae), large quantities of silica sand in vascular bundle-sheath cells (bar = 10 µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Anigozanthos flavida

Phytolith

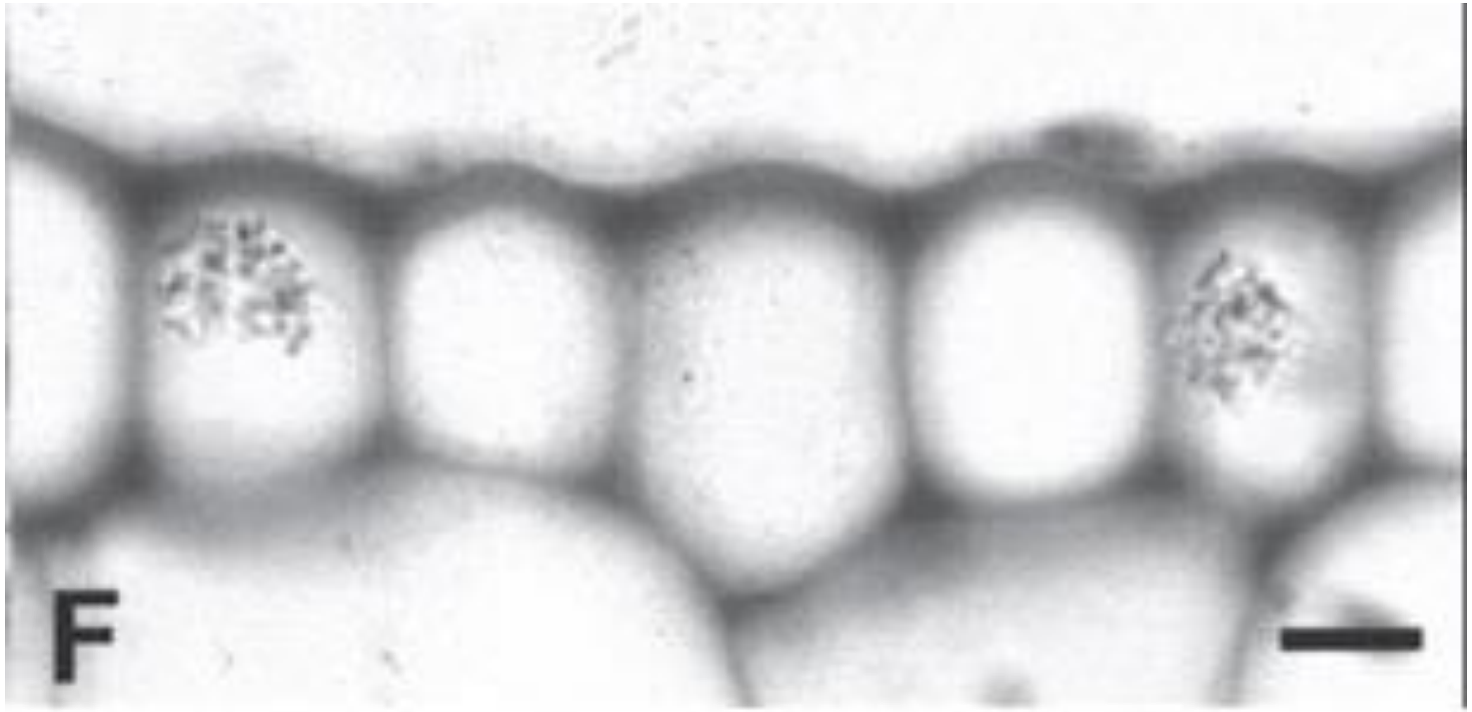


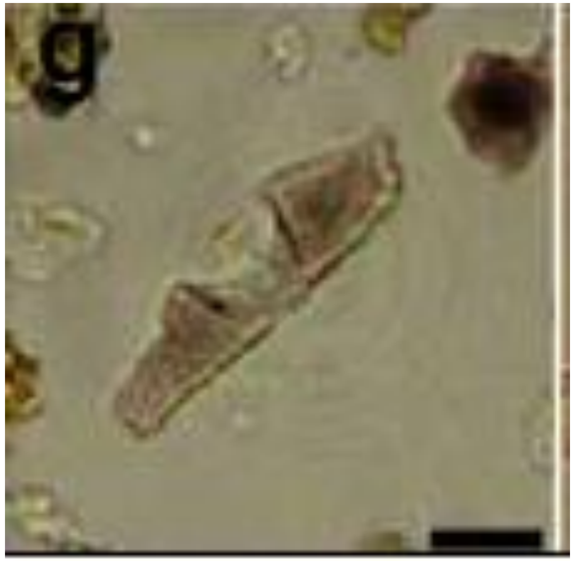
Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. F. Anigozanthos flavida (Haemodoraceae) epidermal cells containing silica sand (bar = 10 µm)

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

HELICONIACEAE

Heliconiaceae

Phytolith



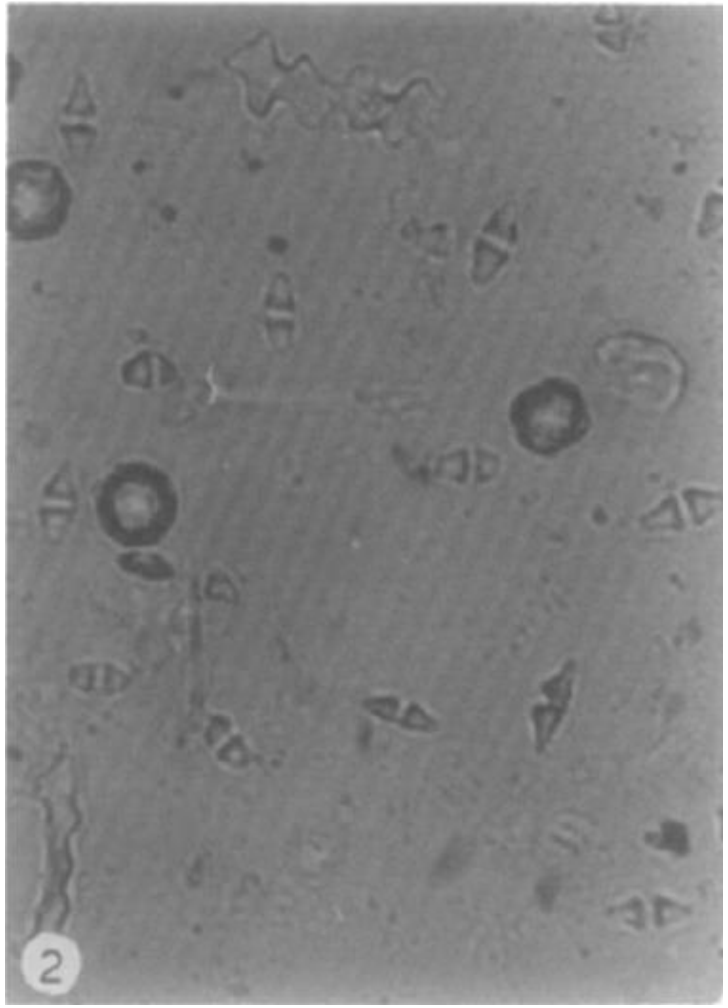
g. Morphotype with trough diagnostic of the wild plantain family (Heliconiaceae).

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Heliconia sp.

Phytolith

2. Silica bodies with troughs from Heliconia (250 x). Also present are spherical rugulose phytoliths and two narrowly oblong sinuate phytoliths.



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Heliconia sp.

Phytolith

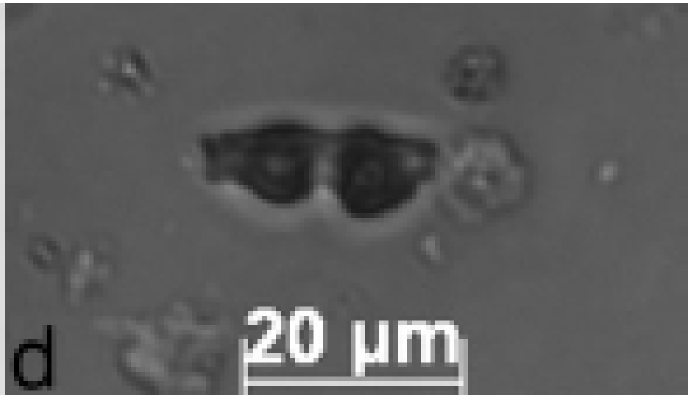


Fig. 3. Phytoliths from San Andre ́s. (d) A burned Heliconia phytolith from 1,115 cm

Pohl, Mary E. D., Dolores R. Piperno, Kevin O. Pope, and John Glendon Jones. 2007. Microfossil Evidence for Pre-Columbian Maize Dispersals in the Neotropics from San Andres, Tabasco, Mexico. *Proceedings of the National Academy of Sciences* 104 (16):6870–75. http://www.pnas.org/cgi/doi/10.1073/pnas.0701425104.

Heliconia sp.

Phytolith

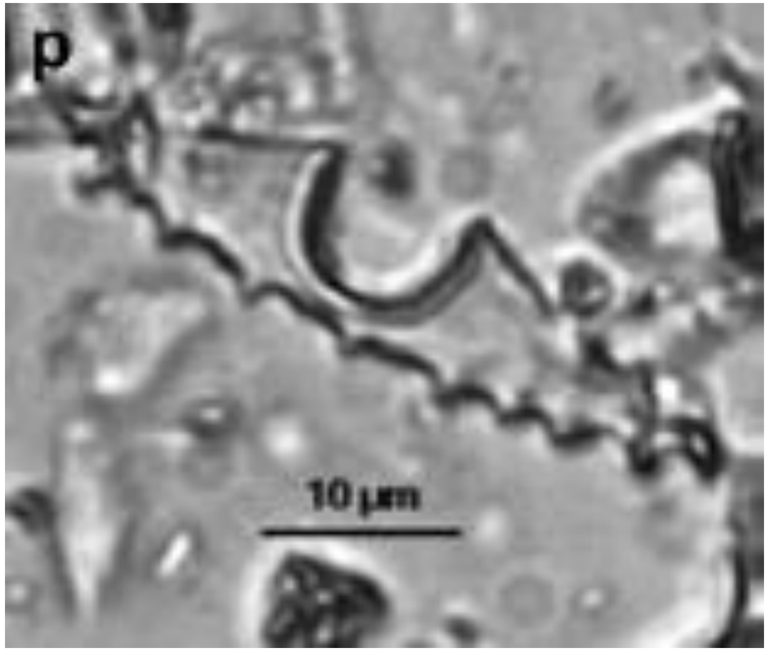


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. p) Decorated Heliconia body with troughs (K-VIIIM3.1, 0e10 cm)

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Heliconia sp.

Phytolith

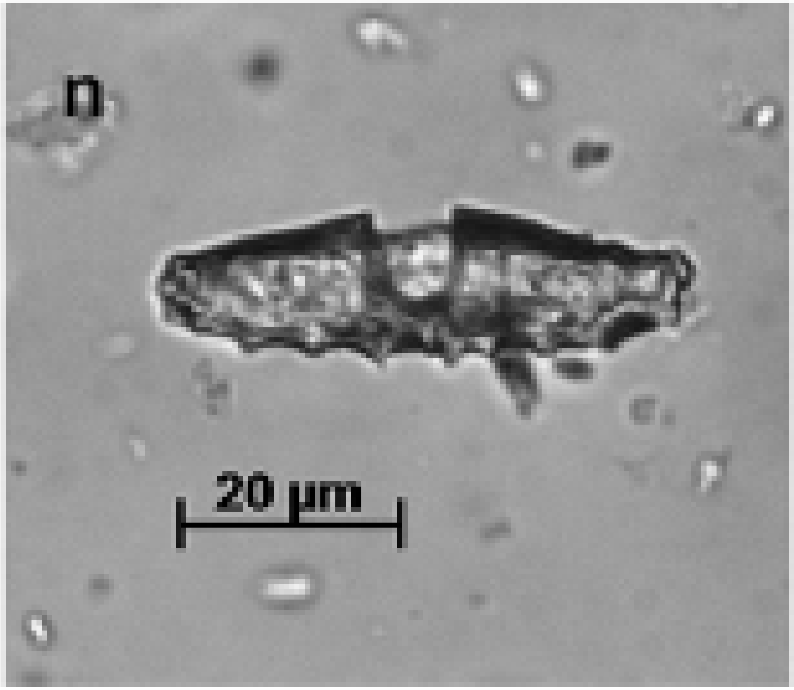


Fig. 5. Selected microbotanical remains. Phytoliths: n) Heliconia troughed phytolith (LM 02-2014)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Heliconia sp.

Phytolith

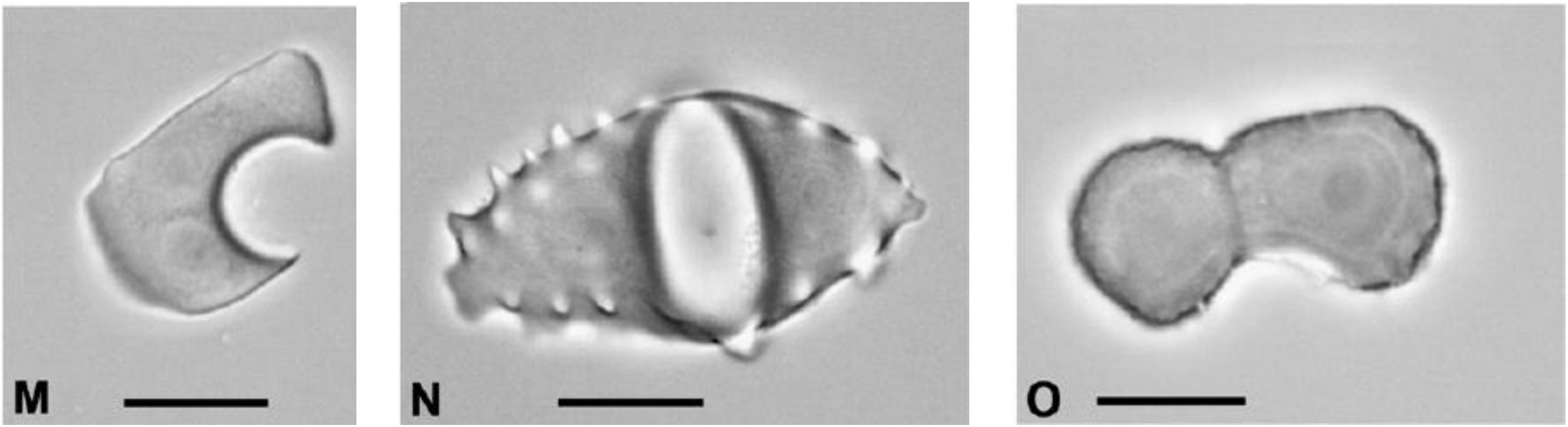


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). M,T1psilate trough from Heliconia sp.rhizome.N, T1 papillate trough from Heliconia sp.rhizome.O,T3 trough (fused globulars)from Heliconia sp.rhizome. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Heliconia bourgaeana

Phytolith

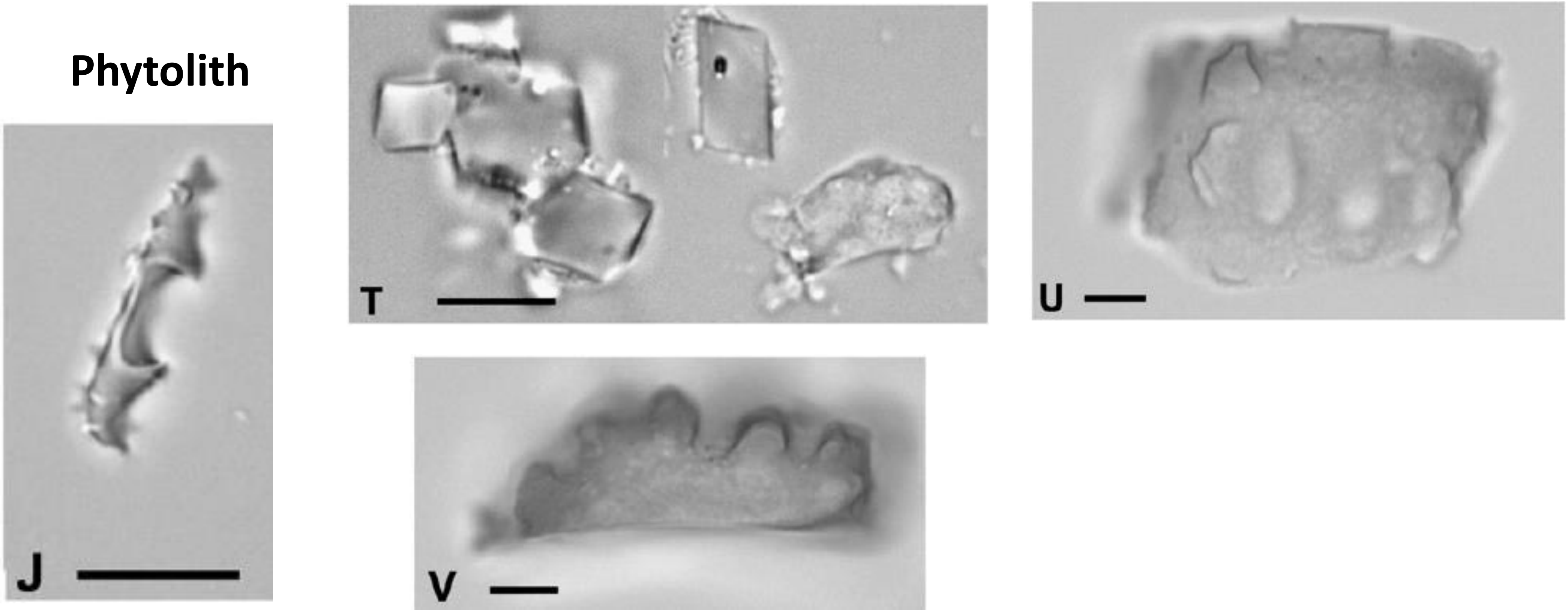


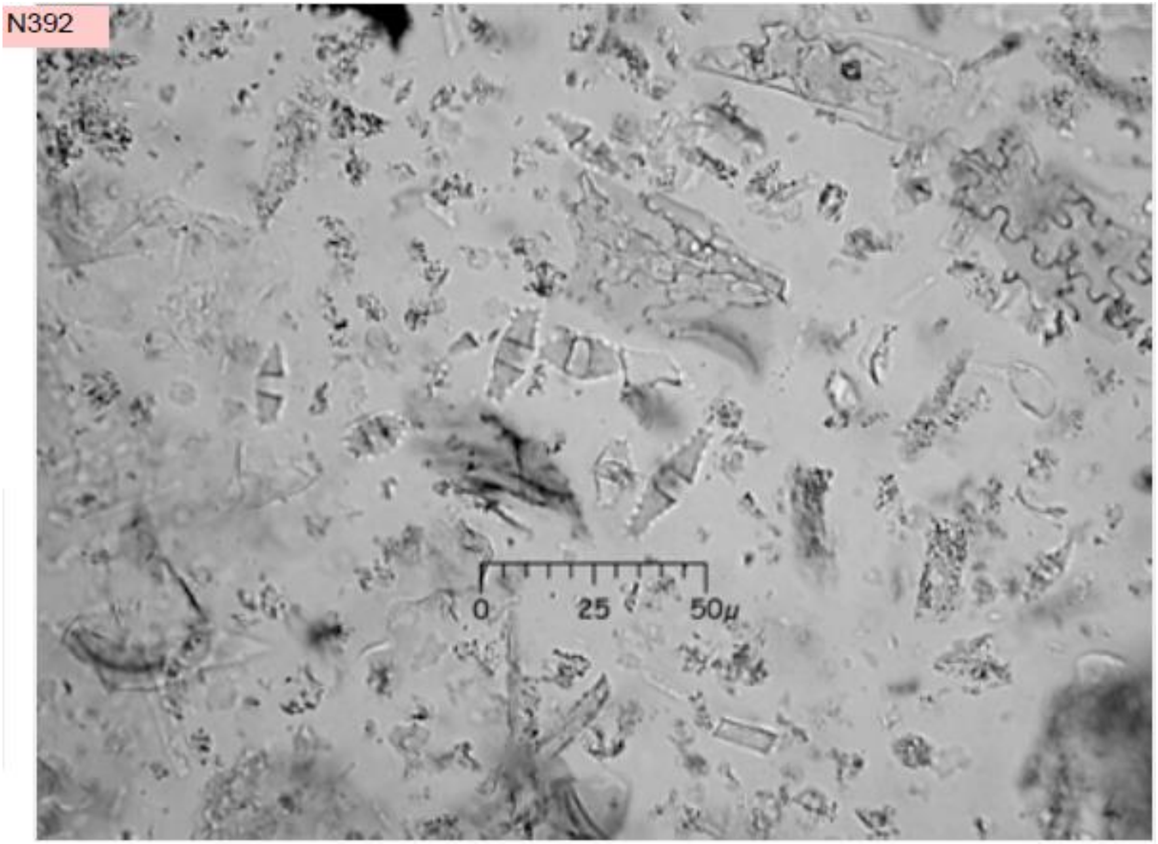
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). .J, T1 papillate trough from Heliconia bourgaeana leaf. T, small polygonal-psilates, occasionally with concavities, from Heliconia bourgaeana fruit. U, top-view of tabular-castelate from Heliconia bourgaeana fruit. V, side-view of tabular-castelate from Heliconia bourgaeana fruit. Scale bars: A–J,M–Z=12 µm; K, L=5 µm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Heliconia curtispatha

Phytolith

Be careful to rotate these phytoliths to see their shape (ellipse or blocky) and the depth of the trough. Check for surface decoration.
Diagnostic level: genus

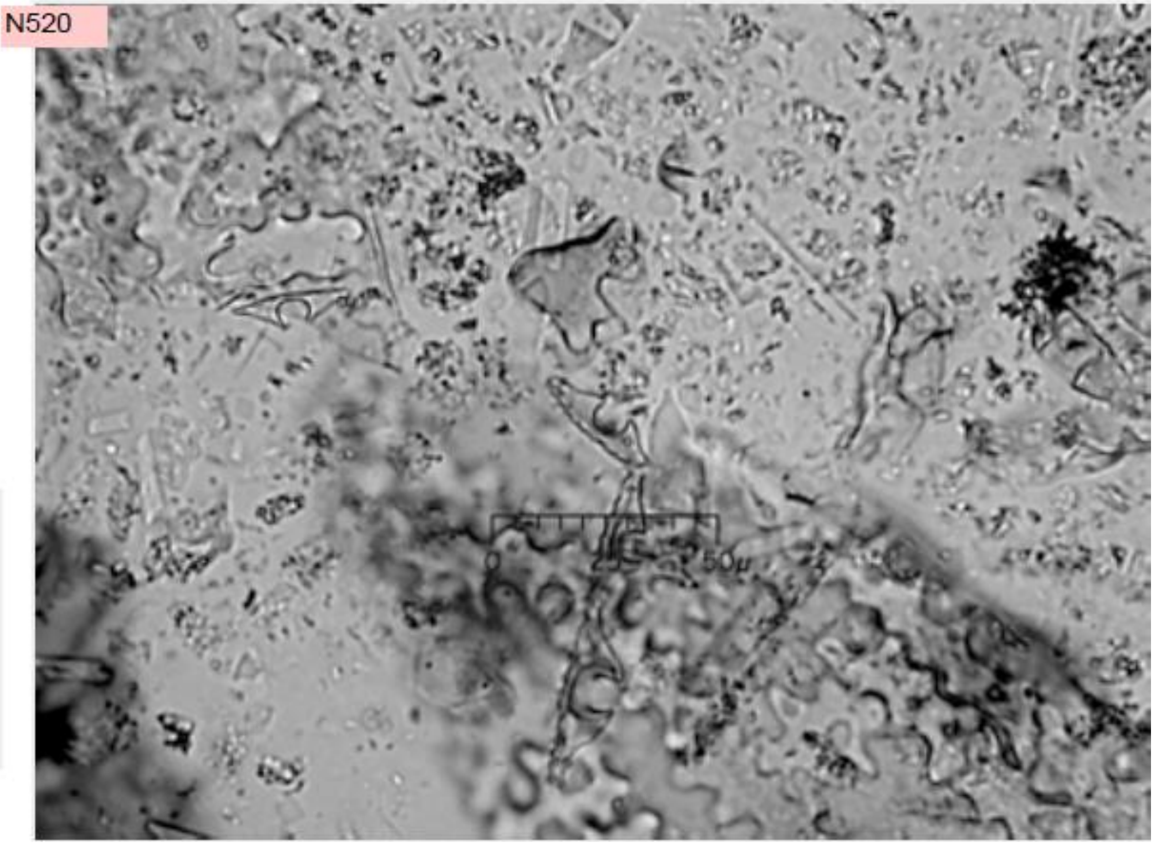


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliconia curtispatha

Phytolith

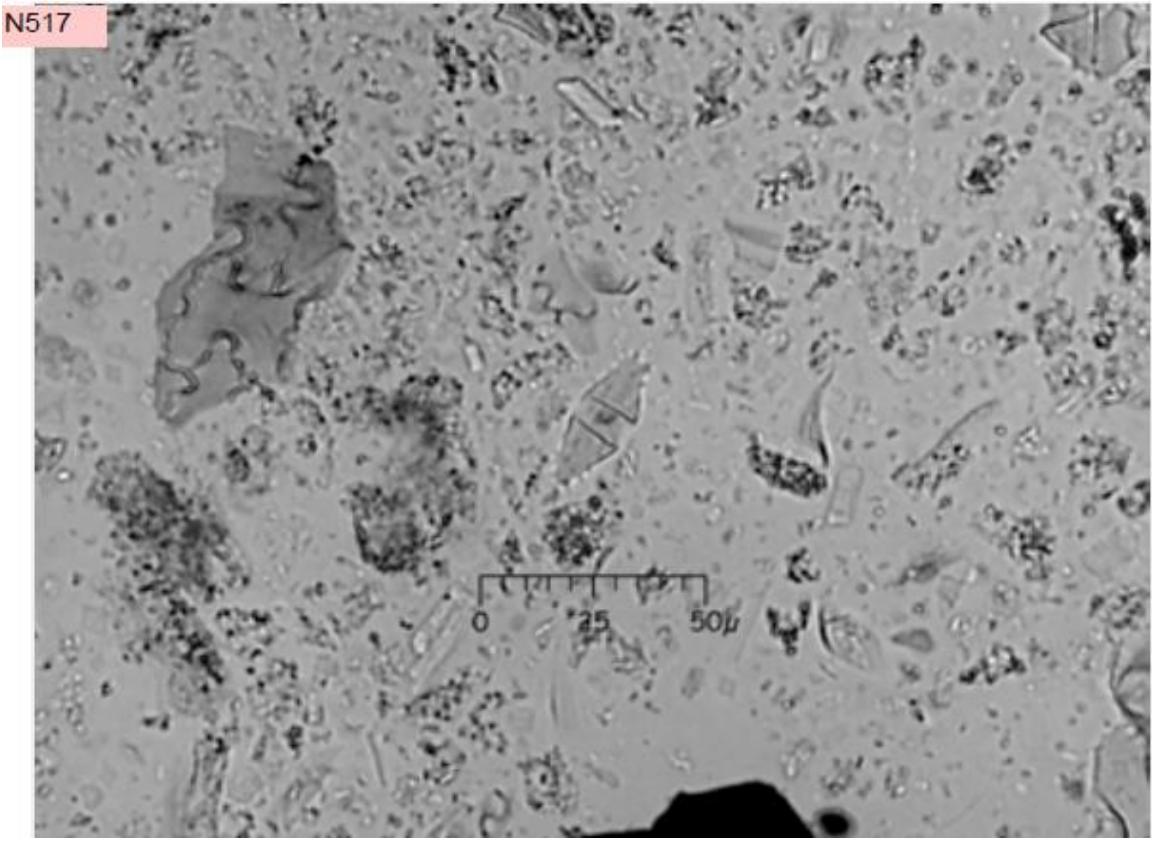
Be careful to rotate these phytoliths to see their shape (ellipse or blocky) and the depth of the trough. Check for surface decoration.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliconia curtispatha

Phytolith



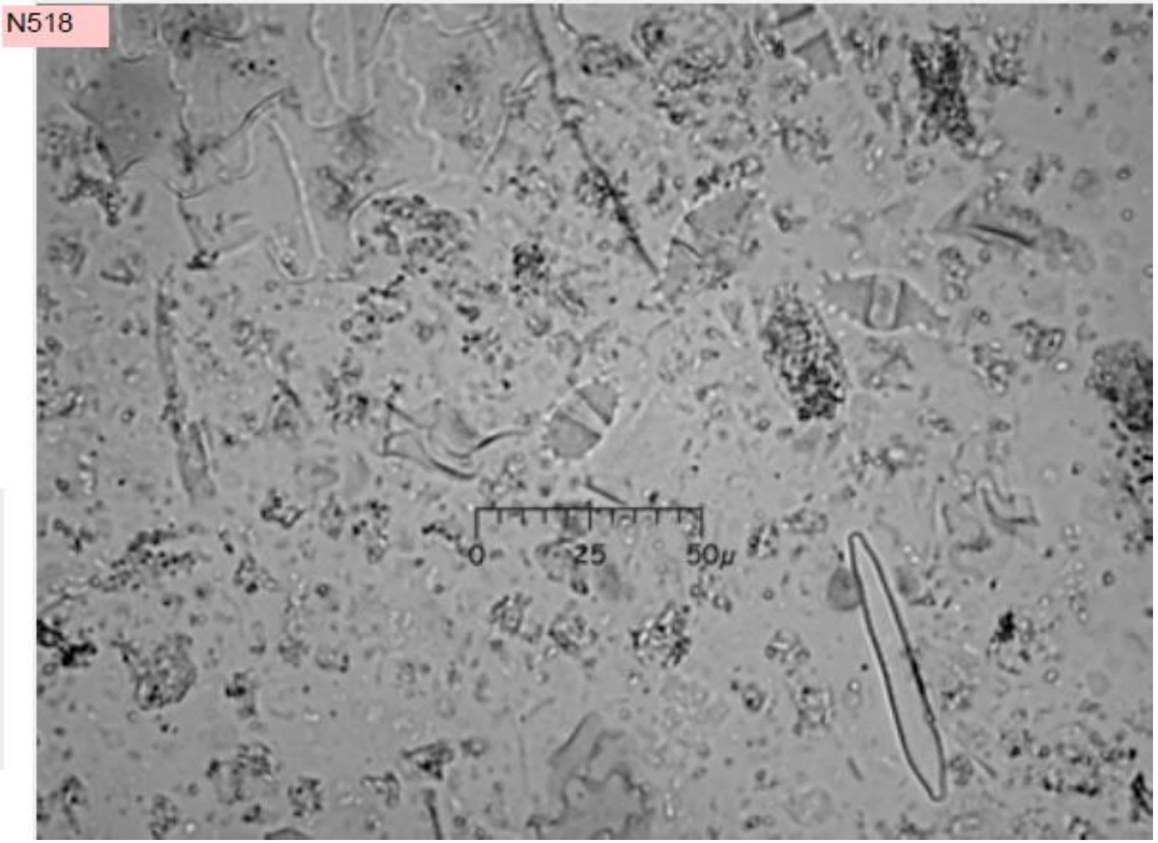
Be careful to rotate these phytoliths to see their shape (ellipse or blocky) and the depth of the trough. Check for surface decoration.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliconia curtispatha

Phytolith

Be careful to rotate these phytoliths to see their shape (ellipse or blocky) and the depth of the trough. Check for surface decoration.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Heliconia lathispatha

Phytolith

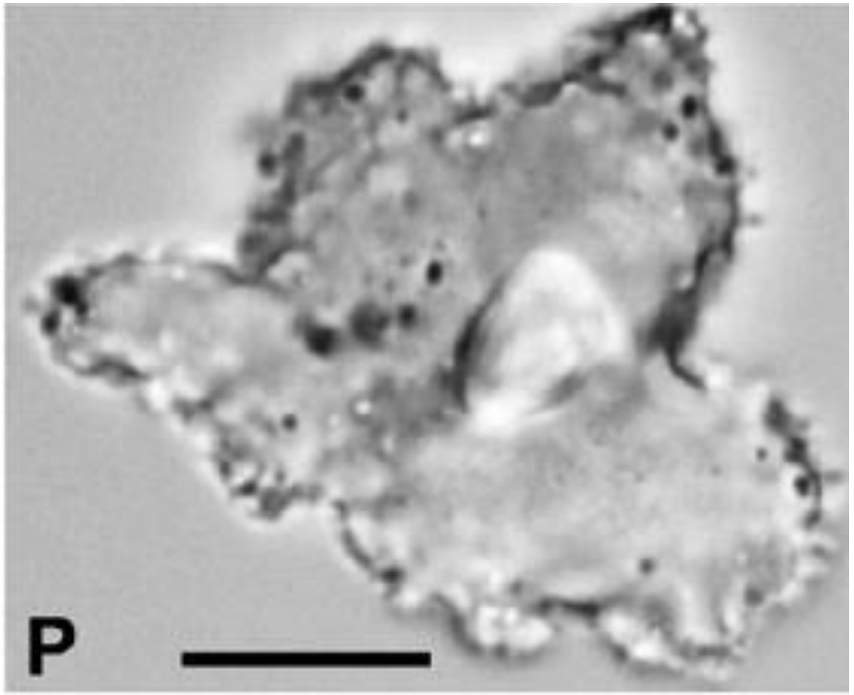


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). .P,Kn1 from Heliconia lathispatha seed. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Heliconia librata

Phytolith

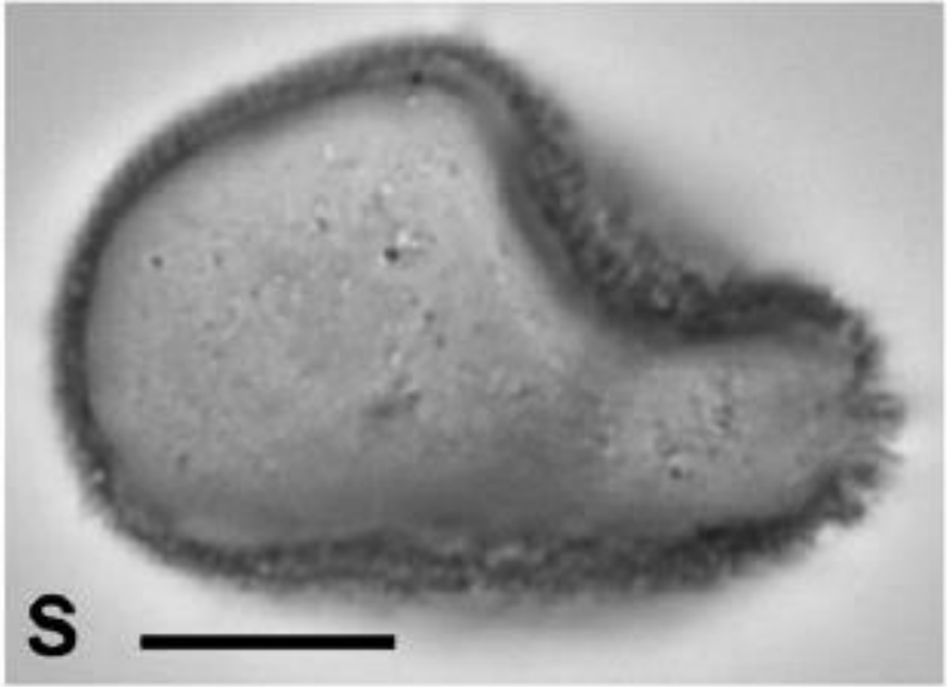


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). S, subglobular-granulate from Heliconia librata fruit. Scale bars: A–J,M–Z=12 µm; K, L=5 µm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Heliconia pendula

Phytolith

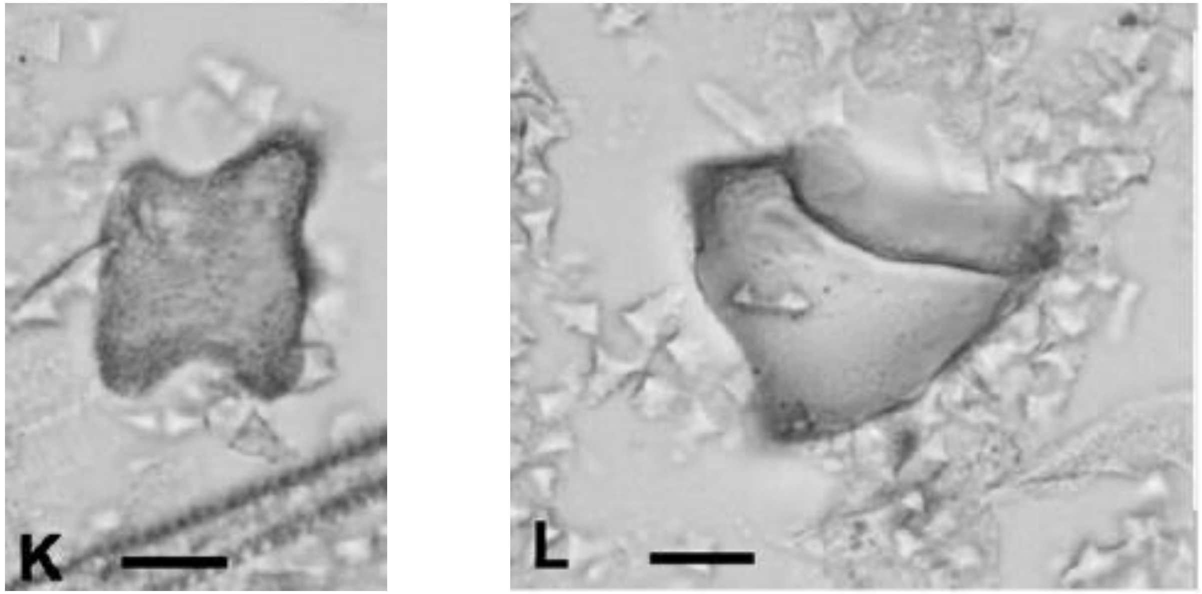


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). K,Ta3 (tabular-granulate) from Heliconia pendula leaf. L, thickened Ta3 from Heliconia pendula leaf. Scale bars: A–J,M–Z=12 µm; K, L=5 µm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Heliconia psittacorum

Phytolith

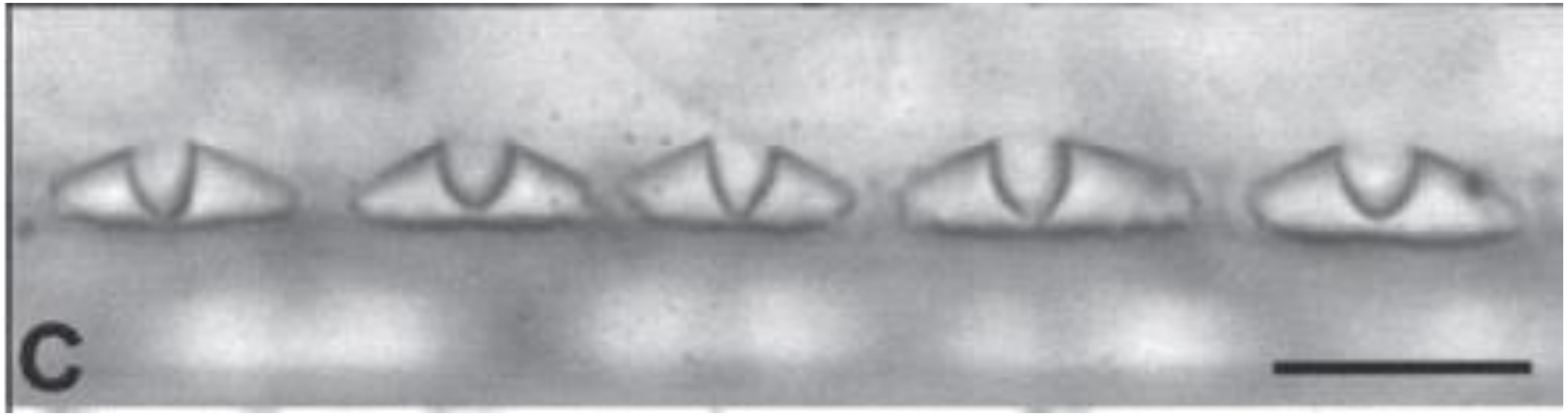


Fig. 3. Various silica body morphologies found in the order Zingiberales. C. Heliconia psittacorum (Heliconiaceae), trough-shaped silica bodies over vascular bundle-sheath fibers (bar = 20 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Heliconia psittacorum

Phytolith

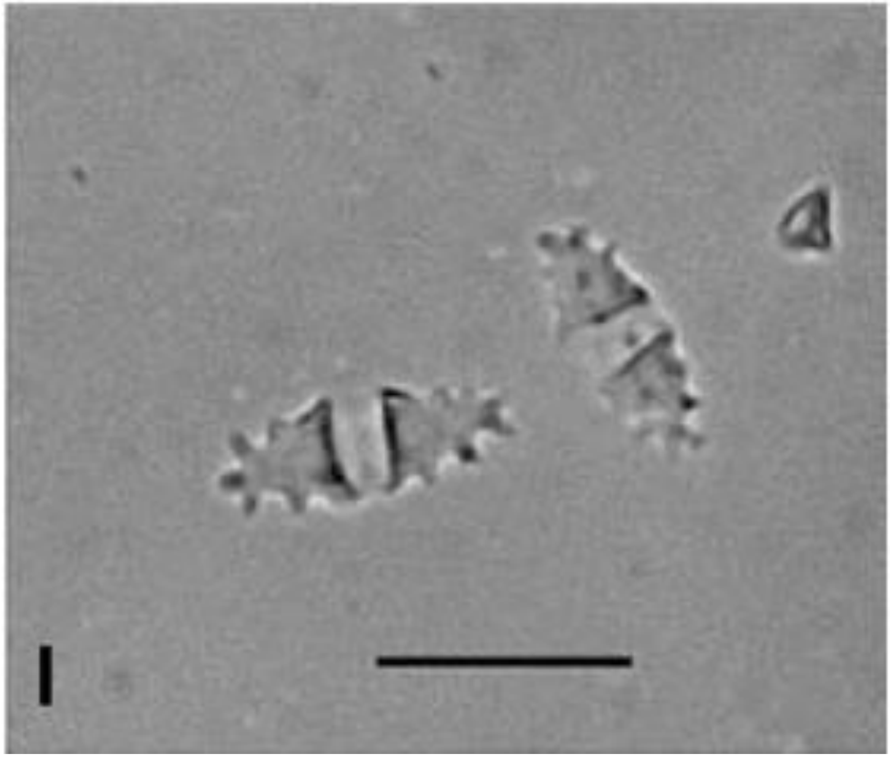


Fig. 3. Phytoliths from non-grass monocots. l) Troughed bodies from Heliconia psittacorum

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Heliconia aff. tortuosa

Phytolith

Fig. 3. Various silica body morphologies found in the order Zingiberales. D. Heliconia aff. Tortuosa (Heliconiaceae), trough-shaped silica bodies with silica fingers projecting from the base into the cell wall (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Heliconia velutina

Phytolith

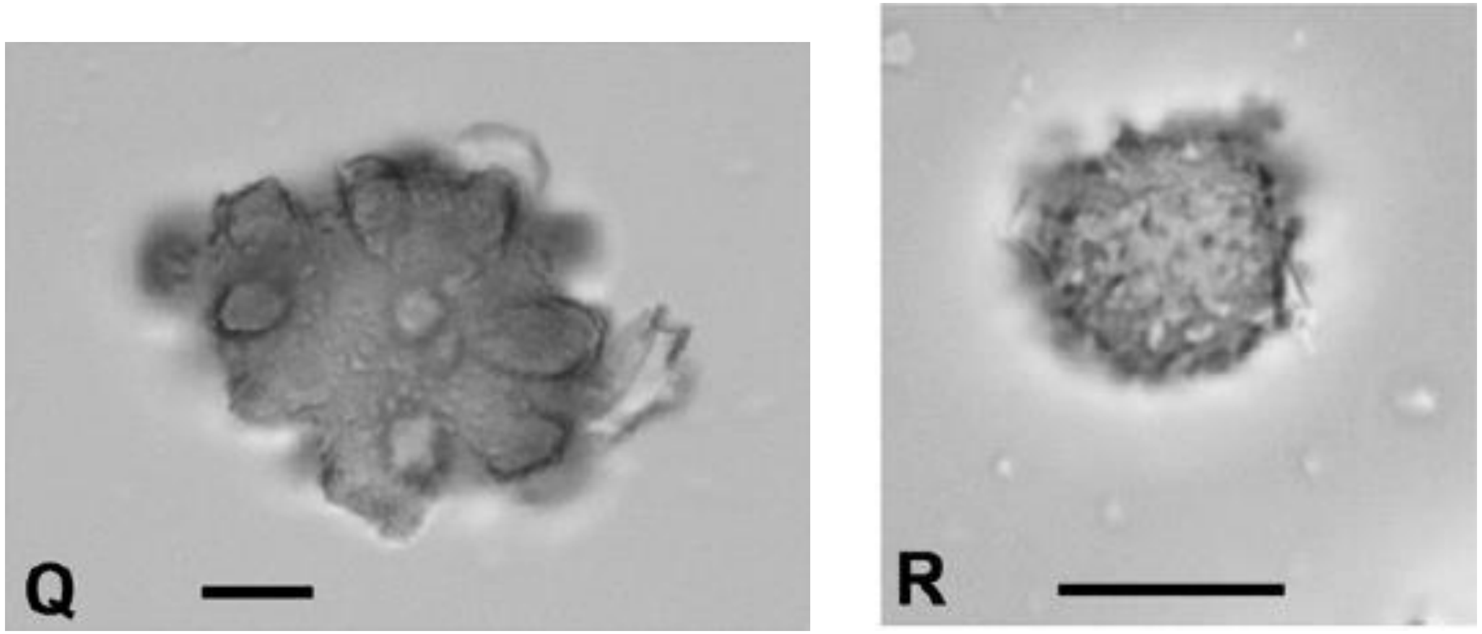


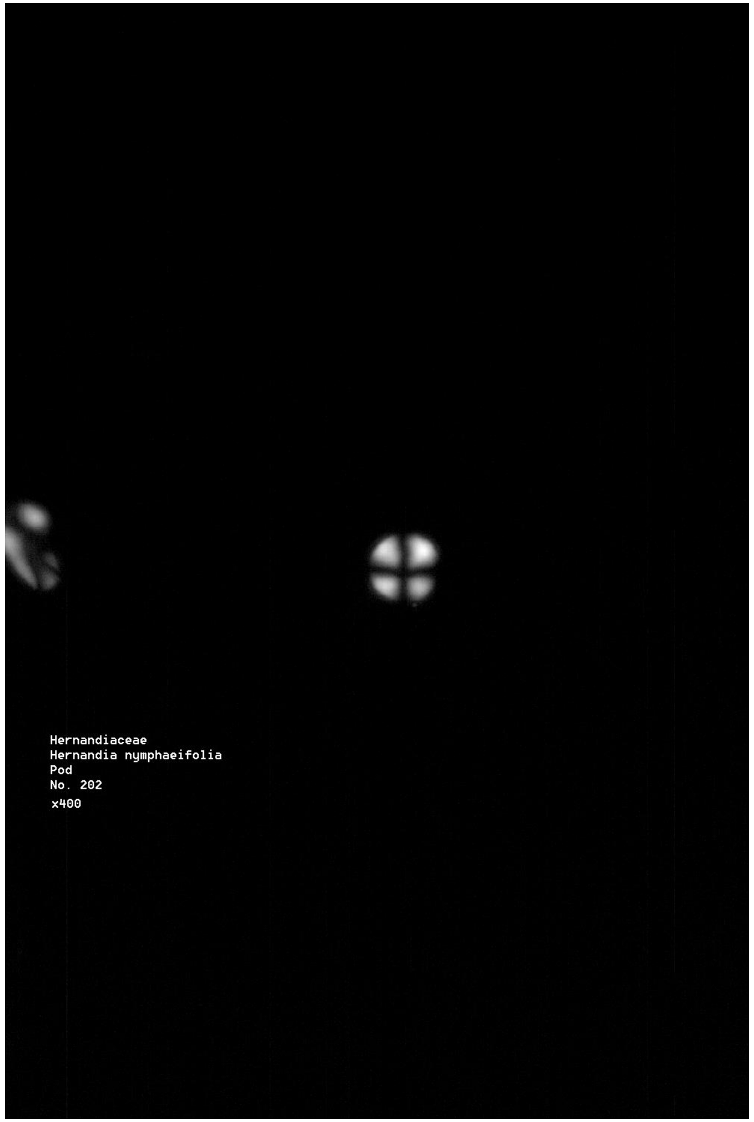
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). Q, Kn2 knobby from H. velutina fruit. R, globular-granulate from Heliconia velutina fruit. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

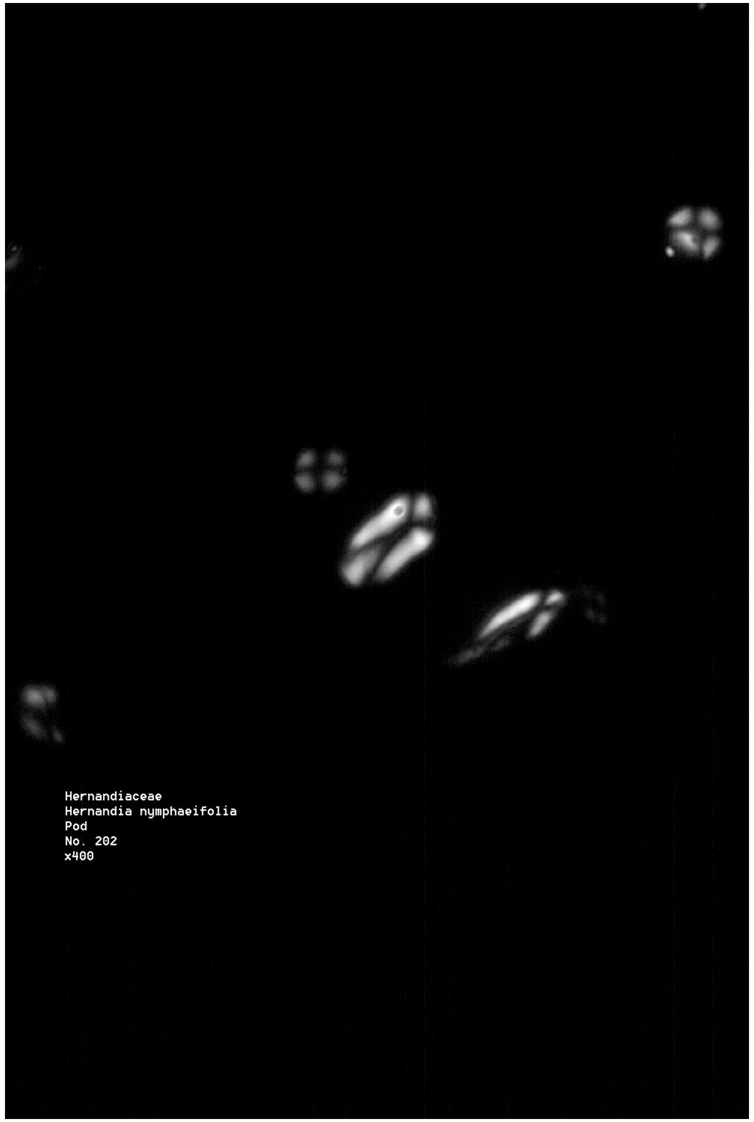
Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

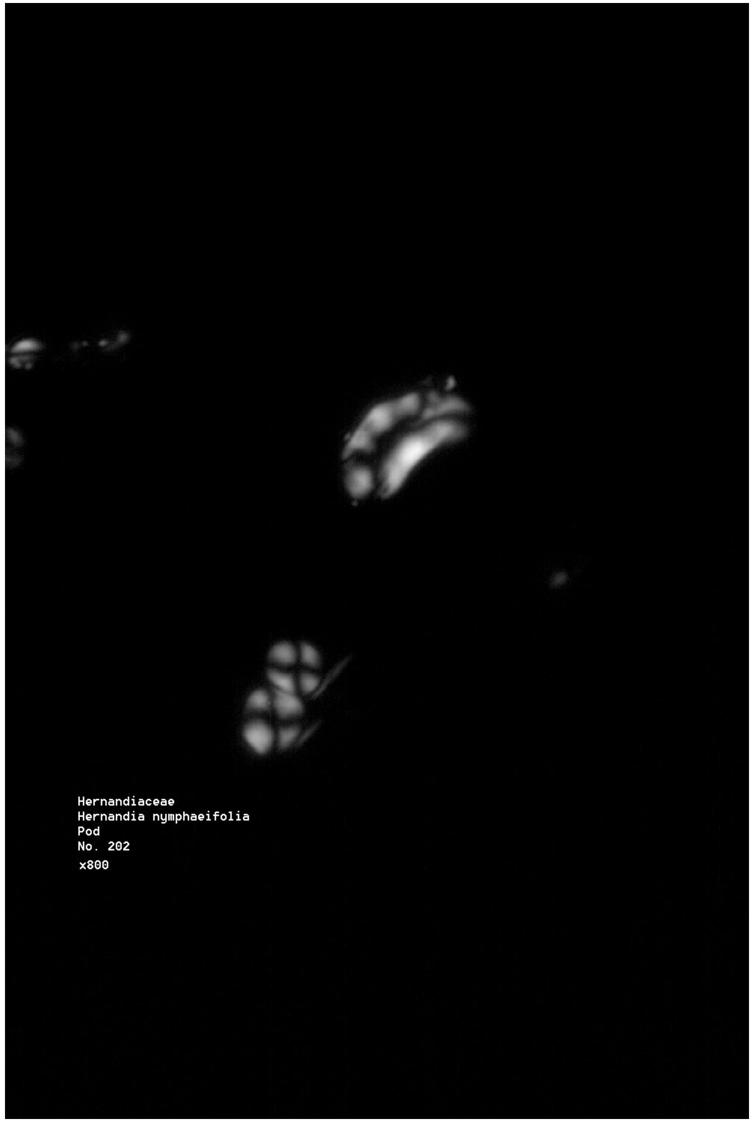
HERNANDIACEAE

Hernandia nymphaeifolia

Australian Museum,
McCown Archaeobotany
Laboratory Collection



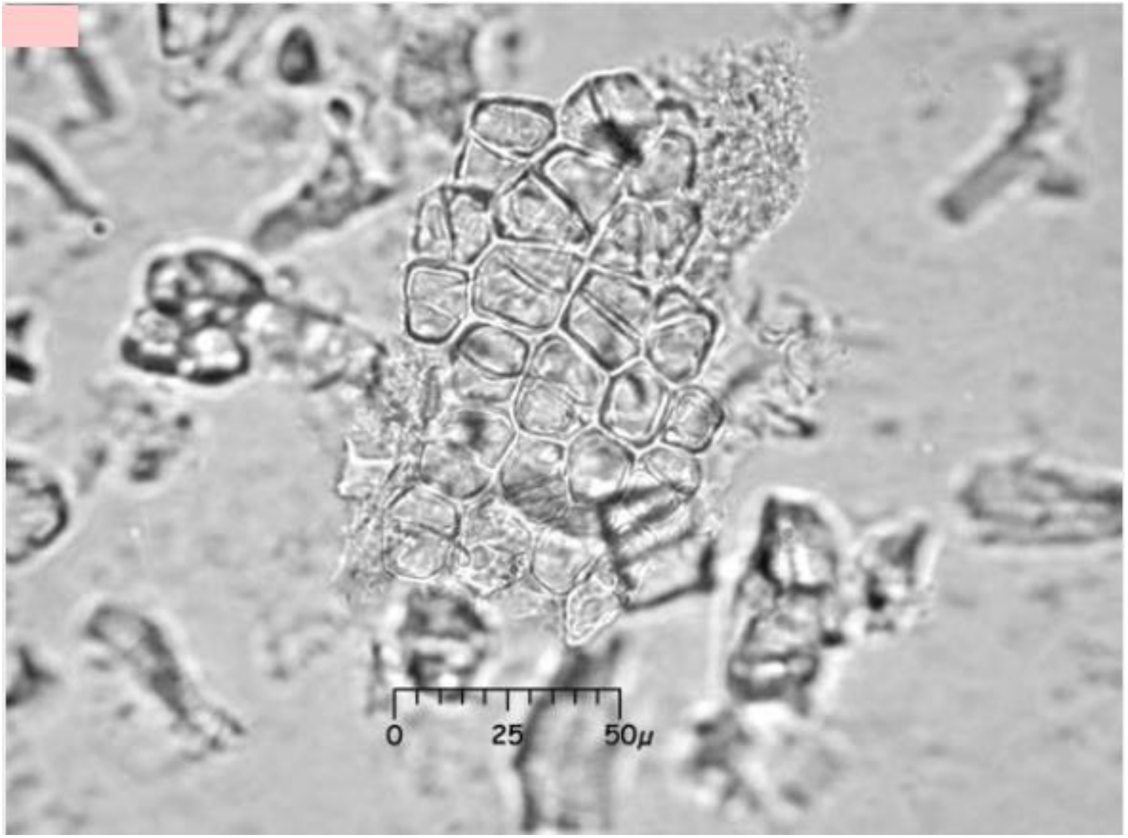




HUMIRIACEAE

Humiriastrum procerum

Phytolith



Occurs in leaf. Type defined by Cesar Vientimilla 05/1991. Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Humiriastrum subcrenatum

Phytolith

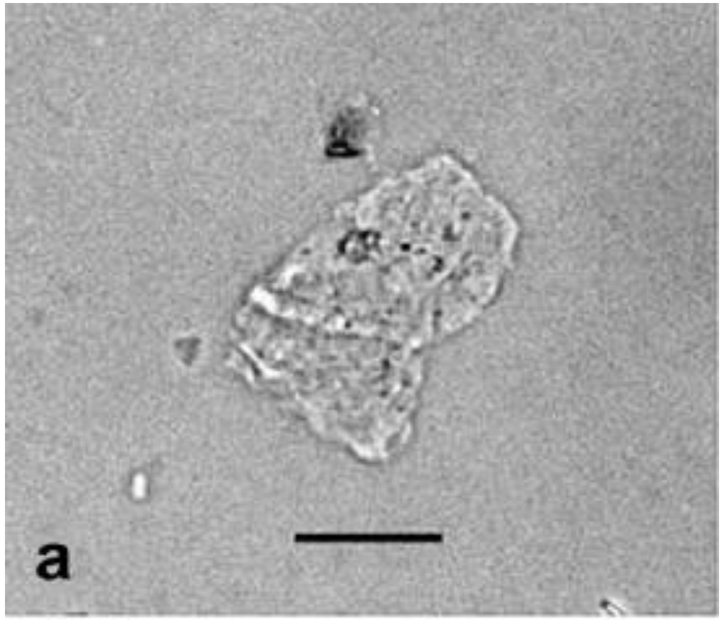


Fig. 2. Phytoliths with little or no taxonomic value. a) Polyhedral epidermis from Humiriastrum subcrenatum

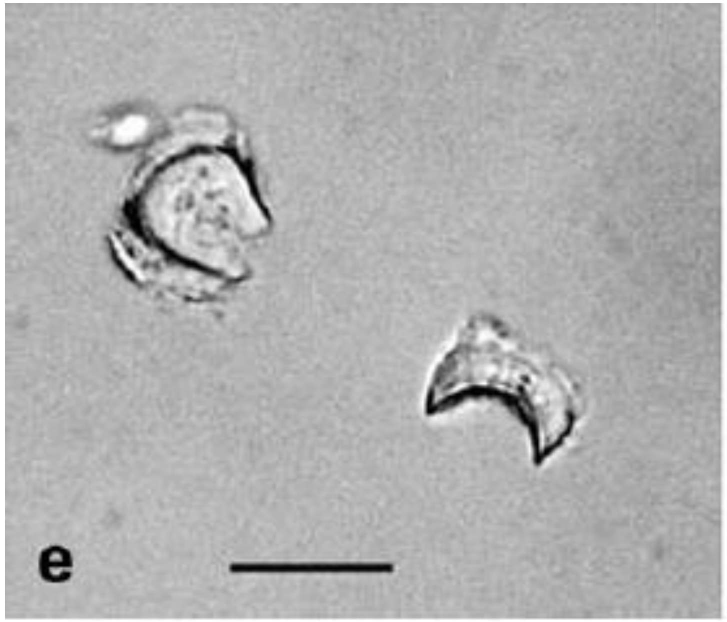
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

HYMENOPHYLLACEAE

Trichomanes hostmannium

Phytolith

Fig. 6. Phytoliths from Pteridophytes. e) Bowl-shaped phytoliths from Trichomanes hostmannium



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

JUGLANDACEAE

Juglans australis

Juglandaceae *Juglans australis* "nuez criolla"

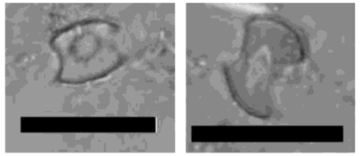
Phytolith assemblage characterization

nut

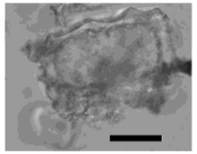
Endocarp and seed embryo.

Non diagnostic phytoliths **(*):**

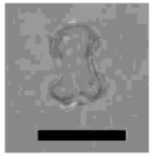
a) Bilobate (saddle) central depressed silica phytolith. Rare.



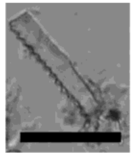
b) Rectangular irregular central depressed silica phytolith. Rare.



c) Tri-lobate irregular silica phytolith. Rare.



d) Rectangular dorsal echinate silica long cell. Rare.



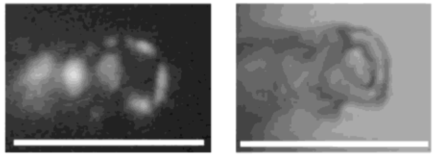
References: Reported as not common epidermis, hair bases, mesophyl in Piperno 1988:35 for *Juglans nigra* leaf (quoting Geis 1973).

Starch assemblage characterization

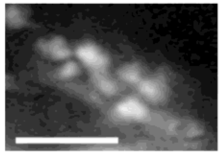
nut

Endocarp and seed embryo.

a) Single grains, variable in shape, oval, spherical, pear-shaped and irregular; variable in size, commonly from 9μm to 17μm, some to 45μm long length; not visible hilum and lamella; a centric hollow with similar shape to the contour of the grain; distinct centric cross, with four arms visible, meeting at a dark circular hollow.



b) Some compound grains, compounded by two subspherical granula. Granula shorter than single ones.



Scale bar = 20μm.

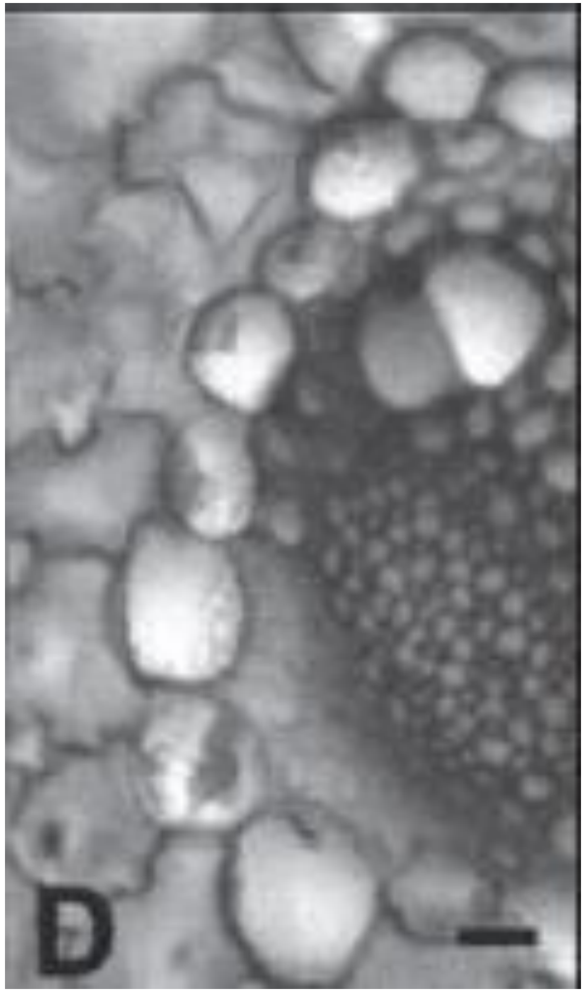
Korstanje and Babot, McCown Archaeobotany Laboratory Collection

JUNCACEAE

Juncus arabicus

Phytolith

Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. D. Juncus arabicus (Juncaceae), silica sand in vascular bundle-sheath cells (bar = 10µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Juncus inflexus

Phytolith

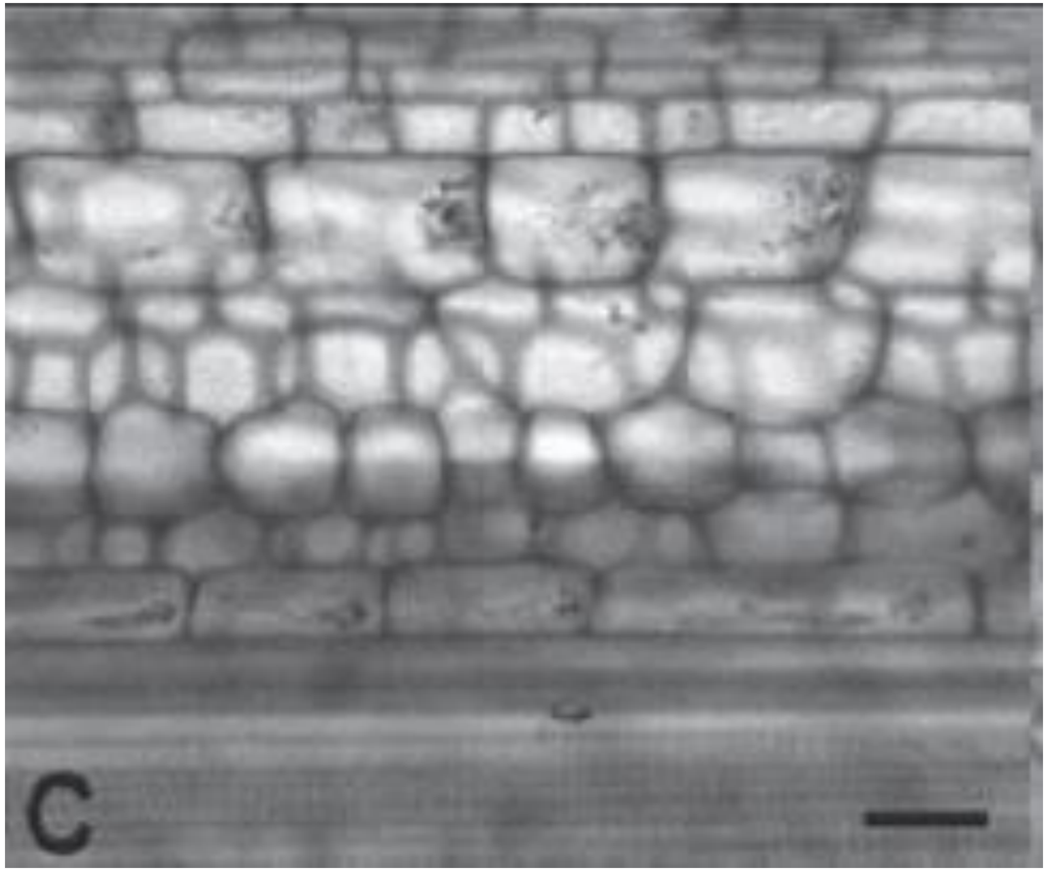


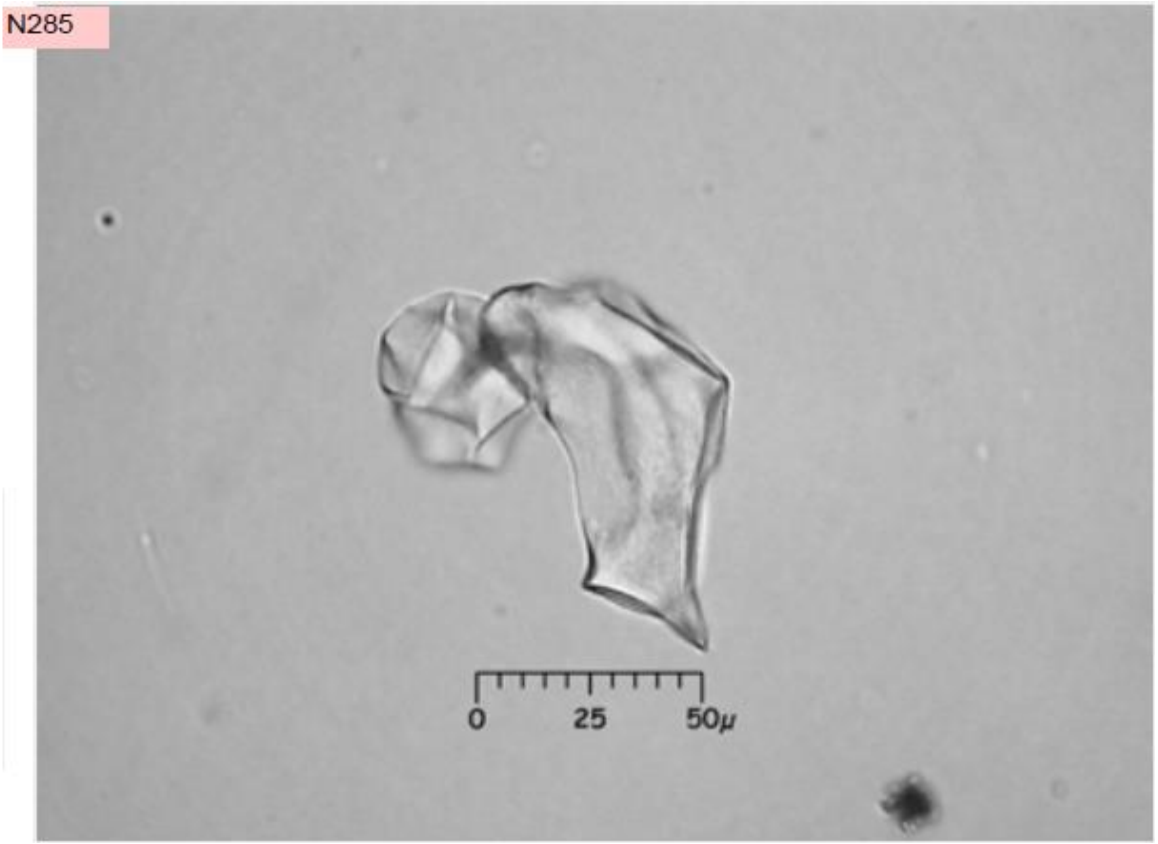
Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. C. Juncus inflexus (Juncaceae), silica sand in bundle-sheath cells (bar = 20 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

LAURACEAE

Aniba hostmanniana

Phytolith



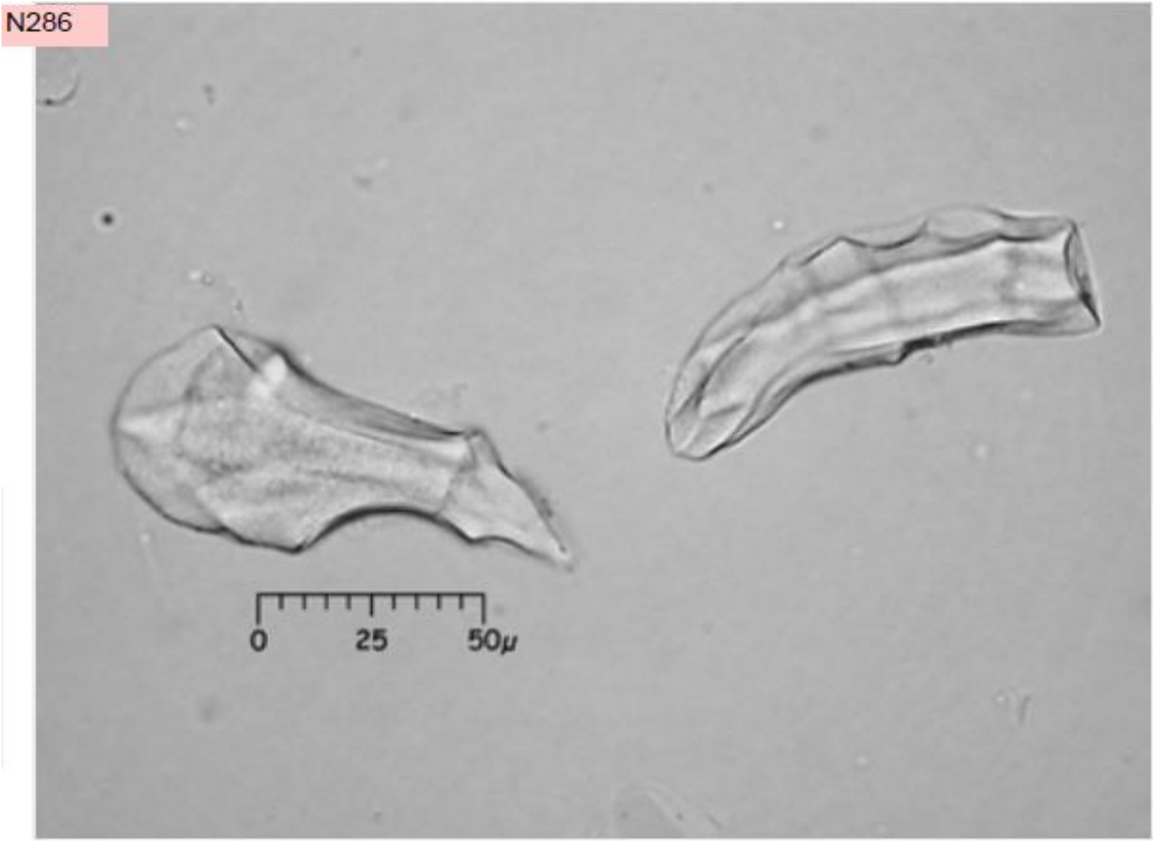
2 large examples of schlerids, note variation in facets, shape.
This taxa produces very sculpted, multi-surfaced bodies.
Diagnostic level: generalized arboreal

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Aniba hostmanniana

Phytolith

2 large examples of schlerids, note variation in facets, shape.
This taxa produces very sculpted, multi-surfaced bodies.
Diagnostic level: generalized arboreal

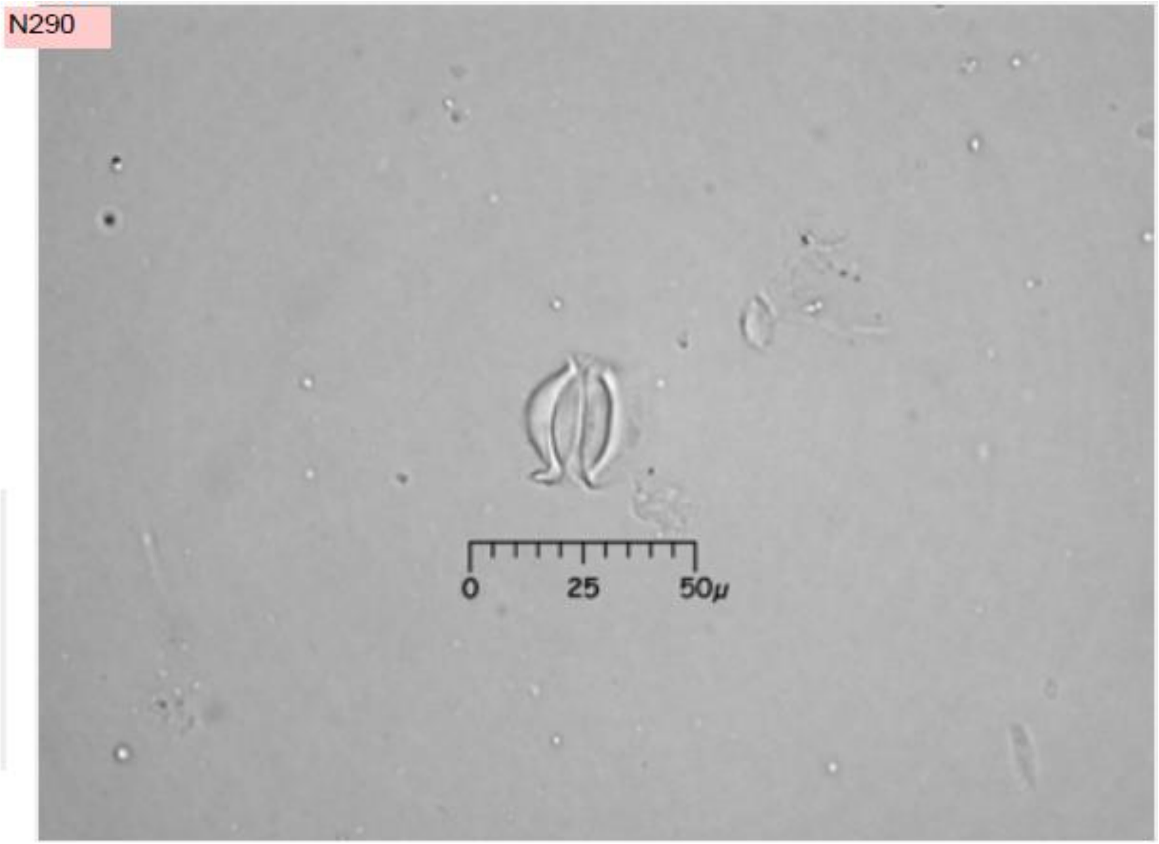


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Aniba hostmanniana

Phytolith

Stomate, note guard cells and turgid state of cells.
Diagnostic level: not diagnostic

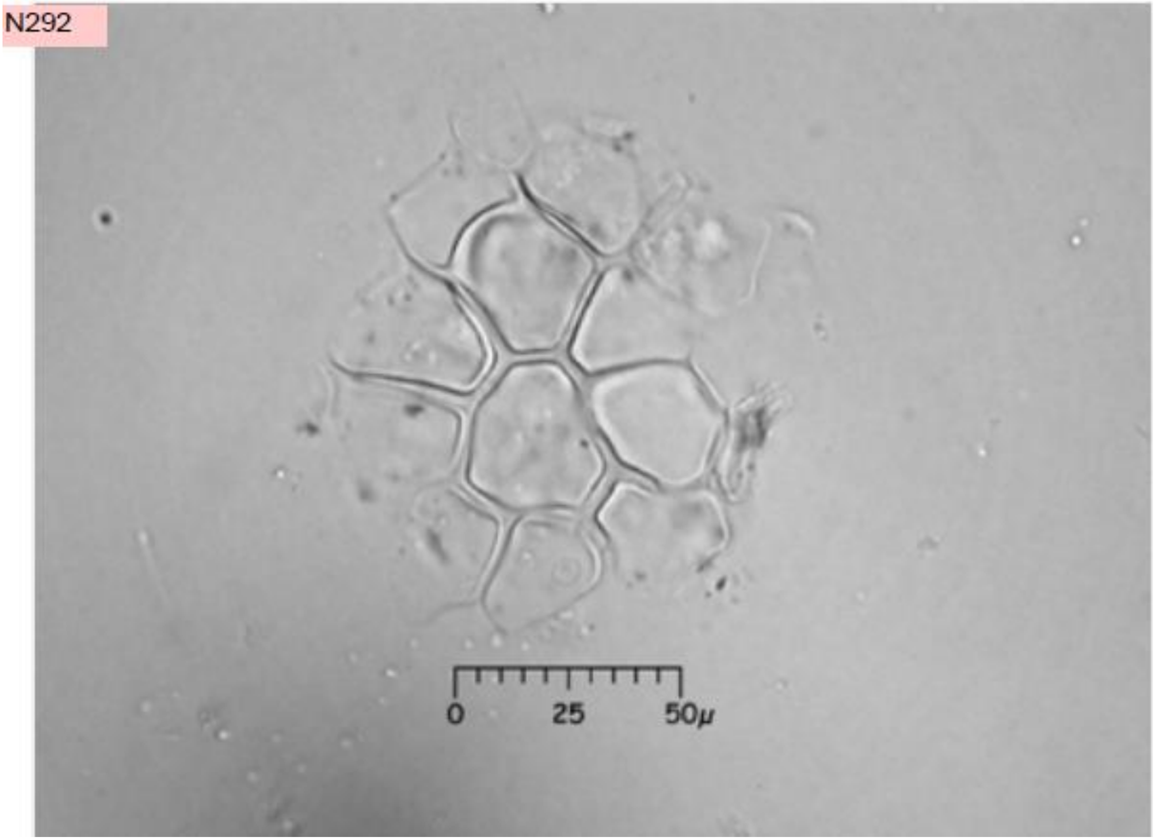


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Aniba hostmanniana

Phytolith

Hair base.
Diagnostic level: family

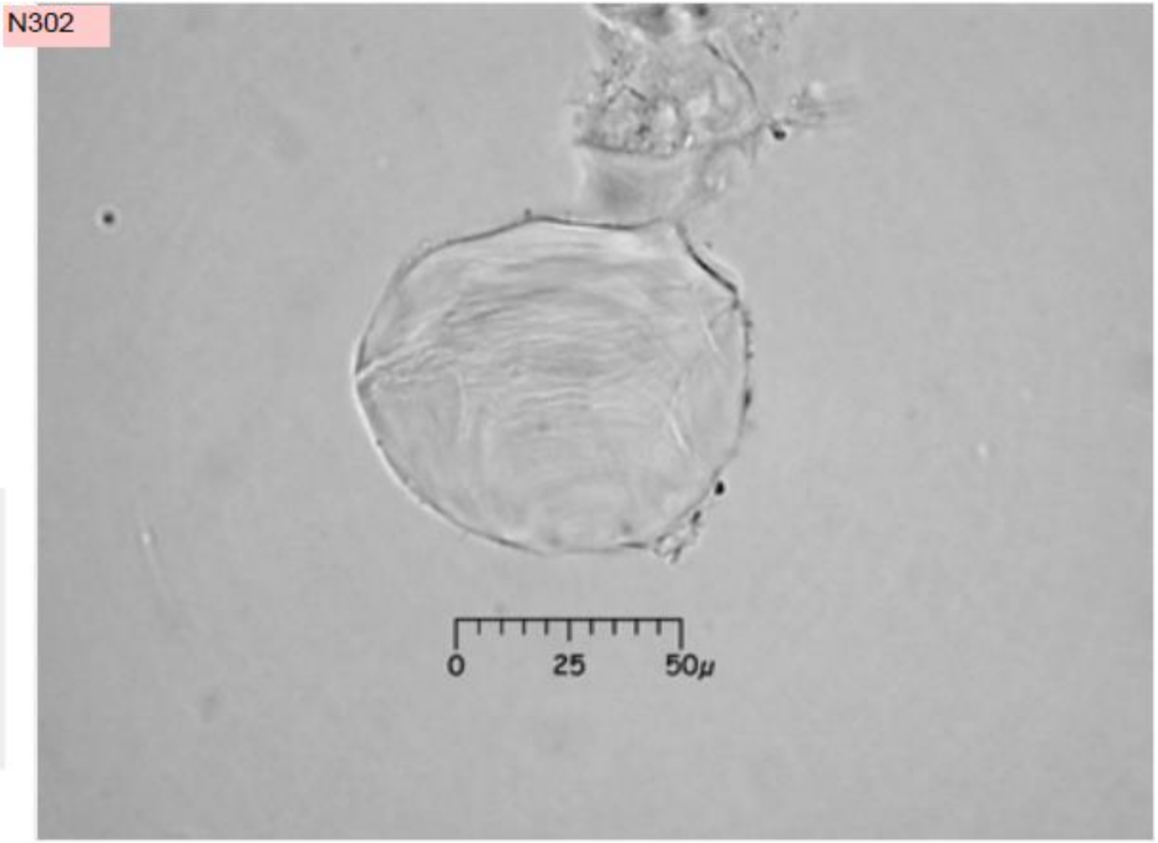


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Beilschmiedia alloiophylla

Phytolith

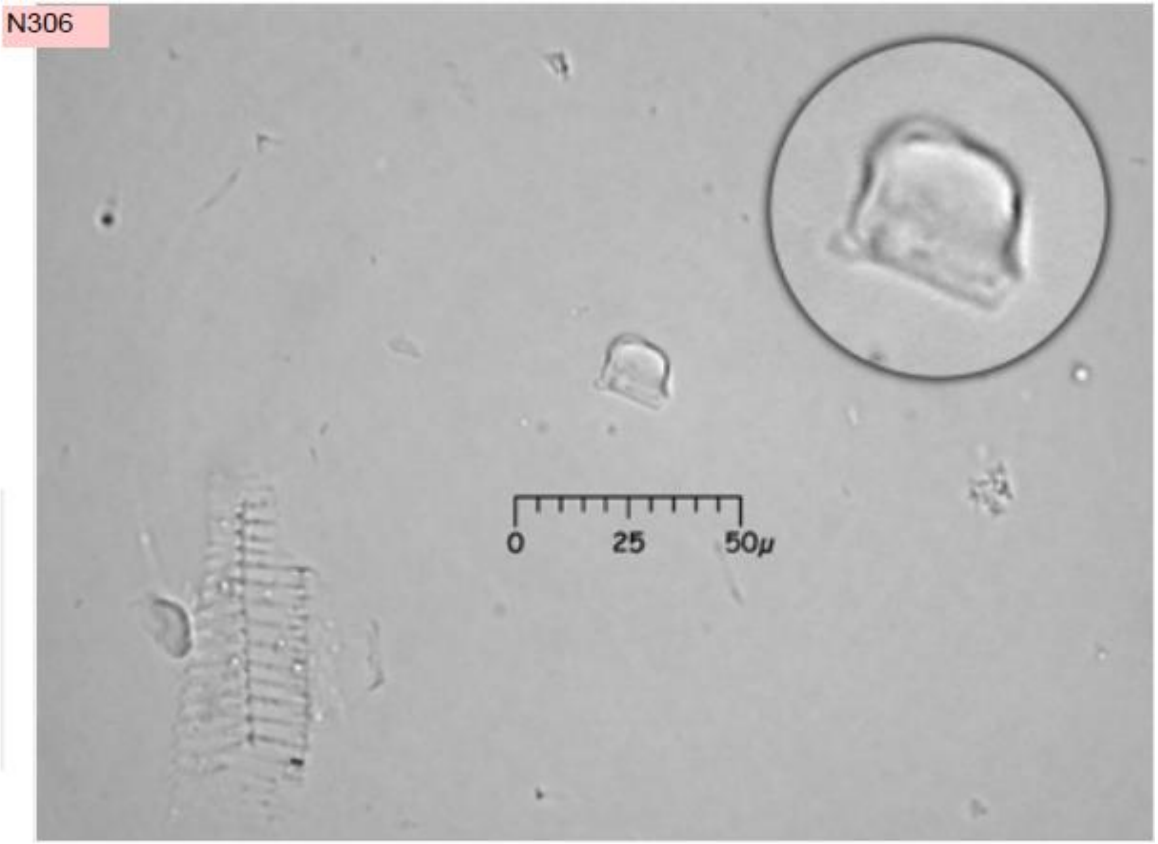
Diagnostic level: family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Caryodaphnopsis fosteri

Phytolith



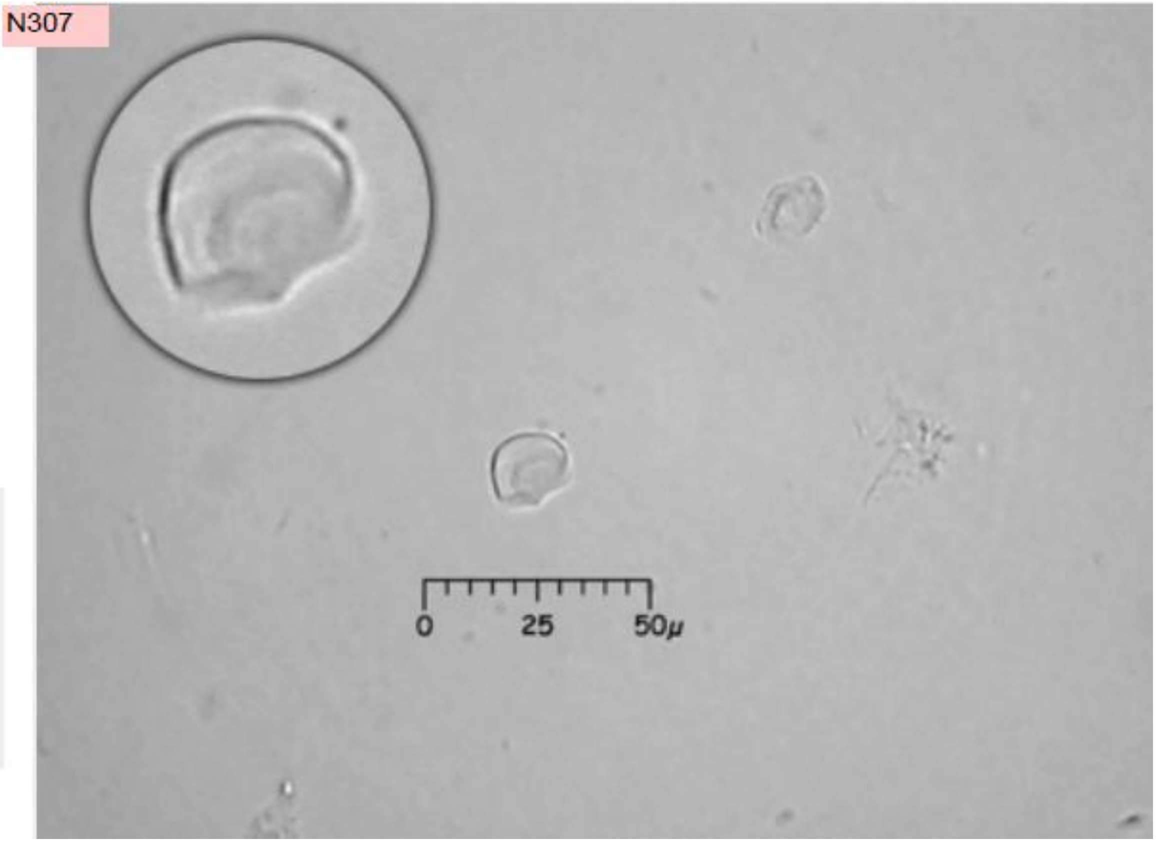
Side view (see Record #193 for top view).
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Caryodaphnopsis fosteri

Phytolith

Top view (see Record #192 for side view).
Diagnostic level: family

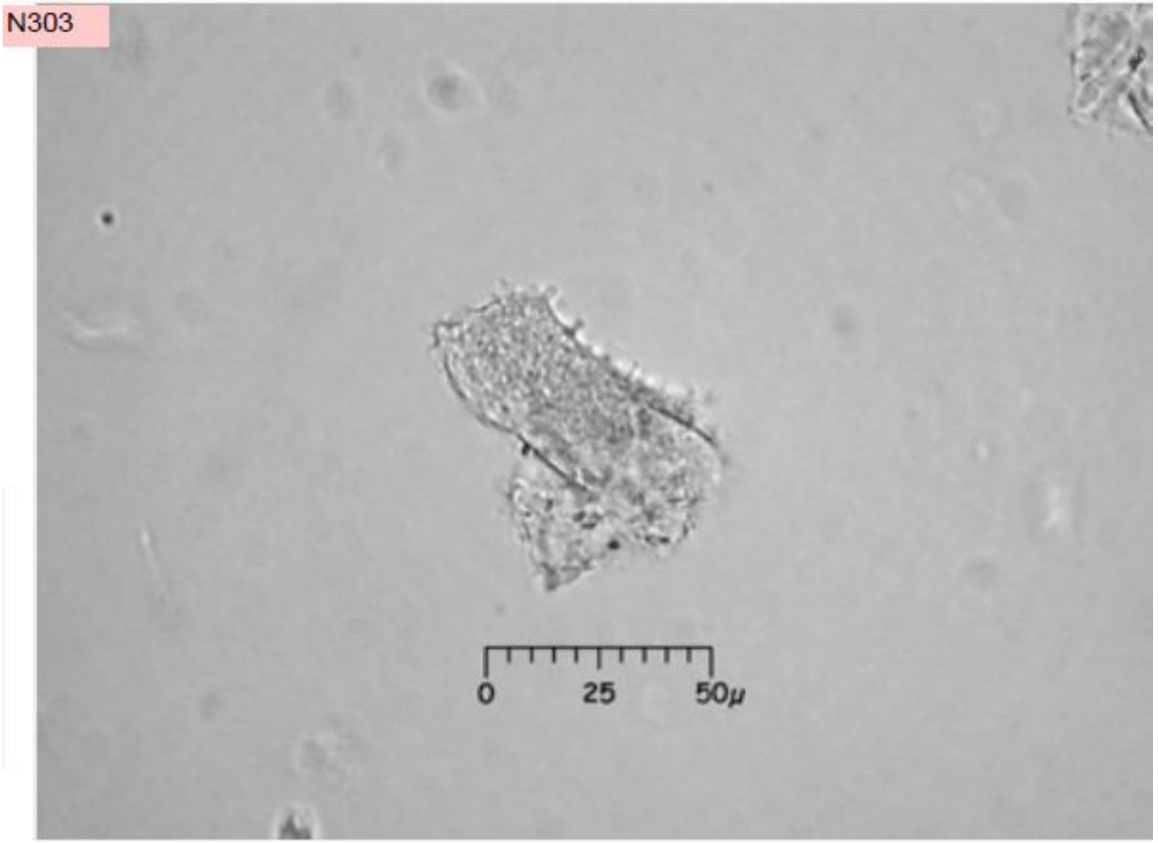


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Chlorocardium venenosum

Phytolith

Diagnostic level: family

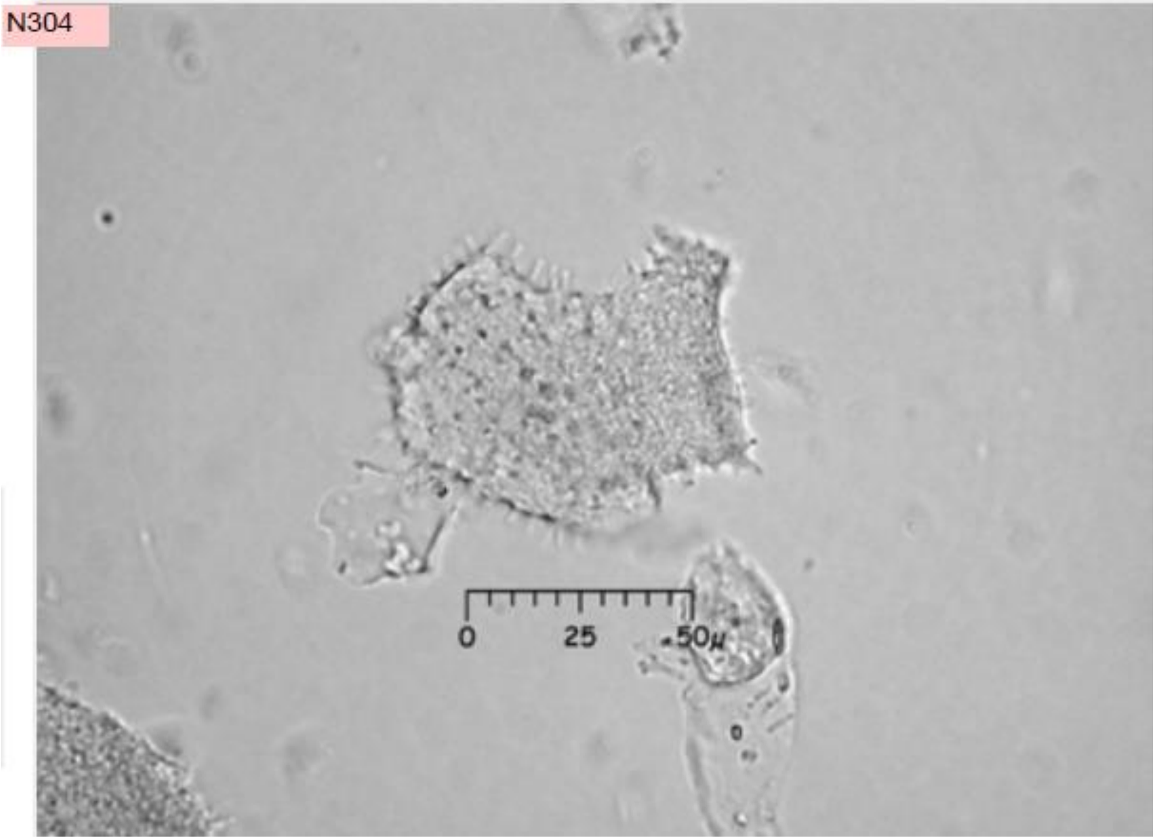


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Chlorocardium venenosum

Phytolith

Diagnostic level: family

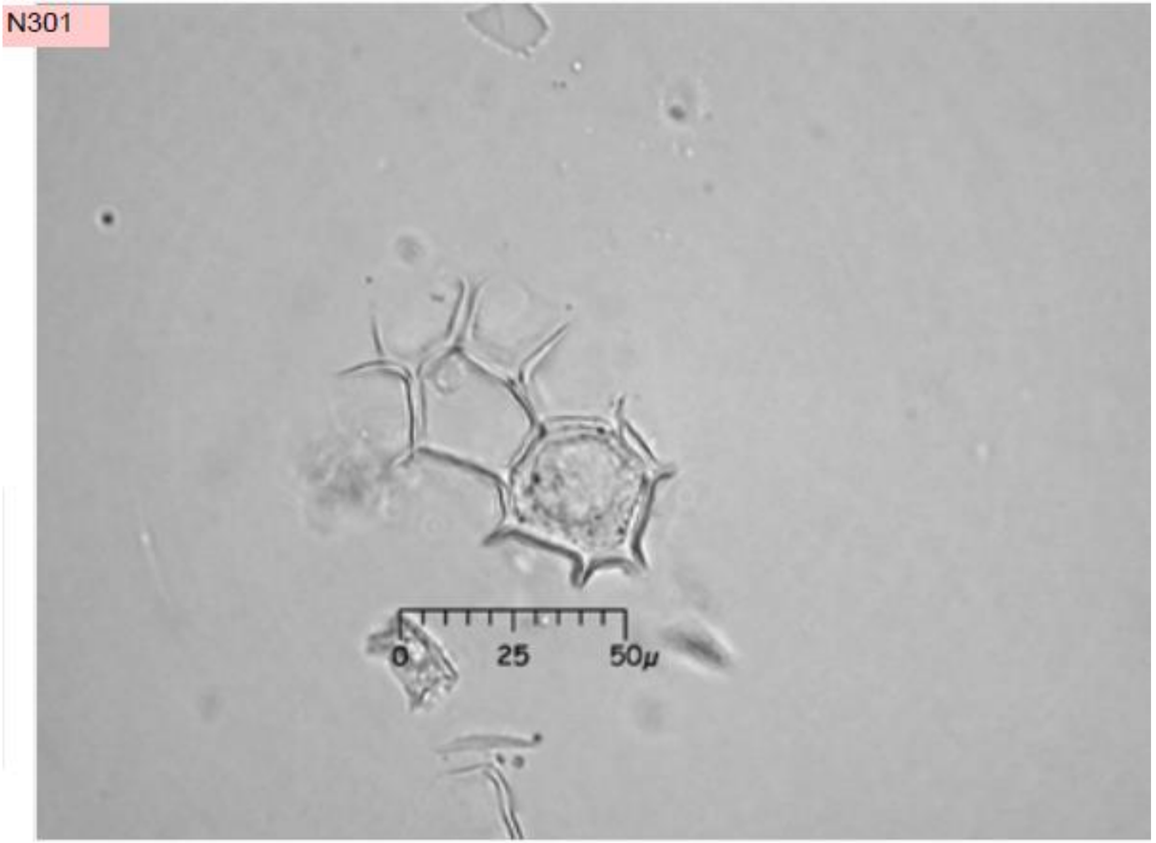


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Nectandra globosa

Phytolith

Diagnostic level: not diagnostic



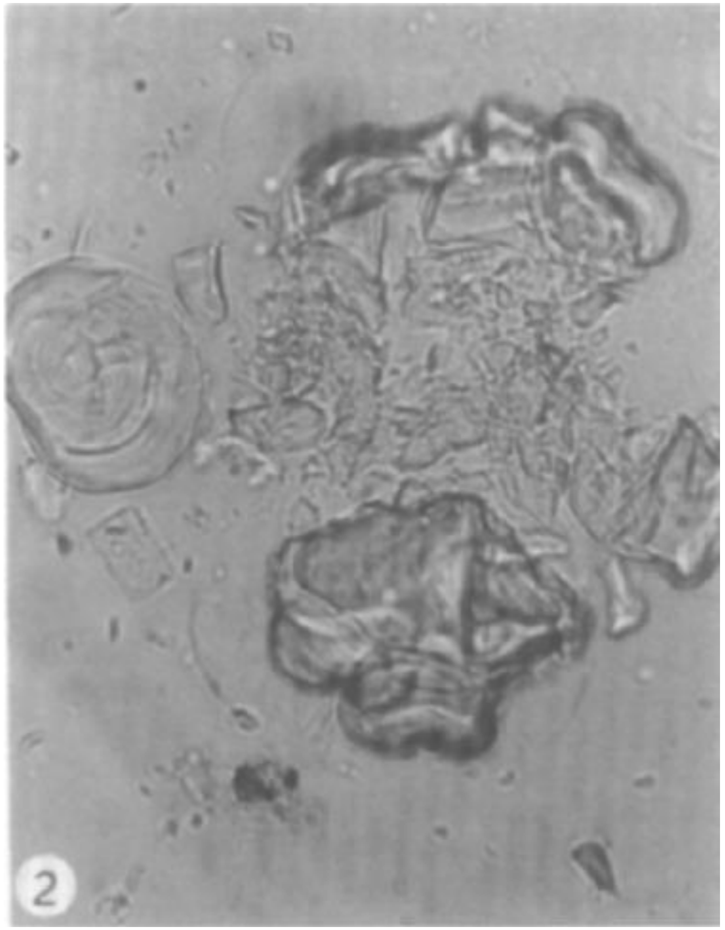
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

LORANTHACEAE

Phrygilanthus corymbosus

Phytolith

2. Irregular, unpointed chunks of silica from Phrygilanthus corymbosus (200 ×)

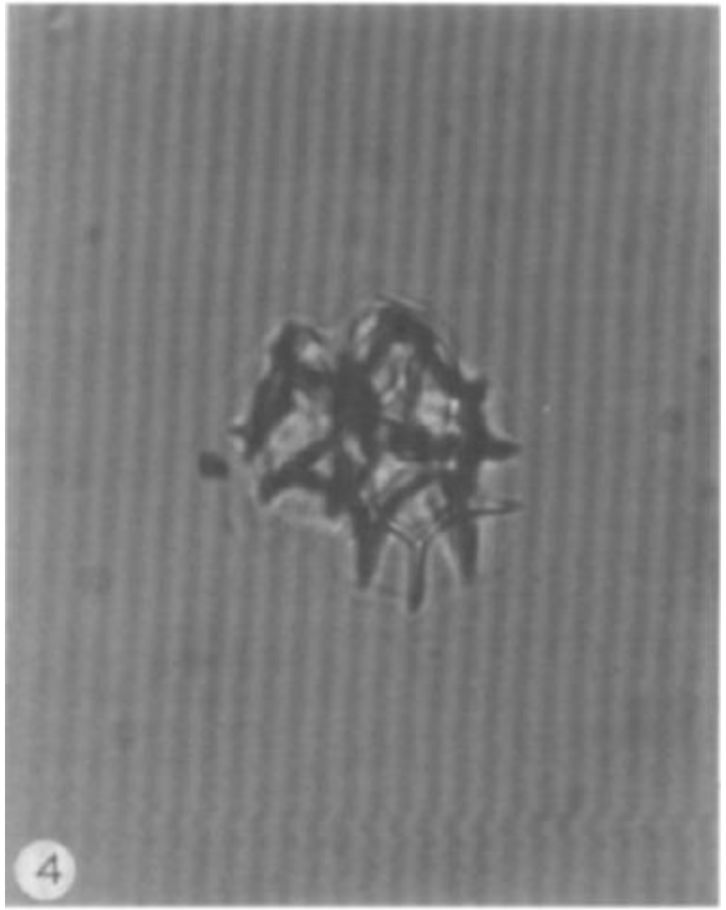


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Phthirusa pyrifolia

Phytolith

4. An irregular, pointed phytolith from Phithirusa pyrifolia (250 x)



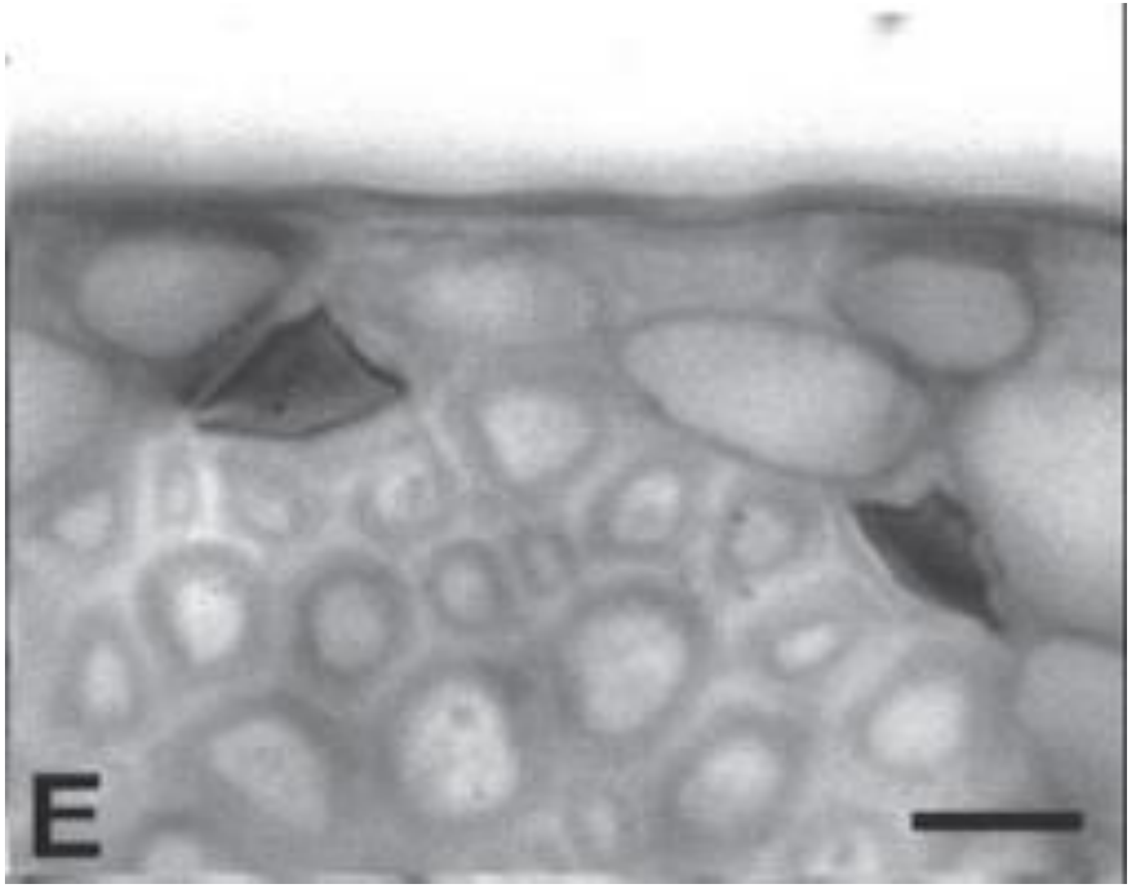
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

LOWIACEAE

Orchidantha sp.

Phytolith

Fig. 3. Various silica body morphologies found in the order Zingiberales. E. Orchidantha sp. (Lowiaceae), truncated conical silica bodies overlying a vascular bundle (bar =10 µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Orchidantha chinensis

Phytolith

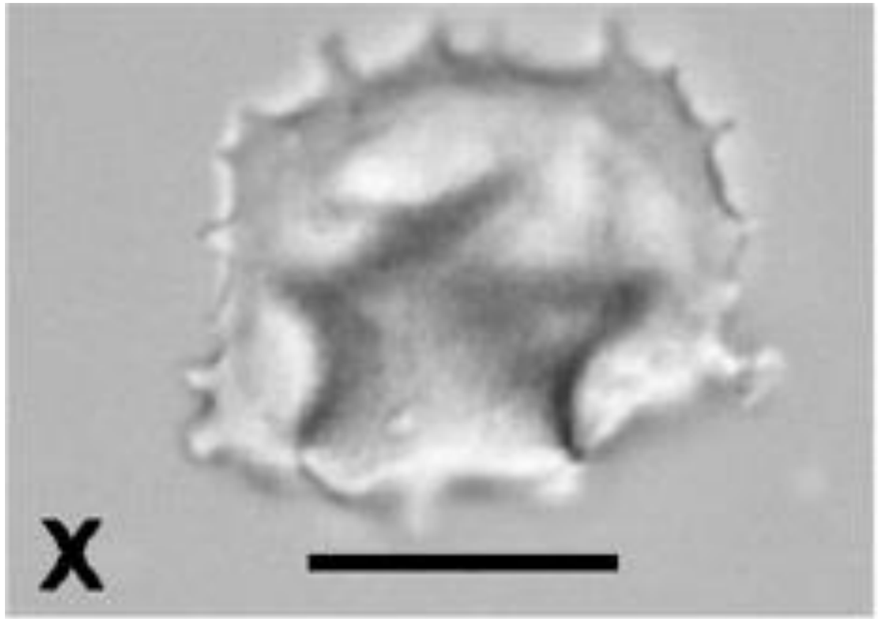


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). X, hat-shape with knobby edges from Orchidantha chinensis leaf. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Orchidantha longiflora

Phytolith

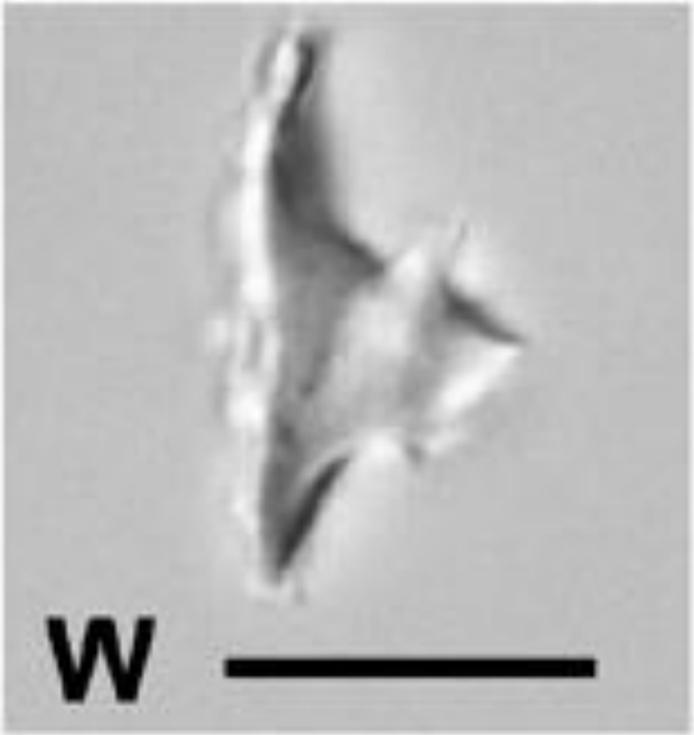


Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). W, side-view of hat-shape with knobby edges from Orchidantha longiflora leaf. Scale bars: A–J,M–Z=12 μm; K, L=5 μm

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Orchidantha siamensis

Phytolith

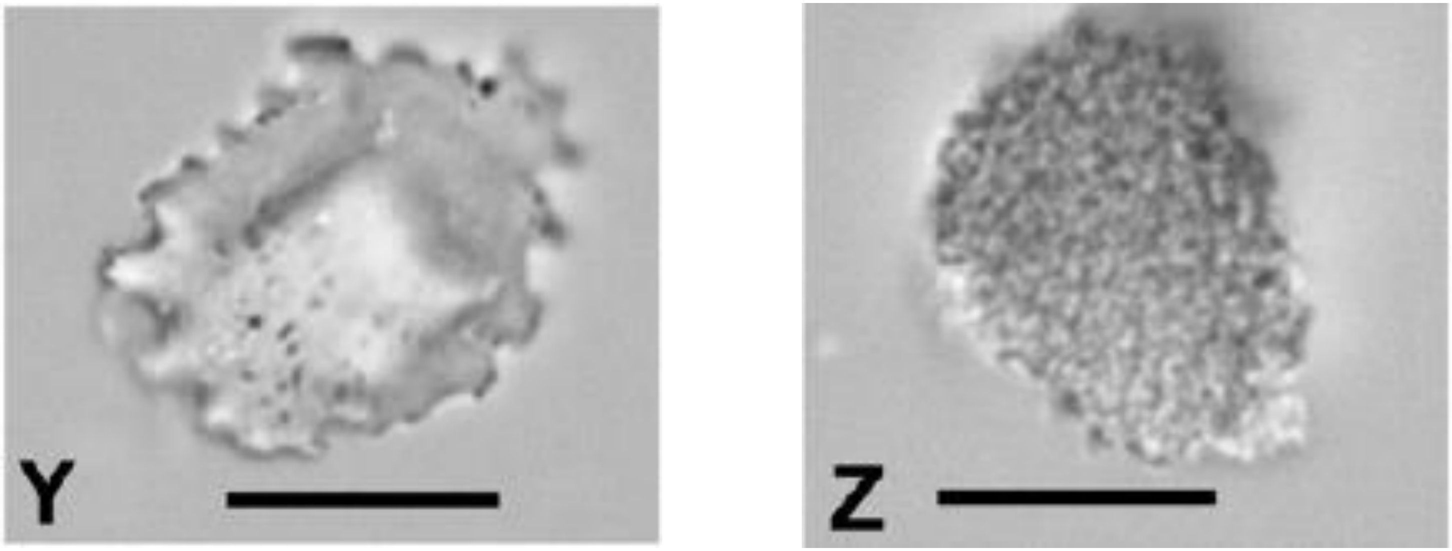


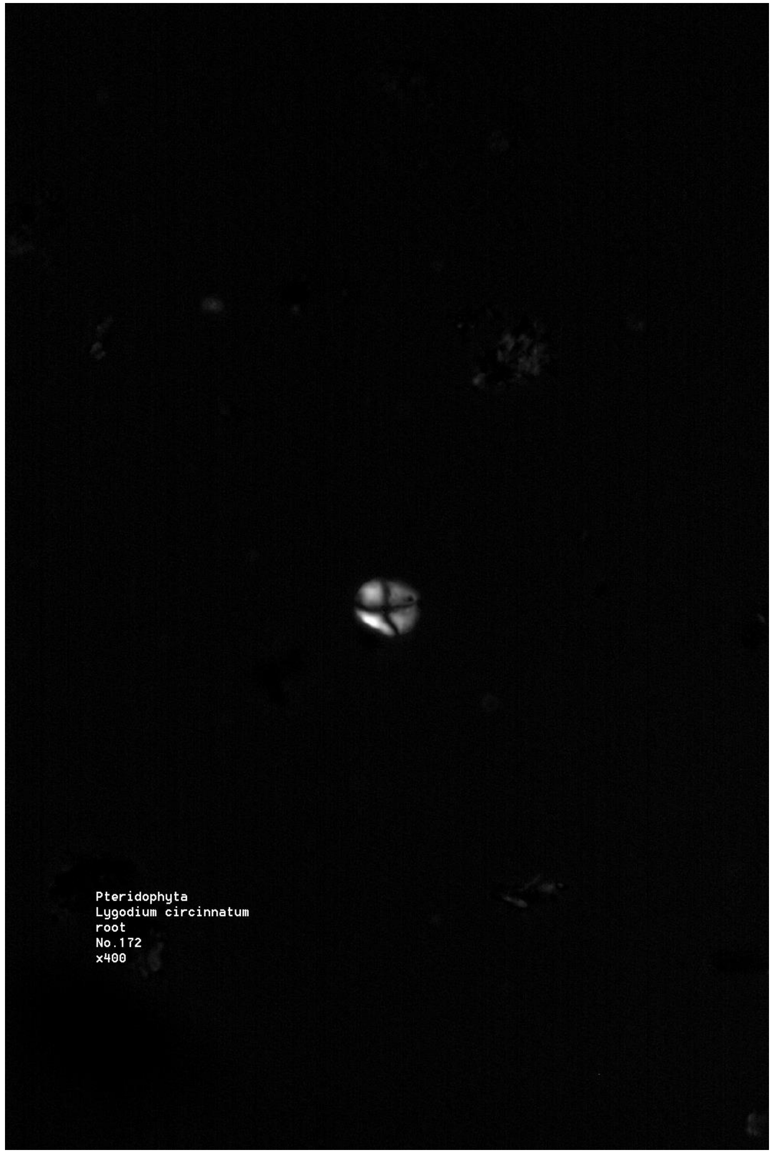
Fig. 2. Phytoliths from Cannaceae (A–D), Costaceae (E–I),Heliconiaceae (J–V), and Lowiaceae (W–Z). Y, hat-shapewith crenate edges from Orchidantha siamensis leaf.Z,Ta3 (tabular-granulate)from Orchidantha siamensis leaf. Scale Scale bars: A–J,M–Z=12 µm; K, L=5 µm

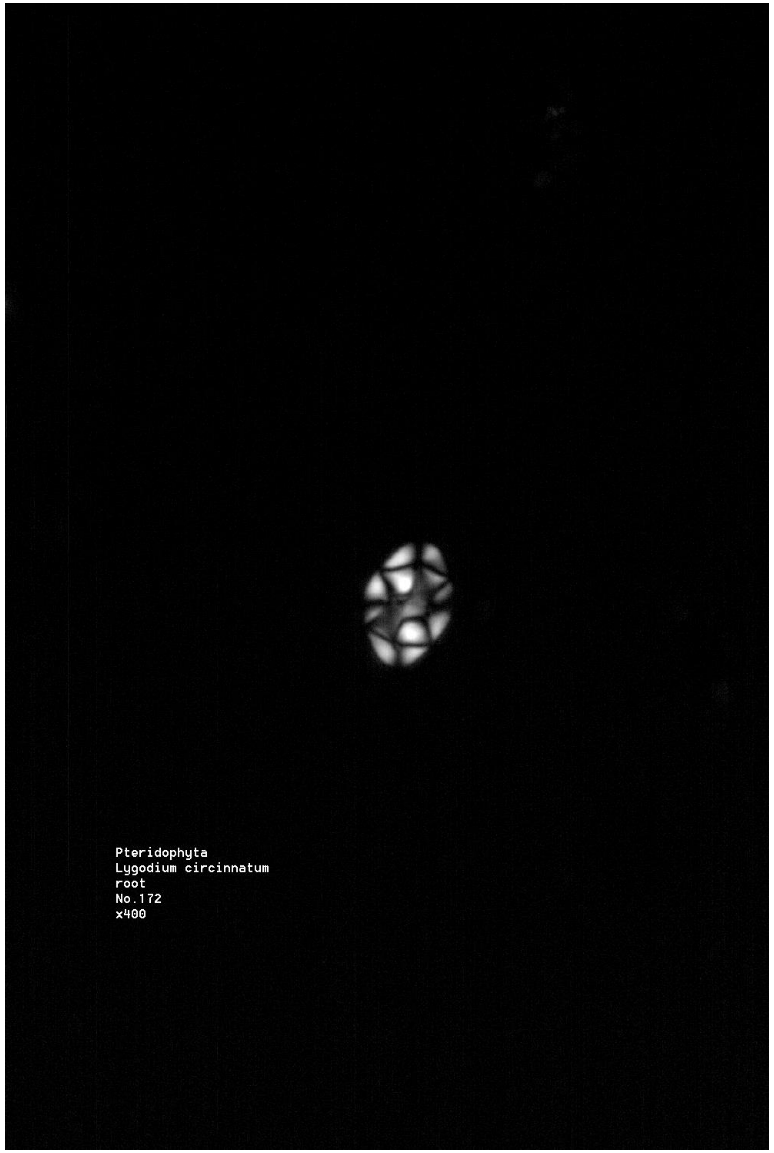
Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

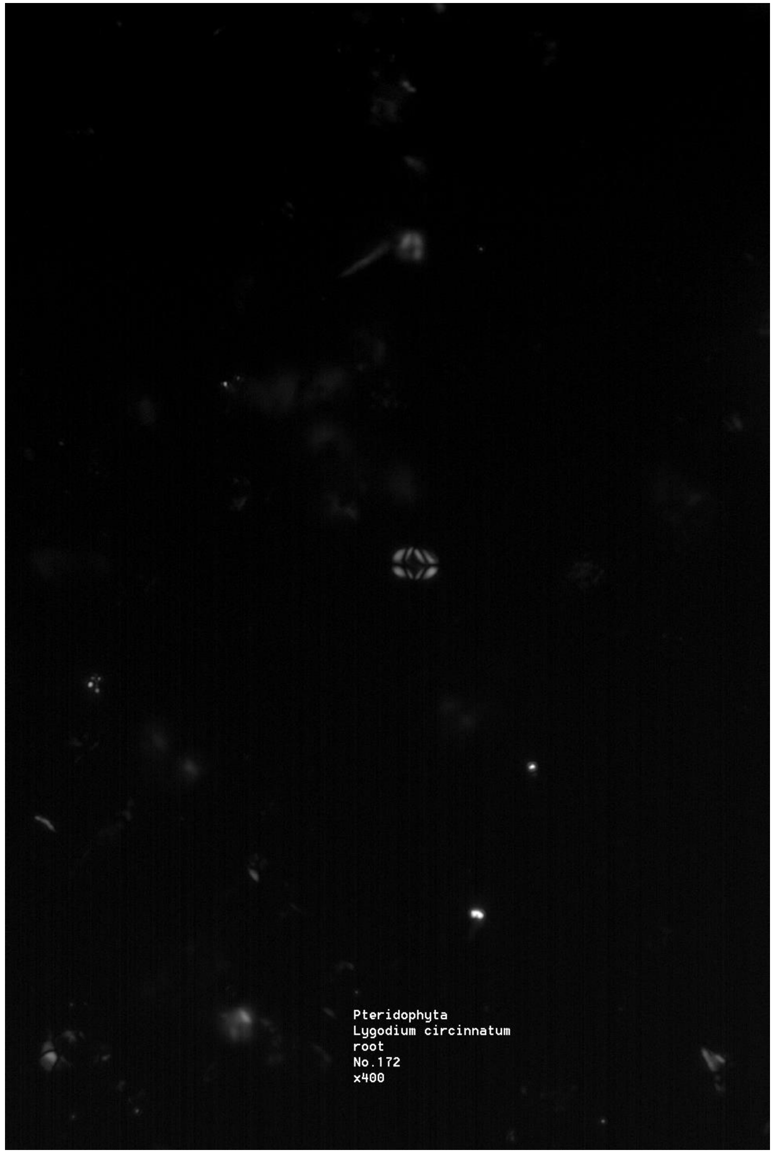
LYGODIACEAE

Lygodium cirunntum

Australian Museum,
McCown Archaeobotany
Laboratory Collection

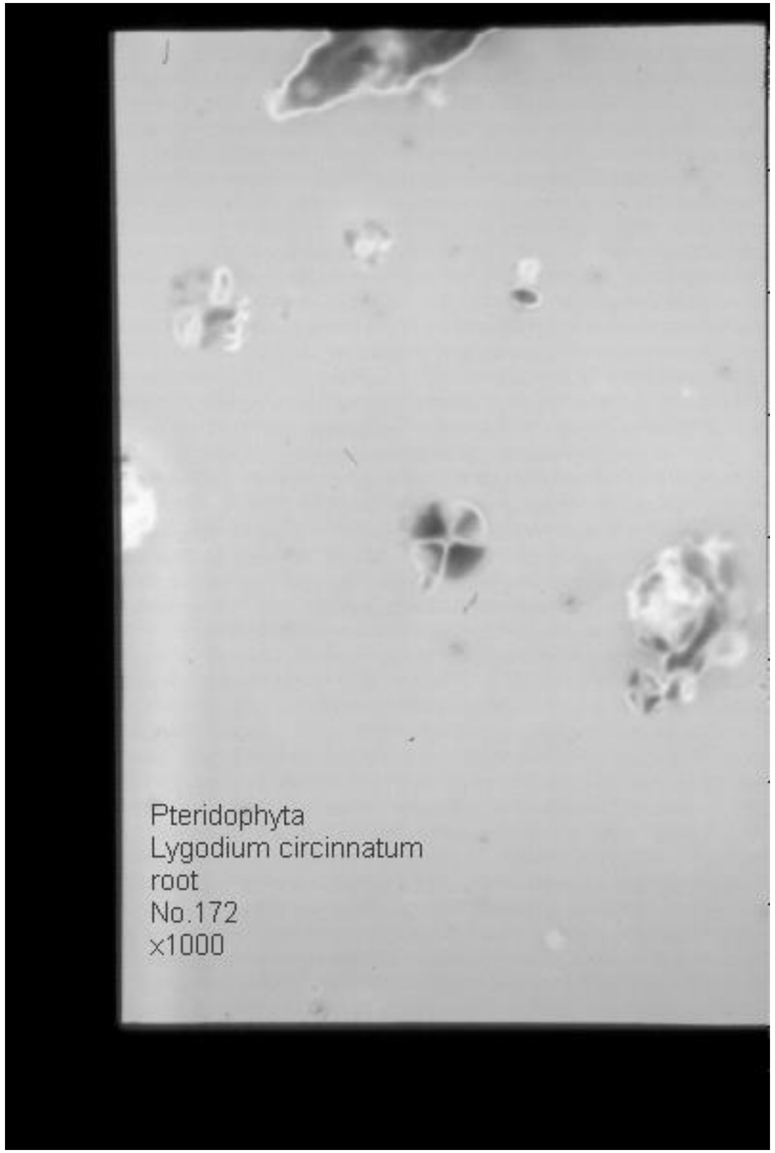






Lygodium cirunntum

Australian Museum,
McCown Archaeobotany
Laboratory Collection



MAGNOLIACEAE

Magnolia sp.

Phytolith

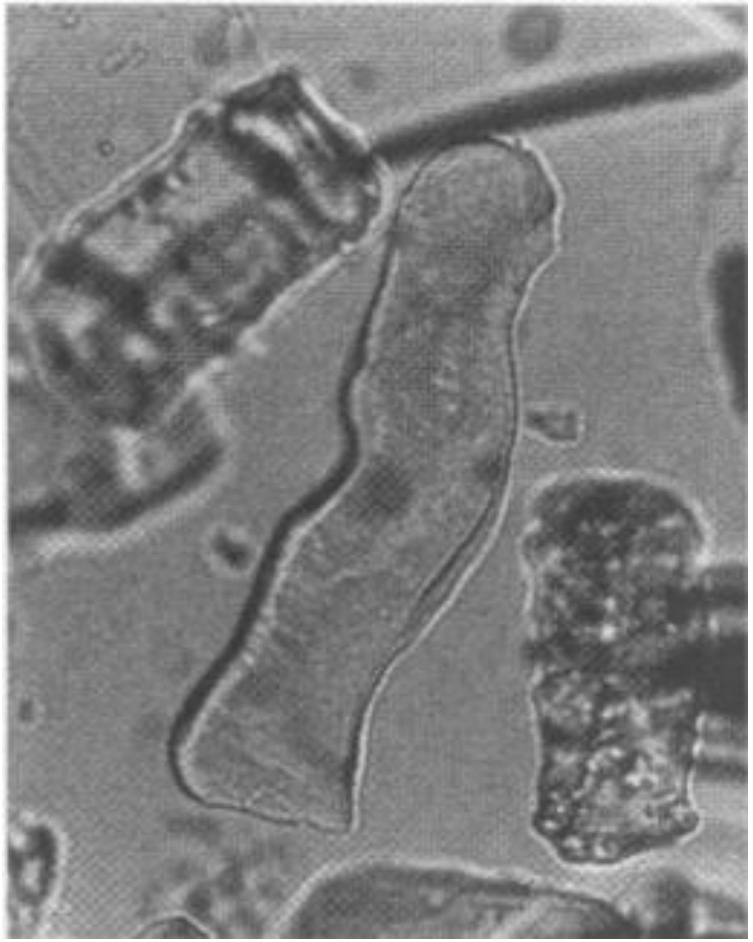


Fig. 2. Center, a genus-specific phytolith from the leaves of Magnolia from (Magnoliaceae) Late Pleistocene-age lake sediment from Panama. Palynologists are unable to distinguish the pollen of the closely related taxa Talauma and Magnolia.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Talauma sp.

Phytolith

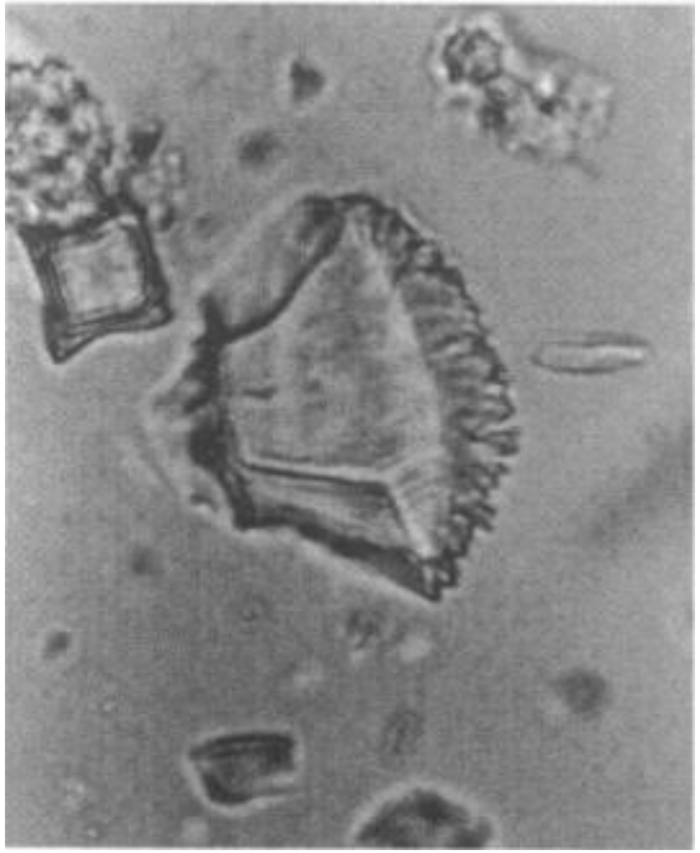


Fig. 1. Center, a genus-specific phytolith from the leaves of Talauma (Magnoliaceae) from modern soils underneath tropical montane forest in Panama.

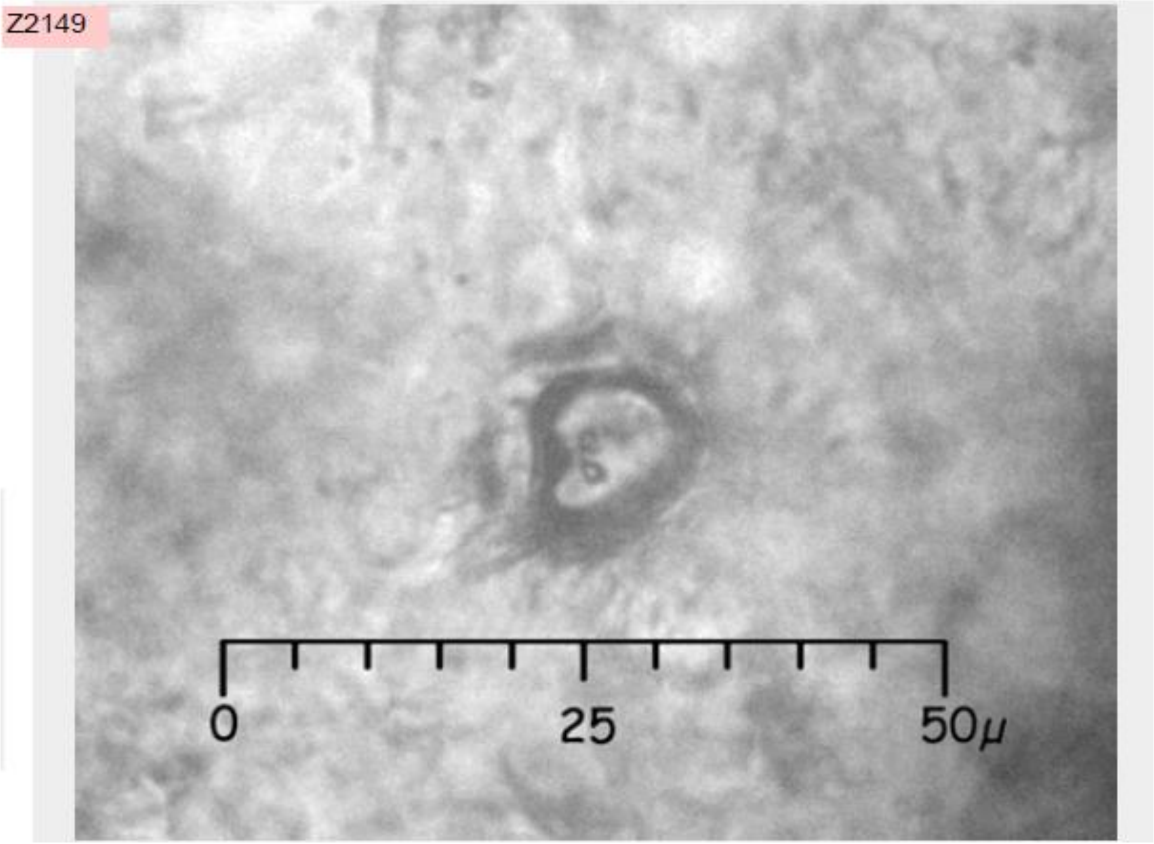
Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

MALVACEAE

Gossypium sp.

Phytolith

Compare to 160I, small heart-shaped secretory body. 160II has a variably shaped center. Observed in Gossypium (PC 2665); diagnostic level under study.

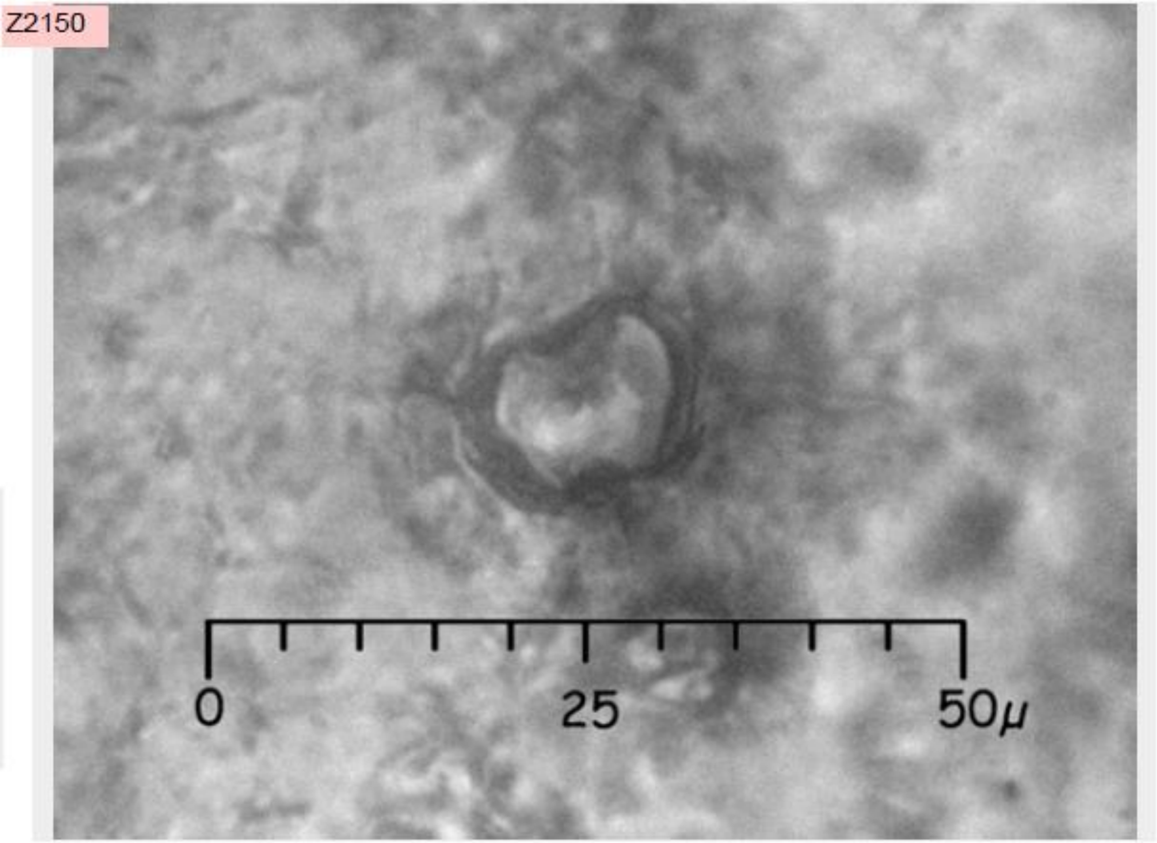


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gossypium sp.

Phytolith

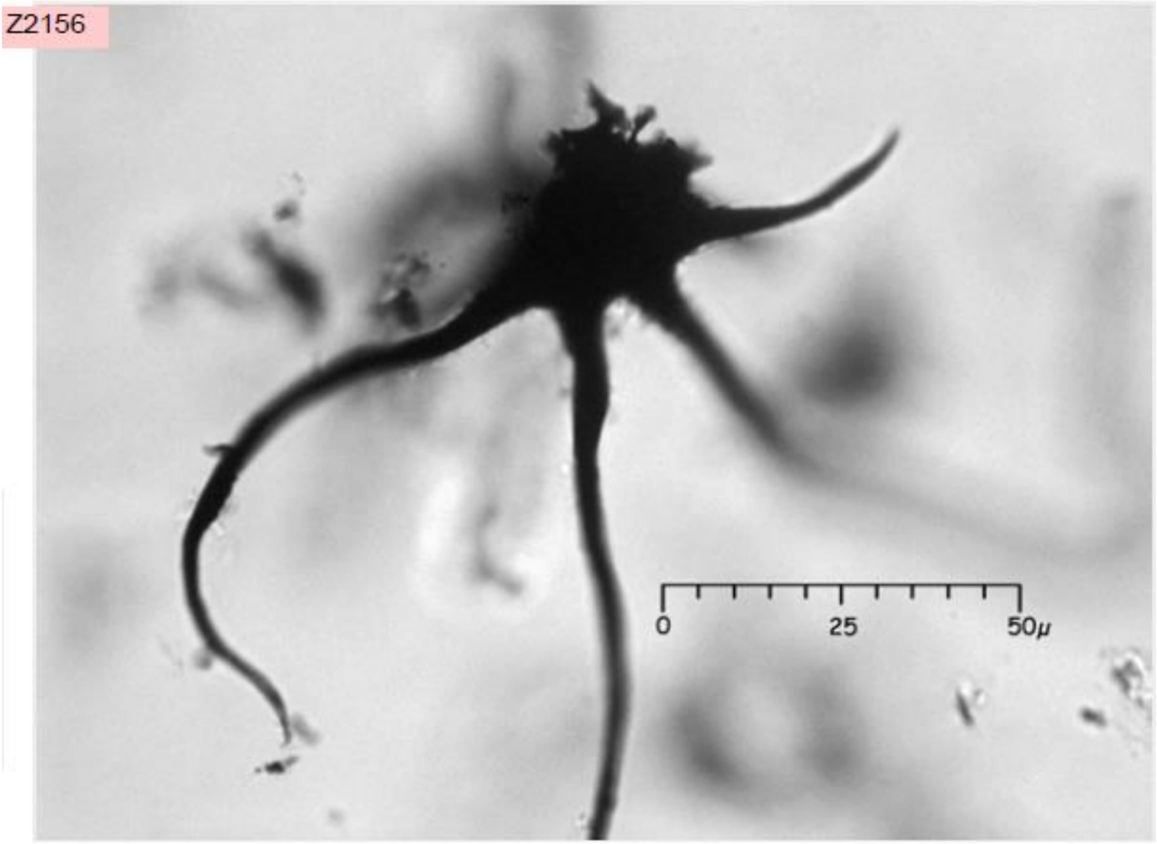
Compare to 160I, small heart-shaped secretory body. 160II has a variably shaped center. Observed in Gossypium (PC 2665); diagnostic level under study.



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gossypium sp.

Phytolith



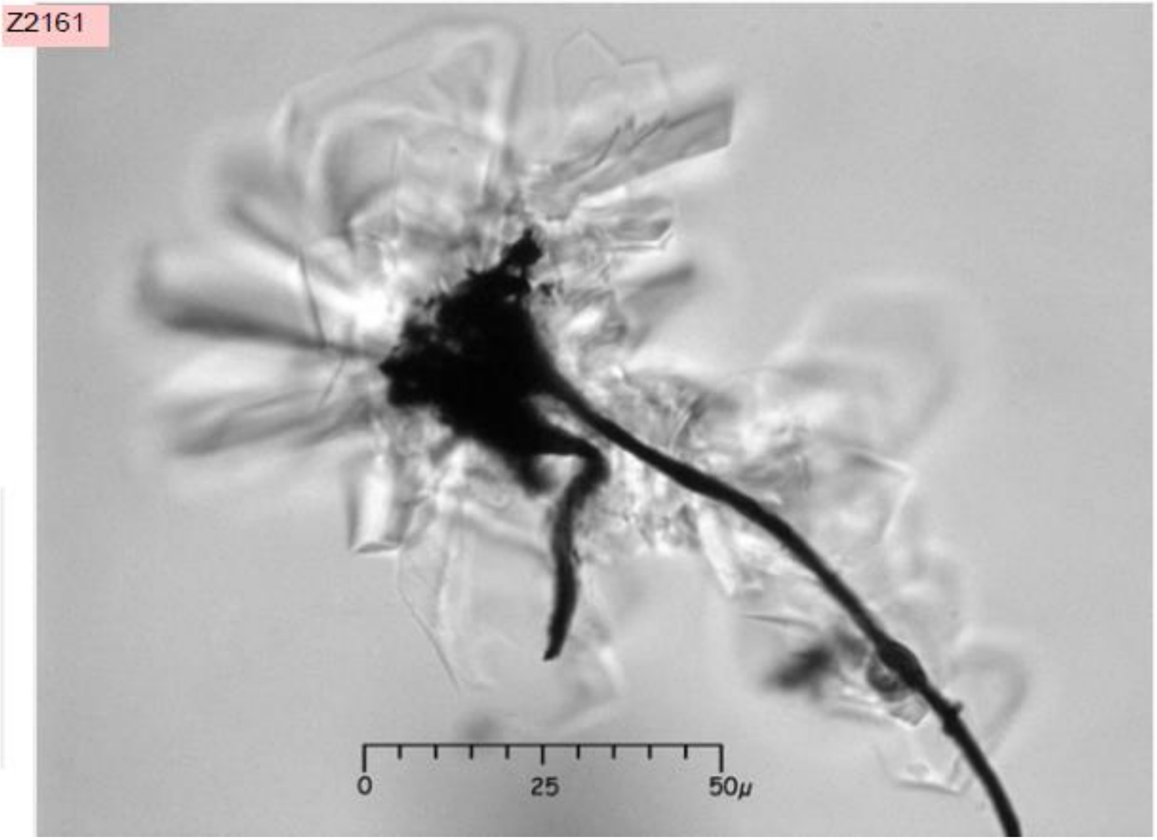
In PC E1022, Gossypium. Also observed in PC E1004, Malachra alceifolia, Malvaceae
Diagnostic level: Malvaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gossypium sp.

Phytolith

PC E1022. This image shows hair base cells, a spherical cystolith of loose structure.
Diagnostic level: Malvaceae

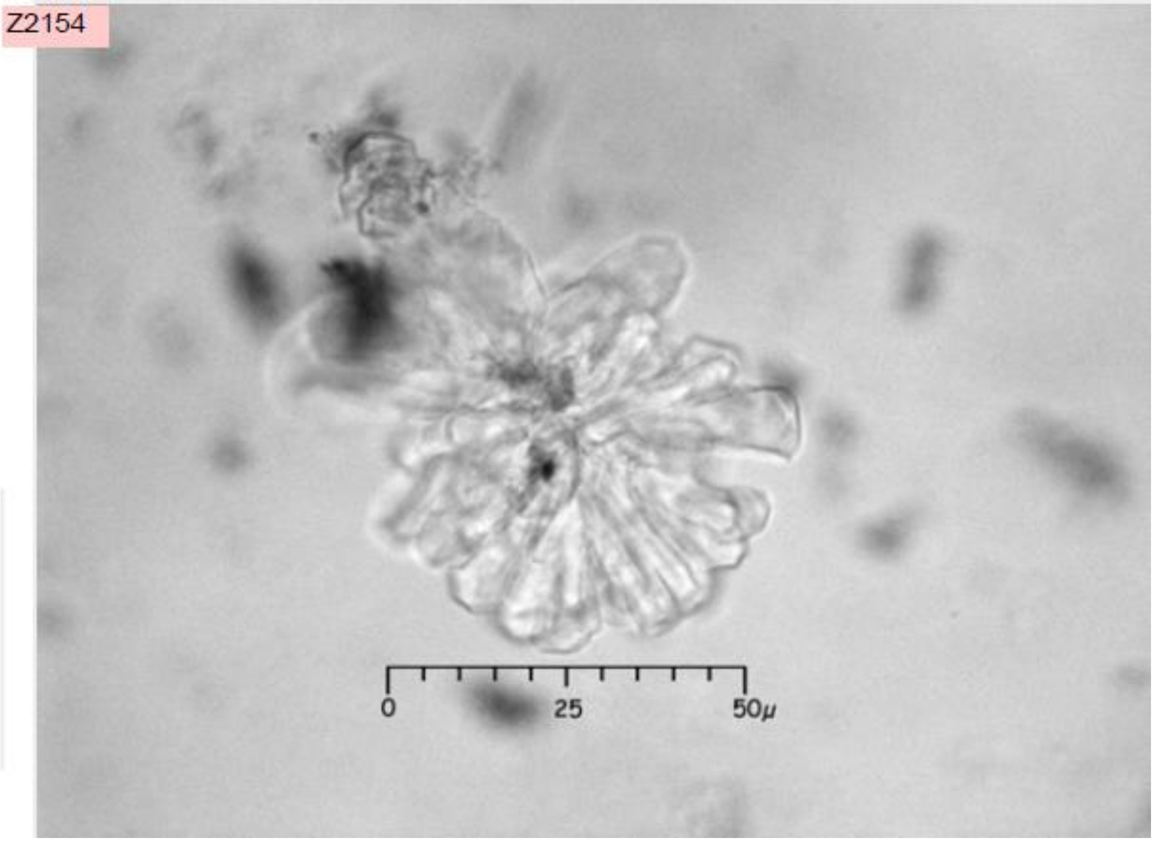


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gossypium sp.

Phytolith

See size variation in cystoliths.
Diagnostic level: generalized arboreal
Note that this type formed the base of hair 40IIIBb

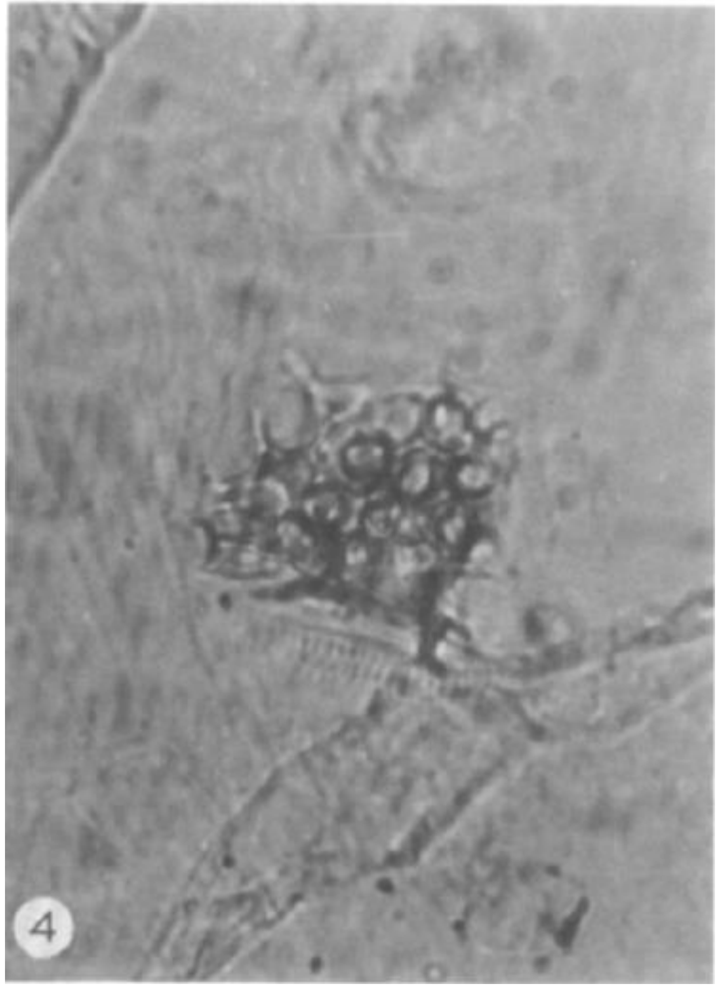


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Gossypium barbadense

Phytolith

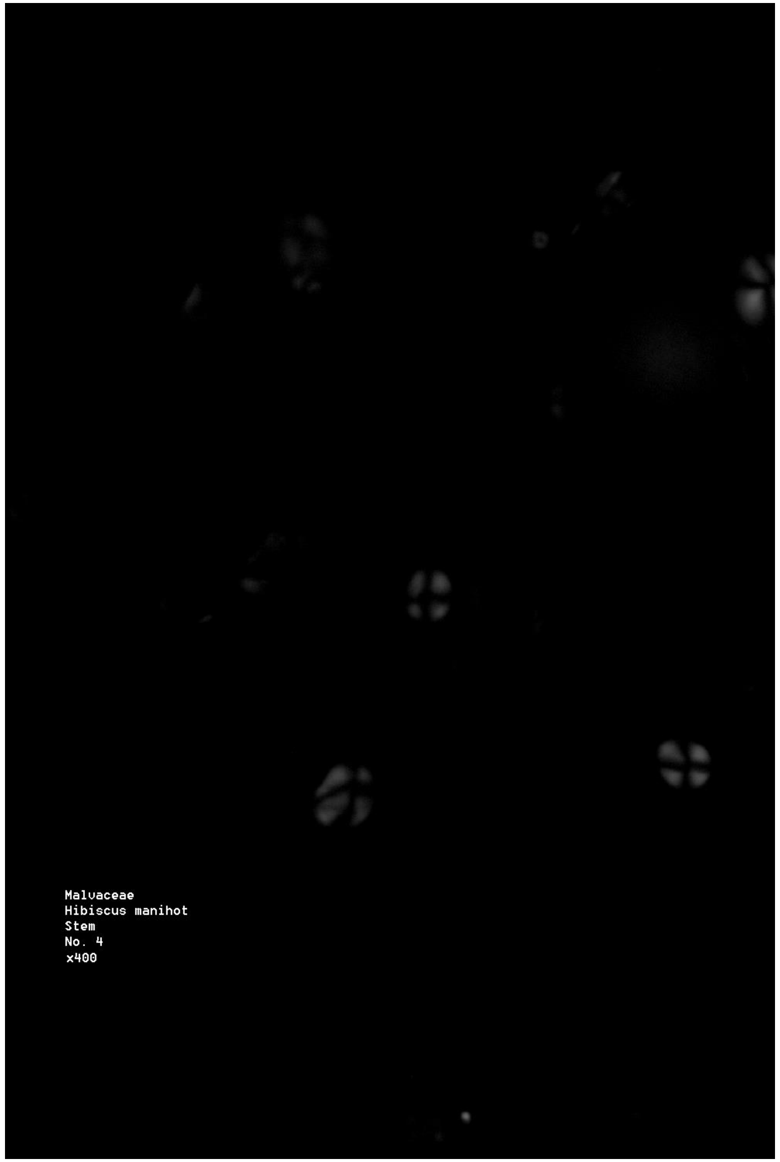
4. Silicified mesophyll cells from Gossypium barbadense (250 x).

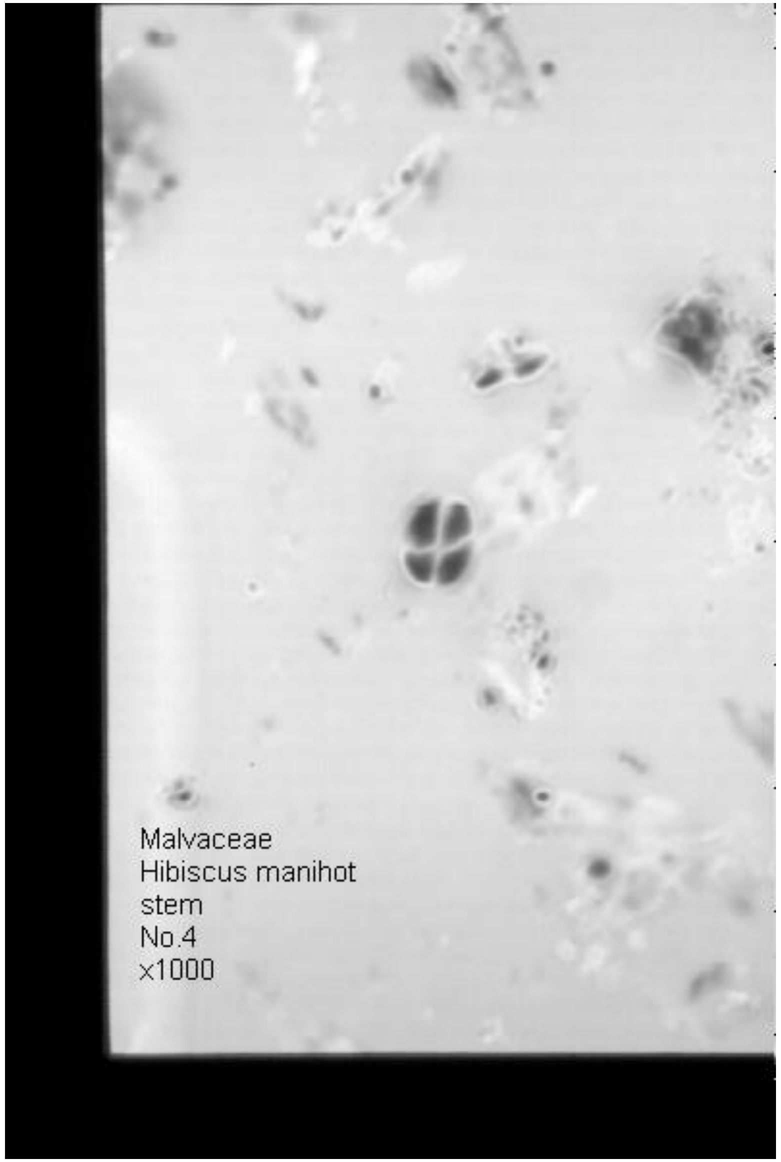


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Hibiscus manihot

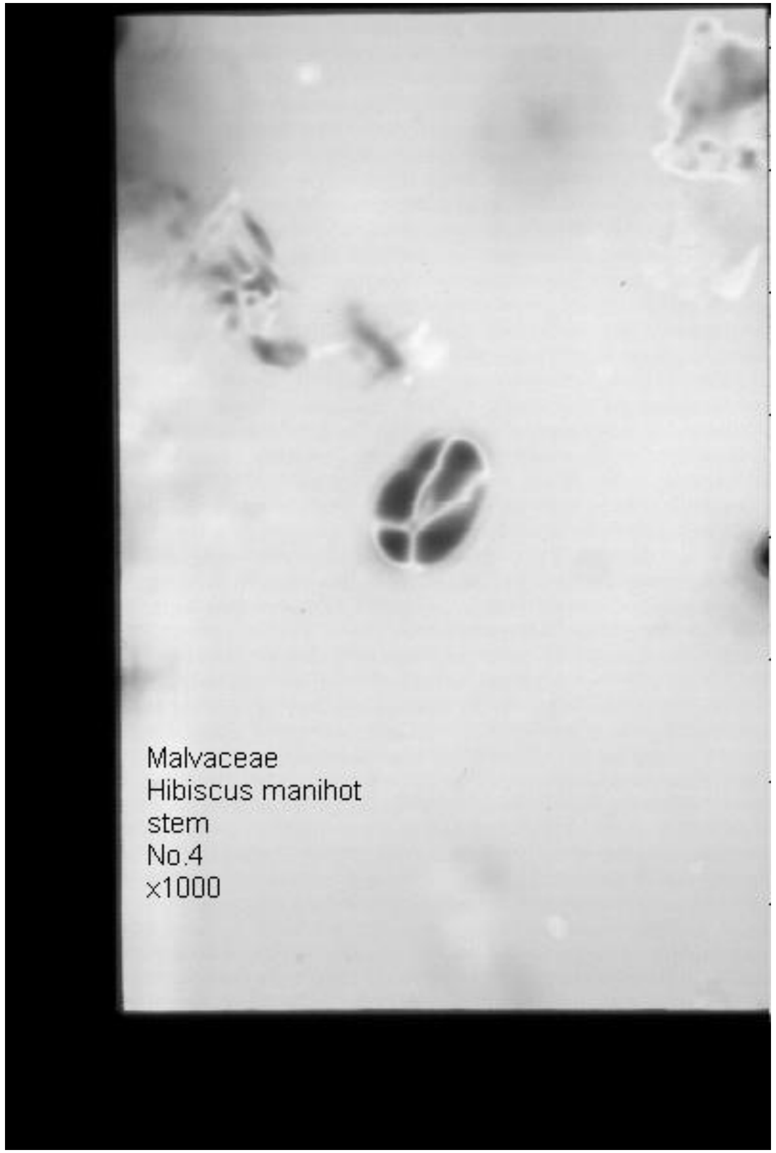
Australian Museum,
McCown Archaeobotany
Laboratory Collection

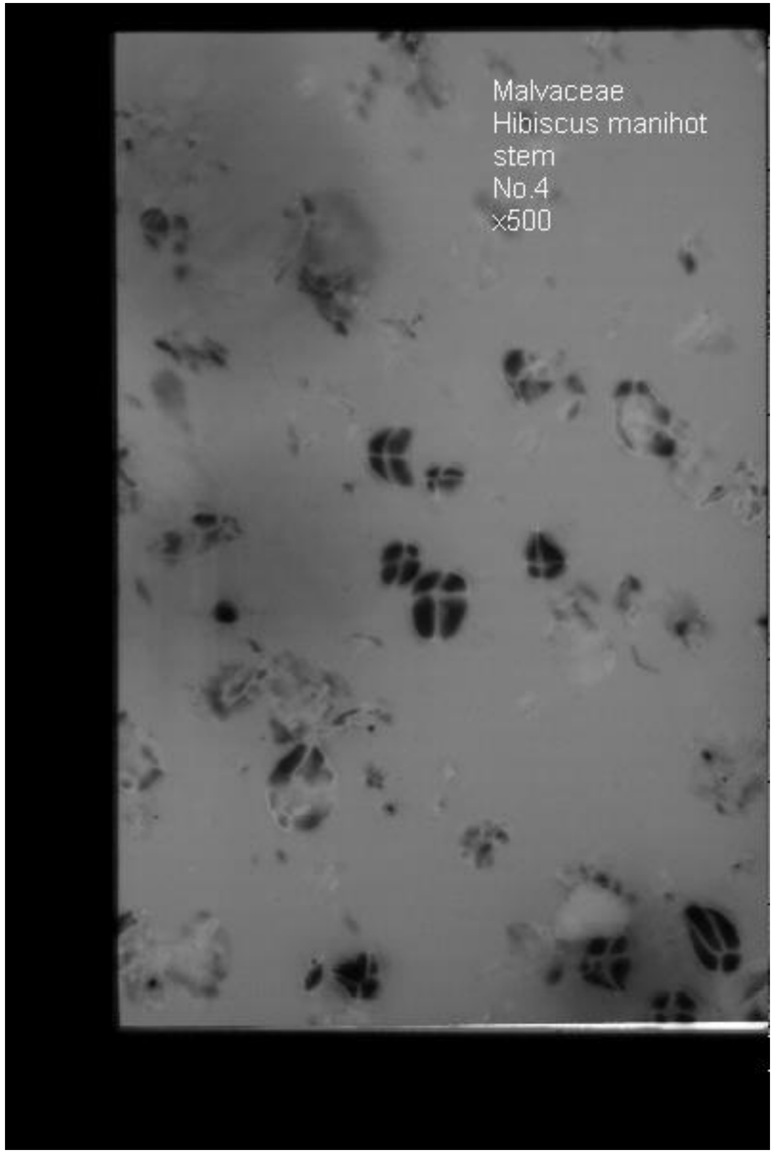




Hibiscus manihot

Australian Museum,
McCown Archaeobotany
Laboratory Collection

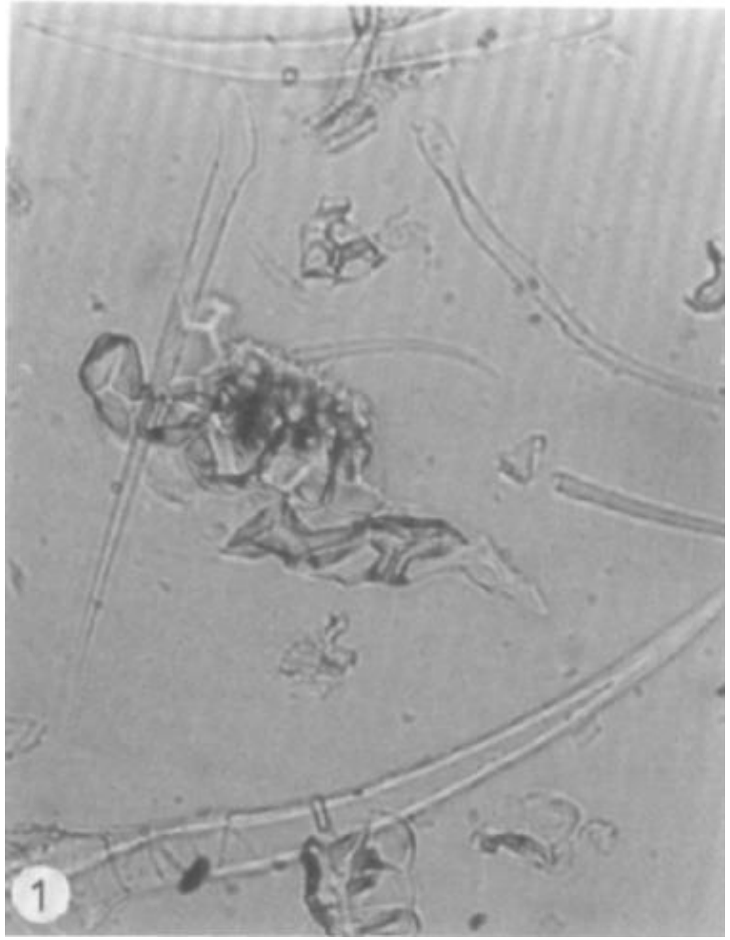




Malvaviscus arboreus

Phytolith

1. Threadlike hairs from Malvaviscus arboreus (156 ×).

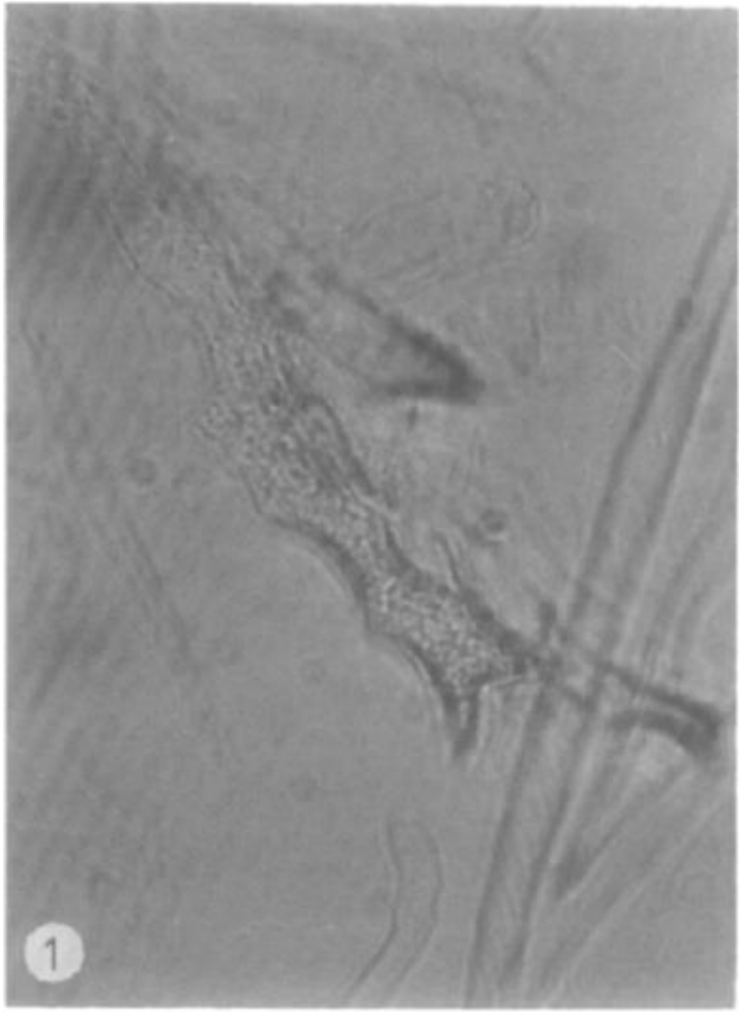


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Theobroma cacao

Phytolith

1. A silicified tracheid from Theobroma cacao (250 ×).

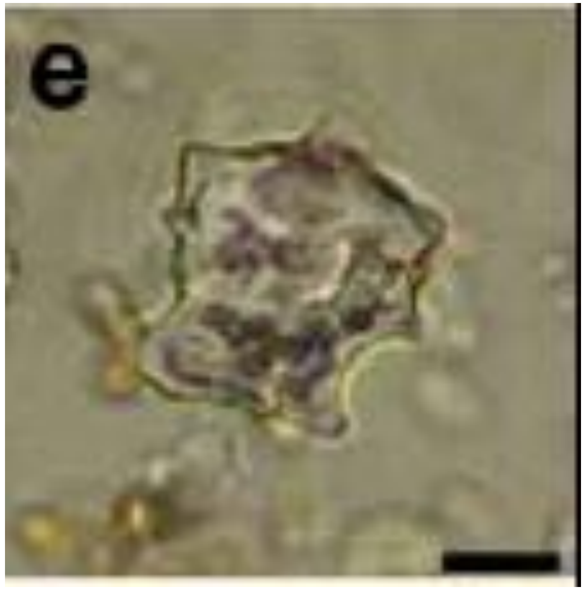


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

MARANTACEAE

Marantaceae

Phytolith



Morphotype diagnostic of the Marantaceae, and likely derived from the seed of arrowroot (*Maranta arundinacea* L.)

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Marantaceae

Phytolith

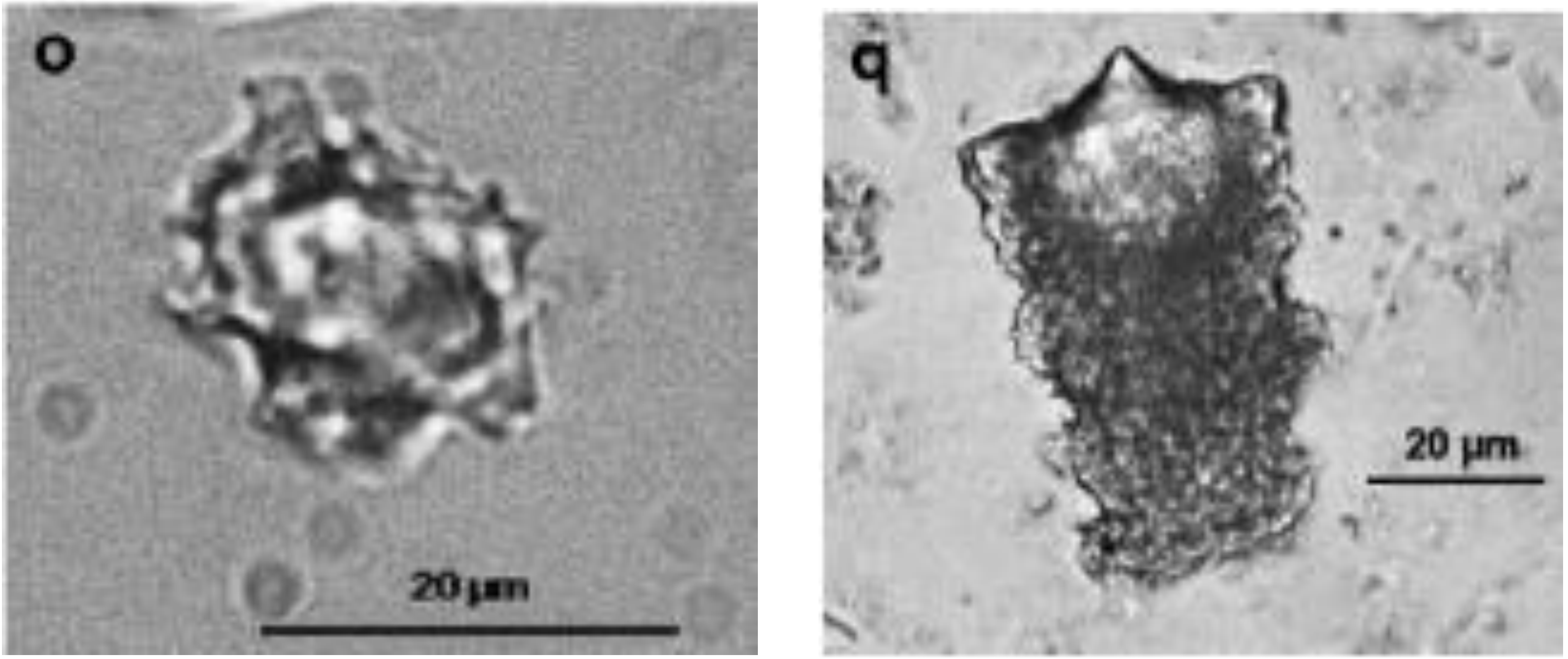


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. o) Marantaceae sphere (BD M1, 20-30 cm). q) Marantaceae seed phytoliths (P Ridged Field 2, 10-20 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Marantaceae

Phytolith

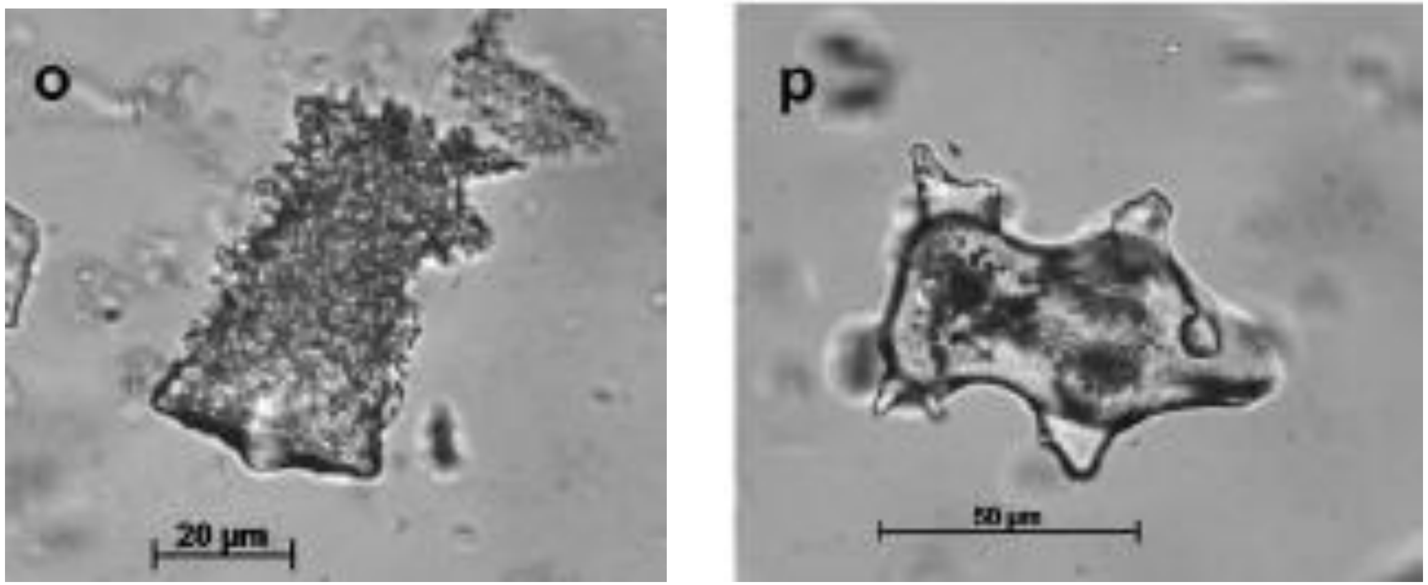


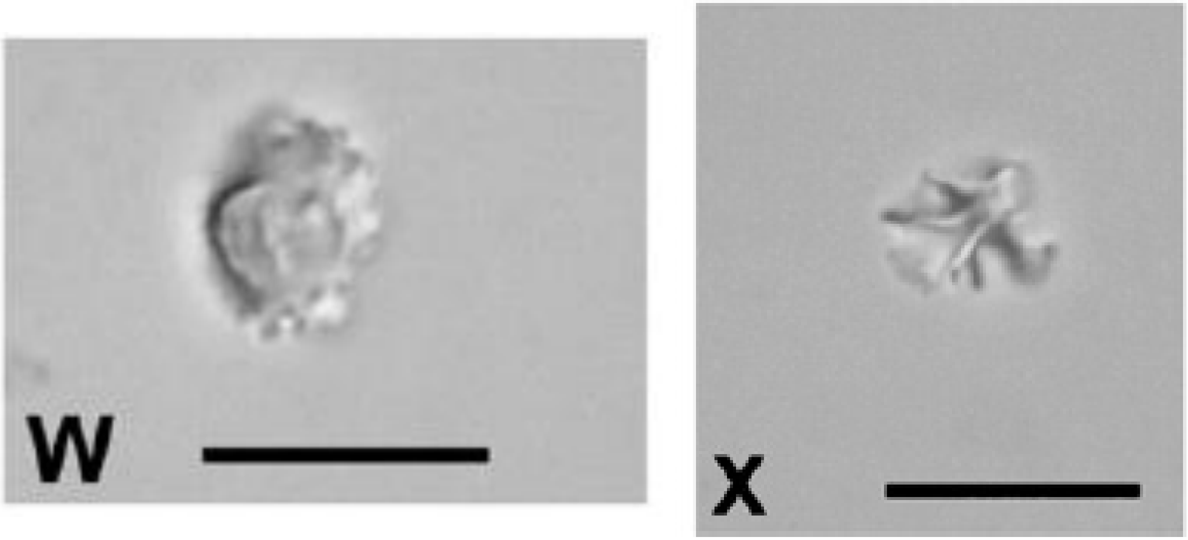
Fig. 5. Selected microbotanical remains. Phytoliths: o) Marantaceae 1 seed (Sed. Sample 4), p) Marantaceae 2 seed (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Ataenidia conferta

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). W, rugose hat-shape with sinulate margins from Ataenidia conferta leaf. X, D1 fringed druse from Ataenidia conferta leaf. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Calathea/Maranta

Phytolith

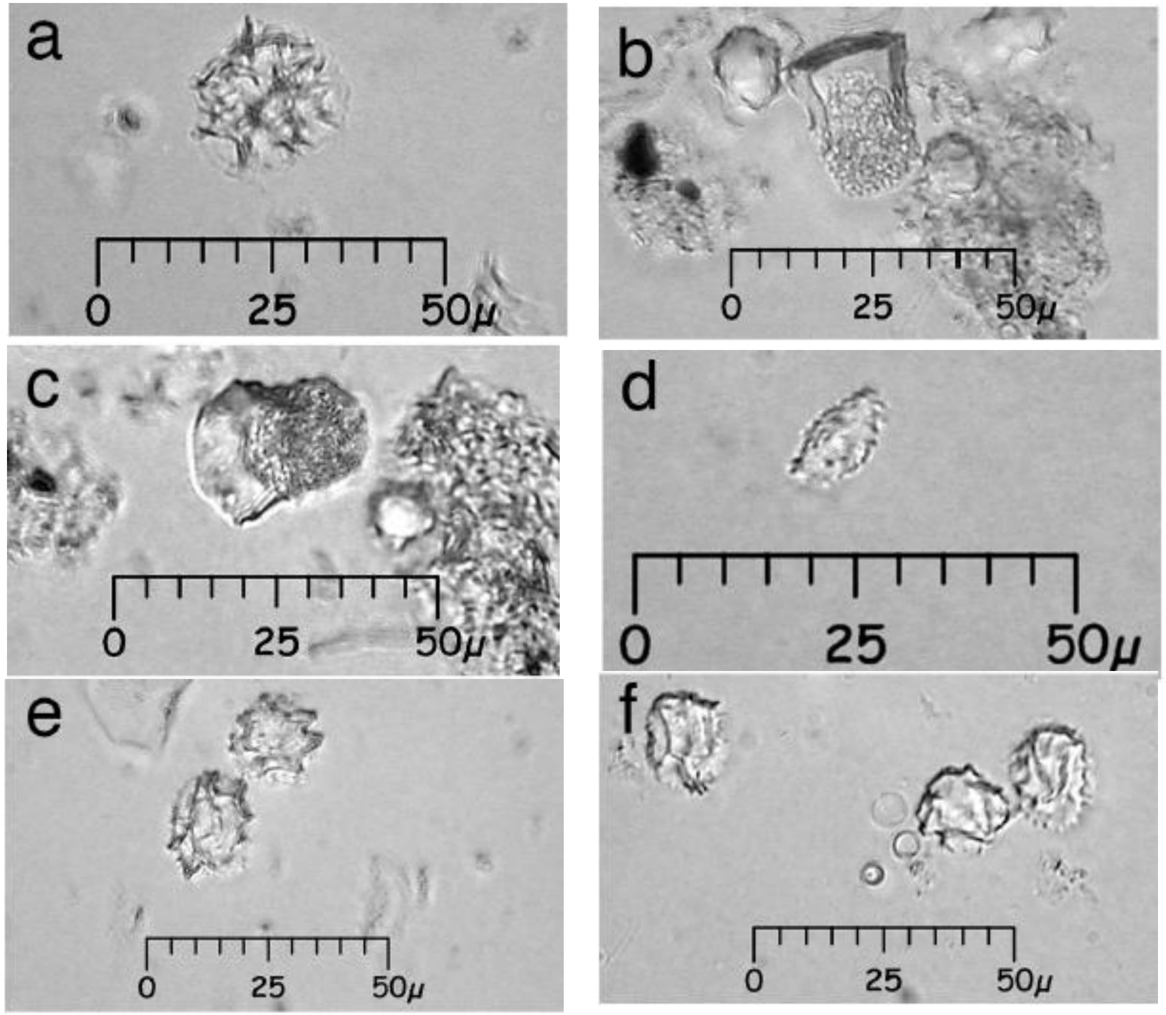


Fig. 1. Selected new diagnostic phytoliths. See MU Phytolith website (http://www.missouri.edu/~phyto) for photographs of all types. a. 26IAa Calathea (Marantaceae) irregular rhizome cylinder. b, c. 26IAb Calathea (Marantaceae) flat domed rhizome cylinder. d. 26IB Maranta/Calathea (Marantaceae) rhizome spindle. e, f. 26IIB Calathea (Marantaceae) flat rhizome type.

Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

Calathea sp.

Phytolith

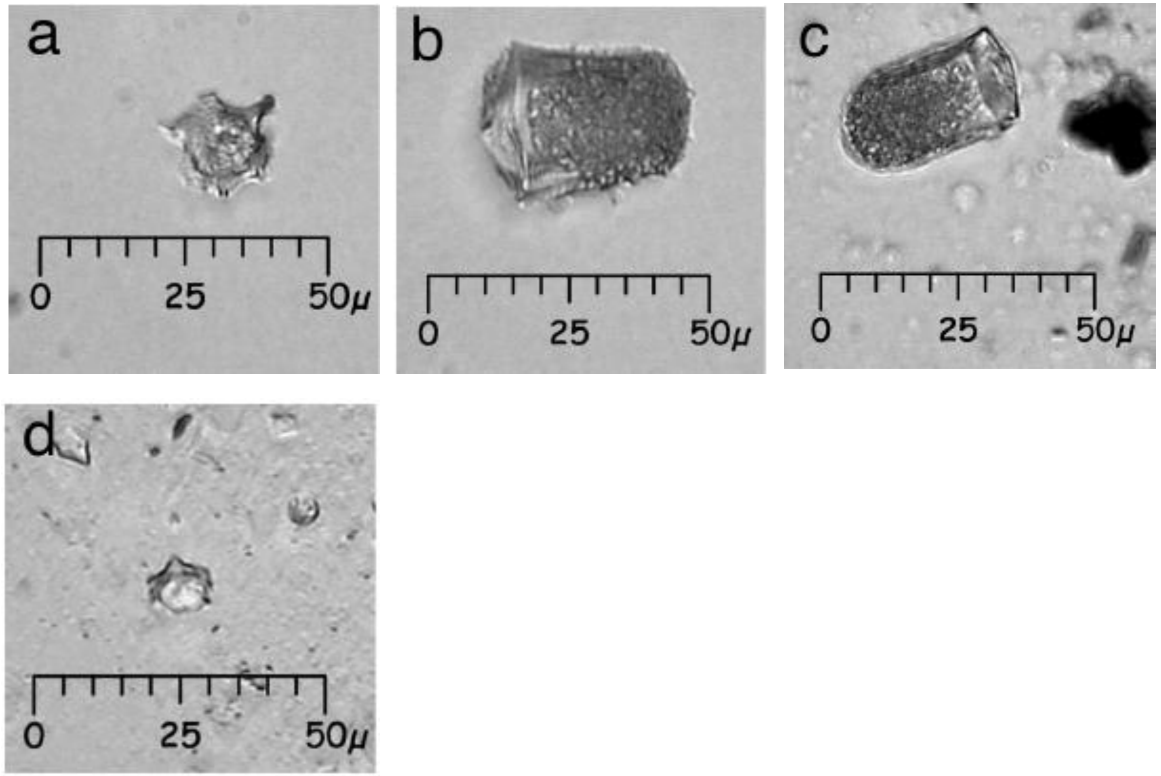


Fig. 5. Selected phytoliths and starch granules recovered from tools. See MU Phytolith website (http://www. missouri.edu/~phyto) for other photographs. a. 26IAa Calathea irregular rhizome cylinder, PS1749 FS 3290-A. b. 26IAb Calathea flat domed rhizome cylinder, PS1749 FS 3290-A. c. 26IAb Calathea flat domed rhizome cylinder, PS1765 FS 3293-B. d. 26IIB Calathea flat rhizome type, PS1804 FS3294-B.

Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

Calathea allouia

Phytolith

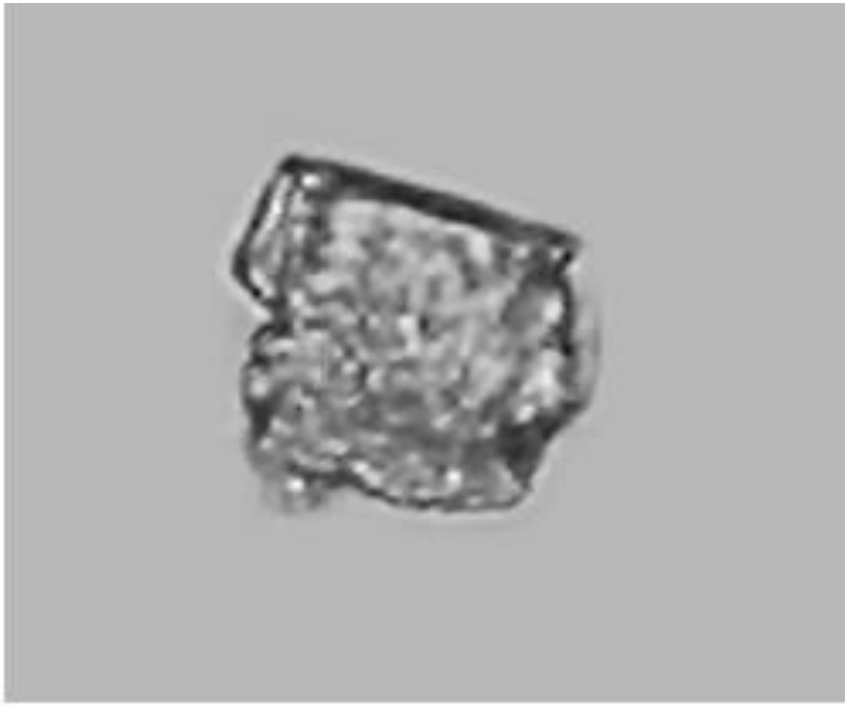


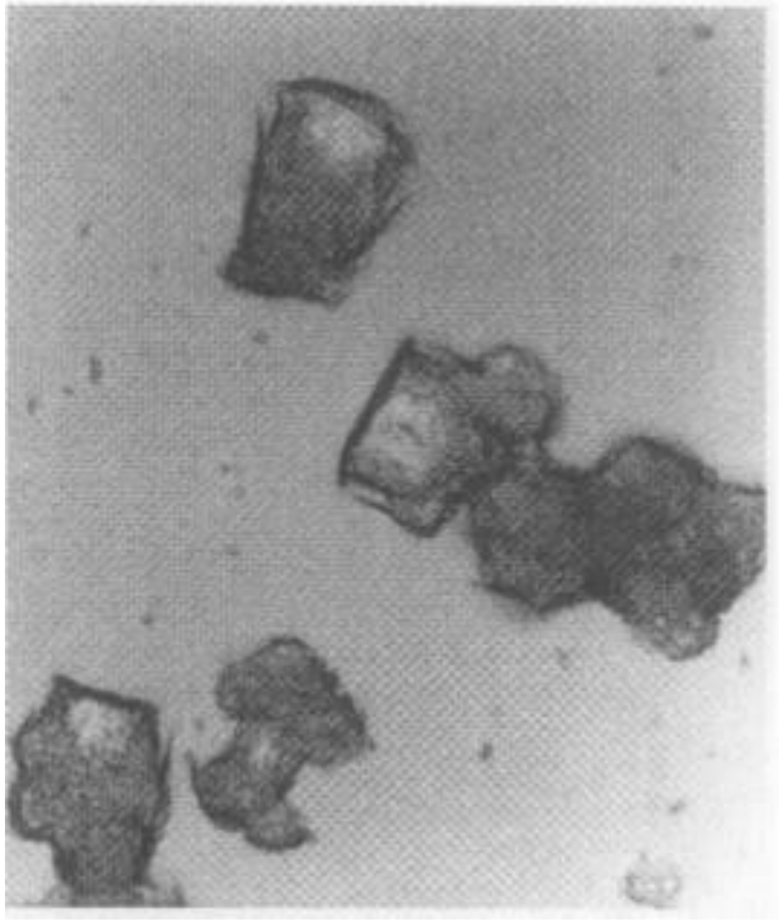
Fig. 8. Seed phytolith from lleren. It is 40 mM long. From Piperno, 2006.

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Calathea allouia

Phytolith

Fig. 18. Phytoliths from the seeds of Calathea allouia (leren). They are diagnostic because they have flat and undecorated upper bodies, in contrast to all other studied species in the Marantaceae.

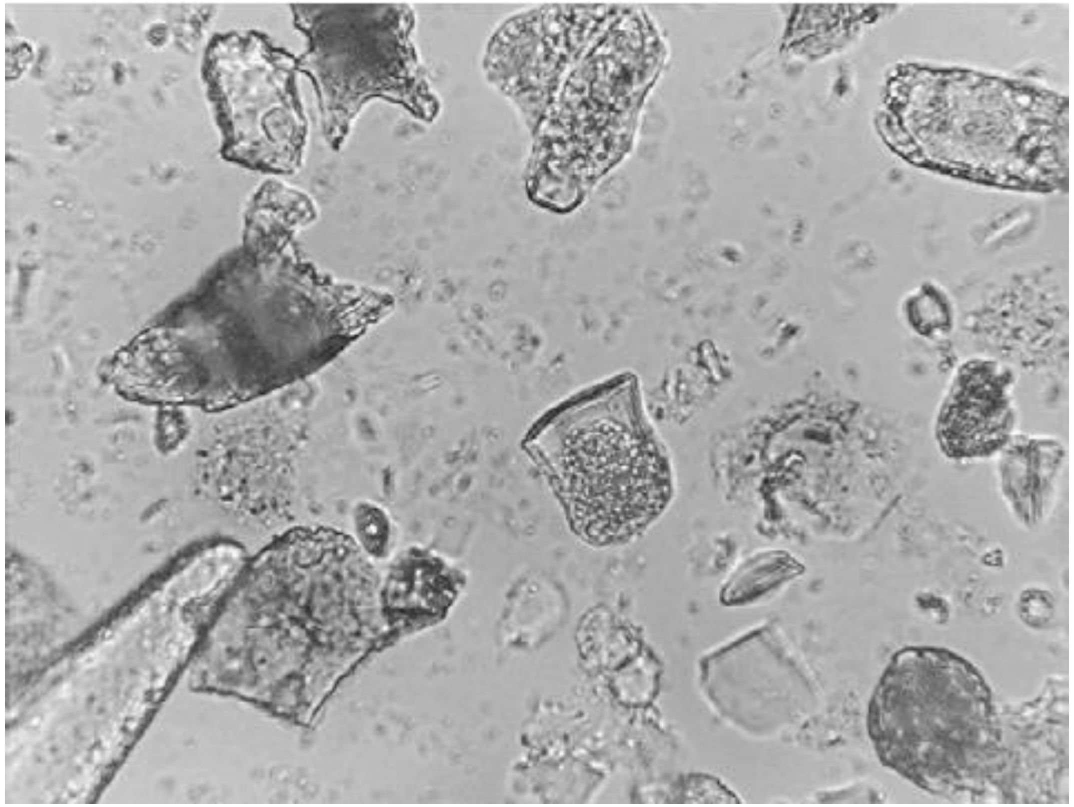


Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Calathea allouia

Phytolith

Fig. 12. Center, a phytolith from the rhizome of Calathea allouia recovered from a preceramic level of Vegas Site 80. The phytolith assemblage of which it was a part was directly dated to 93207250 B.P. The phytolith is 30mm long.

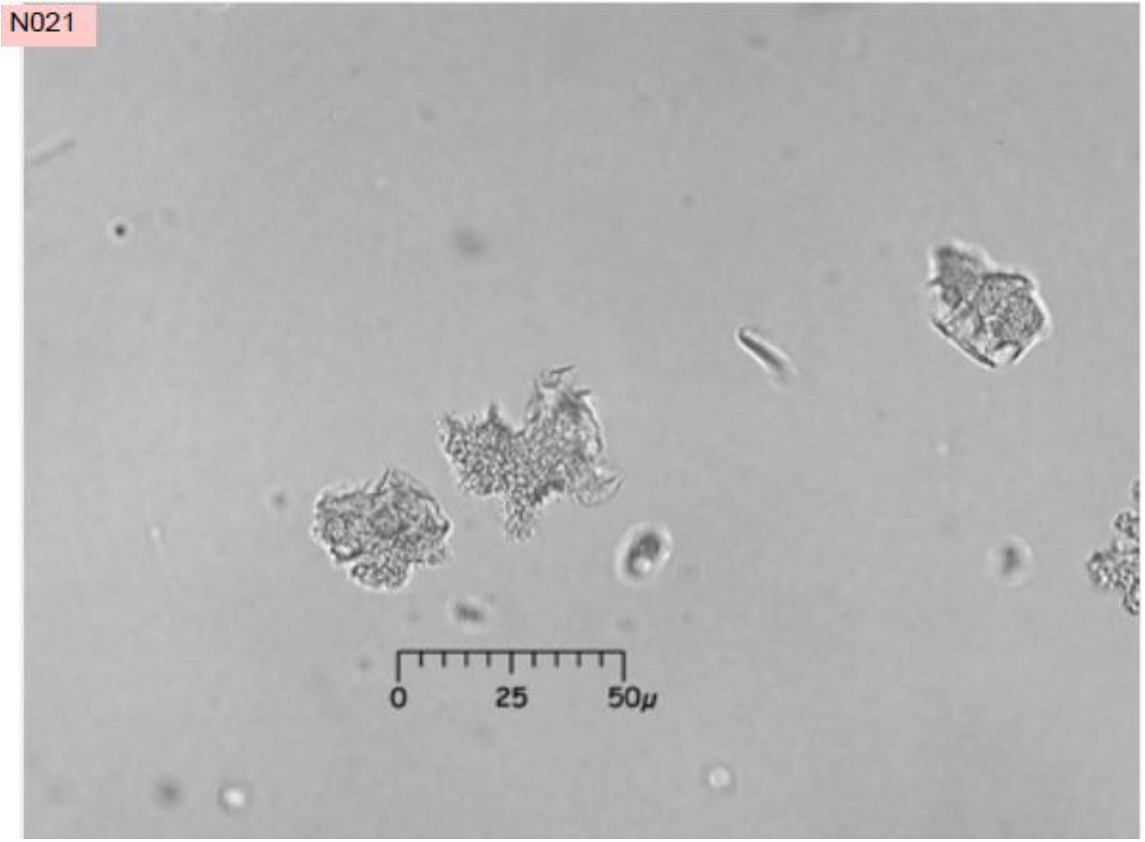


Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Calathea allouia

Phytolith

Body on left is 22VIIBc2 (no spikes).
Body on right is 22VIIBc3 (spikes).
Diagnostic level: species (both types)

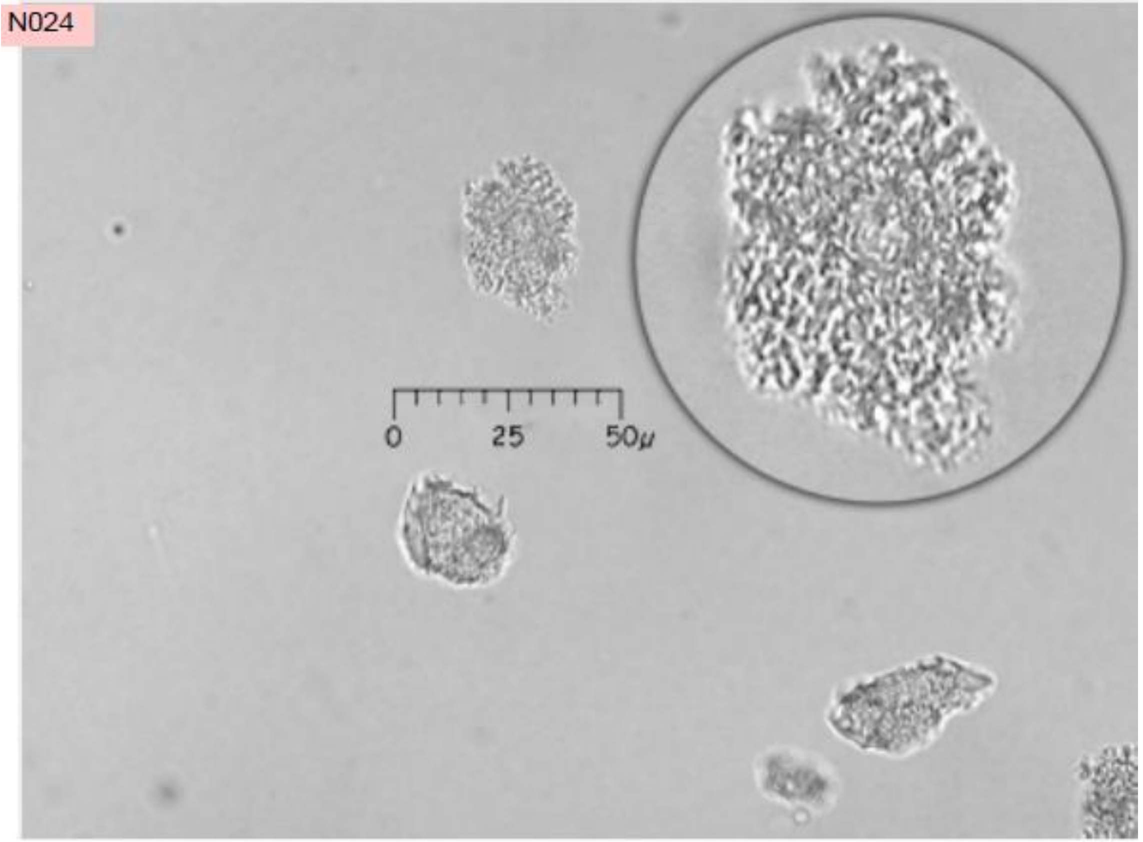


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

“Top” or dome-side view of “tip only” from Calathea allouia.
You can only identify to species if you can match dome and spines. Otherwise identify only to Genus.
Inset shows closeup of underside of C. allouia “tip only” where shaft of cylinder has broken away.

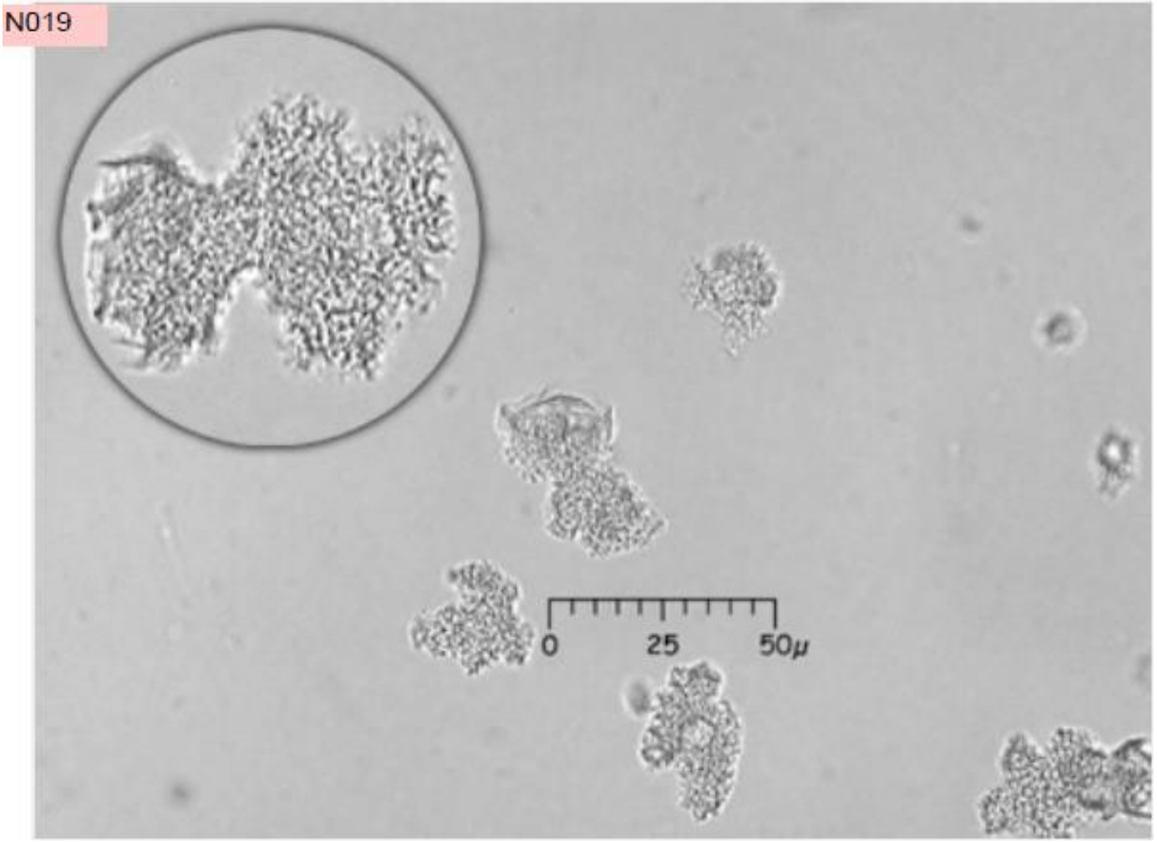


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

Diagnostic level: species Note that the "tip only" and pieces of cylinder only are also visible in this image (bottom view of "tip only" in bottom right side of field, piece of cylinder only in center left side of field). Inset shows closeup of C.allouia type... Notice the distinctive traits of the thin spines surrounding a flattened dome tip.

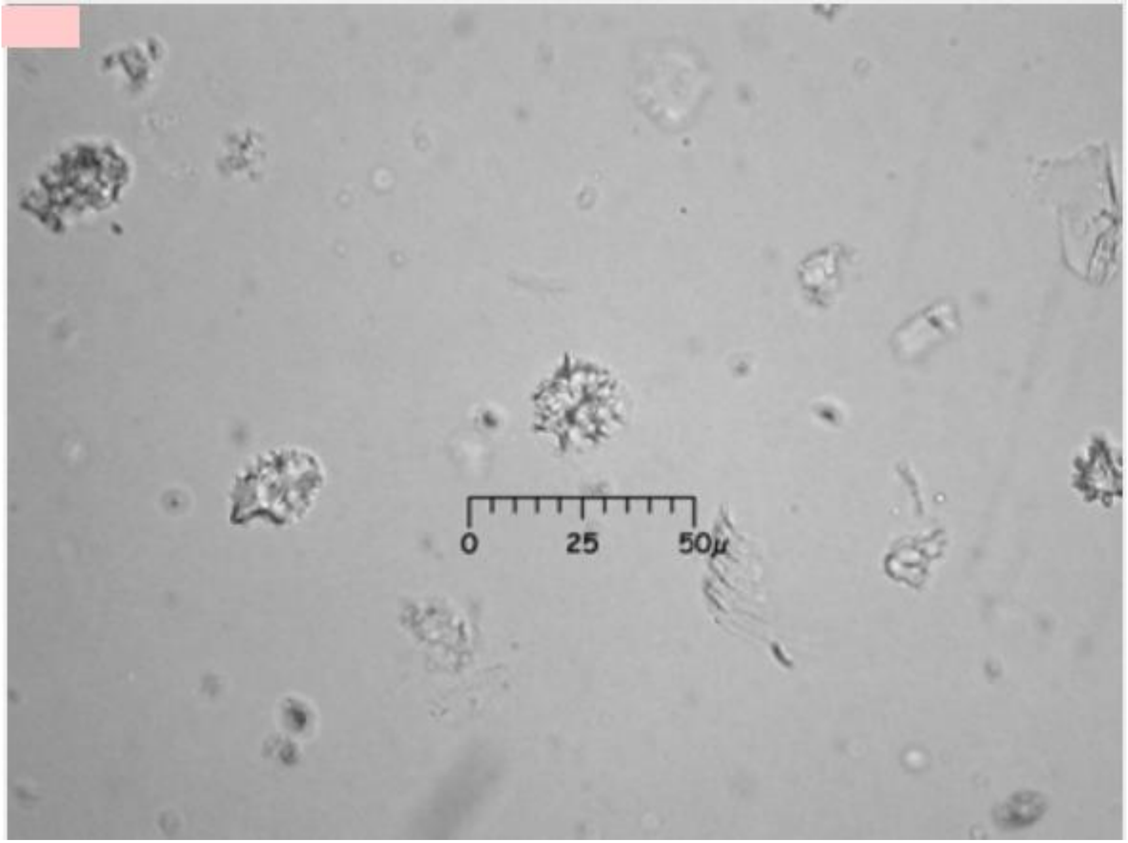


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

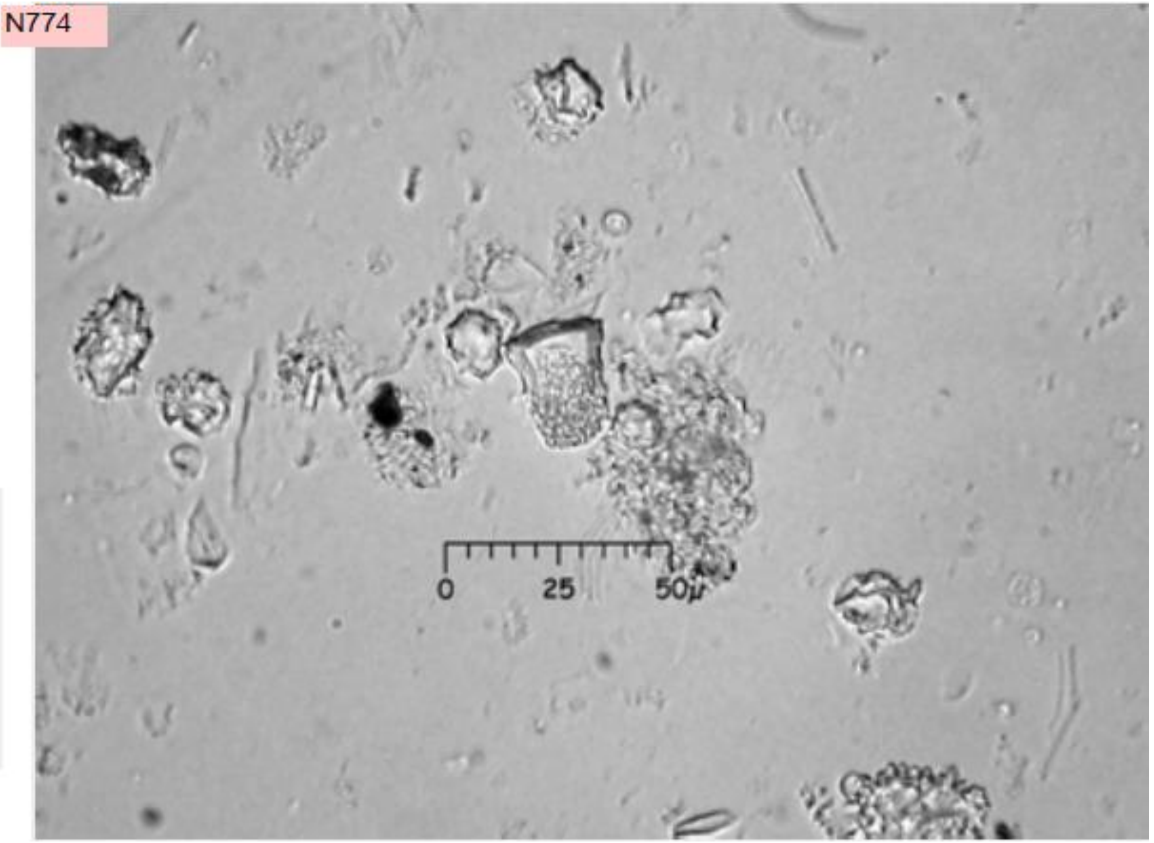
The phytolith to the left of the scale shows the tip clearly.
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea rhizomes



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith



Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea rhizomes

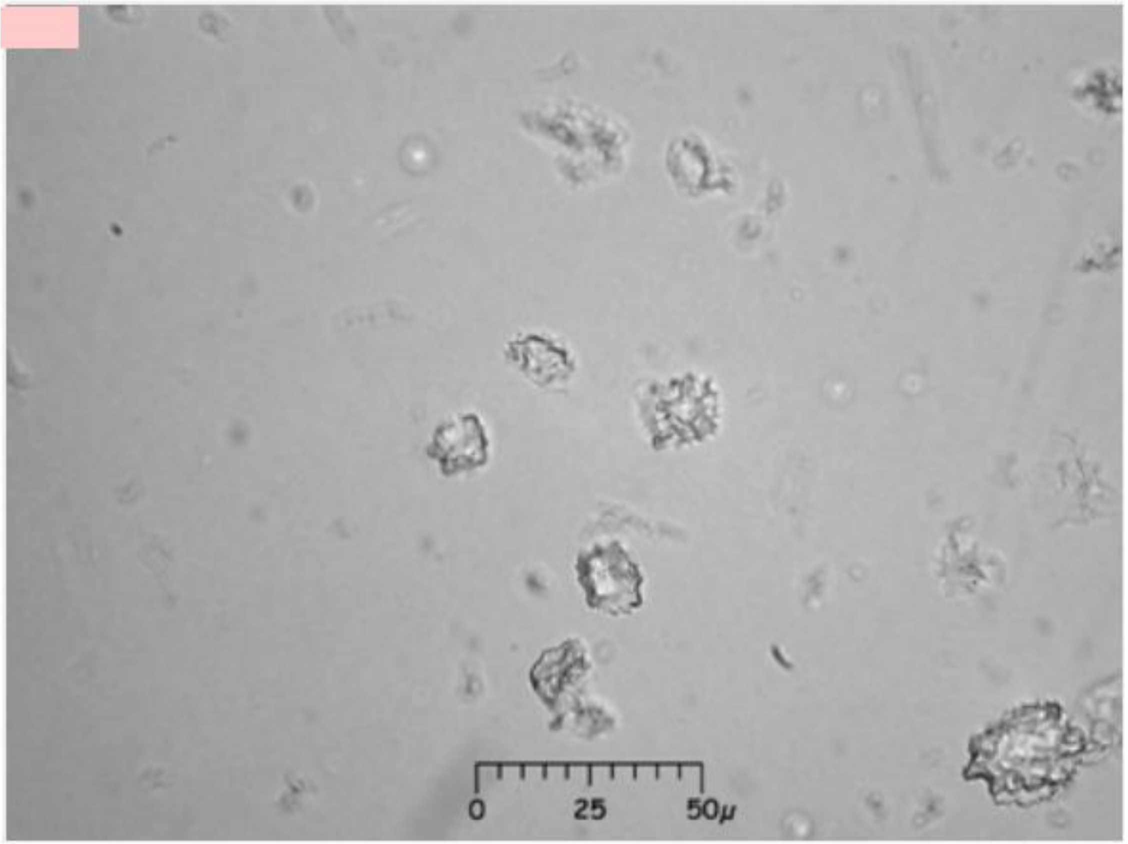
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

Phytoliths above the scale are this type. Phytolith at lower right is 26IAa (see record 258)
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea genus, rhizome

See phytolith at lower right. The other forms are 26IIB
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea, rhizome



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

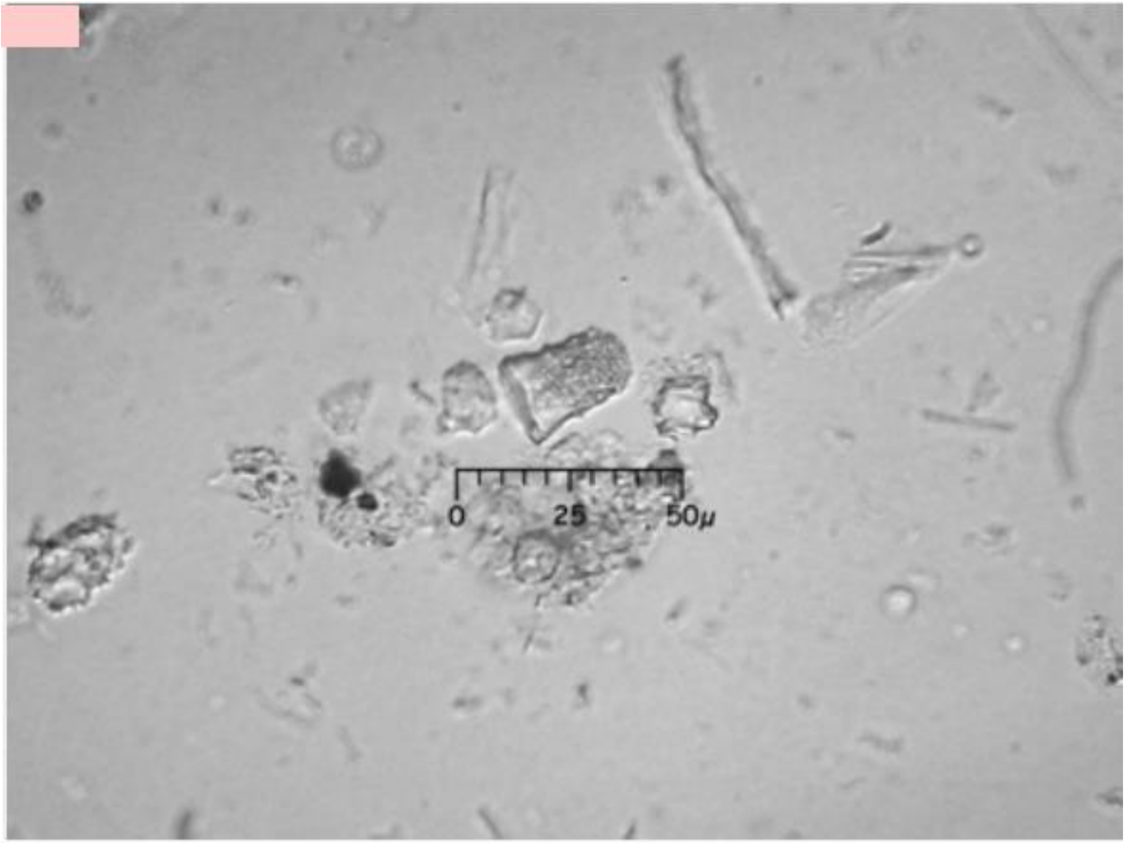
Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith



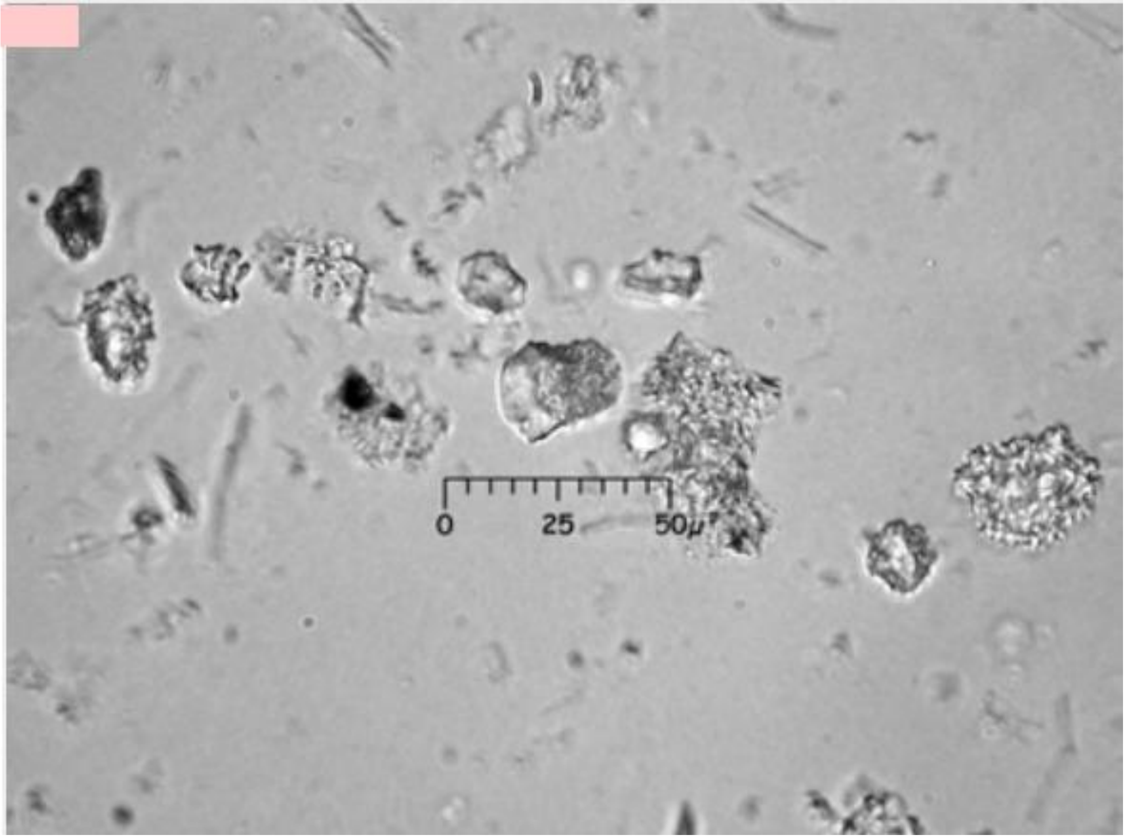
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea, rhizome

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea, rhizome

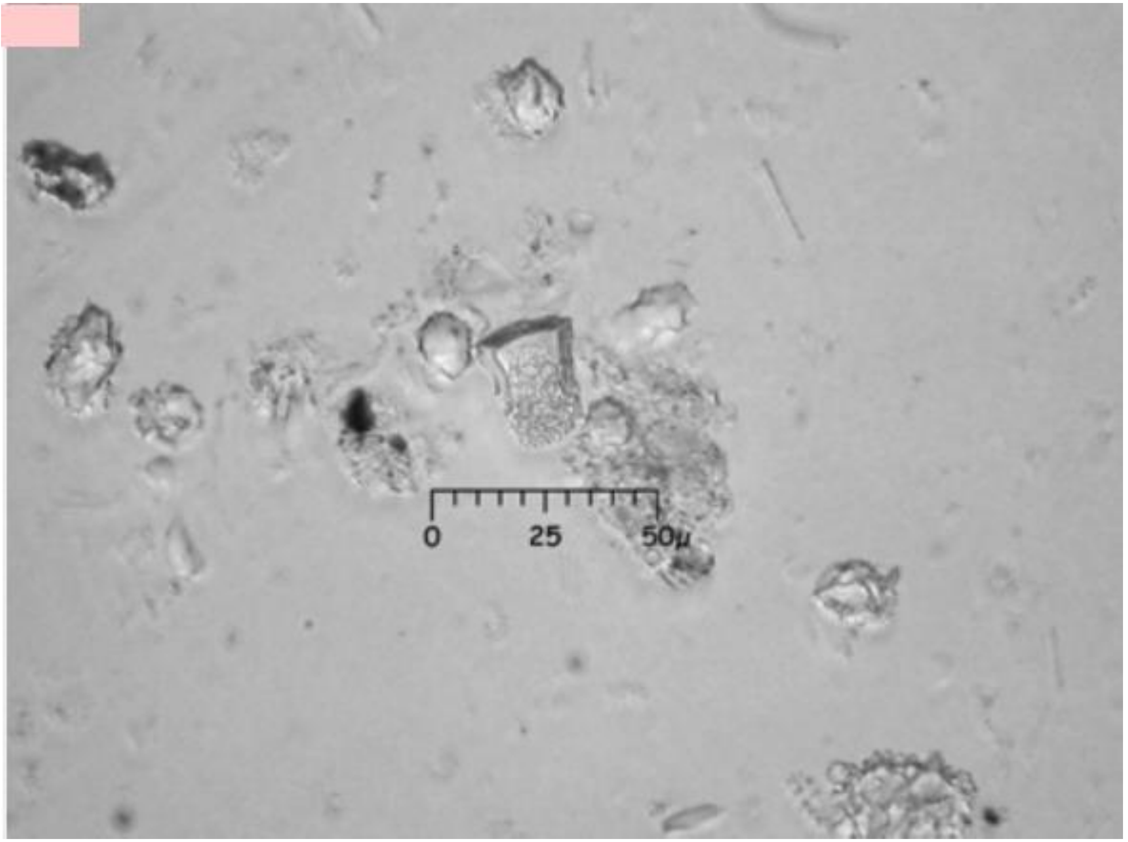


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea, rhizome

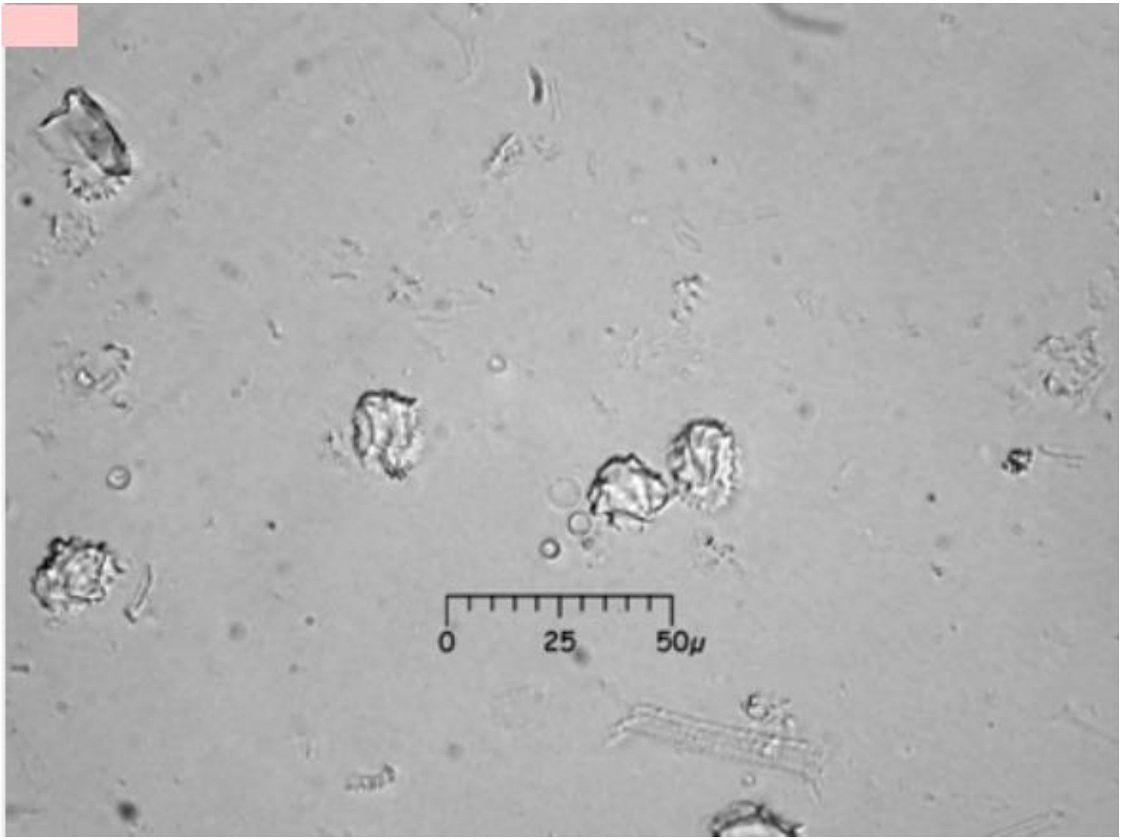


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea genus, rhizome

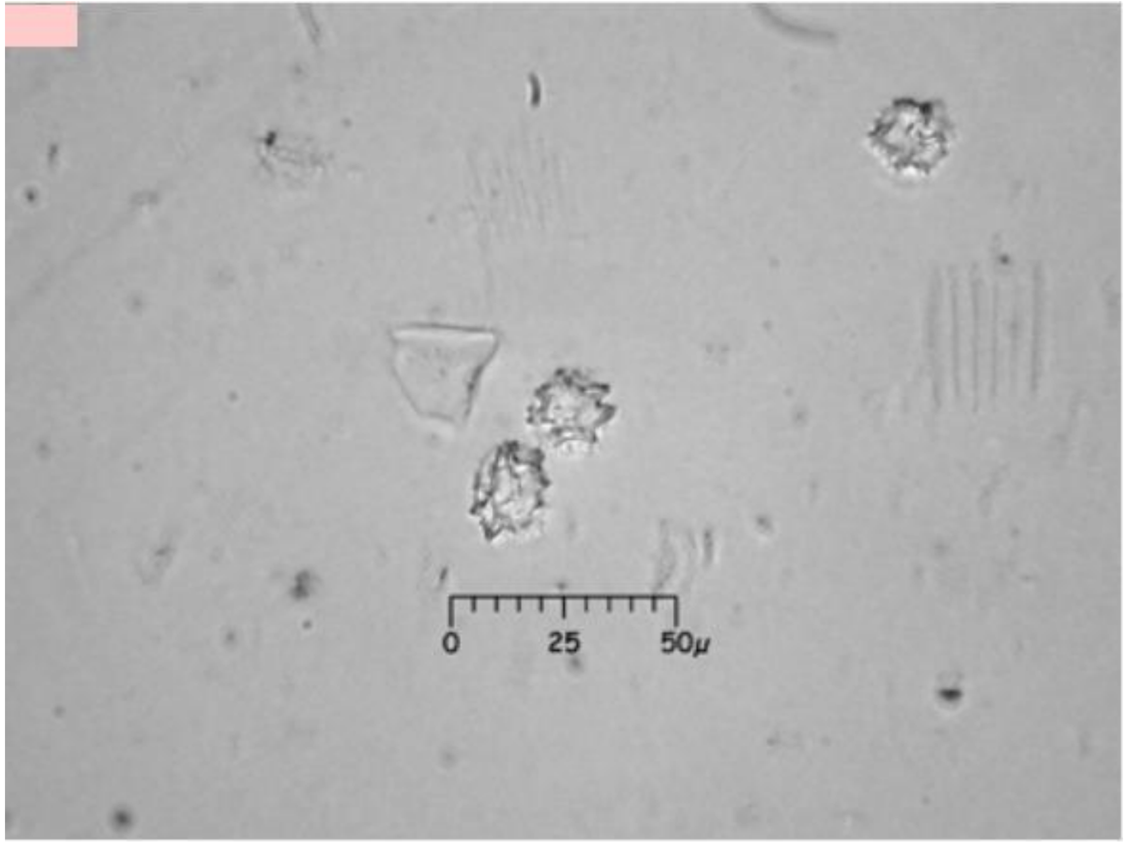


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

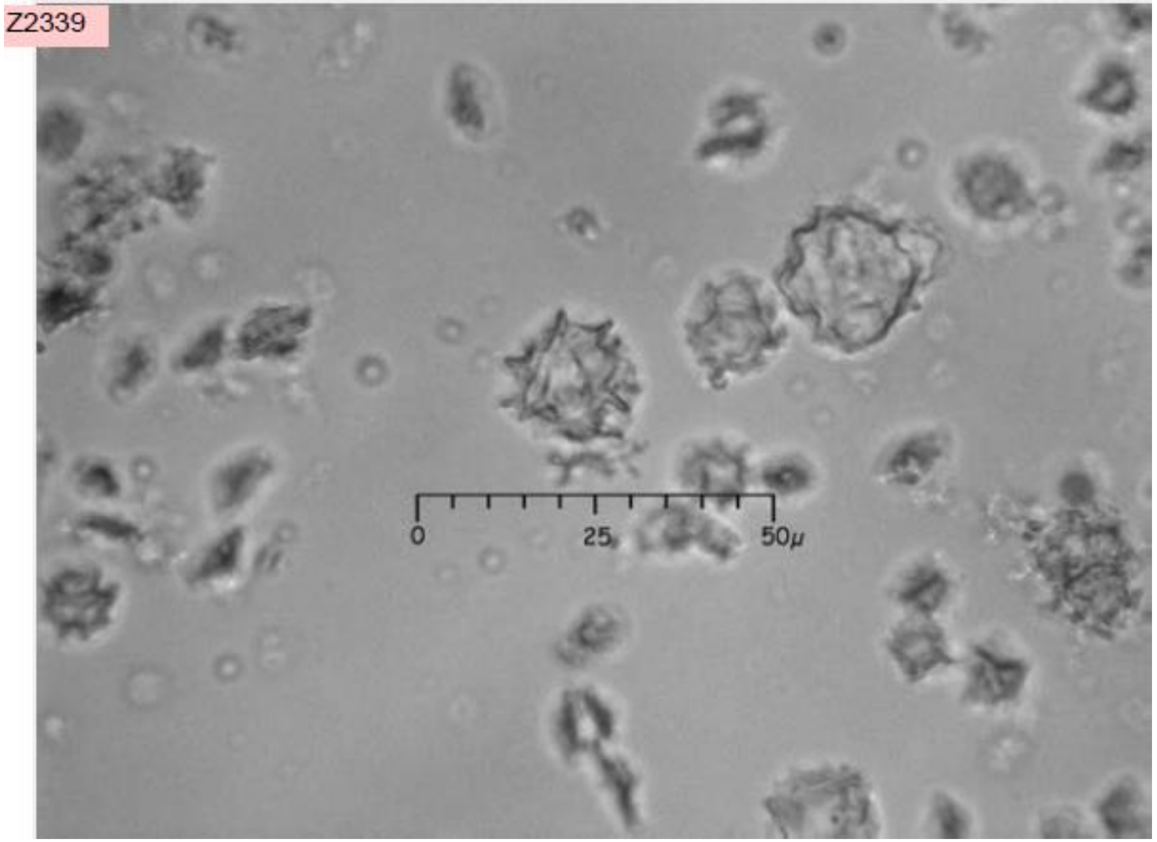
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Calathea genus, rhizome



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith



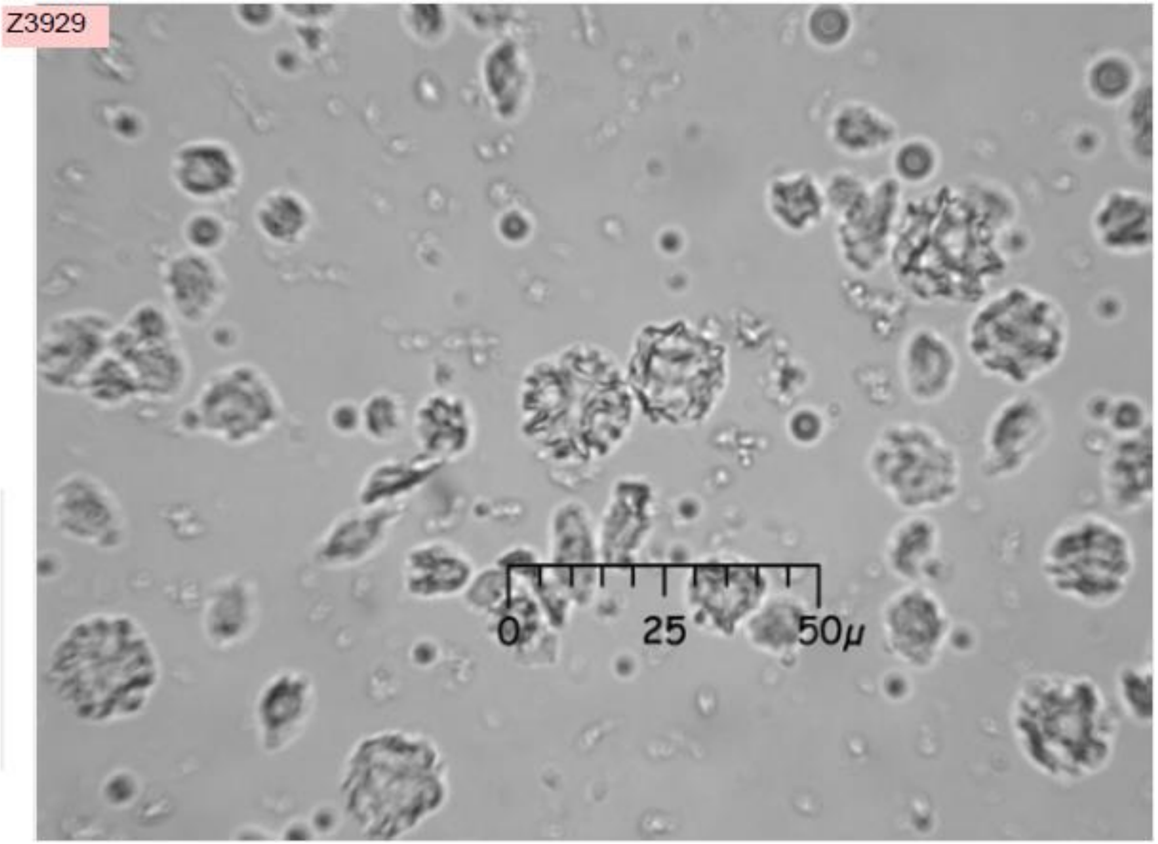
PC2458
Diagnostic level: Potential species-level diagnostic. Type overlaps with 80IKa, but is distinguished by size.
Occurs in leaf and less often in inflorescence

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2458
Diagnostic level: Potential species-level diagnostic. Type overlaps with 80IKa, but is distinguished by size.
Occurs in leaf and less often in inflorescence

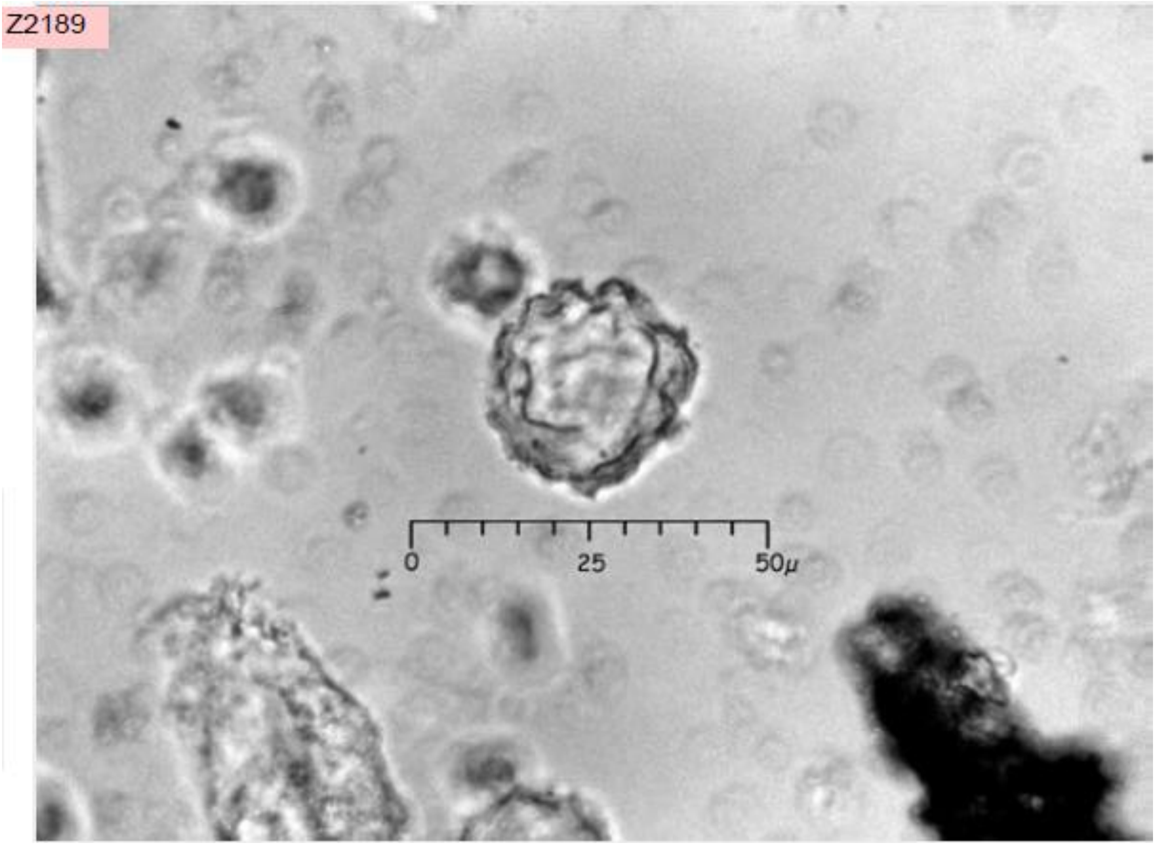


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2596 Calathea allouia leaf These folded/angled spheres have distinctive nodules separate from the folds. Grade into rugulose (bumpy, rough surface) spheres.
Type first defined by Karol Chandler-Ezell
Diagnostic level under study

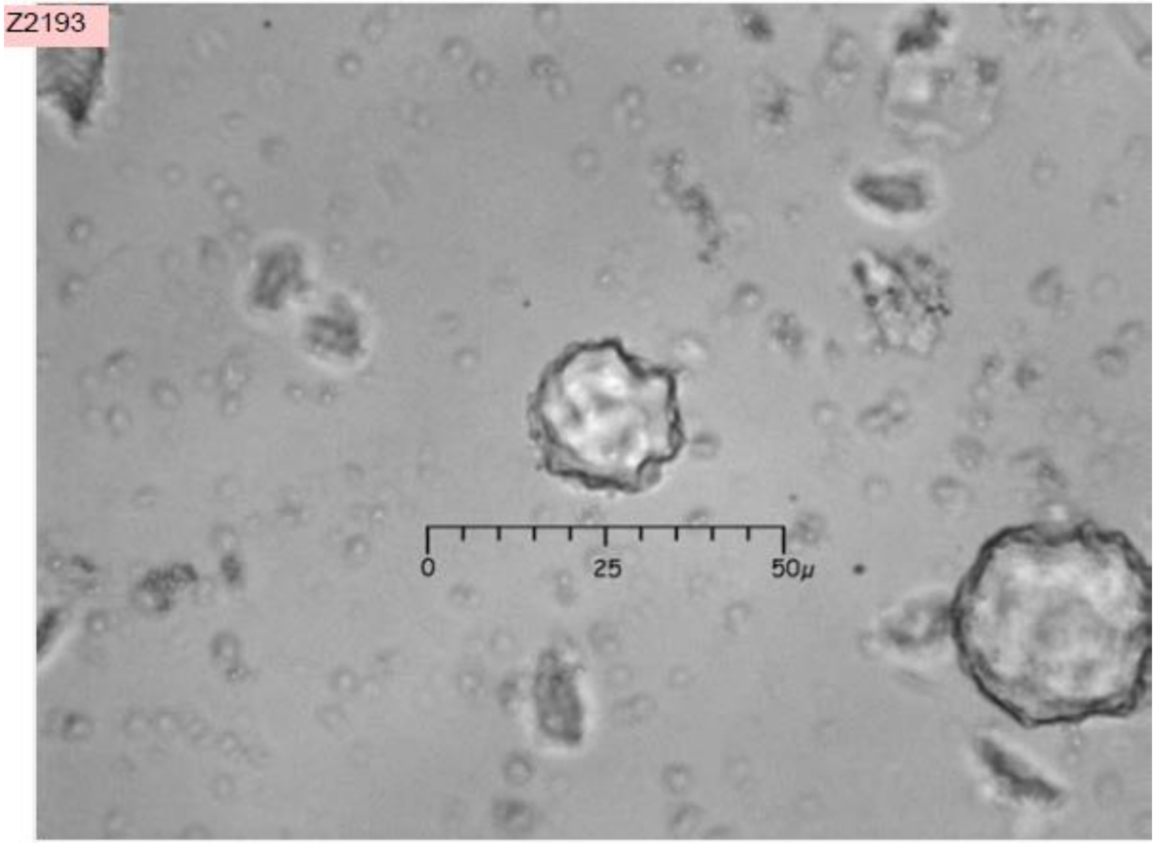


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2596 Calathea allouia leaf These folded/angled spheres have distinctive nodules separate from the folds. Grade into rugulose (bumpy, rough surface) spheres.
Diagnostic level under study

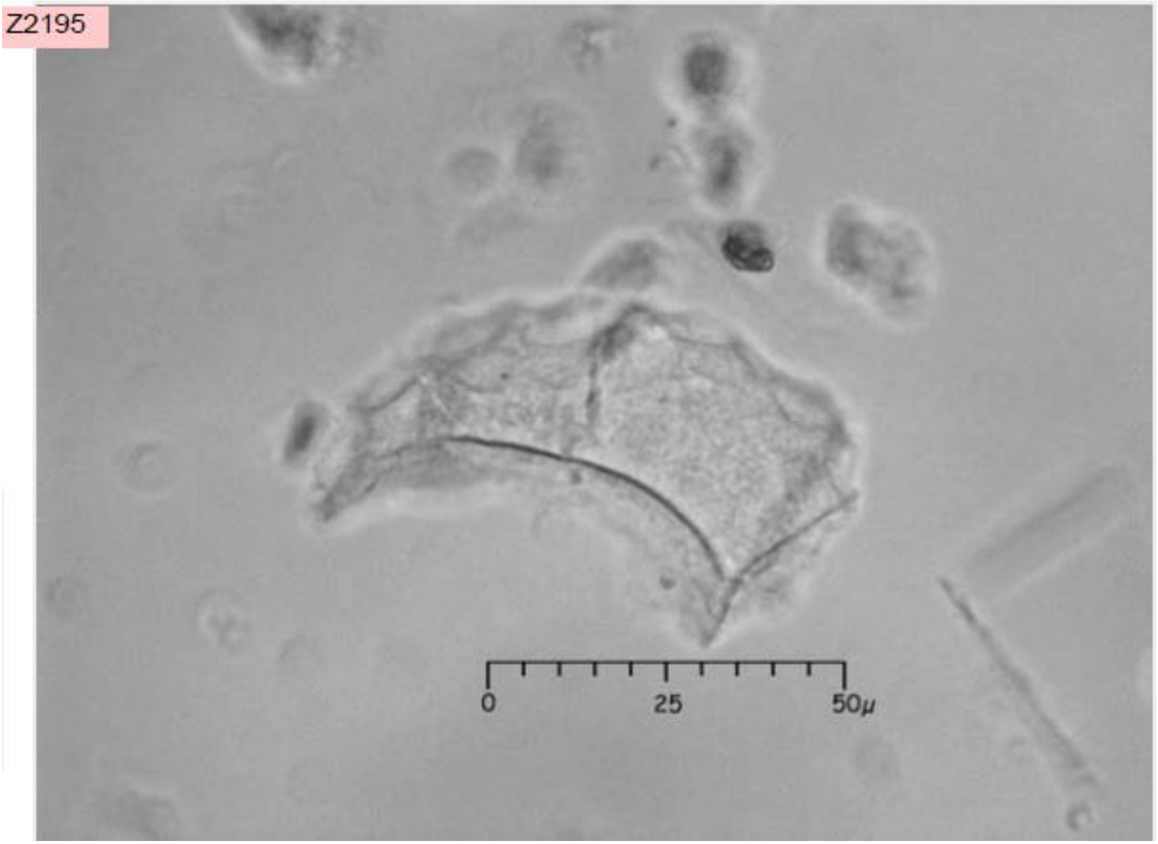


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2597 Calathea allouia stem some examples are curved, but not hemispherical
Diagnostic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2597 Calathea allouia stem some examples are curved, but not hemispherical
Diagnostic level: under study

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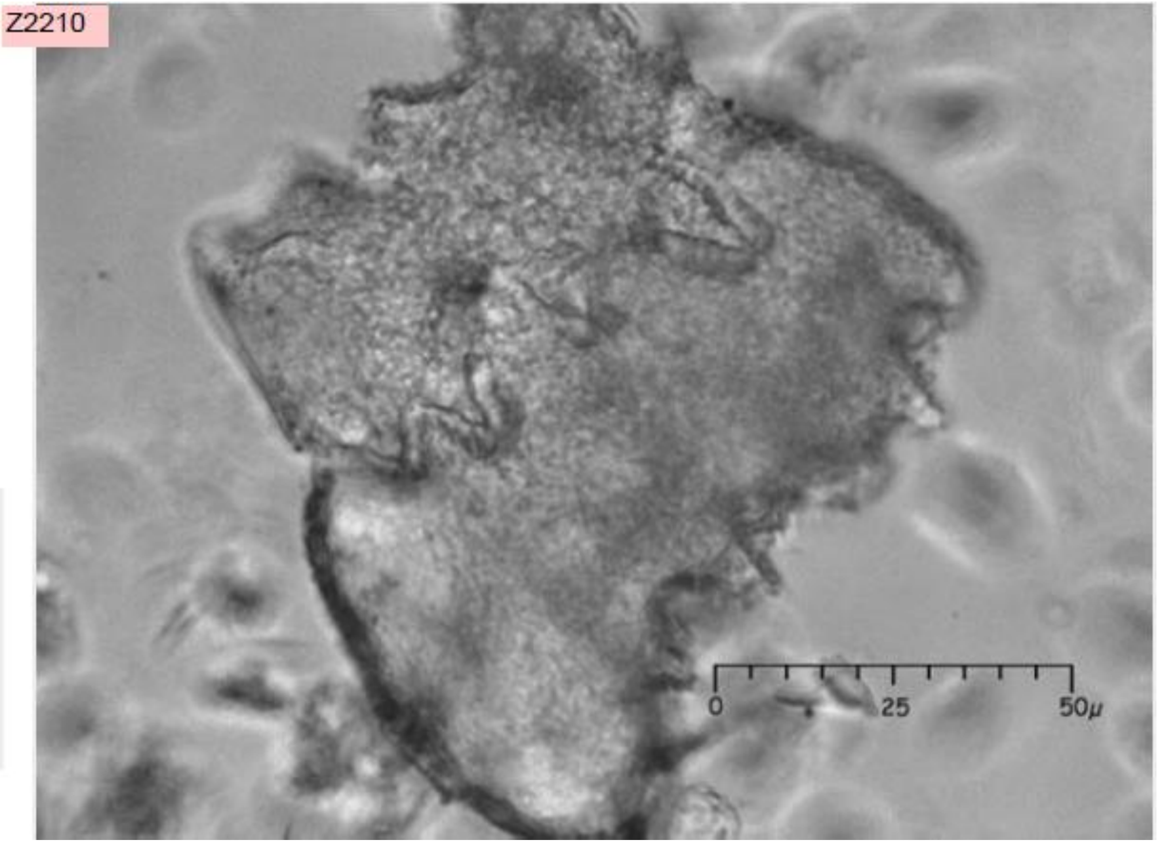
Calathea allouia

Phytolith



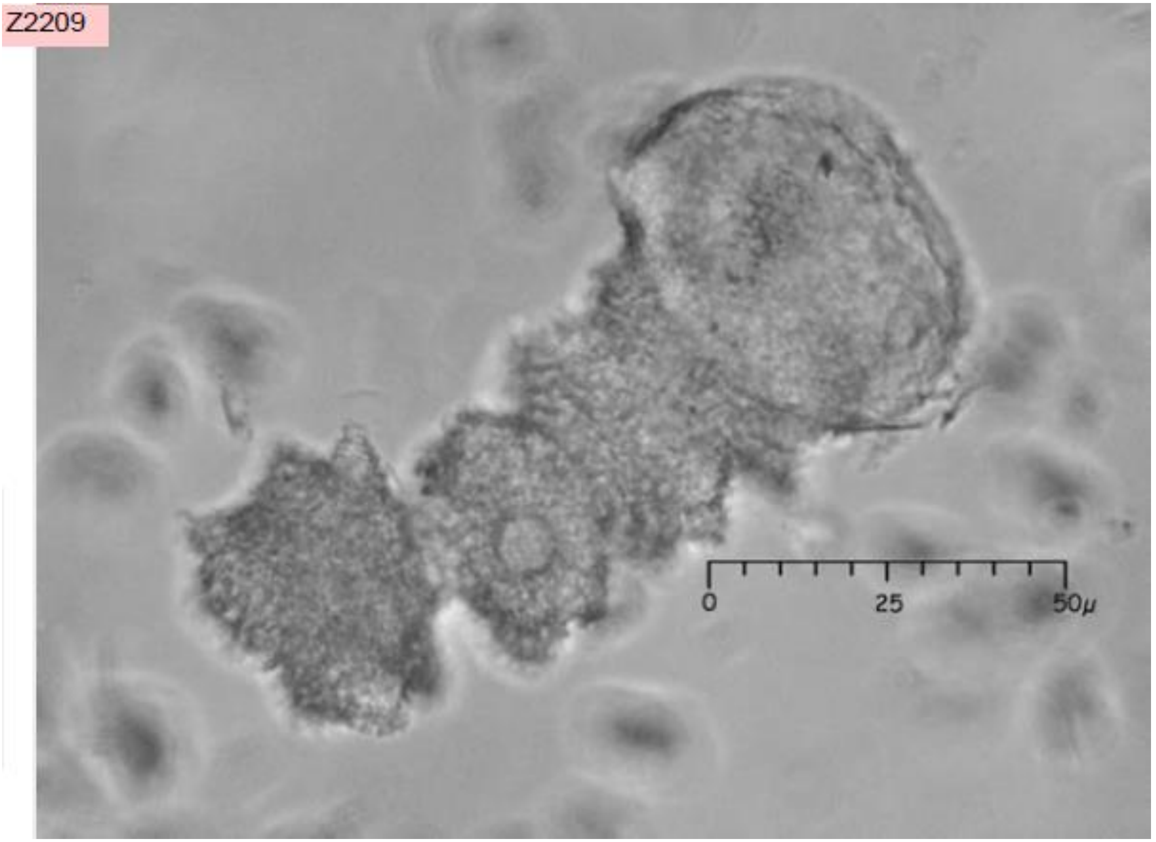
PC2598, inflorescence
Note that this type can be quite long; considerable variation is present
Diagnotic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2598, inflorescence
Note that these inflorescence types can be quite large; size is variable
Diagnostic level: species



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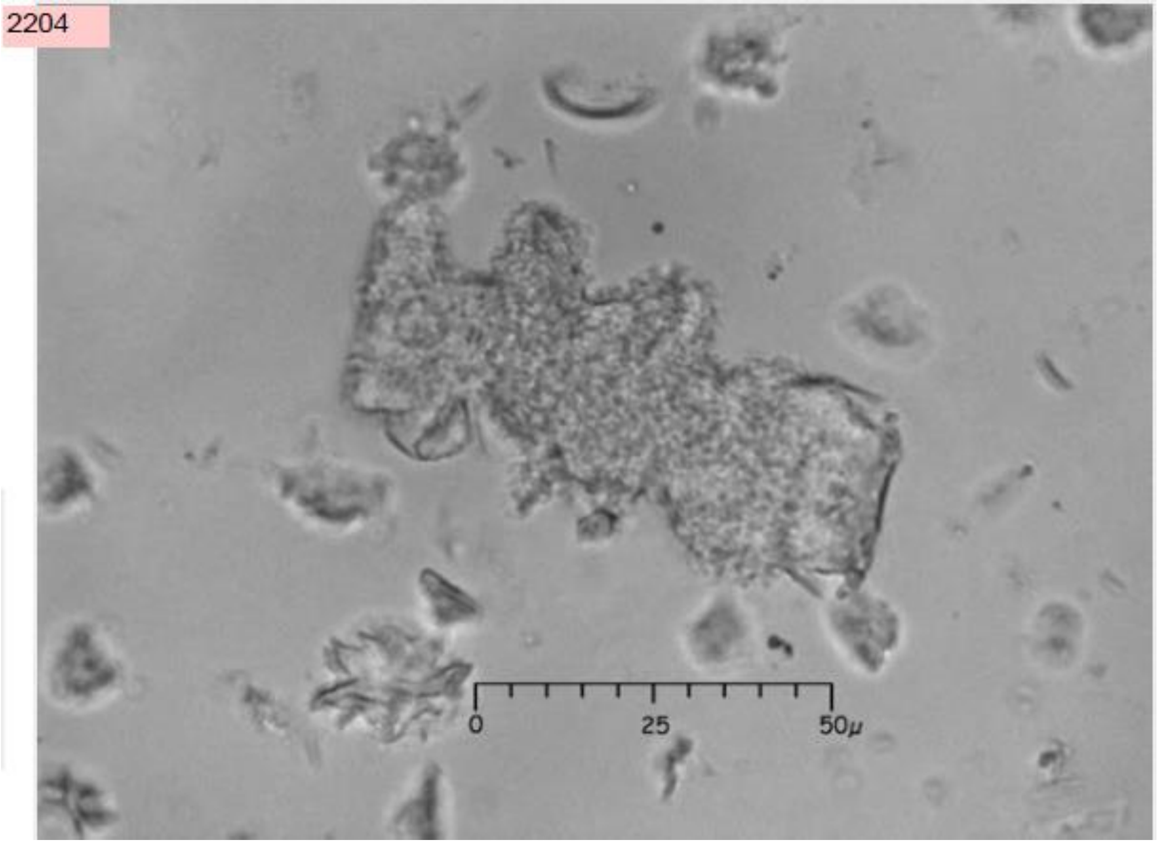
Calathea allouia

Phytolith

PC2598, inflorescence
Note that these inflorescence types can be quite large; size is variable
Diagnostic level: species



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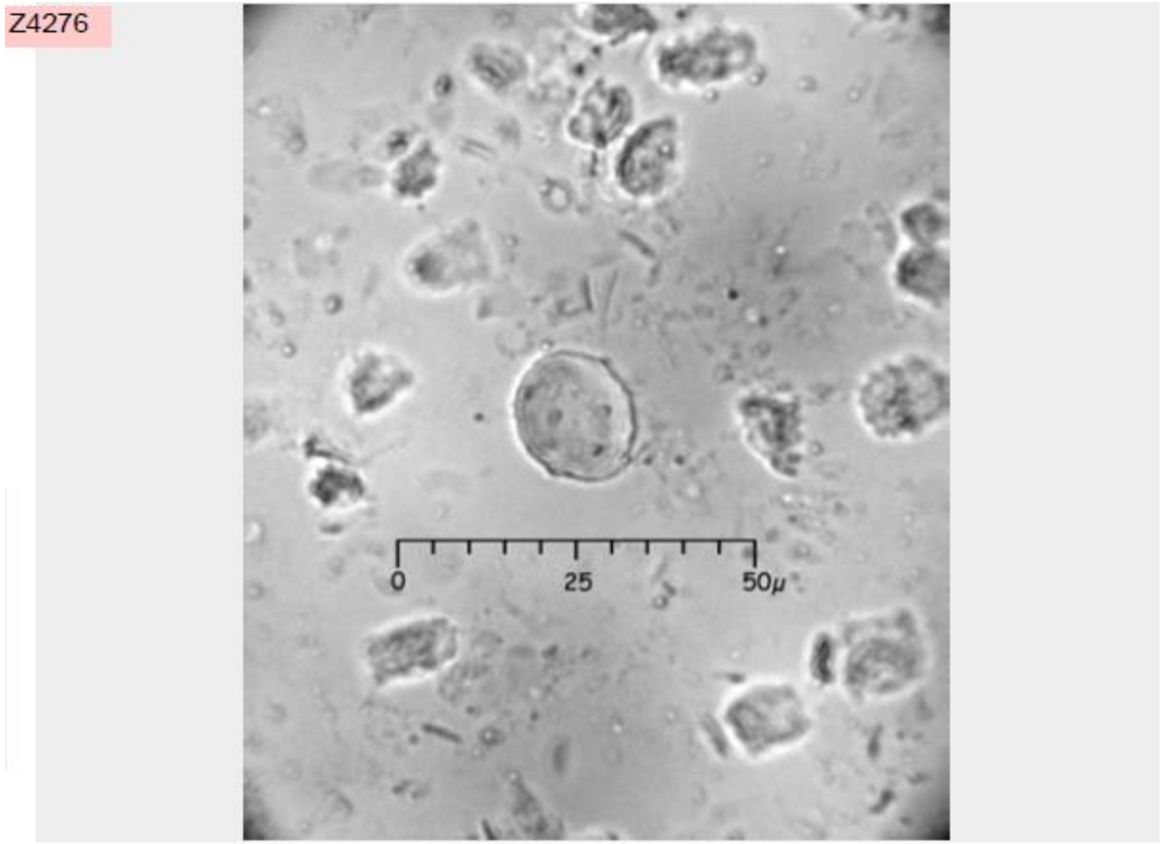
Calathea allouia

Phytolith

PC2598, inflorescence, type occurs rarely
Spheres produced by Canna range from smooth to rugulose to irregularly angled or folded. Type 80IAa201 is based on a modern specimen of Canna edulis leaf. Ephemeral spherical bodies are not included in this type.
Diagnostic level: Canna genus (rare in Calathea)

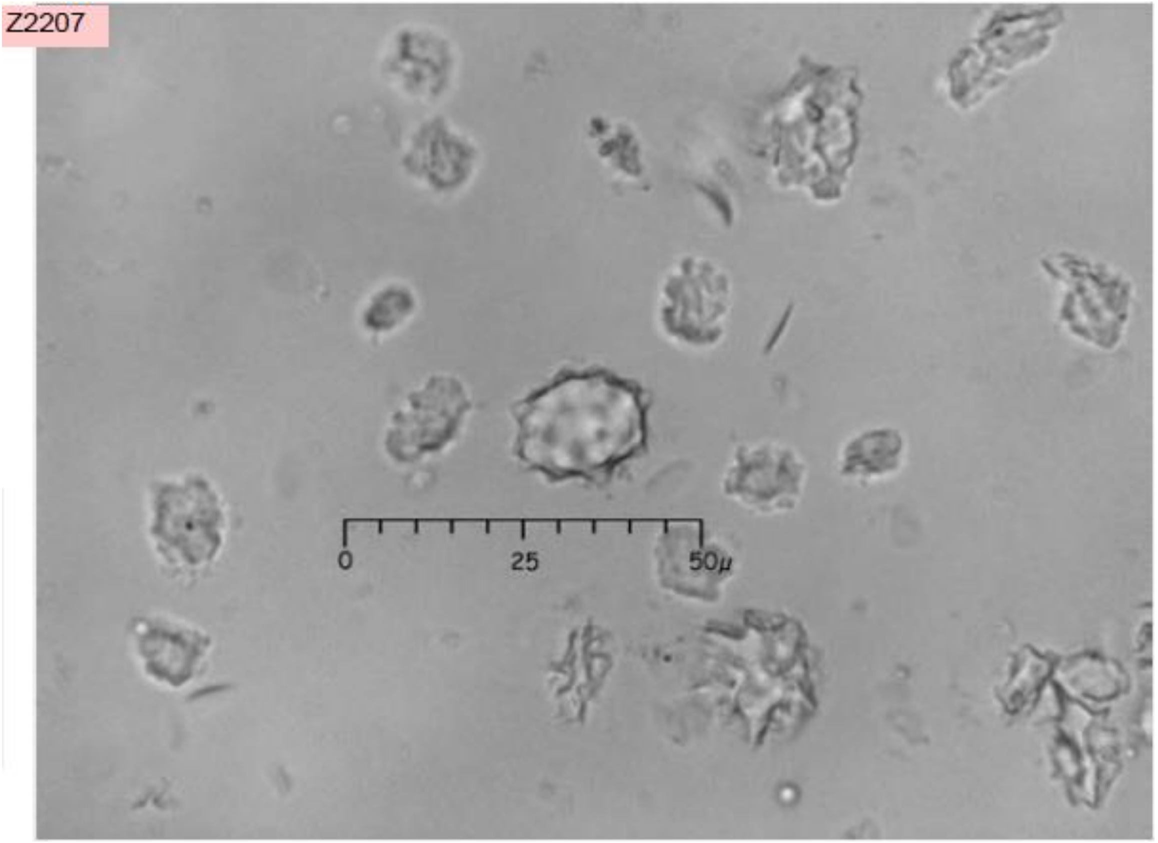


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

PC2598, inflorescence Nodular spheres moderate in occurrence, variable in size and height of projections. This is a large example (80ICa2); smaller also present (80ICa1)



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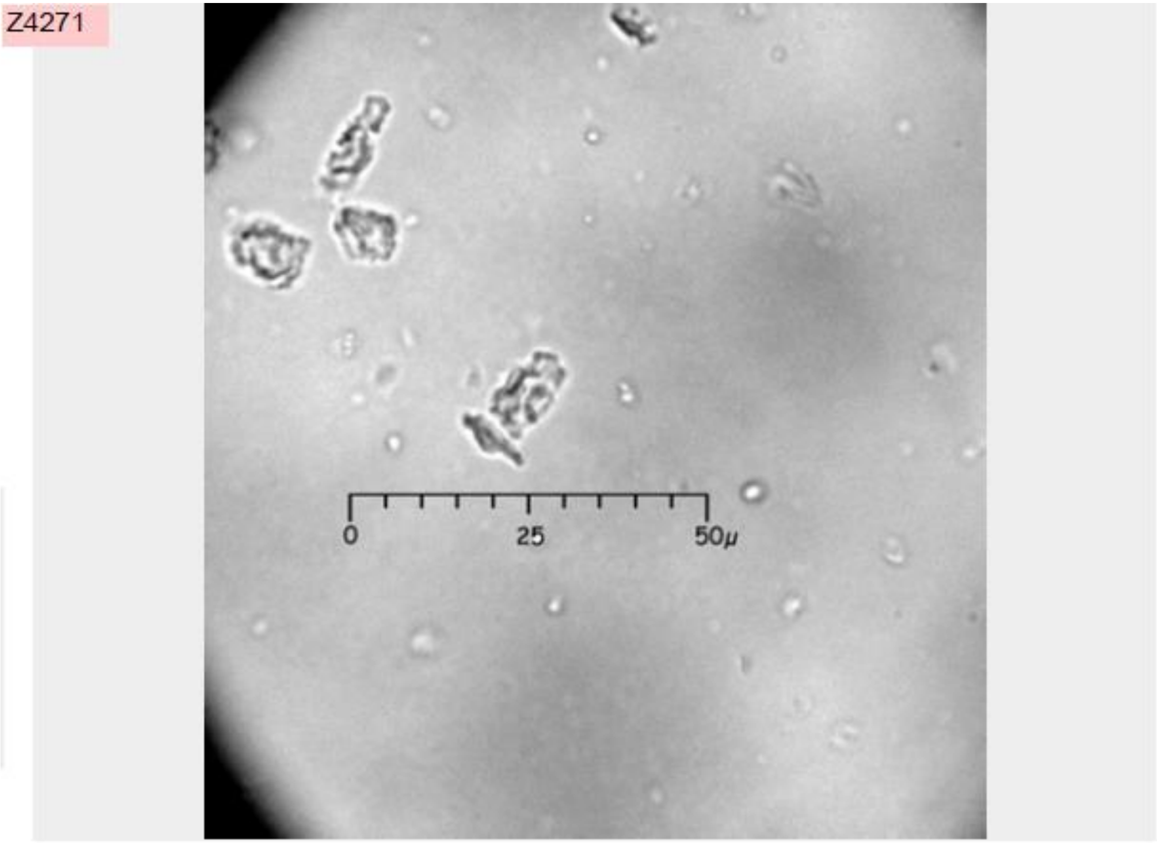
Calathea allouia

Phytolith



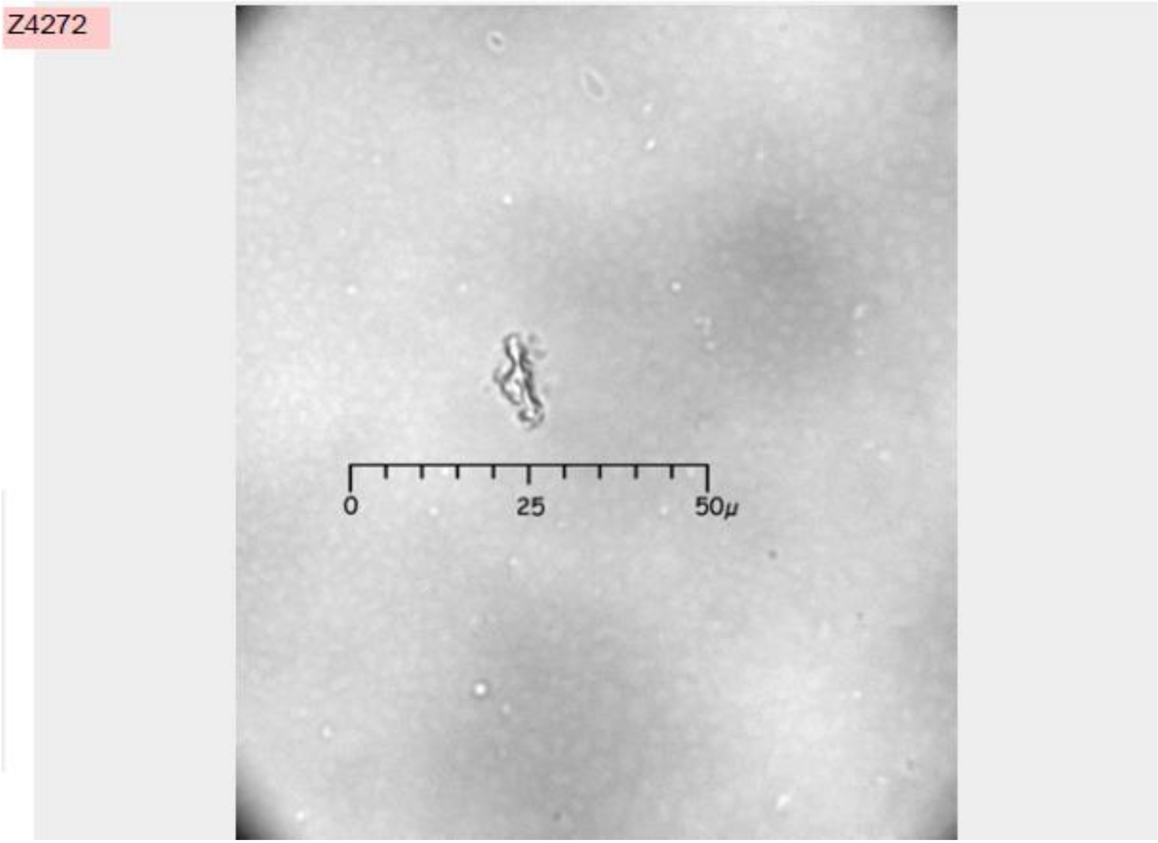
type established by Karol Chandler-Ezell
PC2348, C. allouia inflorescence
Diagnostic level: Calathea/Maranta

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea allouia

Phytolith

type established by Karol Chandler-Ezell
PC2348, C. allouia inflorescence
Diagnostic level: Calathea/Maranta



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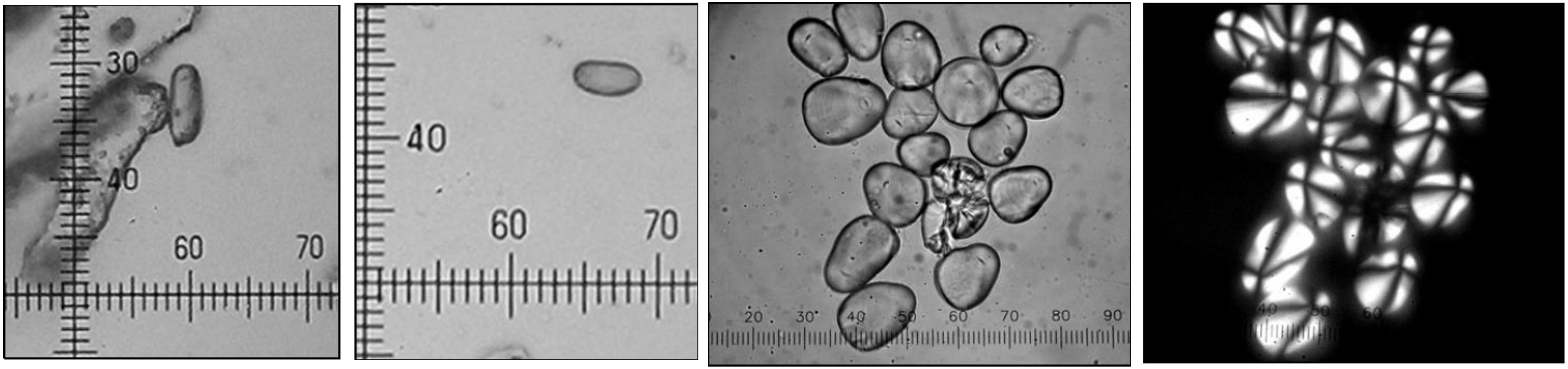
Calathea allouia

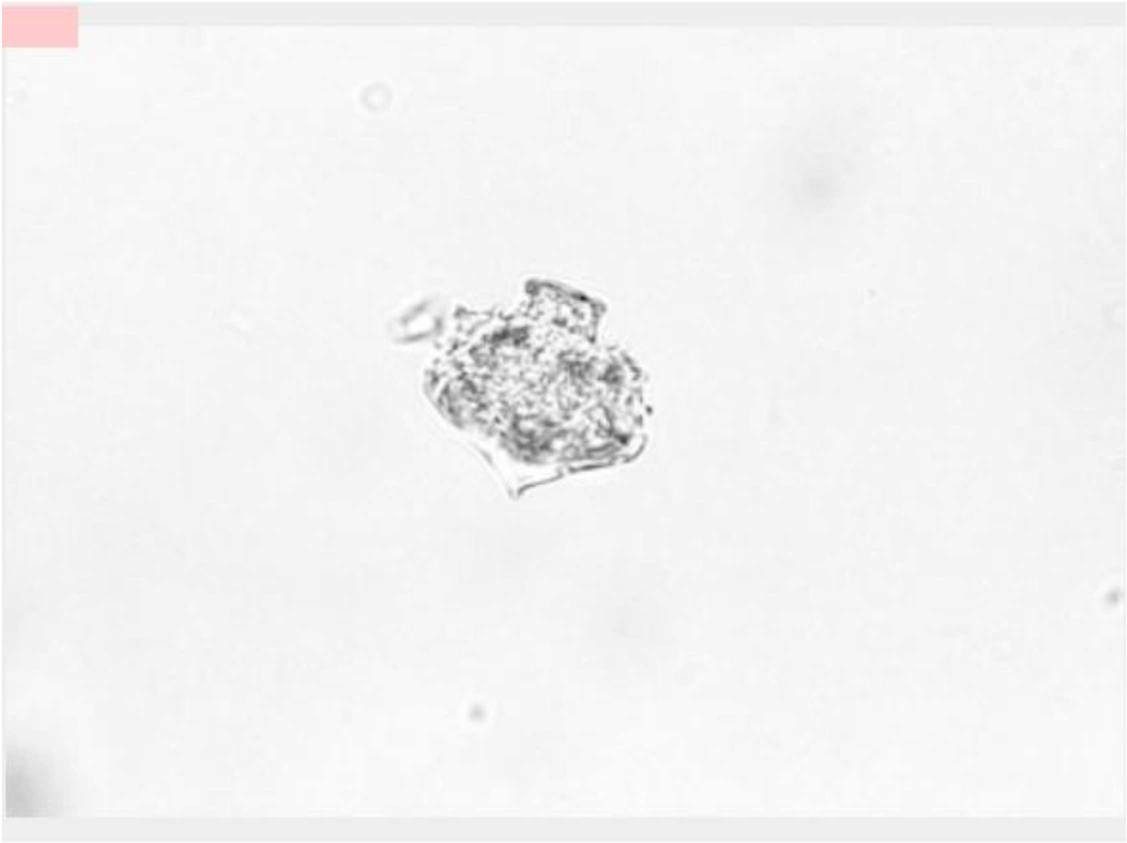
Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Calathea altissima

Phytolith

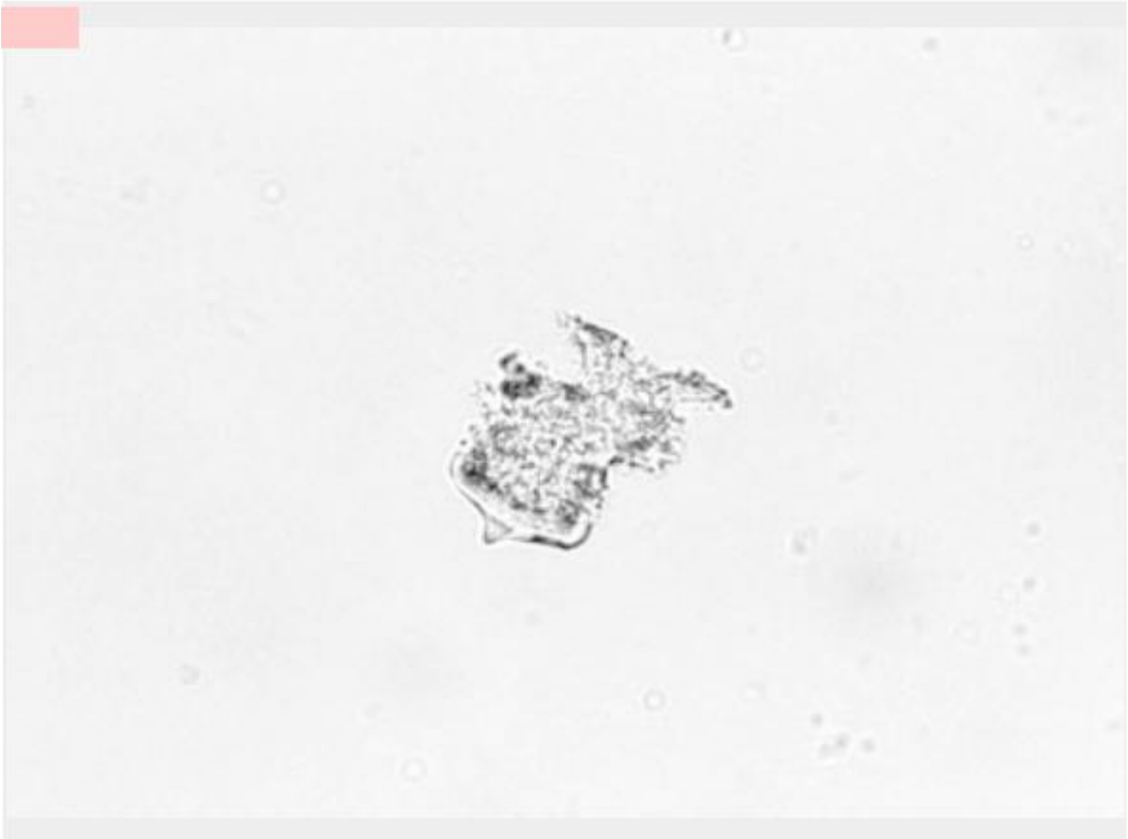


Calathea spp.
seed body, Still has distinct, curved stalk tip of Calathea spp., but cylinder is very short relative to width. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea altissima

Phytolith



seed body, Still has distinct, curved stalk tip of Calathea spp., but cylinder is very short relative to width. note "corkskrew" axis of main body shaft. This appears to be a point where the bodies "break" resulting in Tip pieces and base pieces. Diagnostic level: genus

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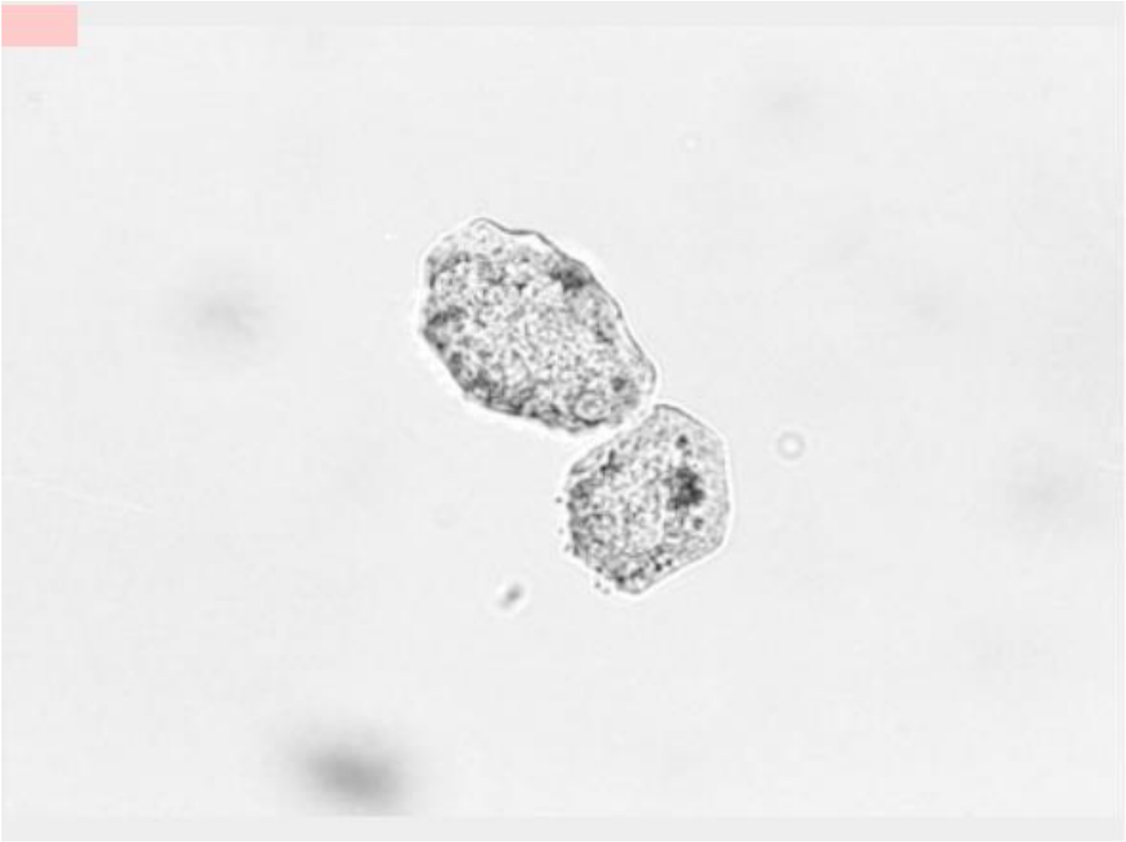
Calathea altissima

Phytolith

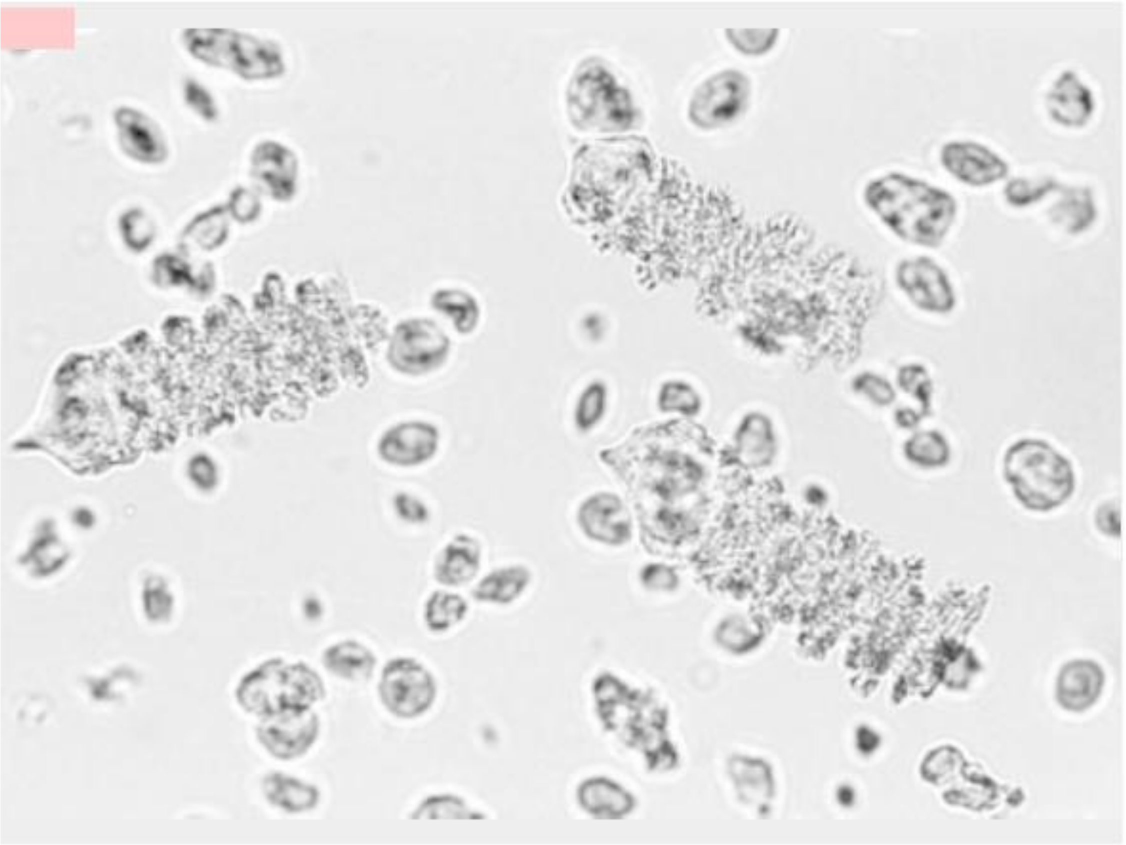


“underside” of seed bodies, Note flattened, polygonal edges, finely rugulose/granular underside Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea crotalifera

Phytolith



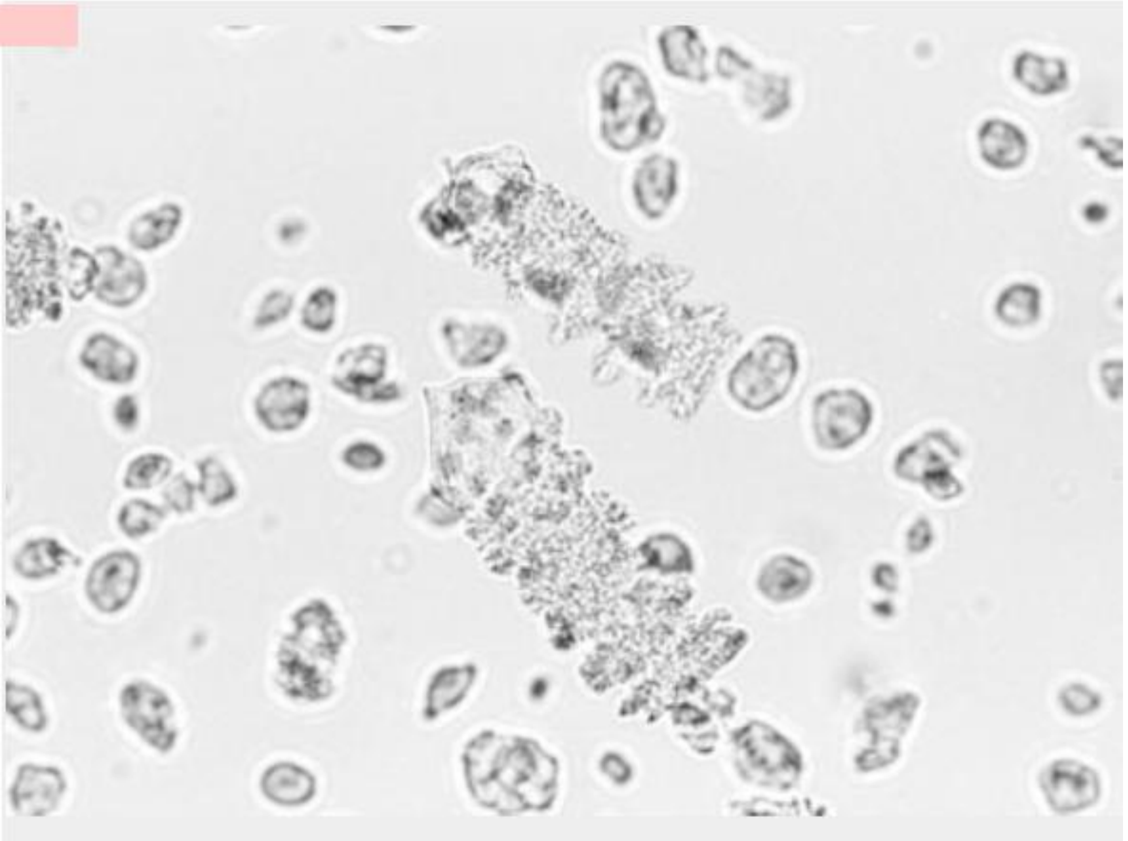
Note the 80IIIB rugulose conical bodies in background....
Especially note bulbous rims of seed body tips.
Diagnostic level: family, wild taxa

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea crotalifera

Phytolith

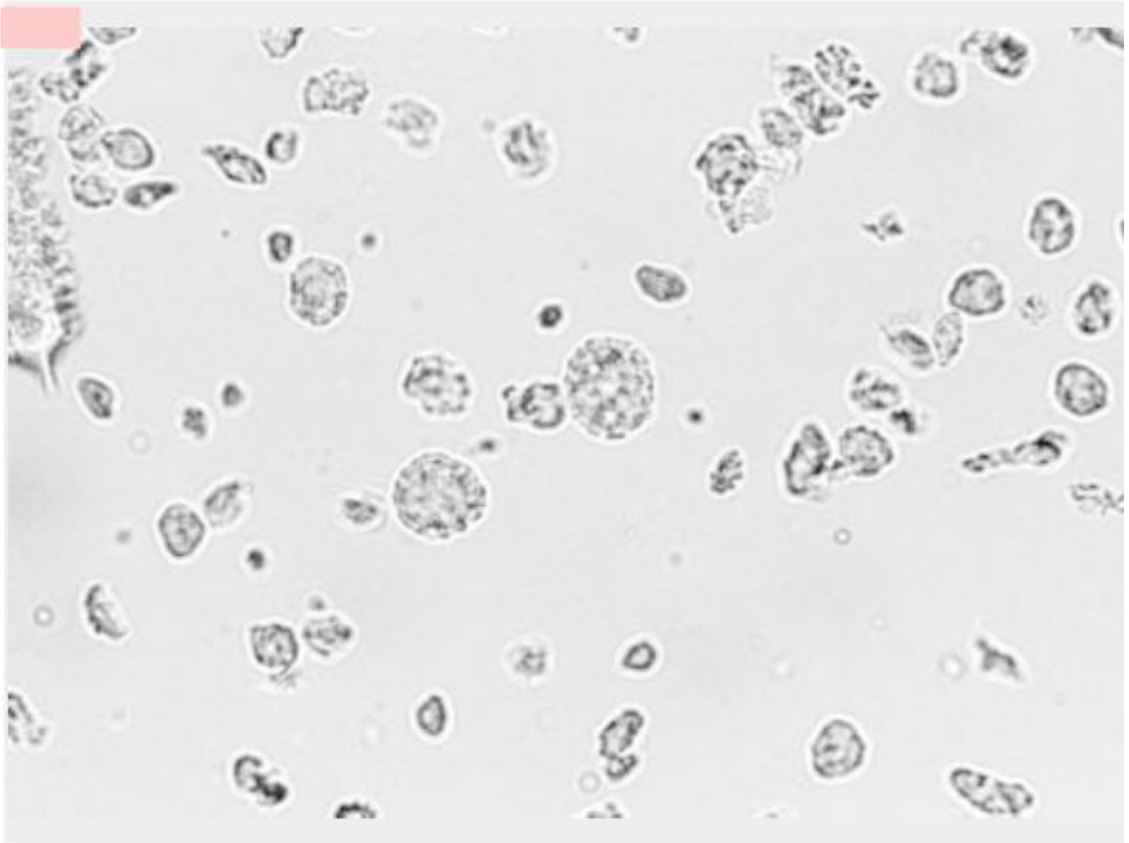
seed bodies, background has rugulose conical bodies
Diagnostic level: family, wild taxa



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea crotalifera

Phytolith



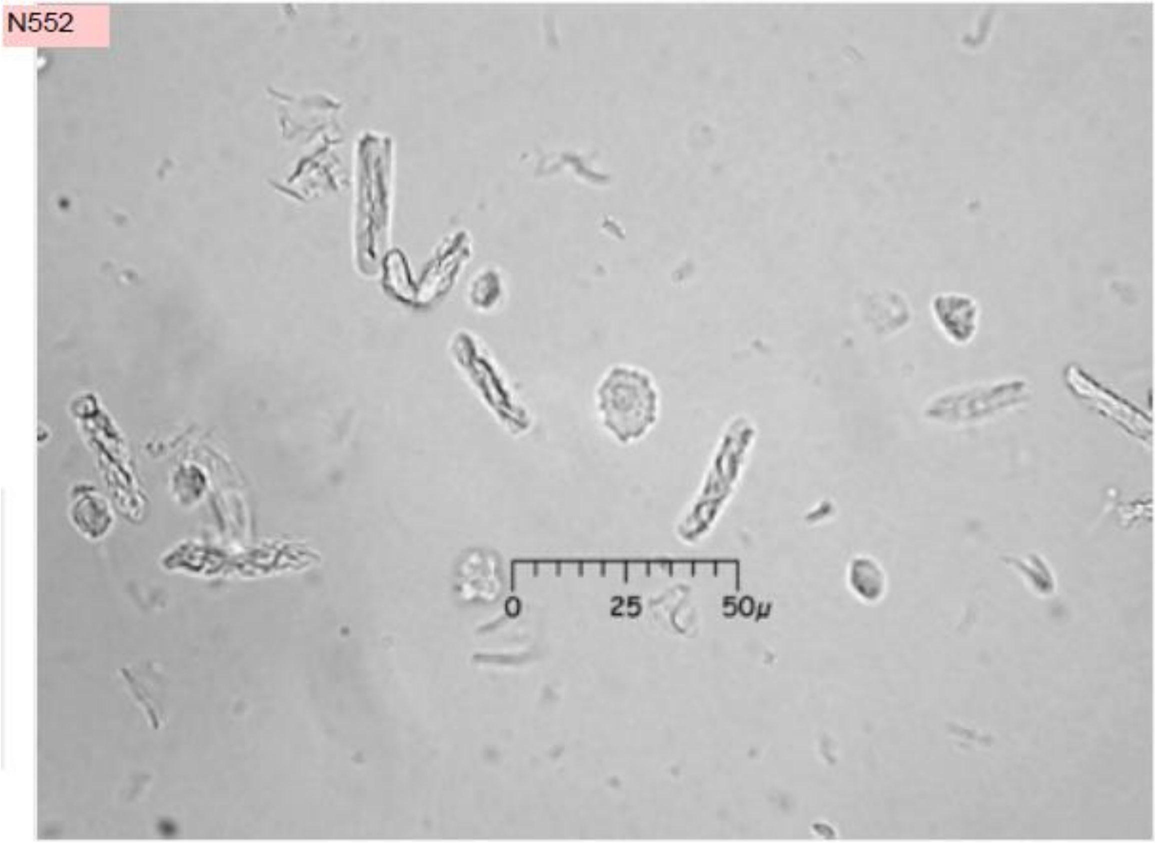
Marantaceae nodular spheres and rugulose conical bodies Diagnostic level:
Marantaceae/Bombacaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea lutea

Phytolith

Marantaceae conical body Top view.
Type is centered above the 25.
Diagnostic level: family



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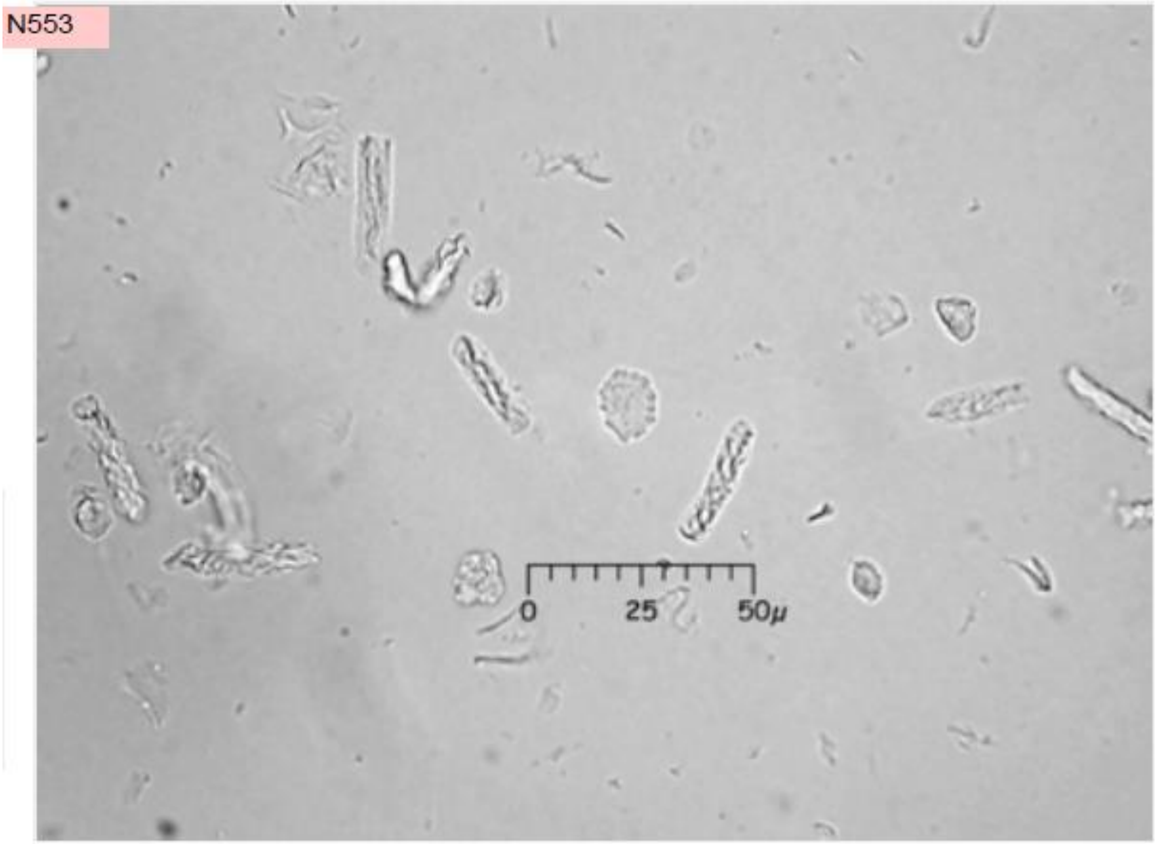
Calathea lutea

Phytolith

Length is 27.5 microns leaf sample. Body occurs to the right of the 80IIIB example.
Diagnostic level: family



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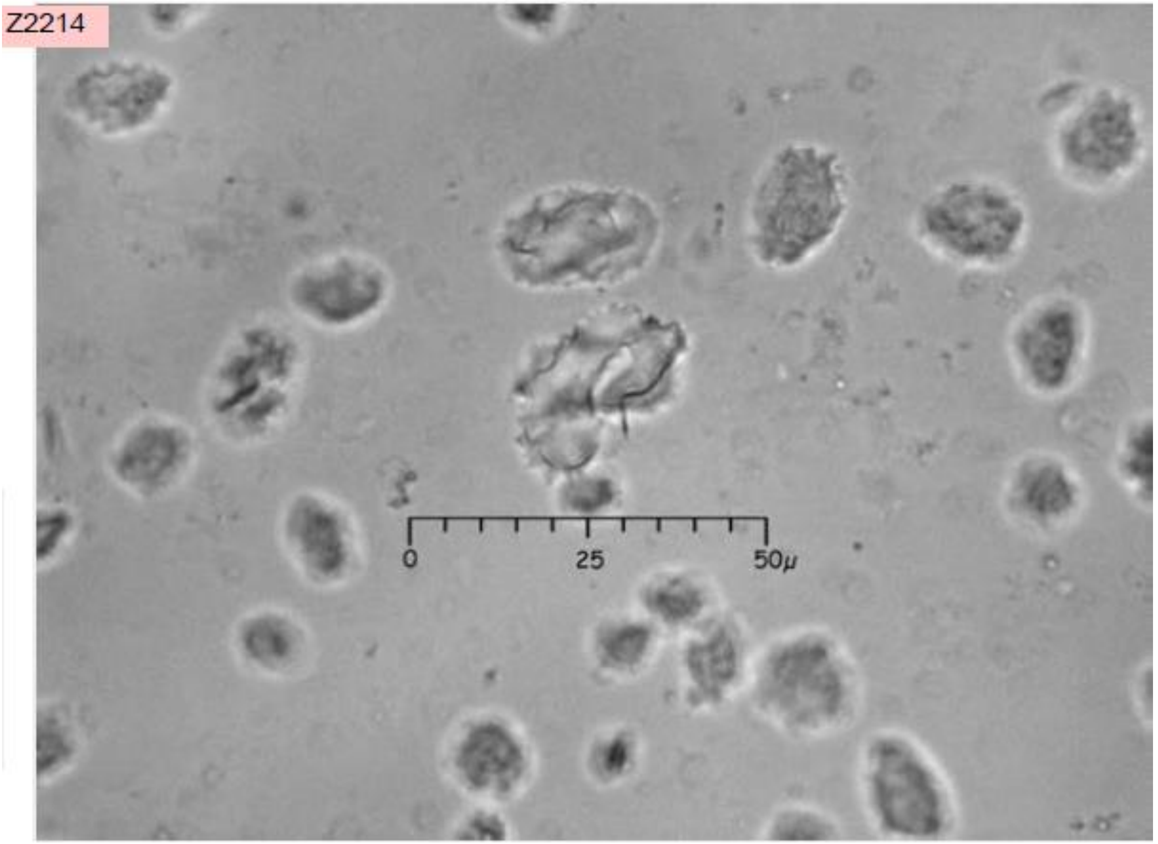
Calathea lutea

Phytolith

PC2594, floret
These are large examples of the type, VA
Diagnostic level: Calathea/Maranta



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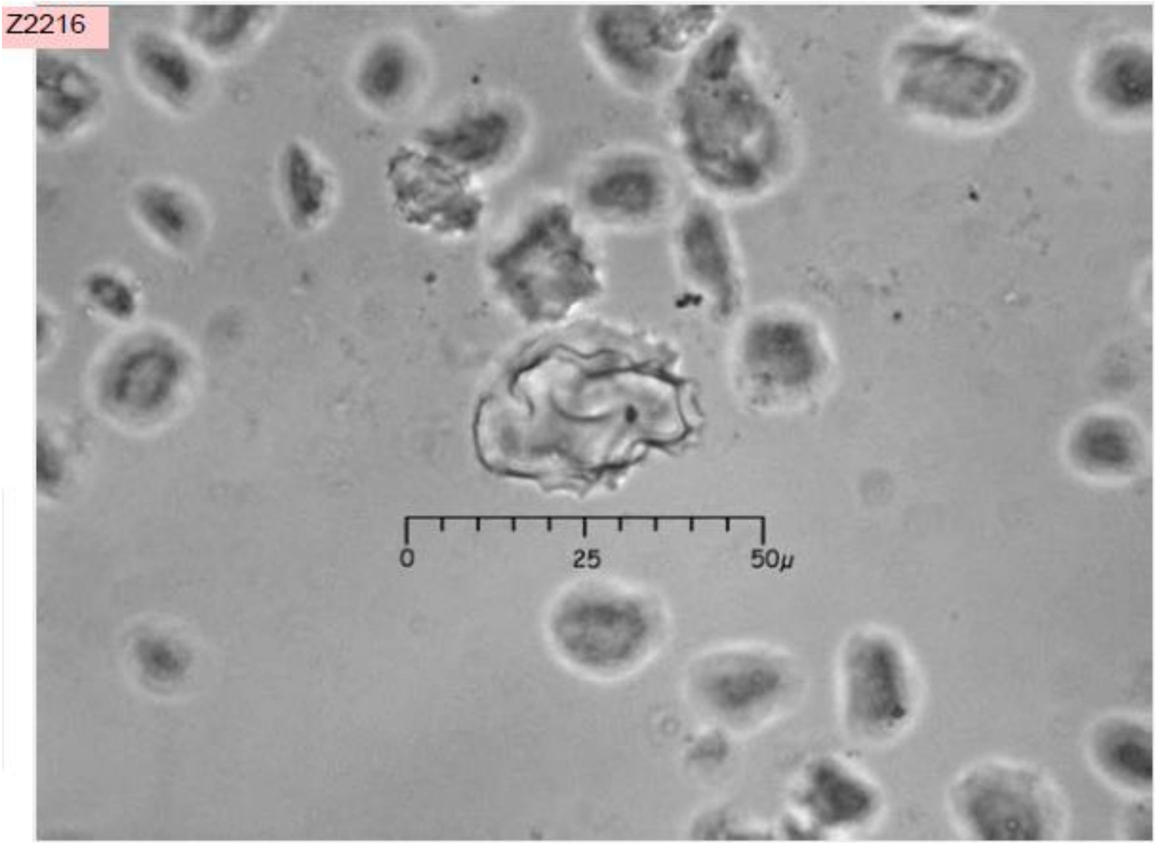
Calathea lutea

Phytolith

PC2594, floret
These are large examples of the type, VA
Diagnostic level: Calathea/Maranta



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Calathea lutea

Phytolith

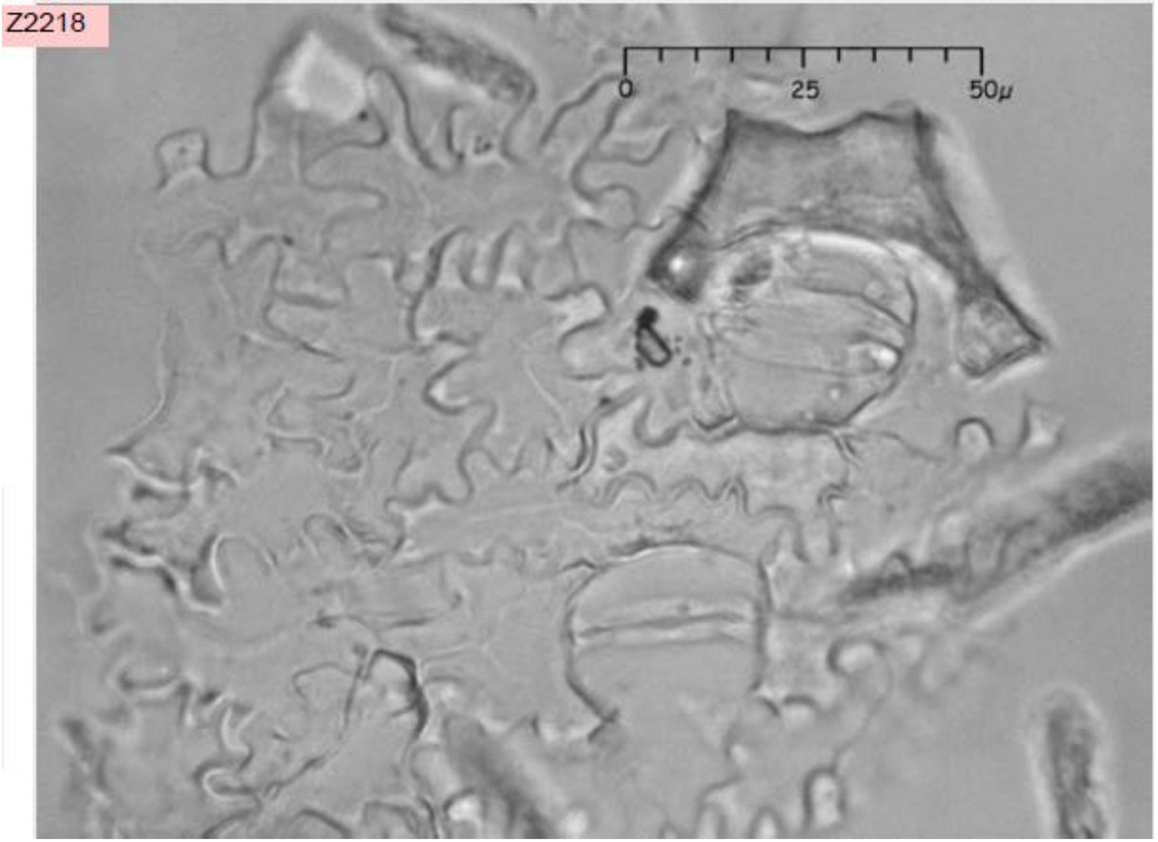
PC2595, leaf
This photo shows a string of the bodies
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea lutea

Phytolith

PC2595, leaf, abundant
Epidermis fragment showing anticlinal cells (20IA), stomata (120), and schlerids (110).
Diagnostic level: not diagnostic



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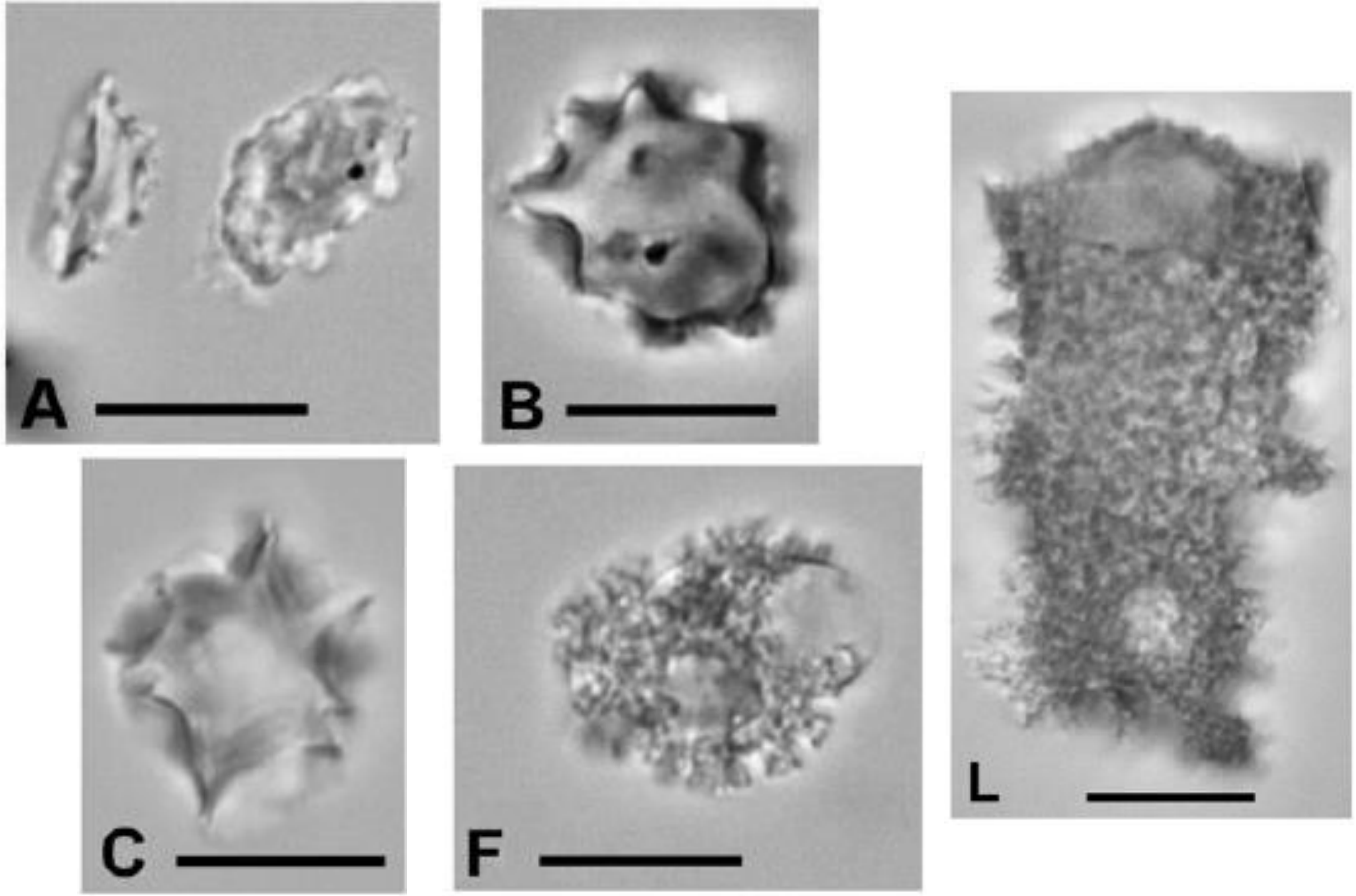
Calathea macrosepala

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). A, rugose hat-shapes from Calathea macrosepala leaf. B, subglobular-papillate from Calathea macrosepala leaf. C, D1 fringed druse from Calathea macrosepala stem. F, globular-densely granulate with non-centered concavity from Calathea macrosepala seed. L, cylindrical-densely granulate with non-centered concavity from Calathea macrosepala seed. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Calathea macrosipalia

Phytolith

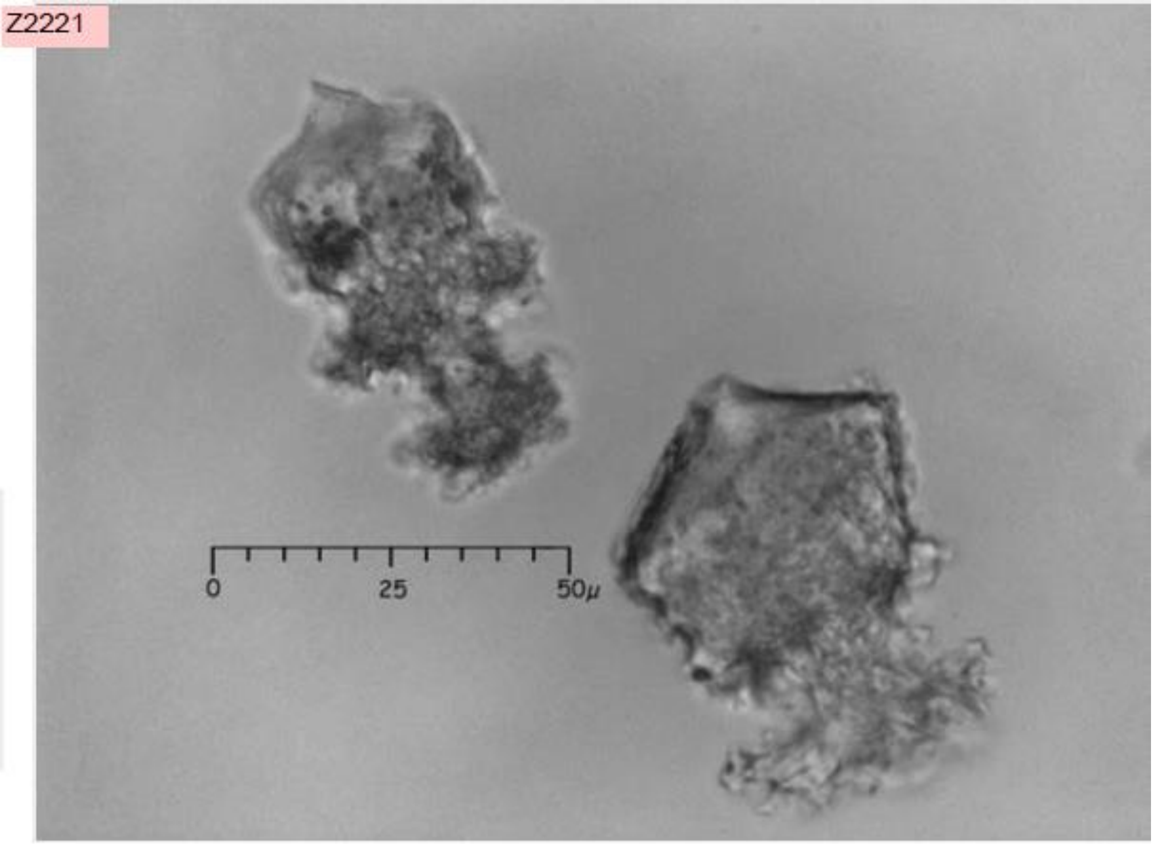
Length is 27.5 microns leaf specimen
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea majestica

Phytolith

PC1385a, fruit, very abundant
seed body, still has distinct, curved stalk tip of Calathea spp., but cylinder is very short relative to width.
note “corkskrew” axis of main body shaft. This appears to be a point where the bodies “break” resulting in Tip pieces and base pieces. Diagnostic level: genus



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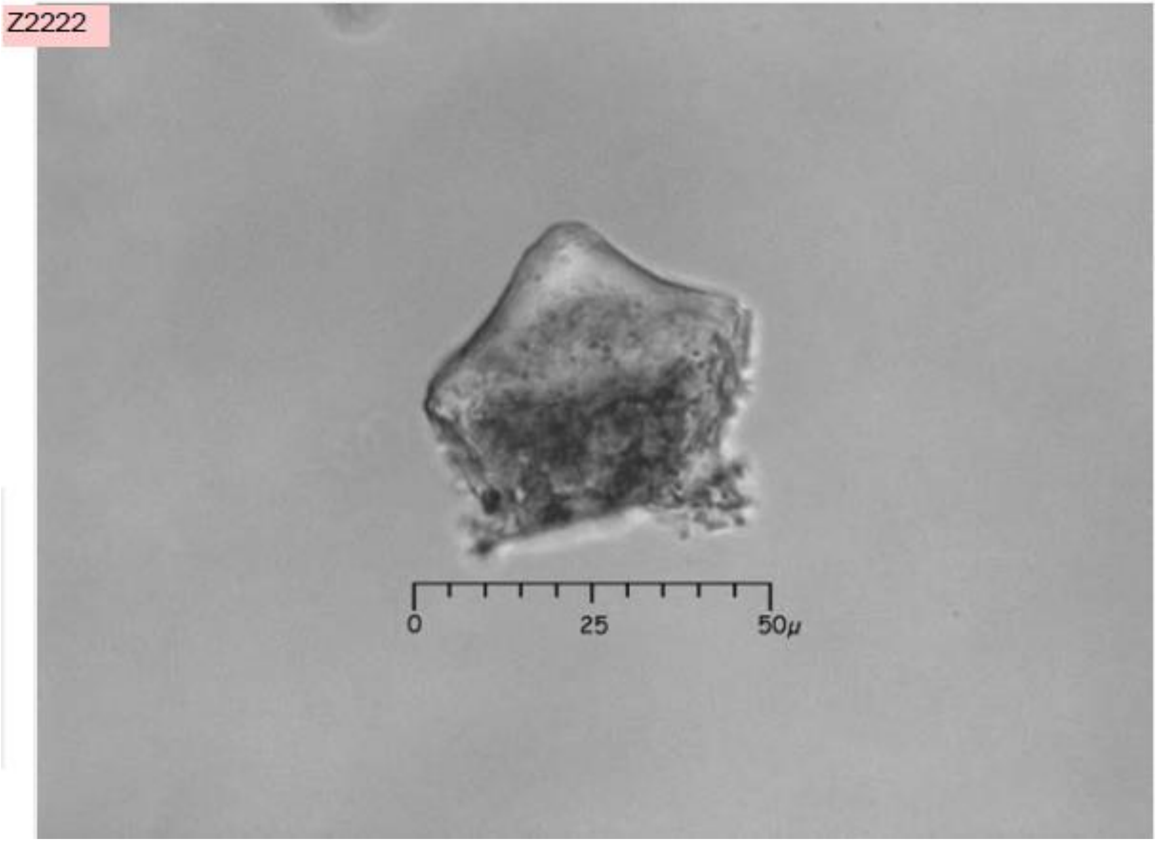
Calathea majestica

Phytolith



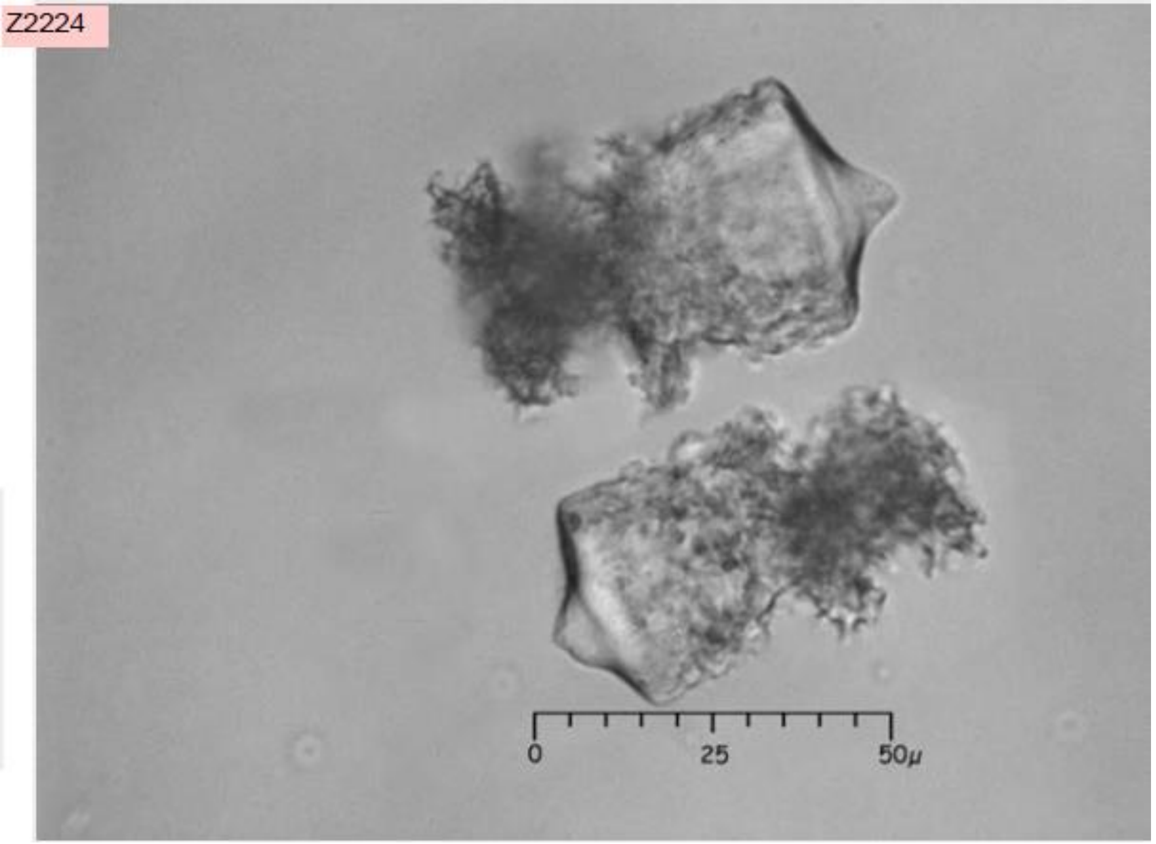
PC1385a, fruit, very abundant
seed body, still has distinct, curved stalk tip of Calathea spp., but cylinder is very short relative to width.
note “corkskrew” axis of main body shaft. This appears to be a point where the bodies “break” resulting in Tip pieces and base pieces. Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea majestica

Phytolith

PC1385a, fruit, very abundant
seed body, still has distinct, curved stalk tip of Calathea spp., but cylinder is very short relative to width.
note “corkskrew” axis of main body shaft. This appears to be a point where the bodies “break” resulting in Tip pieces and base pieces. Diagnostic level: genus

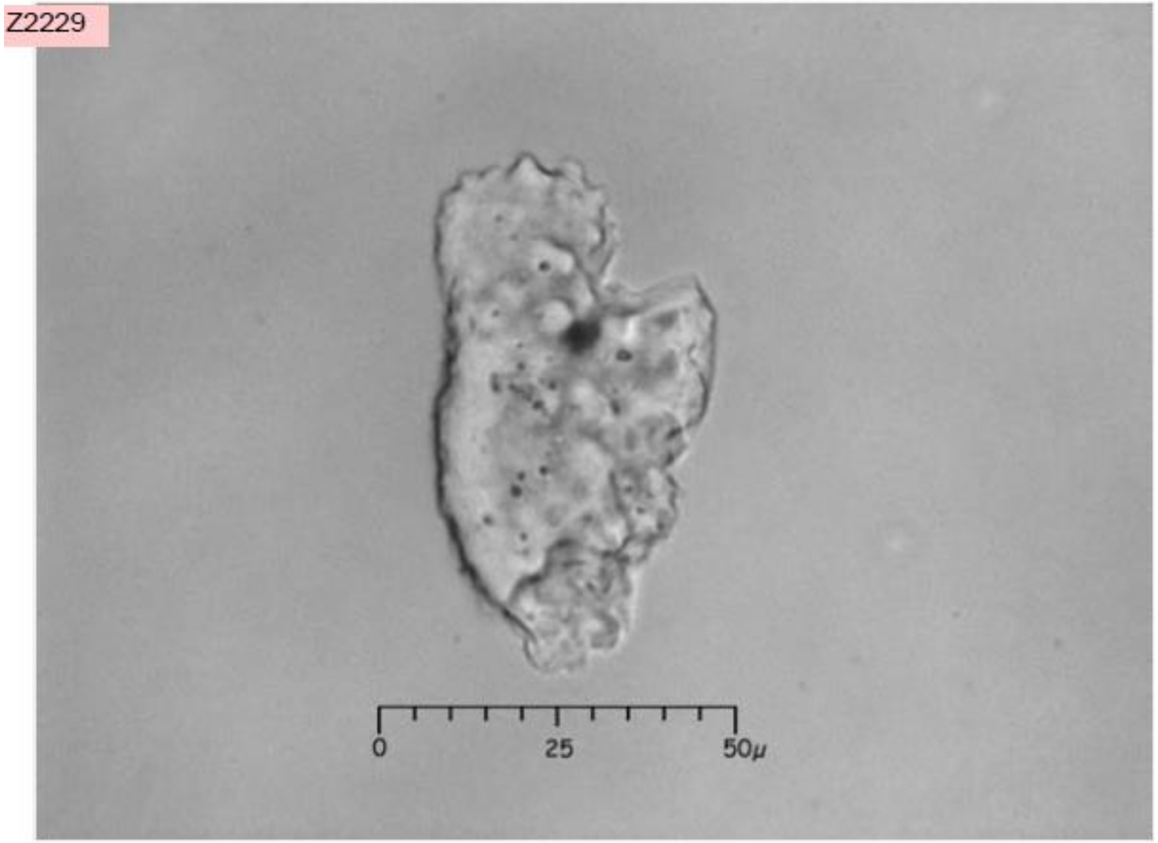


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Calathea majestica

Phytolith

PC1385a fruit
Diagnostic level: under study



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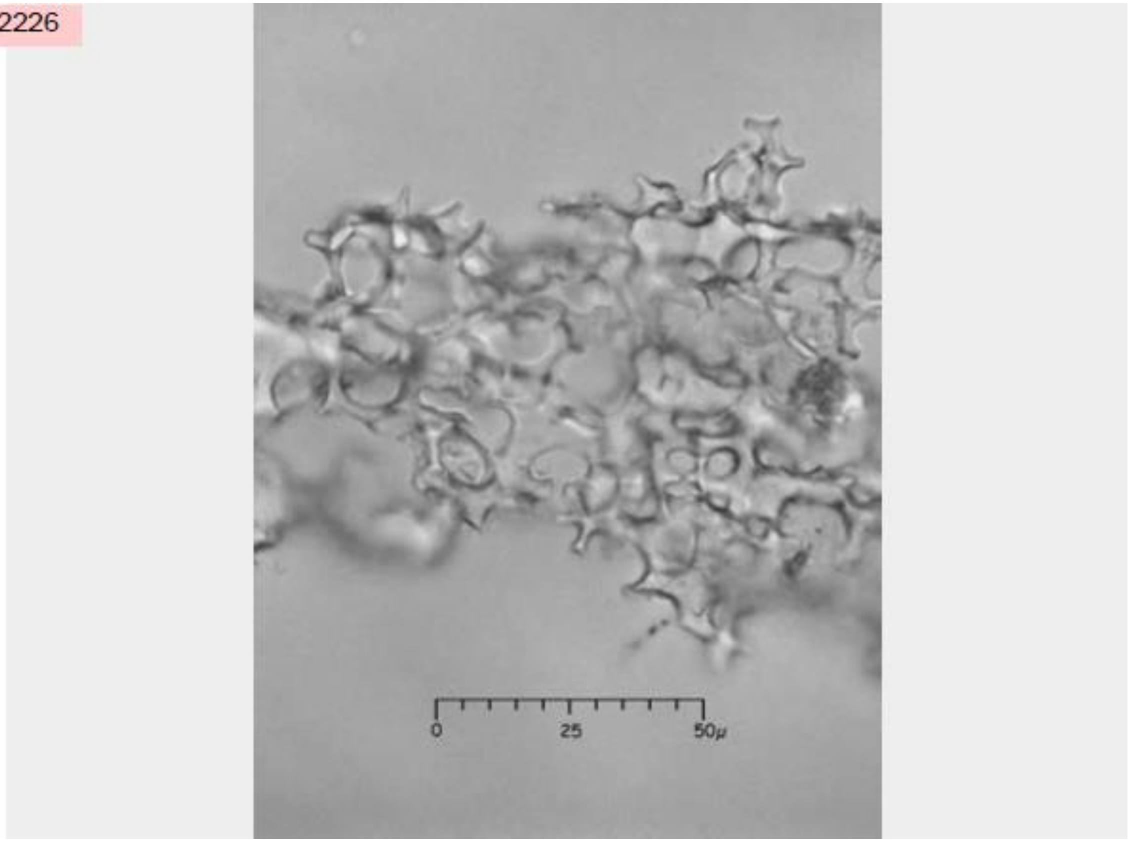
Calathea majestica

Phytolith

PC1385 fruit, rare. Also observed in
Donax, Maranta specimens
Diagnotic level: under study



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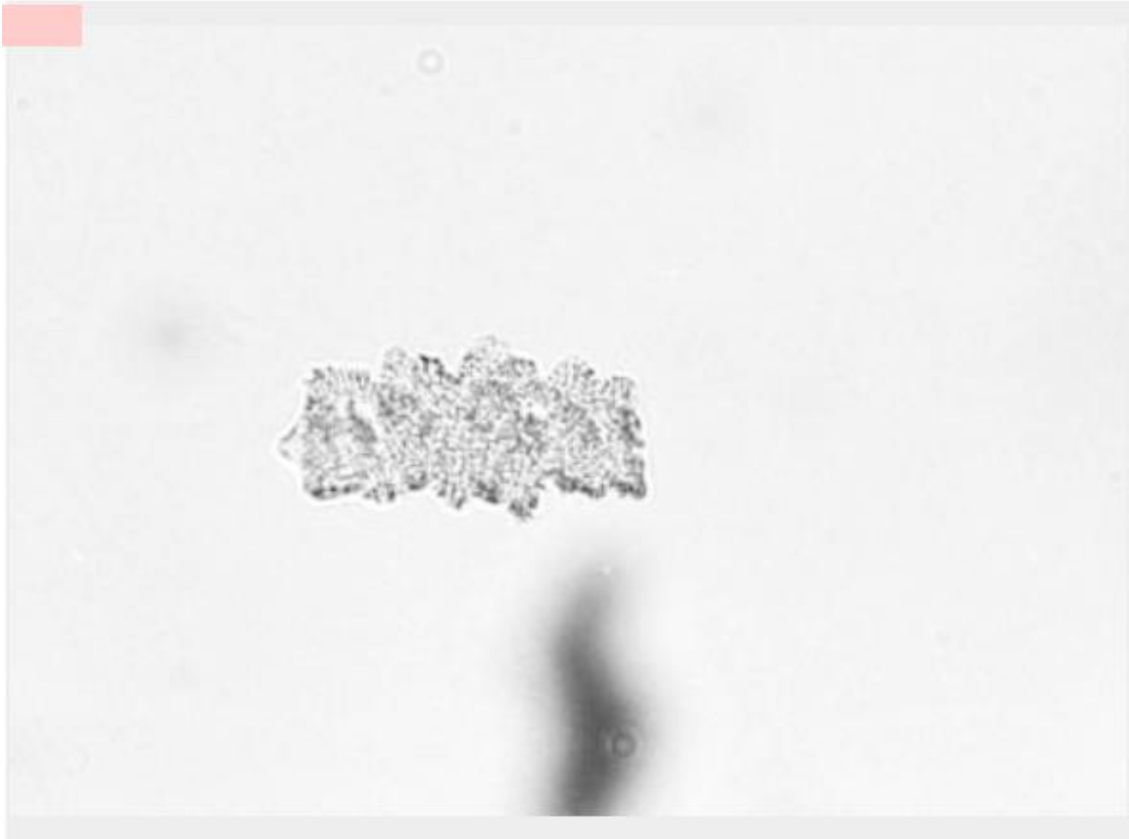
Calathea marantina

Phytolith



Wild Marantaceae seed body.
Diagnostic level: family, wild taxa

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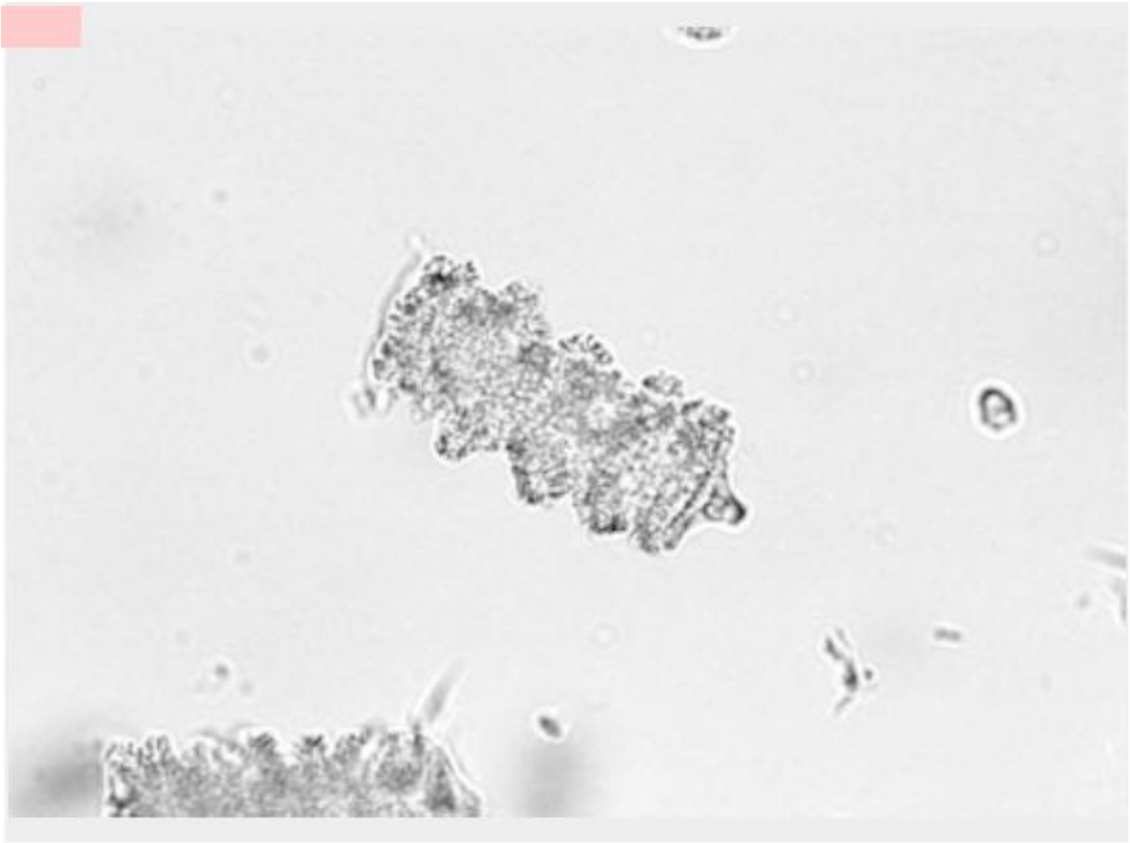
Calathea marantina

Phytolith



seed body
Diagnostic level: family, wild taxa

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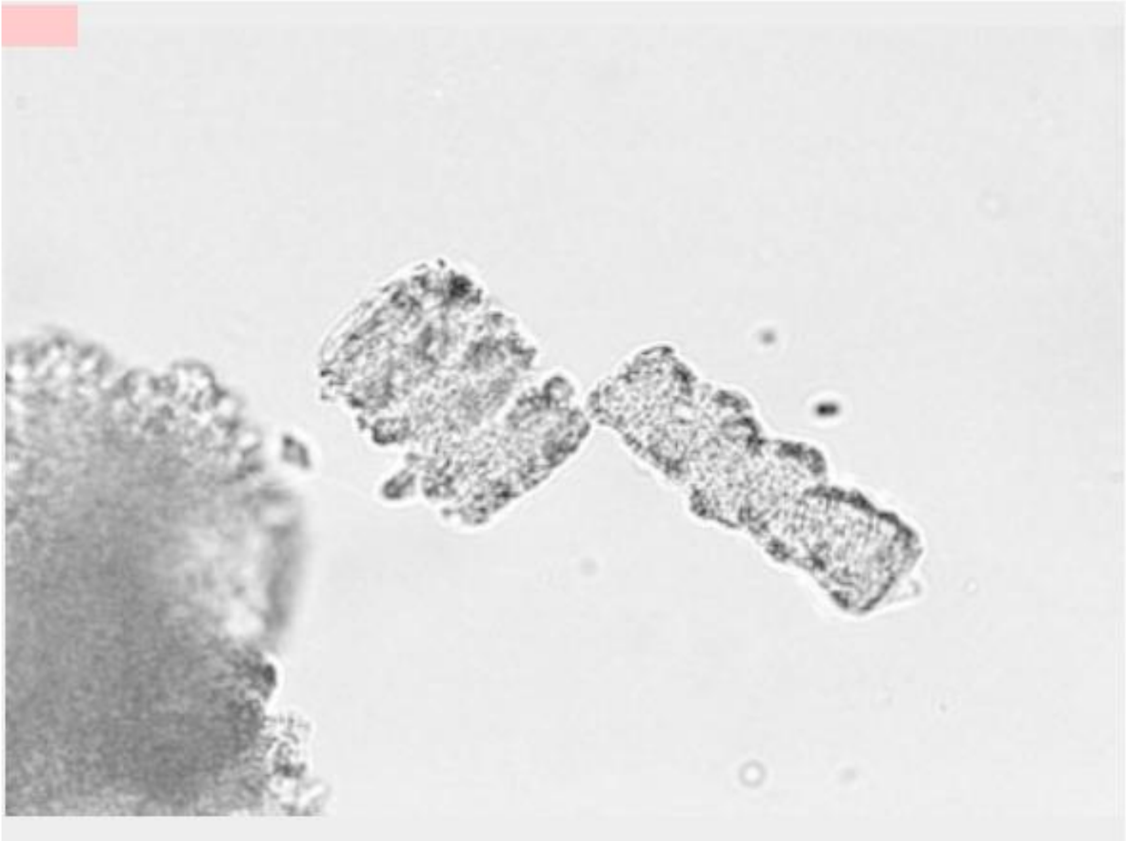
Calathea marantina

Phytolith

seed body.
Note variation in width of cylinder, Stalk on tip of body on left is very small, reduced.
Stalk is missing on body on the left.
Diagnostic level: family, not Maranta



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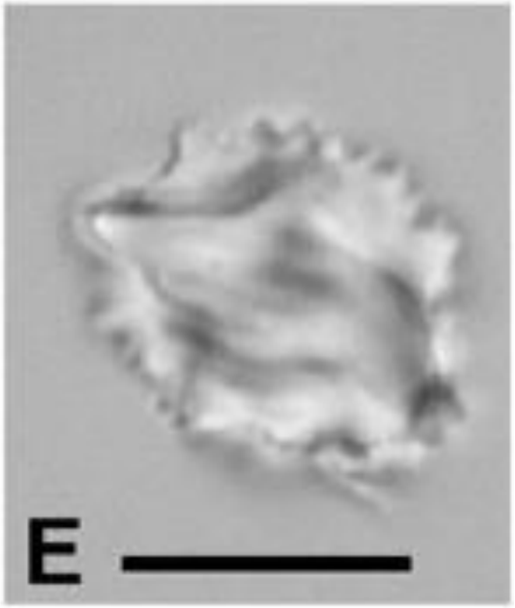
Calathea micans

Phytolith

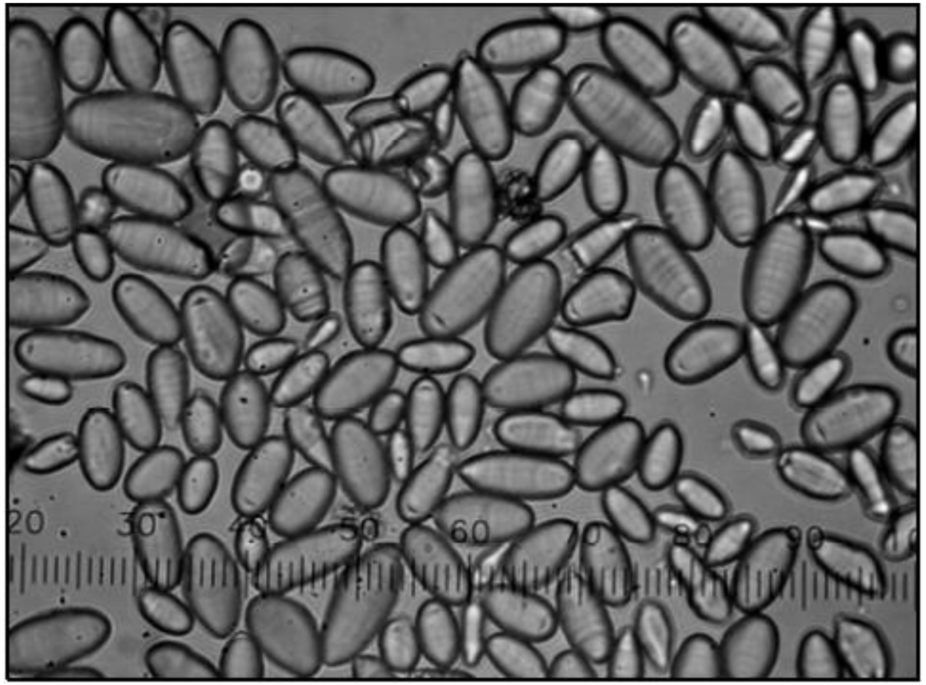
Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). E, globular-rugulate from Calathea micans rhizome+root. Scale bars=12 µm.

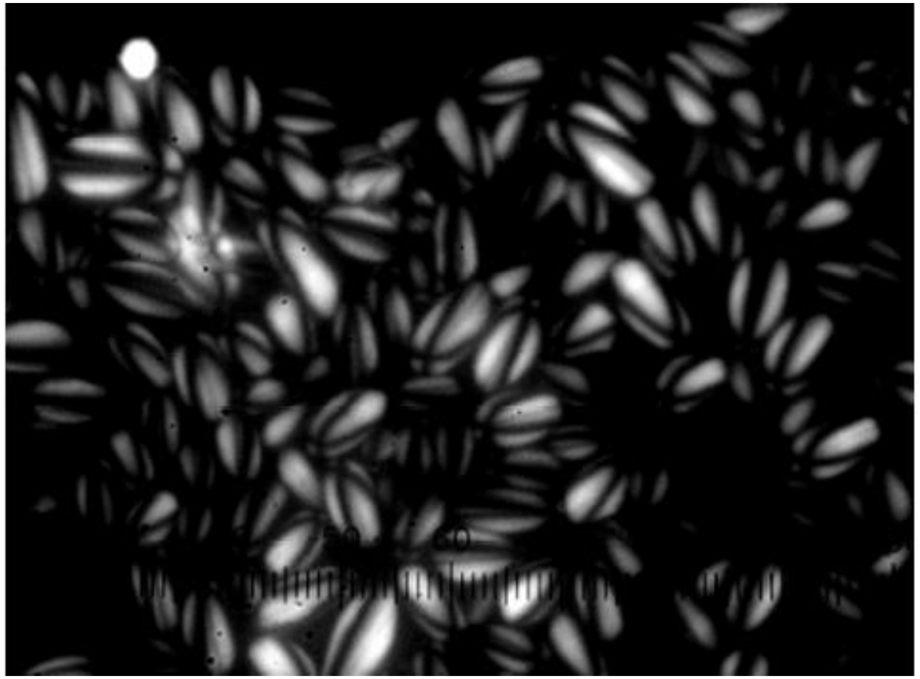


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Calathea veitchiana

Starch



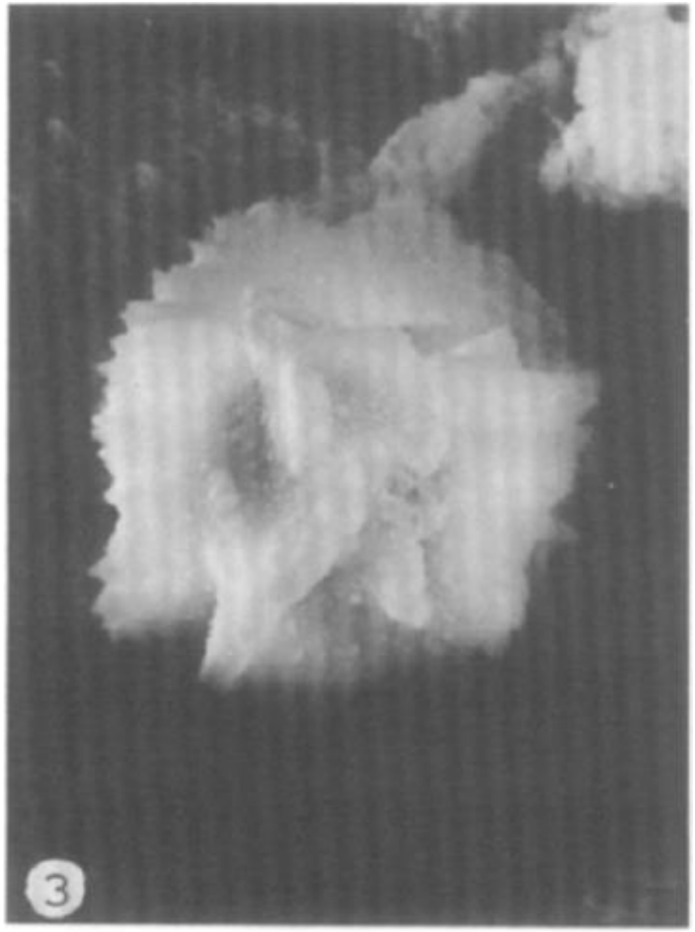


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Calathea violacea

Phytolith

SEM photograph of a phytolith with an irregularly angled or folded surface from Calathea violacea (4000x).

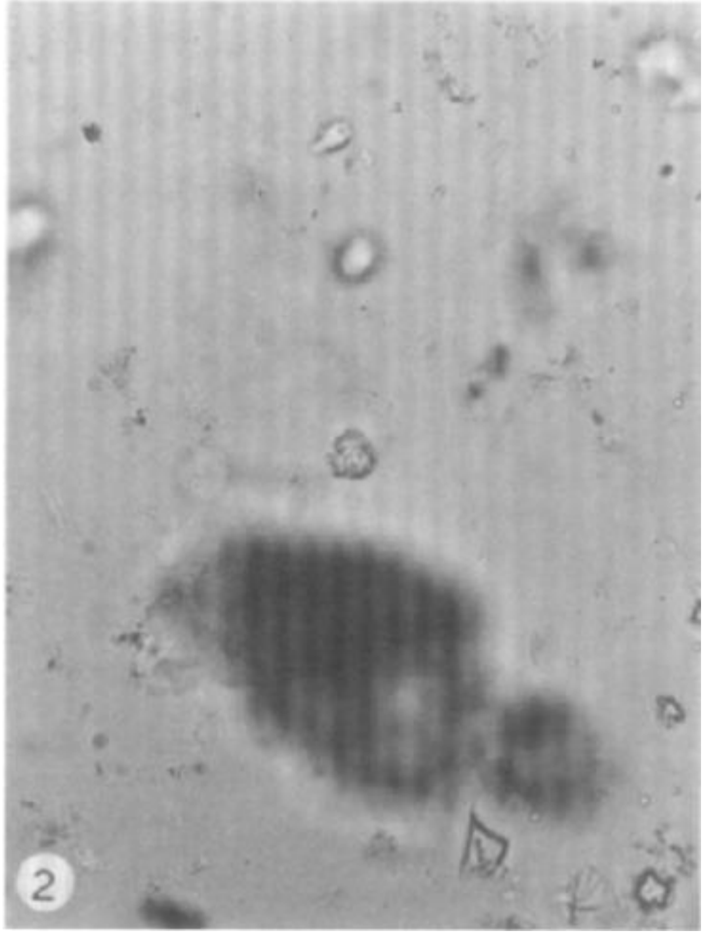


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Calathea violacea

Phytolith

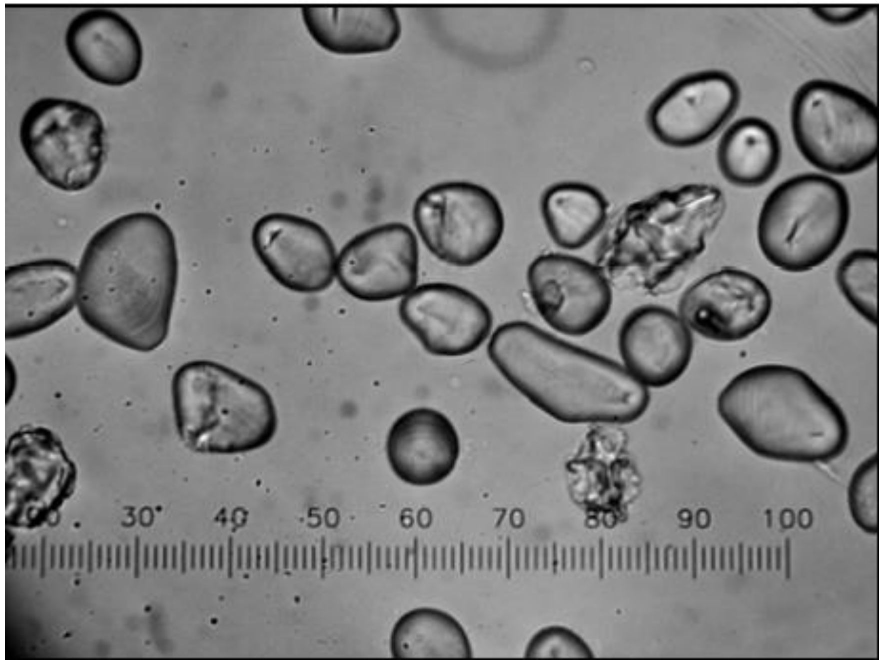
2. Center, a hat-shaped nodular silica body from Calathea violacea (400 x).

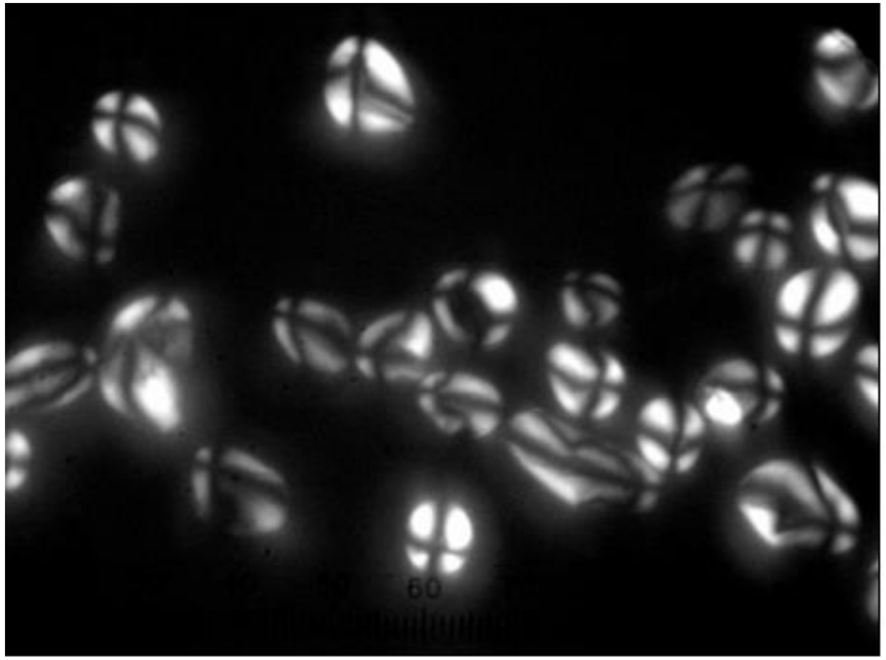


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Calathea zebrina

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Calathea zebrina

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). D, elongate D1 fringed druse from Calathea zebrina rhizome. Scale bars=12 µm.

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Calathea sp.

Starch

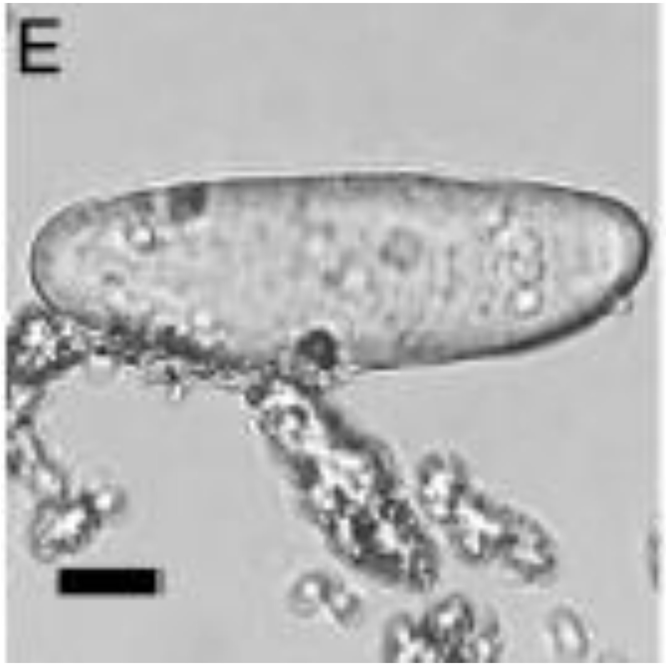
A cf. Calathea starch grain from La Mula. 160x. The grain measures 50 microns by 16 microns.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Calathea sp.

Starch

Fig. 2. Selected archaeological starch grains. (E) Calathea sp. starch from Casita de Piedra, edge-battered cobble 69/2,?3600 cal BP. (Scale bar: 10 µm.) Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8.

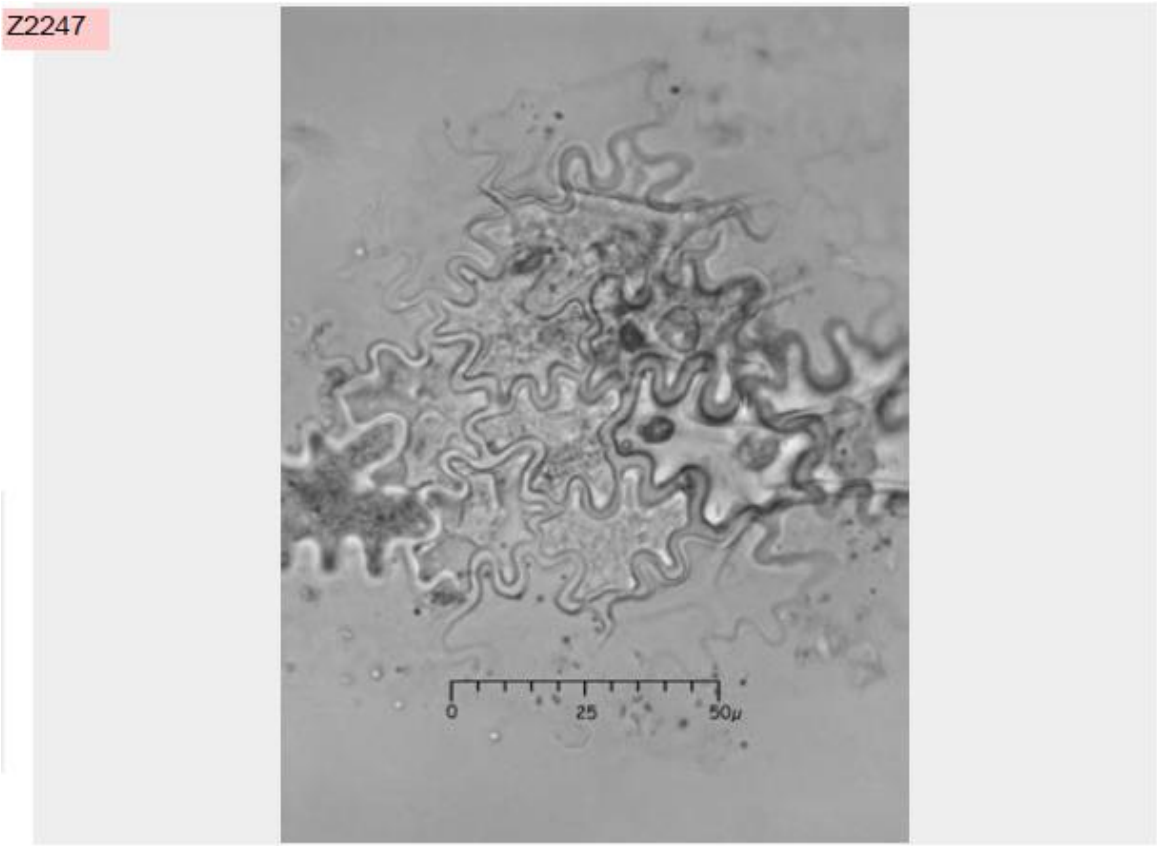


Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Donax sp.

Phytolith

PC1387, leaf, common
Epidermis fragment showing anticlinal cells
Diagnostic level: not diagnostic

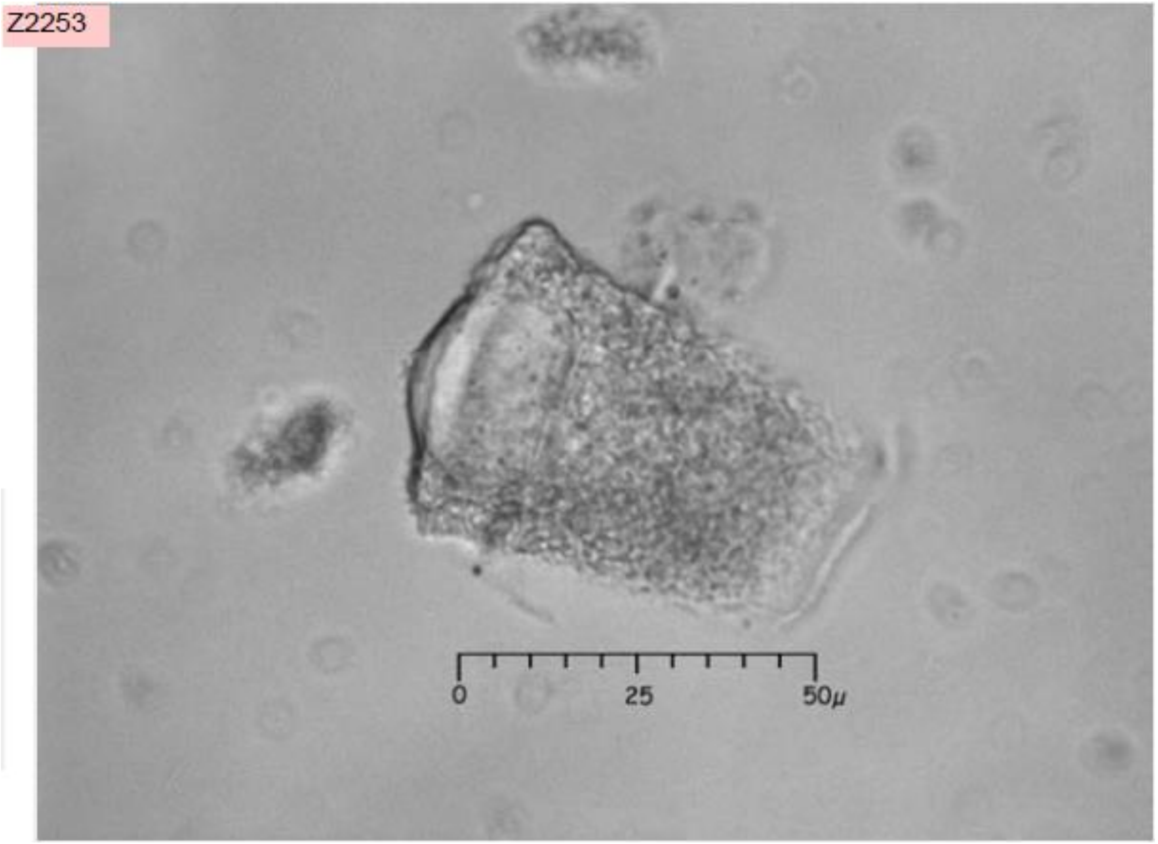


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith

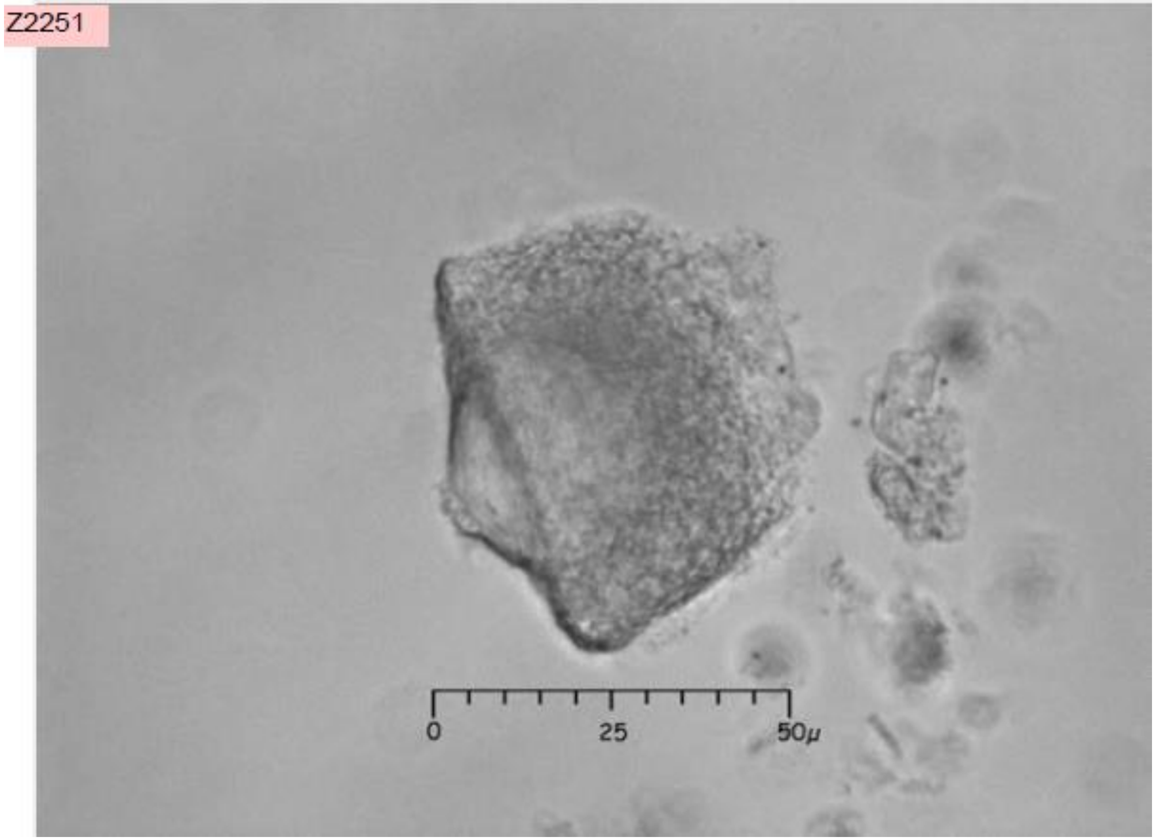
PC1388 fruit, very abundant Diagnostic level: Donax



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith



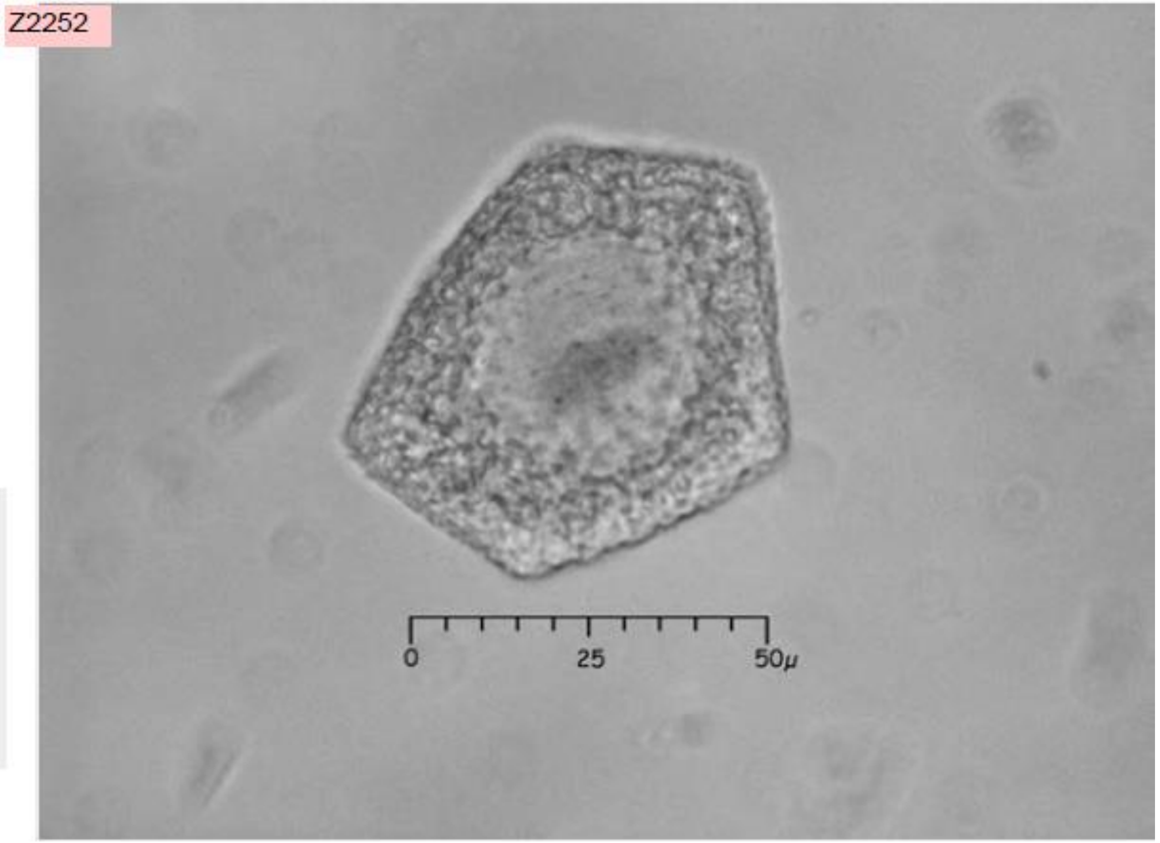
PC1388 fruit, very abundant Diagnostic level: Donax

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith

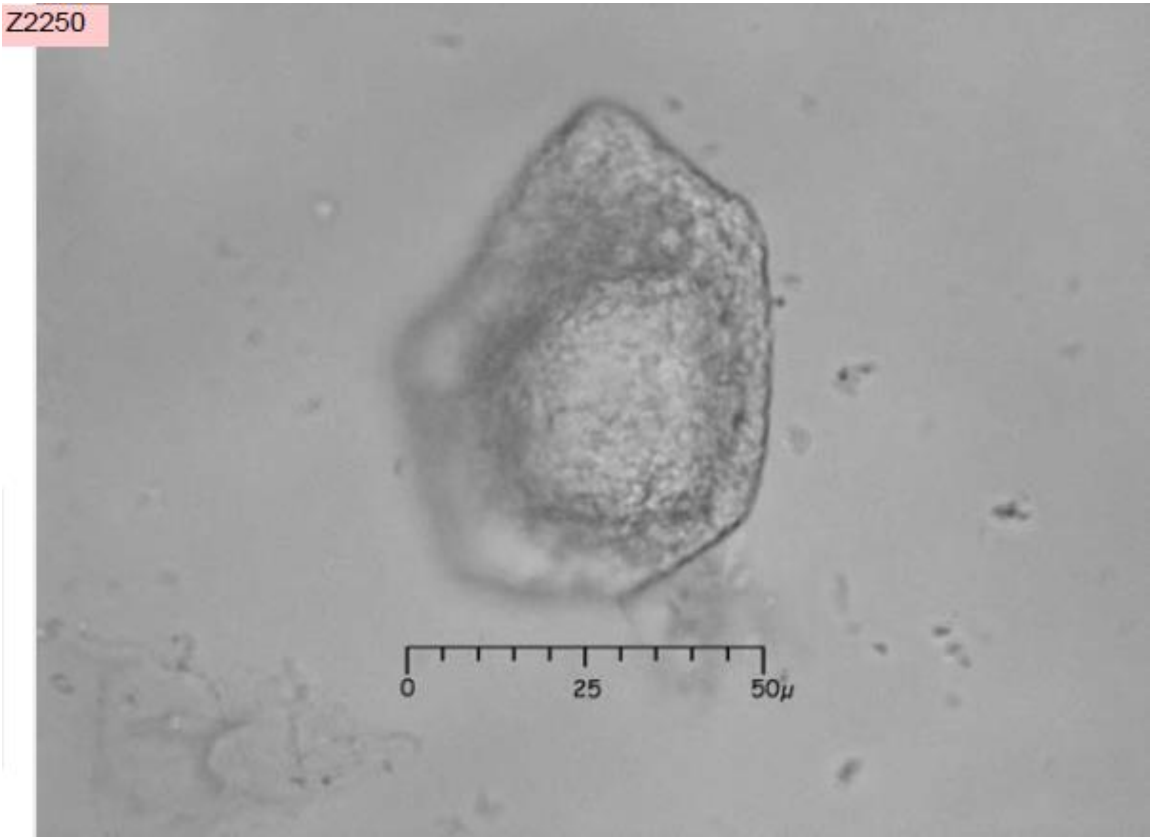
PC1388 fruit, very abundant Diagnostic level: Donax
This image shows the base of the head, within the cylinder (from beneath)



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith



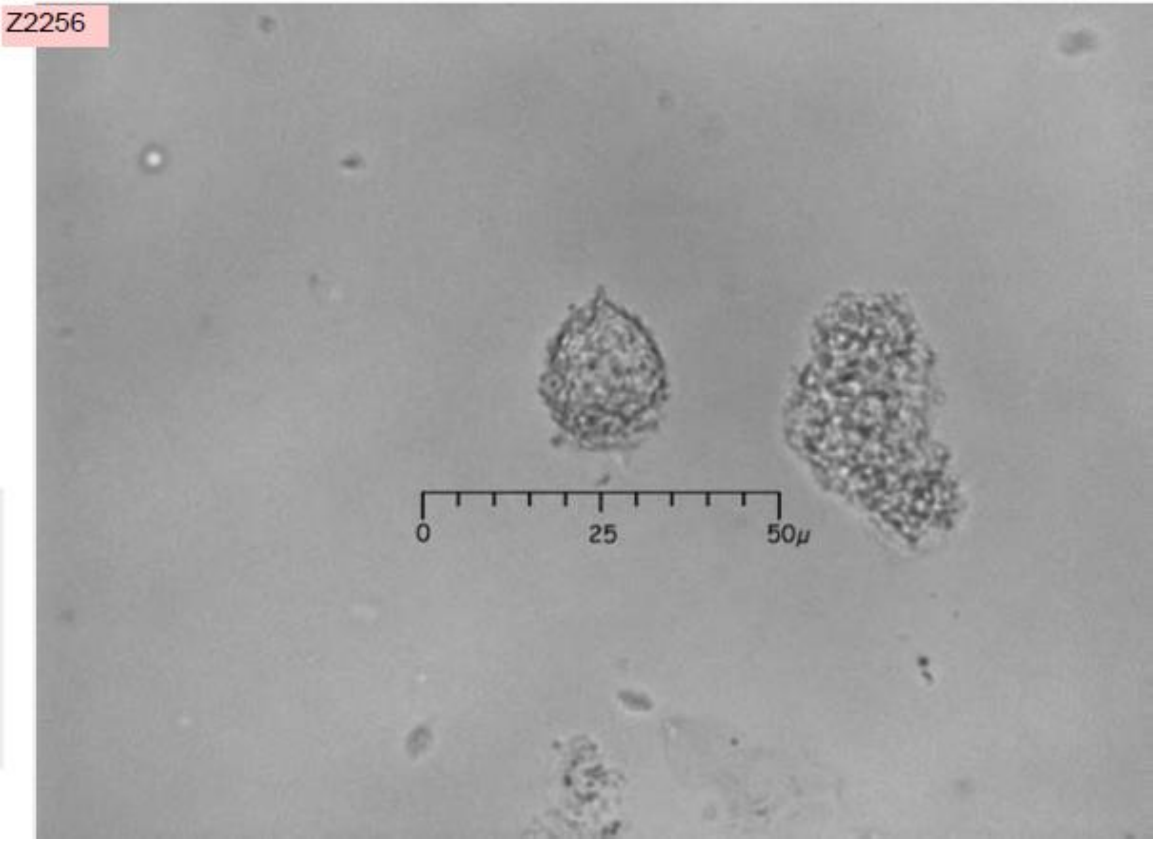
PC1388 fruit, very abundant Diagnostic level: Donax
This image shows the top of the head, extending out from the cyclinder

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith

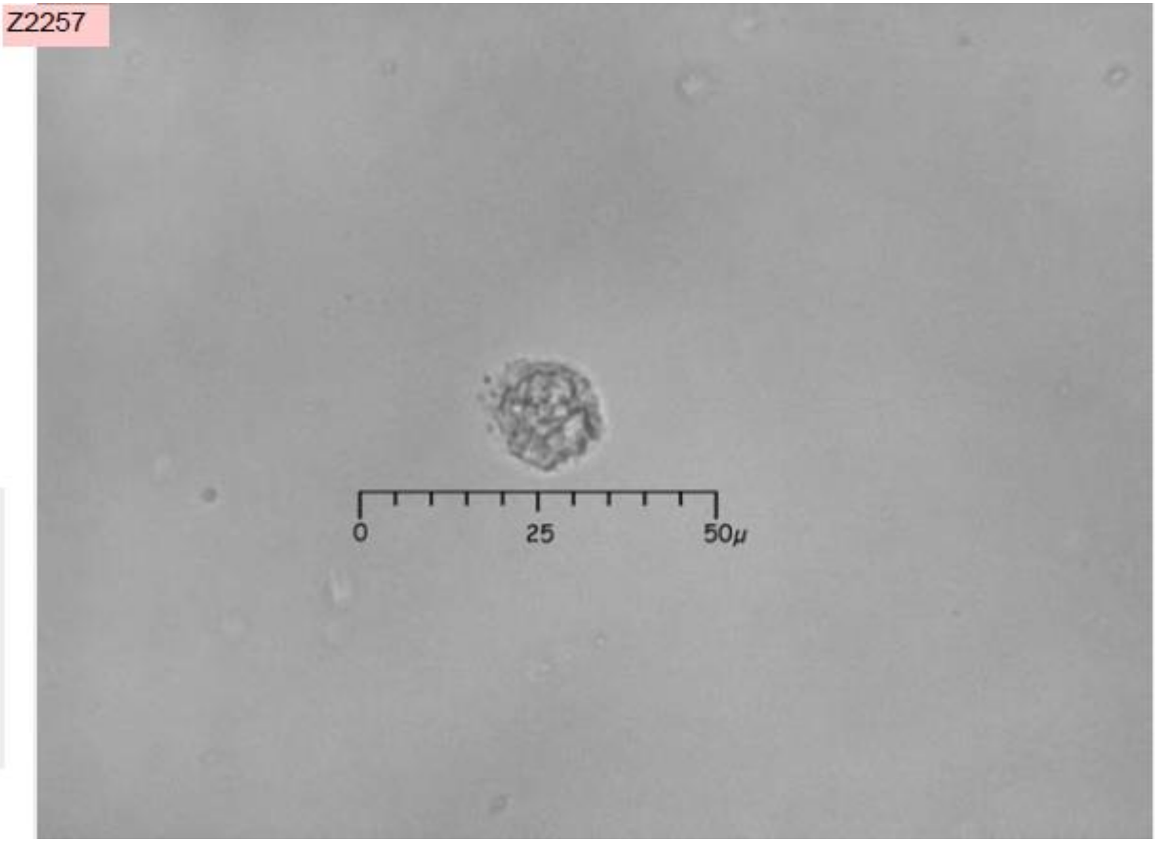
PC1388 fruit Moderate
Diagnostic level under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax sp.

Phytolith



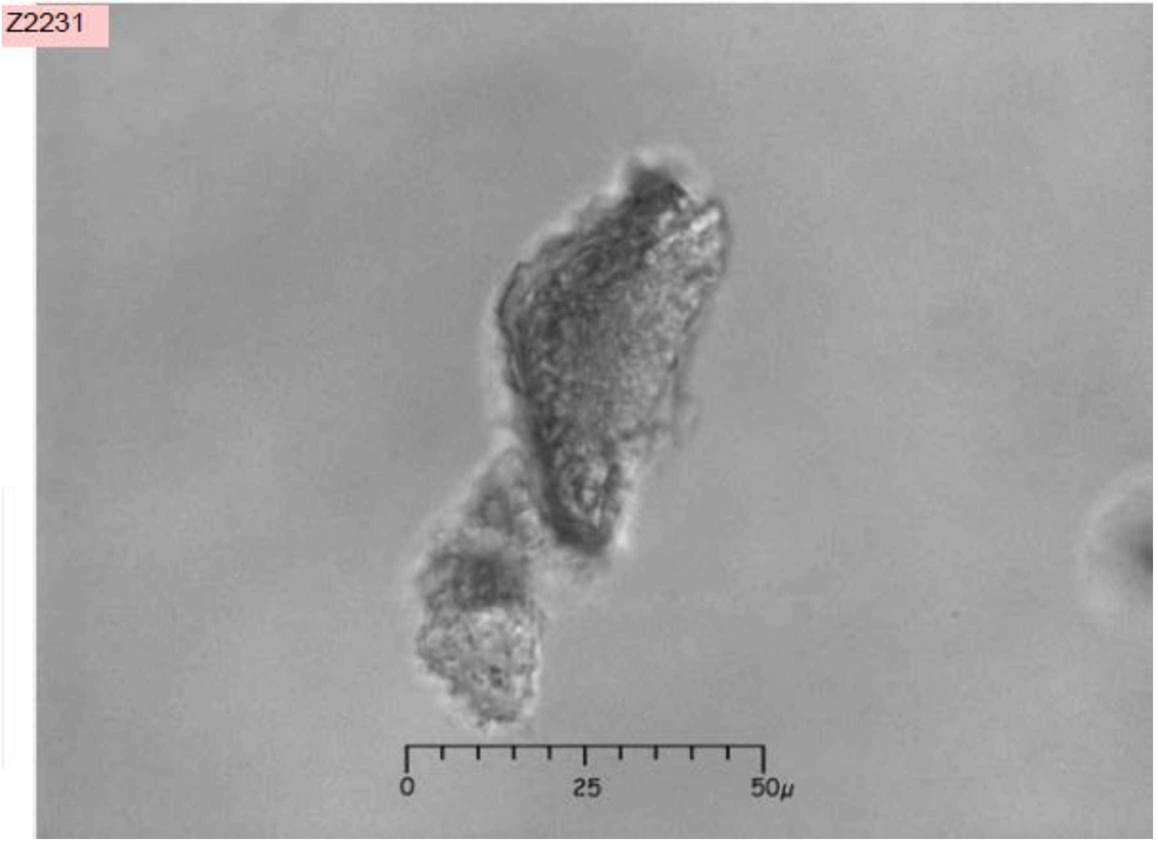
PC1388 fruit Moderate
Diagnostic level under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Can look like a very large conical body
Diagnostic to genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

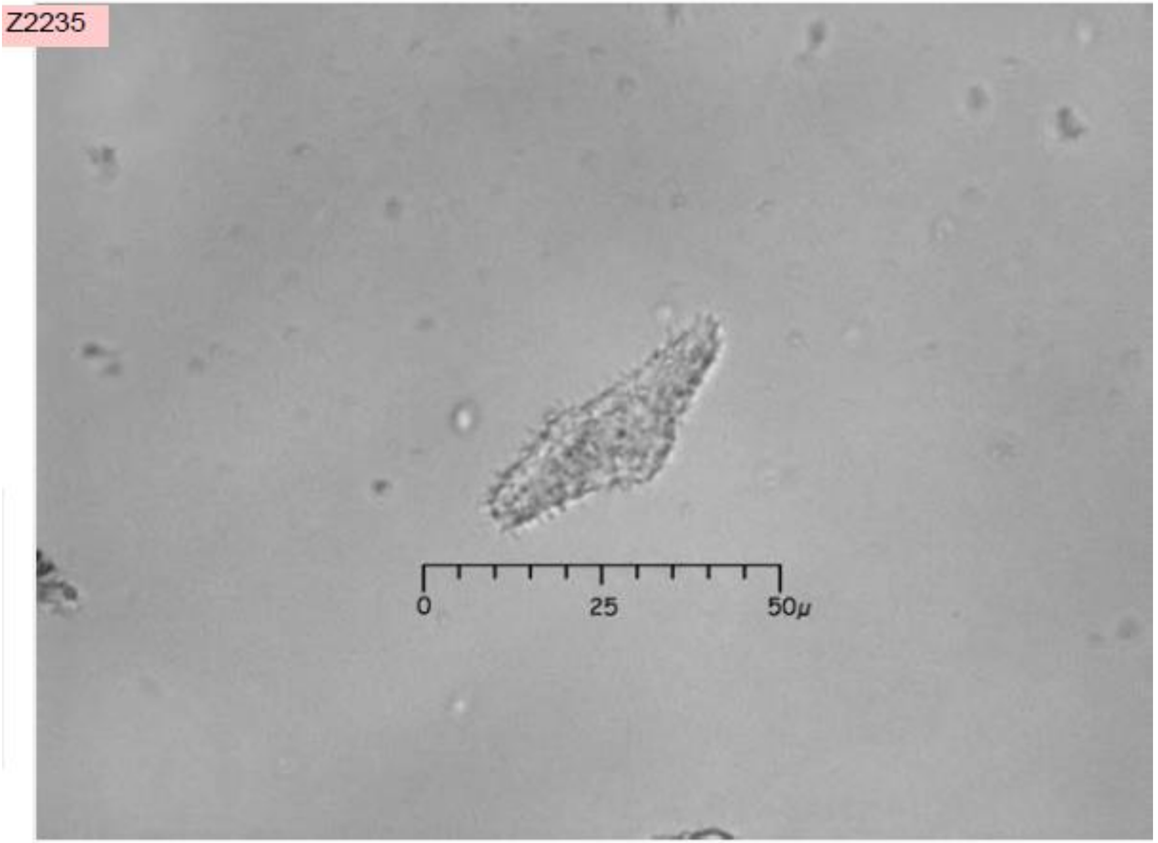
PC280 inflorescence Type first defined in Costus.
Side view of conical form. Sometimes the projections break off, leaving flat rugulose/nodular bodies
Diagnostic level: under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280 inflorescence, common
Diagnostic level: under study

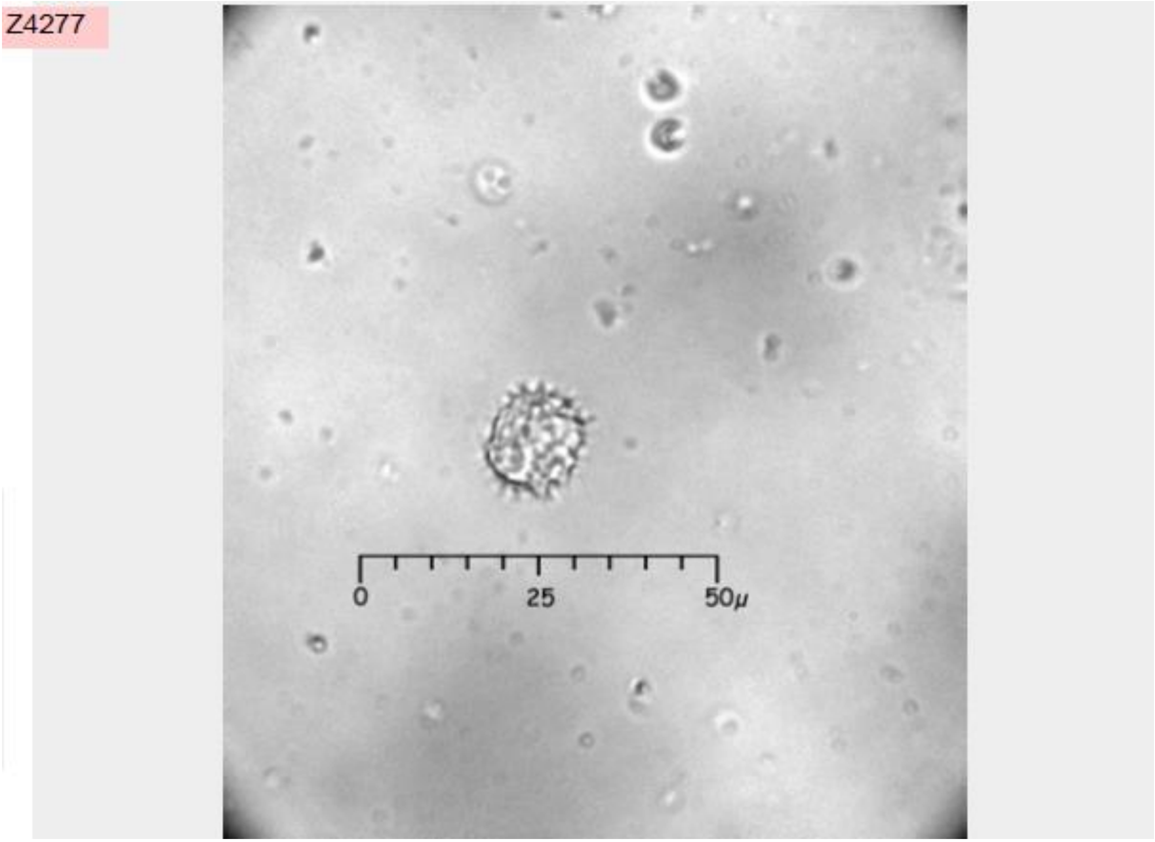


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280 inflorescence
Diagnostic level under study



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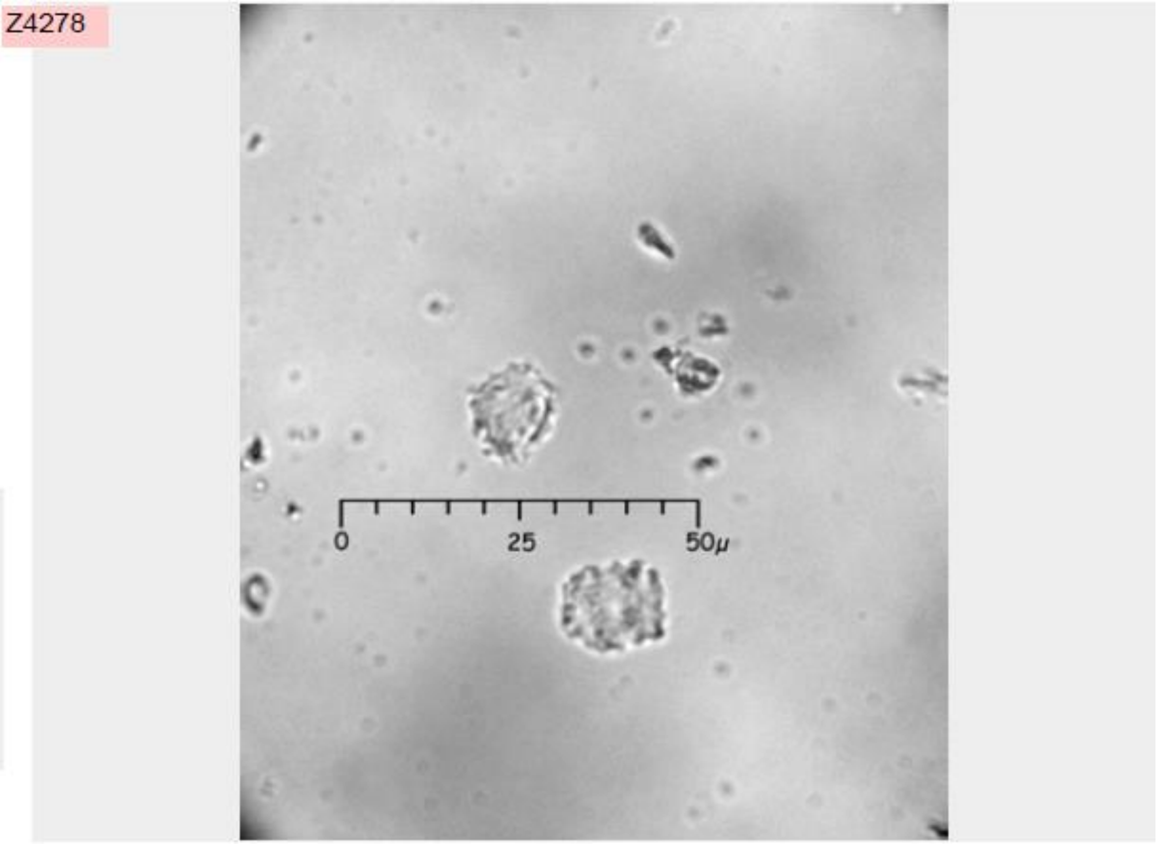
Donax arundastrum

Phytolith

PC280 inflorescence Diagnostic level under study
Body below scale bar is conical (80IIIB) viewed from top

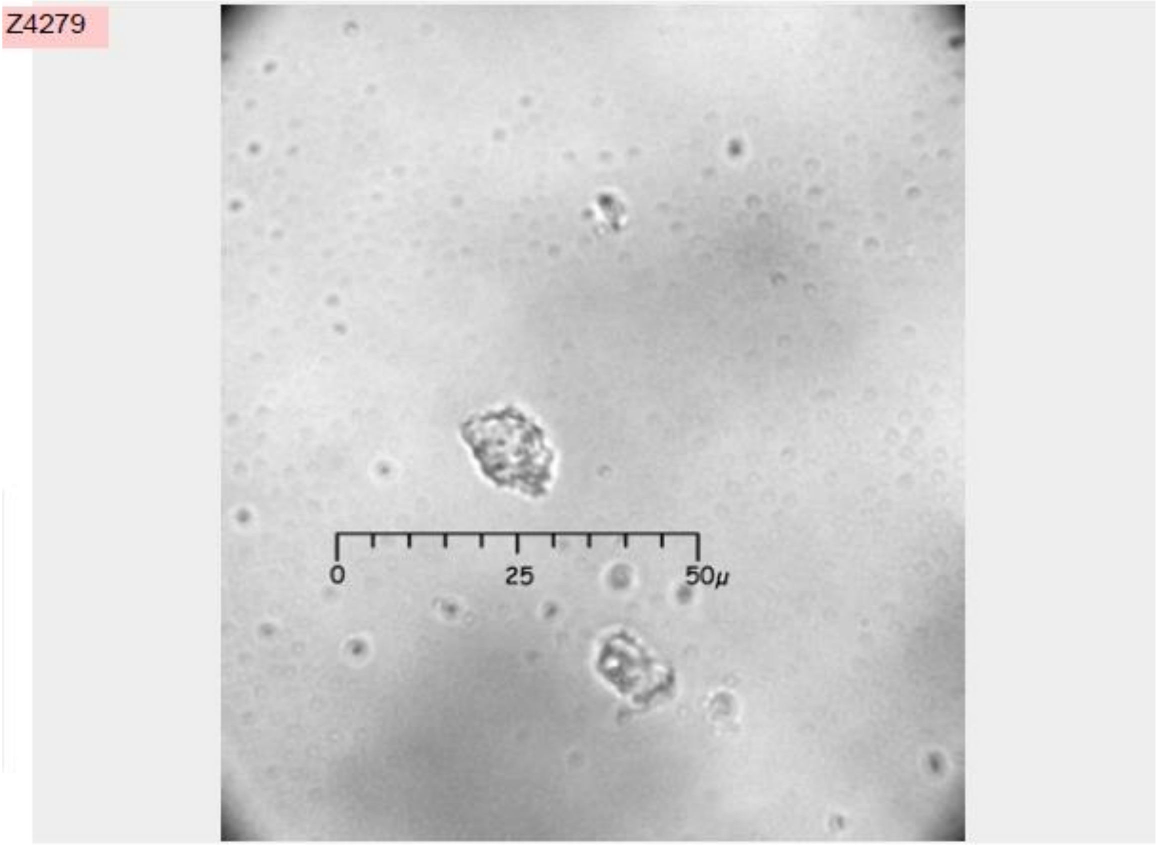


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280 inflorescence
Diagnostic level under study

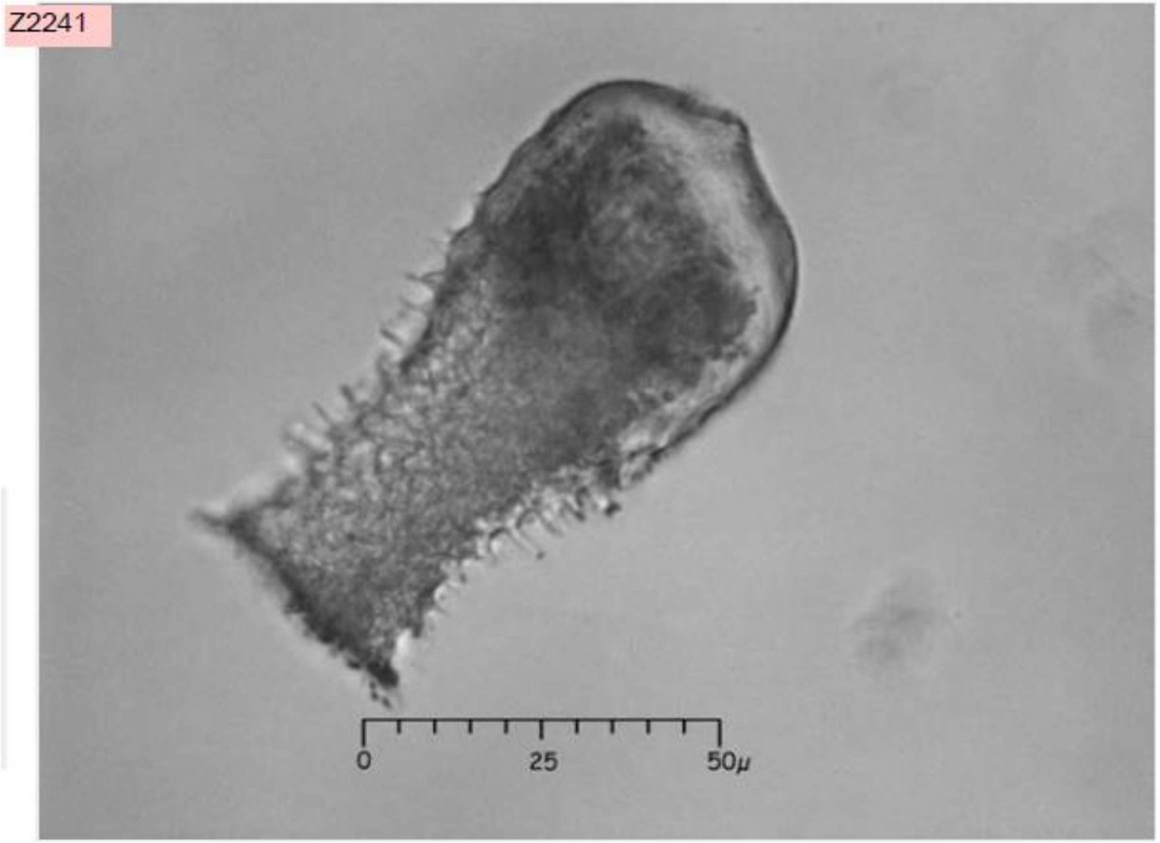


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Note variation in size, shown in following records.
Diagnostic level: genus

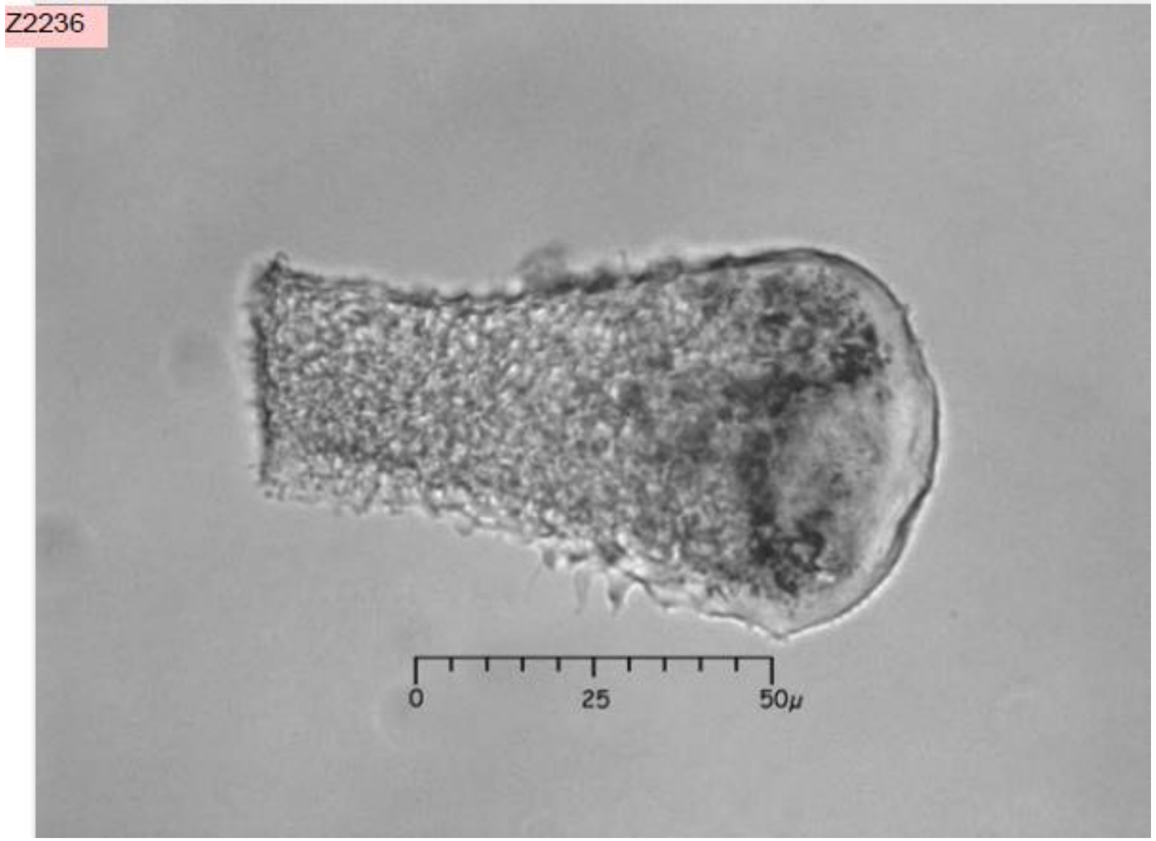


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Note variation in size, shown in following records.
Diagnostic level: genus

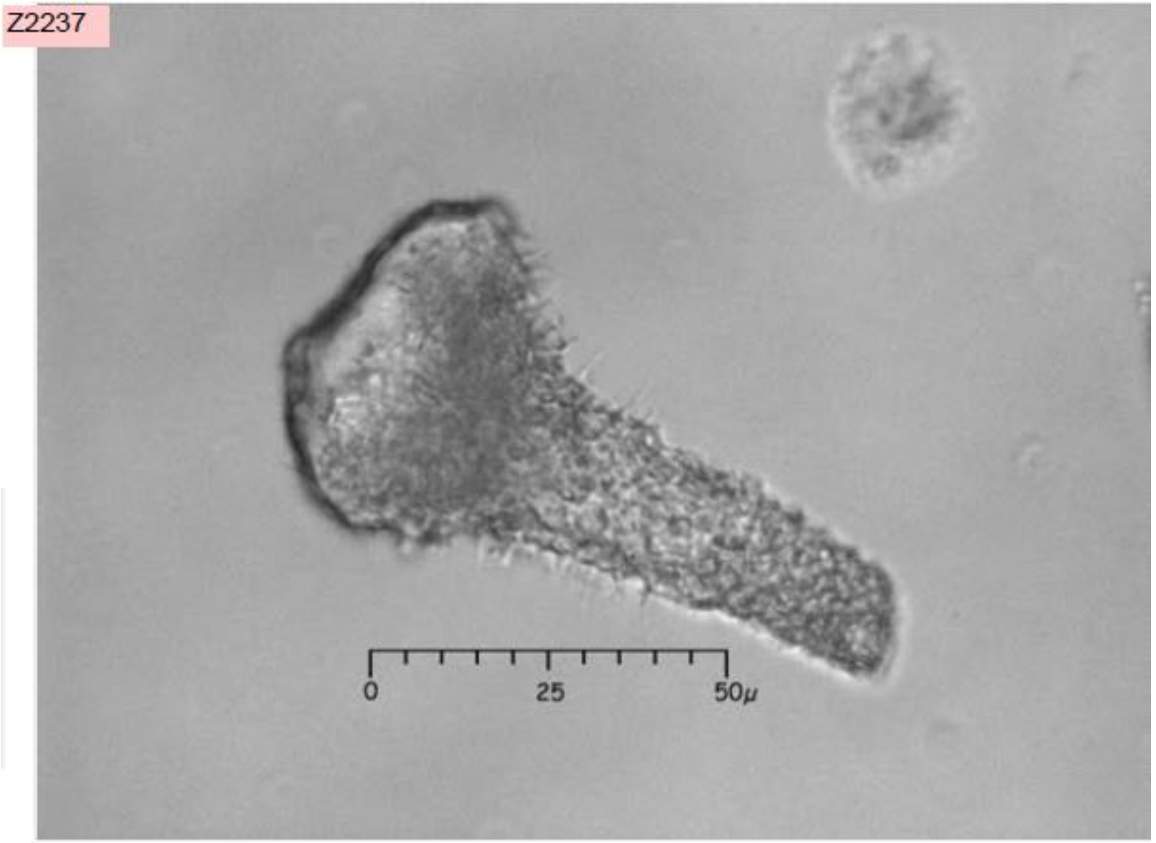


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Note variation in size, shown in following records.
Diagnostic level: genus

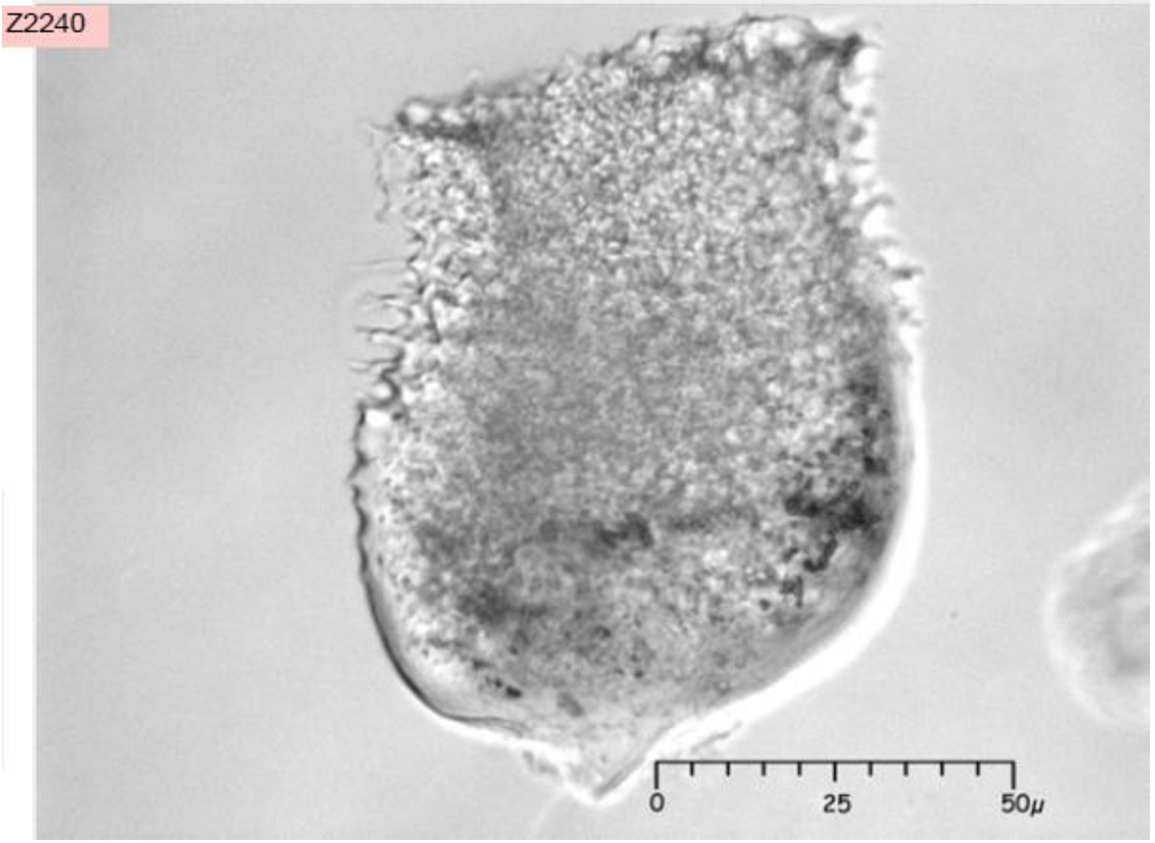


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Note variation in size, shown in following records.
Diagnostic level: genus

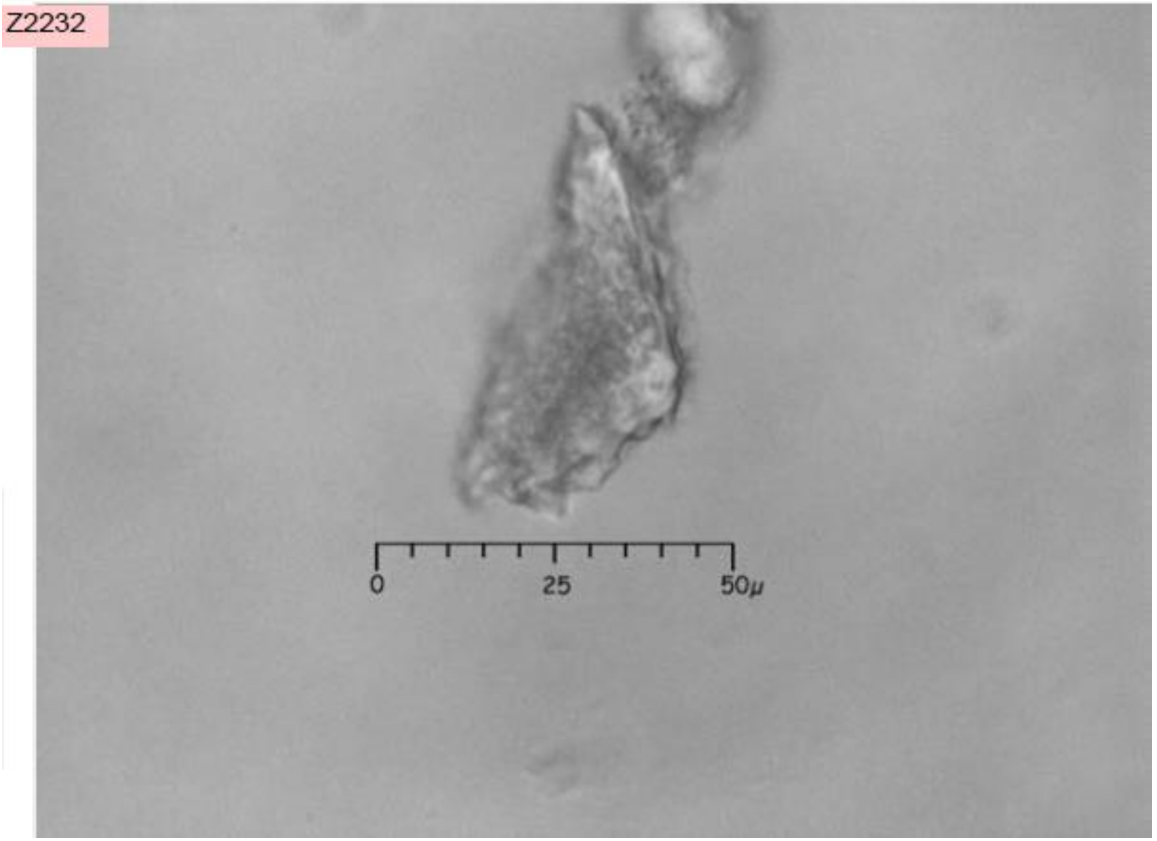


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
May look like a large conical body
Diagnostic level: genus

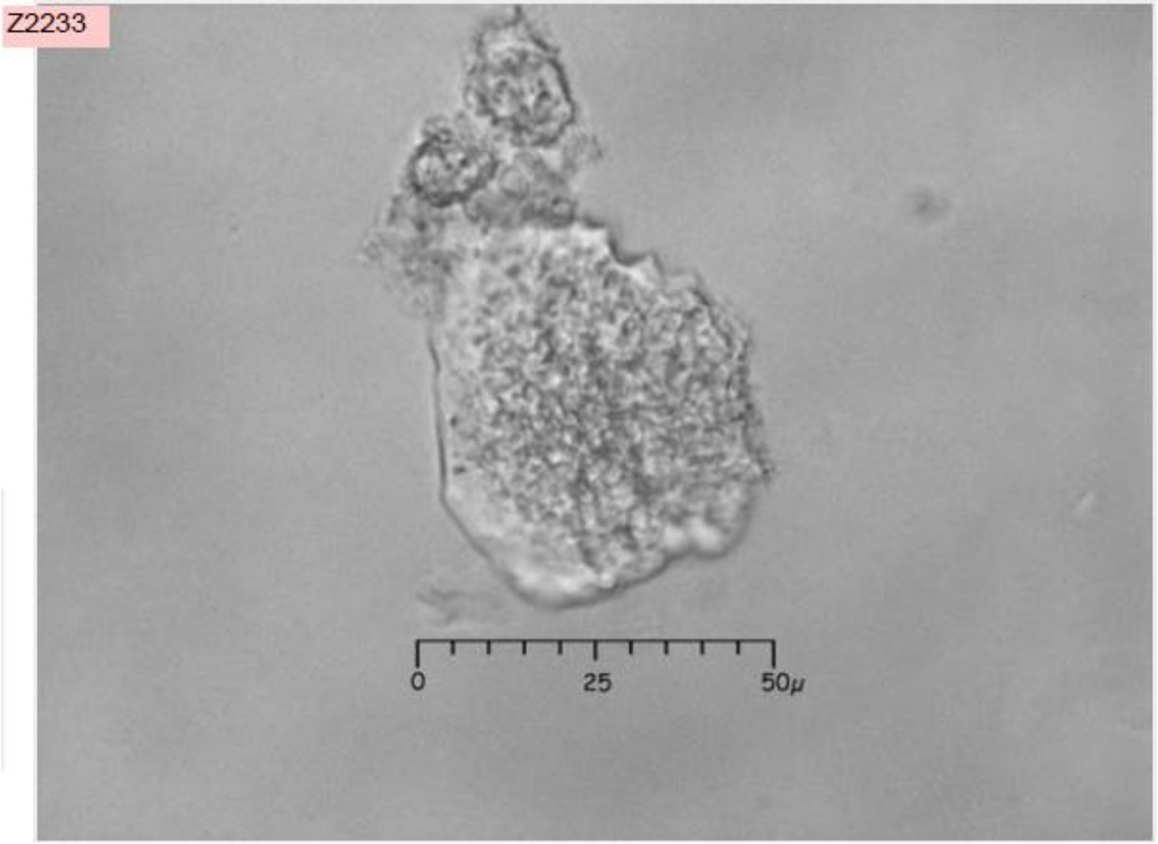


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
Diagnostic level: Marantaceae

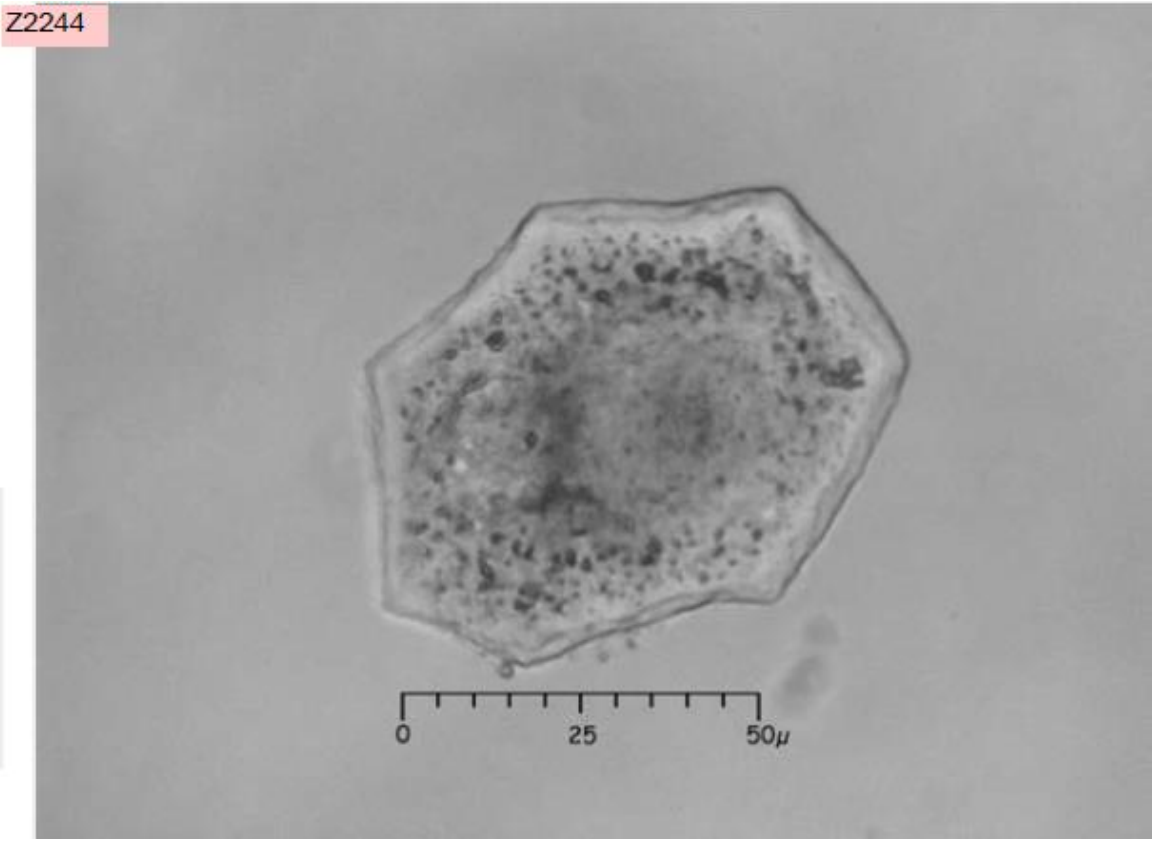


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax arundastrum

Phytolith

PC280, inflorescence
When very broad are difficult to roll and appear in bottom view, as seen here
Diagnostic level: genus



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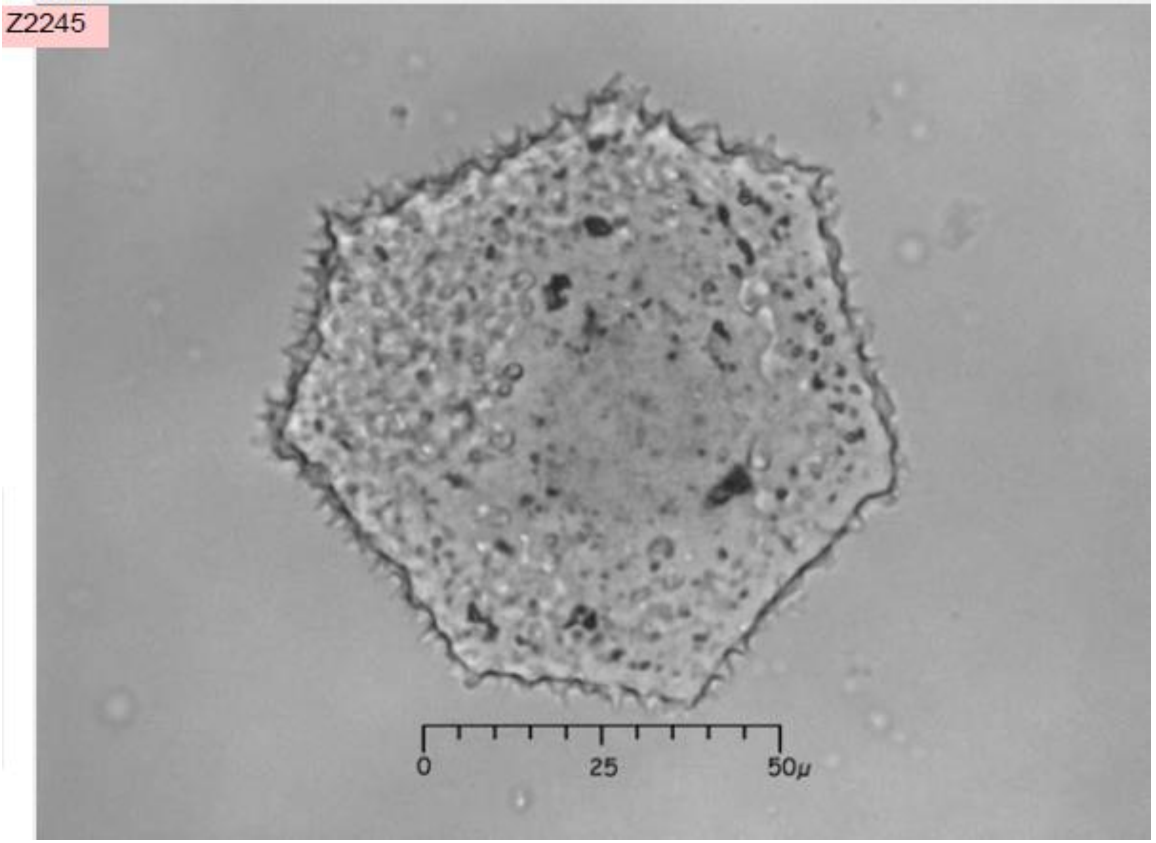
Donax arundastrum

Phytolith

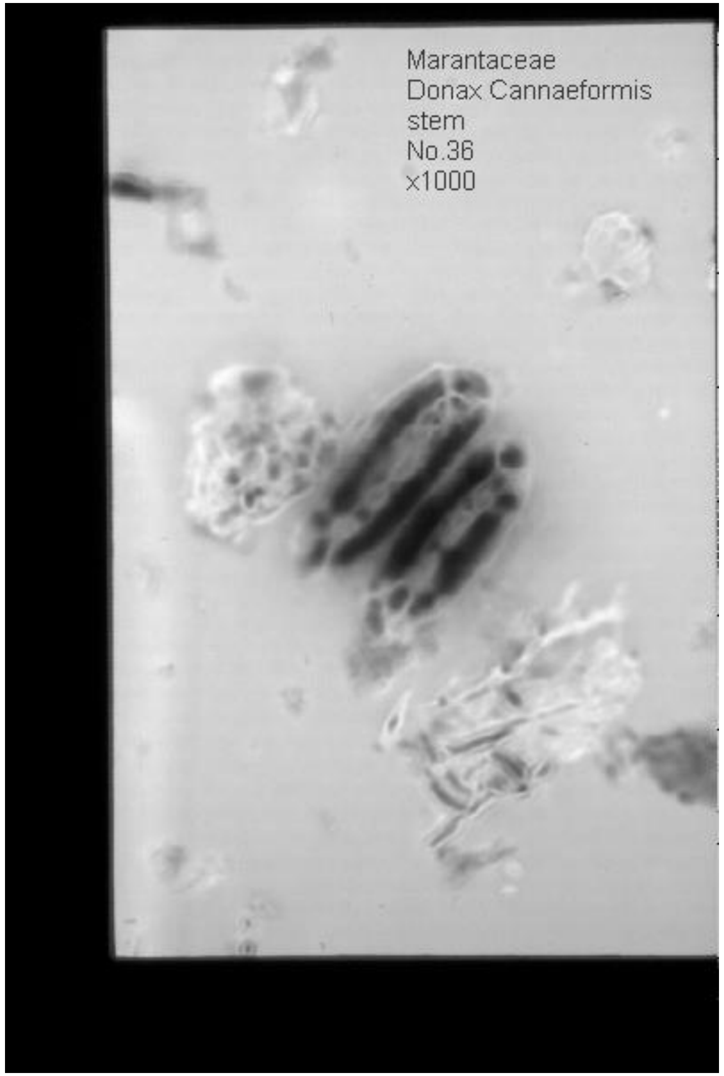
PC280, inflorescence
When very broad are difficult to roll and appear in bottom view, as seen here
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Donax cannaeformis

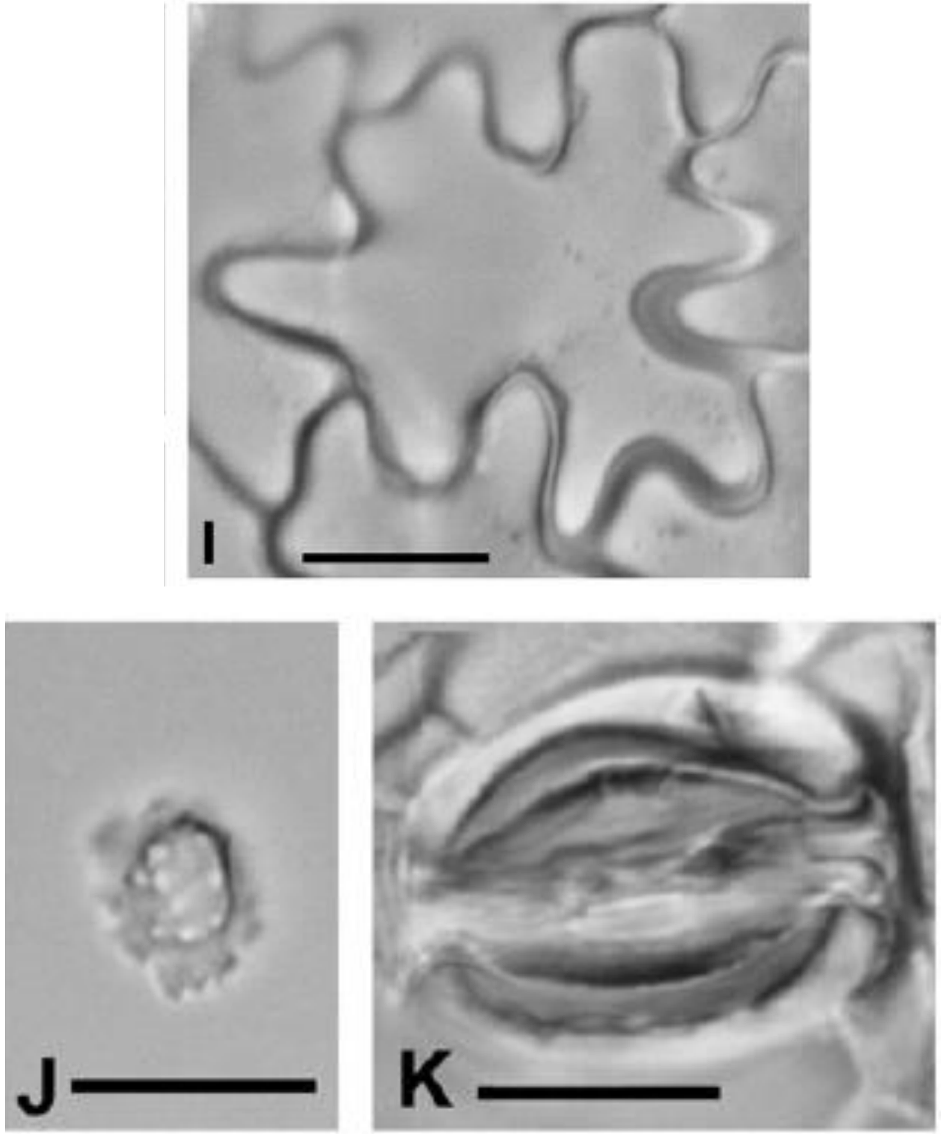
Australian Museum,
McCown Archaeobotany
Laboratory Collection



Donax grandis

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). I, tabular-jigsaw from Donax grandis leaf. J, rugose hat-shape from Donax grandis leaf. K, stomatal complex from Donax grandis leaf. Scale bars=12 μm.

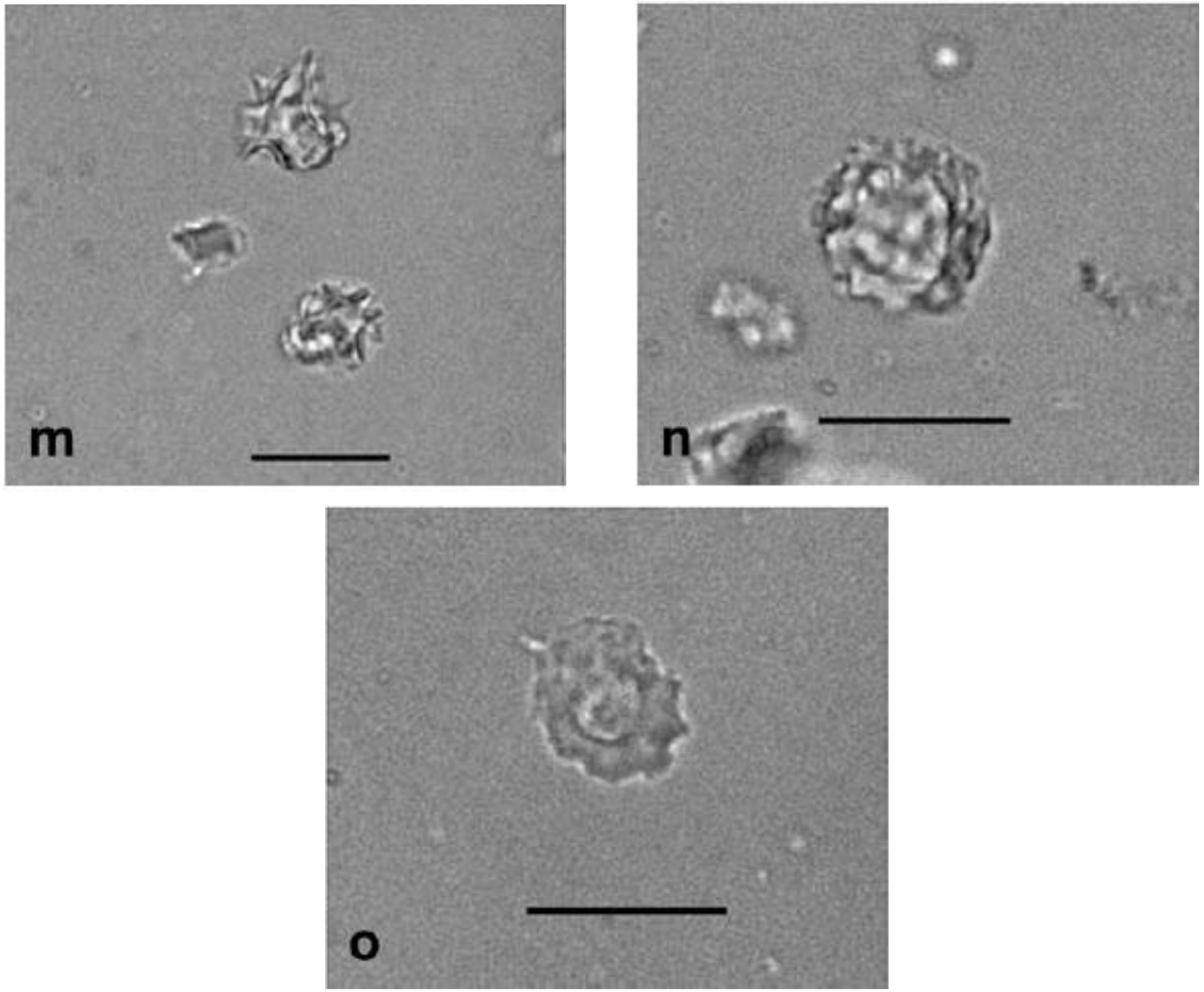


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Ichnosiphon arouma

Phytolith

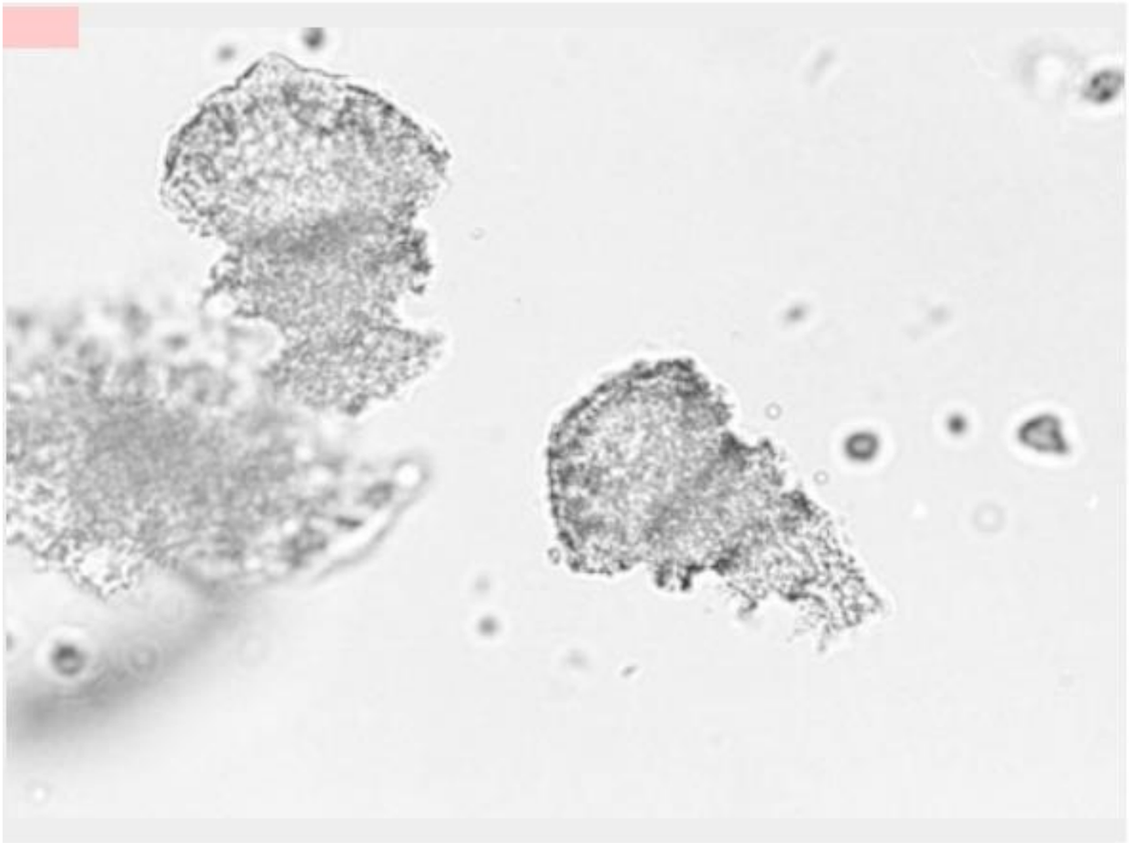
Fig. 3. Phytoliths from non-grass monocots. m) Irregularly angled/folded bodies from Ichnosiphon arouma, n) Nodular sphere from I. arouma, o) Conical body from I. arouma



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Ischnosiphon inflatus

Phytolith



seed bodies.
Show range of variation in wild types.
Diagnostic level: Marantaceae, wild taxa

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Ischnosiphon inflatus

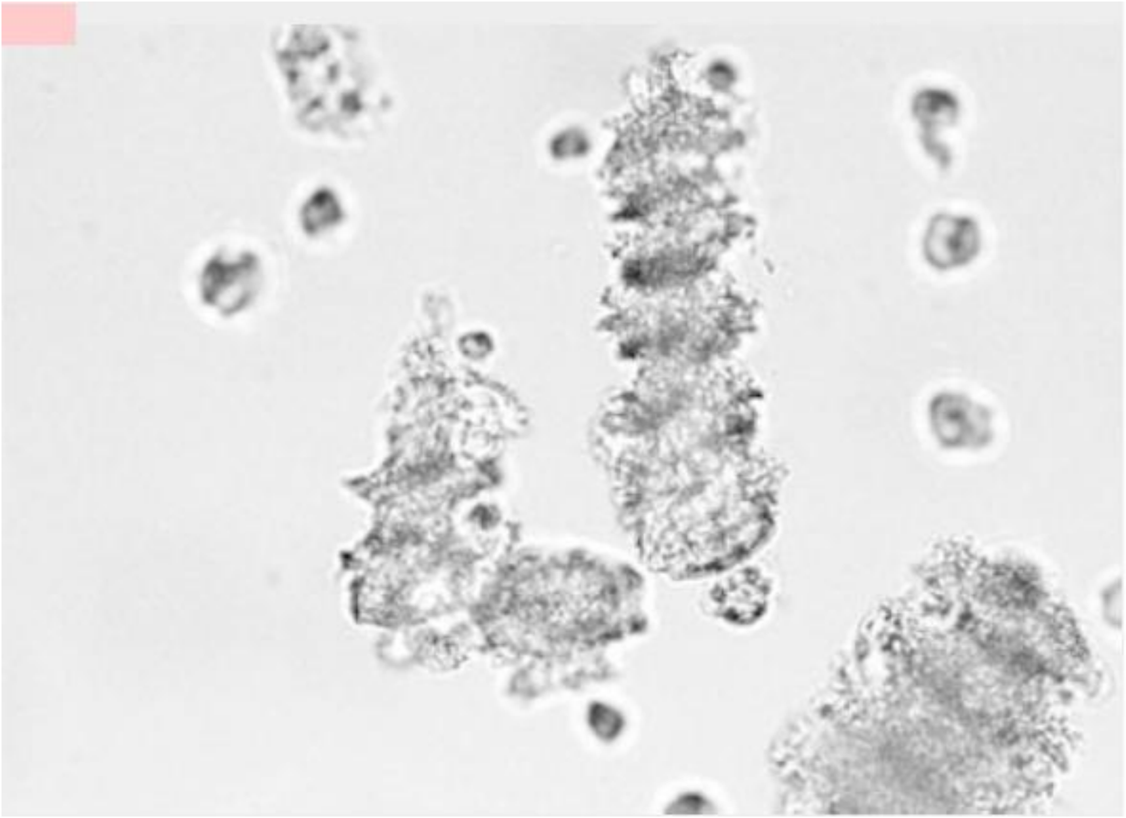
Phytolith

seed bodies, Note how body continues to narrow below tip.
Diagnostic level: family, wild taxa

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Ischnosiphon inflatus

Phytolith



Spiralling of "corkscrew" along shaft
very apparent in body right of center.
Diagnostic level: family, wild taxa

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta sp.

Starch

Figure 3. Light micrographs of archaeological starch granules representative of the recovered assemblage. b: Starch granule of Maranta sp. recovered from flake 2.

Perry, Linda. 2002. Starch Analyses Reveal Multiple Functions of quartz “manioc” Grater Flakes from the Orinoco Basin, Venezuela. *Interciencia* 27 (11):635–39.

Maranta arundinacea

Phytolith

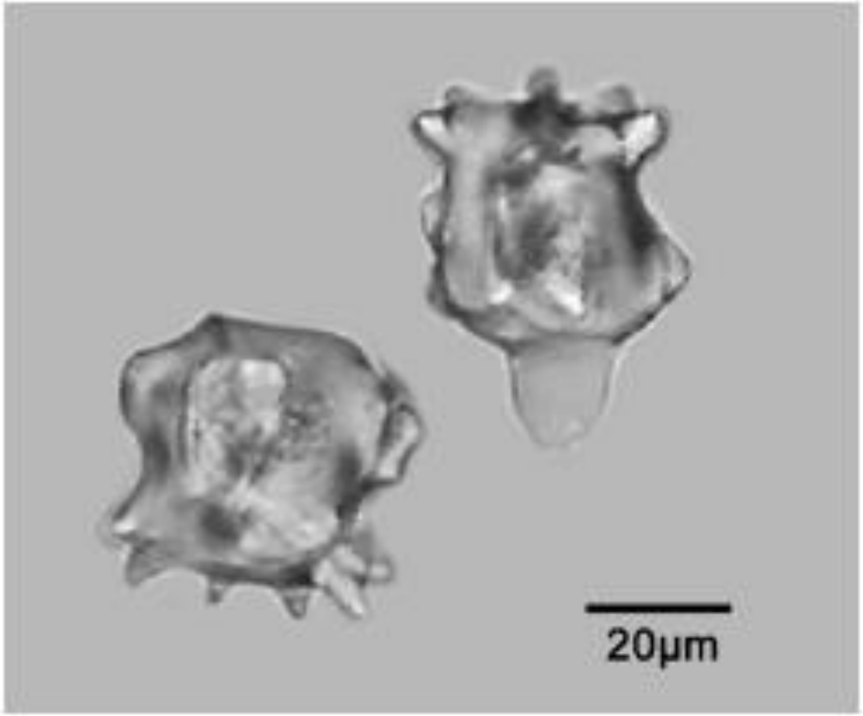


Fig. 7. Seed phytoliths from arrowroot. From Piperno, 2006.

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Maranta arundinacea

Phytolith

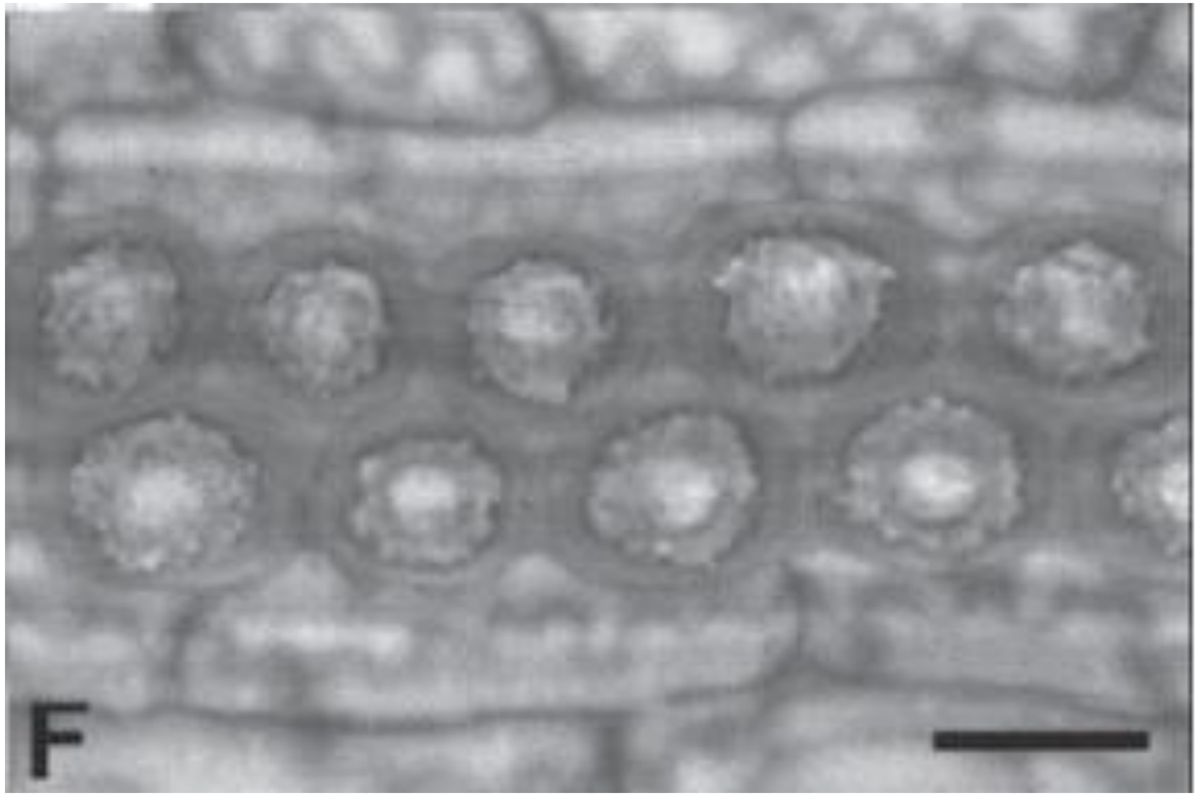


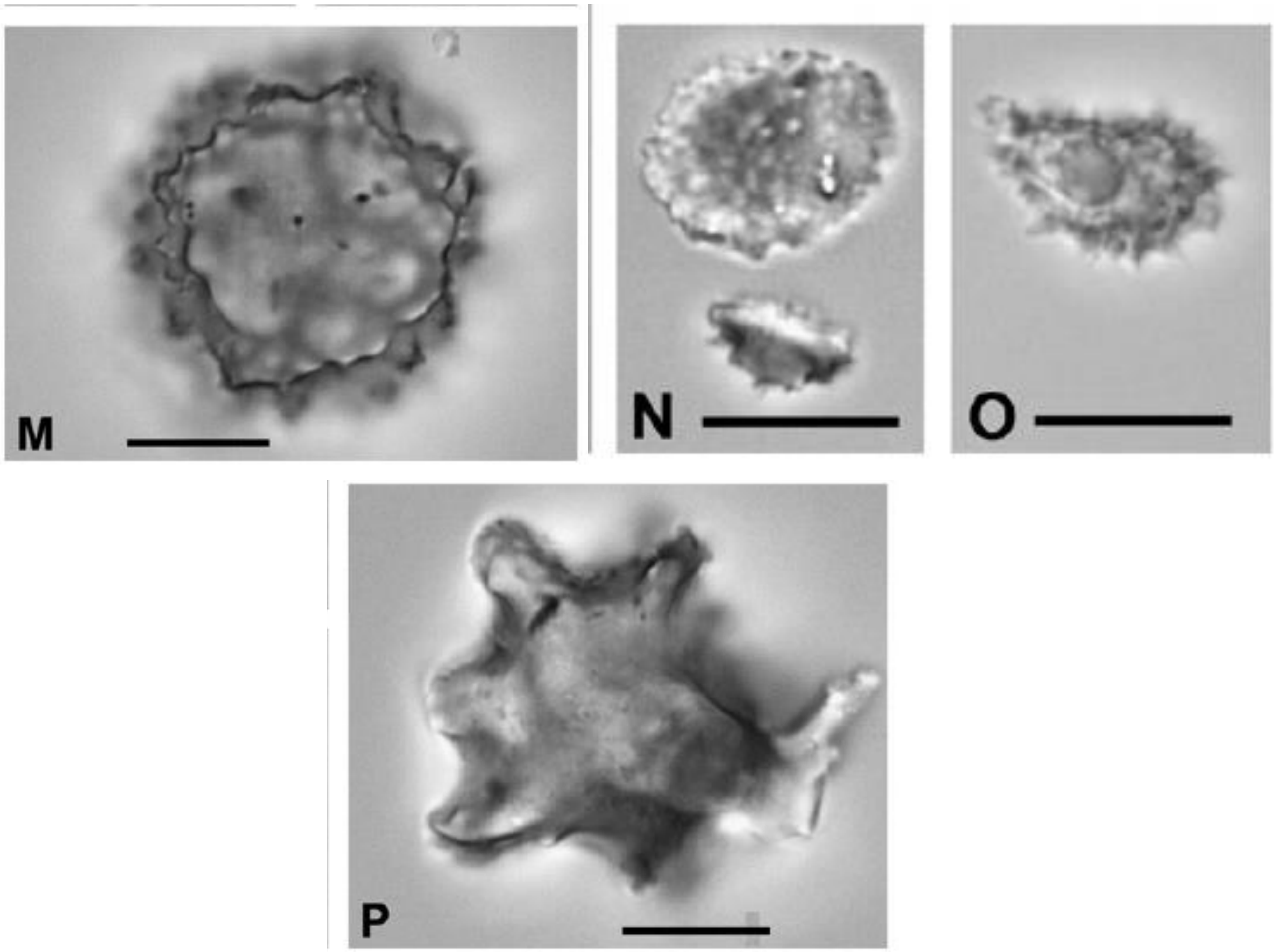
Fig. 3. Various silica body morphologies found in the order Zingiberales. F. Maranta arundinacea (Marantaceae), costal silica bodies in mesophyll cells (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Maranta arundinacea

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). M, globular-rugulate from Maranta arundinacea leaf. N, rugose hat-shapes with crenate margins from Maranta arundinacea leaf. O, globular-papillate with concavity from Maranta arundinacea seed. P, Kn2 knobby from Maranta arundinacea seed. Scale bars=12 µm.

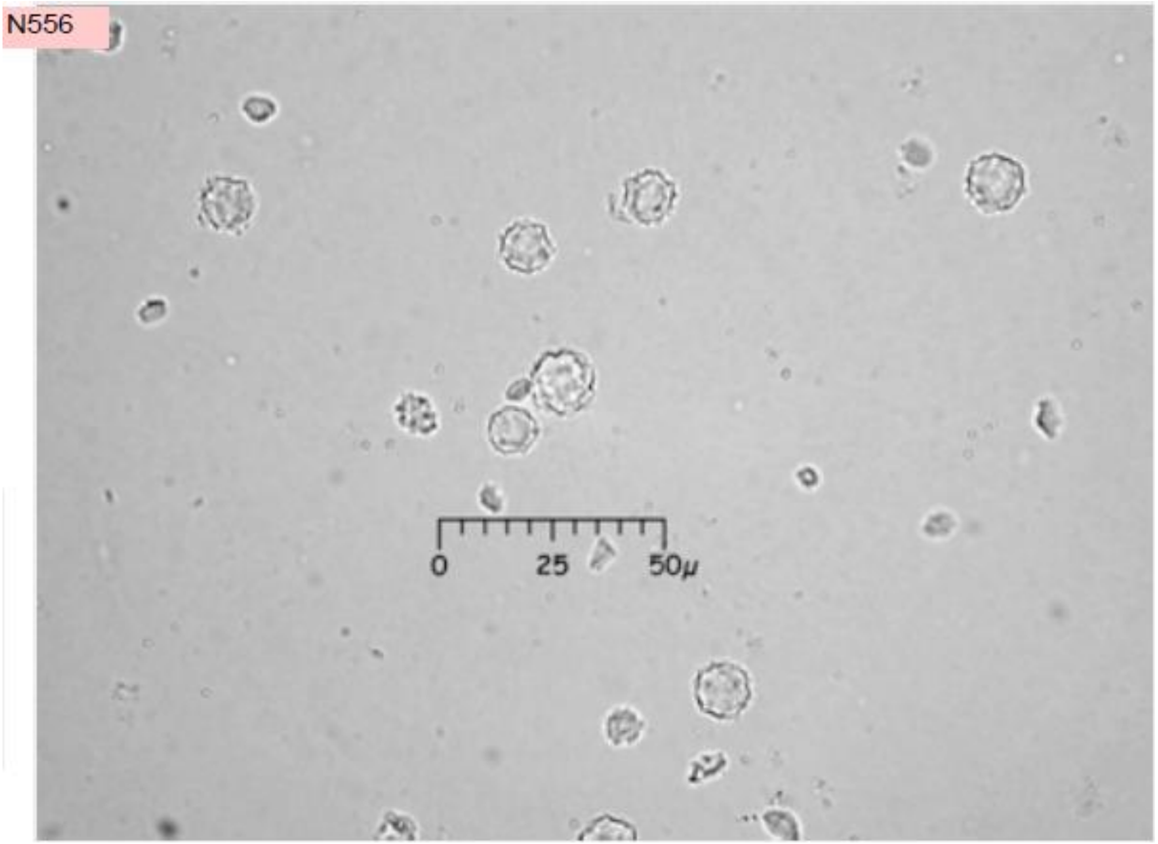


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Maranta arundinacea

Phytolith

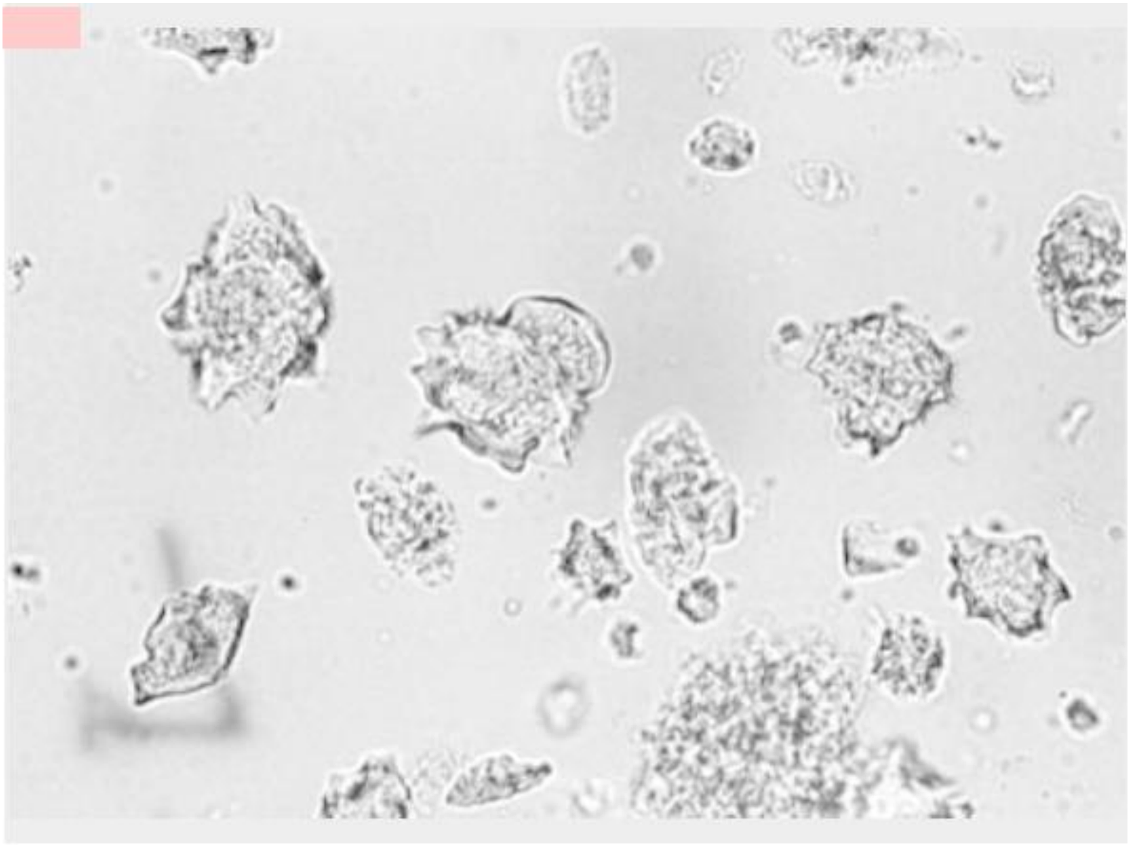
Note both conical (hat-shaped) bodies and nodular spheres in this field. Both appear in Marantaceae. 80IIIB looks like rugulose or nodular sphere in flat view, but side view shows conical shape.
Diagnostic level, 80IIIB: family
Diagnostic level, 80ICa1: Marantaceae/Bombacaceae



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

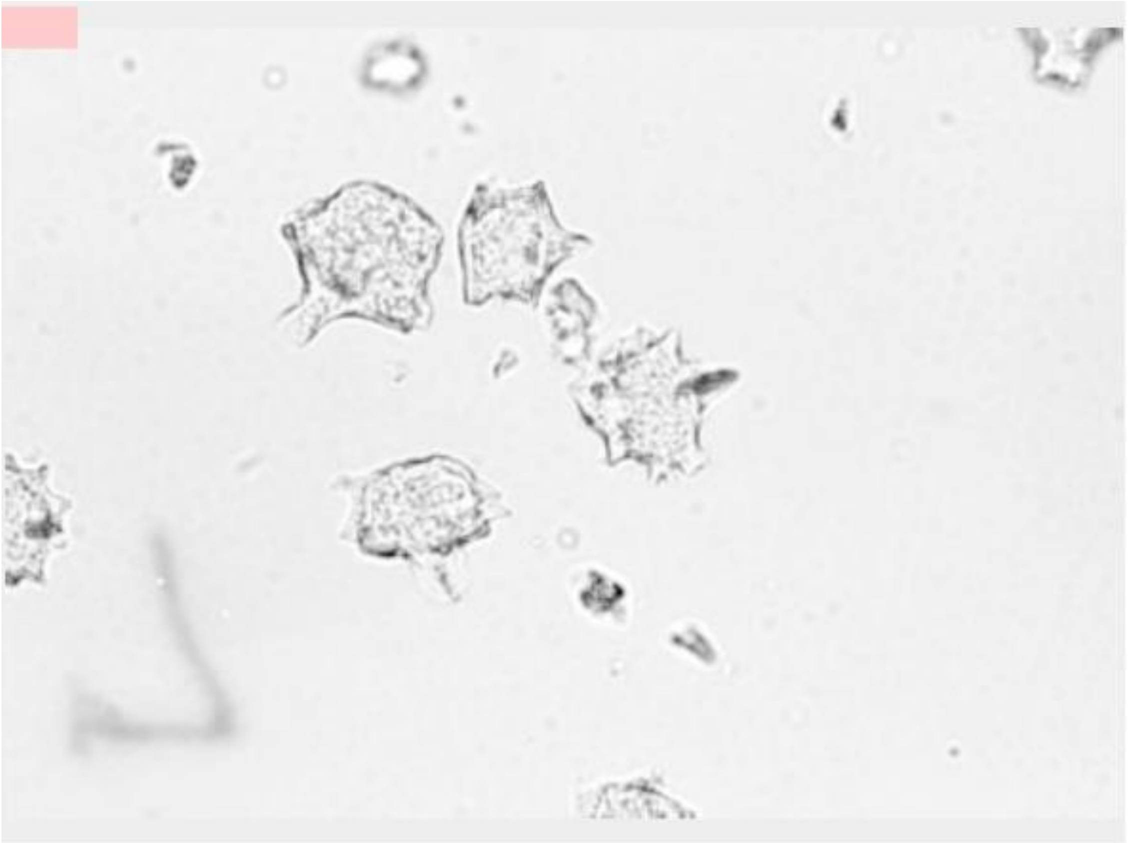


Note the “bottom” view of the bodies, since this is the typical side up. Often it looks like an irregular star- shape or a granular textured disk with irregular margins.
Note in bottom left and far right “tip” only bodies. see below.
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

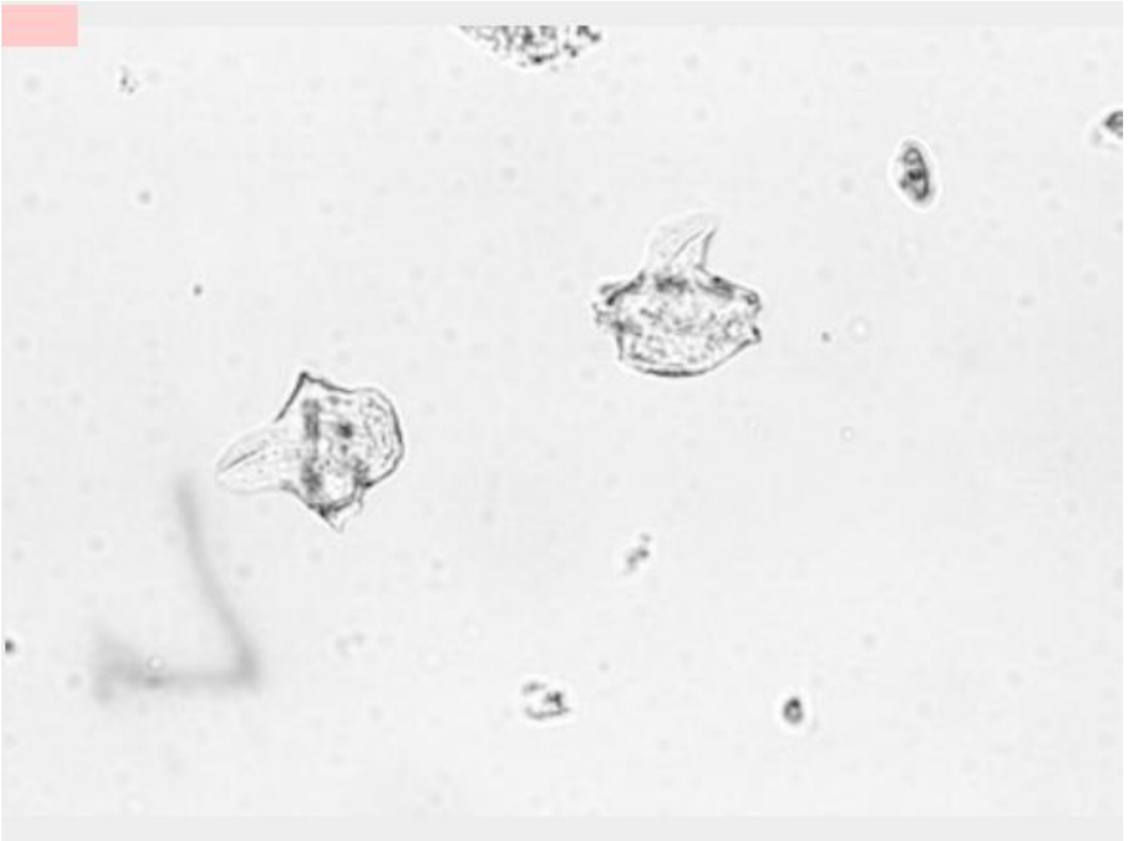


Note how much shorter in length cylinders are compared to Maranta spp. type -- yet “tips” are larger
Compare to other photos of this type for variation.
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith



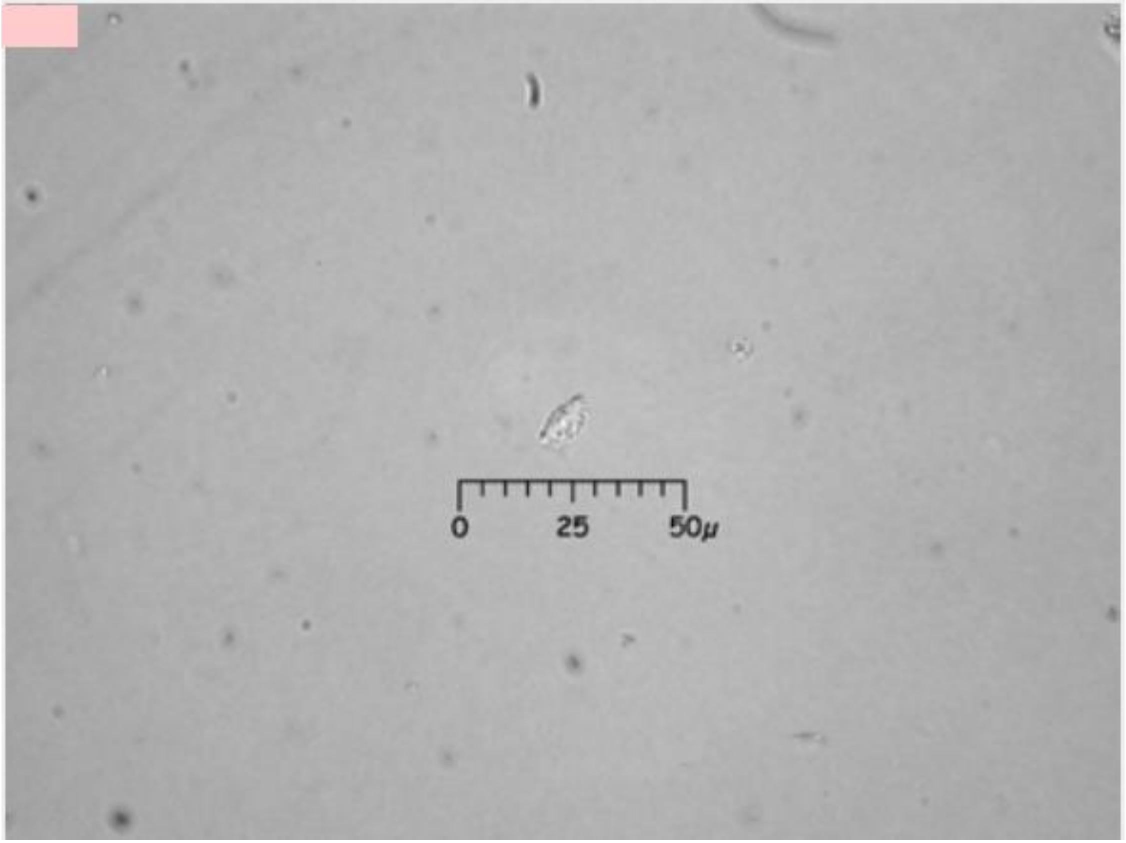
Note shortness of cylinder compared to “tip” and Maranta sp. type.
Diagnostic level; species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

Type established by Karol Chandler-Ezell, 2004
Diagnostic level: Maranta/Calathea rhizomes

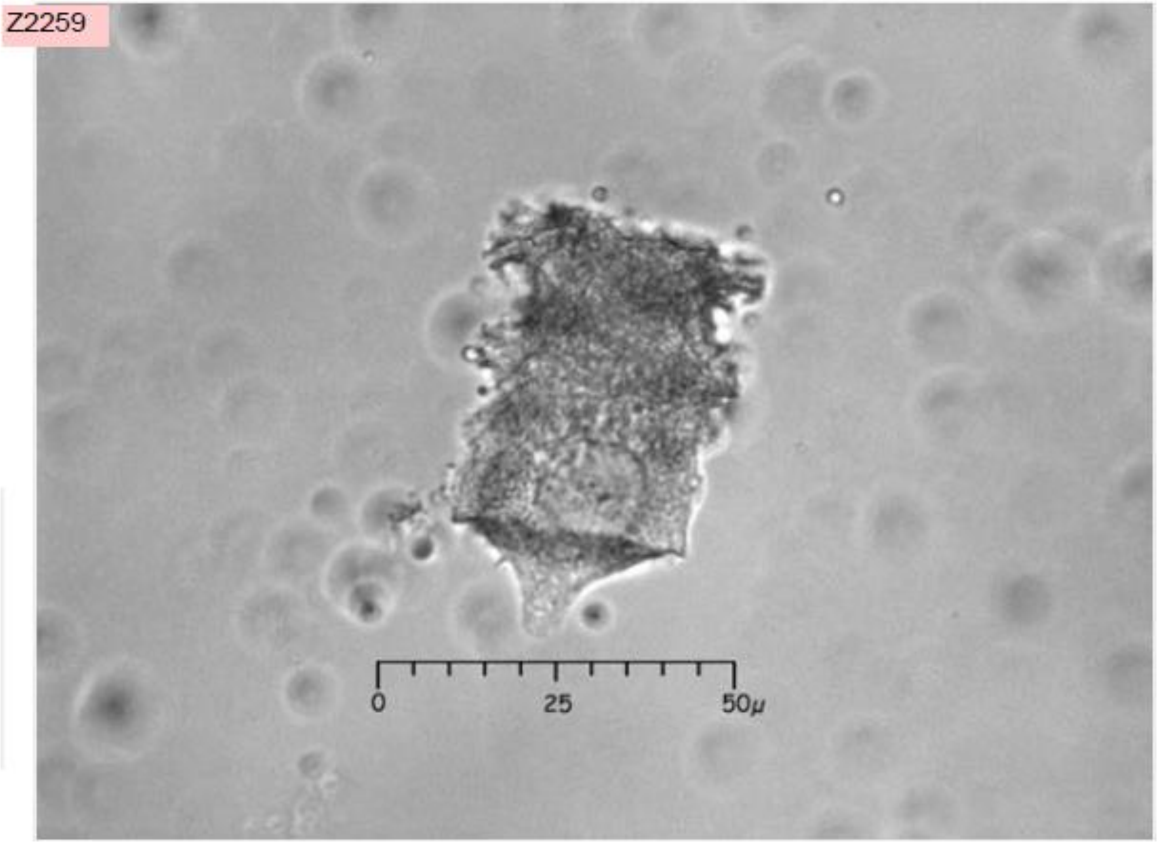


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2670, fleshy rhizome, moderate
A seed body type,
Diagnostic level: family, wild taxa;
occurs in one specimen of arrowroot rhizome

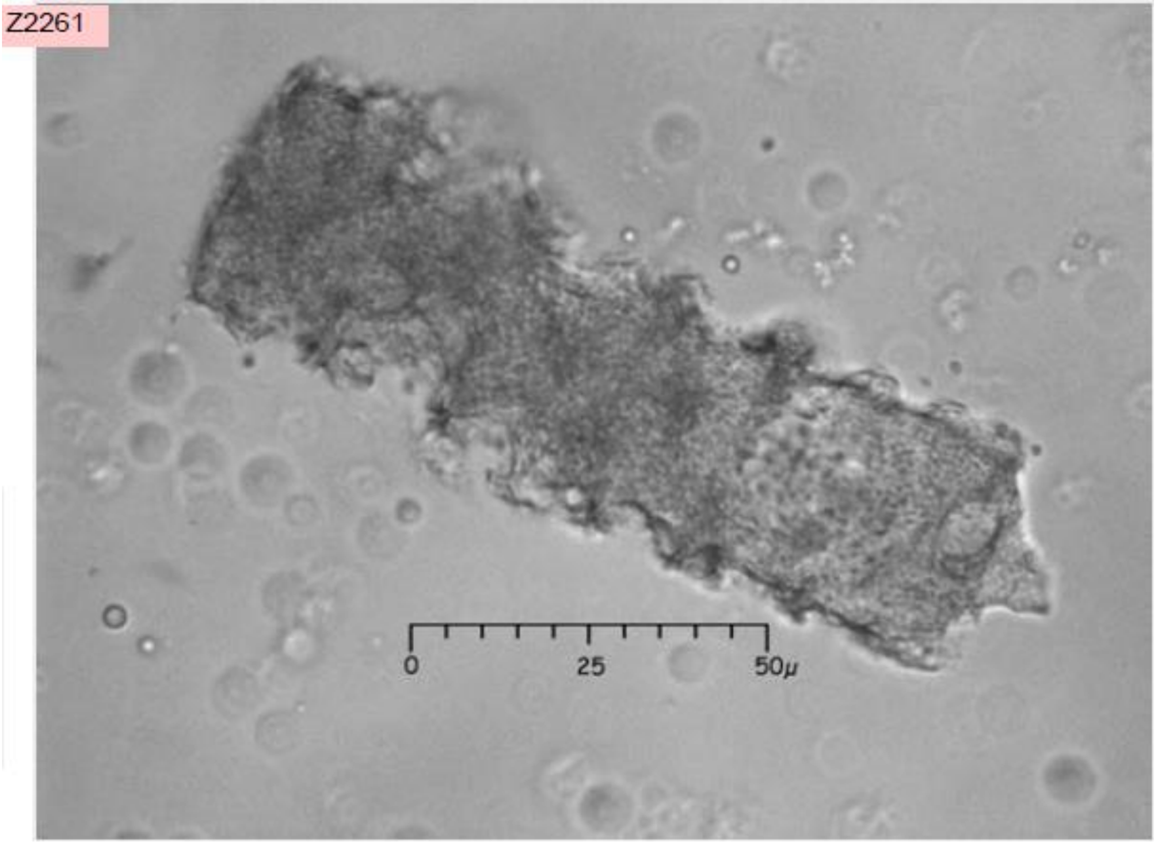


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2670, fleshy rhizome, moderate
A seed body type,
Diagnostic level: family, wild taxa;
occurs in one specimen of arrowroot
rhizome

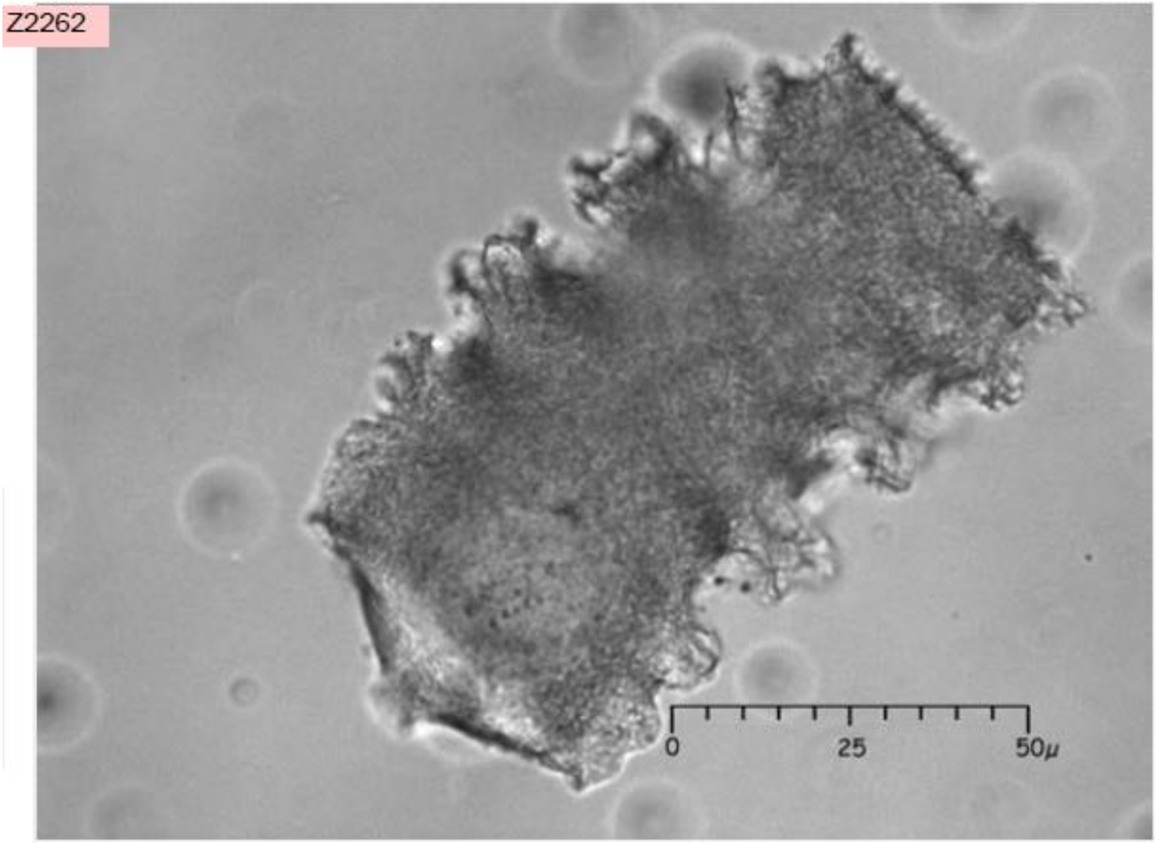


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2670, fleshy rhizome, moderate A seed body type,
Diagnostic level: family, wild taxa; occurs in one specimen of arrowroot rhizome

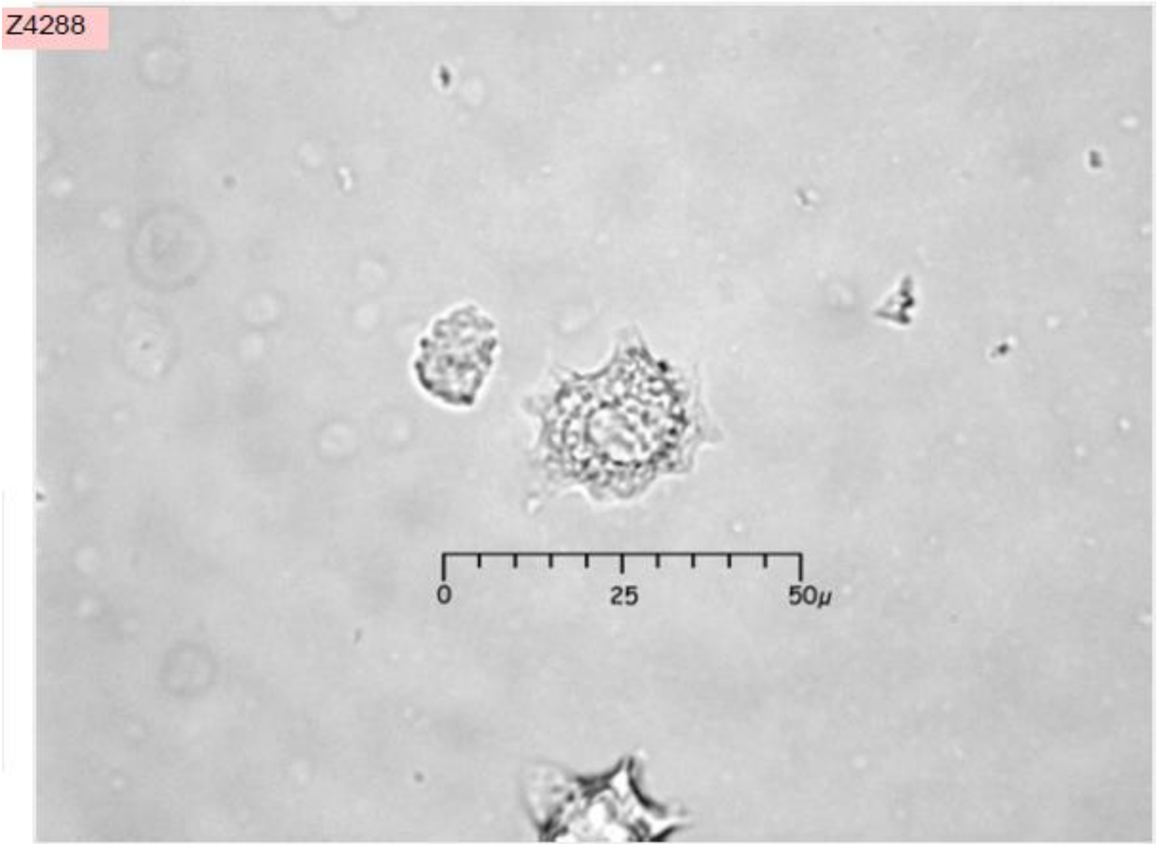


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2038, inflorescence
Diagnostic level: species
This image is a view from the bottom
(often in this rotation)

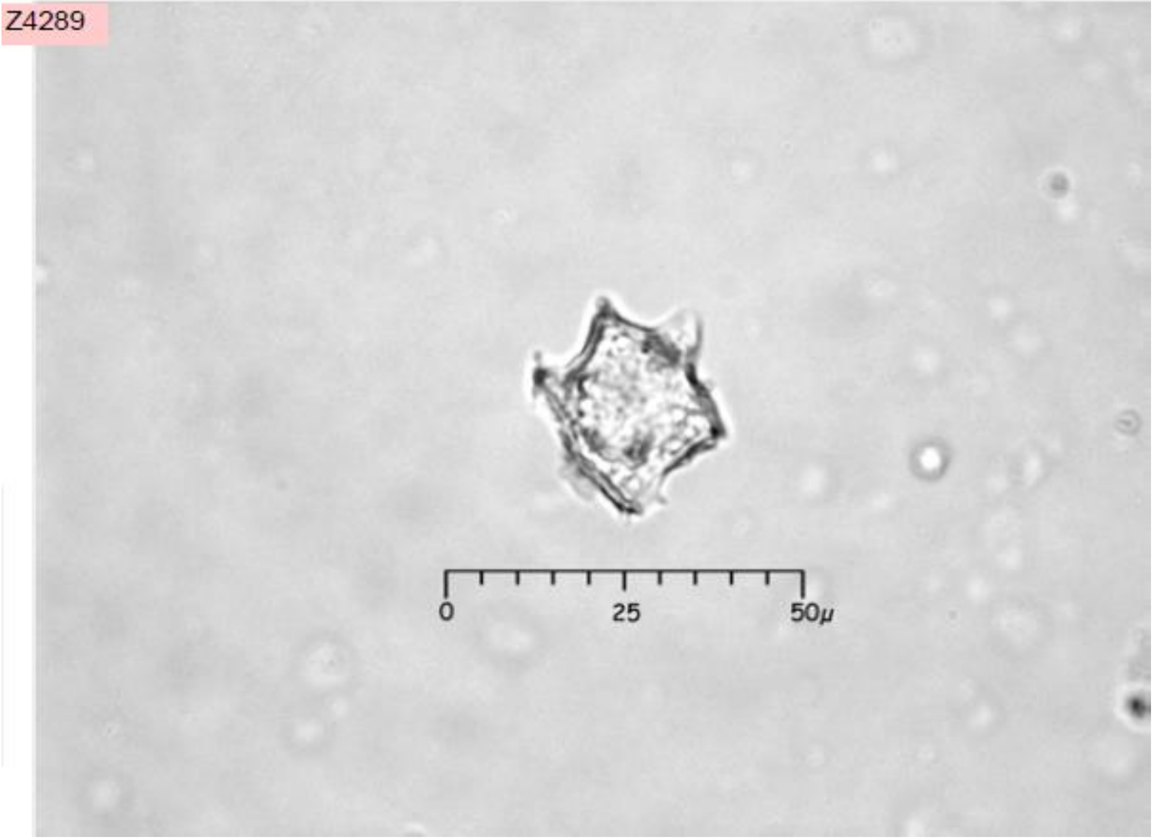


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2038, inflorescence
Diagnostic level: species

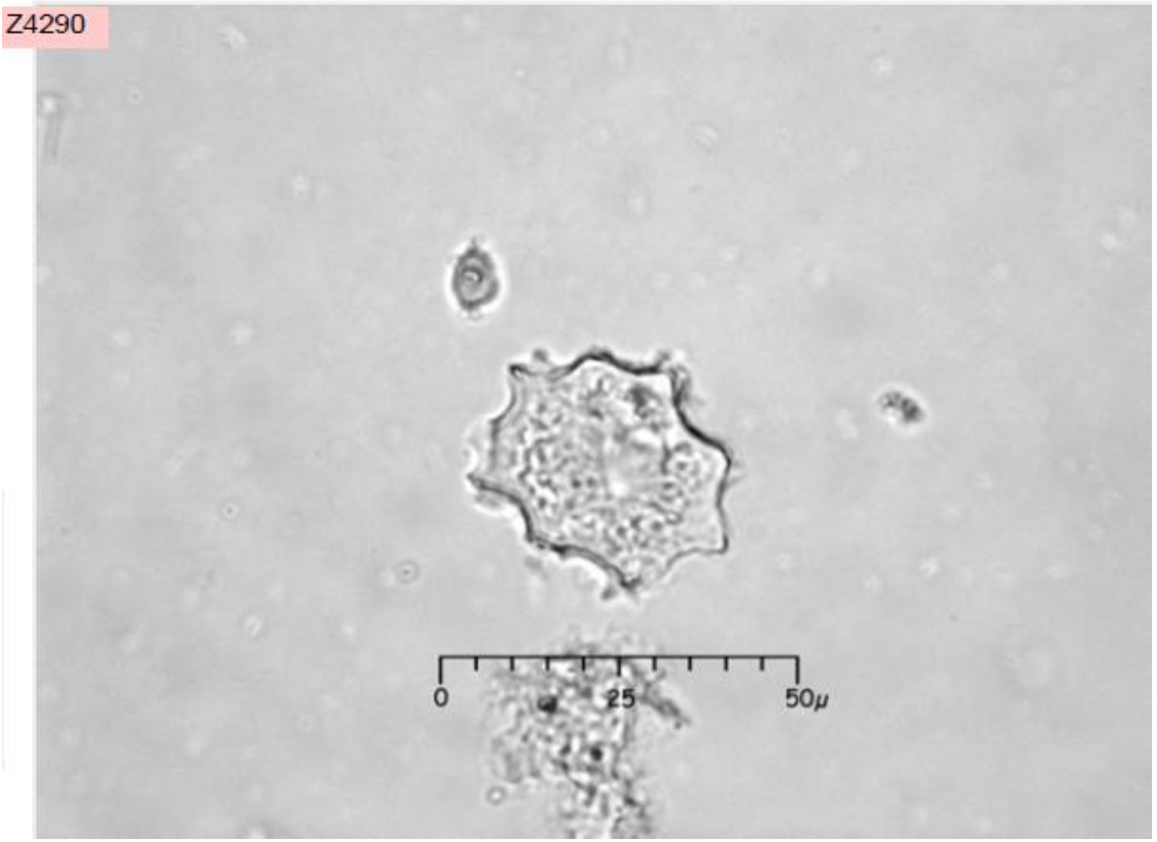


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

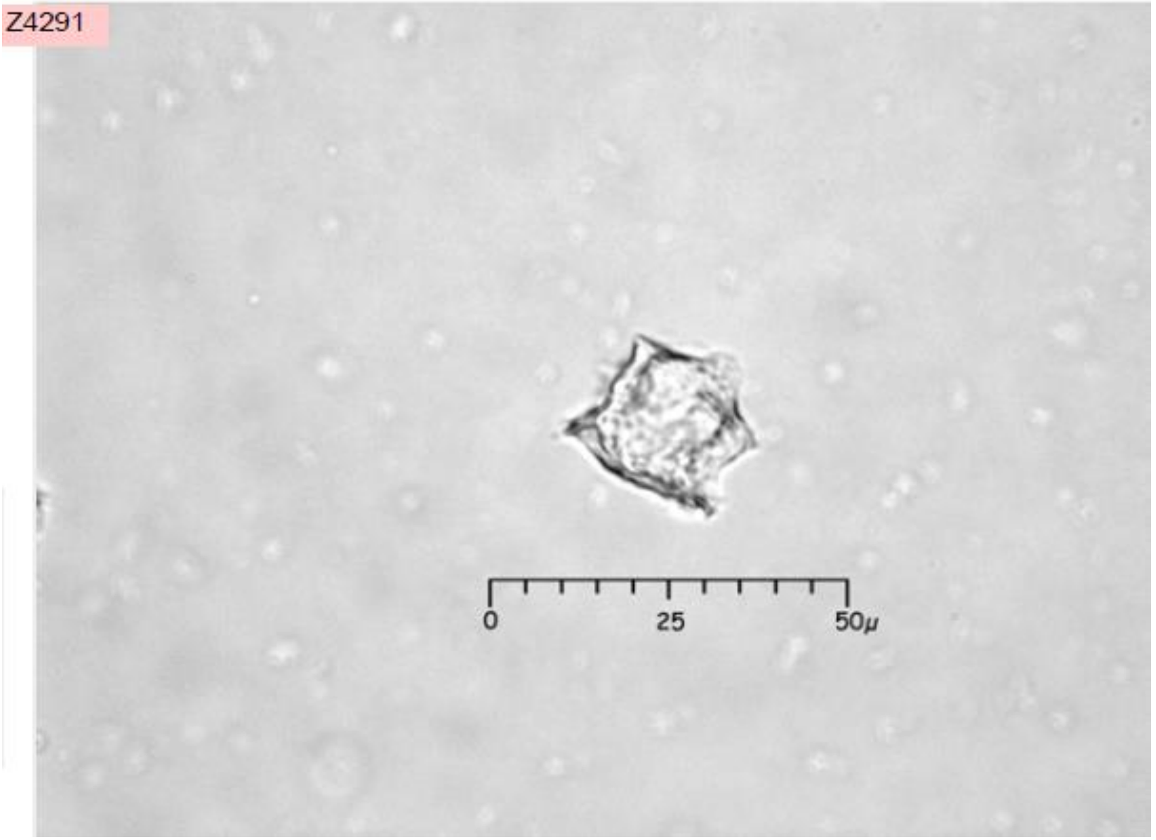
PC2038, inflorescence
Diagnostic level: species
View from the bottom



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith



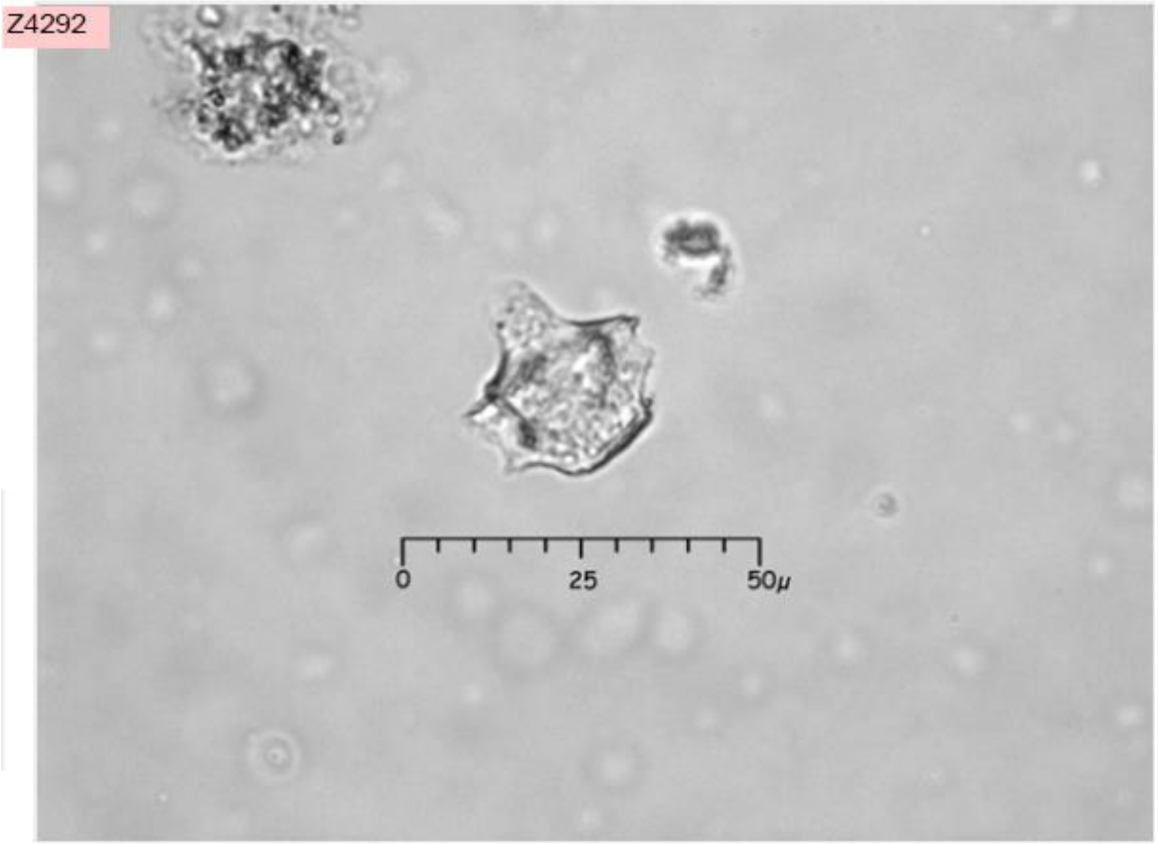
PC2038, inflorescence
Diagnostic level: species

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2038, inflorescence
Diagnostic level: species

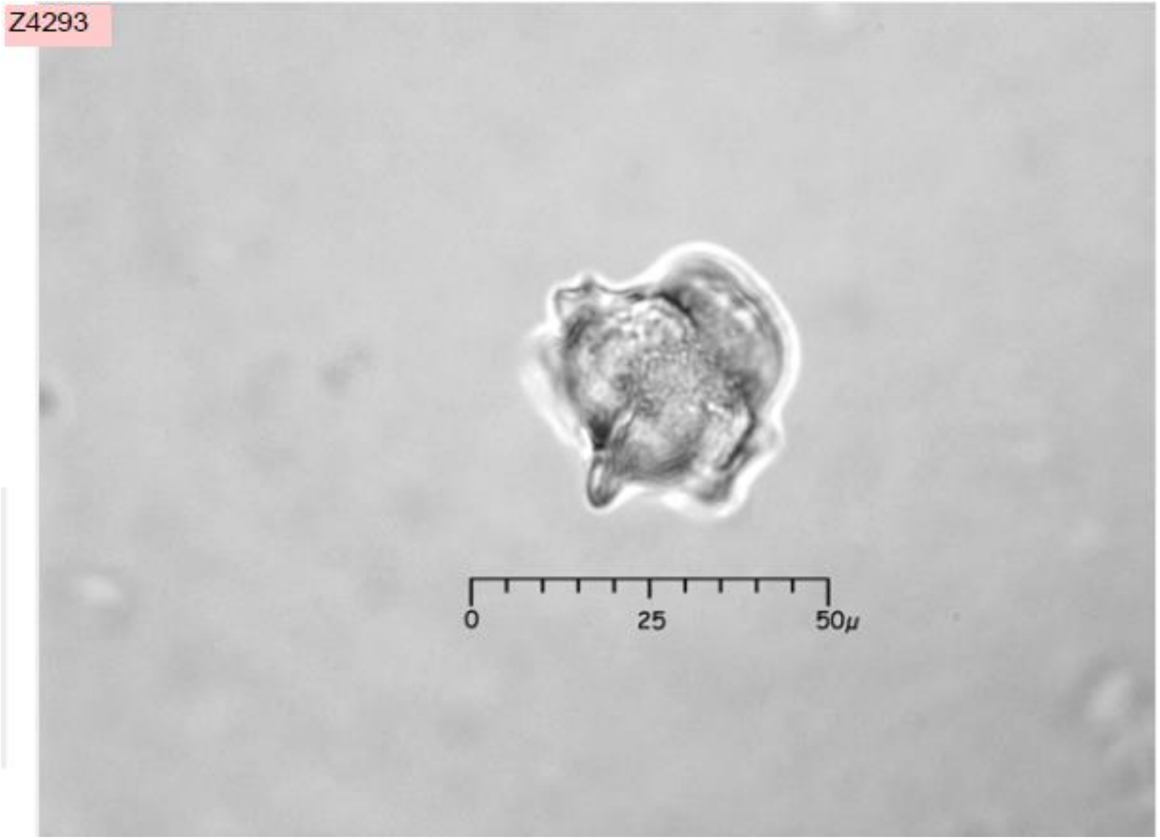


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

PC2038, inflorescence
Diagnostic level: species
View is of partially rotated body

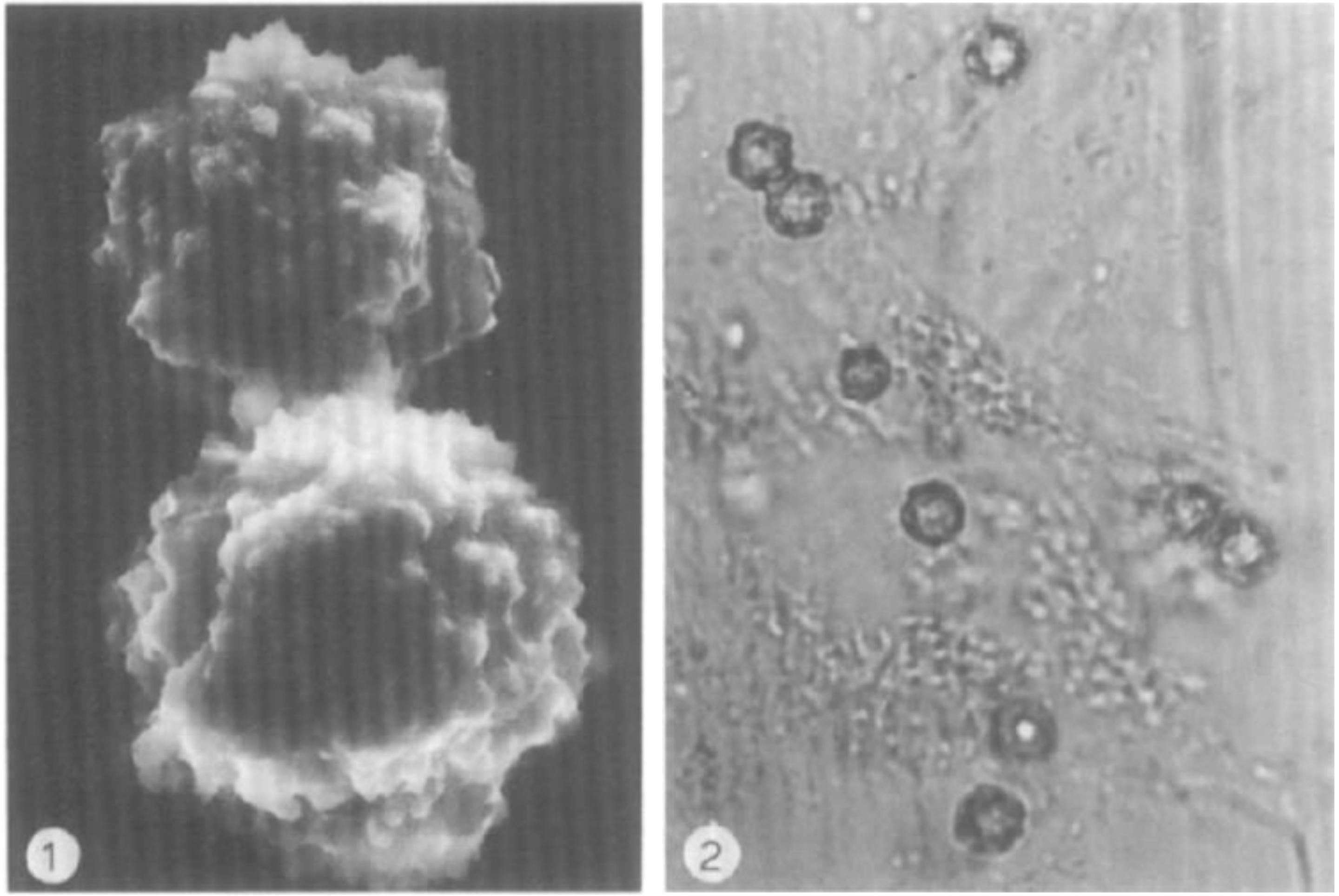


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta arundinacea

Phytolith

1. SEM photograph of spherical, nodular phytoliths from Maranta arundinacea (3000x).
2. Spherical, rugulose phytoliths from Maranta arundinacea (200x).

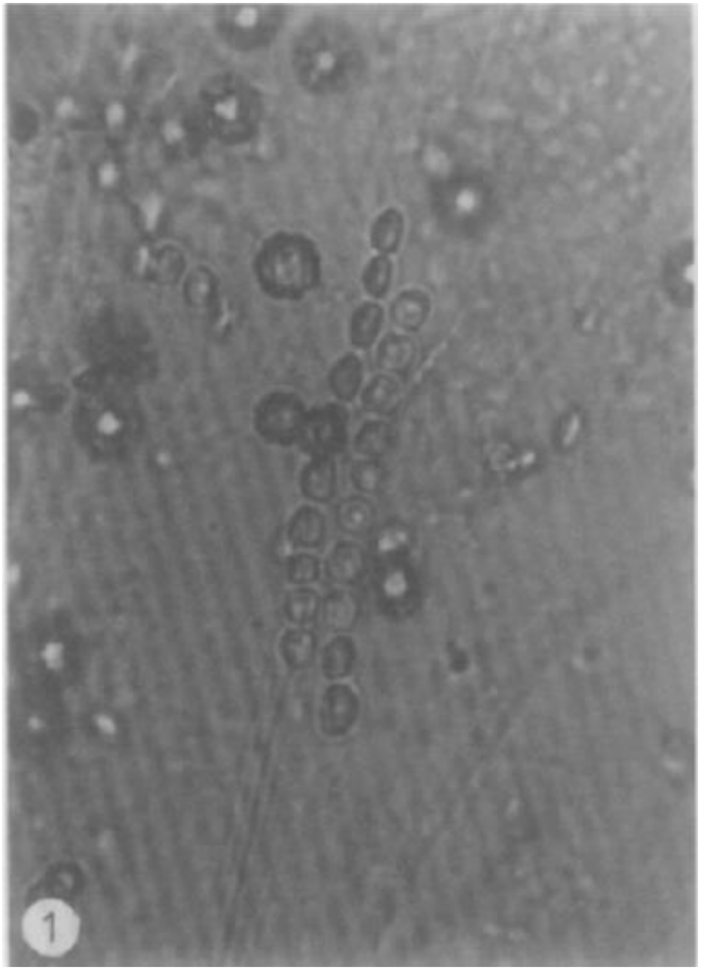


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Maranta arundinacea

Phytolith

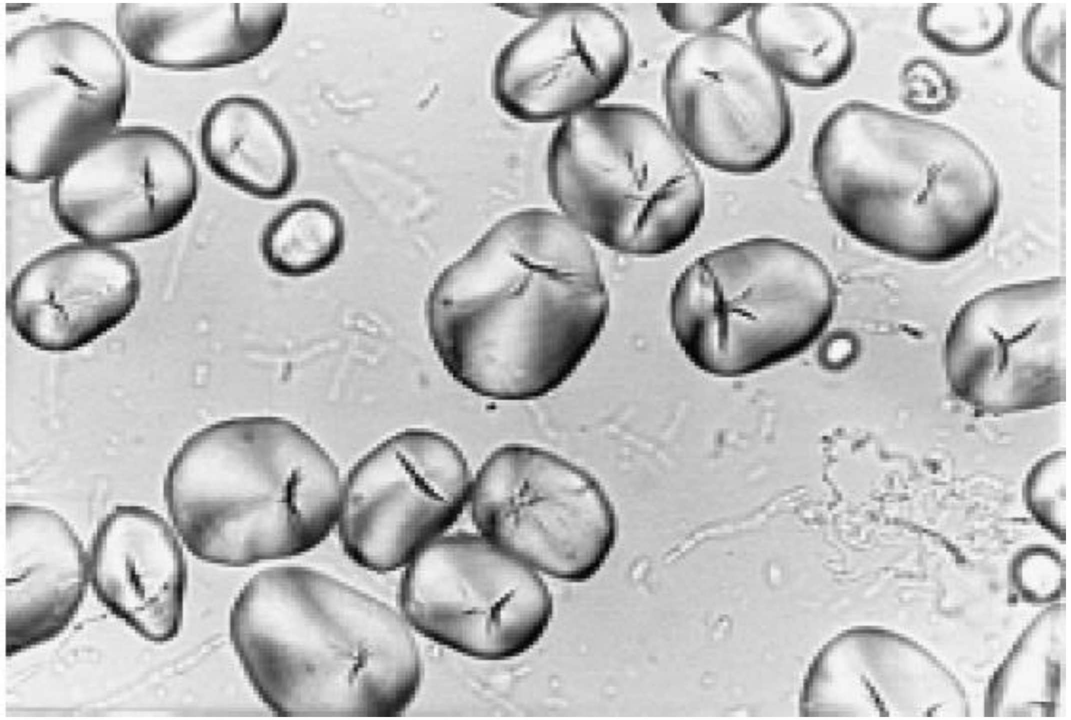
1. Center, two rows of hat-shaped phytoliths from Maranta arundinacea (200×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Maranta arundinacea

Starch



Starch grains from a modern tuber of arrowroot. 80x

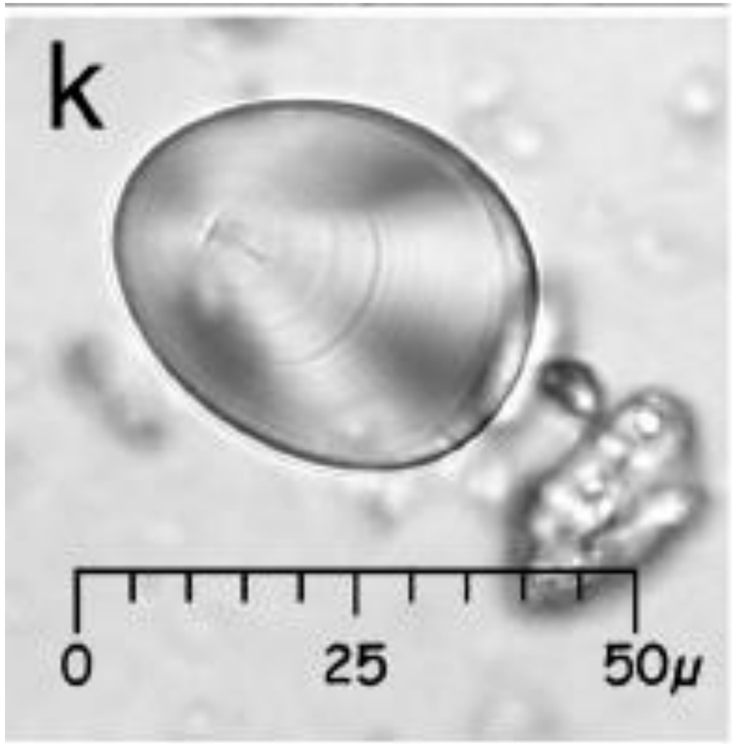
APPENDIX:
Maranta arundinacea (arrowroot) (Figure 5). Simple, oval grains, with one or two indentations, laminated. The hilum is eccentric and often has one fissure or a y fissure placed on the proximal edge of the grain. Size: 10–50 microns long

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Maranta arundinacea

Starch

Fig. 5. Selected phytoliths and starch granules recovered from tools. See MU Phytolith website (http://www. missouri.edu/~phyto) for other photographs. k. Maranta arundinacea starch granule, SS42 FS3294-B

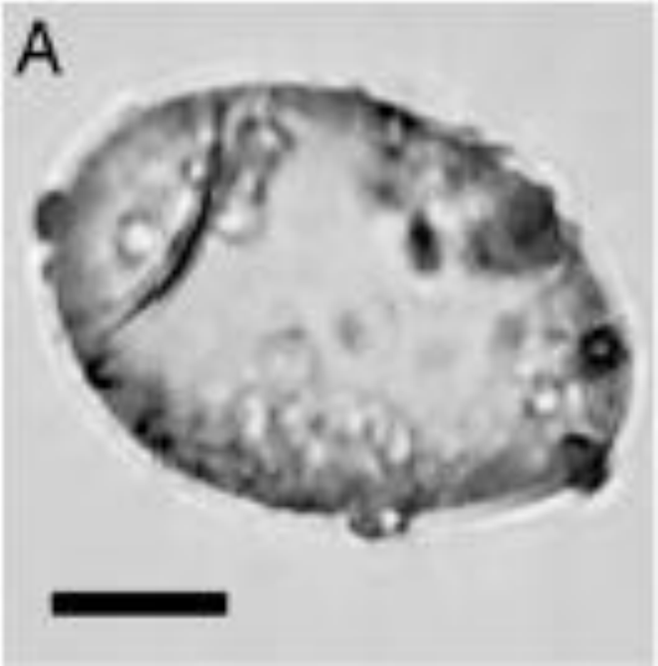


Chandler-Ezell, Karol, Deborah Marie Pearsall, and James A. Zeidler. 2006. Root and Tuber Phytoliths and Starch Grains Document Manioc (Manihot Esculenta), Arrowroot (Maranta Arundinacea), and Llerén (Calathea Sp.) at the Real Alto Site, Ecuador. *Economic Botany* 60 (2):103–20. http://www.bioone.org/doi/abs/10.1663/0013-0001(2006)60%5B103:RATPAS%5D2.0.CO%3B2.

Maranta arundinacea

Starch

Fig. 2. Selected archaeological starch grains. (A) Arrowroot (Maranta arundinacea) starch from Casita de Piedra, flakeknife 101/15,?7400cal BP. (Scale bar: 10 µm) Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8.

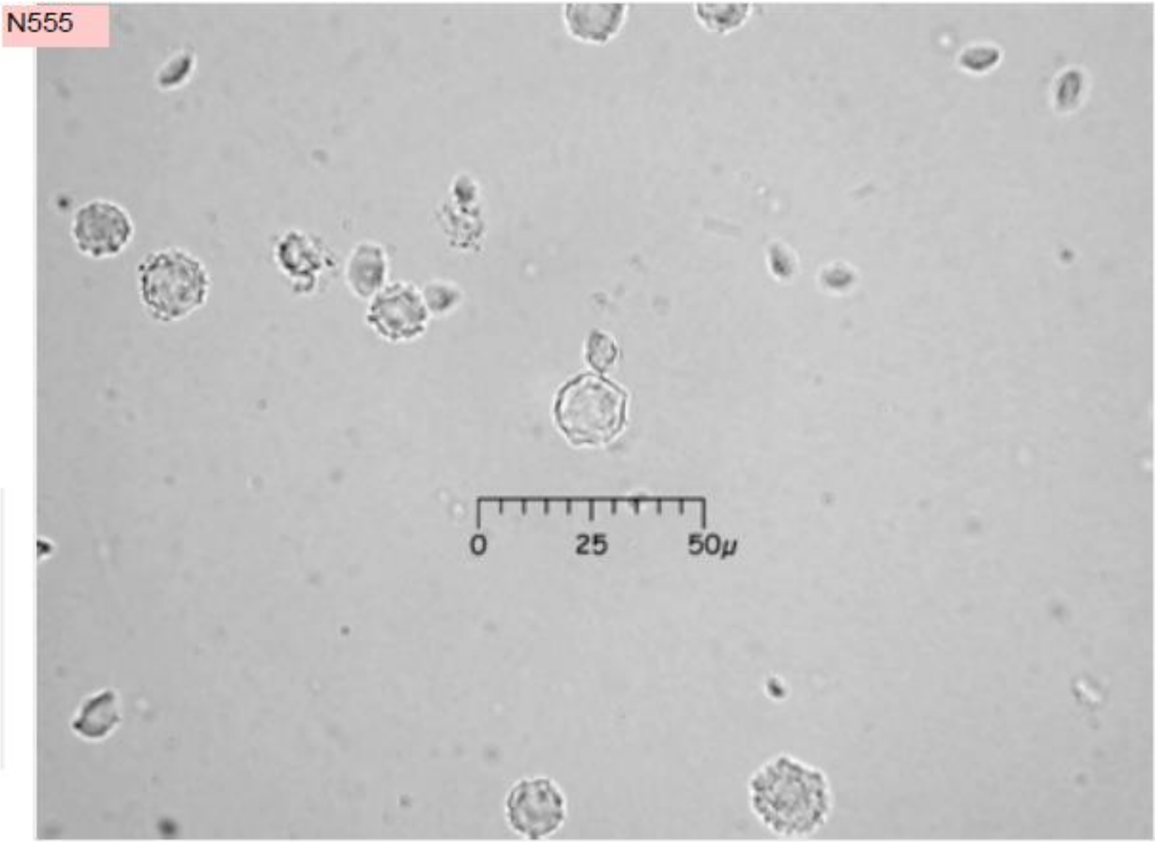


Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Maranta gibba

Phytolith

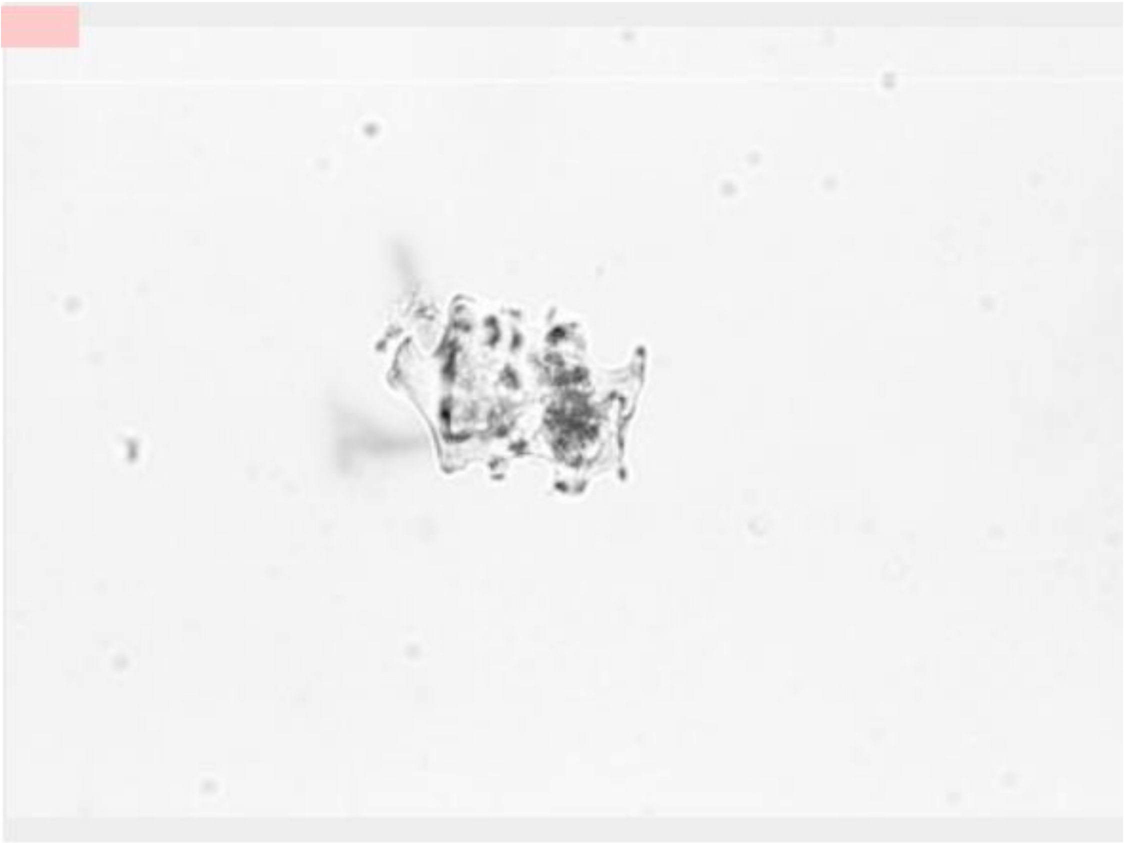
Large (10-30 microns) rugulose spheres. Rugulose spheres occur in many taxa, very common in Marantaceae, Bombacaceae, Cannaceae, Heliconiaceae, and Chrysobalanaceae. Small rugulose spheres (< 10 microns) that are well silicified (i.e., opaque) are, according to Iriarte and Piperno, characteristic of woody dicots. Large spheres (10-30



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

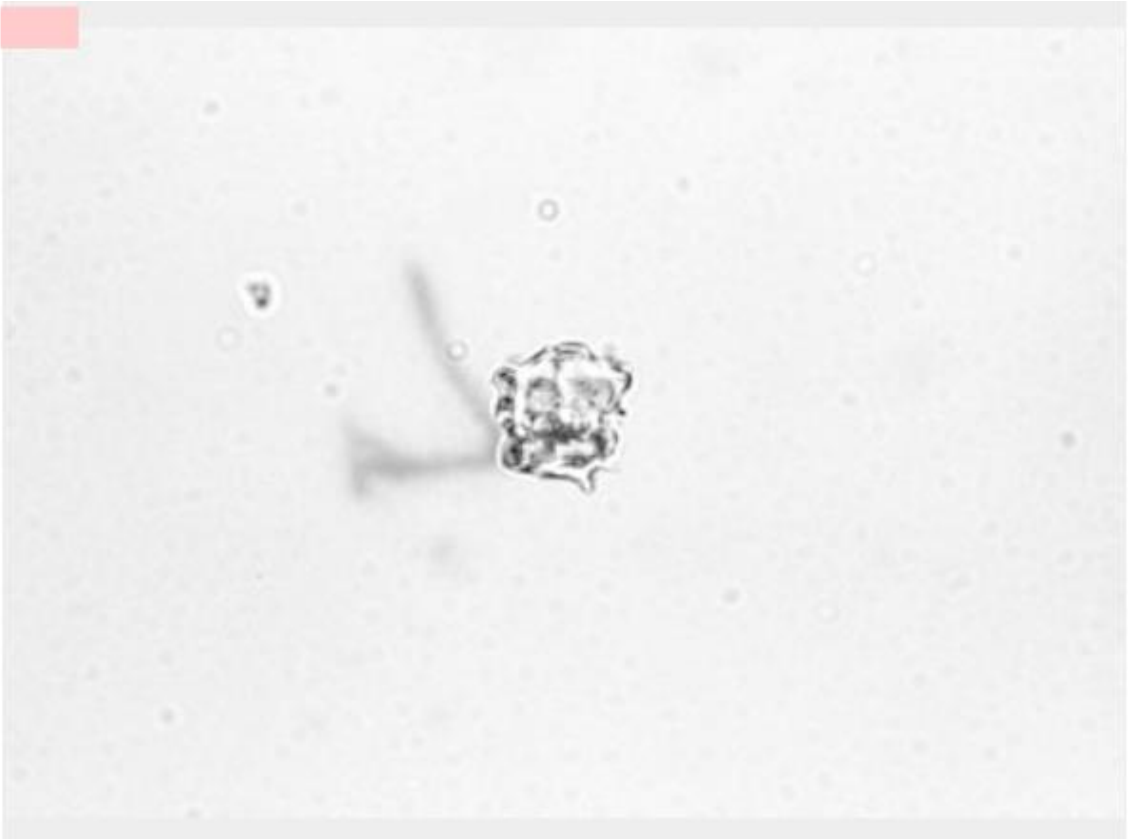


Maranta spp. inflorescense body,
Diameter of central cylinder is
37microns wide
Note: may occur in all Maranta spp.,
including Maranta arundinacea
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

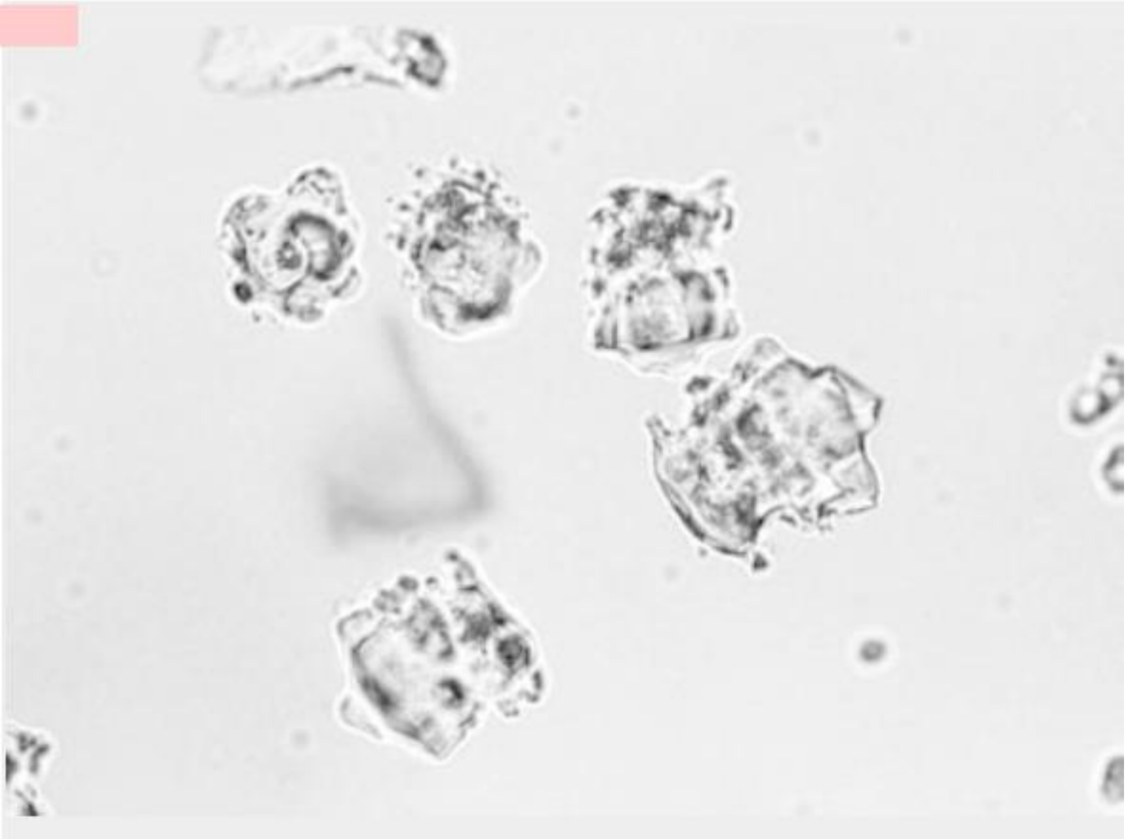


Small, “incomplete” seed body. Note absence of “tip” or “stalk” typical of the body...only a tiny or vestigial stalk at bottom of body.
This photo is to illustrate the extreme end of the type.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith



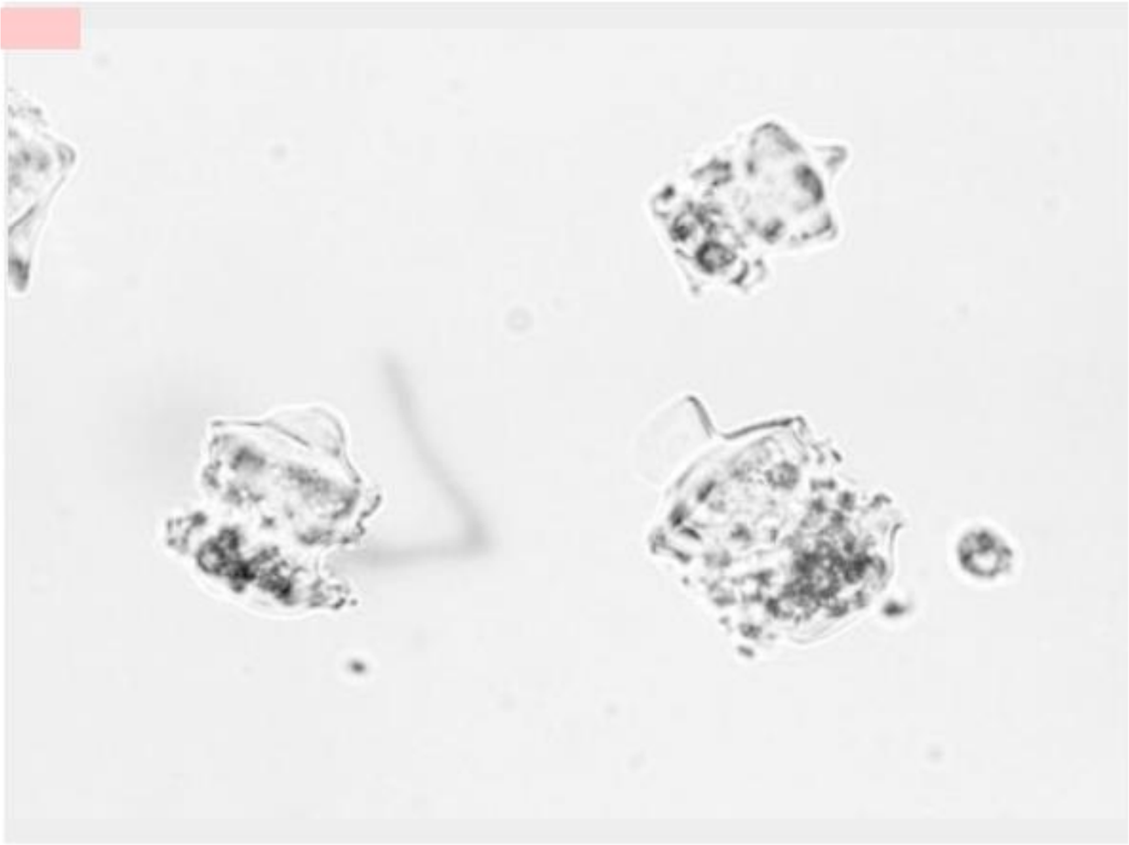
Size range in length: 25 - 55 microns
Note: may occur in all Maranta spp., including Maranta arundinacea
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

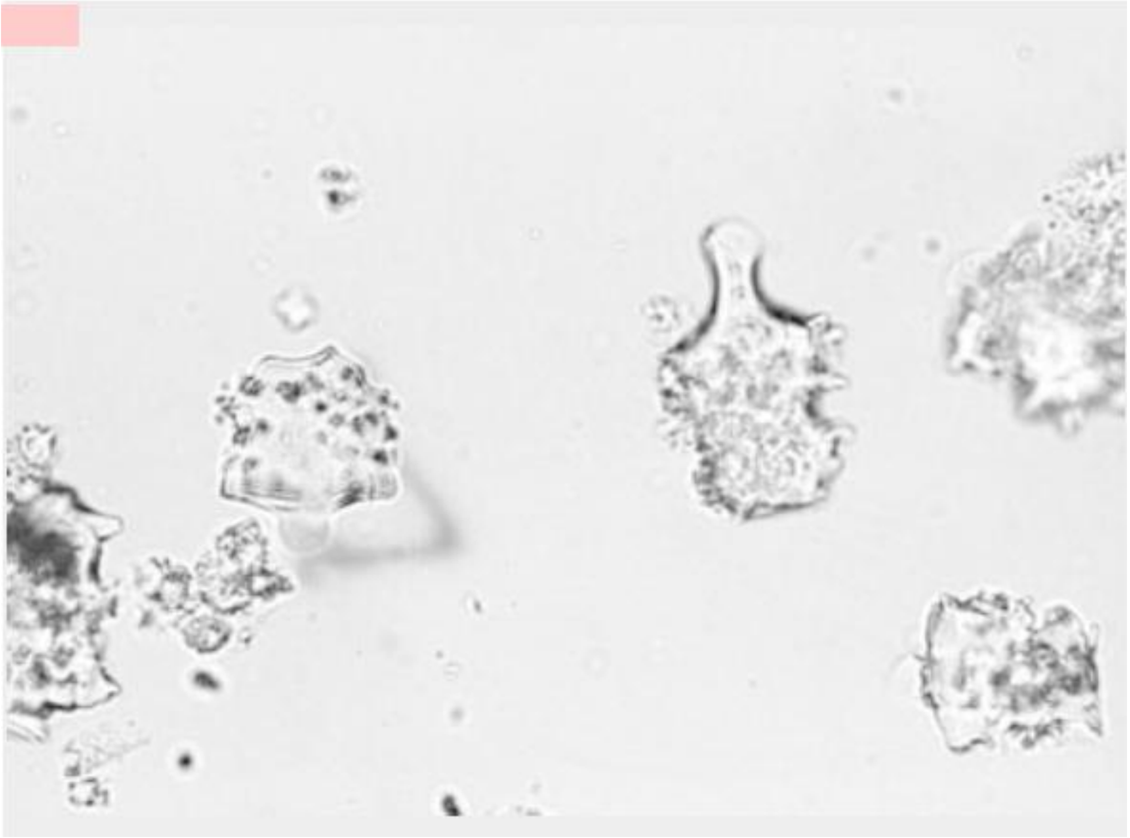
Note smooth stalks on wide tips of bodies. Cylinders are covered in projections and surface decoration. Note: may occur in all Maranta spp., including Maranta arundinaceae NOTE: In some samples, you may see JUST the tip of the body -- 22VII Ca Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

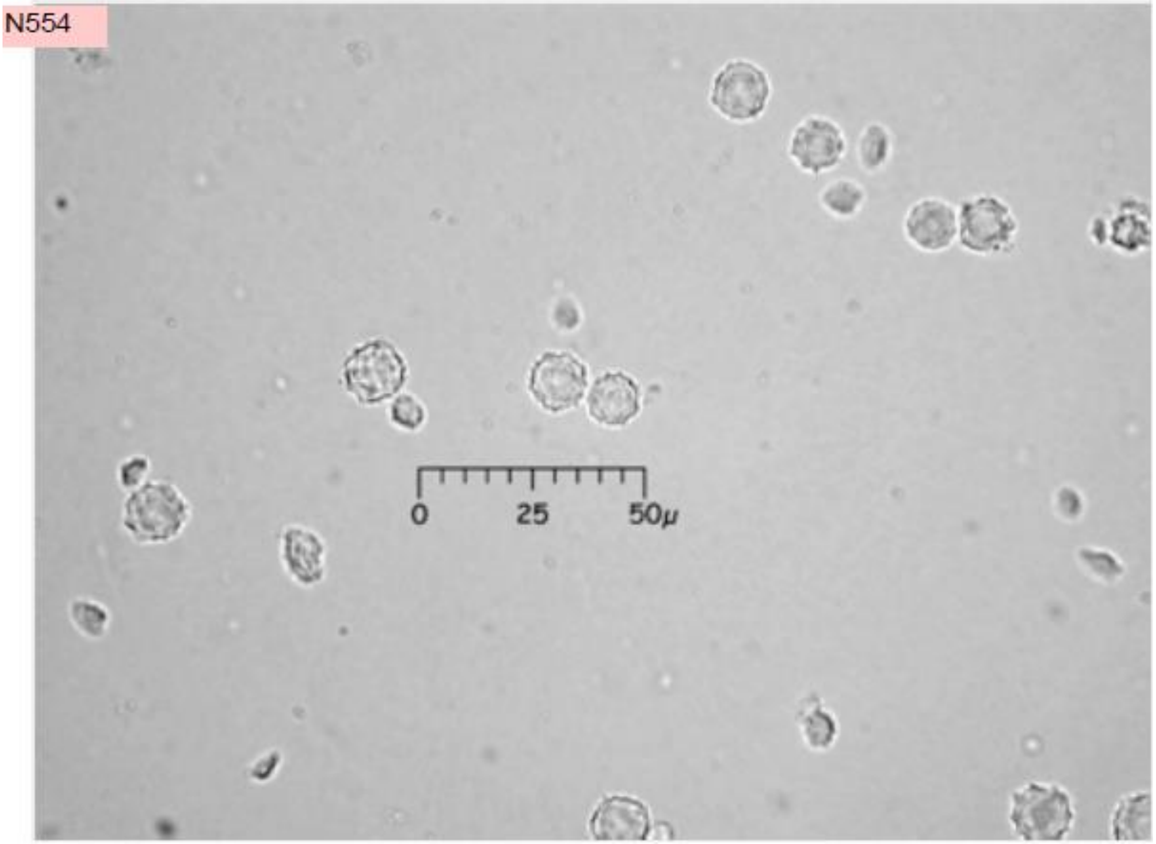


Note range of variaiton in size, nature of decoration on cylinders, and proportional length of bodies between bodies on the right and left.
Note: may occur in all Maranta spp., including Maranta arundinaceae Note: you may encounter the “tip” of the body only: see below
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith



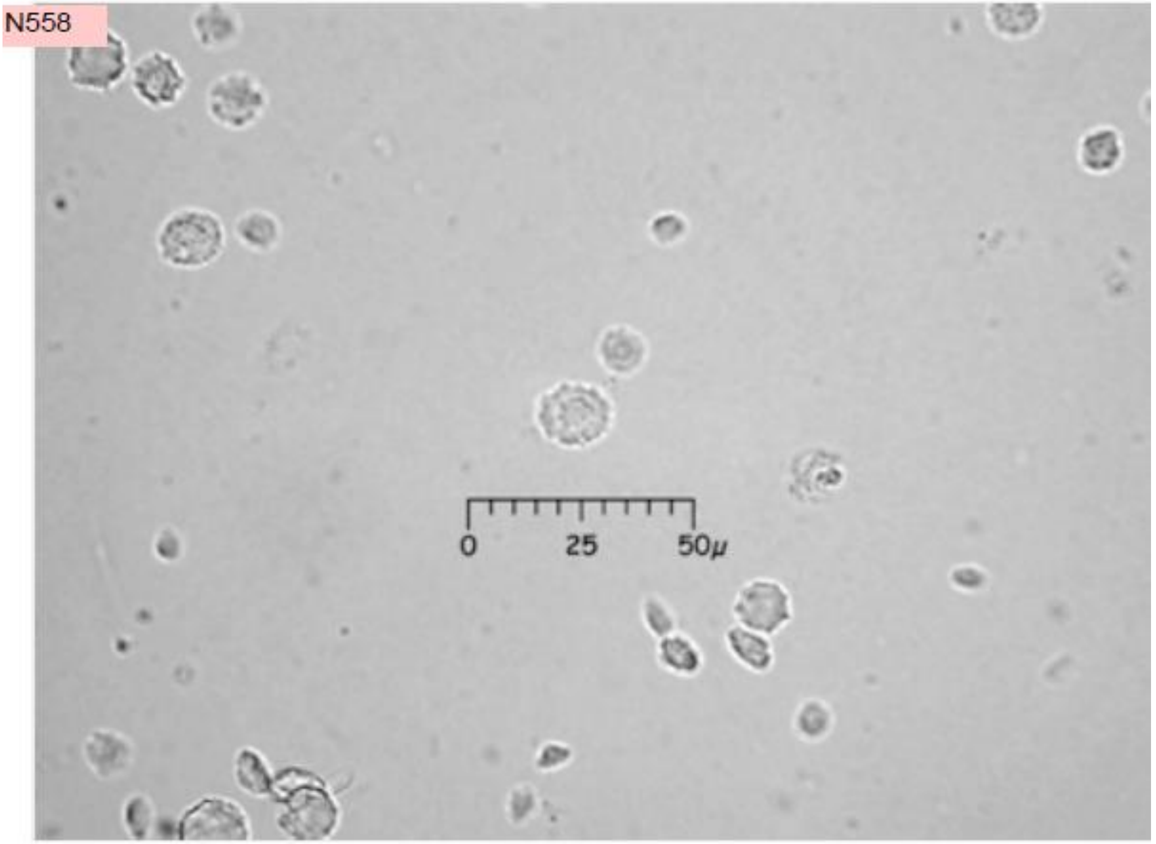
Typical of leaf samples, both 80IIIB and 80ICa also appeared in the inflorescense sample of this taxon.
Diagnostic level, 80IIIB: family
Diagnostic level, 80ICa: Marantaceae/Bombacaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

rugulose conical bodies, Leaf sample
Diagnostic level: family

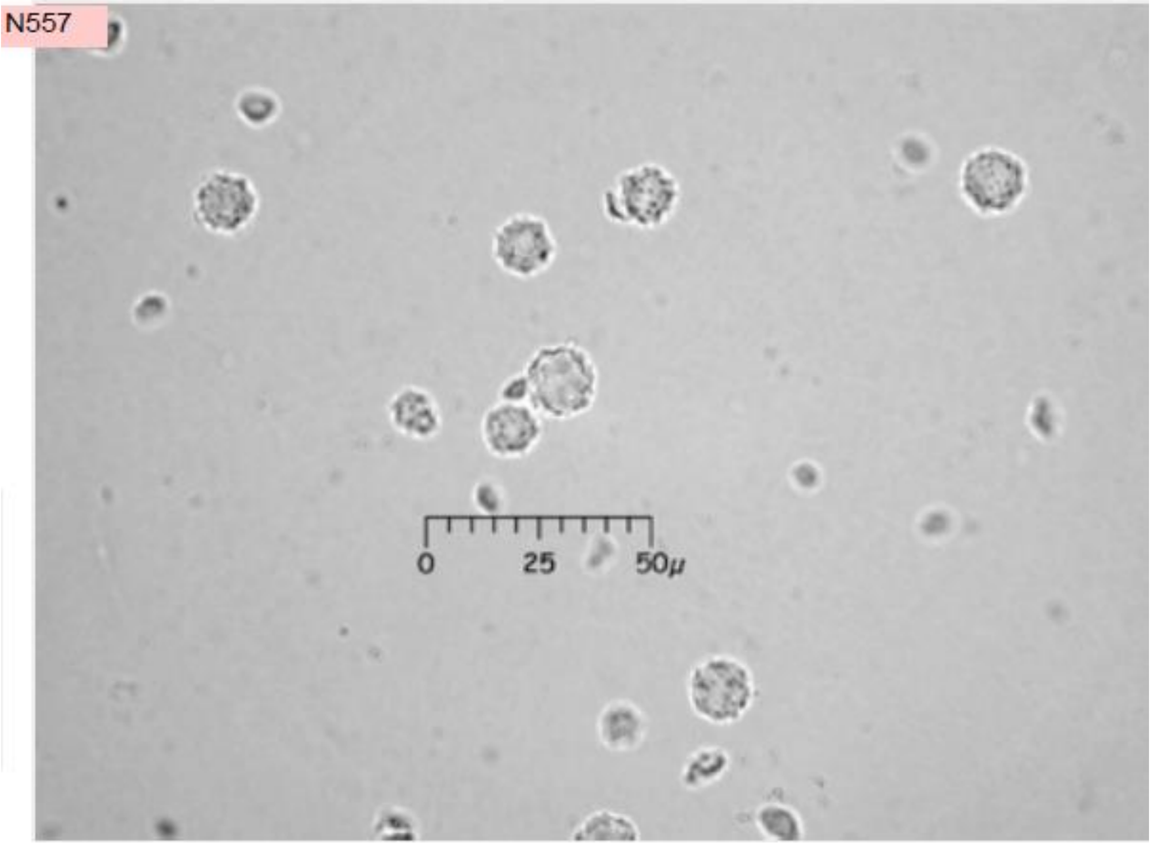


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

Very elongate end of range for this type. Nodular spheres
Diagnostic level:
Marantaceae/Bombacaceae

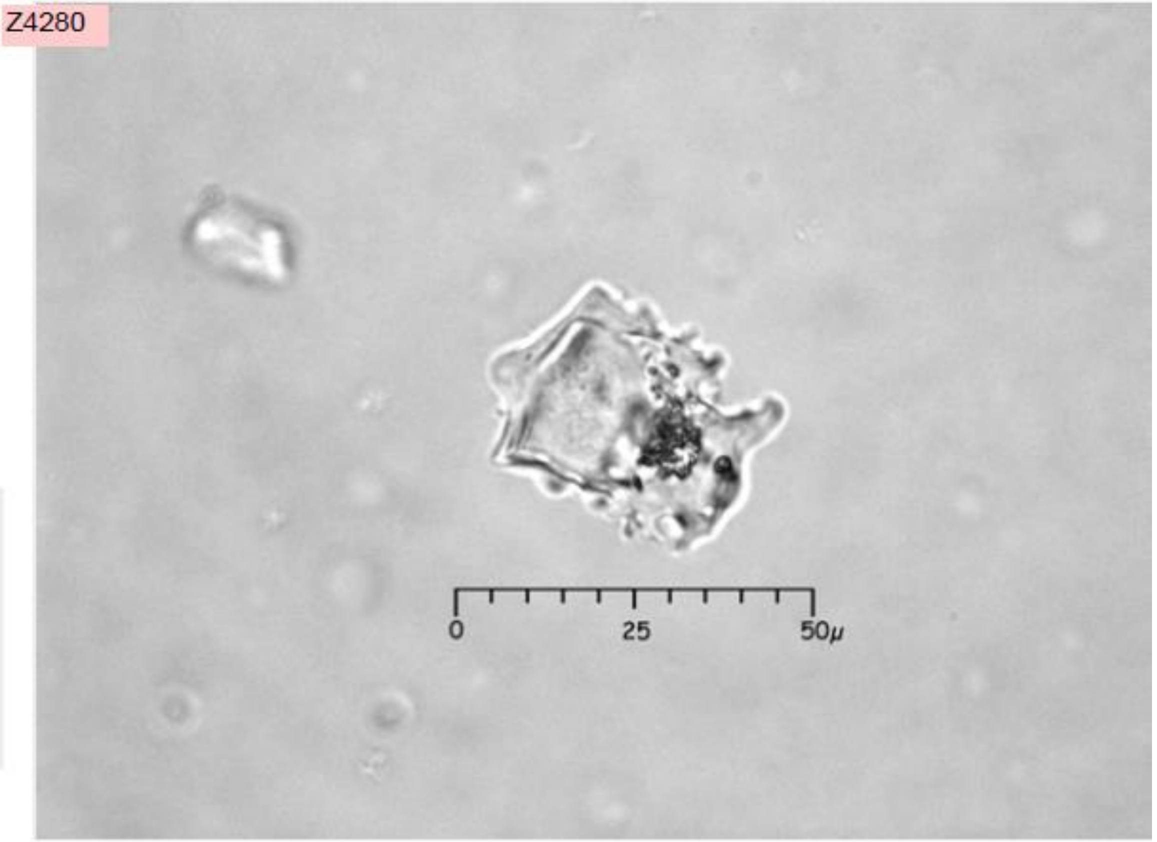


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

PC2036, inflorescence
Diagnostic level: genus

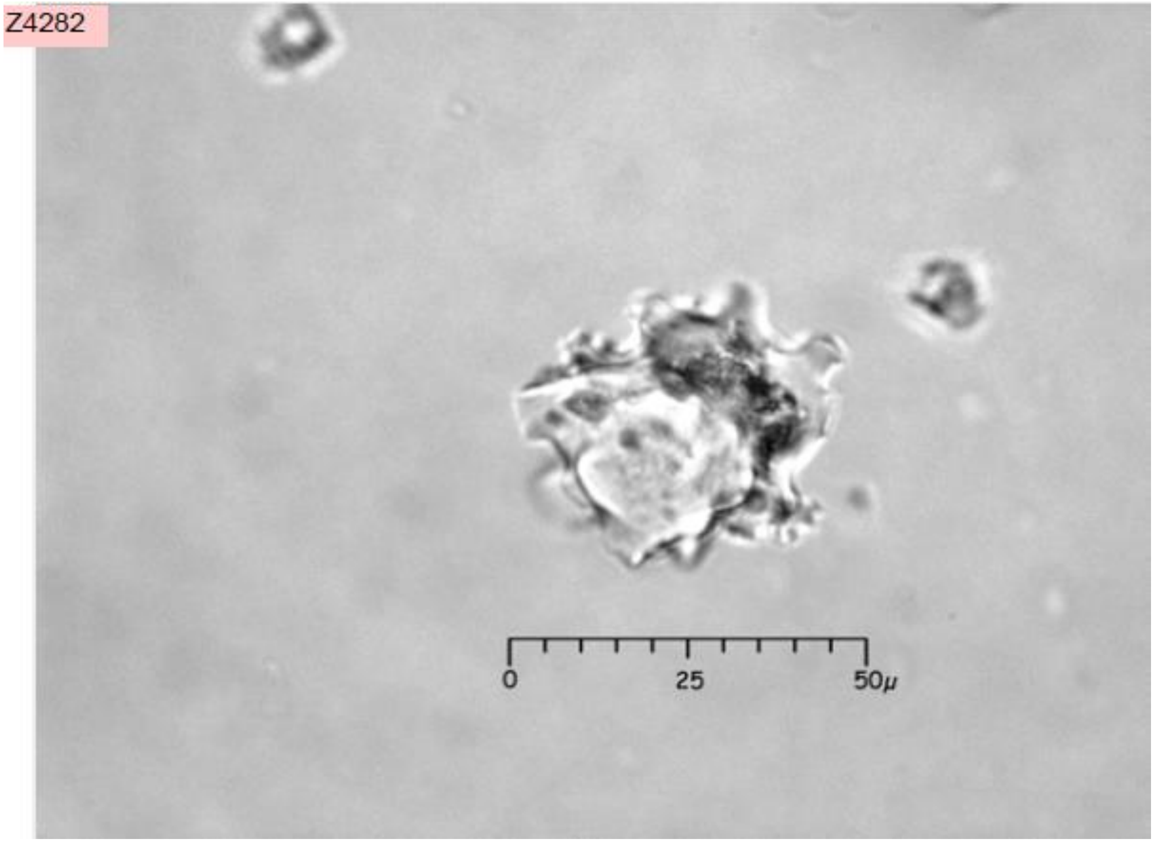


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

PC2036, inflorescence
Diagnostic level: genus
View shows the large irregular scallops

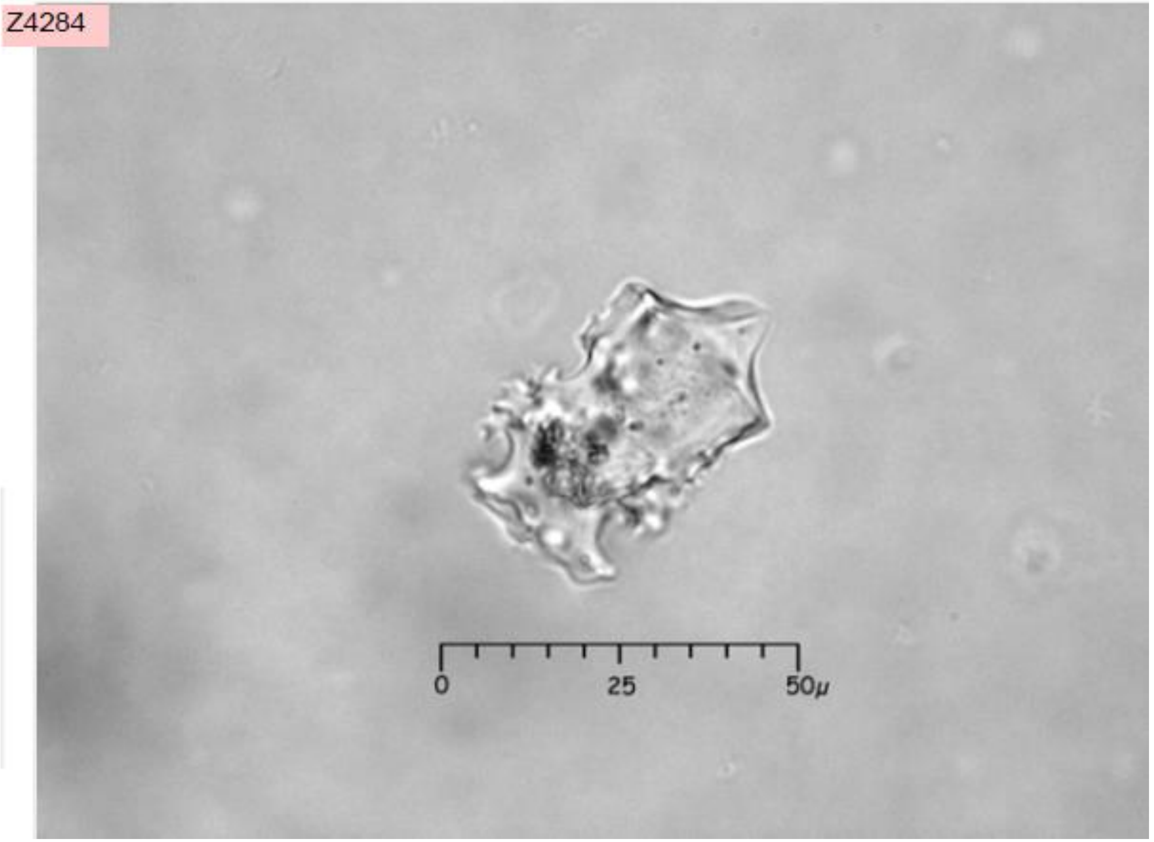


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

PC2036, inflorescence
Diagnostic level: genus

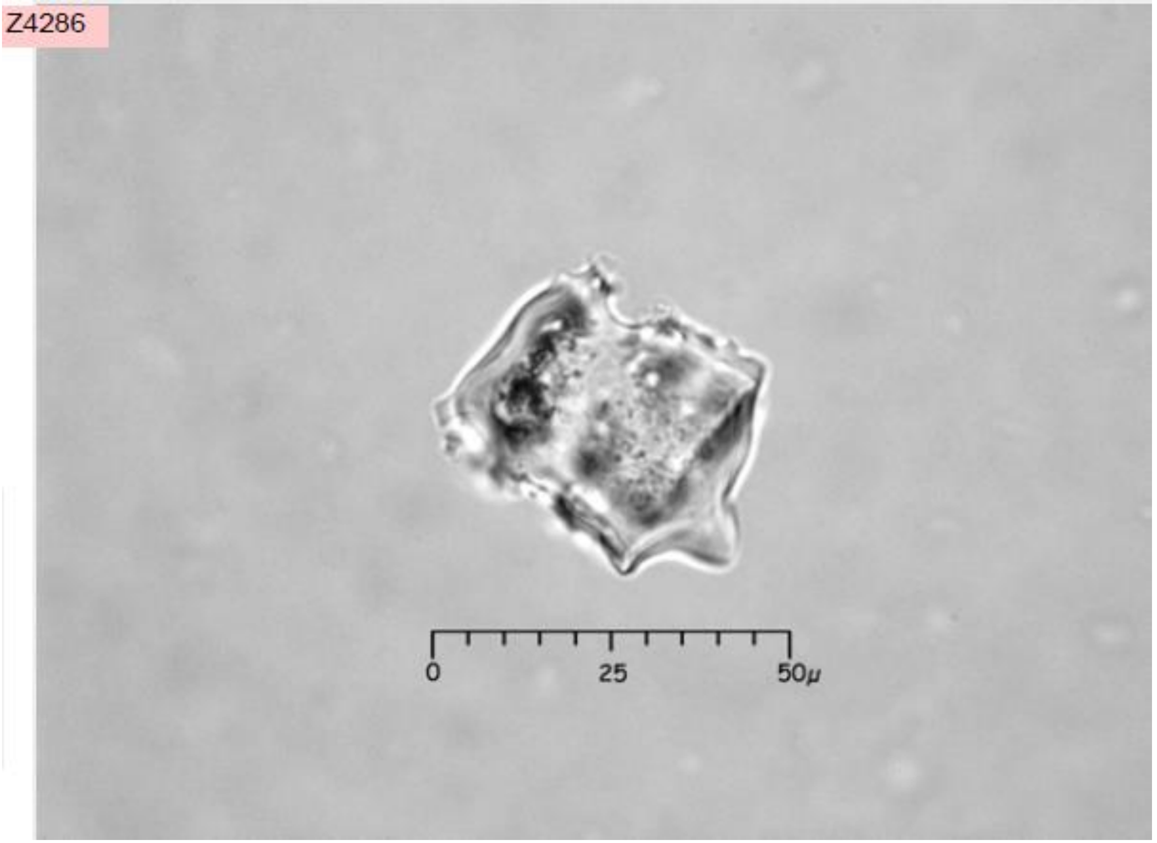


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

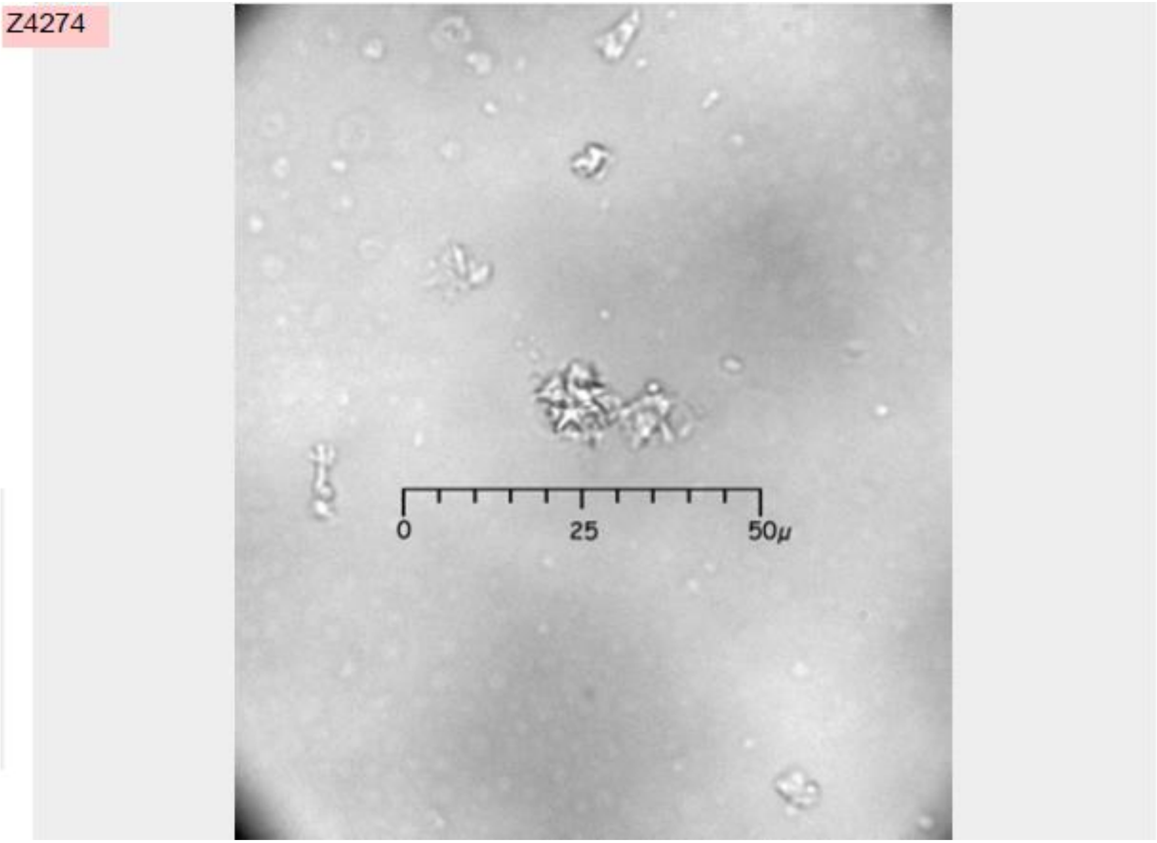
PC2036, inflorescence
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith



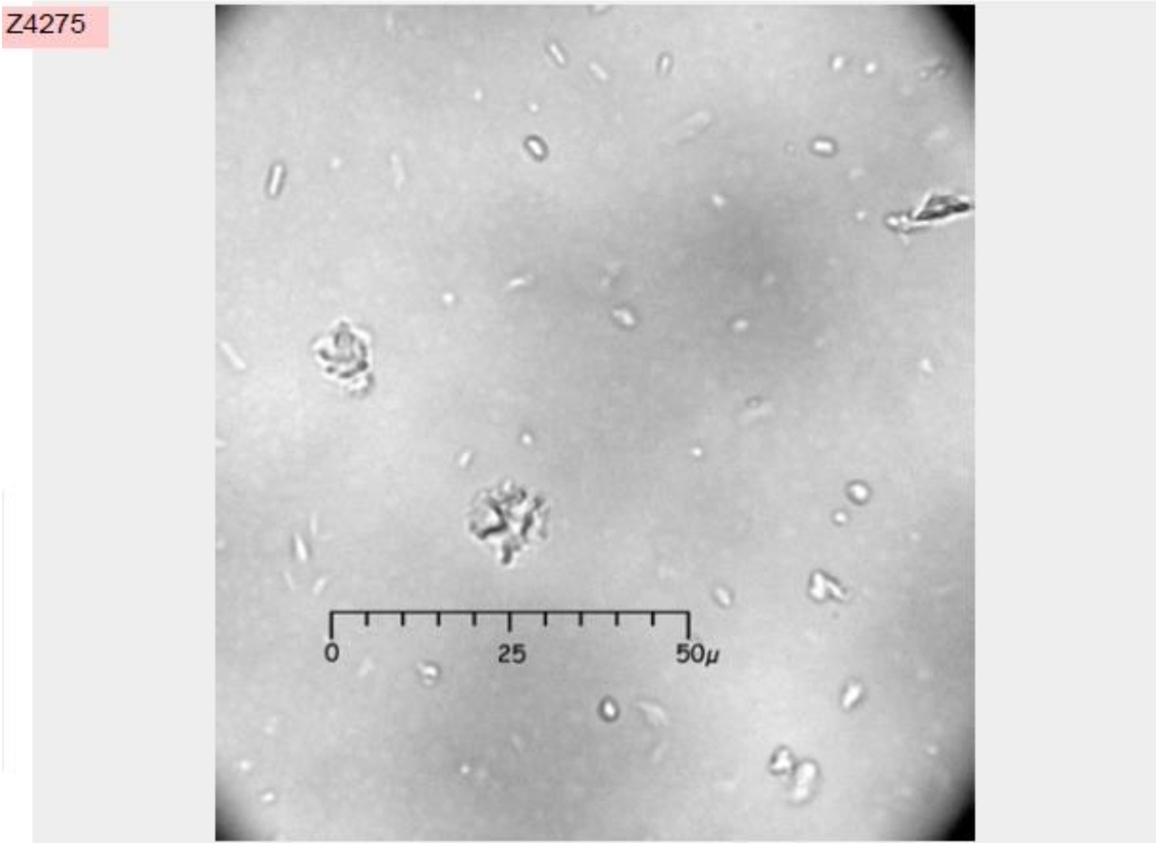
type established by Karol Chandler-Ezell
PC2732 Maranta gibba stem base
Diagnostic level: Calathea/Maranta

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Maranta gibba

Phytolith

type established by Karol Chandler-Ezell
PC2732 Maranta gibba stem base
Diagnostic level: Calathea/Maranta

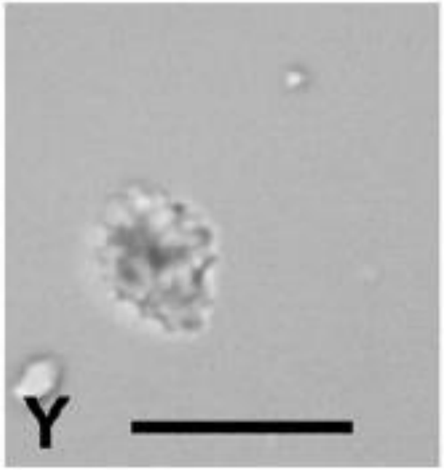


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Marantochloa hirsuta

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). Y, thin rugose hat-shape from Marantochloa hirsuta leaf+stem. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Marantochloa purpurea

Phytolith

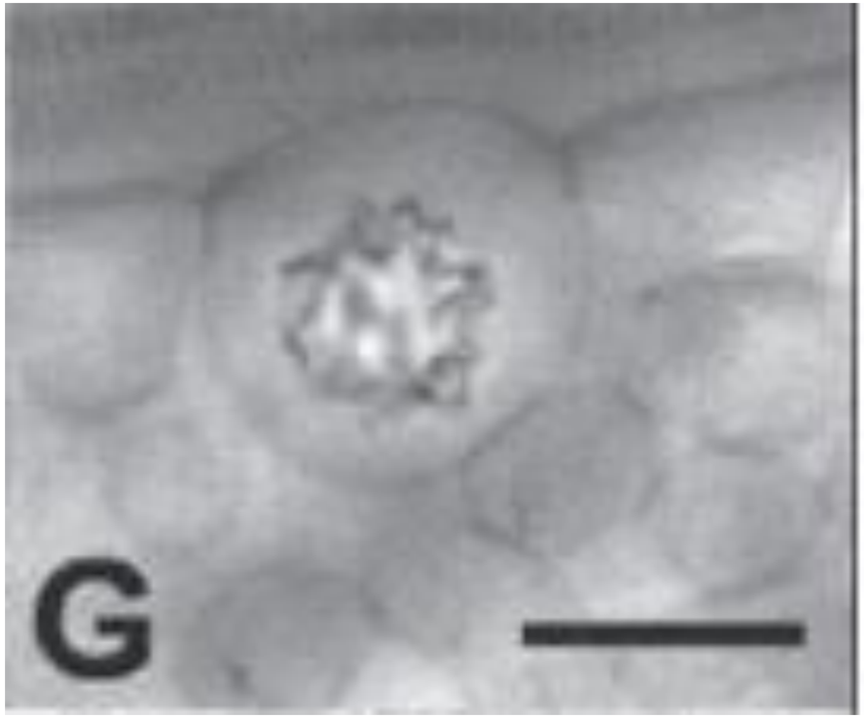


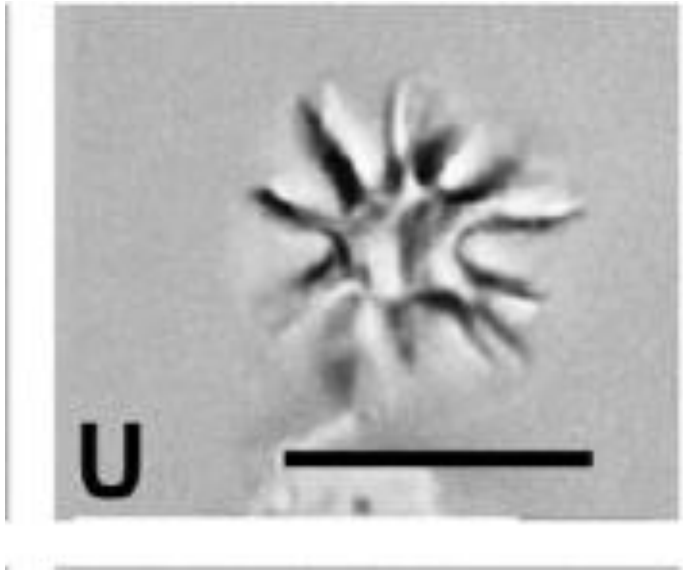
Fig. 3. Various silica body morphologies found in the order Zingiberales. G. Marantochloa purpurea (Marantaceae), a druse-like intercostal silica body in a mesophyll cell (bar = 20 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Megaphrynium macrostachyum

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). U, globular-echinate with thin, long echinae from Megaphrynium macrostachyum leaf. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Myrosma sp.

Starch

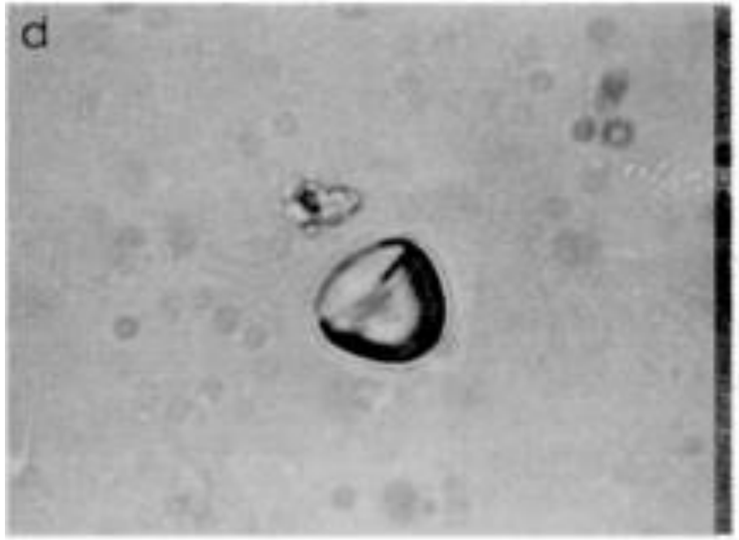


Figure 3. Light micrographs of archaeological starch granules representative of the recovered assemblage. d: Starch granule of Myrosma sp. recovered from flake 3.

Perry, Linda. 2002. Starch Analyses Reveal Multiple Functions of quartz “manioc” Grater Flakes from the Orinoco Basin, Venezuela. *Interciencia* 27 (11):635–39.

Pleiostachya pruinosa

Phytolith

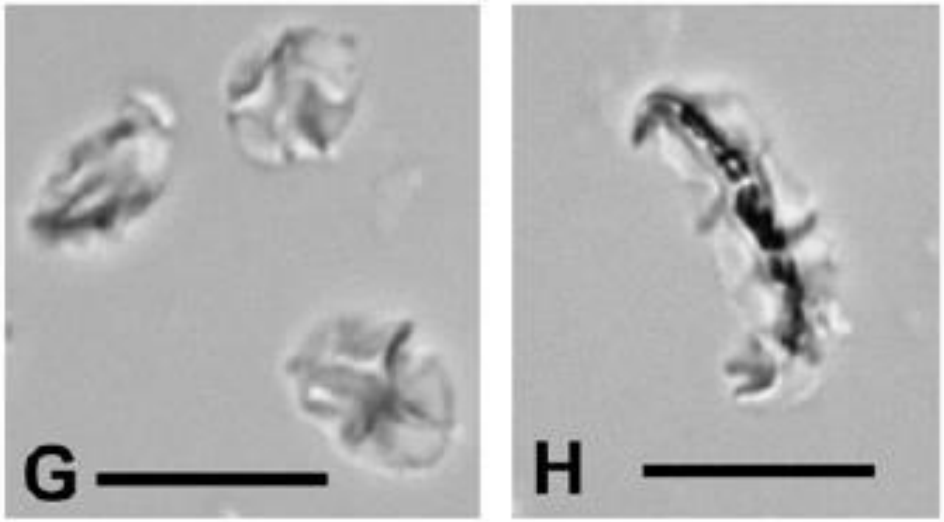


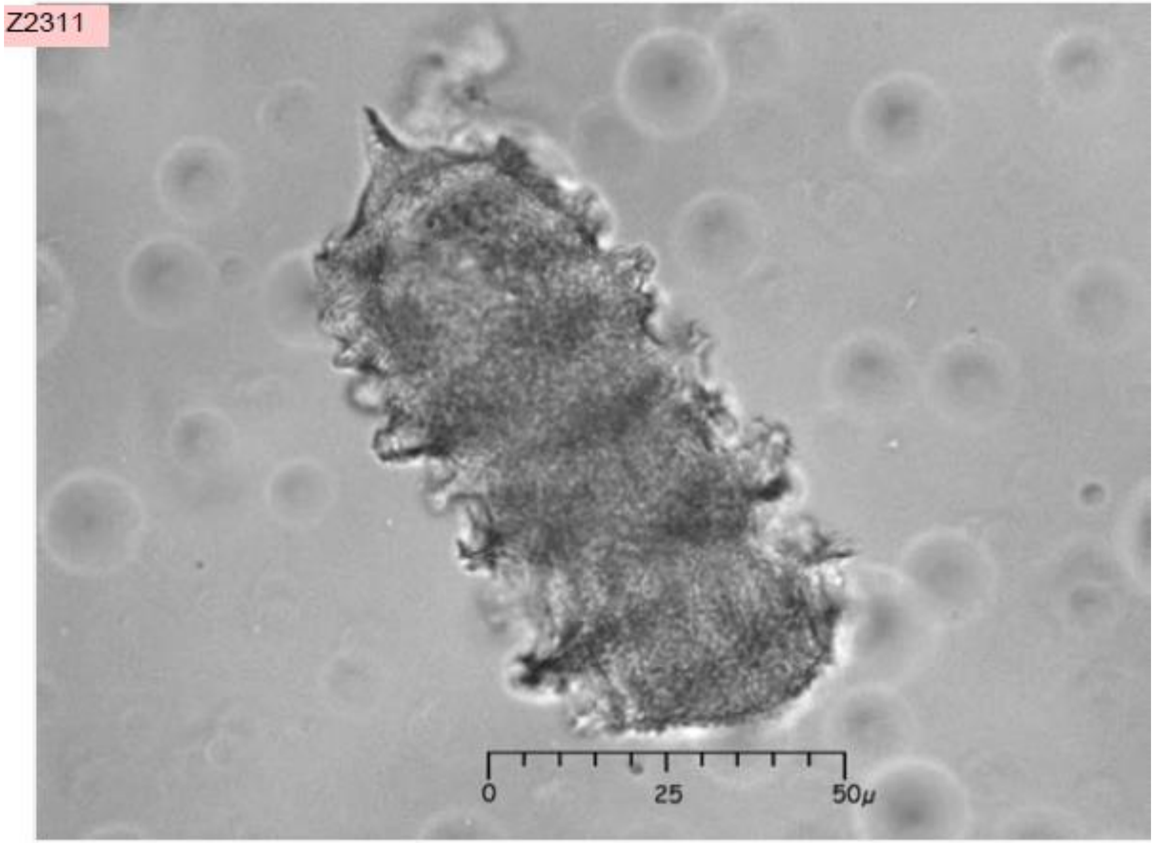
Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). G, D1 fringed druses from Pleiostachya pruinosa leaf. H, D3 druse with an elongate axis and three main ridges in cross section from Pleiostachya pruniosa leaf. Scale bars=12 µm.

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Pleistochya morlaei

Phytolith

PC1826 inflorescence
Diagnostic level: family

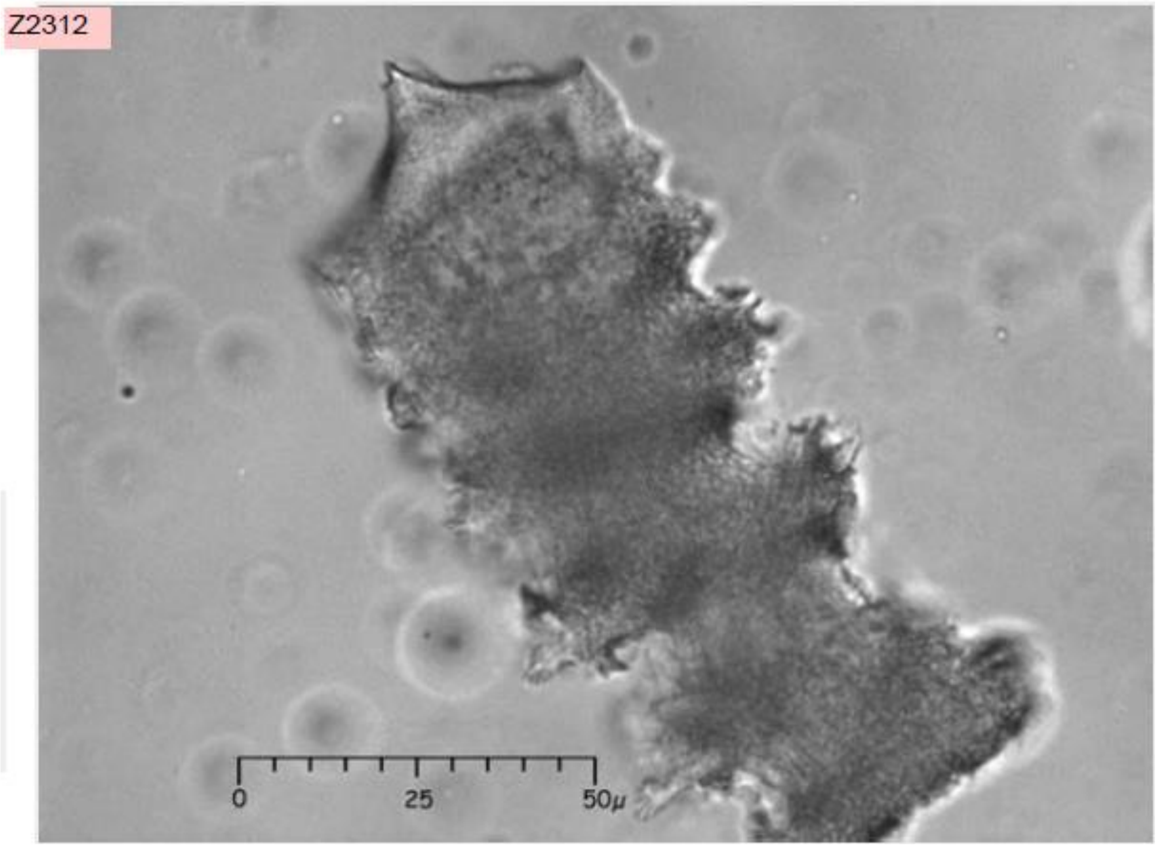


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleistochya morlaei

Phytolith

PC1826 inflorescence
Diagnostic level: family

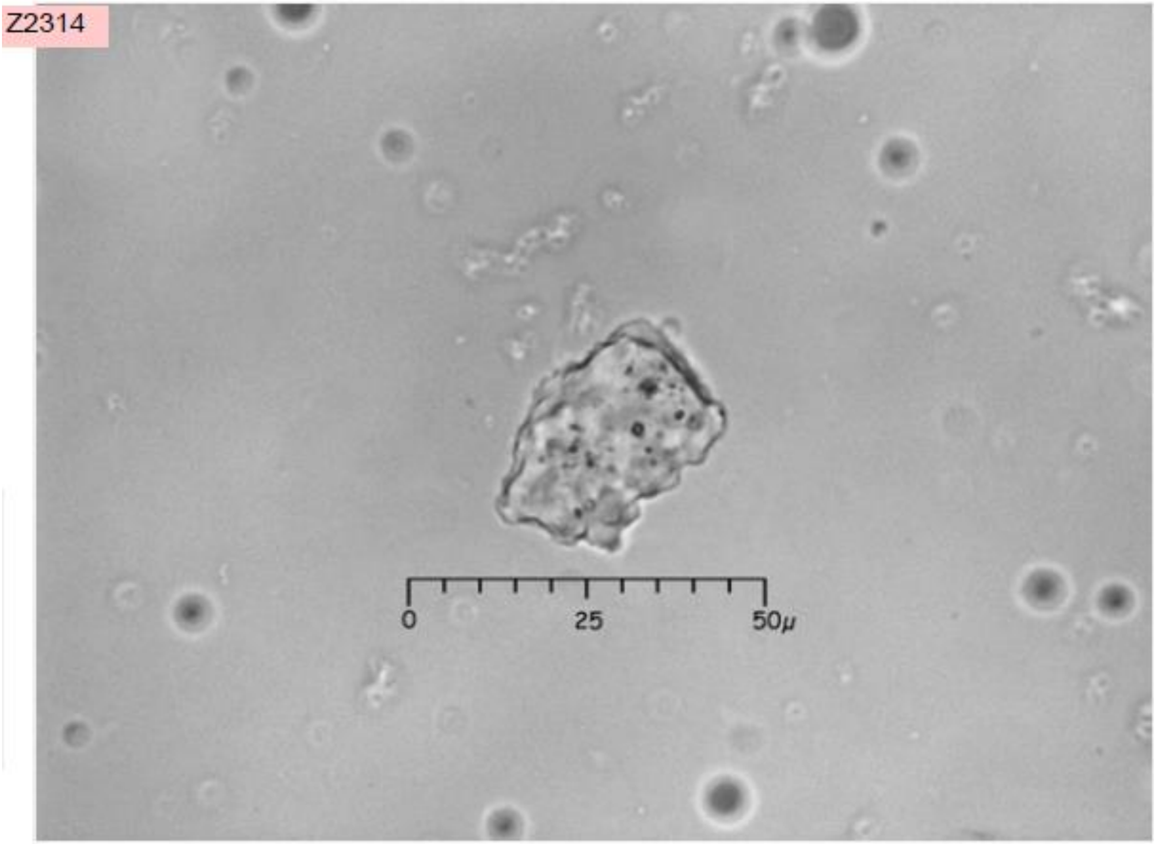


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleistochya morlaei

Phytolith

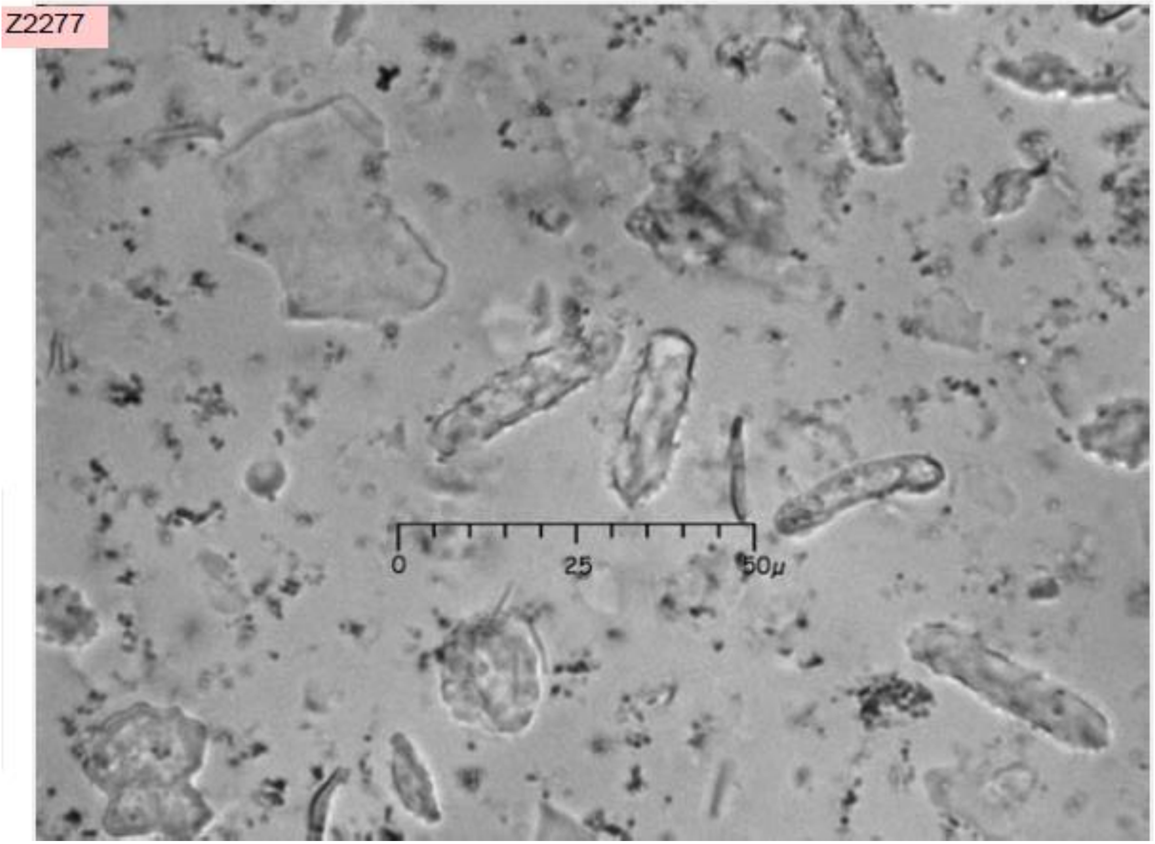
PC1826, inflorescence
Diagnostic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Pleistochya morlaei

Phytolith



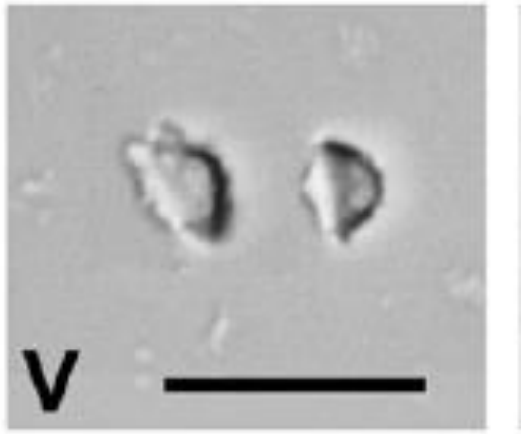
PC1825, leaf
In this specimen the bodies are smoother, and sometimes have small projections.
Diagnostic level: family

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Sarcophrynium sp.

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). V, psilate hat-shapes from Sarcophrynium sp. leaf. Scale bars=12 µm.

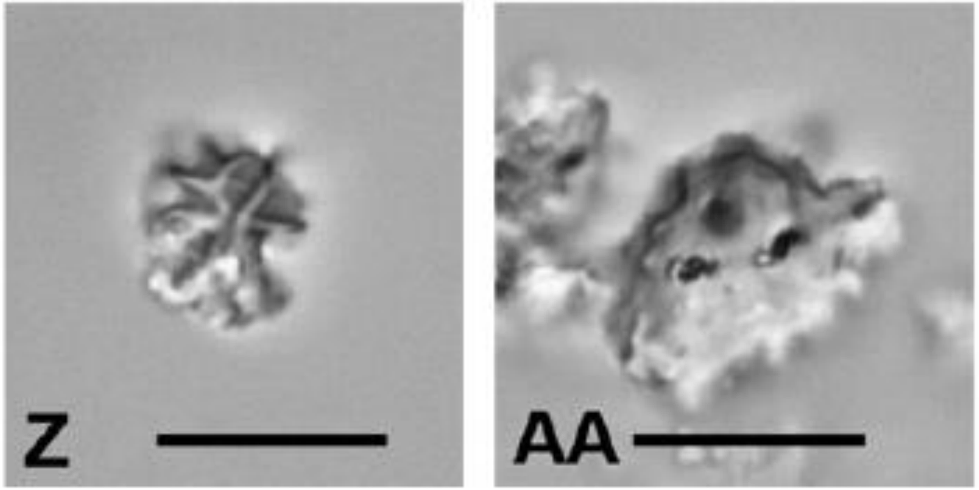


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Stachyphrynium sp.

Phytolith

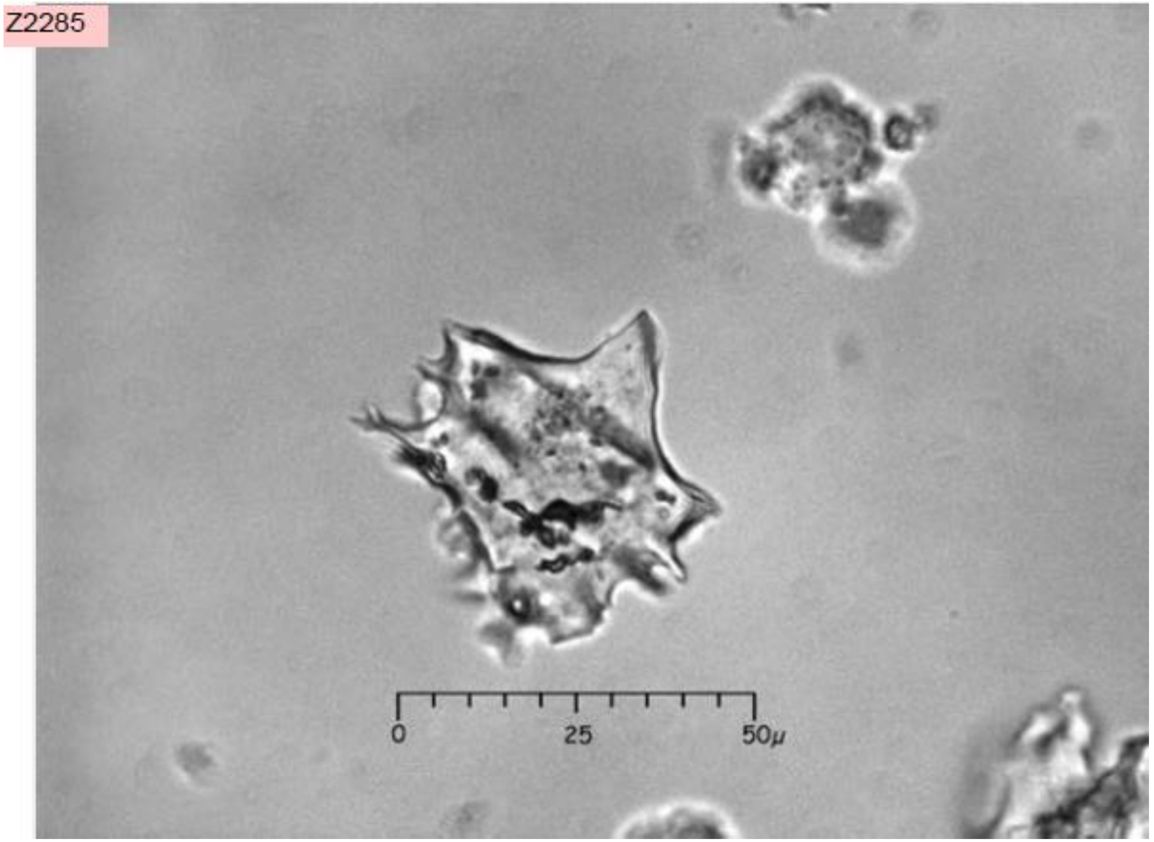
Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). Z, D1 fringed druse from Stachyphrynium sp. leaf. AA, large rugose hat-shape from Stachyphrynium sp. leaf. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Stromanthe jarquinii

Phytolith



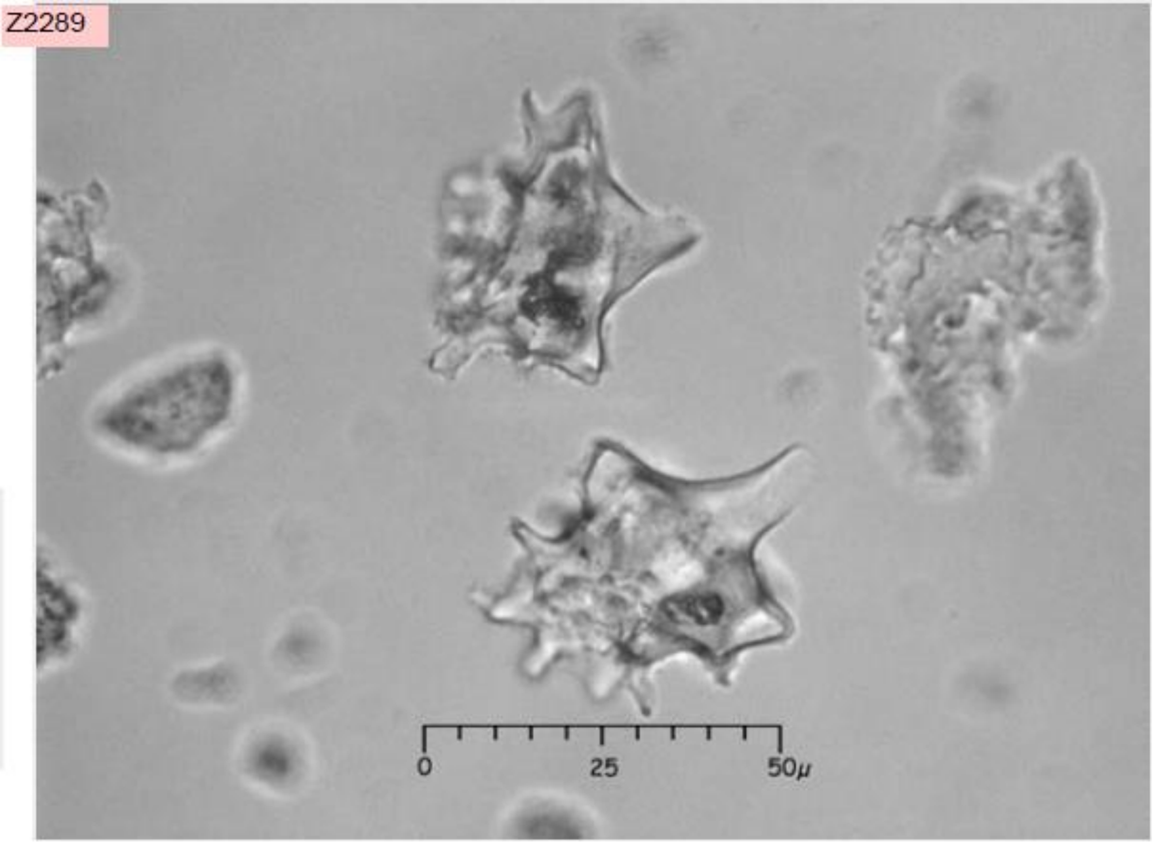
PC1822, inflorescence
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

PC1822, inflorescence
Diagnostic level: genus

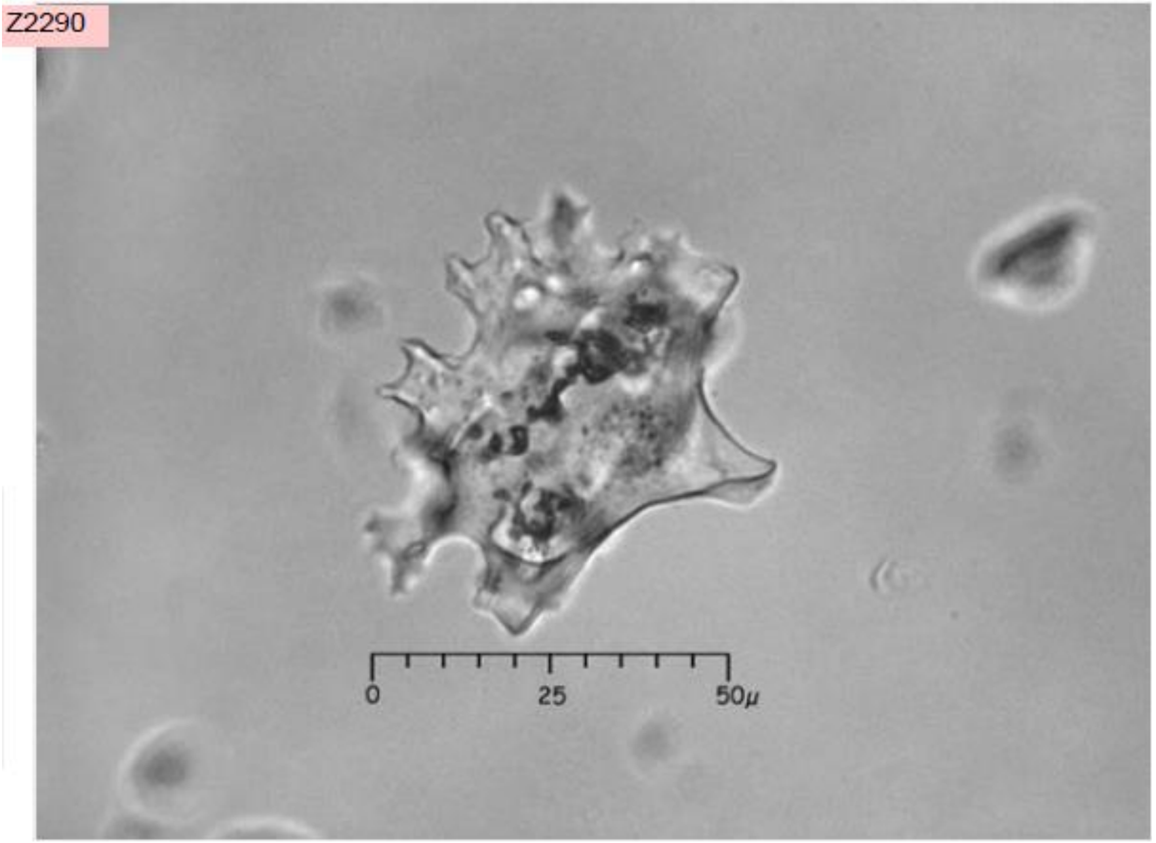


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

PC1822, inflorescence
Diagnostic level: genus

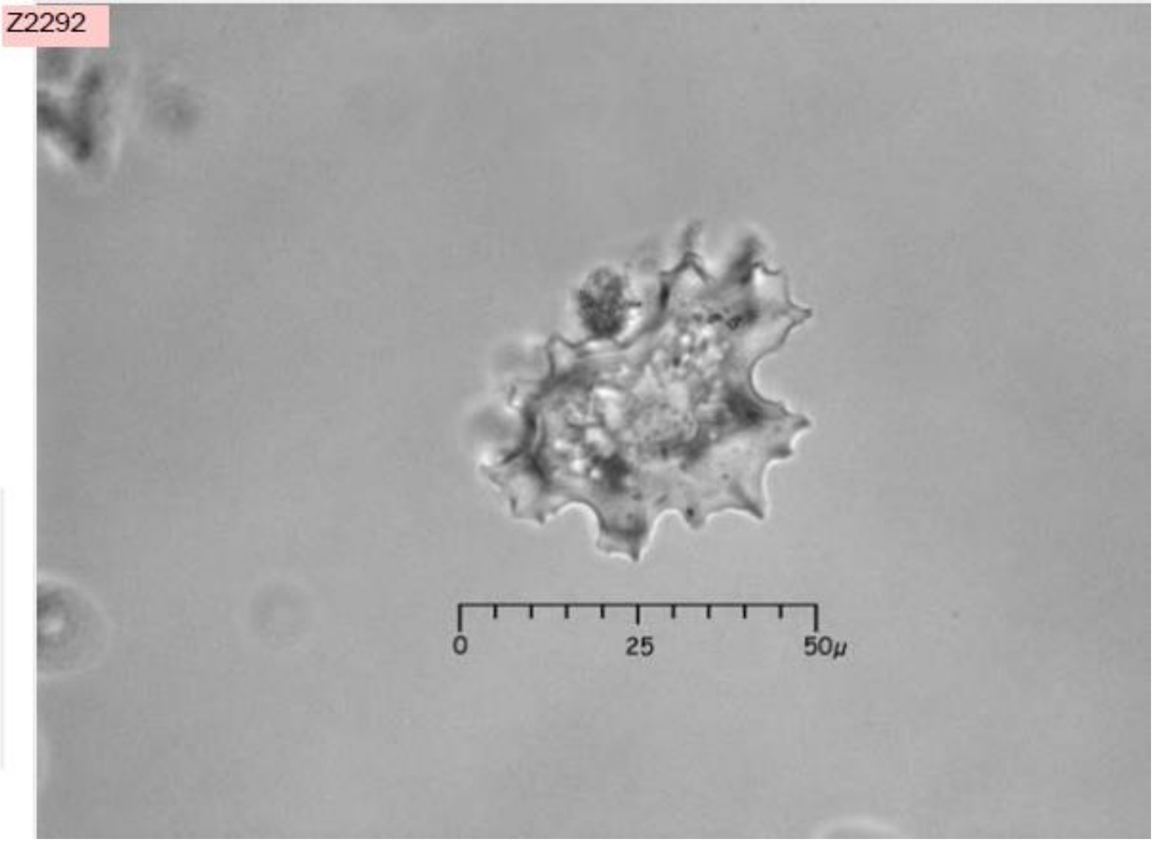


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

PC1822, inflorescence
Diagnostic level: genus
View is from base

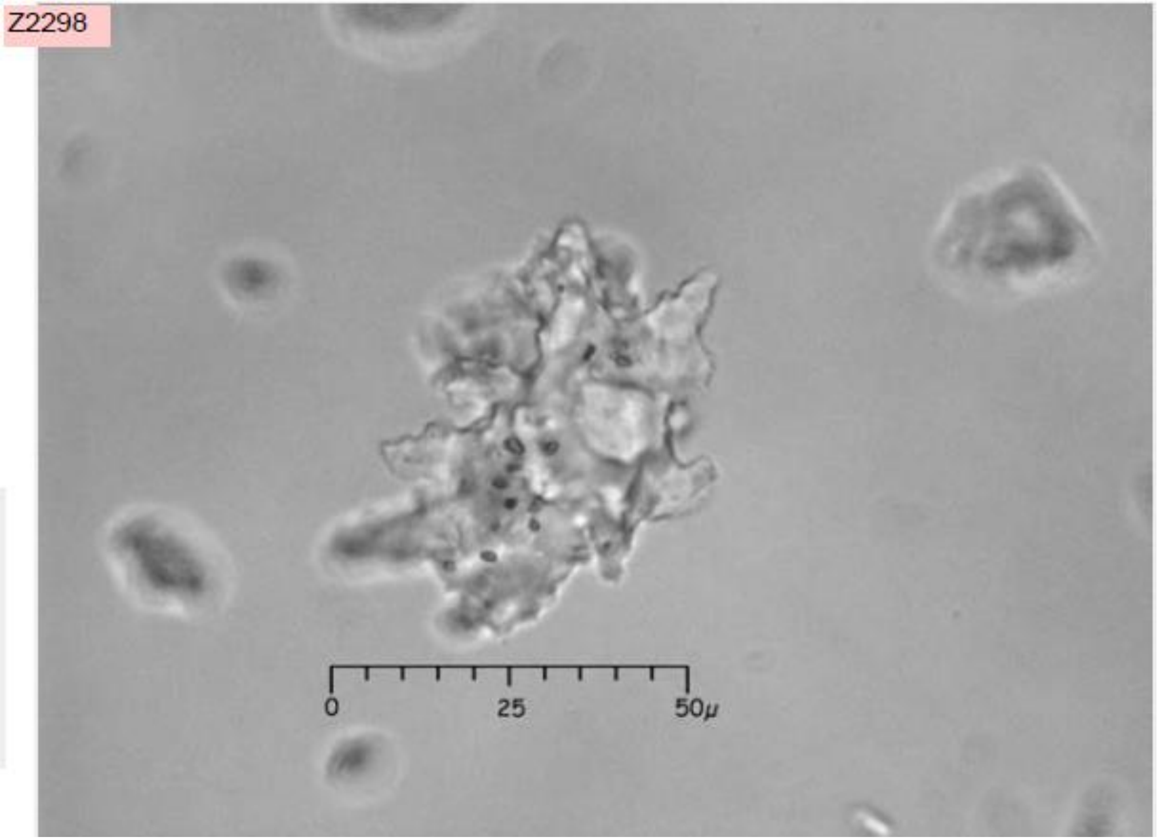


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

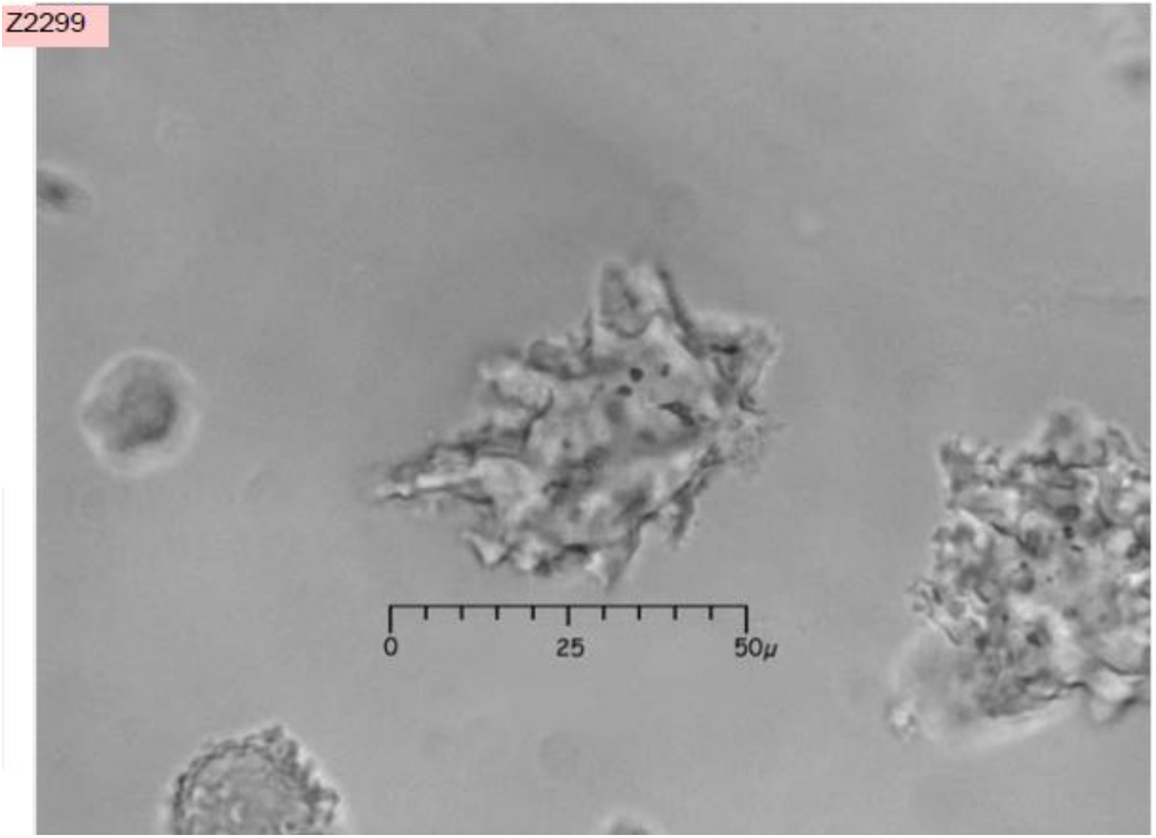
PC1822, inflorescence
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith



PC1822, inflorescence
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

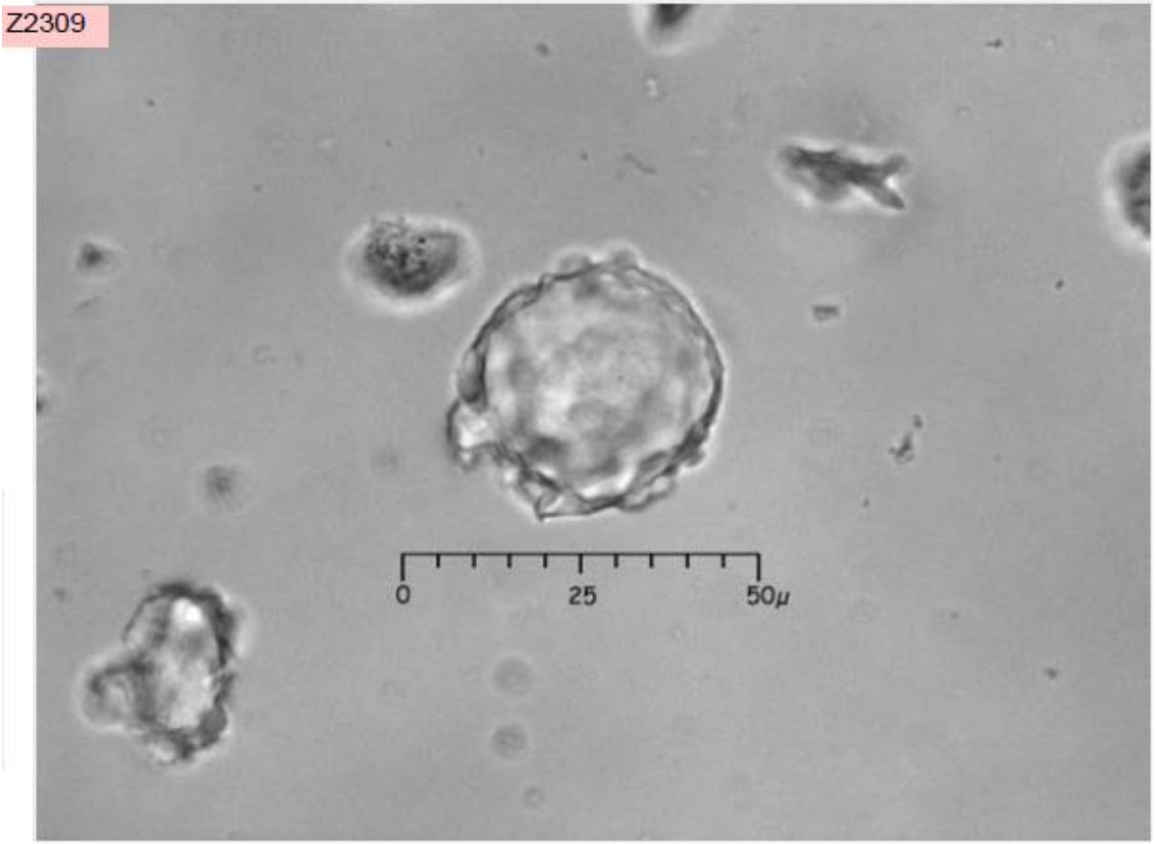
PC1822, inflorescence
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: not diagnostic

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

PC1822, inflorescence
Diagnostic level: under study
This view shows the round concavities

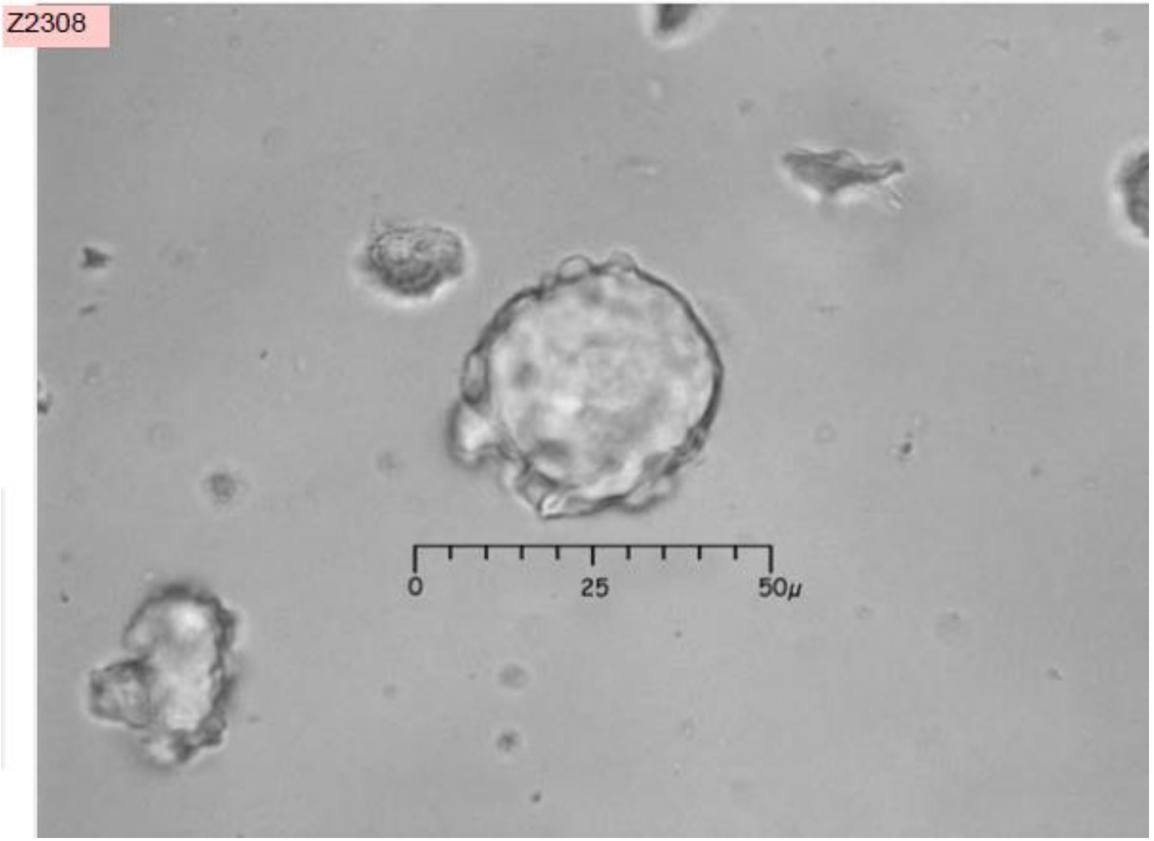


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

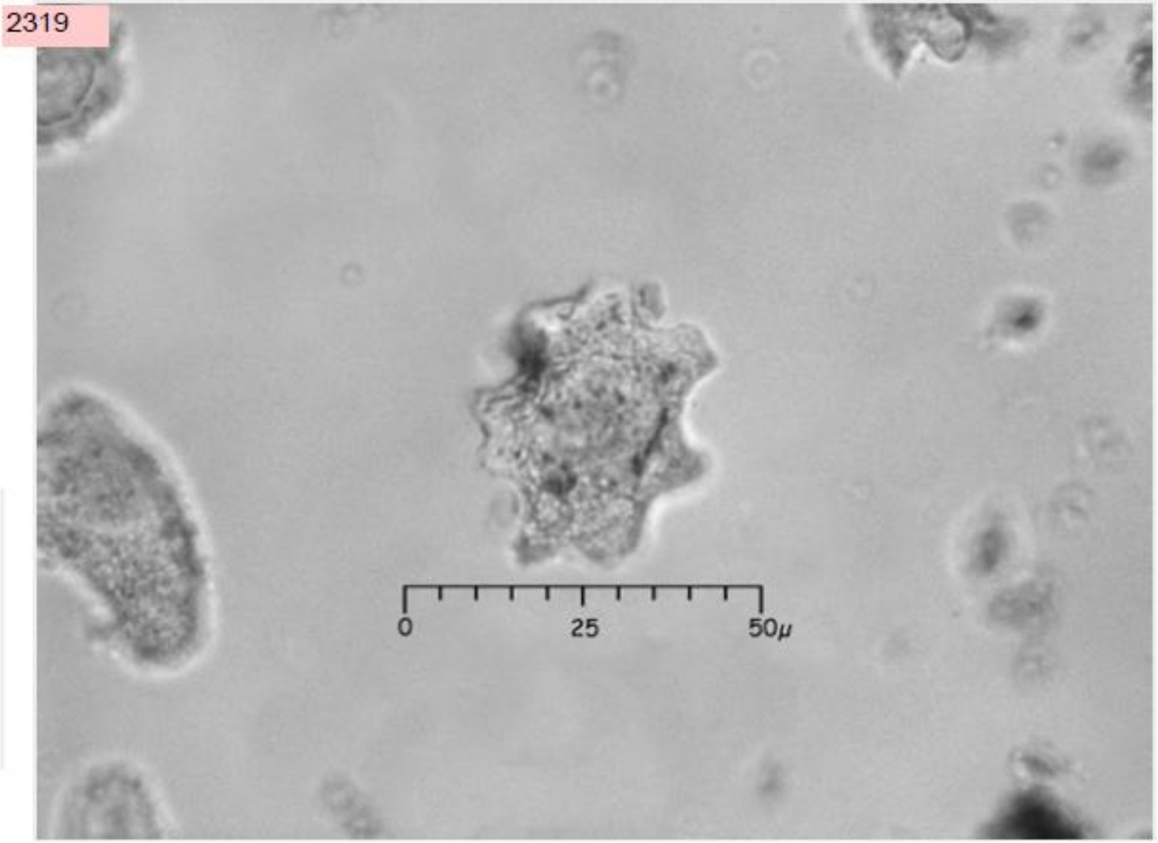
PC1822, inflorescence
Diagnostic level: under study
This view shows the rounded projections



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

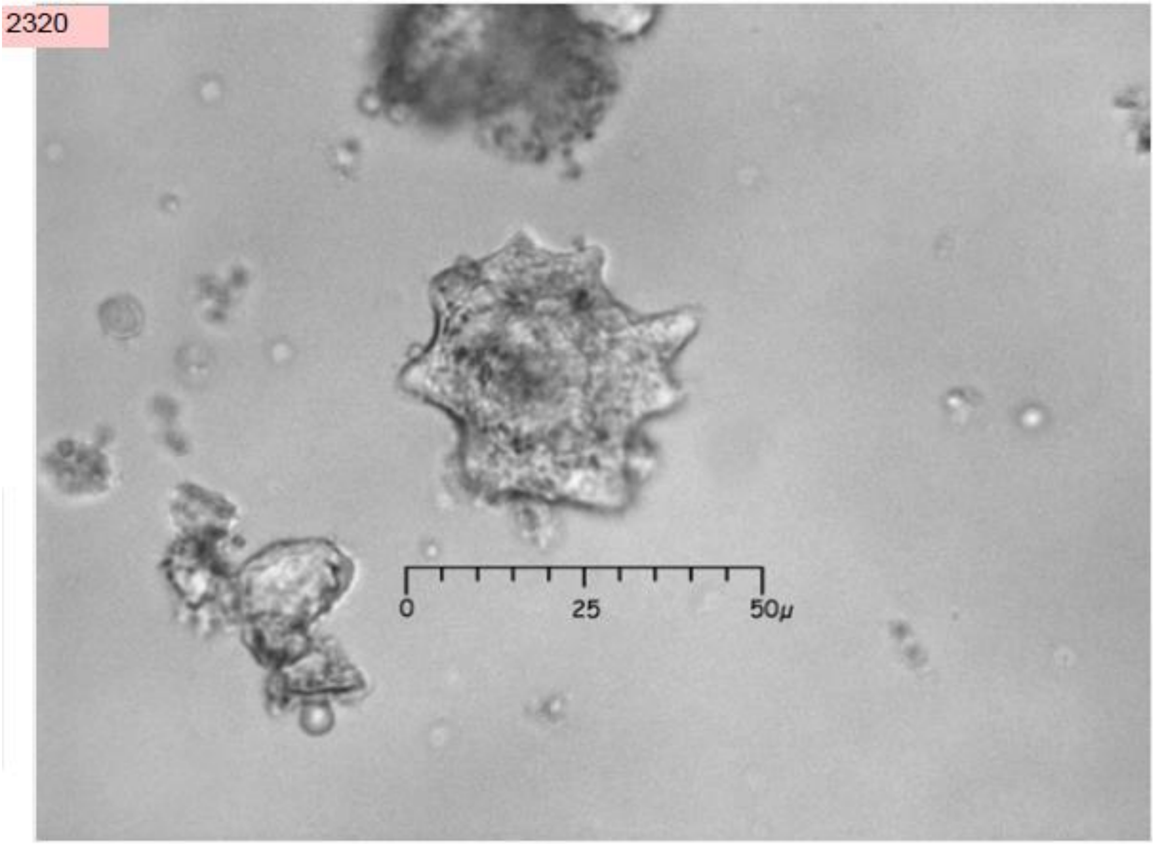


PC2622, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen had only short cylinders.
Bottom view
Compare to 22VIIDd, Donax

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith

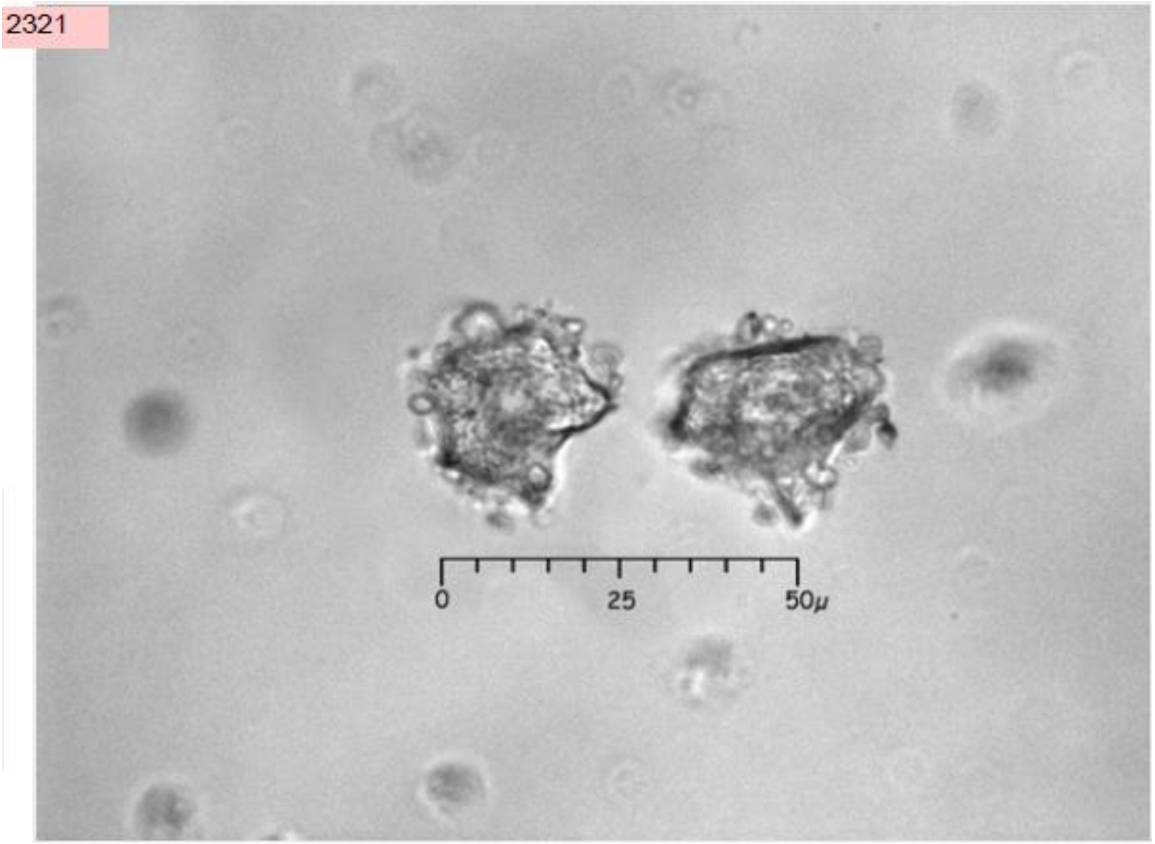


PC2622, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen had only short cylinders.
Bottom view
Compare to 22VIIDd, Donax

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe jarquinii

Phytolith



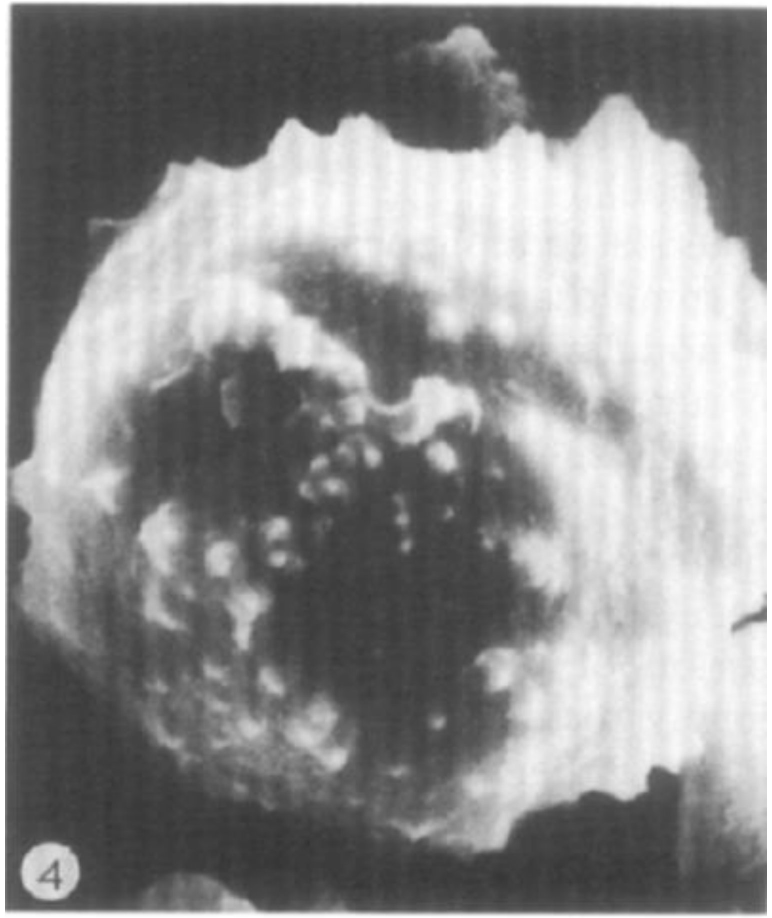
PC2622, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen had only short cylinders.
Body on right shows the side view
Compare to 22VIIDd, Donax

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe lutea

Phytolith

4. SEM photograph of a spherical nodular phytolith from Stromanthe lutea (2500 x).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Stromanthe stromanthoides

Phytolith

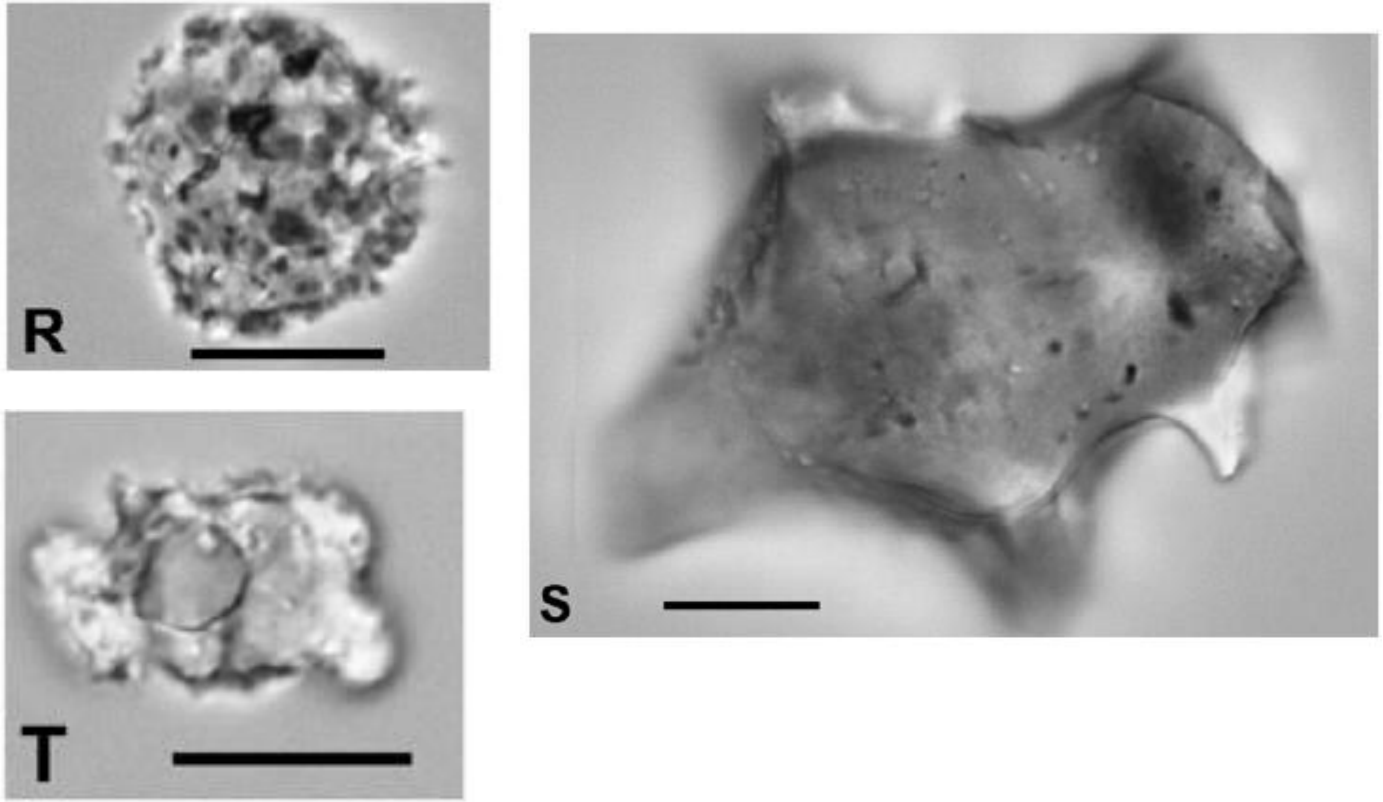
PC1824, inflorescence
Type established by Karol Chandler-Ezell, 2004
Diagnostic level: not diagnostic
Image shows variation in size and shape; note very elongated example

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Stromanthe stromanthades

Phytolith

Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). R, flattened globular-granulate from Stromanthe stromanthades fruit bract. S, Kn2 knobby from Stromanthe stromanthades seed. T, Ta5 (irregularly thickened, more or less rectangular with a granulate surface and non-raised central concavity) from Stromanthe stromanthades seed. Scale bars=12 µm.

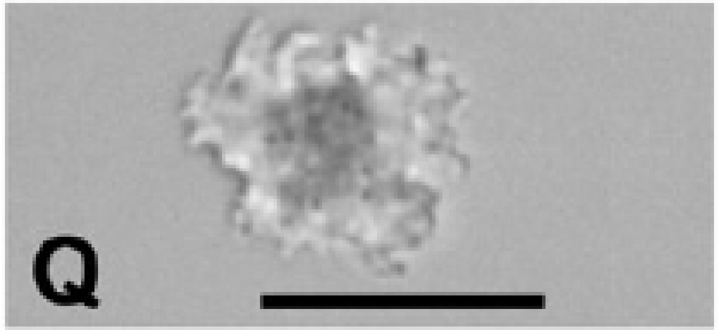


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Stromanthe tonckat

Phytolith

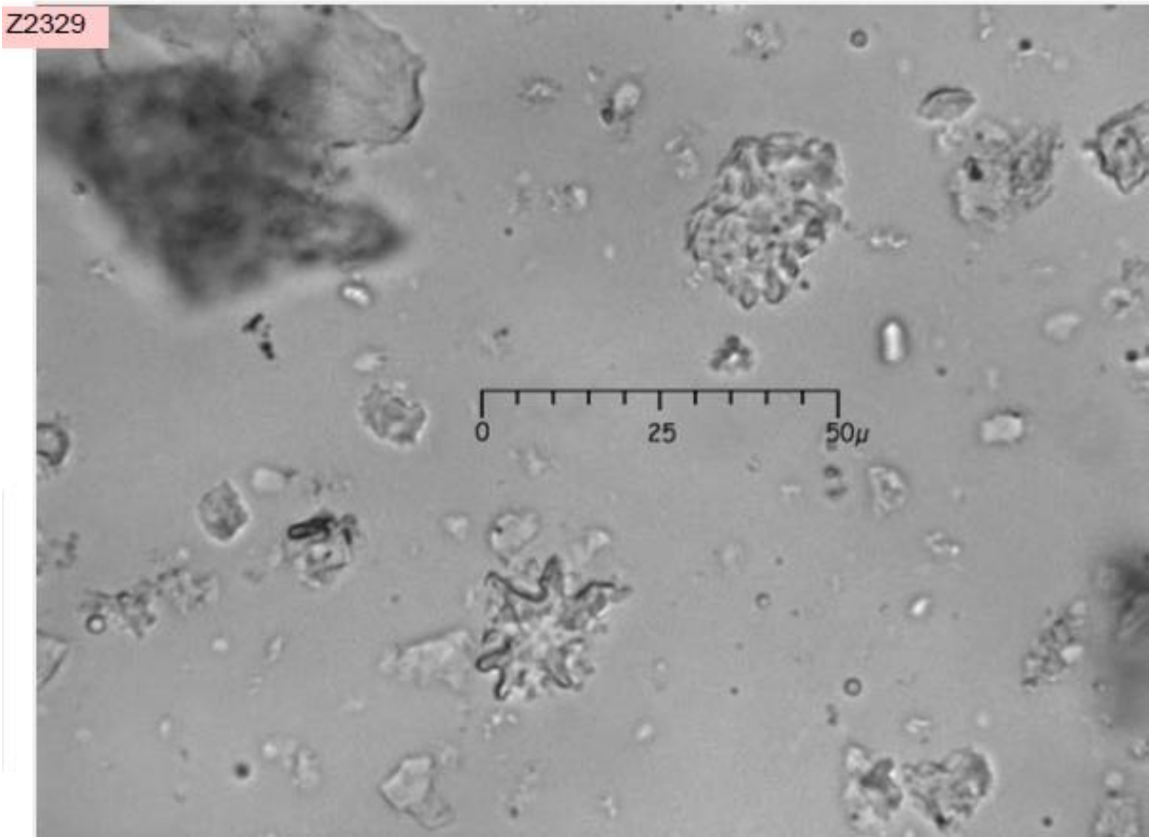
Fig. 3. Marantaceae; Calathea clade (A–H, L), Donax clade (I–K), Maranta clade (M–S), Sarcophrynium clade (T–U), Stachyphrynium clade (V–AA). Q, rugose hat-shape with crenate margins from Stromanthe tonckat leaf. Scale bars=12 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Thalia geniculata

Phytolith

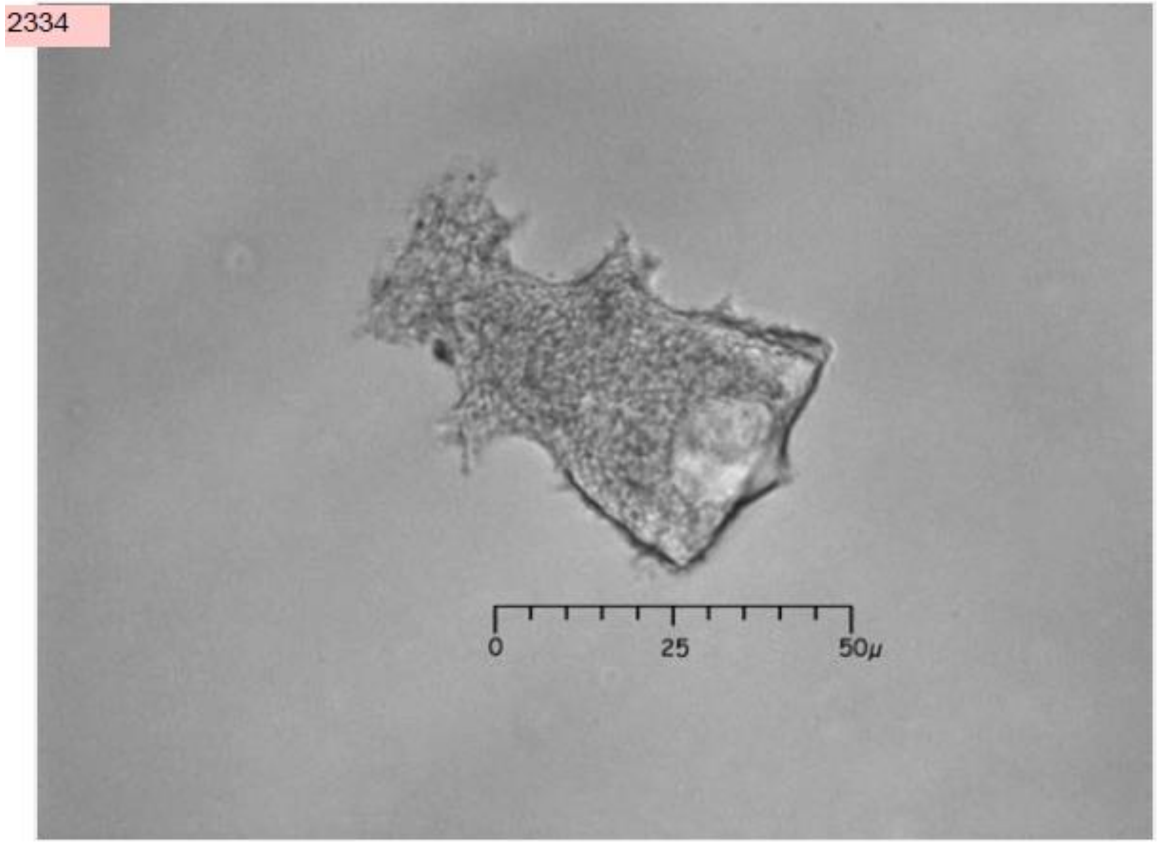


PC1156, fruit
Diagnostic level: under study
This specimen had some examples with longer projections; see body below the scale and compare to one above the scale
Rarely observed in Thalia multiflora leaf

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith



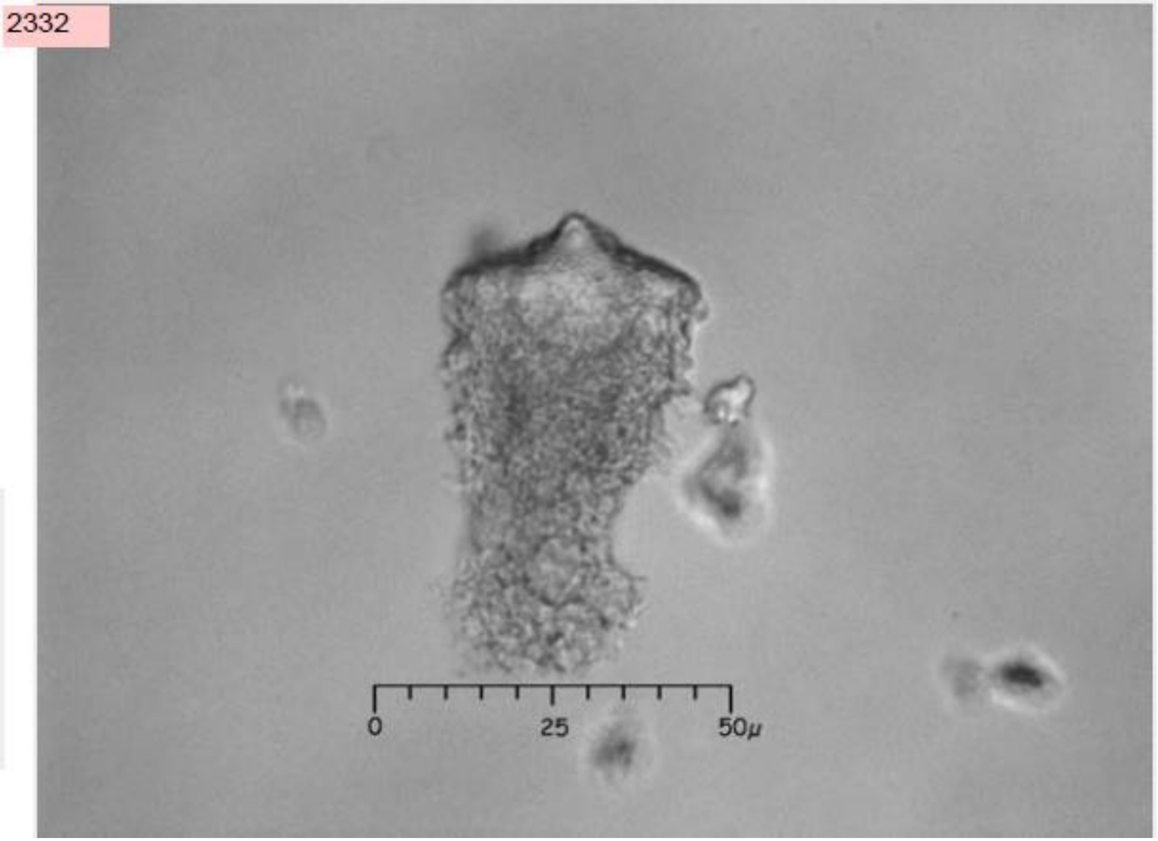
PC1818, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen has long cylinders
Compare to 22VIIDd, Donax

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith

PC1818, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen has long cylinders
Compare to 22VIIDd, Donax

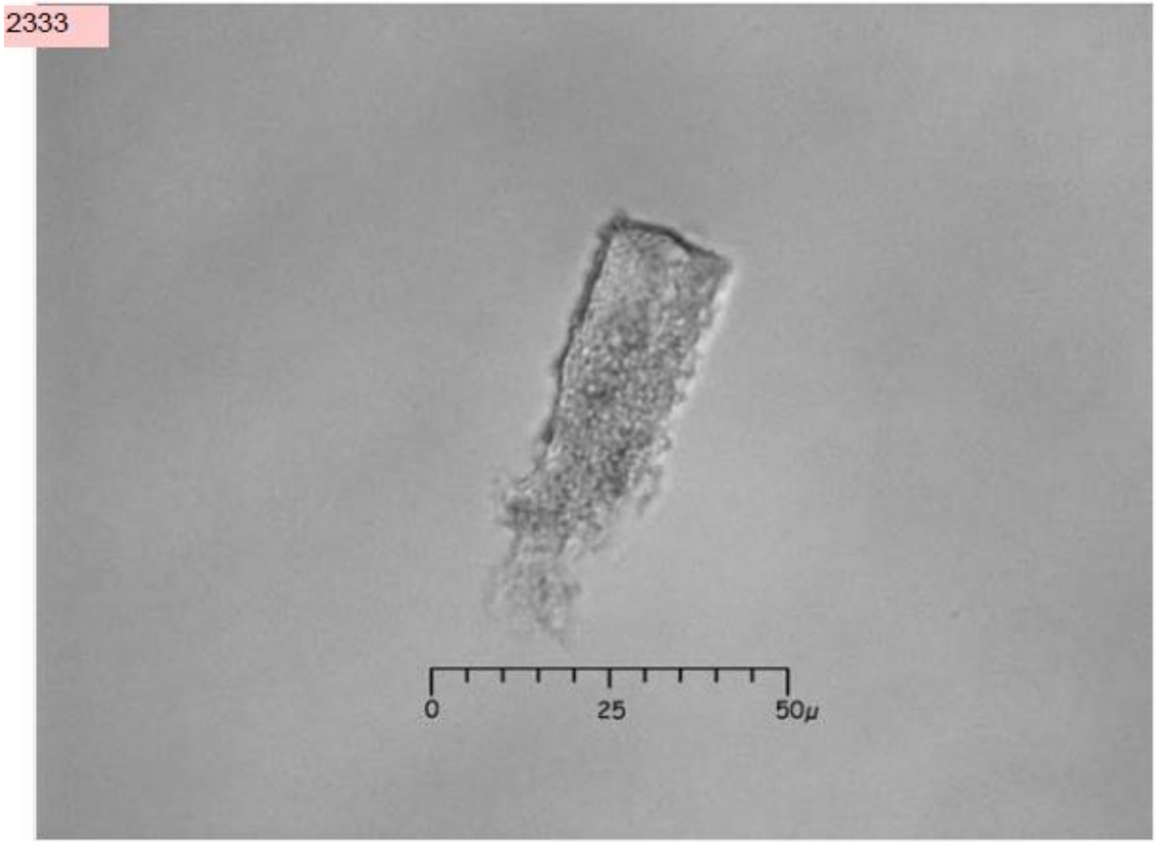


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith

PC1818, inflorescence
Diagnostic level: Stromanthe, Thalia
This specimen has long cylinders. Image shows an example which lacks projecting tip
Compare to 22VIIDd, Donax

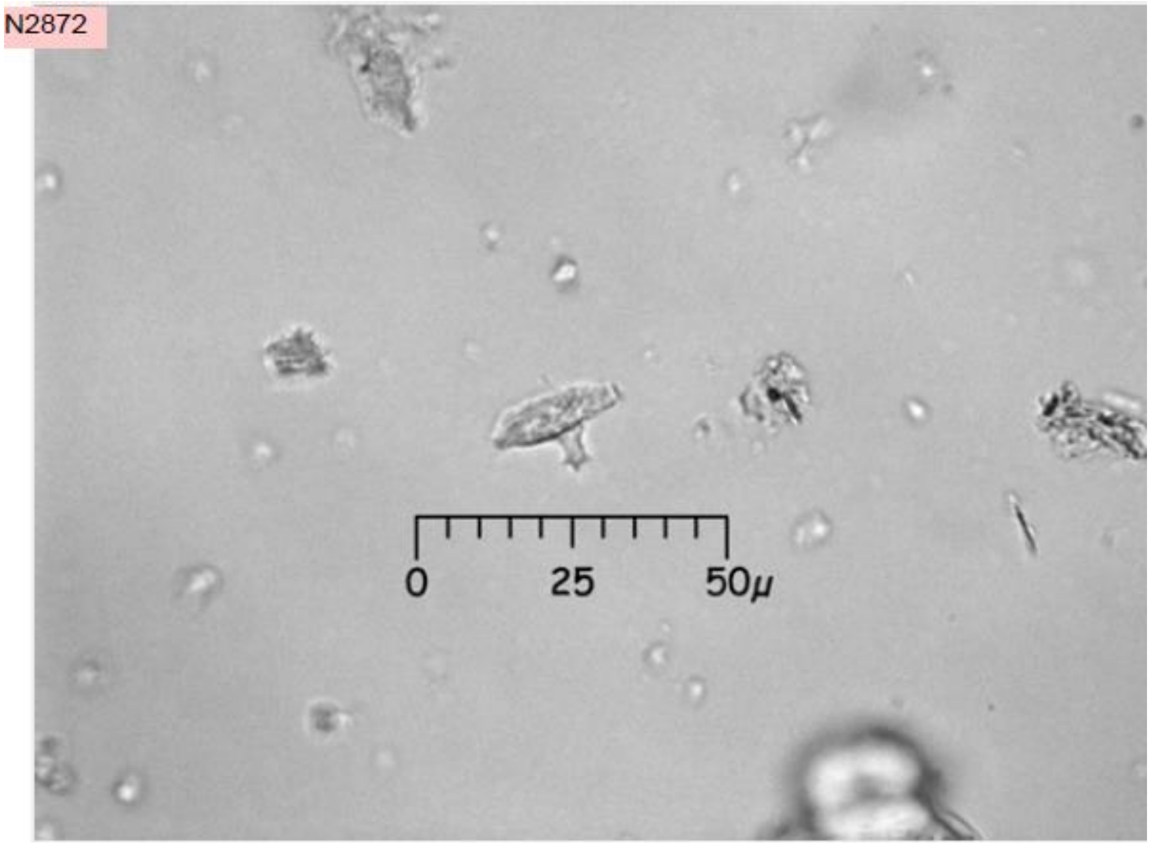


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith

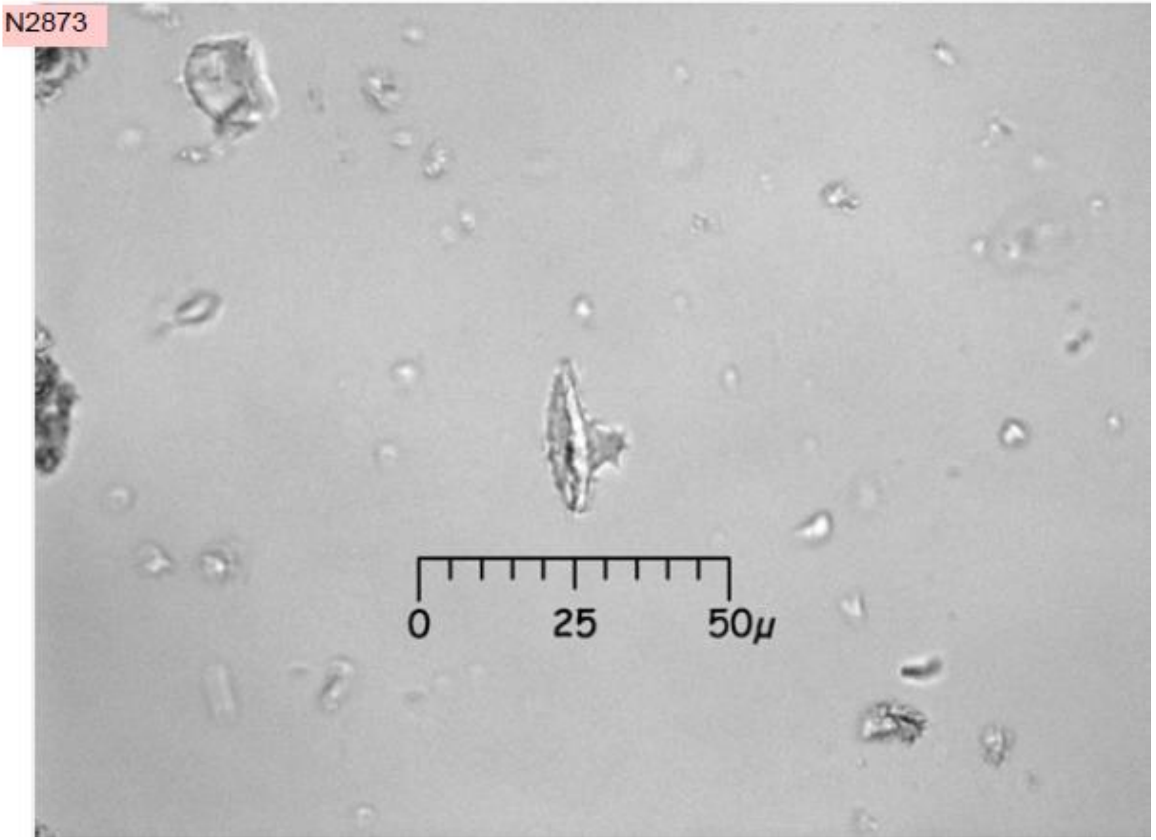
PC1740, root, common.
Type defined by Karol Chandler-Ezell, 11/2004
Diagnostic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith



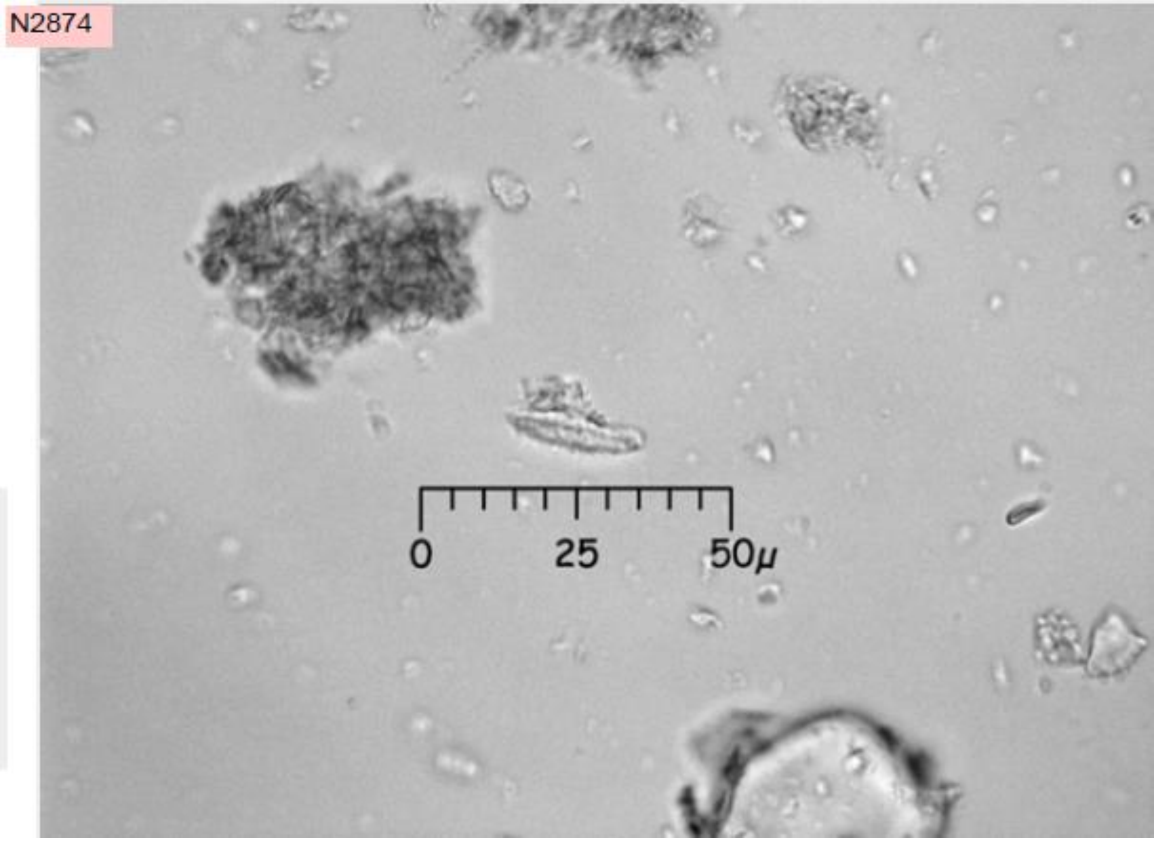
PC1740, root, common.
Type defined by Karol Chandler-Ezell, 11/2004
Diagnostic level: under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith

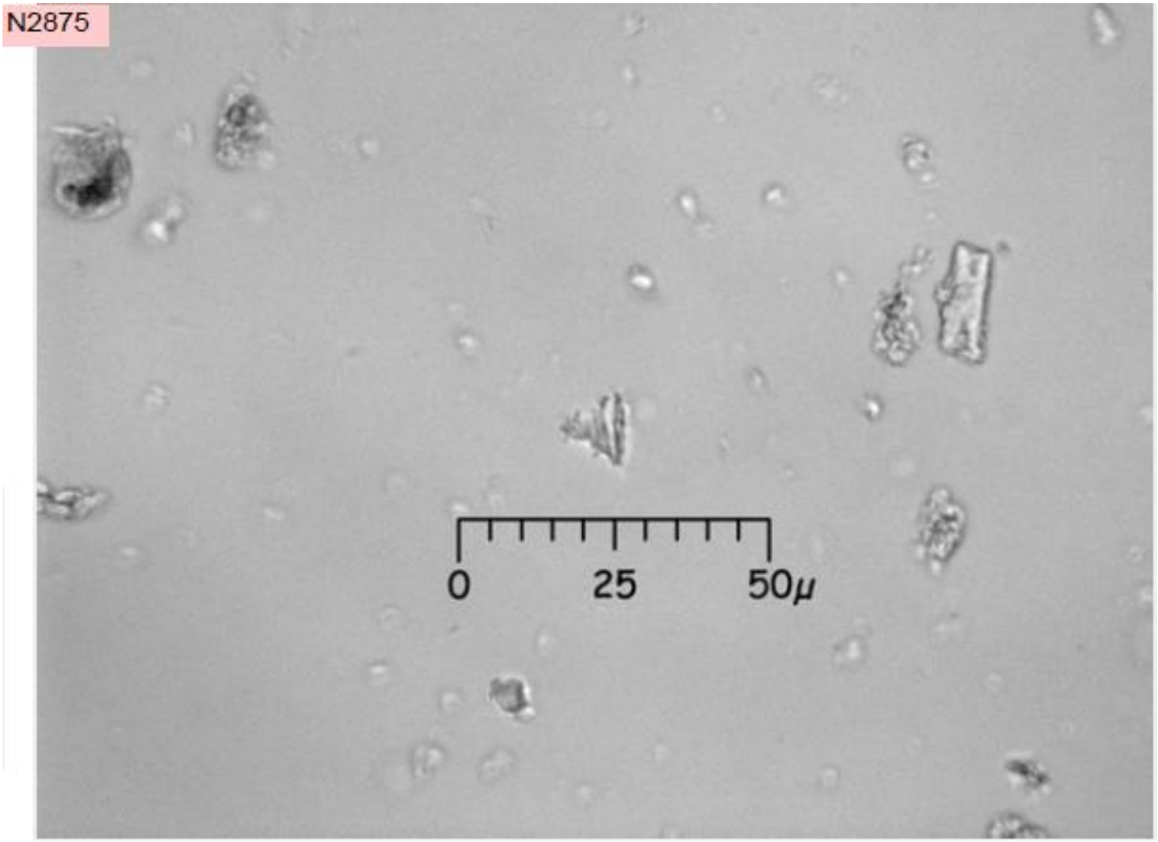
PC1740, root, common.
Type defined by Karol Chandler-Ezell, 11/2004
Diagnostic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Thalia geniculata

Phytolith



PC1740, root, common.
Type defined by Karol Chandler-Ezell, 11/2004
Diagnostic level: under study

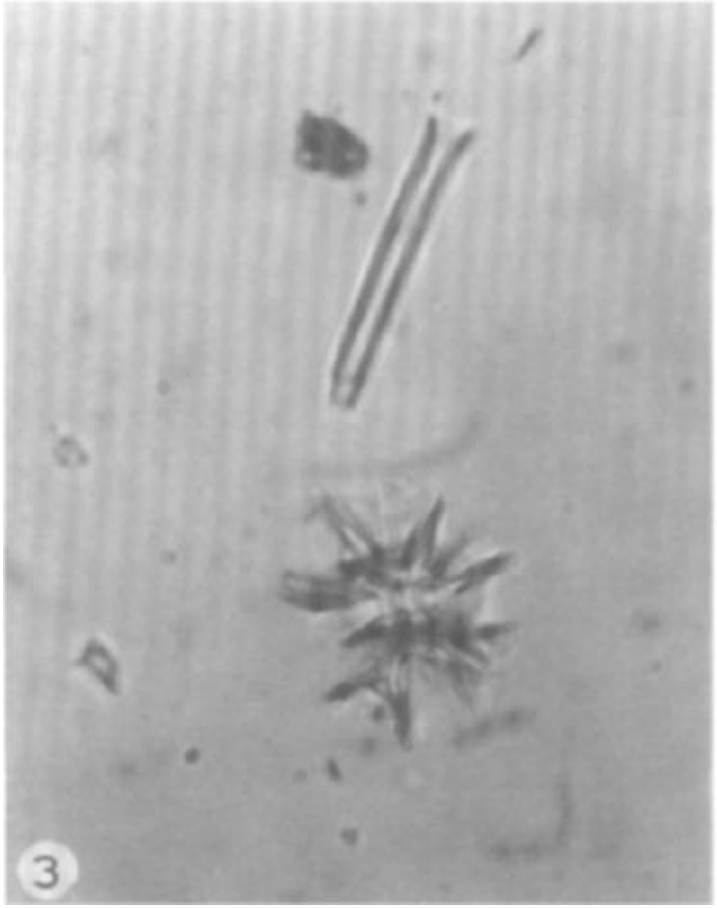
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

MENISPERMACEAE

Odontocarya tarnoides

Phytolith

3. Bottom, an irregular pointed phytolith from Odontocarya tarnoides (400 ×)



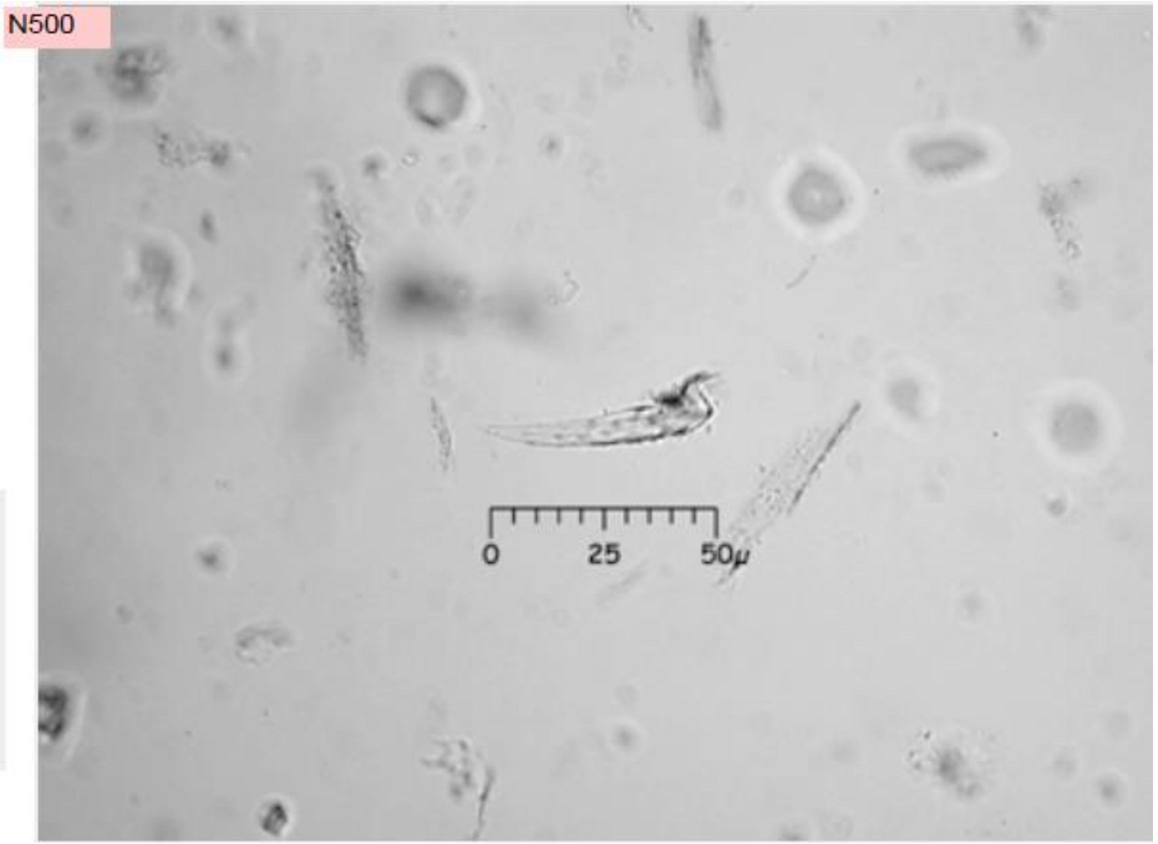
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

MORACEAE

Artocarpus altilis

Phytolith

Armed hair; hair is bent in a right angle from base, rather than curving as in Boraginaceae Cordia lutea 40IIIAb100. Often has a piece of attached epidermal tissue at base with a “torn” appearance. Distinct multiple outline appearance helps to separate it from similar types.
Diagnostic level: family

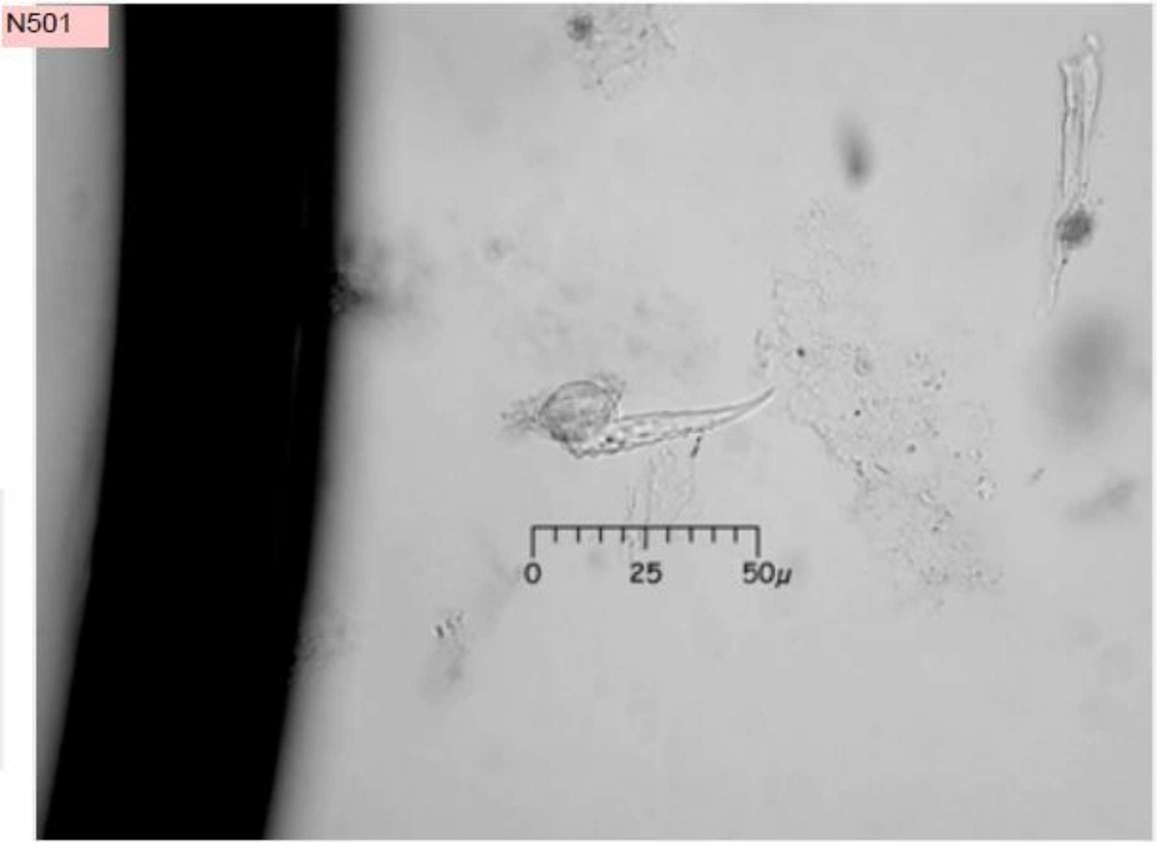


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Artocarpus altilis

Phytolith

Armed hair; hair is bent in a right angle from base, rather than curving as in Boraginaceae Cordia lutea 40IIIAb100. Often has a piece of attached epidermal tissue at base with a “torn” appearance. Distinct multiple outline appearance helps to separate it from similar types.
Diagnostic level: family

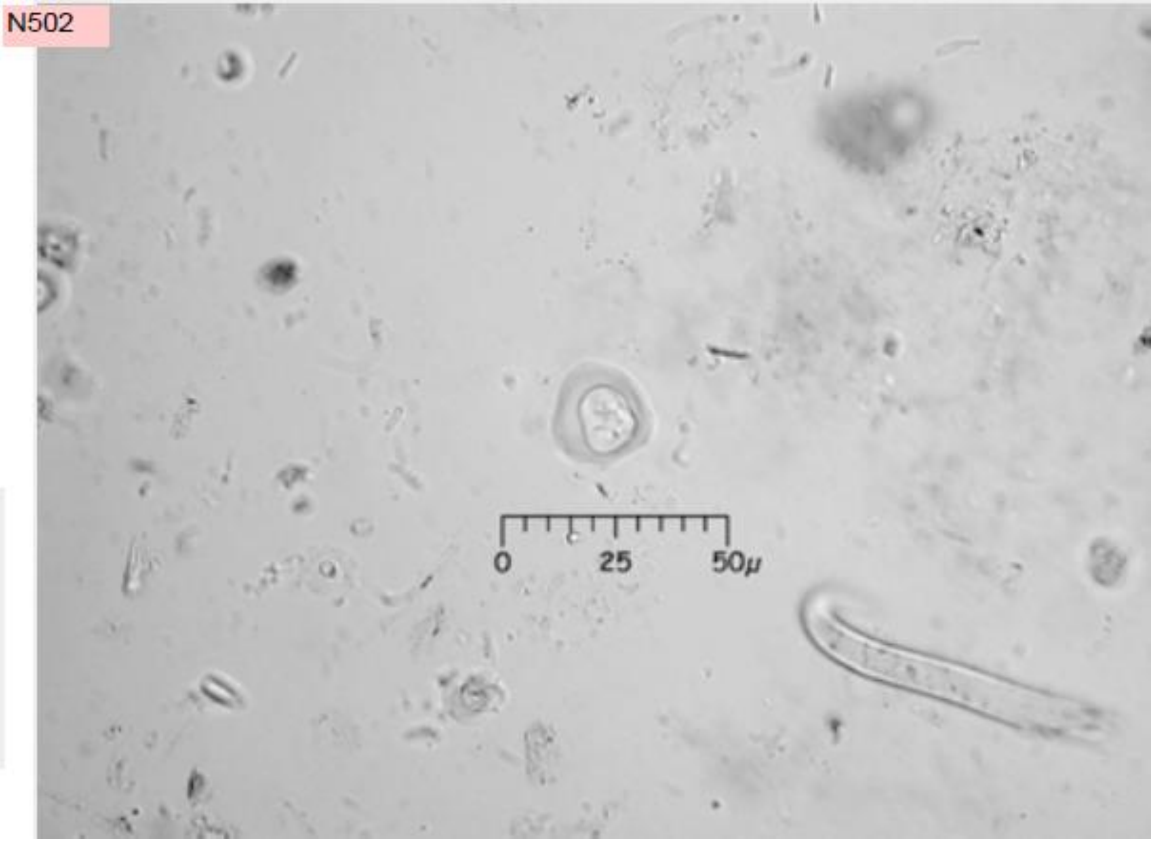


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Artocarpus altilis

Phytolith

Diagnostic level: family

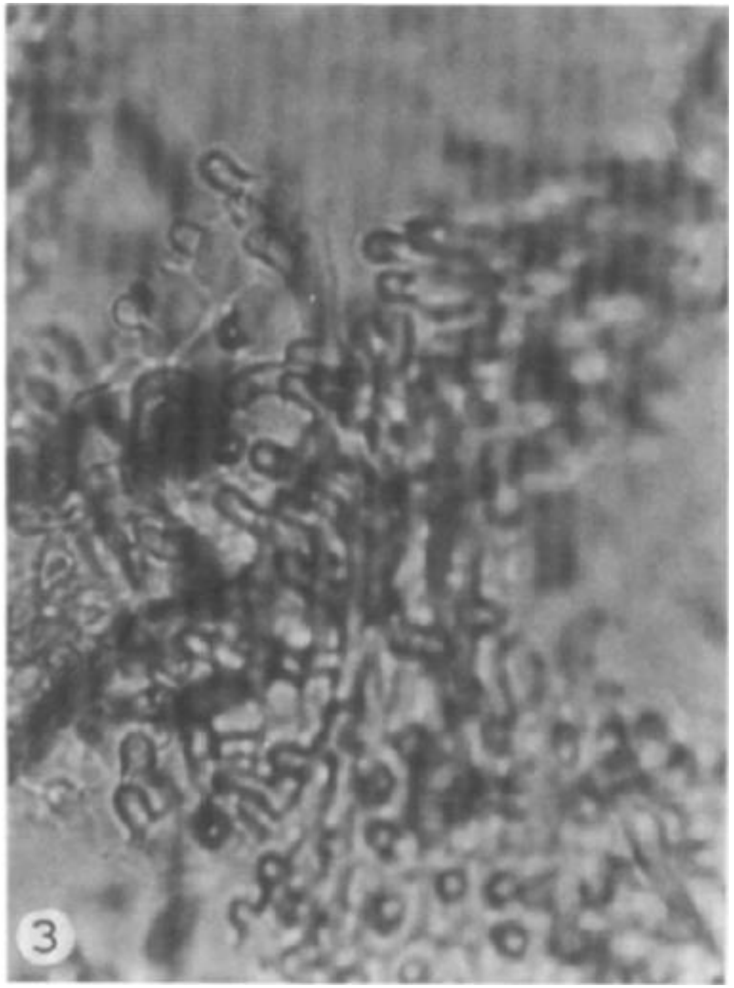


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Brosimum discolor

Phytolith

3. Non-segmented hairs with rounded tips from Brosimum discolor (250 x)

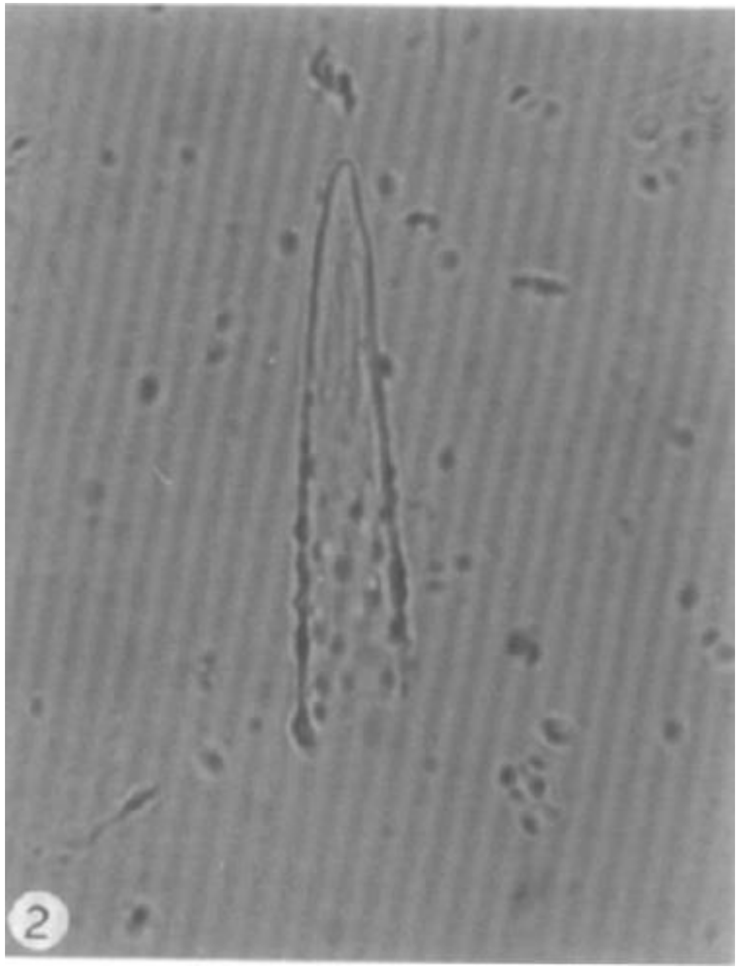


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Castilla elastica

Phytolith

2. A non-segmented armed hair with an unarmed apex from Castilla elastica (250 ×)

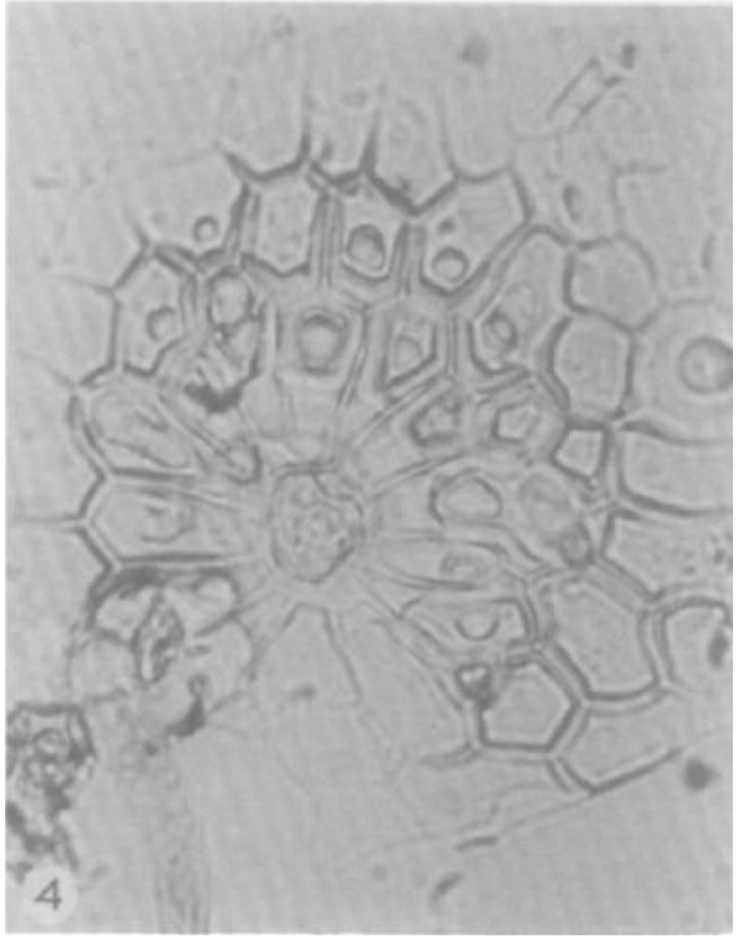


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Chlorophora tinctoria

Phytolith

4. Stellate-shaped hair base from Chlorophora tinctoria. It is surrounded by epidermis with spherical inclusions (200 x).

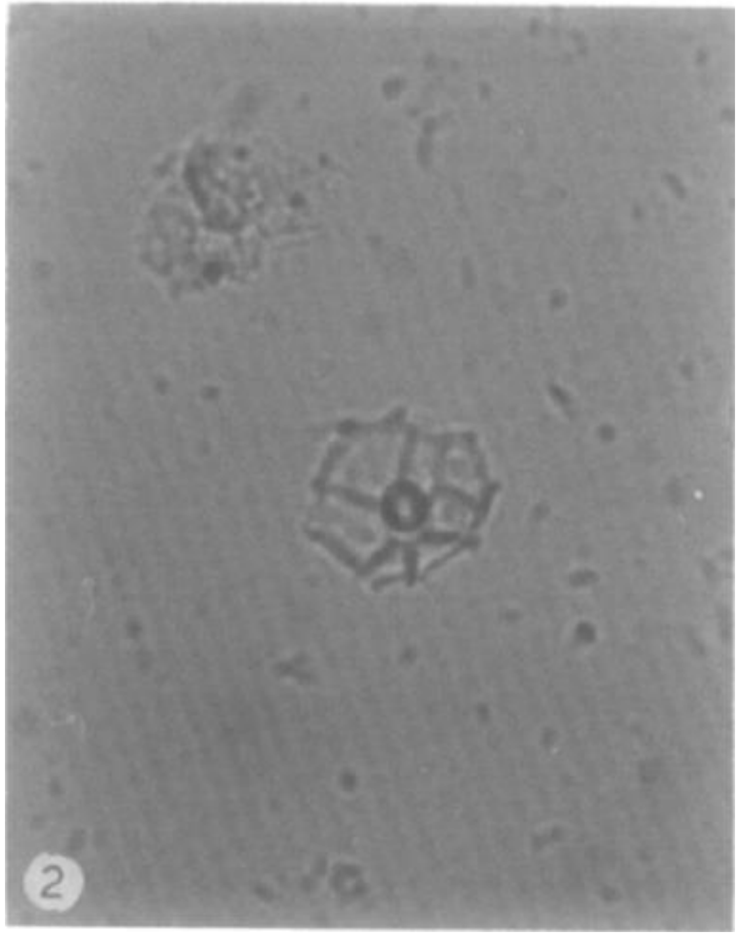


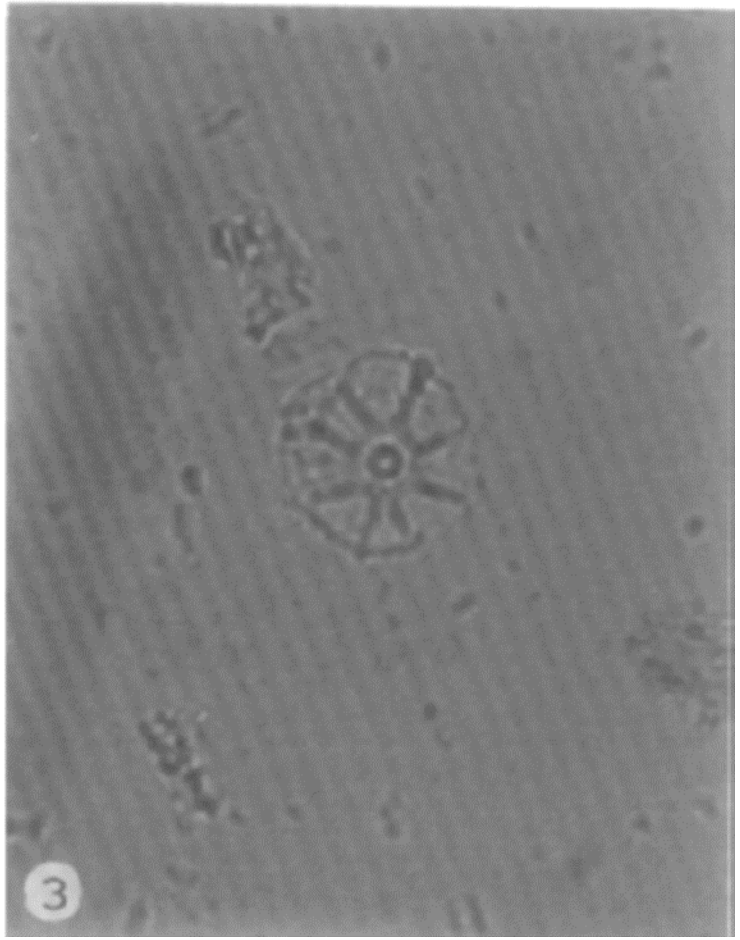
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Ficus americana

Phytolith

2. Hair base with irregular striations radiating from the center of the cell from Ficus americana (250 x).
3. Hair base with a regular striated pattern inside of the base from Ficus americana (250x).



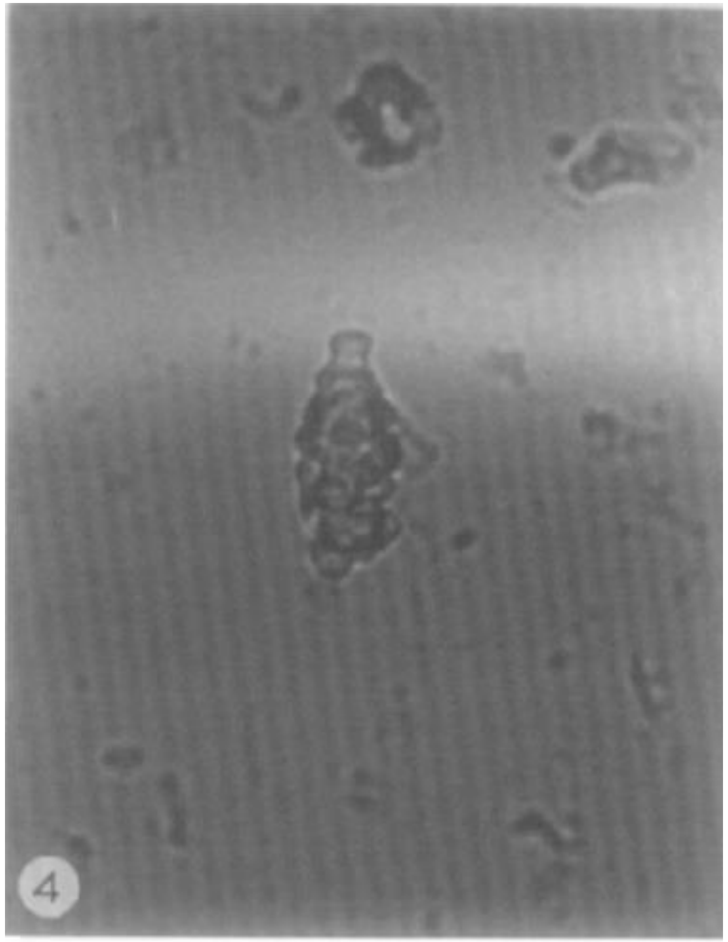


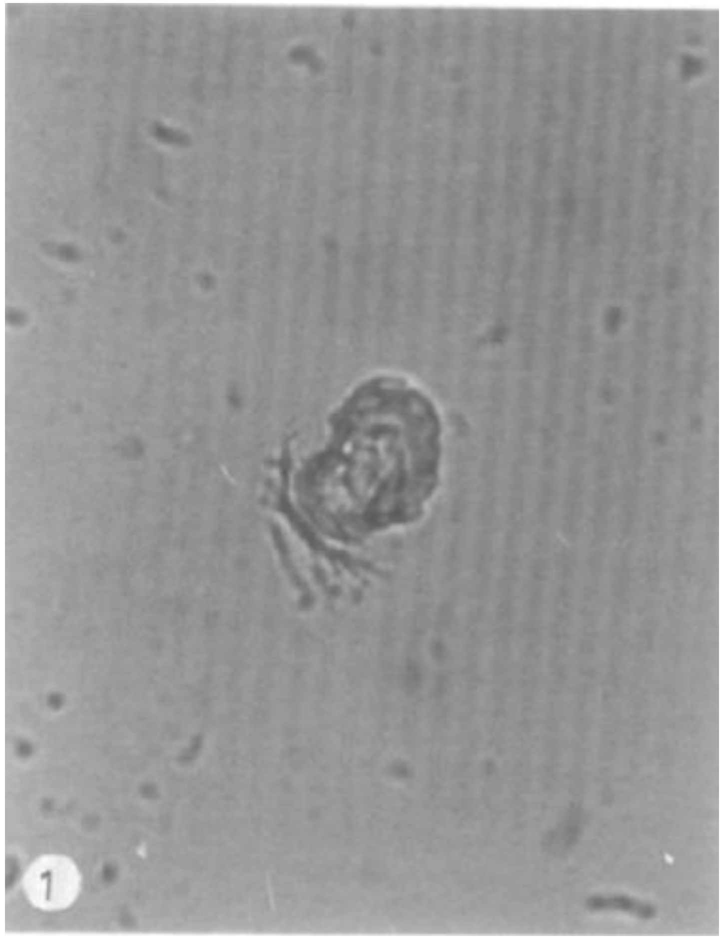
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Ficus americana

Phytolith

4. Torpedo-shaped cystolith with a stalk and a rugulose surface pattern from Ficus americana (250 x).
1. Ellipsoidal-shaped cystolith with a rugulose surface pattern from Ficus americana (250 ×).



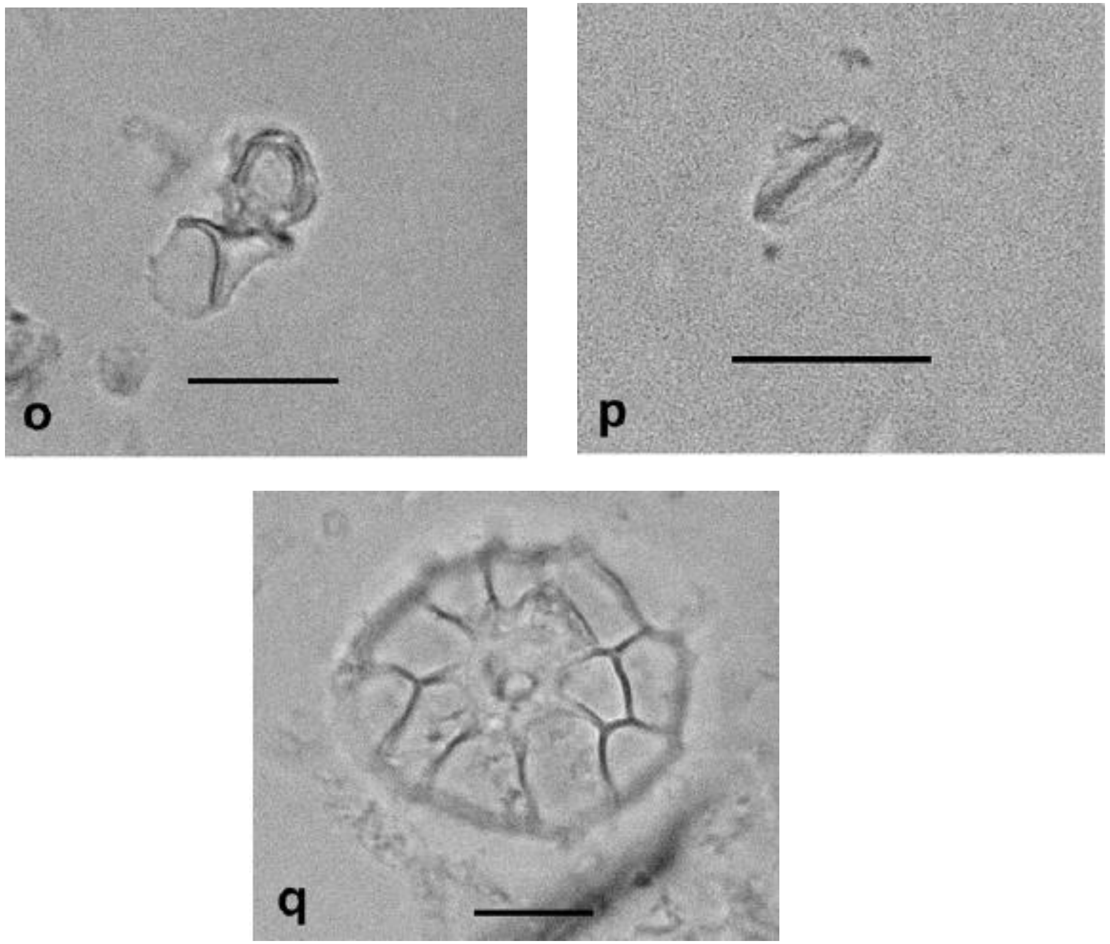


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Ficus guianensis

Phytolith

Fig. 5. Phytoliths from dicotyledons. o) Trichomes from Ficus guianensis, p) Squat trichome from F. guianensis, q) Hair base from F. guianensis leaf.



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Perebea xanthochyma

Phytolith

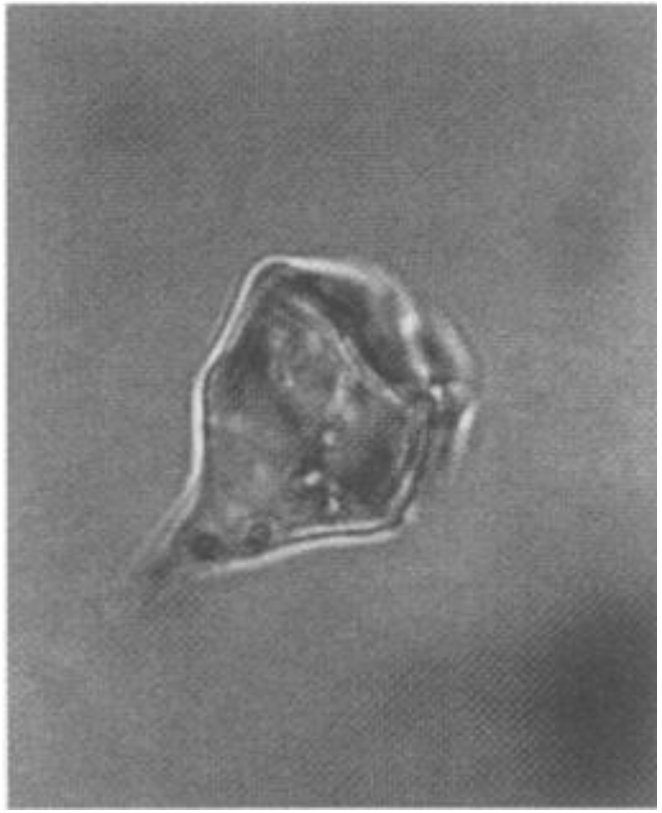


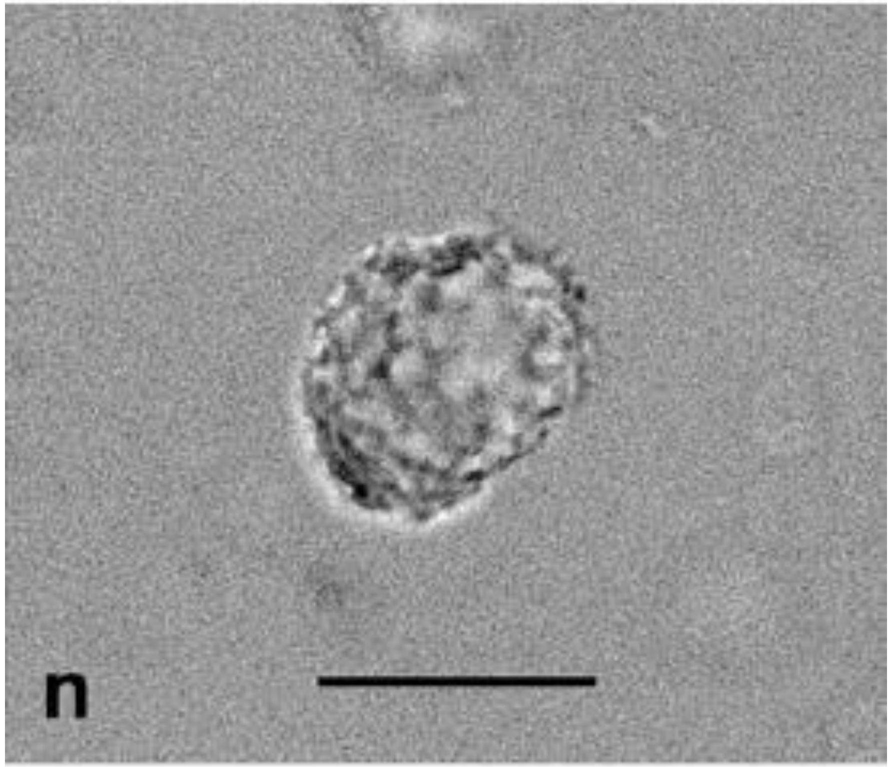
Fig. 3. A probable genus-specific phytolith from the leaves of Perebea xanthochyma (Moraceae). Palynologists often cannot discriminate genera in this family.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Sorocea muriculata

Phytolith

Fig. 5. Phytoliths from dicotyledons.
n) Cystolith from Sorocea muriculata

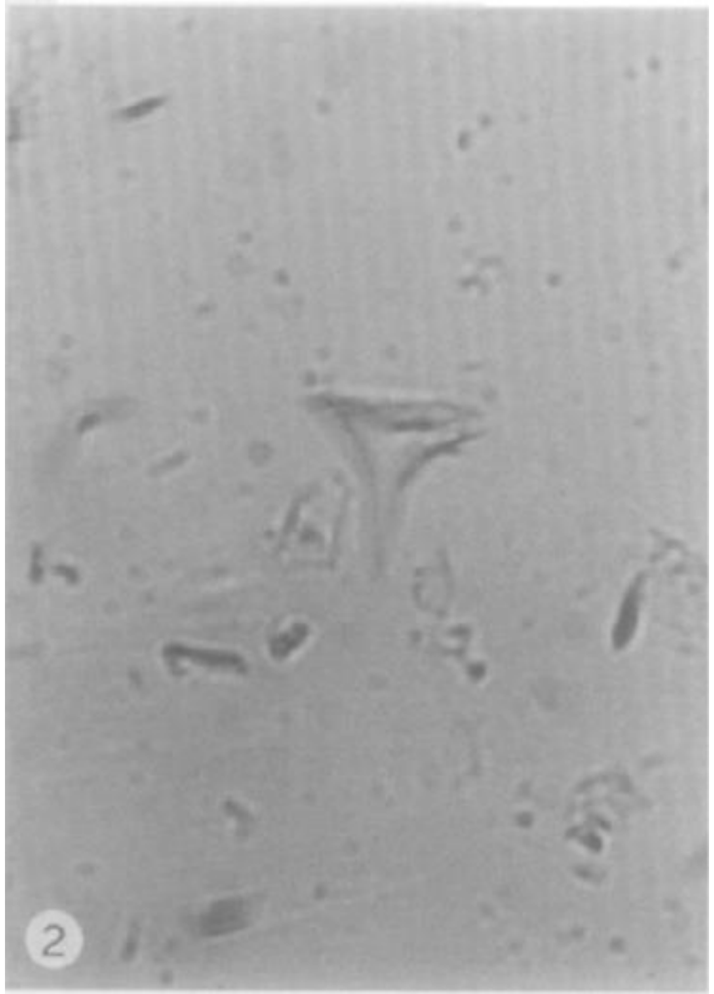


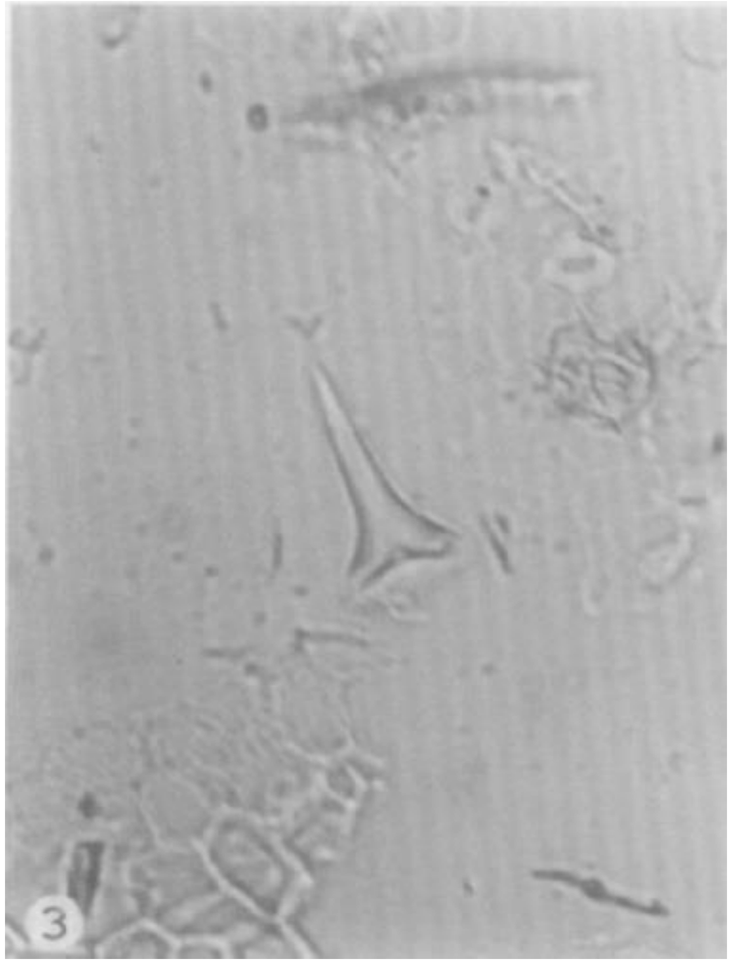
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Trophis racemosa

Phytolith

2. Non-segmented hair with an elongated flat base from Trophis racemosa (200 ×).
3. Non-segmented hair with an elongated indented base from Trophis racemosa (200 x).





Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

MUSACEAE

Musa sp. and Ensete sp.

Phytolith

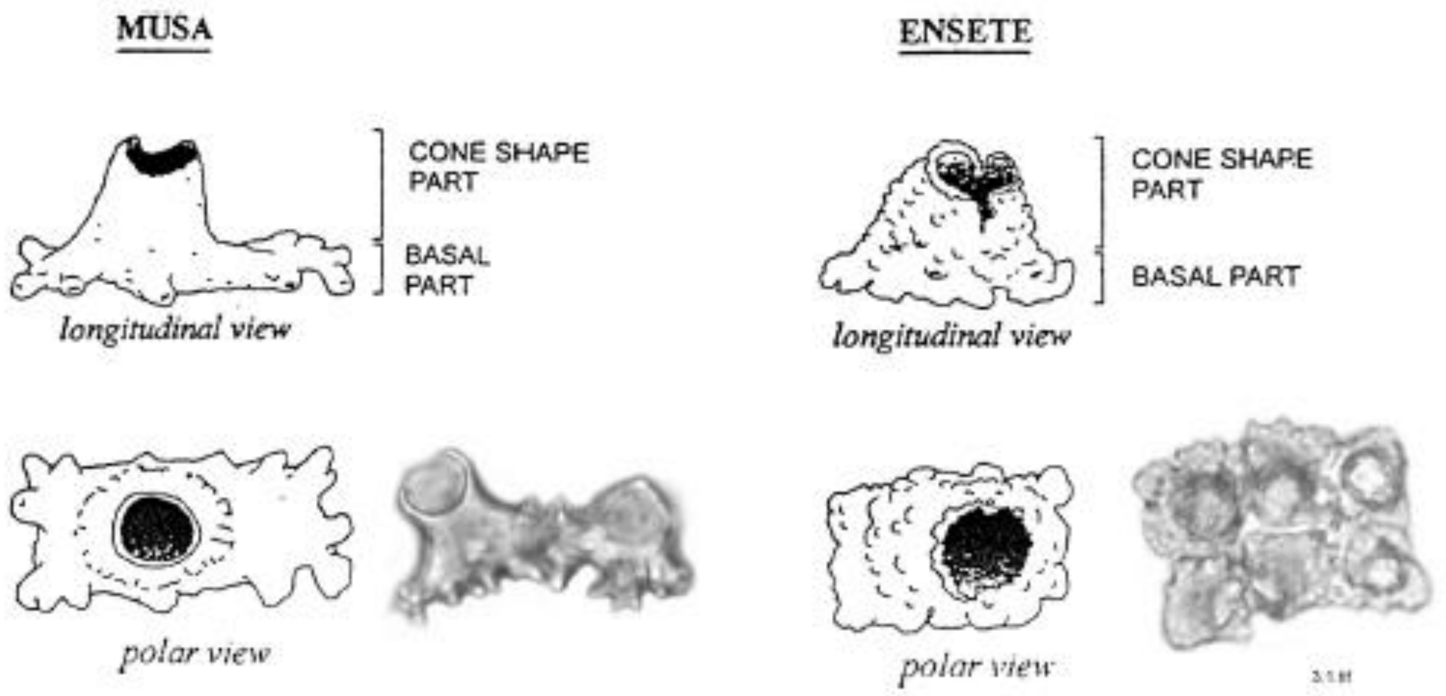


Fig. 17. A comparison of leaf phytoliths from Ensete and Musa. From Piperno, 2006. The schematic drawings were originally from Mbida et al., 2001 and the photographs were courtesy of Carol Lentfer

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Musa acuminata banksii and Ensete sp.

Phytolith

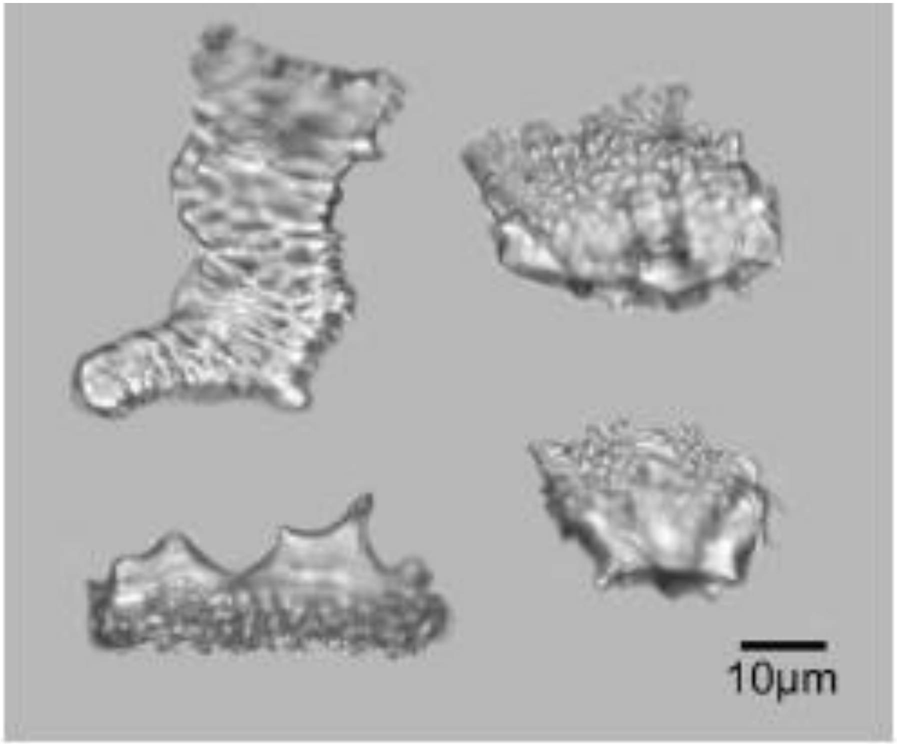


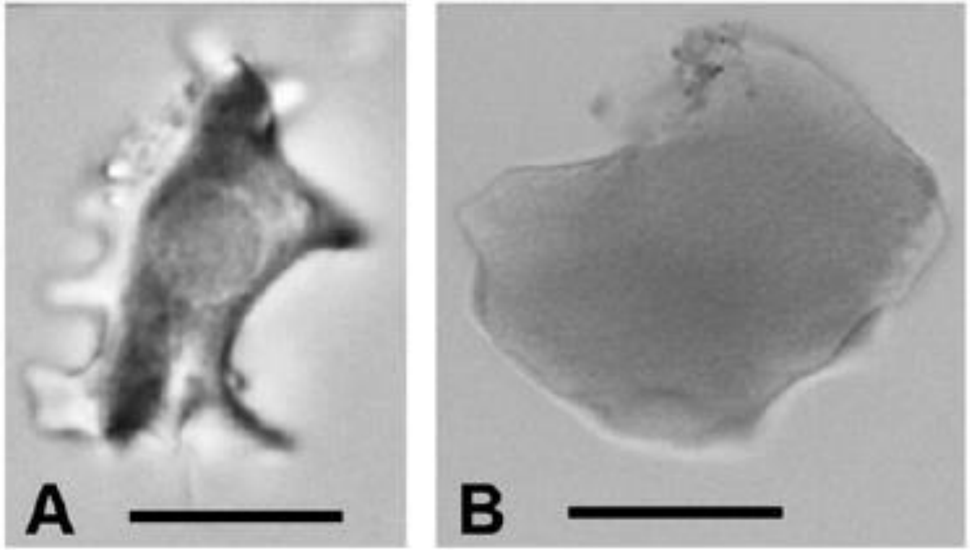
Fig. 15. Seed phytoliths from Musa acuminata subsp. banksii (left) and Ensete, right. From Piperno, 2006; originally courtesy of Carol Lentfer.

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Ensete sp.

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). A, T2 trough with papillae edges from Ensete sp. leaf. B, tabular-microgranulate from Ensete sp. leaf. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.

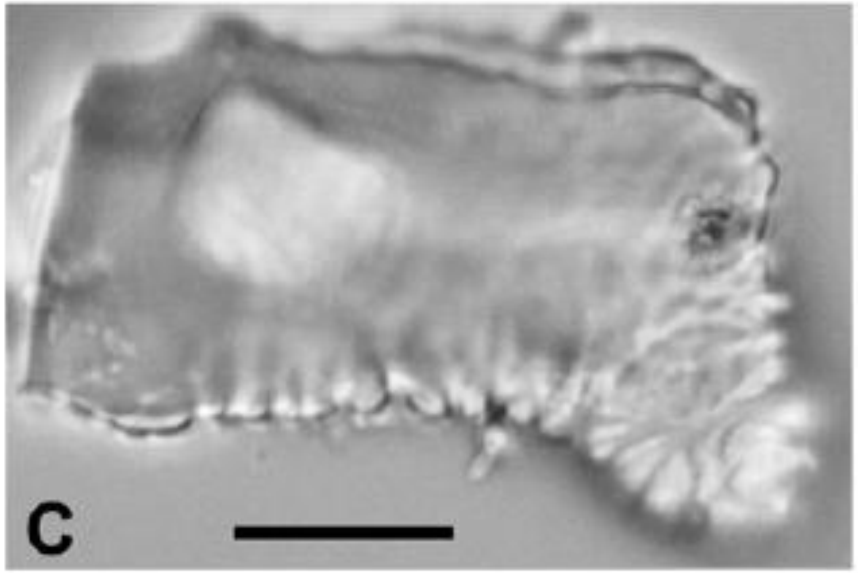


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Ensete glaucum

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). C, Ta6 (with central processes which dividing and anastomosing ridges radiate out from) from Ensete glaucum seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Ensete glaucum

Phytolith

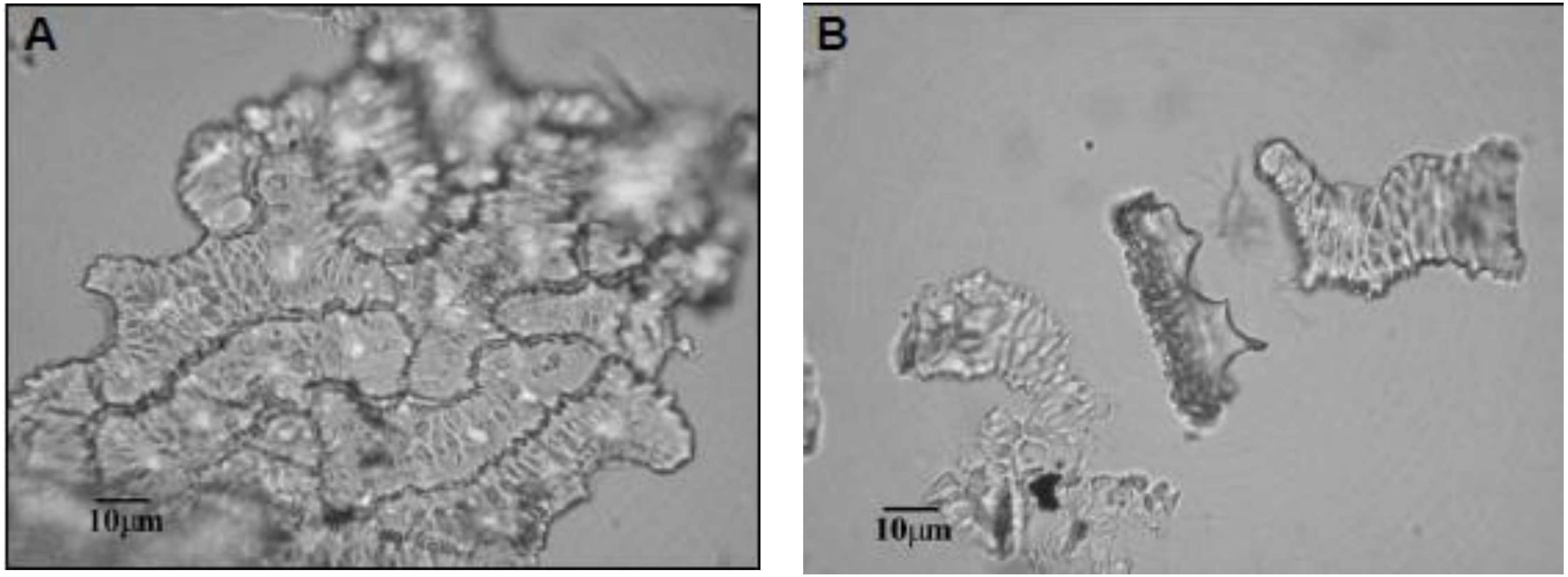
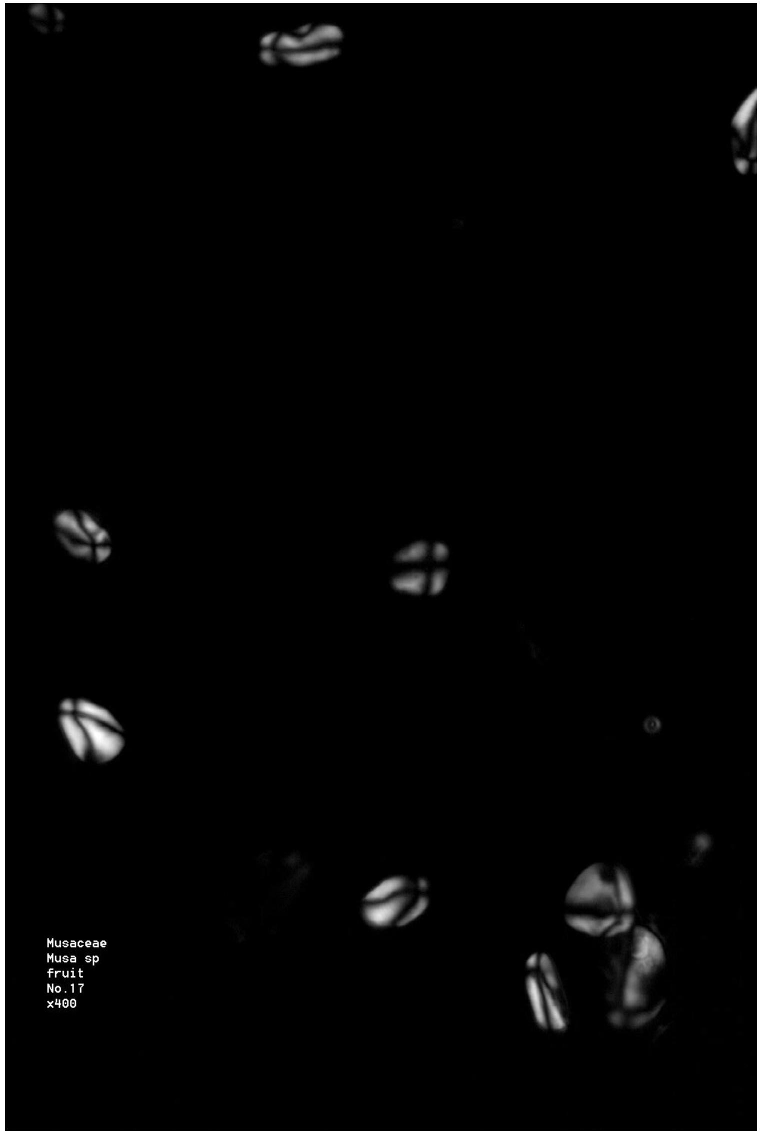


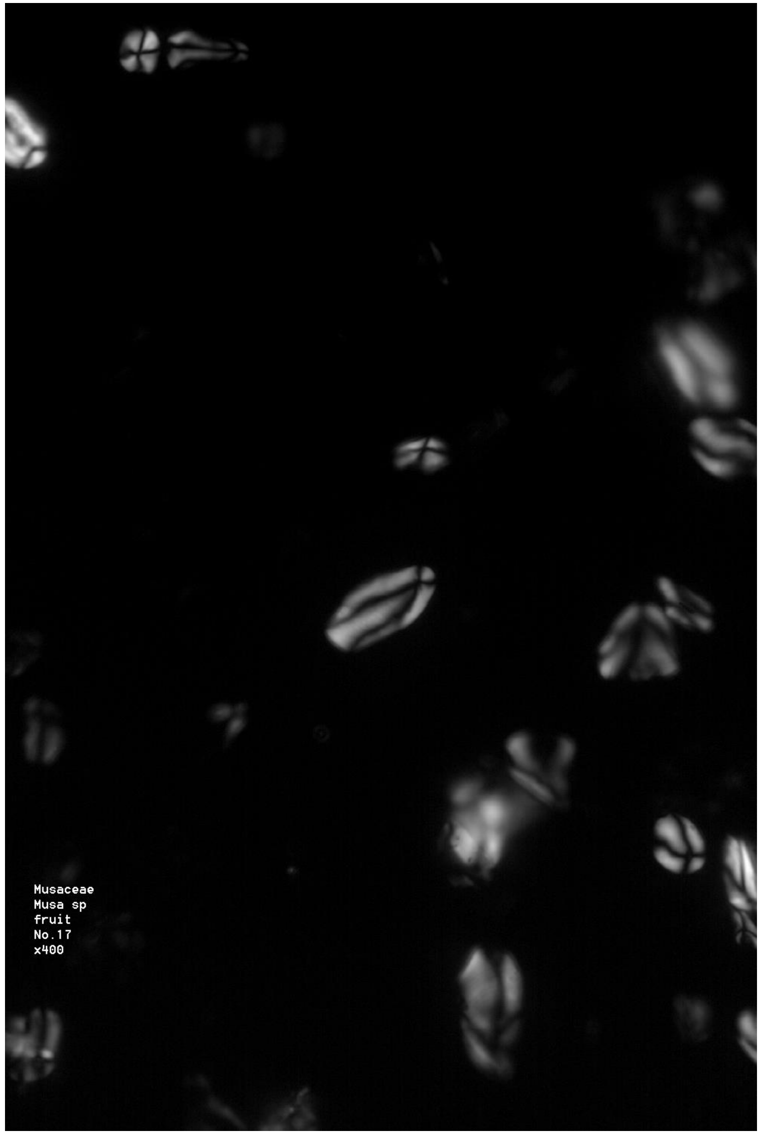
Figure 1. Diagnostic seed morphotypes of wild *Musa* bananas and *Ensete* from Papua New Guinea. A-B. *Ensete glaucum* (Accession No. QH28807)

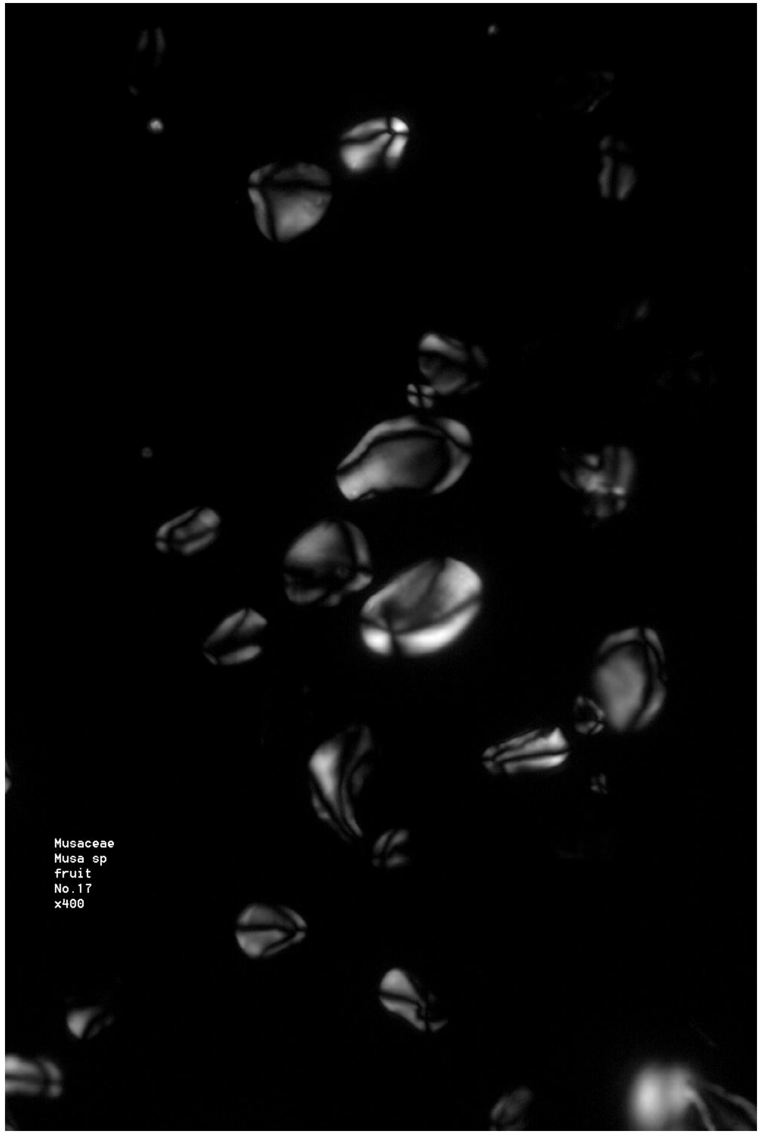
Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa sp.

Australian Museum,
McCown Archaeobotany
Laboratory Collection

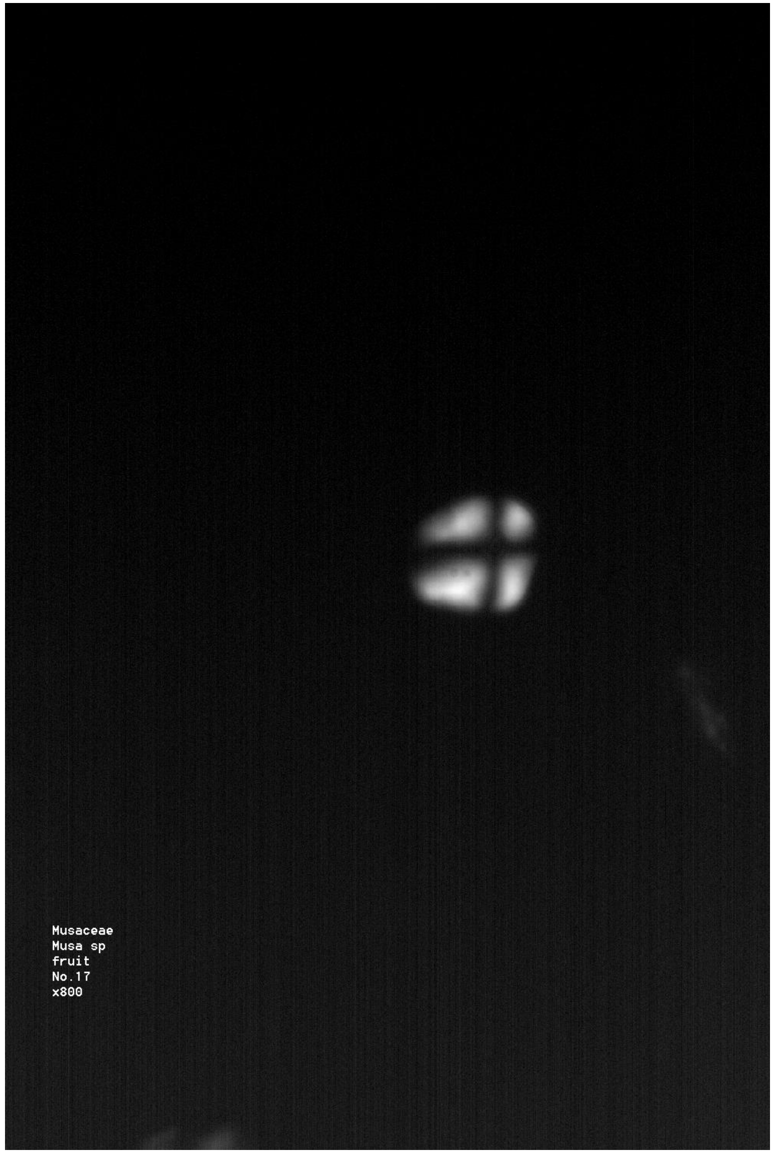


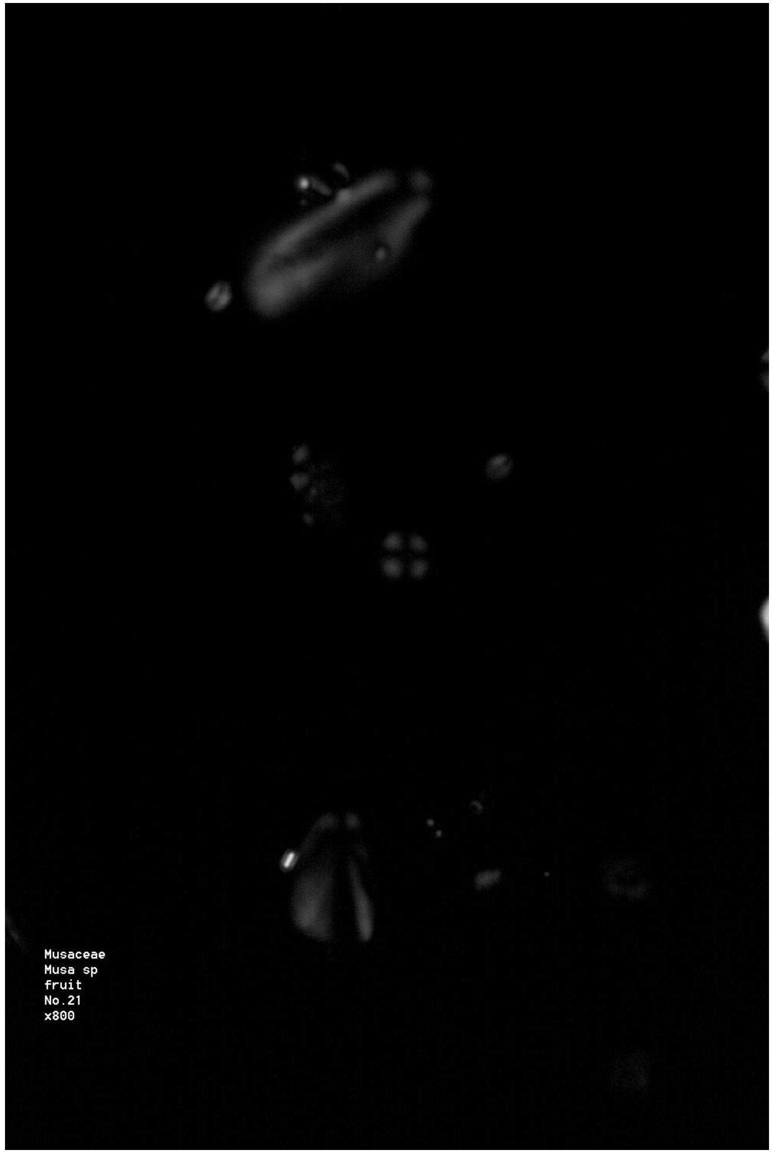


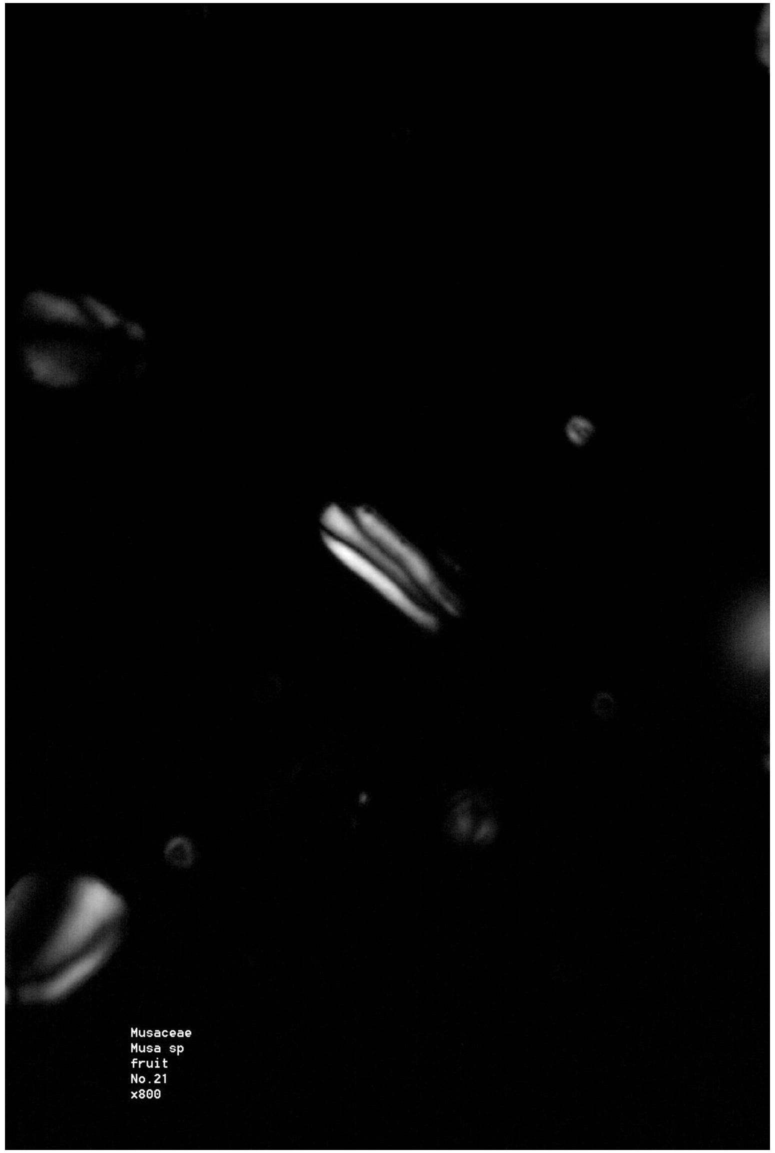


Musa sp.

Australian Museum,
McCown Archaeobotany
Laboratory Collection

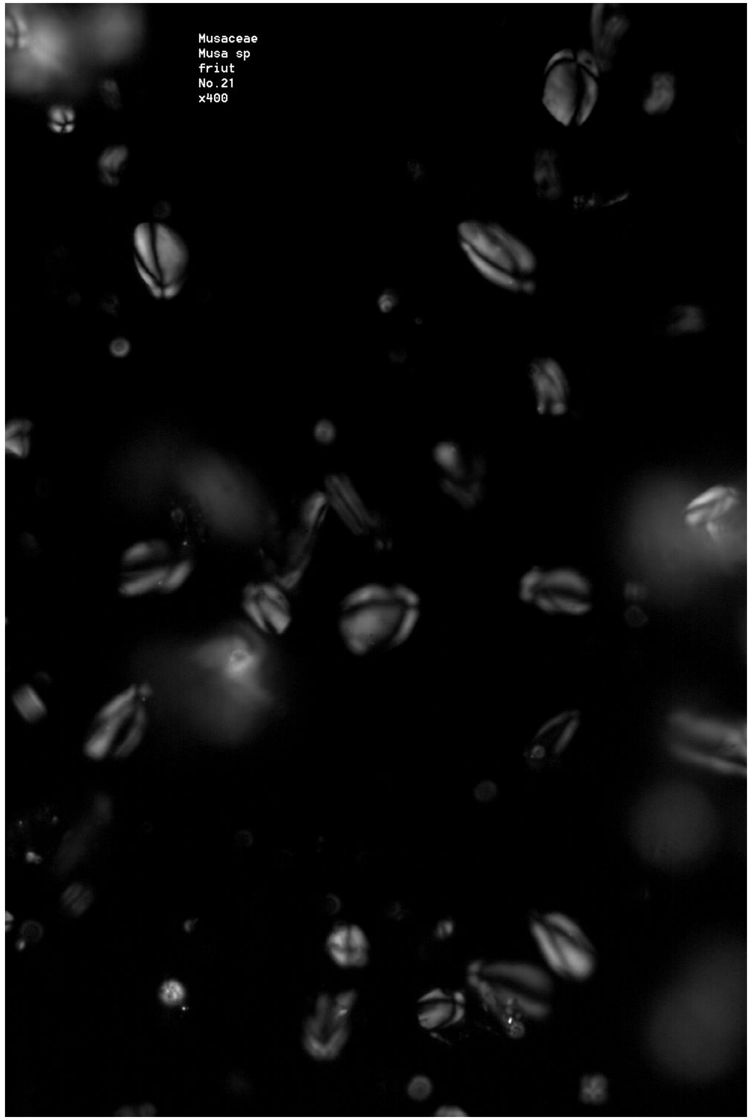


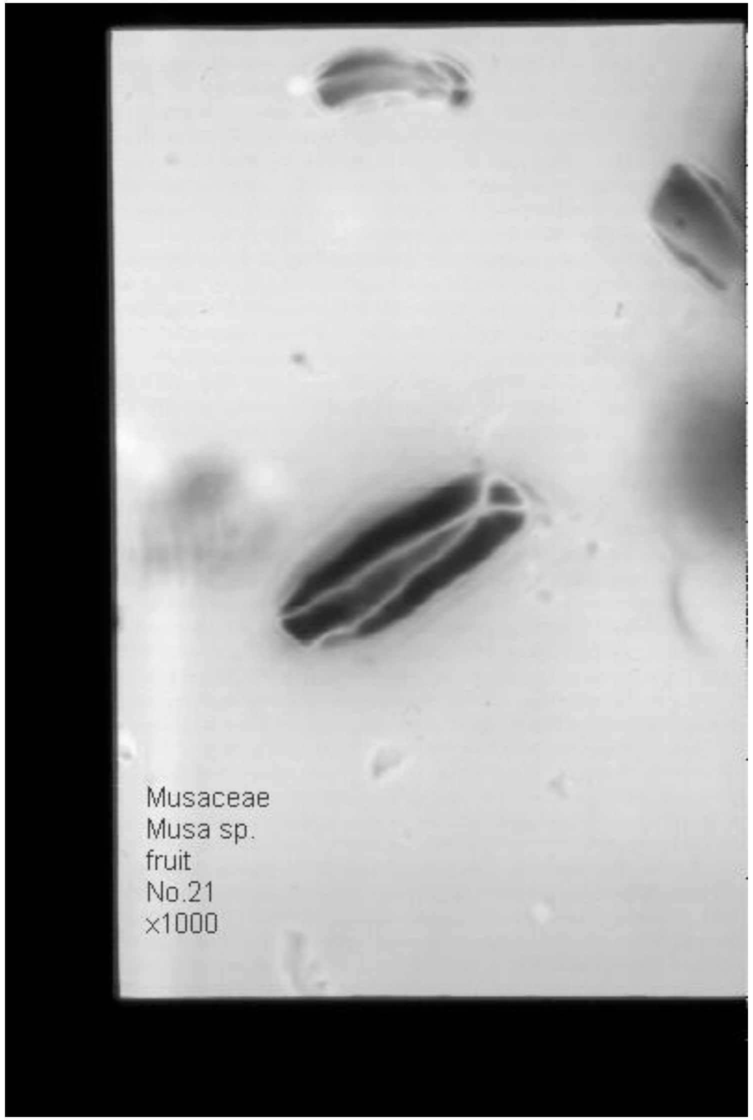


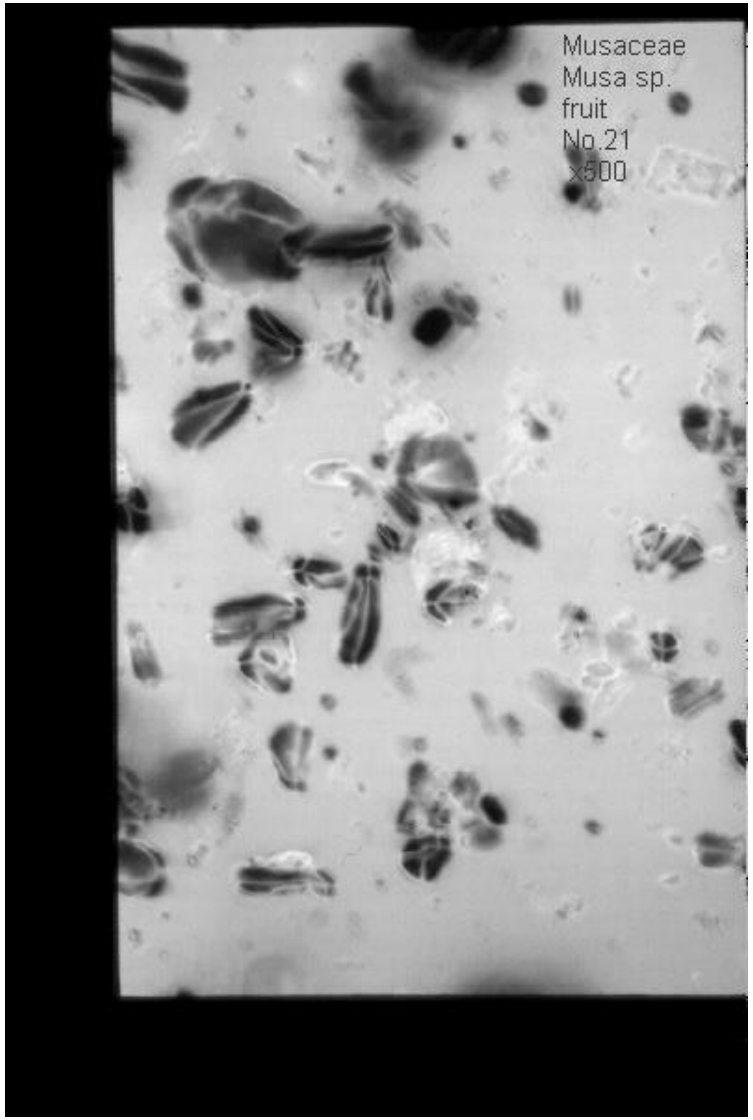


Musa sp.

Australian Museum,
McCown Archaeobotany
Laboratory Collection

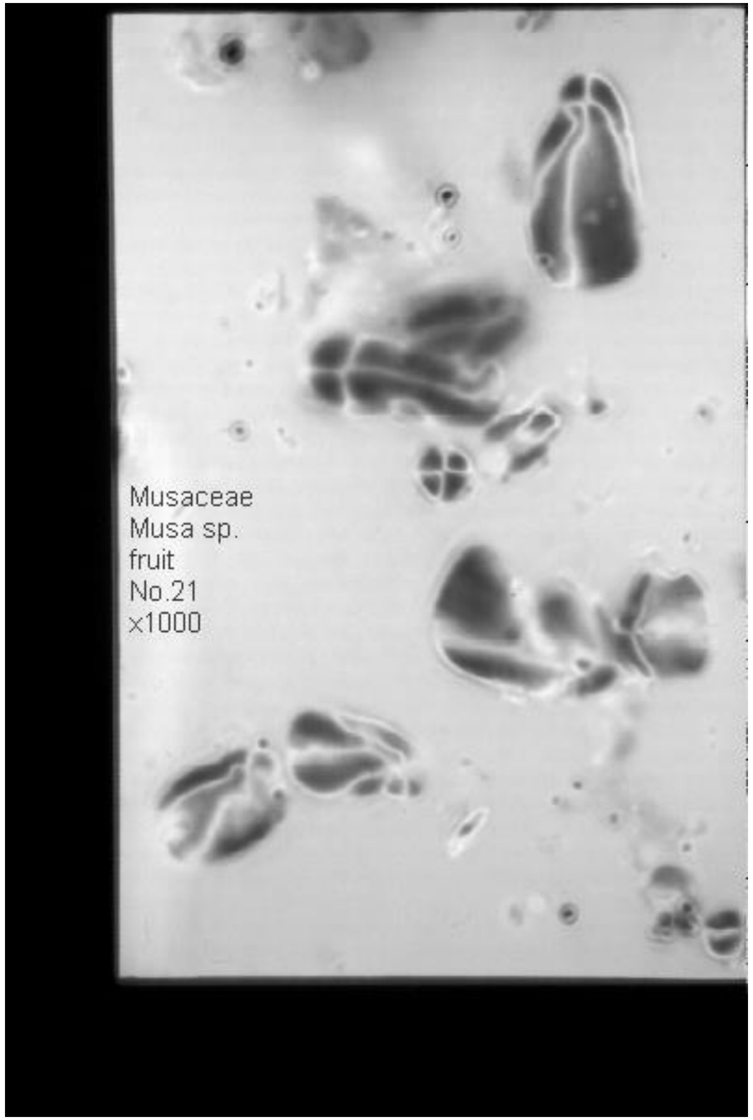


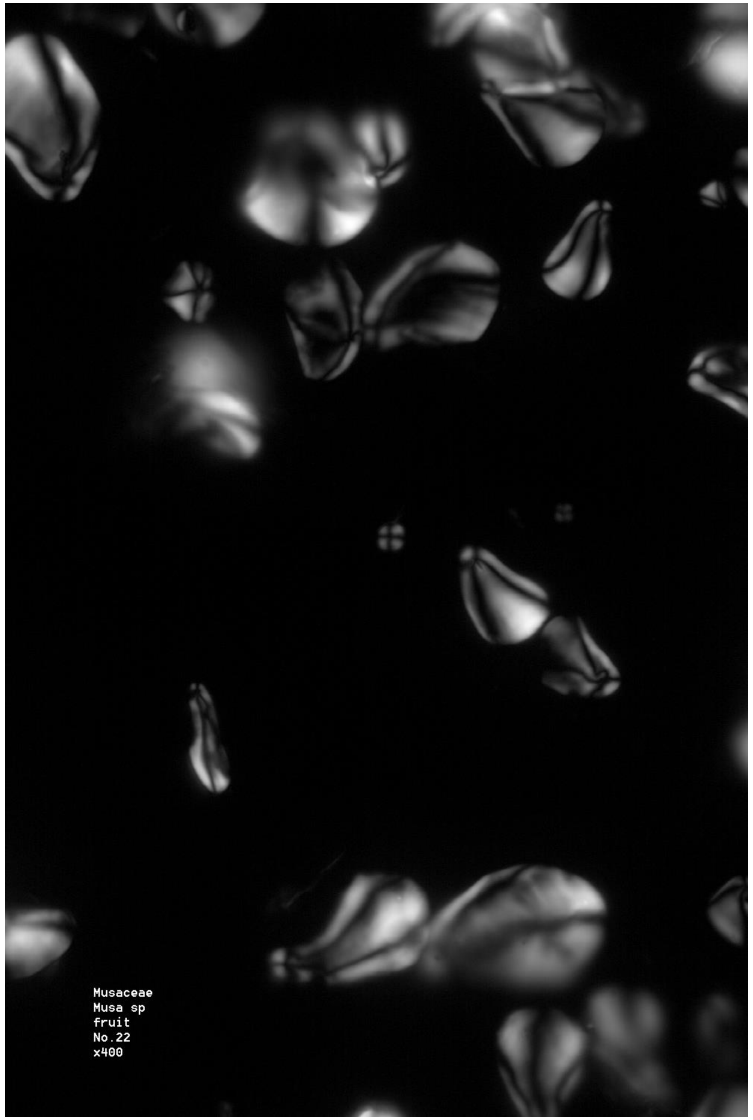


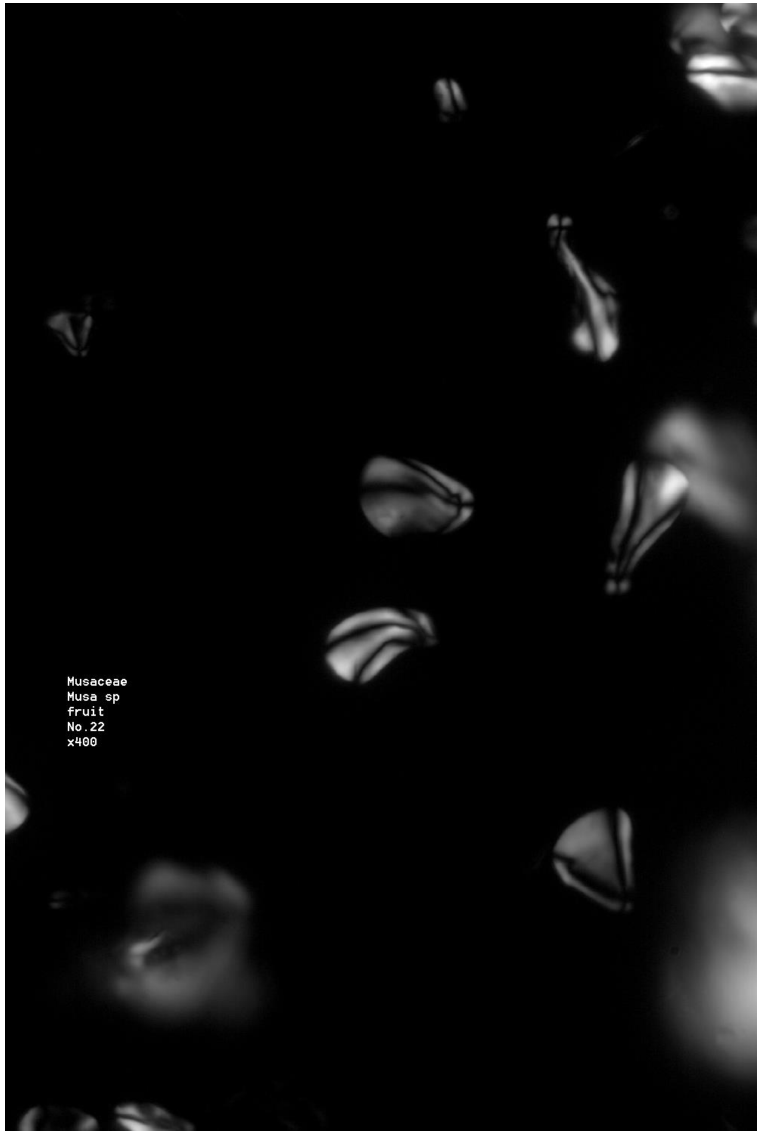


Musa sp.

Australian Museum, McCown Archaeobotany Laboratory Collection

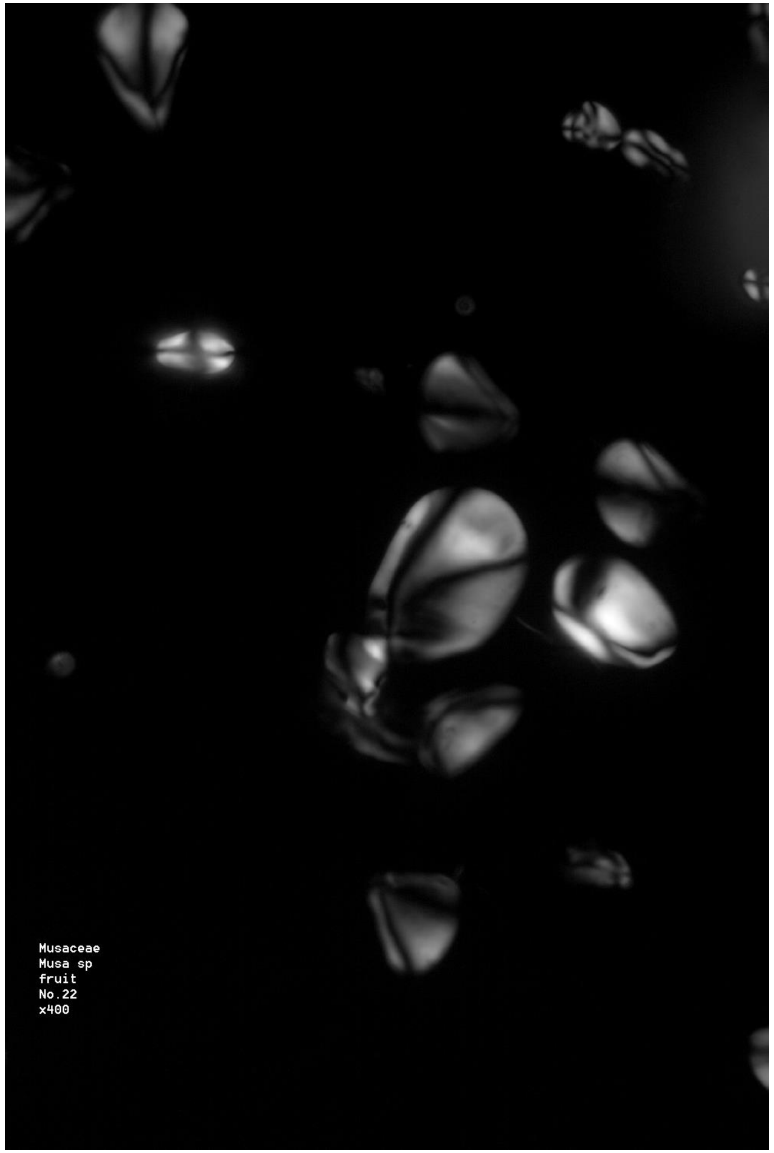


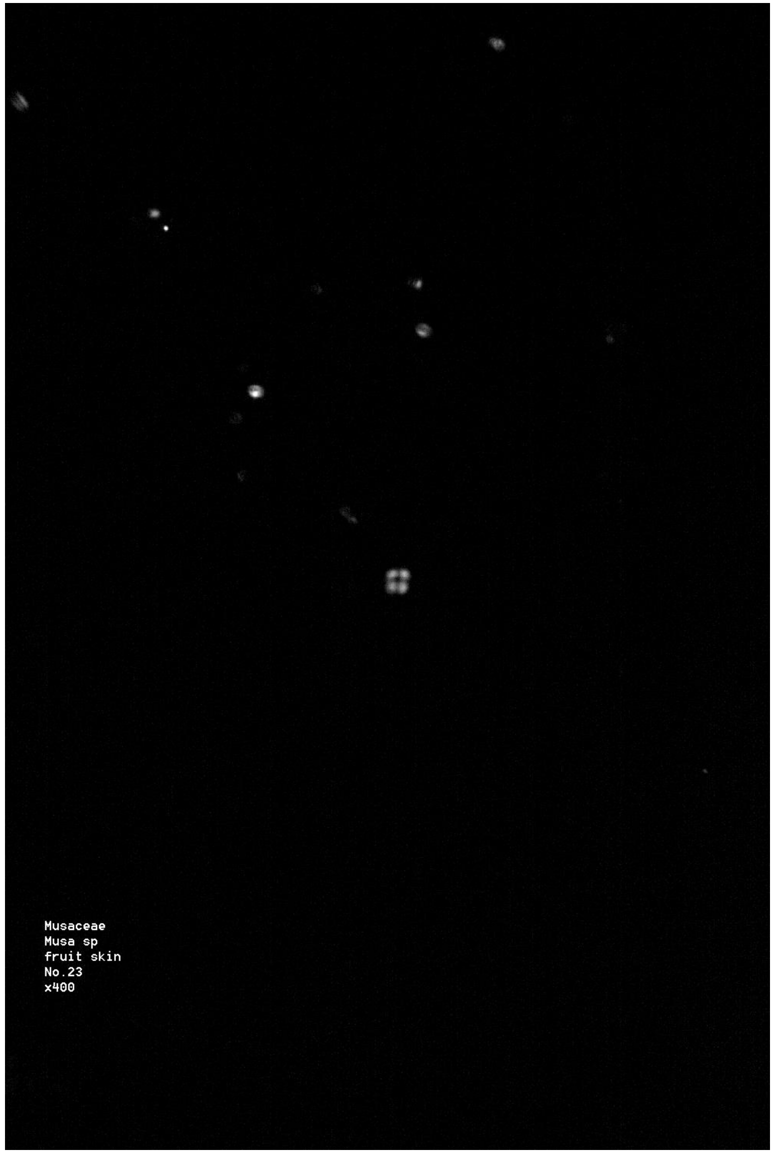


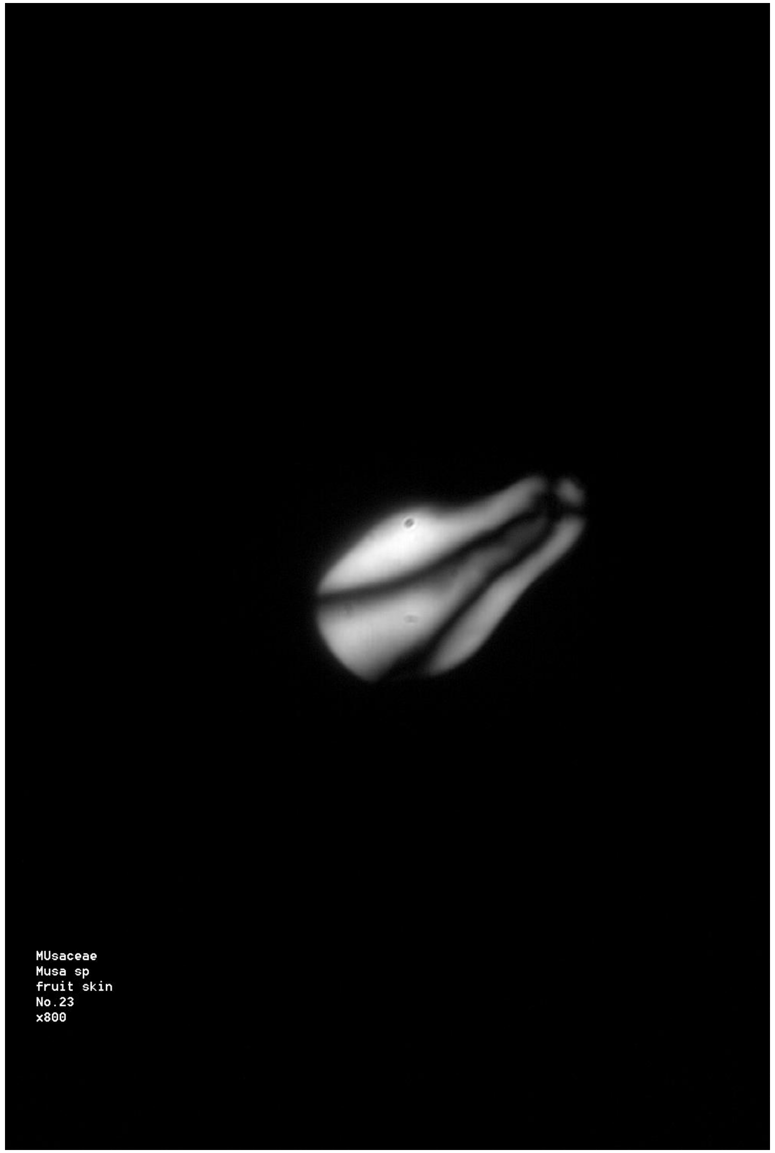


Musa sp.

Australian Museum,
McCown Archaeobotany
Laboratory Collection

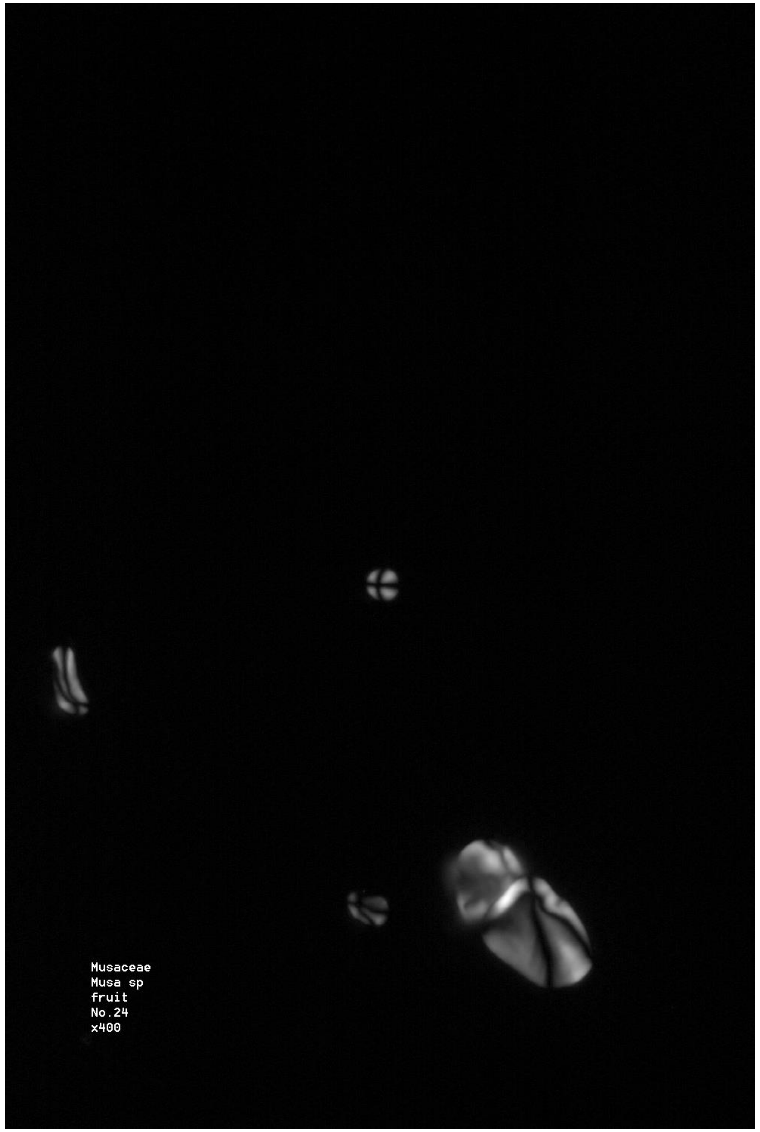


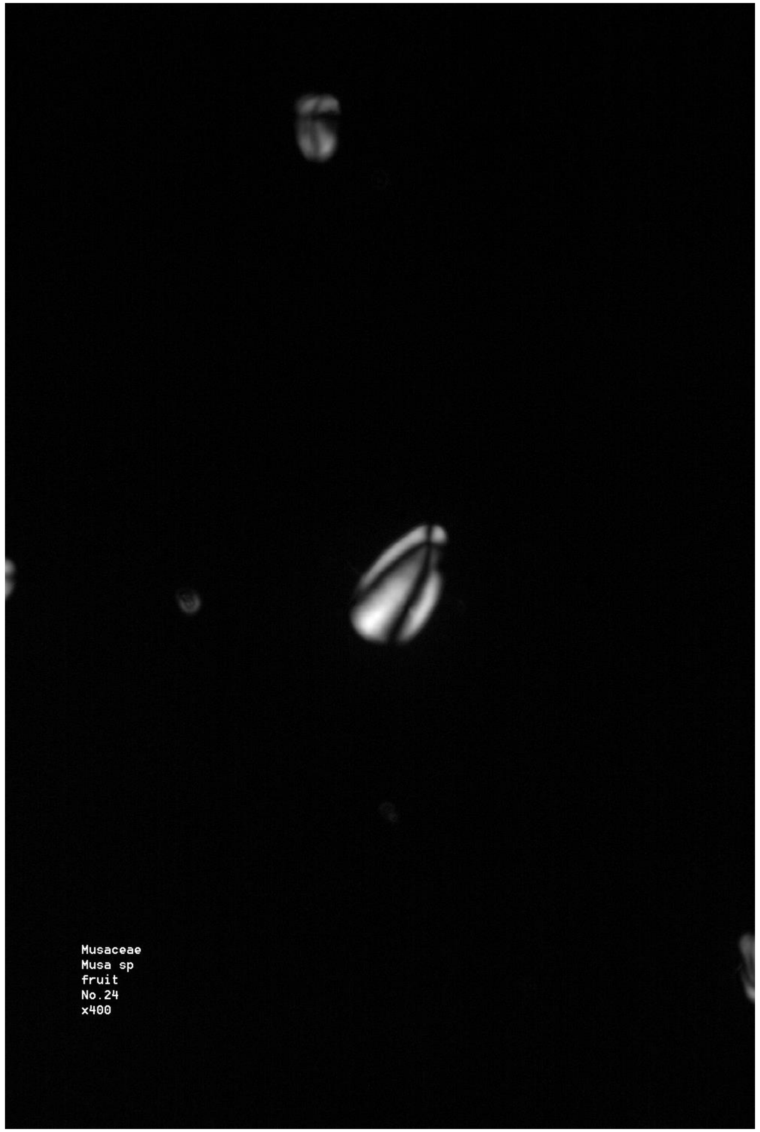




Musa sp.

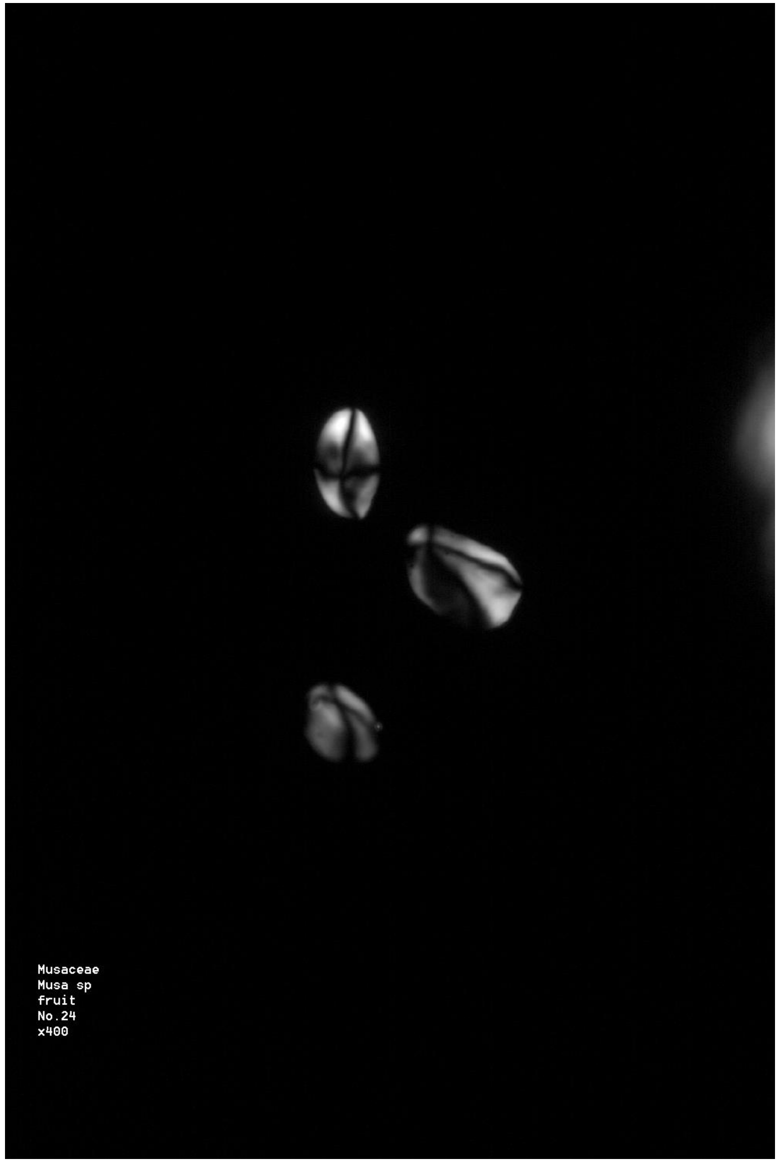
Australian Museum,
McCown Archaeobotany
Laboratory Collection

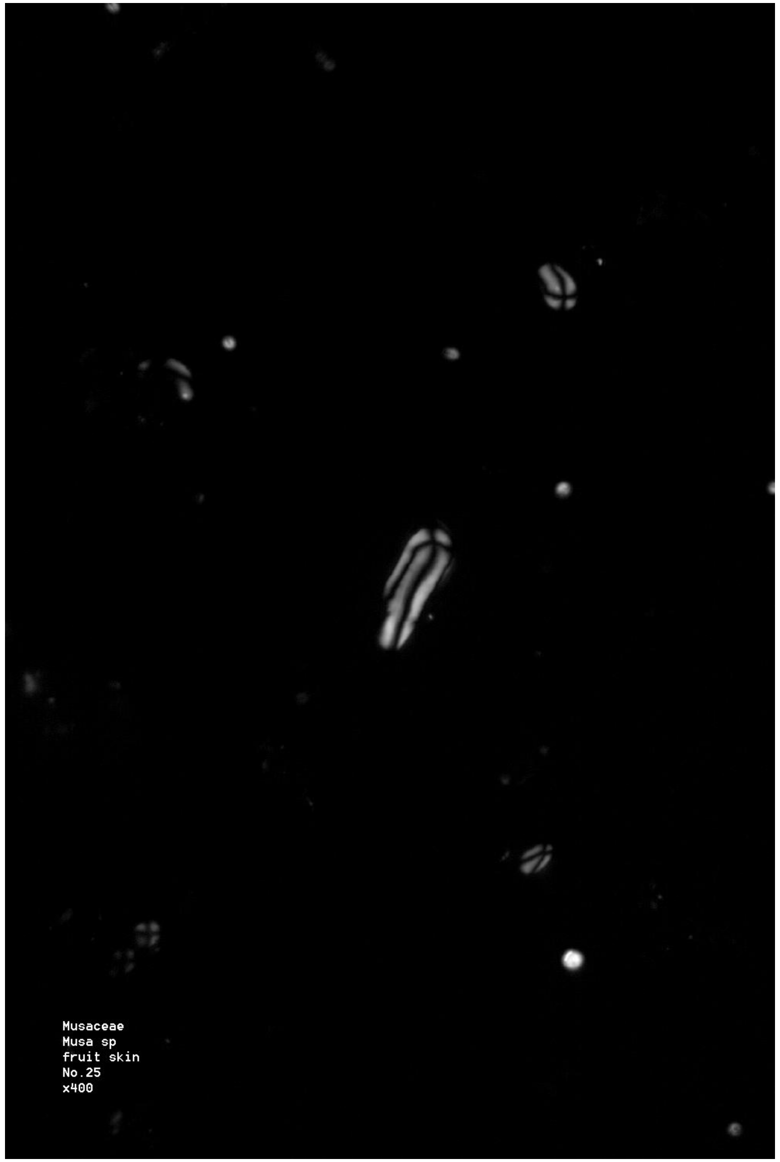




Musa sp.

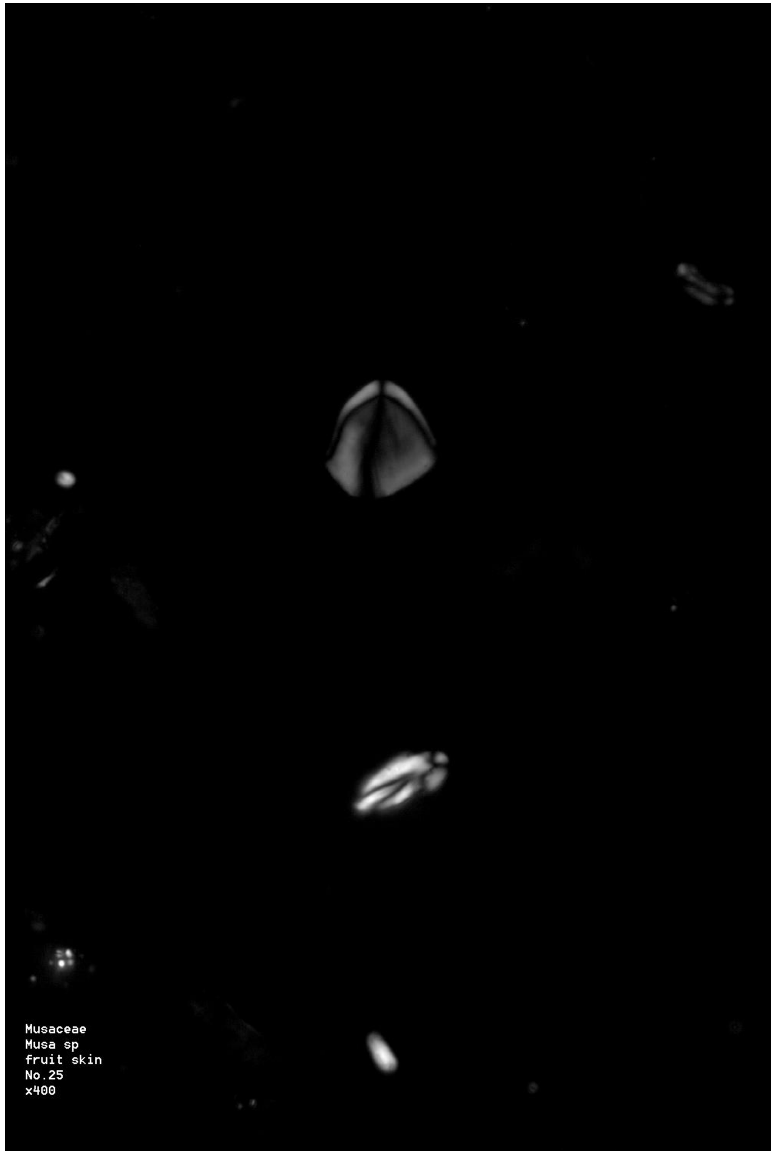
Australian Museum,
McCown Archaeobotany
Laboratory Collection





Musa sp.

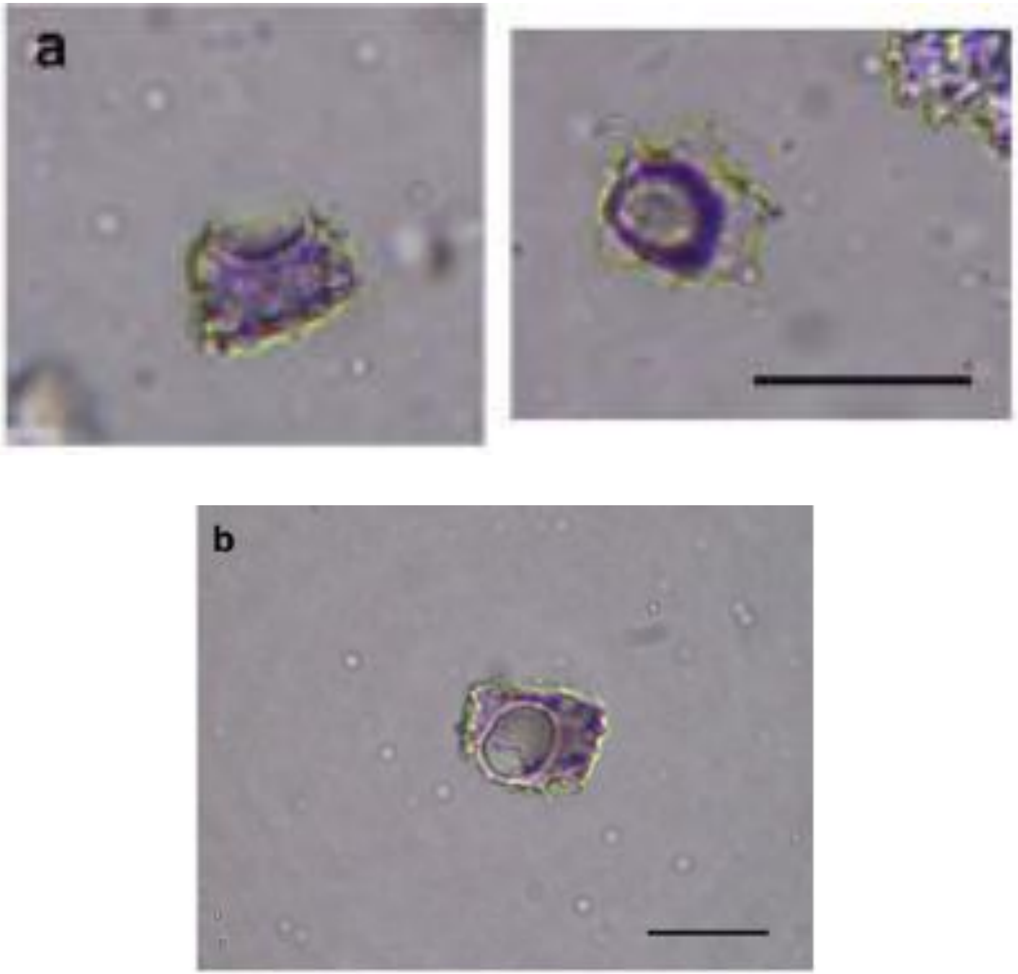
Australian Museum,
McCown Archaeobotany
Laboratory Collection



Musa sp.

Phytolith

Fig. 7. Plant microfossils from Kona (a, b mounted in Caedax; c–h mounted in glycerol jelly; 100x,400x or 600x; scale bars: 20 mm). (a, b) Musa leaf phytoliths showing rectangular/squarish base with protuberances all along the sides of the base and truncated cone (c.f. Fig. 8a, b). Of the three examples shown here, two are viewed looking down into the cone (a, right panel; b) and the other (a, left panel) looking at the cone side-on.

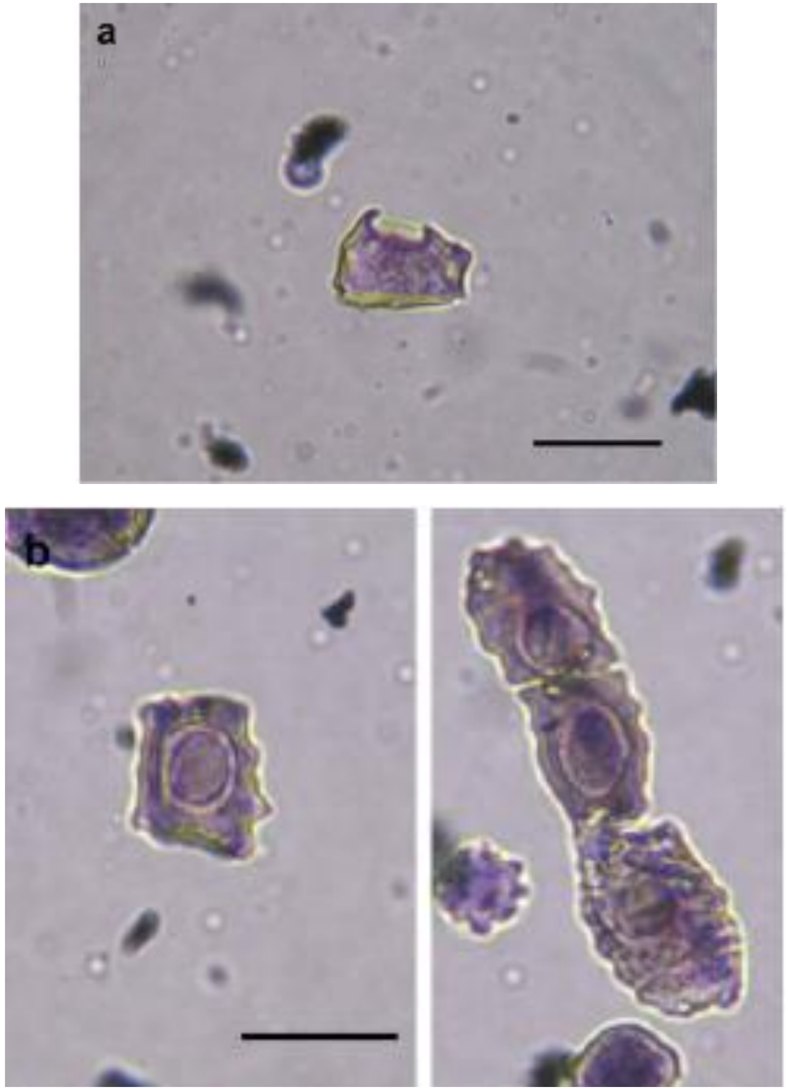


Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Musa sp.

Phytolith

Fig. 8. Modern reference samples ((a, b mounted in Caedax; c–f mounted in glycerol jelly; 400x or 600x; scale bars: 20 mm). (a, b) Musa (AAB group) leaf phytoliths. For detailed descriptions see Mindzie et al. (2001) and Ball et al. (2006). Musa leaf phytoliths consist of a base (mostly rectangular or squarish) with protuberances all along the sides of the base and a raised truncated cone or sub-cylinder (crater). Right panel of (b) shows three phytoliths in a chain, as they form in the leaf. Of the five examples shown here, four are viewed looking down into the crater (b) and the other (a) looking at the crater side-on.

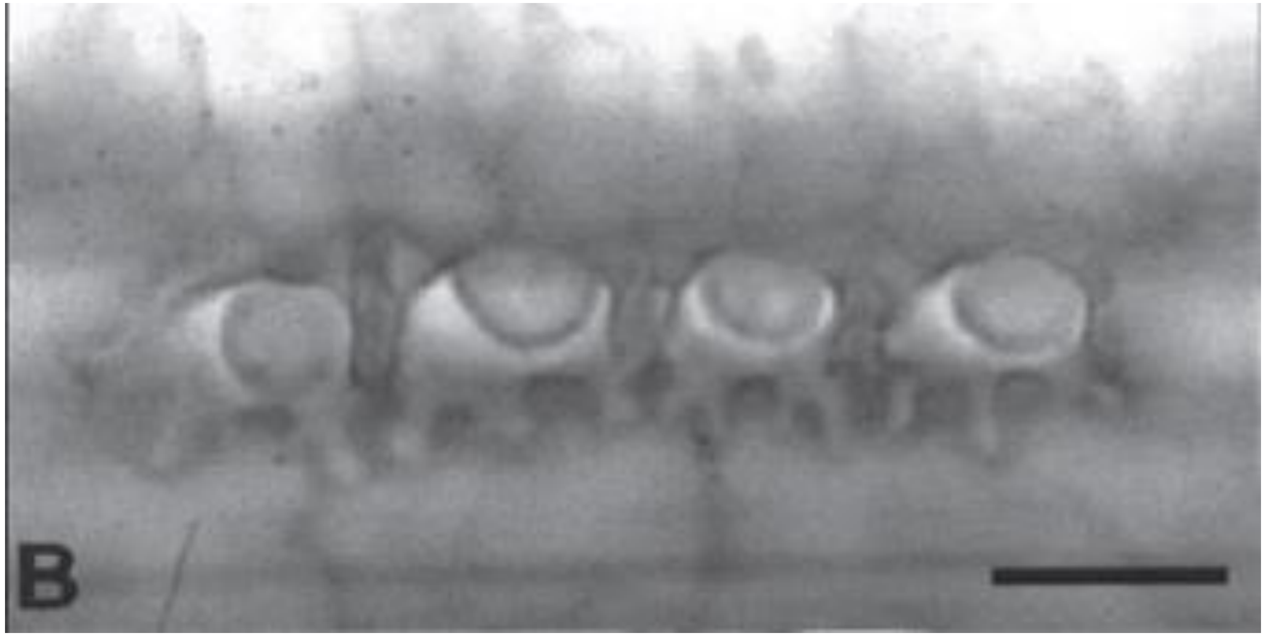


Horrocks, Mark, and Robert B. Rechtman. 2009. Sweet Potato (Ipomoea Batatas) and Banana (Musa Sp.) Microfossils in Deposits from the Kona Field System, Island of Hawaii. *Journal of Archaeological Science* 36 (5). Elsevier Ltd:1115–26. http://dx.doi.org/10.1016/j.jas.2008.12.014.

Musa sp.

Phytolith

Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. B. Musa sp. (Musaceae), trough-shaped silica bodies with silica fingers projecting from the base into cell-wall pits (bar = 10µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Musa sp.

Phytolith

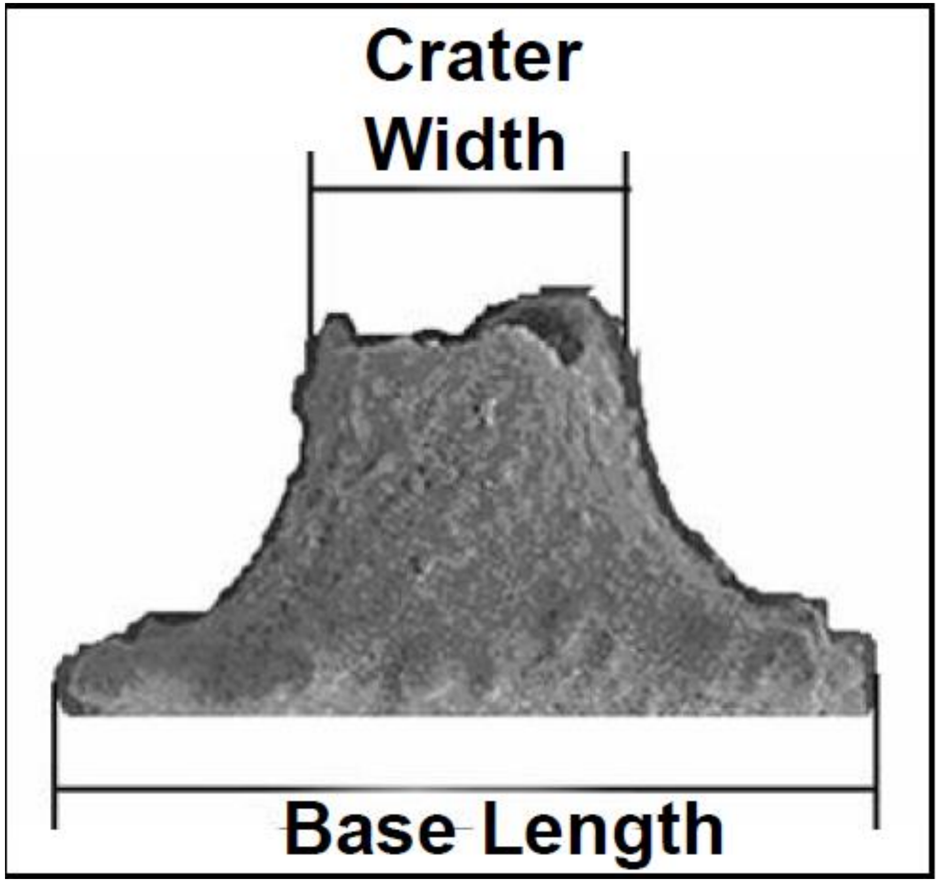


Figure 1. Parameters used for morphometric analysis of volcaniform banana phytoliths

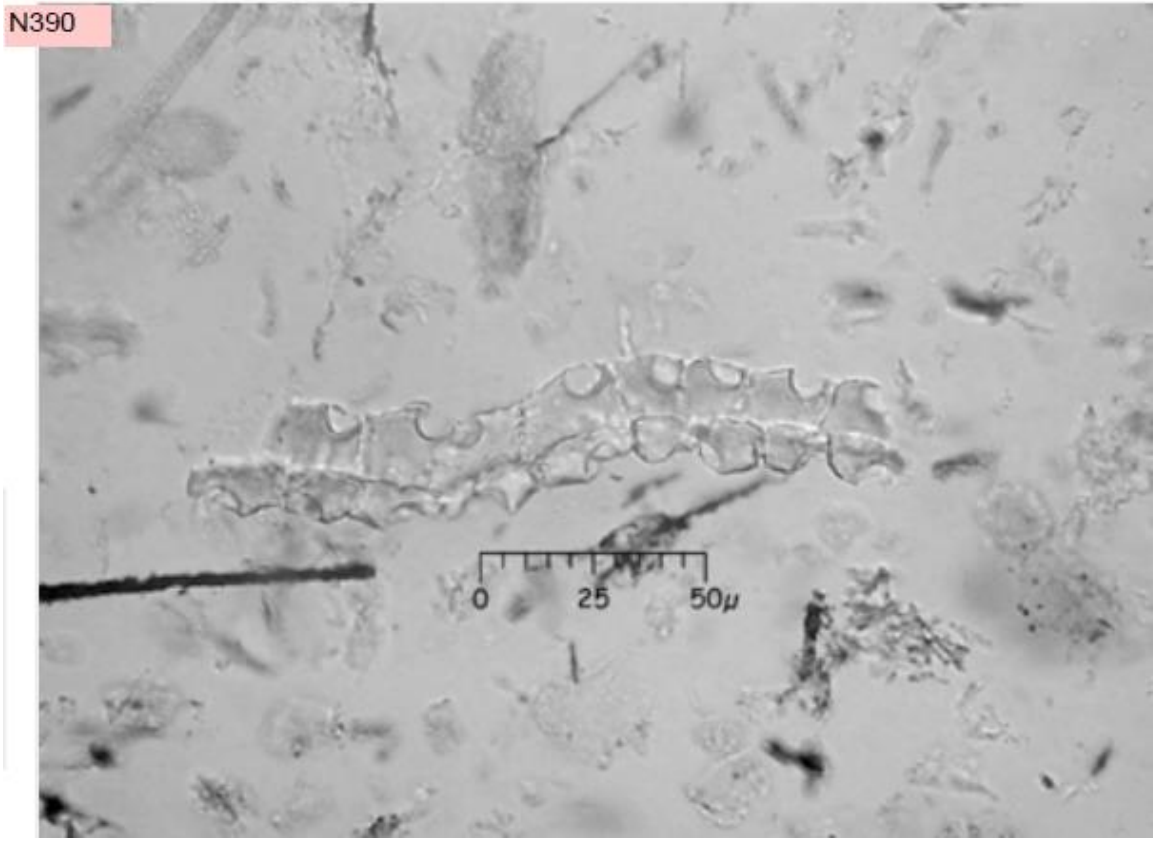
Vrydaghs, L., Terry B. Ball, H. Volkaert, I. Van Den Houwe, J. Manwaring, and E. De Langhe. 2009. Differentiating the Volcaniform Phytoliths of Bananas: Musa Acuminata. *Ethnobotany Research and Applications* 7:239–46.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa sp.

Phytolith

Musa, cultivated banana leaf. Check depth of trough to separate from just extremely rugulose spheres. Should be thick and blocky.
Diagnostic level: genus

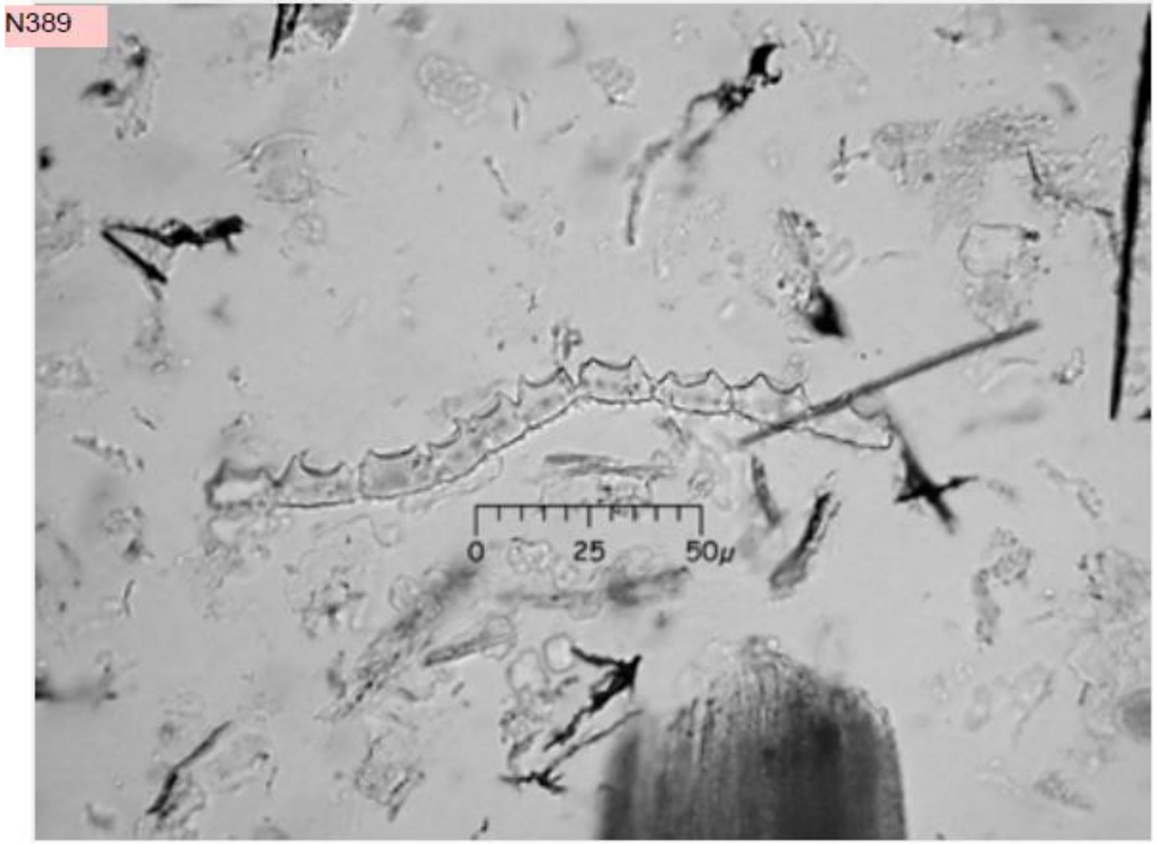


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Musa sp.

Phytolith

Musa, cultivated banana leaf. Often occur in chains. Should be thick and blocky.
Diagnostic level: genus

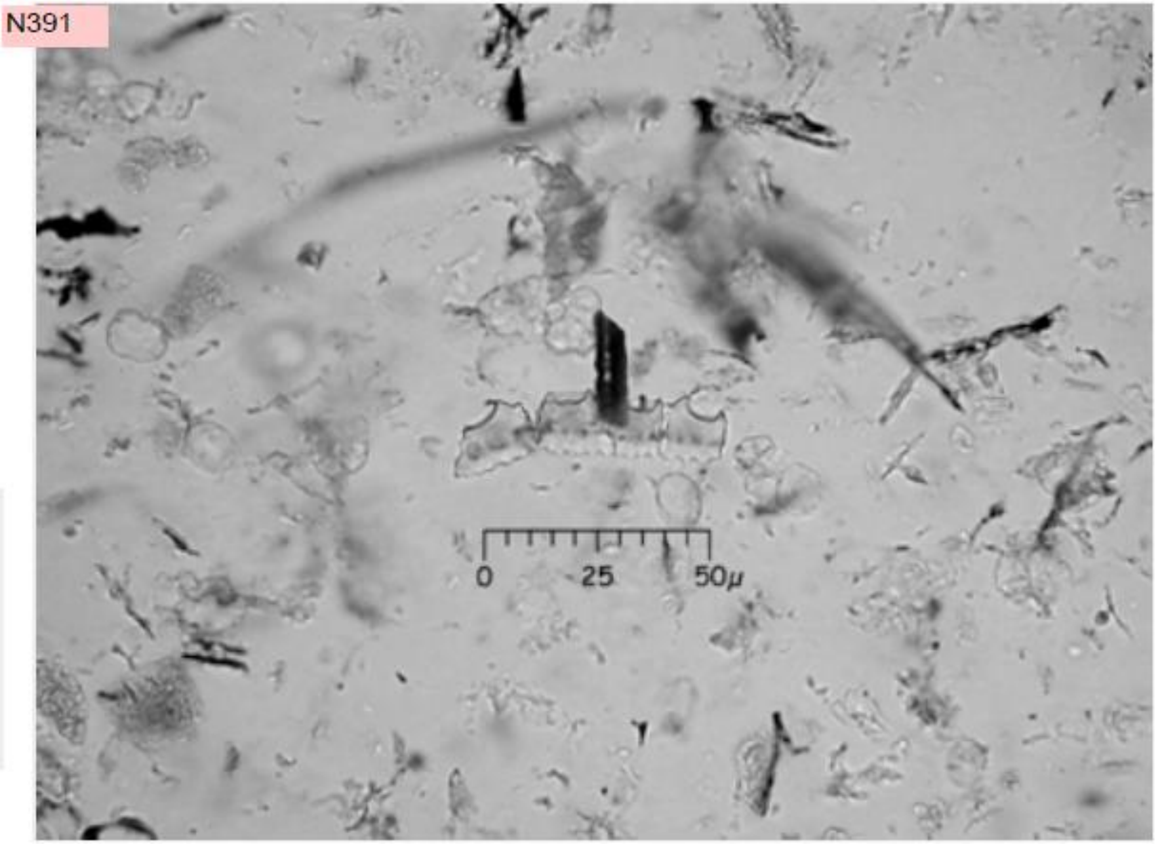


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Musa sp.

Phytolith

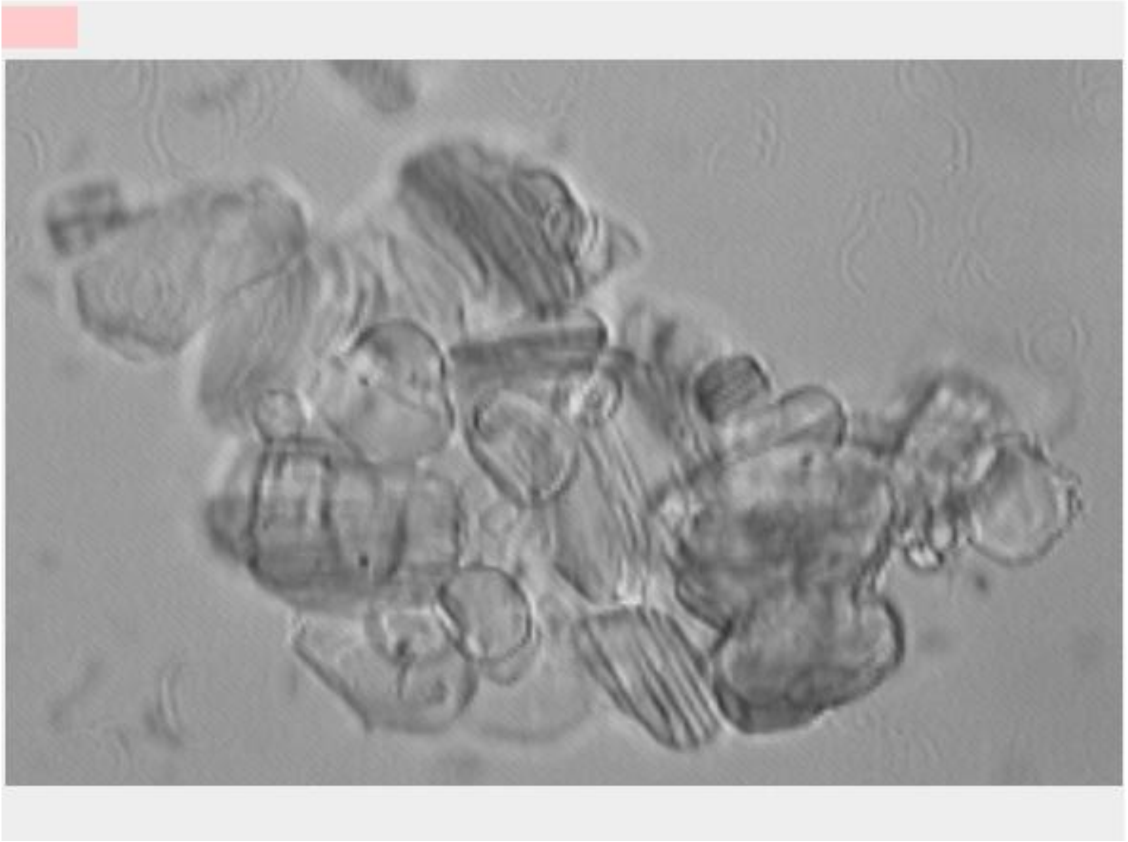
Musa, cultivated banana leaf. Should be thick and blocky.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Musa sp.

Phytolith

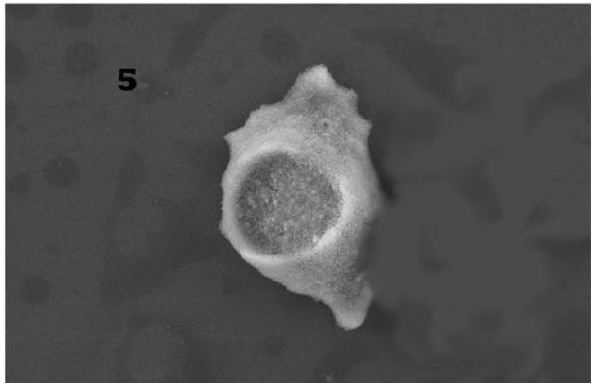


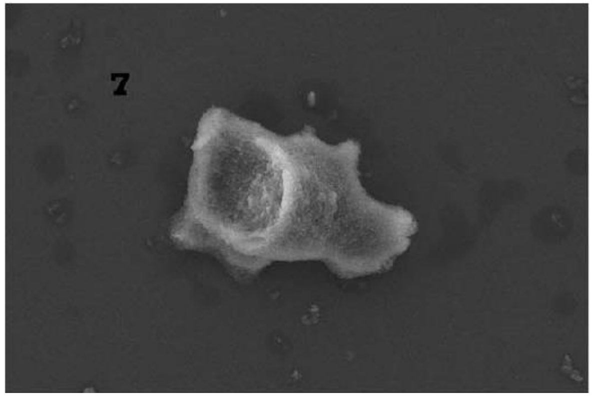
probably calcium carbonate (CaCO3) crystals.
Also observed in Fabaceae, Flaucortiaceae, and Bombacaceae families.
Diagnostic level: not diagnostic

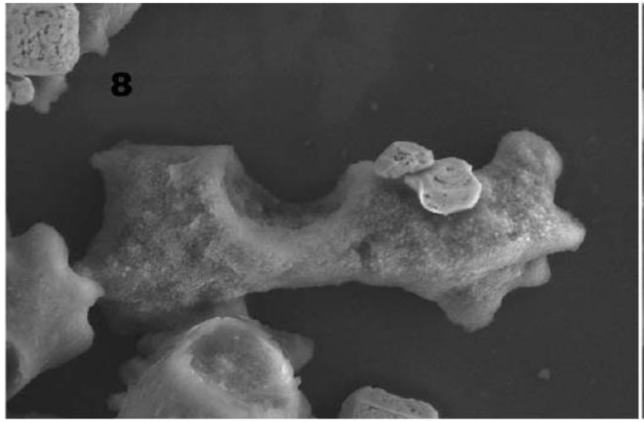
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

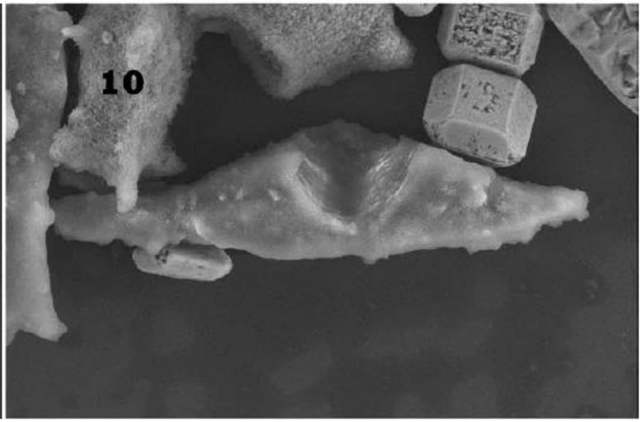
Musa sp. (ITC 0614, a triploid variety)

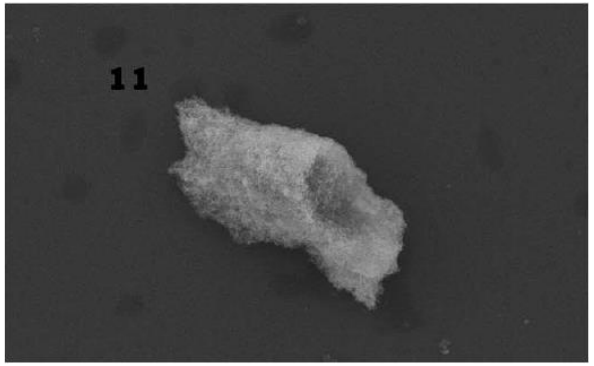
Phytolith











Figs. 1-6. (5) SEM of phytolith produced by ITC 0614, a triploid variety: Variant 2 volcaniform irregular base central concave cone, top view.

Figs. 7-12. (7) SEM of phytolith produced by ITC 0614, a triploid variety: Variant 4 volcaniform irregular base acentric concave cone, top view. (8) SEM of phytolith produced by ITC 0614, a triploid variety: Variant 5 volcaniform regular base central convex cone, side view. (10) SEM of phytolith produced by ITC 0614, a triploid variety: Variant 7 volcaniform irregular base central convex cone, side view. (11) SEM of phytolith produced by ITC 0614, a triploid variety: Variant 8 volcaniform irregular base acentric convex cone, side view.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa acuminata ssp.banksii

Phytolith

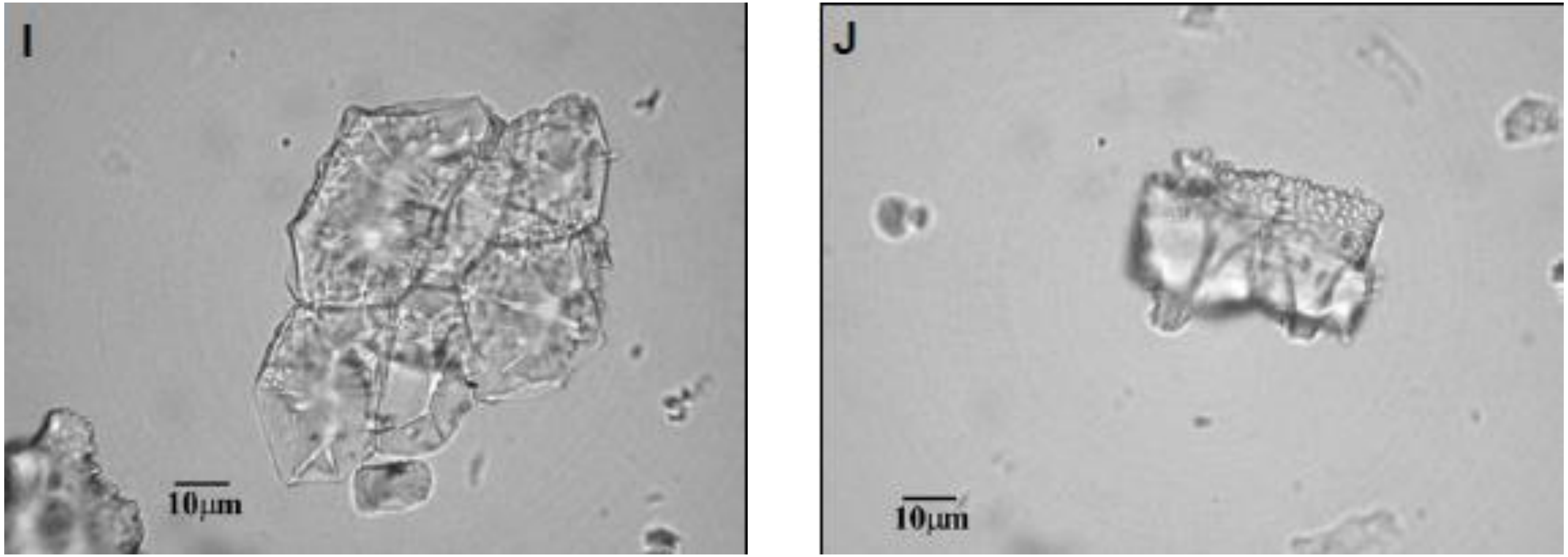


Figure 1. Diagnostic seed morphotypes of wild *Musa* bananas and *Ensete* from Papua New Guinea. I-J. Musa acuminata ssp.banksii, Section Eumusa (Accession No. QH067962)

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa acuminata ssp.banksii

Phytolith

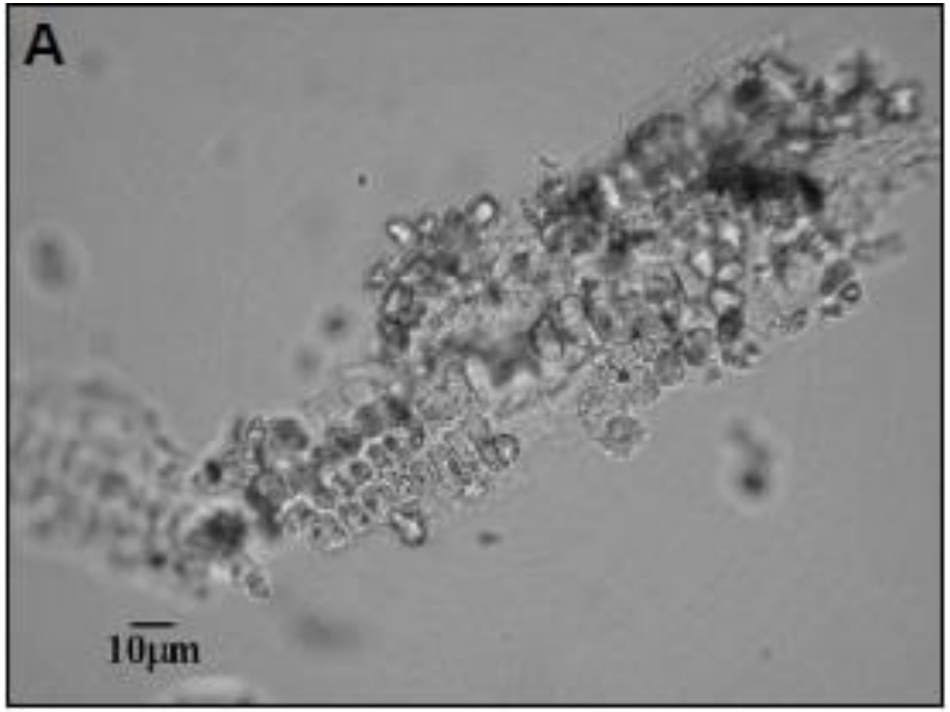
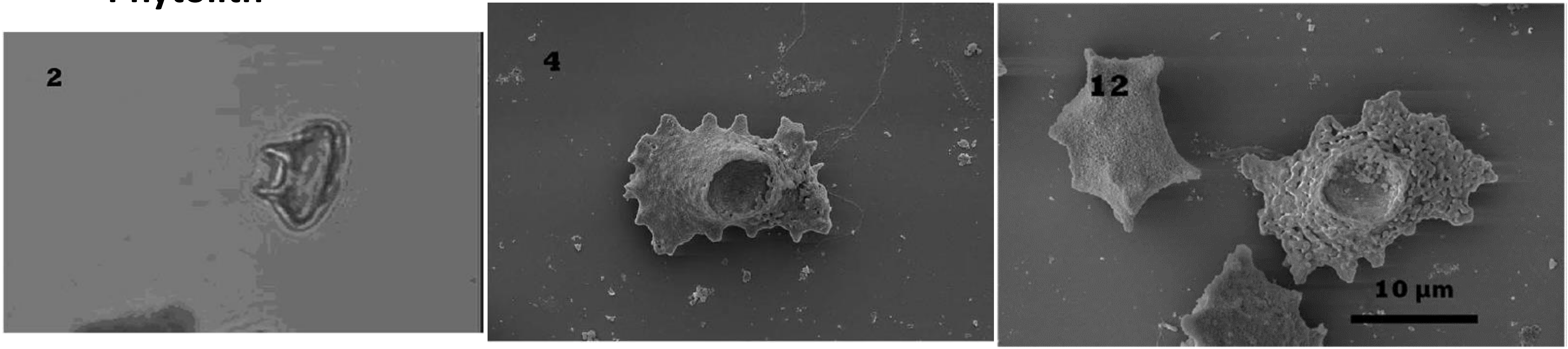


Figure 2. A. Sheet of polygonal and globular seed phytoliths from Musa acuminata ssp. banksii. These morphotypes have craters and were included in the analysis. The plant material was obtained from the Queensland Herbarium (Accession No. QH067962).

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa acuminata ssp.banksii

Phytolith

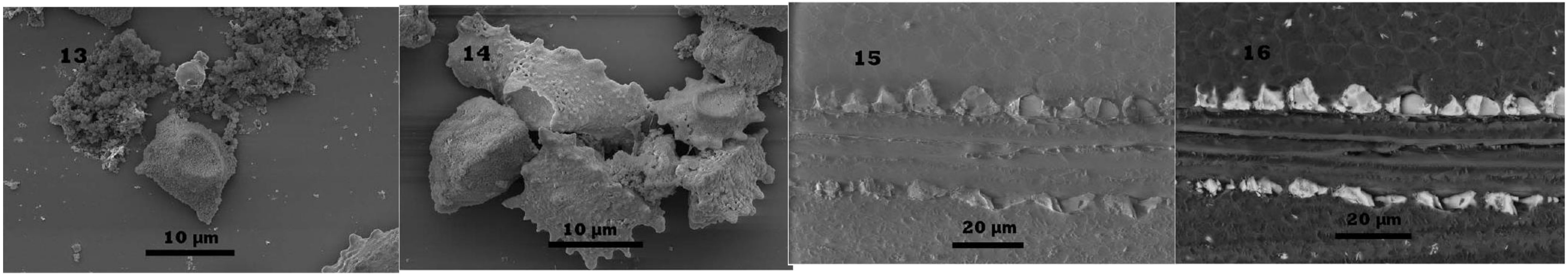


Figs. 1-6. (2) Light micrograph of volcaniform phytolith produced by M. acuminata ssp. banksii: side view. (4) SEM of phytolith produced by M. acuminata ssp. banksii: Variant 1 volcaniform regular base central concave cone, top view.
Figs. 7-12. (12) SEM of volcaniform phytoliths produced by M. acuminata ssp. banksii illustrating granulate to verrucate surface texture.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa acuminata ssp.banksii

Phytolith

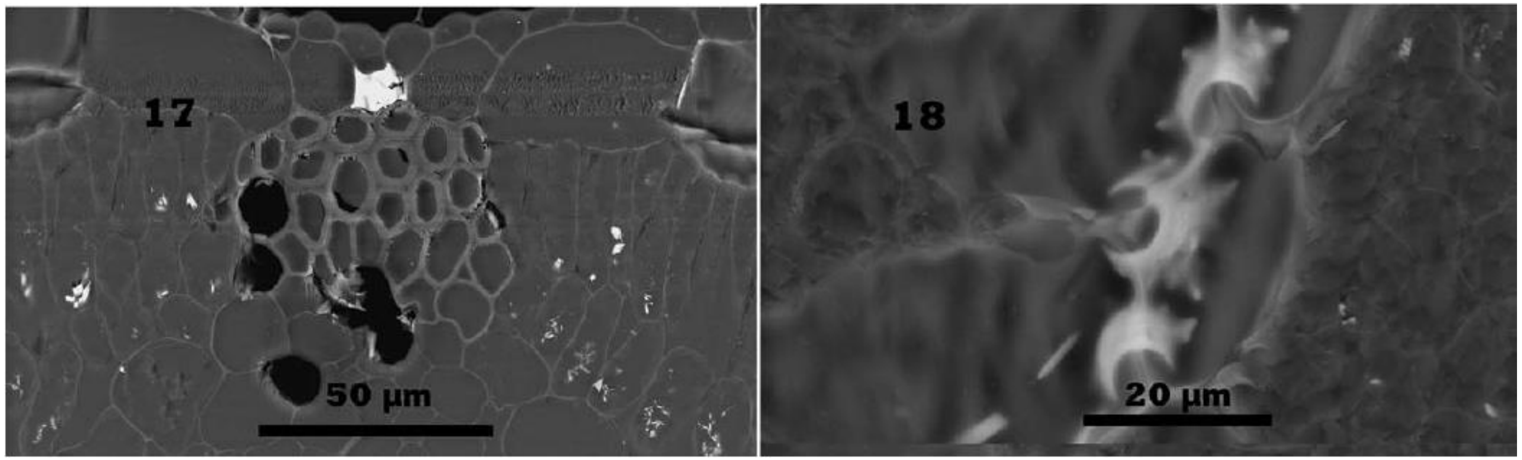


Figs. 13-18. (13) SEM of volcaniform phytolith produced by M. acuminata ssp. banksii with entire base margins. (14) SEM of volcaniform phytoliths produced by M. acuminata ssp. banksii illustrating ornamented bases. (15) SEM of in situ volcaniform phytoliths from Musa acuminata ssp. banksii illustrating their arrange- ment along the fibers of the vascular bundle sheath. Secondary Electron Image. (16) SEM of in situ volcaniform phytoliths from Musa acuminata ssp. banksii illustrating their arrangement along the fibers of the vascular bundle sheath. Phytoliths are the bright structures. Note how they were fractured in sectioning. Back- scattered Electron Image. Phytoliths are the bright structures. Backscattered Electron Image.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa acuminata ssp.banksii

Phytolith

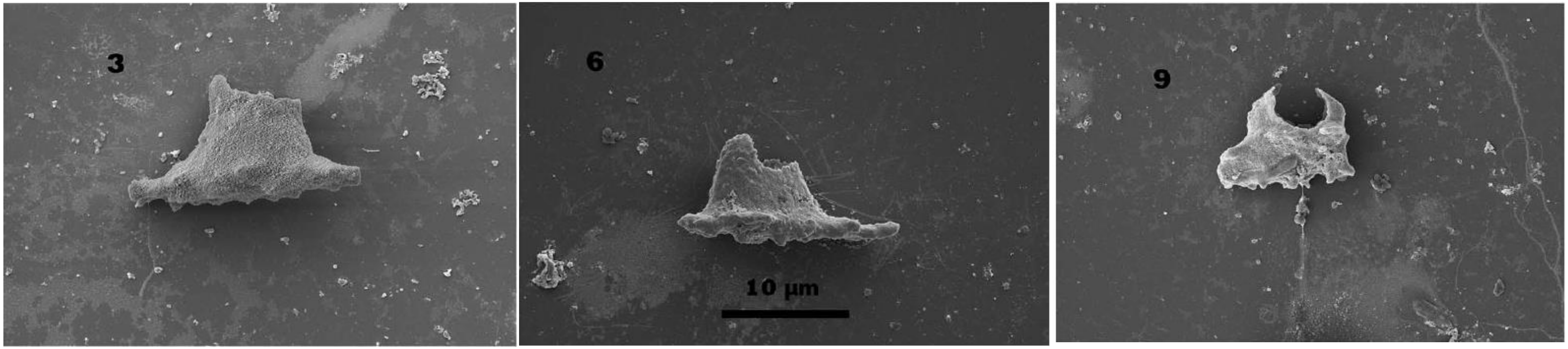


Figs. 13-18. (17) SEM of in situ volcaniform phytolith in cross section from Musa acuminata ssp. banksii illustrating orientation along the fibers of the vascular bundle cap. Phytolith is the large bright structure on top of the thick-walled fibers. Backscattered Electron Image. (18) SEM of in situ volcaniform phytoliths from Musa acuminata ssp. banksii illustrating their attachment to surrounding parenchyma cells. Phytoliths are the bright structures. Backscattered Electron Image.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa balbisiana

Phytolith



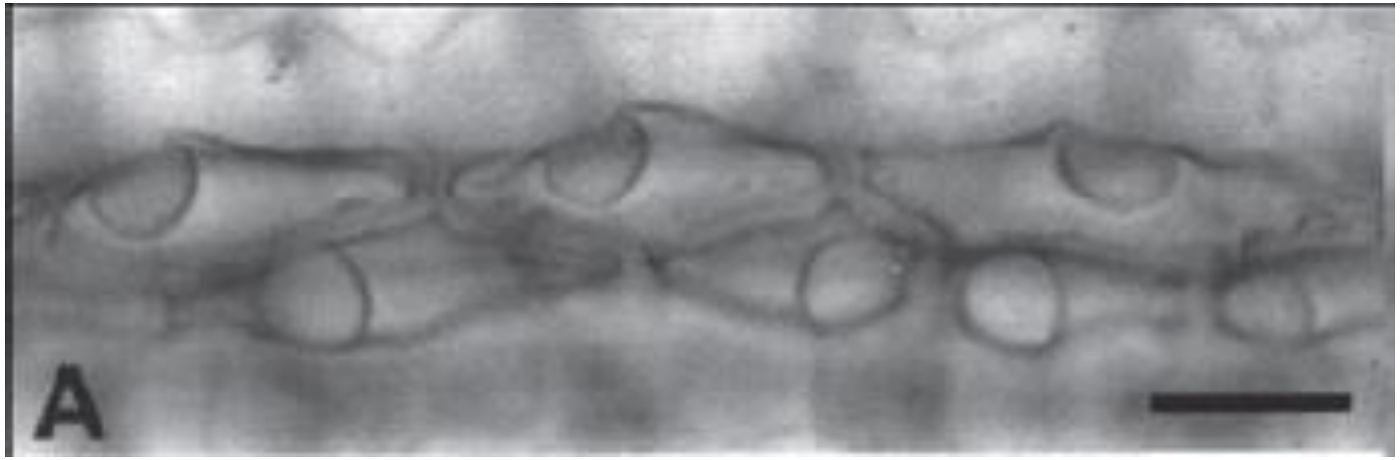
Figs. 1-6. (3) SEM of volcaniform phytolith produced by M. balbisiana: side view. (6) SEM of phytolith produced by M. balbisiana: Variant 3 volcaniform regular base acentric concave cone, side view.
Figs. 7-12. (9) SEM of phytolith producedby M. balbisiana: Variant 6 volcaniform regular base acentric convex cone, side view.

Ball, Terry B., L. Vrydaghs, I. Van Den Hauwe, J. Manwaring, and E. De Langhe. 2006. Differentiating Banana Phytoliths: Wild and Edible Musa Acuminata and Musa Balbisiana. *Journal of Archaeological Science* 33 (9):1228–36.

Musa coccinea

Phytolith

Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. A. Musa coccinea (Musaceae), trough-shaped silica bodies overlying a vascular bundle (bar = 10µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Musa flava

Phytolith

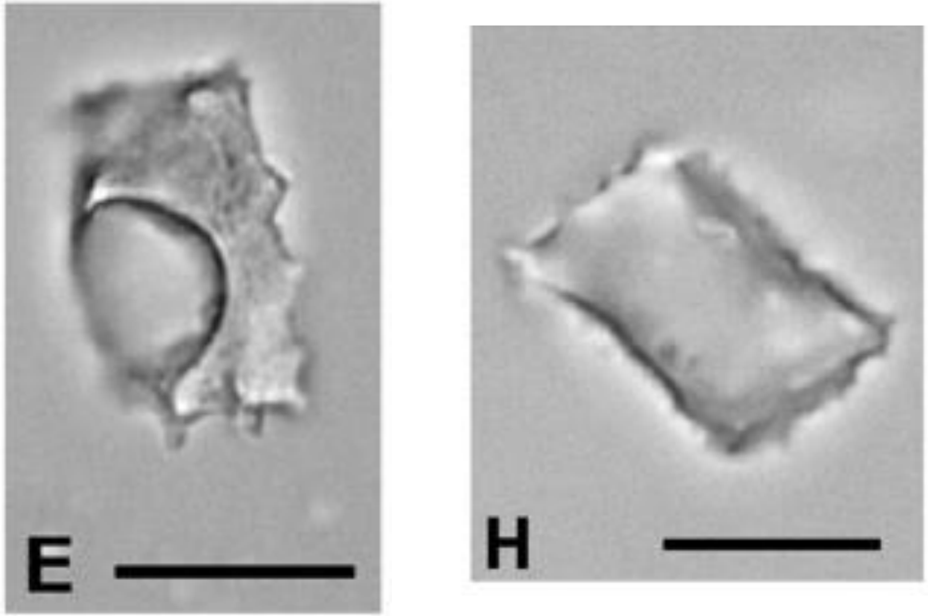


Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). E, T2 trough with papillae on margins from Musa flava sheath. H, cylindrical-rugulate from Musa flava fruit. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Musa ingens

Phytolith

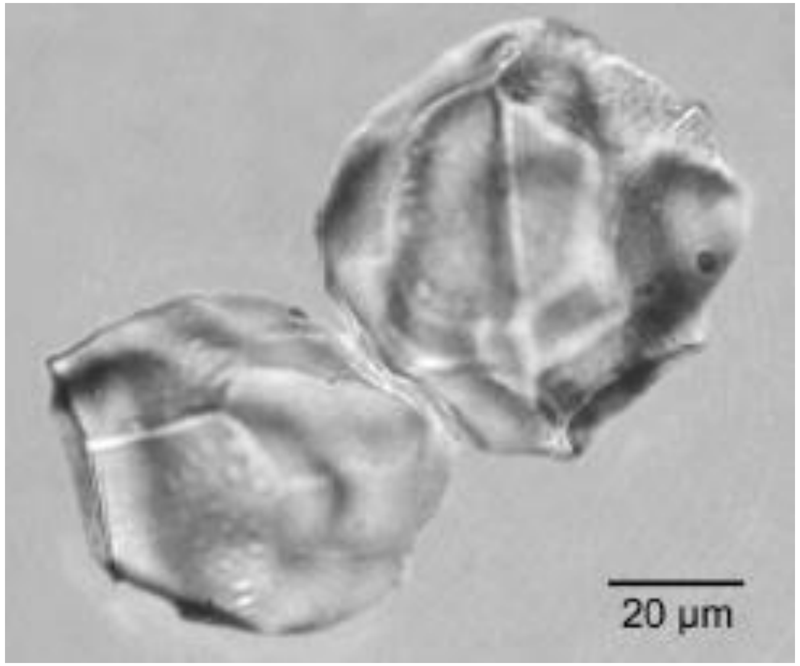


Fig. 16. Seed phytoliths from Musa ingens. From Piperno, 2006; originally courtesy of Carol Lentfer.

Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Musa ingens

Phytolith

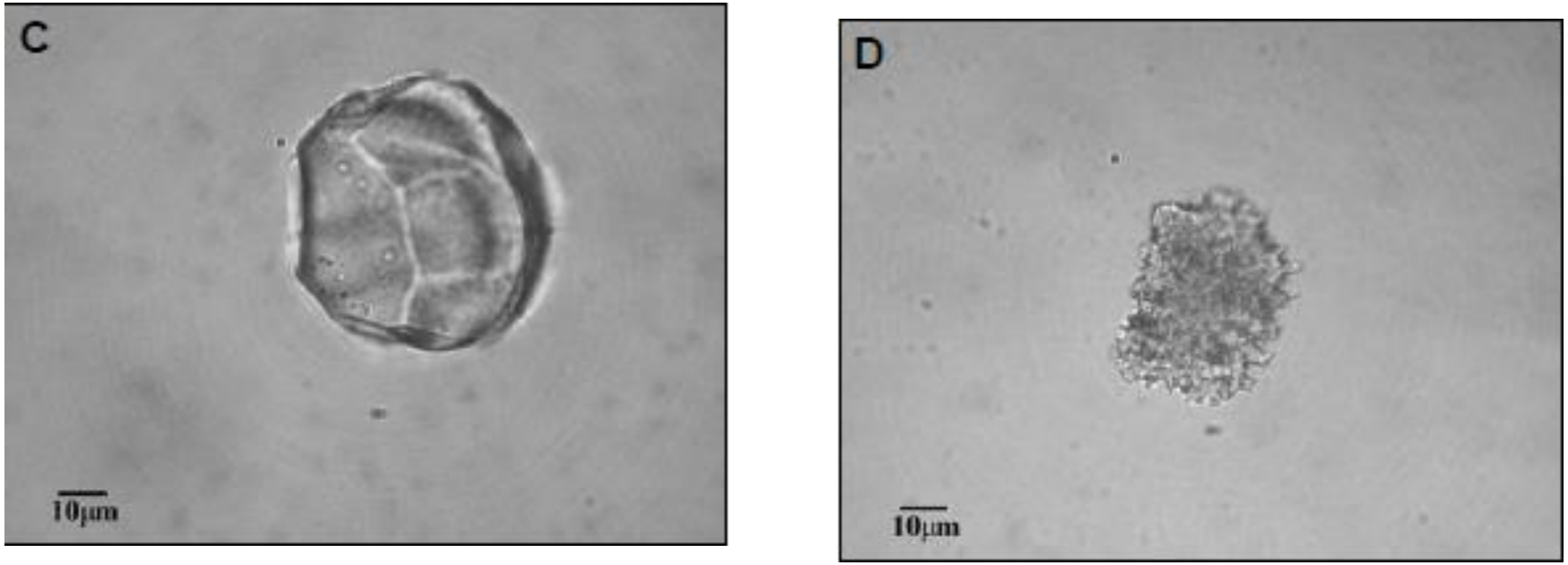


Figure 1. Diagnostic seed morphotypes of wild *Musa* bananas and *Ensete* from Papua New Guinea. C-D. Musa ingens, Section Ingentimusa (Accession No. WH1)

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa maclayi

Phytolith

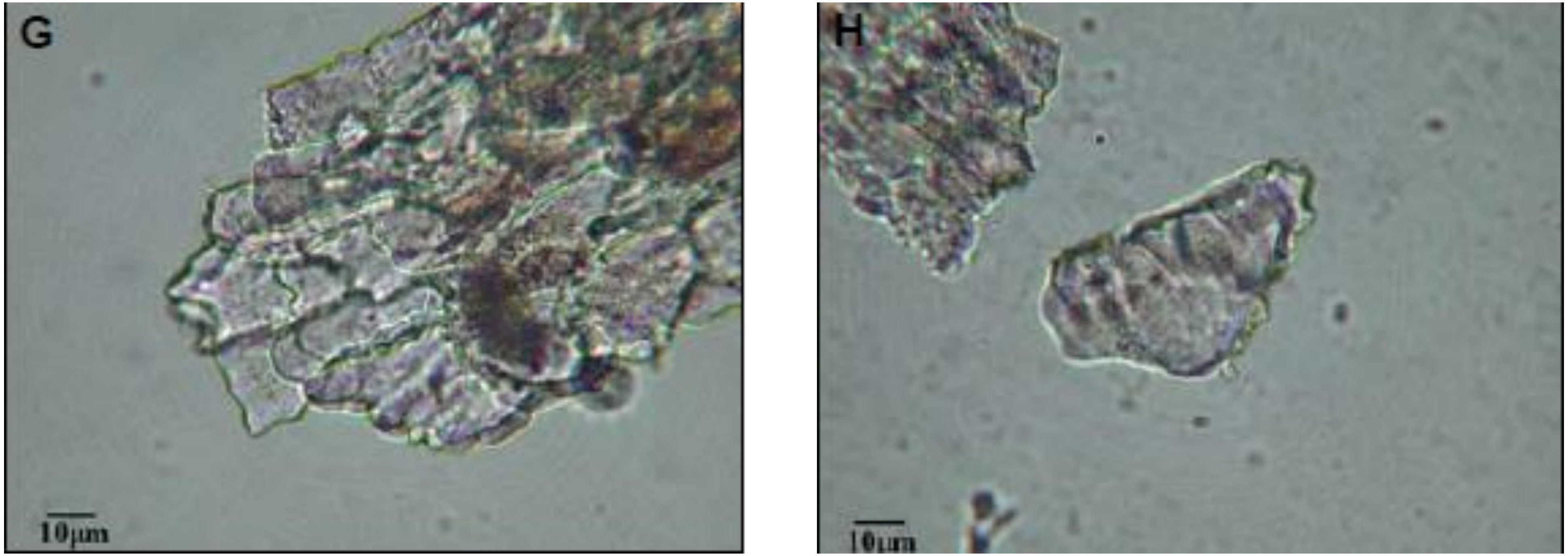


Figure 1 cont. Diagnostic seed morphotypes of wild Musa bananas and Ensete from Papua New Guinea. G-H. Musa maclayi, Section Australimusa (Accession No. MB6)

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa maclayi

Phytolith

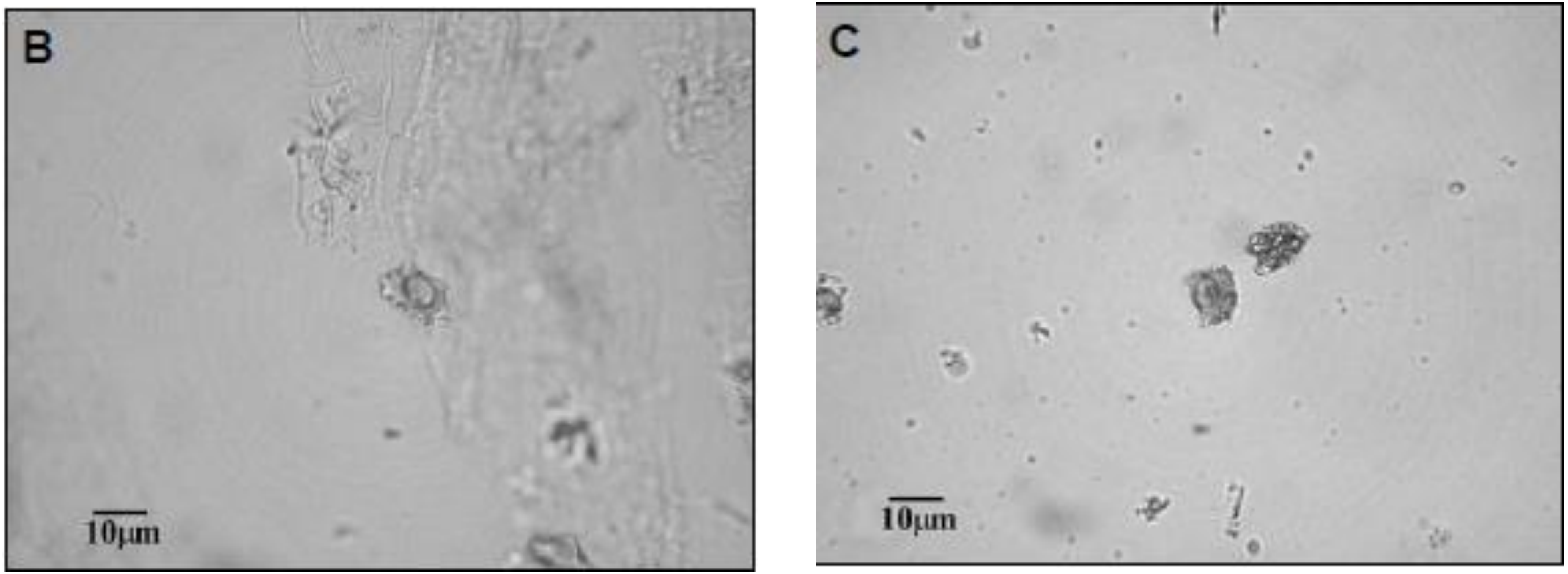


Figure 2. B-C. Examples of volcaniform and globular leaf morphotypes from Musa maclayi (Accession No. NB487) examined in the analysis.

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa peekelii

Phytolith

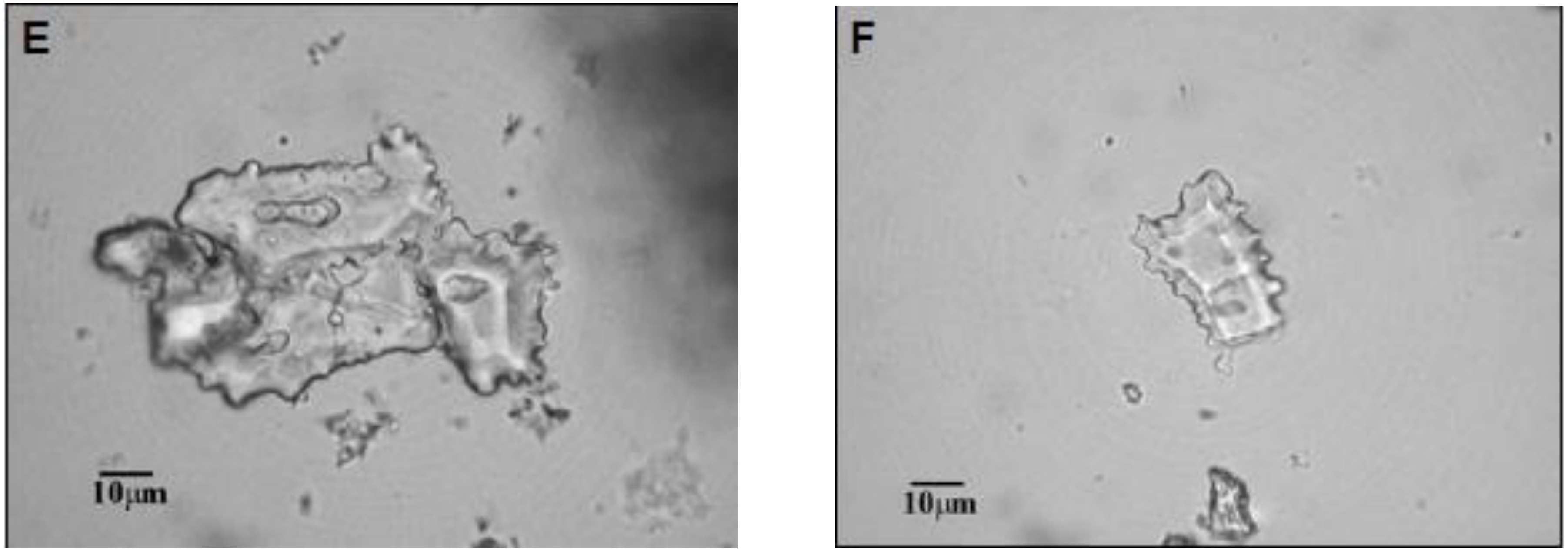


Figure 1. Diagnostic seed morphotypes of wild *Musa* bananas and *Ensete* from Papua New Guinea. E-F. Musa peekelii, Section Australimusa (Accession No. WNB488).

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa sapientum

Phytolith

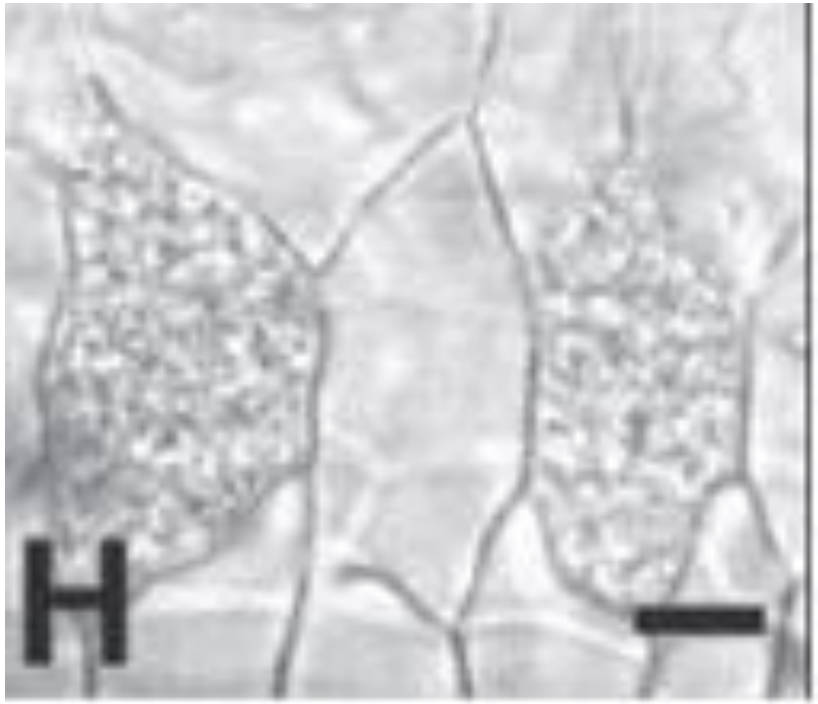
Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). D, T2 trough with papillae on margins from Musa sapientum leaf. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Musa schizocarpa

Phytolith

Fig. 3. Various silica body morphologies found in the order Zingiberales. H. Musa schizocarpa (Musaceae), intercostal, epidermal silica sand (bar = 10 µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Musa schizocarpa

Phytolith

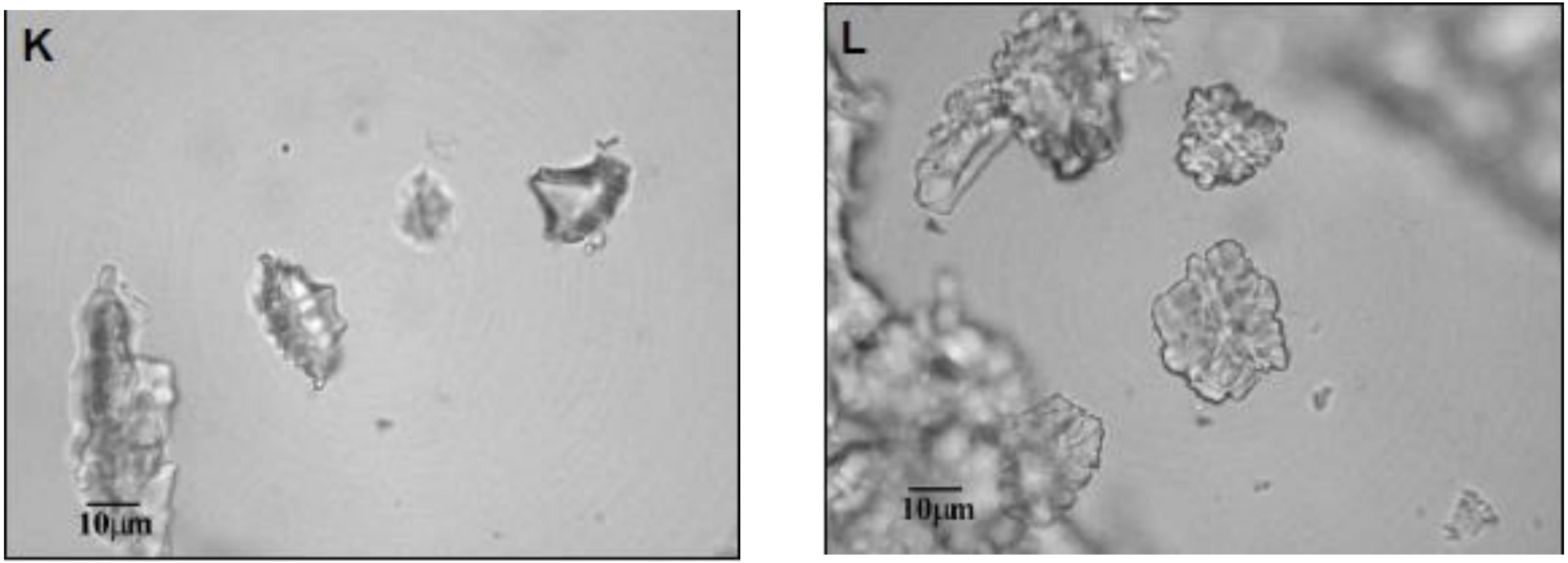


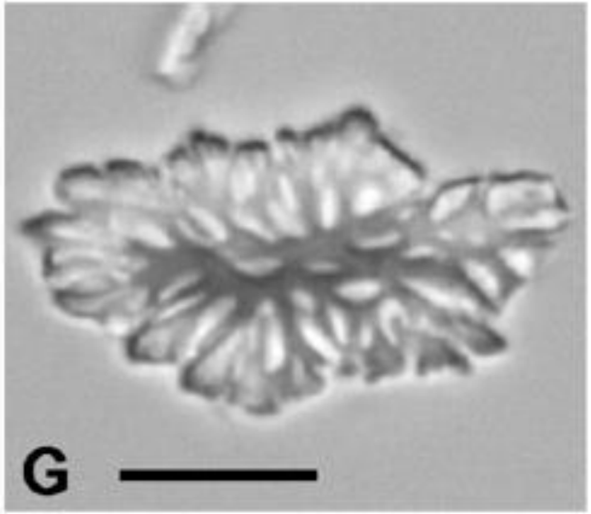
Figure 1. Diagnostic seed morphotypes of wild *Musa* bananas and *Ensete* from Papua New Guinea. K-L. Musa schizocarpa, Section Eumusa (Accession No. NB489).

Lentfer, Carol J. 2009. Tracing Domestication and Cultivation of Bananas from Phytoliths: An Update from Papua New Guinea. *Ethnobotany Research and Applications* 7:247–70.

Musa velutiva

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). G, Ta6 tabular from Musa velutiva seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

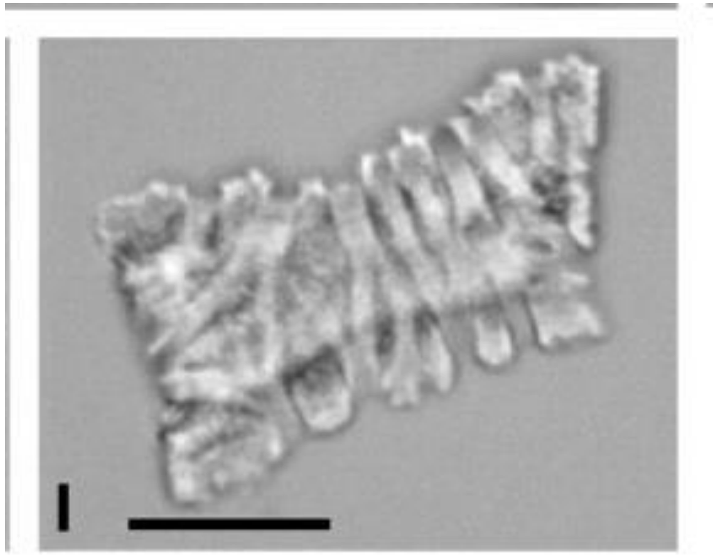


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Musella lasiocarpa

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). I, Tabular with scalariform ridges and internal outline of phytolith shape, similar to Ta6, from Musella lasiocarpa seed. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.

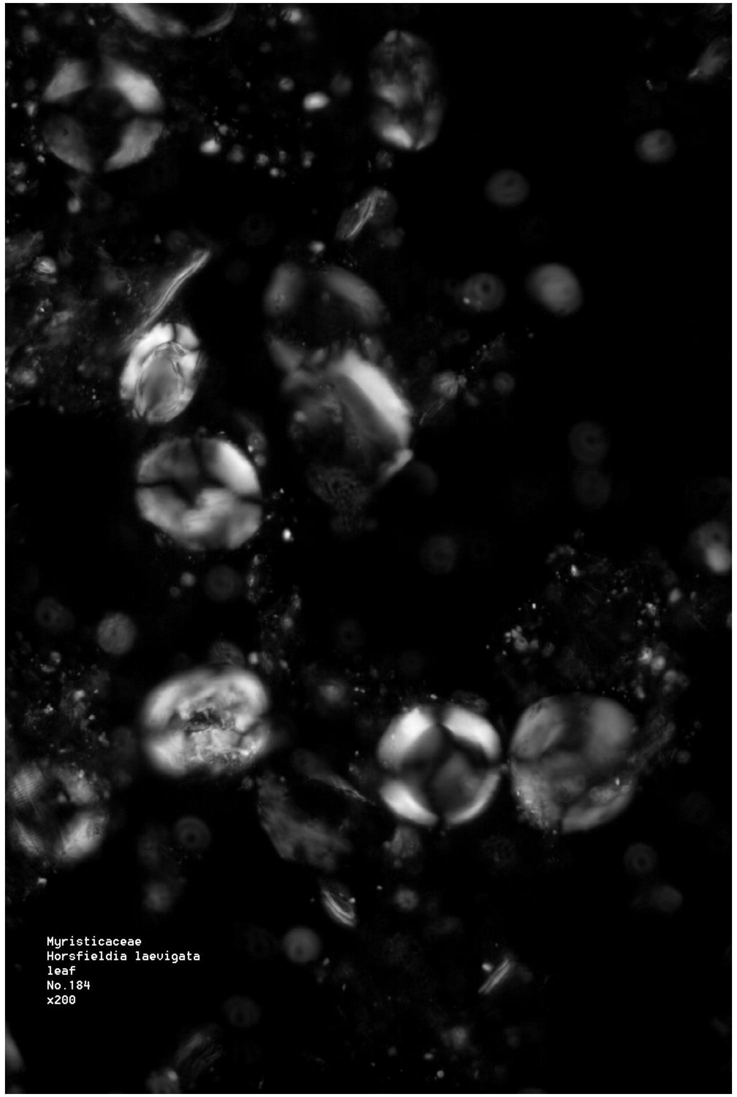


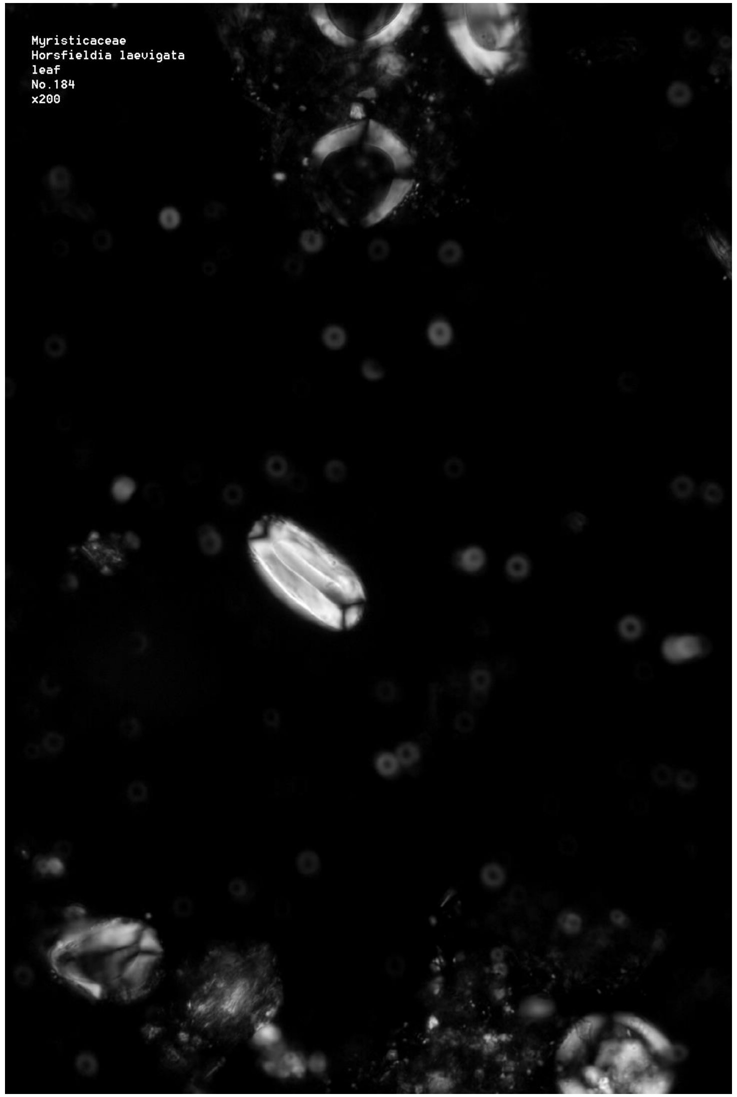
Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

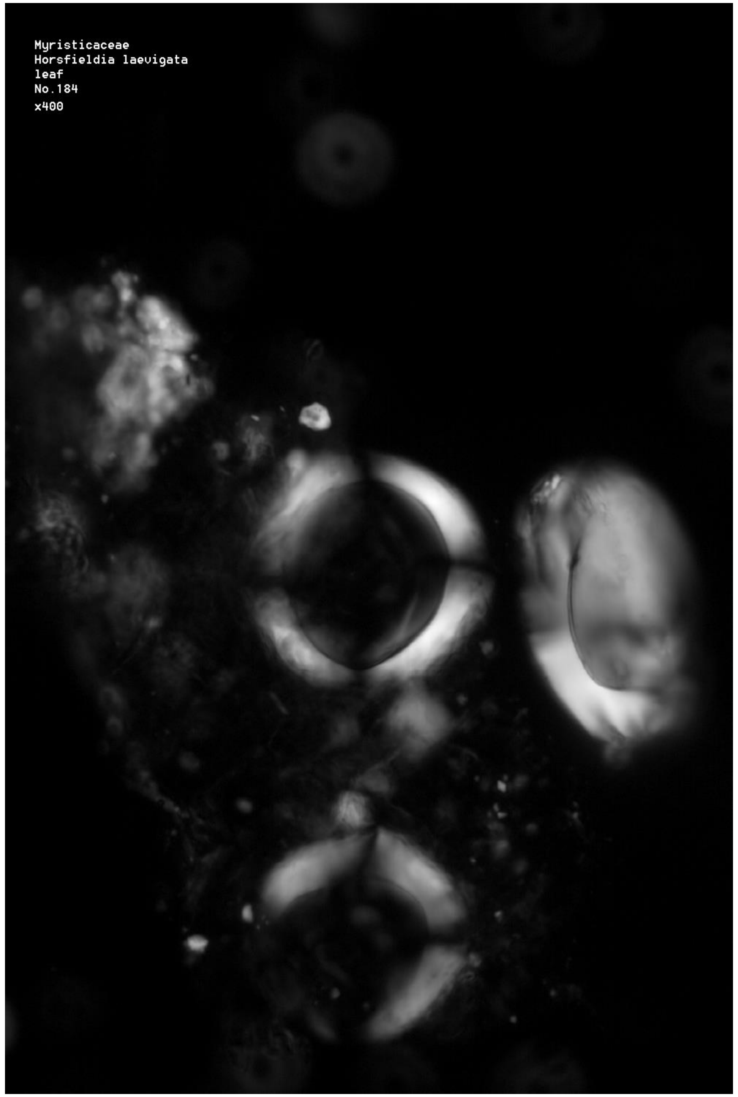
MYRISTICACEAE

Horsfielddia laevigata

Australian Museum, McCown Archaeobotany Laboratory Collection



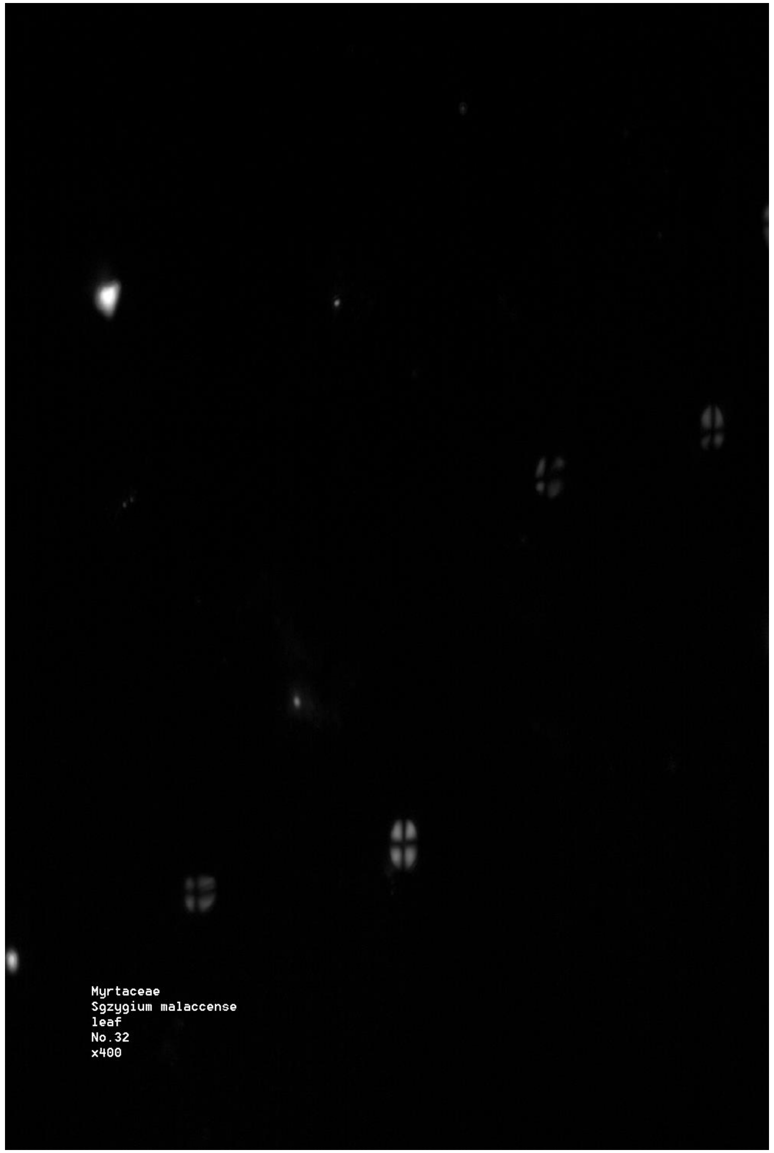


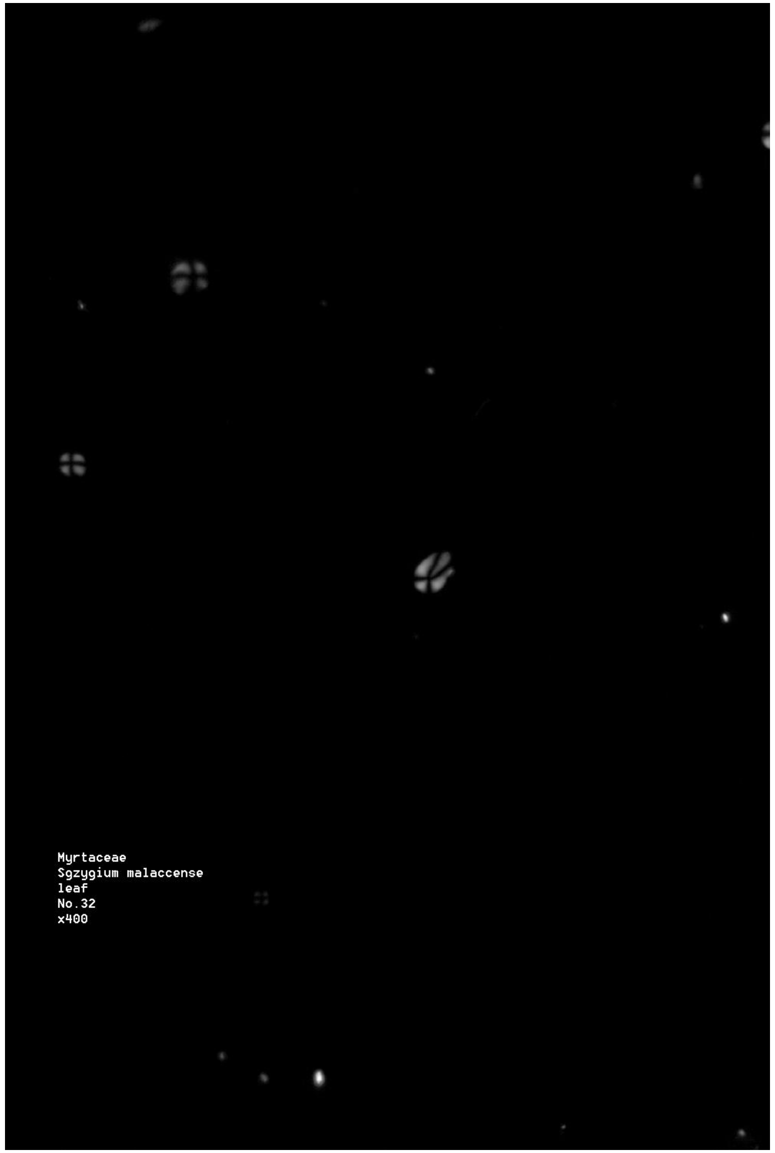


MYRTACEAE

Syzygium malaccense

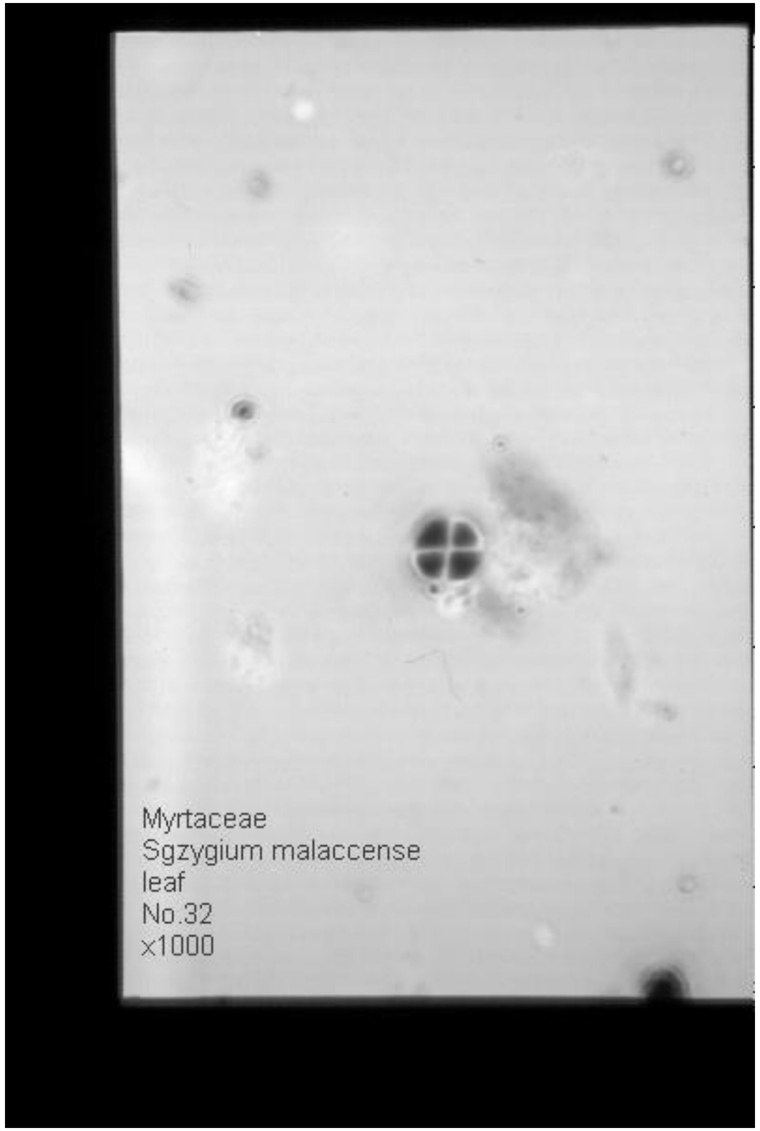
Australian Museum,
McCown Archaeobotany
Laboratory Collection

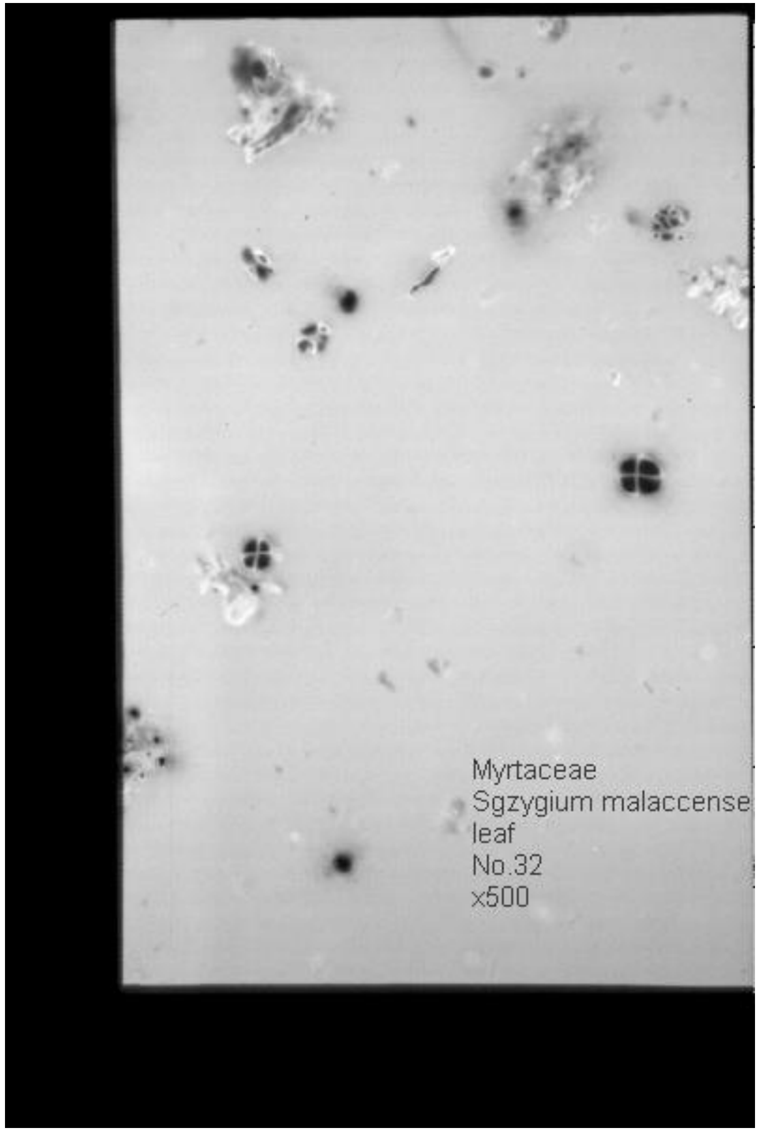




Syzygium malacense

Australian Museum,
McCown Archaeobotany
Laboratory Collection





ORCHIDACEAE

Angraecum chevalieri

Phytolith

Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. B. Angraecum chevalieri (Orchidaceae), spherical bodies overlying sclerenchymatous bundle-sheath cells (bar = 10 μm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Cephalanthera pallens

Phytolith

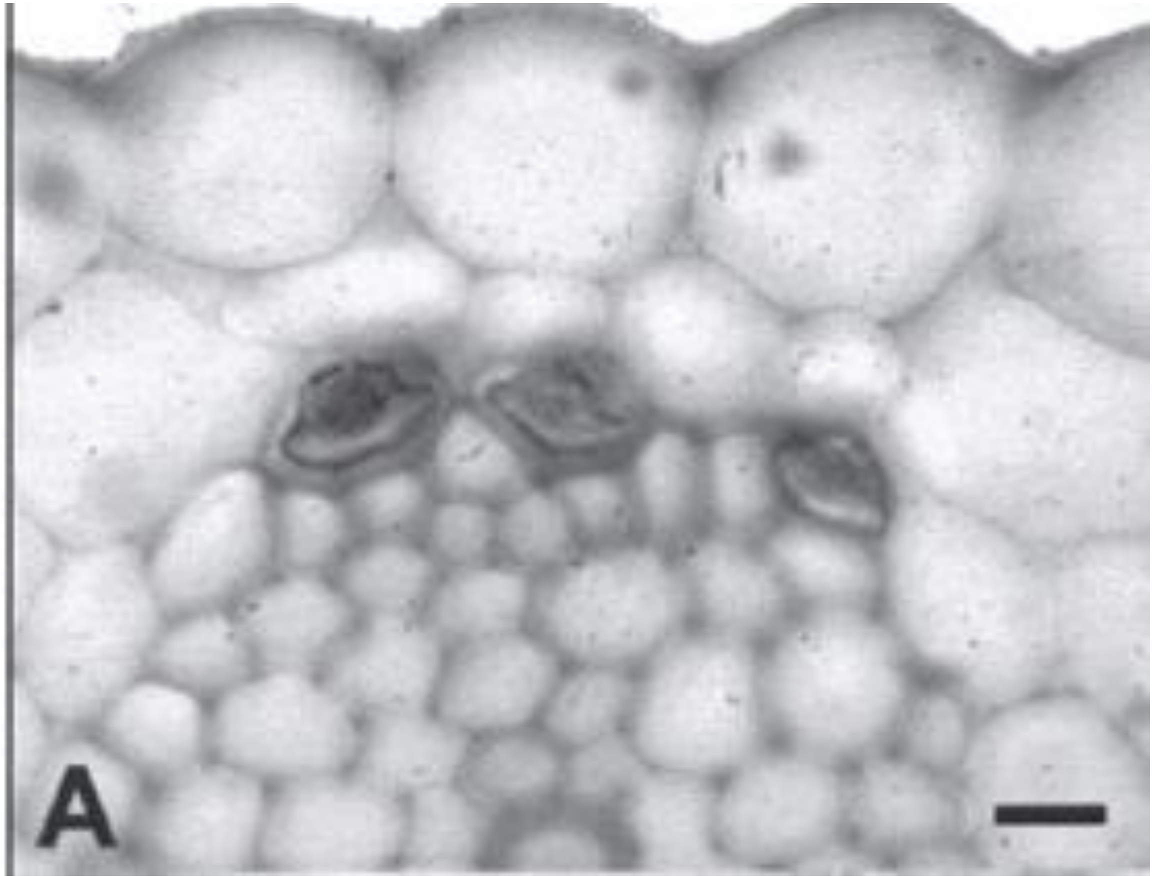


Fig. 2. Various silica body morphologies found in Orchidaceae, Arecaceae and the order Commelinales. A. Cephalanthera pallens (Orchidaceae), conical silica bodies with truncated tops (hat shaped) adjacent to phloem cells (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

OXALIDACEAE

Hypsocharis pimillifolia

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Oxalidaceae *Hypseocharis pimpimllifolia* "soldaque", wild specie

Phytolith assemblage characterization

tuber

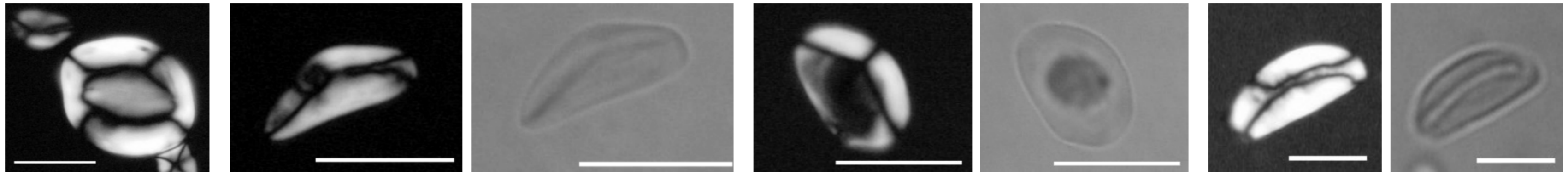
No opal phytoliths **(*).**

References: Reported as a family where phytoliths have been found to be not present, rare or not taxonomically significant in Pearsall 2000:371.

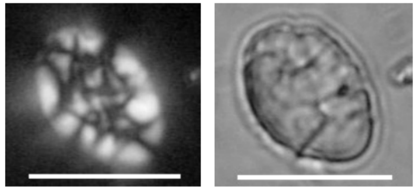
Starch assemblage characterization

tuber

a) Mainly single grains, oval, sausage-shaped, and triangulate with round sides and vertex; variable in size commonly from 15μm to 25μm, but also more than 40μm long length; not visible hilum; sometimes very distinct lamella; sometimes a fissure in a regular line, or a central circular to oval hollow; distinct, mainly centric but variable placed cross, with four arms visible, equal or two long and two short, intersecting in a line or meeting two by two. A few subspheric grains with a central circle formed by the arms of the cross.



b) Rarely compound grains, oval, from 20μm-22μm, compounded by variable number of granula. Granula different in shape and size.



Scale bar = 20μm.

Oxalis tuberosa

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Oxalidaceae *Oxalis tuberosa* "oca"

Phytolith assemblage characterization

seed

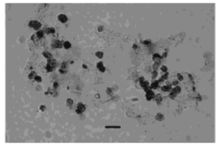
No phytoliths **(*)**.

References: Reported as a family where phytoliths have been found to be: not present, rare or not taxonomically significant (Pearsall 2000:371).

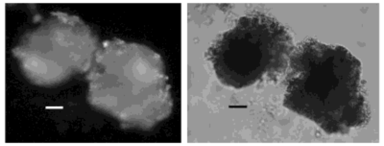
leaf

No diagnostic phytoliths and oxalates **(*)**:

a) Sub-spherical irregularly granulate opal phytoliths. Common. (5-10μm).



b) Amorphous granulate oxalates. Common.

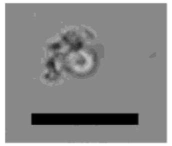


References: Reported as a family where phytoliths have been found to be: not present, rare or not taxonomically significant (Pearsall 2000:371).

flower

No diagnostic phytoliths. **(*)**:

a) Round with a central density silica phytolith. Rare.

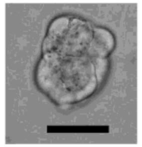


References: Reported as a family where phytoliths have been found to be: not present, rare or not taxonomically significant (Pearsall 2000:371).

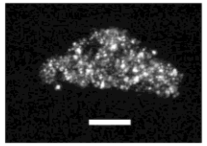
tuber

Some non diagnostic phytoliths **(*)** and oxalates **(*)**:

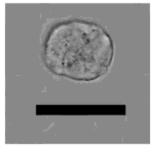
a) Globose irregularly lobated silica phytolith. Rare.



b) Sub-spherical irregularly shaped oxalates. Common.



c) Round planar silica phytolith. Rare.

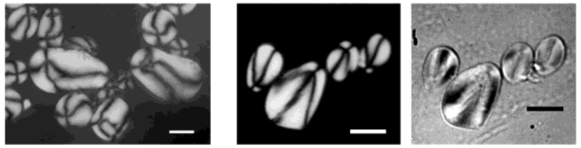


Starch assemblage characterization

tuber

a) Single grains, globular or subglobular; less than 7μm.

b) Single grains, generally asymmetrical, irregular, pear-shaped, prismatic, ovoid, oval and spherical, sometimes with a partially truncate-rounded end; from 10μm to 60μm long length; distinct highly eccentric hilum as a circle or line; very distinct lamella; radiating lines from the hilum to the border of grain; sometimes a centric fissure; distinct eccentric cross to one end, with irregular, broken dark arms intersecting at more than one point, fibrous appearance.



References: Partially based on Cortella and Pochettino 1995.

c) Compound grains compounded by two-five granula. Granula, generally unequal and asymmetrical.

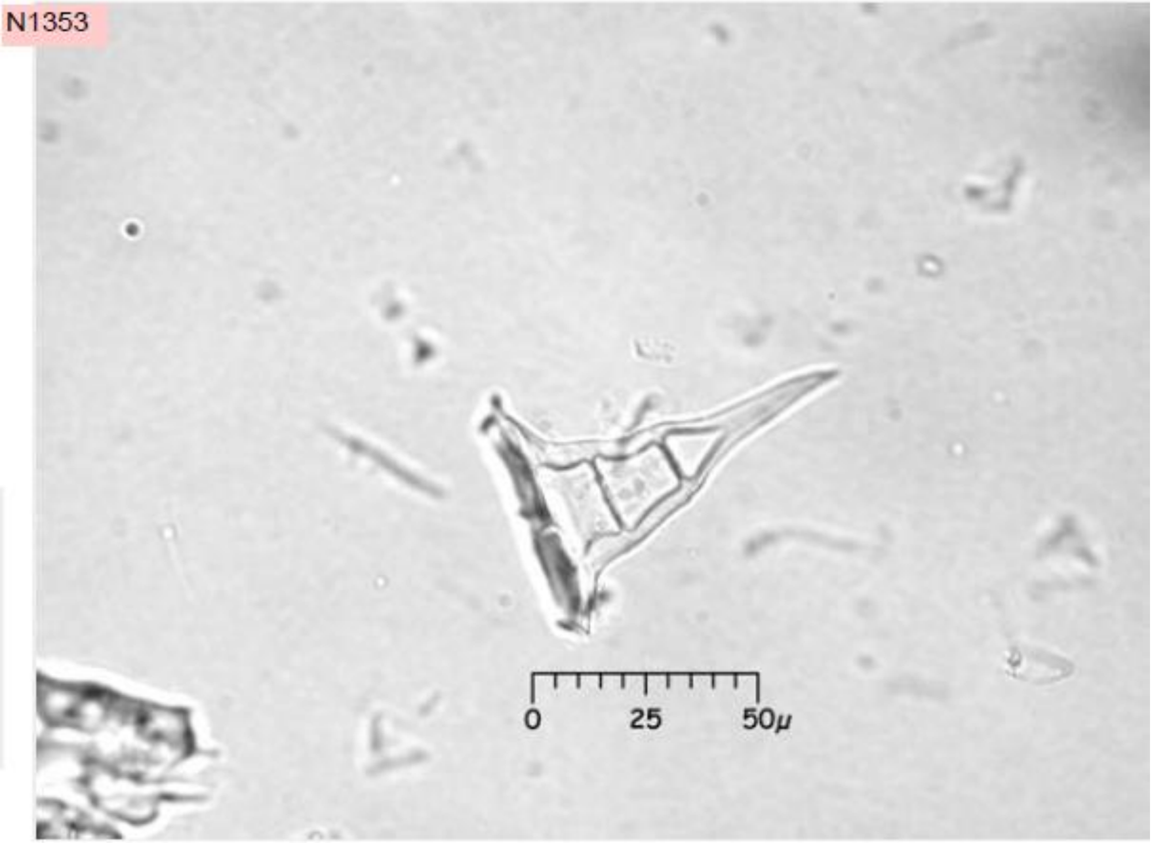
Scale bar = 20μm.

PIPERACEAE

Piper aduncum

Phytolith

Slide 1397a; Leaf

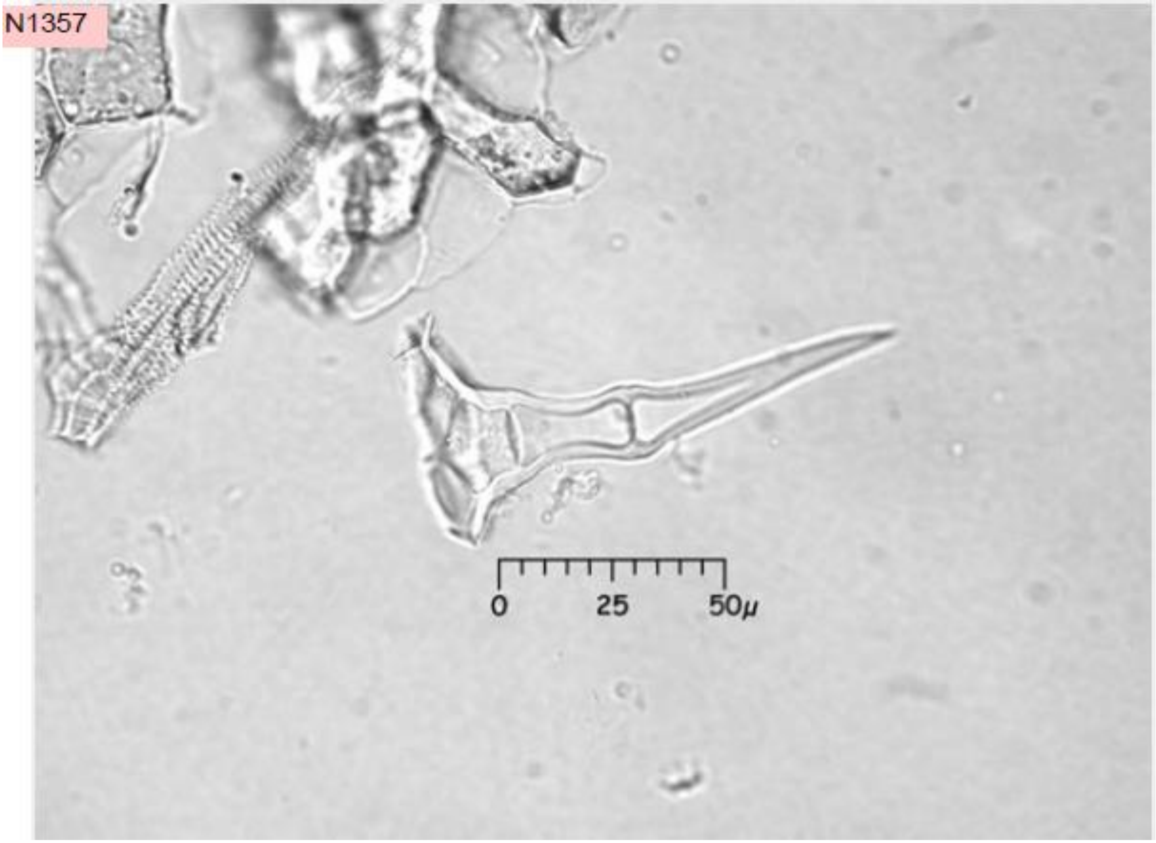


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf



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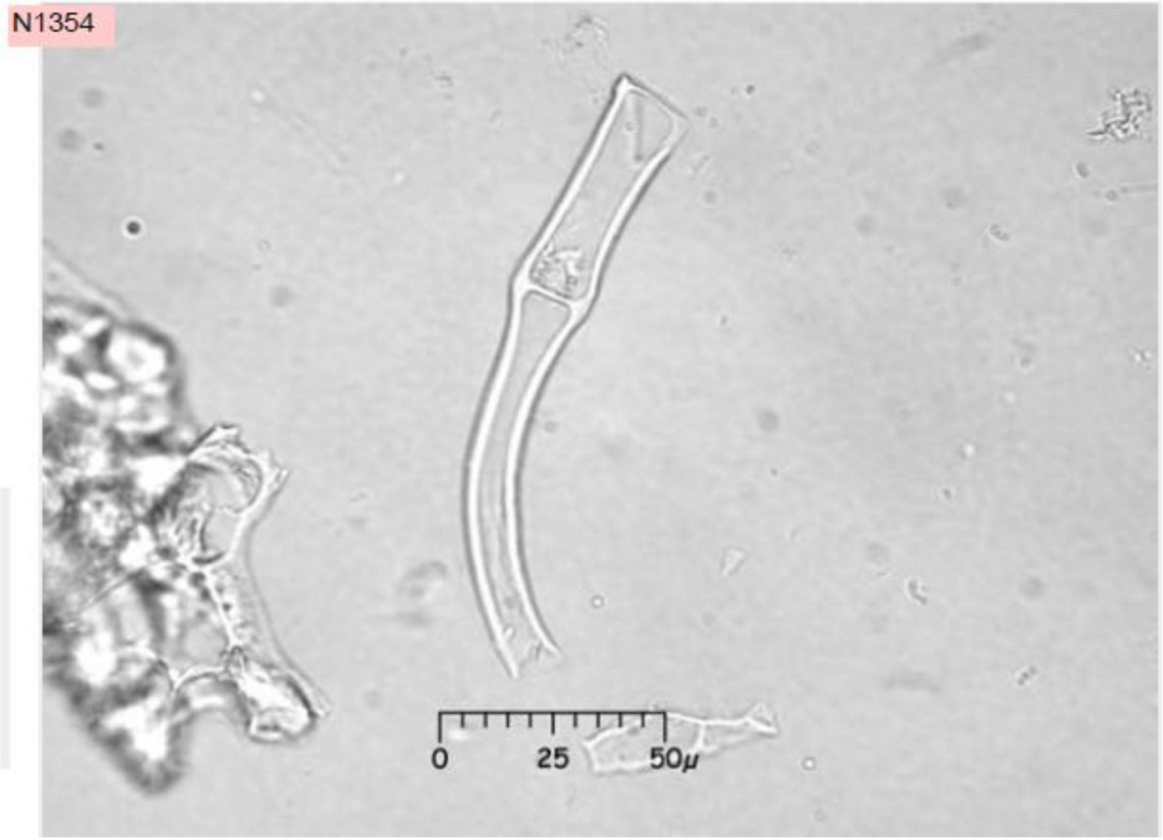
Piper aduncum

Phytolith

Slide 1397a; Leaf
Picture shows a broken hair without the tip

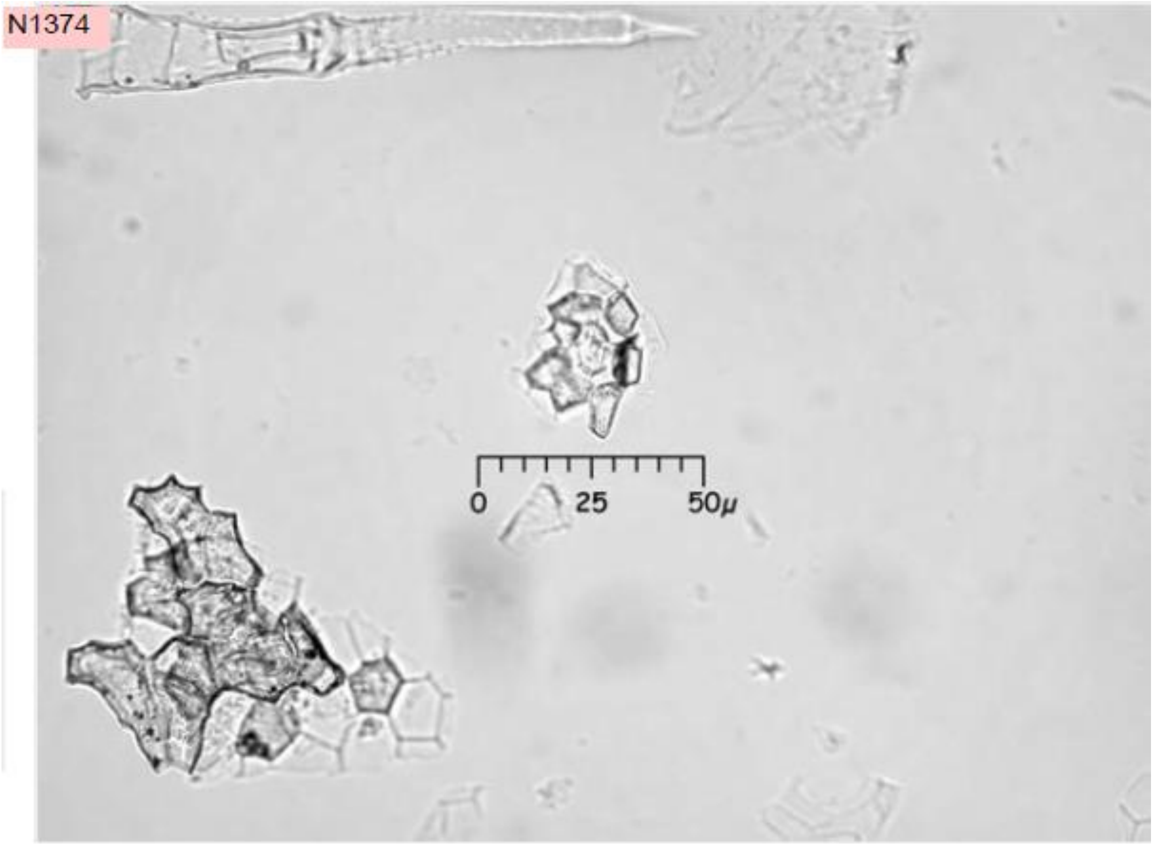


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf

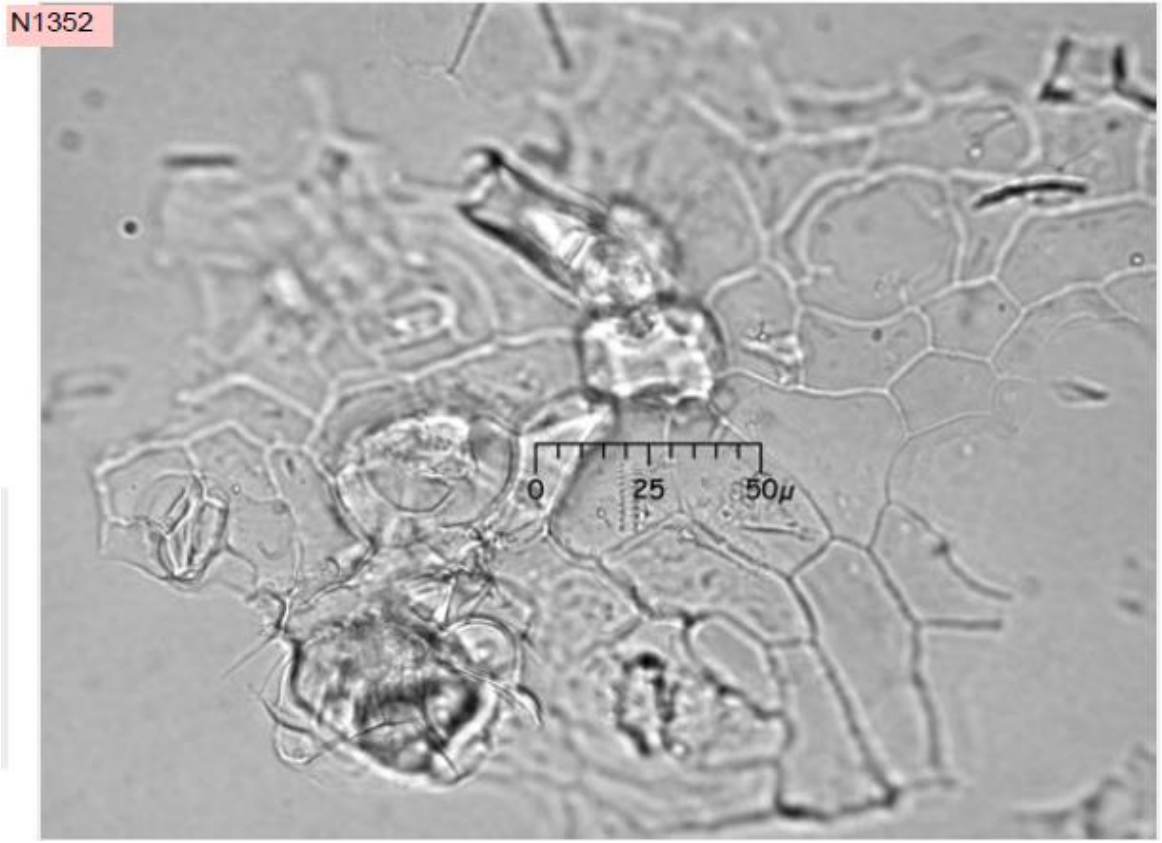


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf
Hair shaft still attached to base

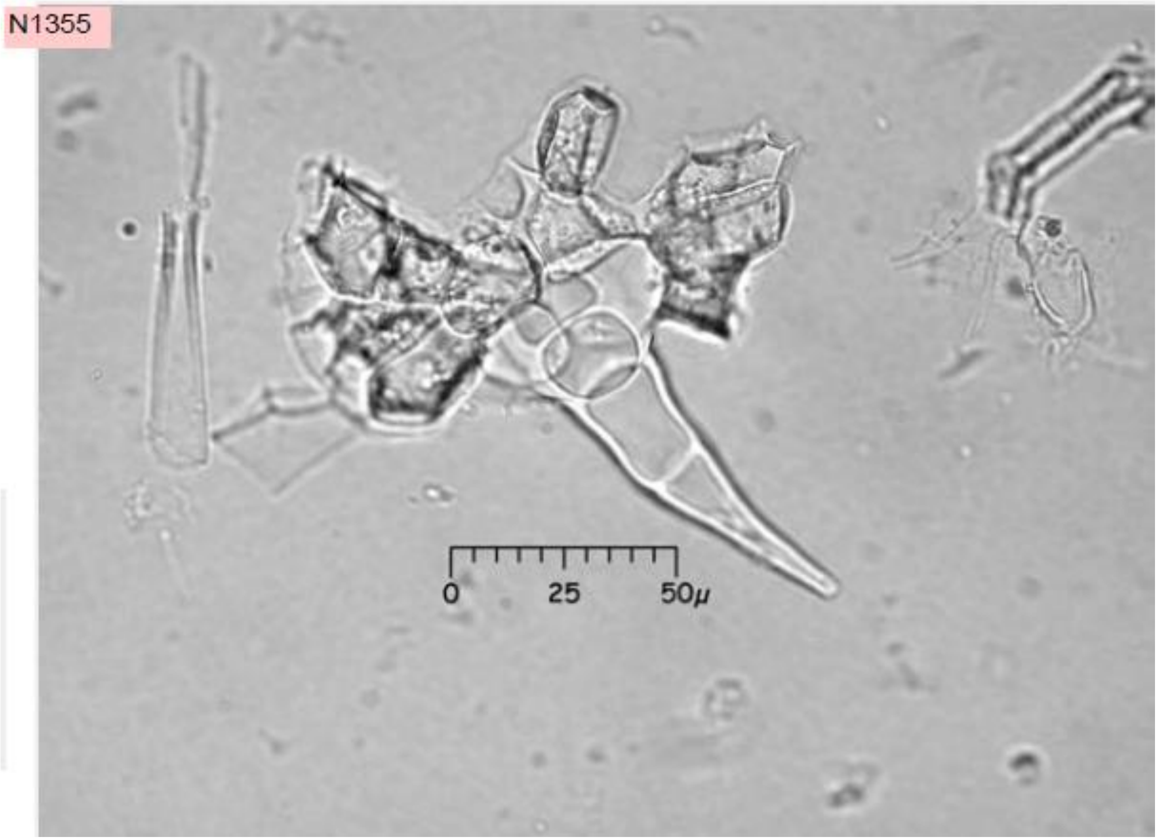


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf

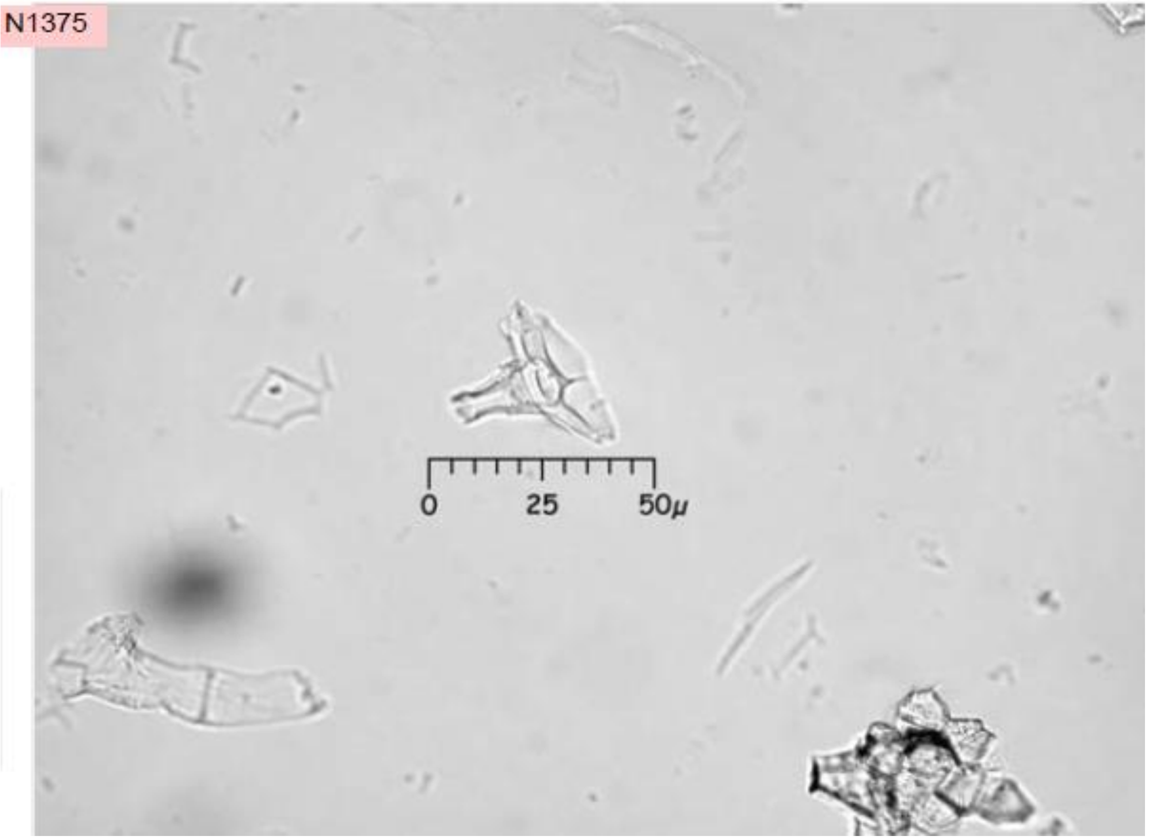


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

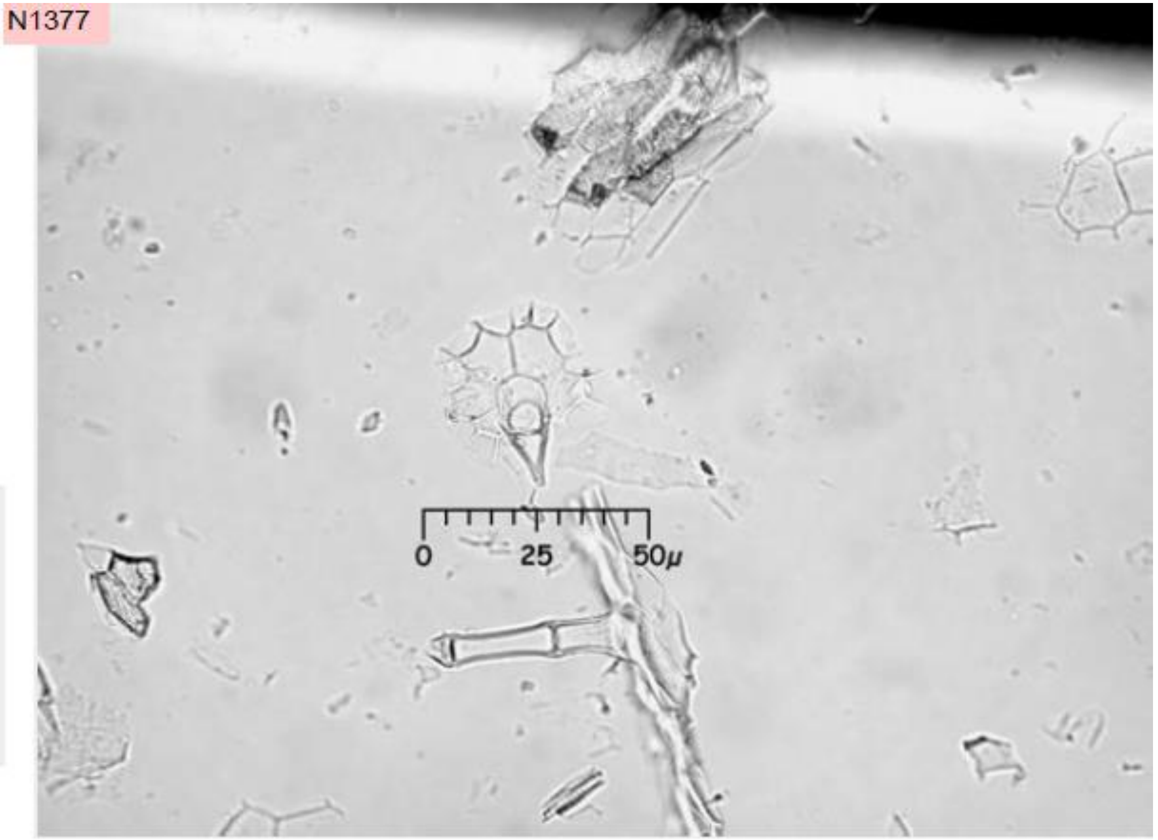
Slide 1397a; Leaf
Picture shows four highly silicified central cells

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1397a; Leaf



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Piper aduncum

Phytolith

Slide 1397a; Leaf

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Piper aduncum

Phytolith

Slide 1397a; Leaf

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

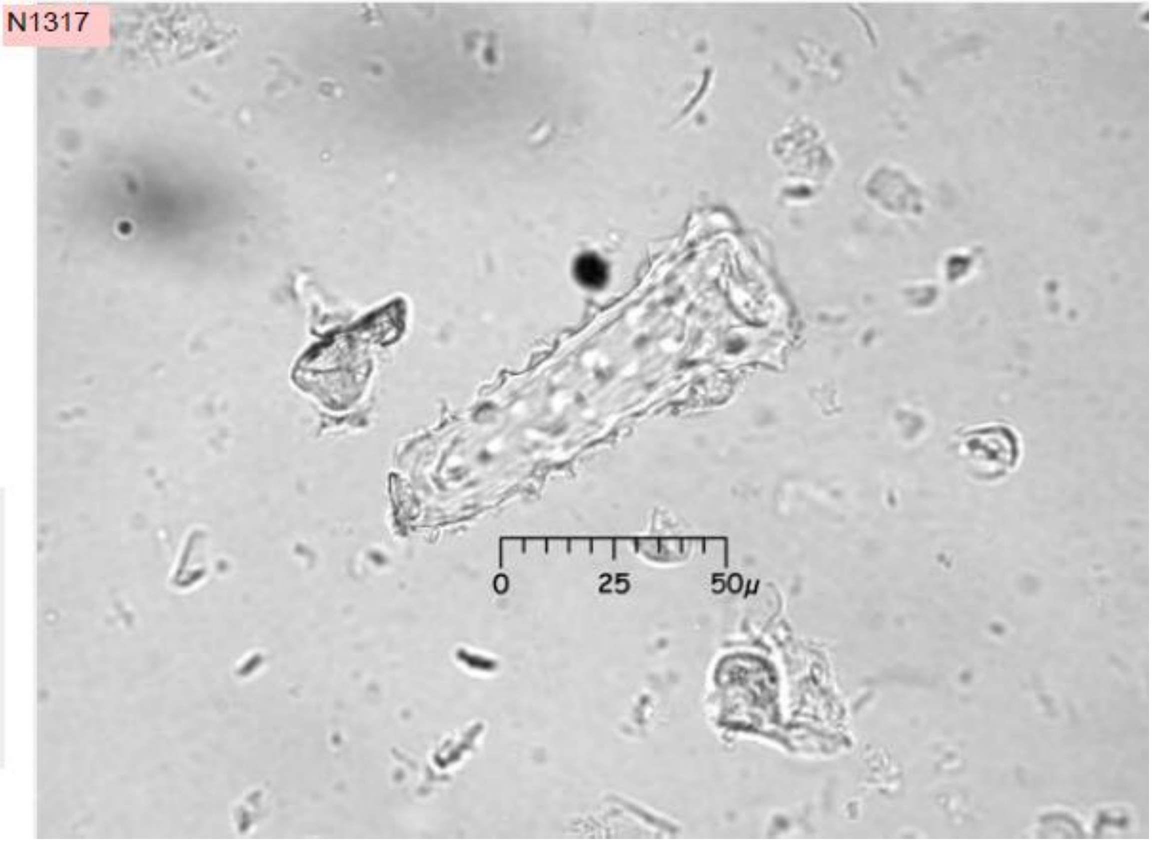
Slide 1397a; Leaf

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1398a. Inflorescence. Picture only shows one segment of a hair.



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1398a. Inflorescence

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

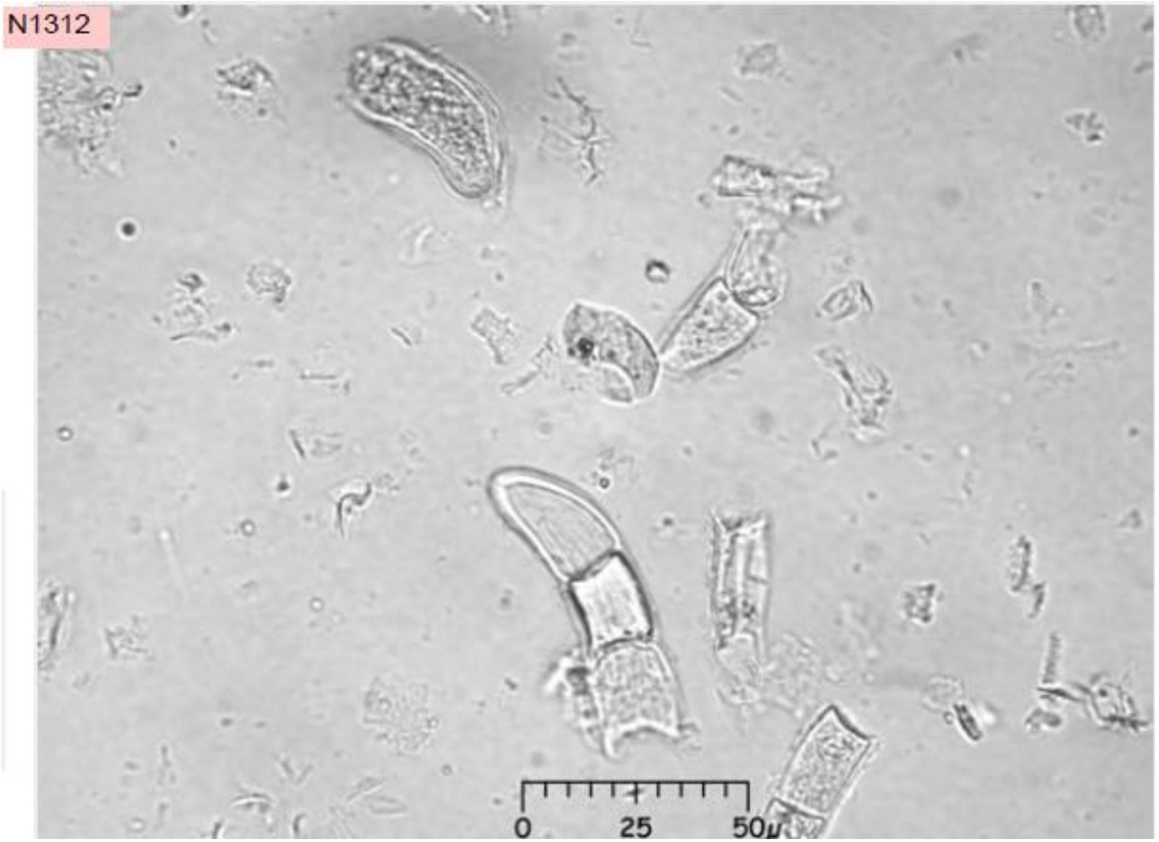
Phytolith

Slide 1398a. Inflorescence
Segments often occur individually or in pairs throughout slide

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith



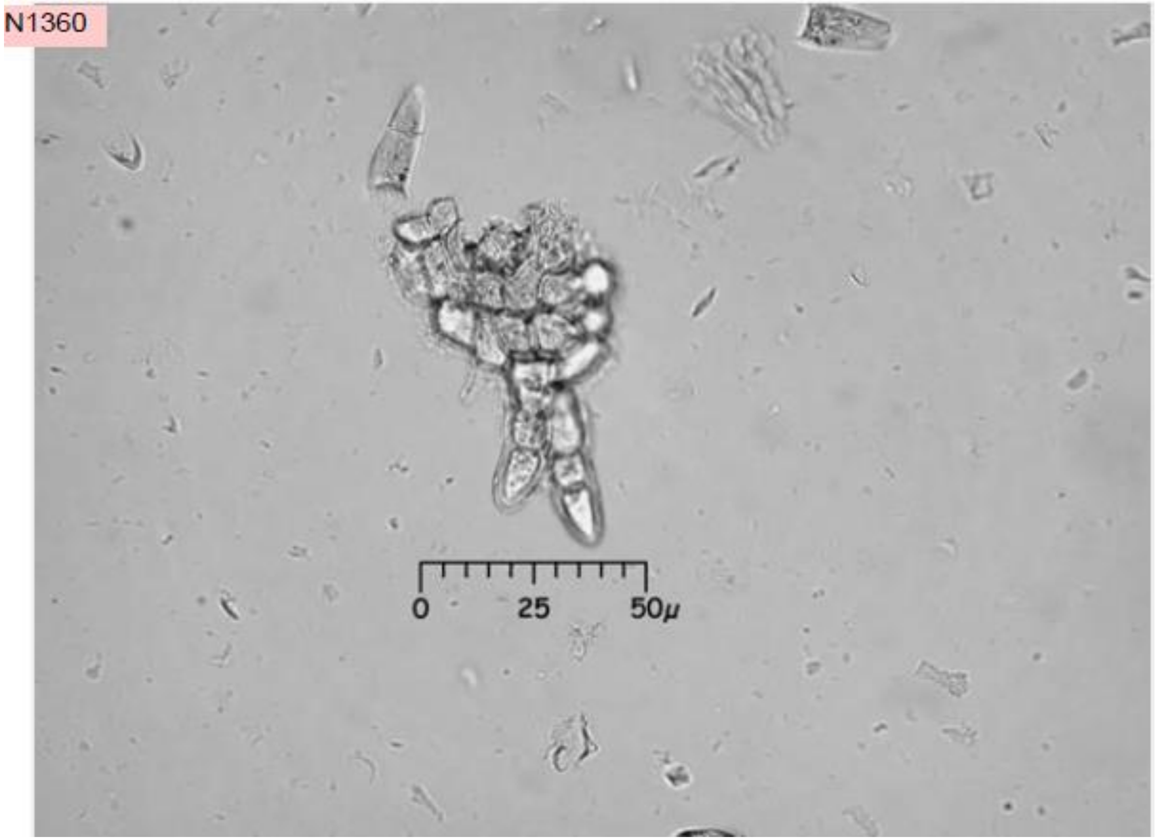
Slide 1398a. Inflorescence
Segments often occur individually or in pairs throughout slide

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1398a. Inflorescence



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1398a. Inflorescence.
Picture shows hair base with hair attached and to the far right a hair base without hairs attached.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper aduncum

Phytolith

Slide 1398a. Inflorescence.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Piper flagellicuspe

Phytolith

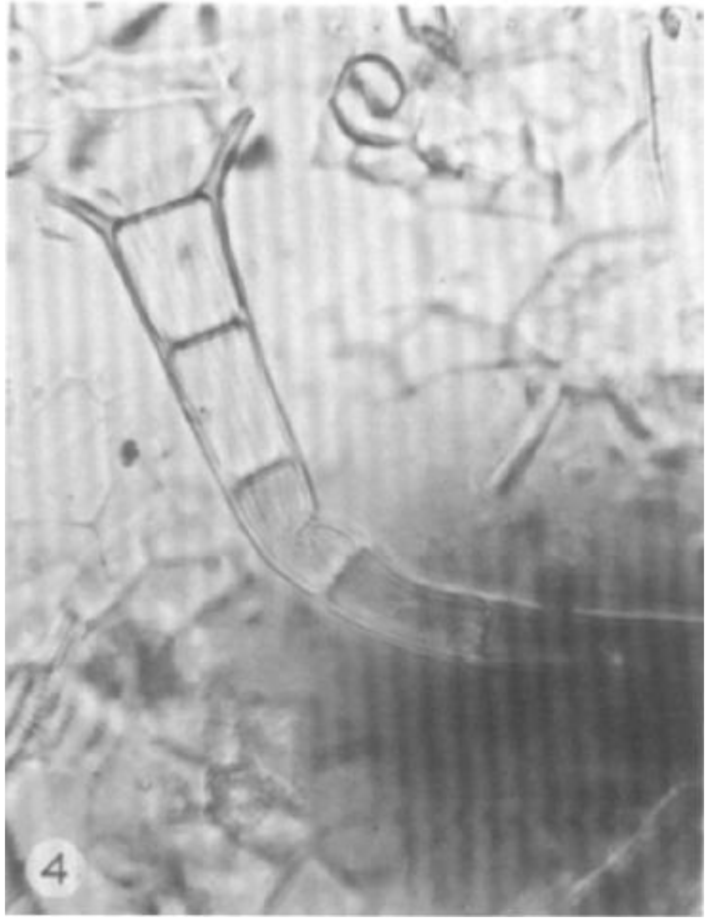
2. Hair cell phytoliths with two rounded ends from Piper flagellicuspe (400 x).

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Piper pseudoasperi

Phytolith

4. Segmented hair with long distinct striations on the surface from Piper pseudoasperi (400×).



Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

POACEAE

Panicoideae

Phytolith

i. Charred silicified sheet fragment of long-cells and bilobate-type short-cells diagnostic of the Poaceae subfamily Panicoideae, and likely derived from leaf material.

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Panicoideae

Phytolith

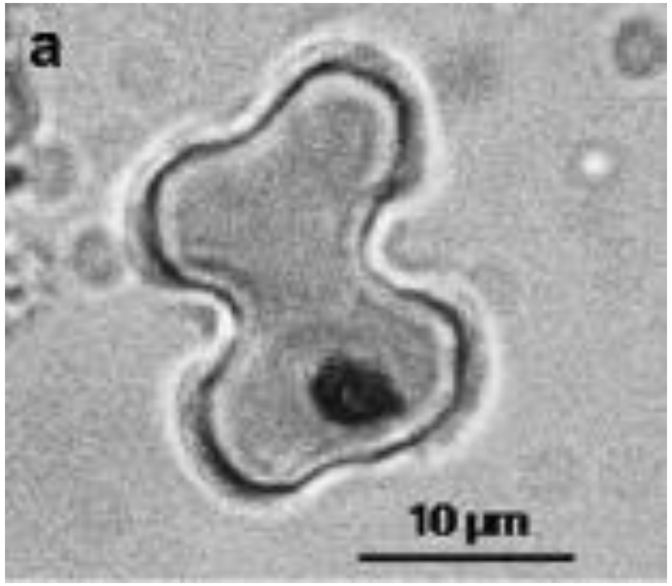


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. a) Panicoideae cross-shaped phytolith (BD M1, 10-20 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Panicoideae

Phytolith

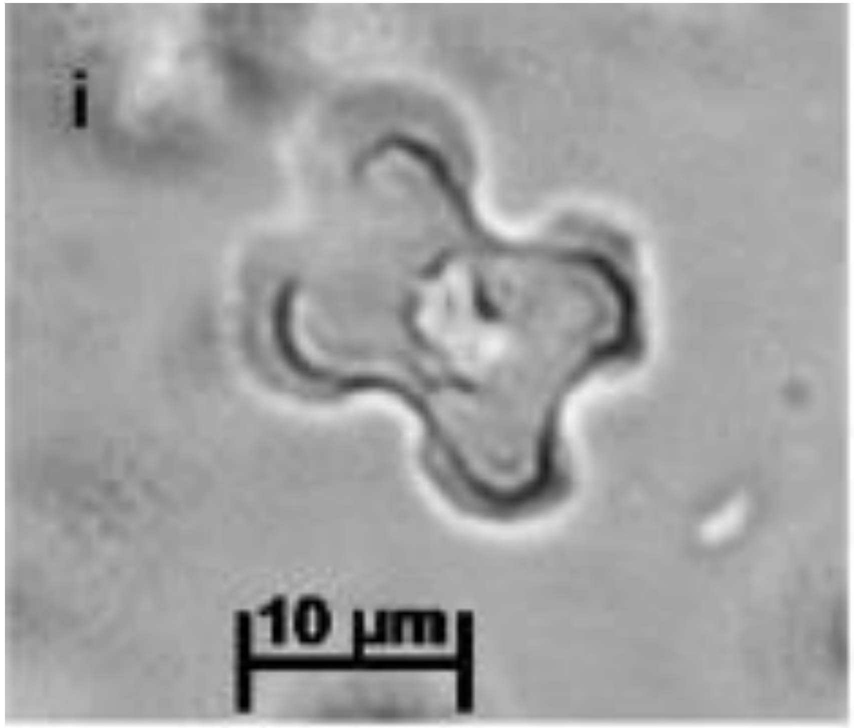


Fig. 5. Selected microbotanical remains. Phytoliths: i) Panicoideae cross-shape (Sed. Sample 2)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Oryzoideae

Phytolith

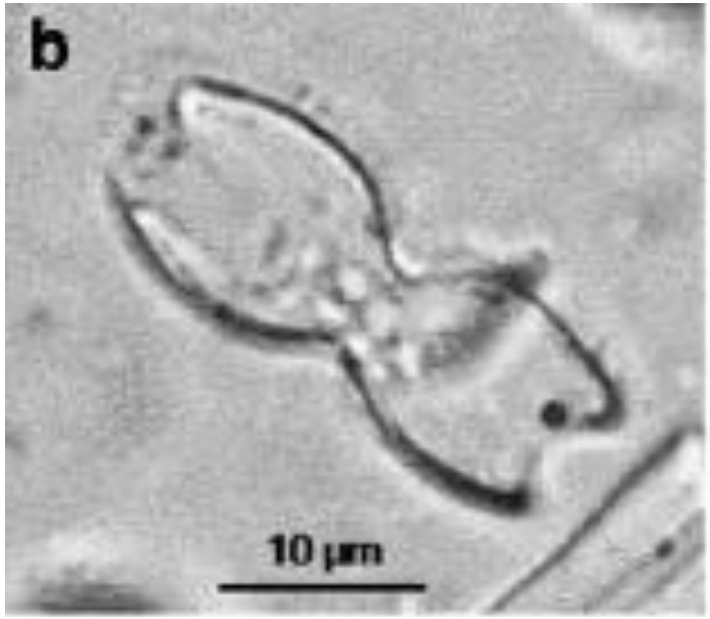


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. b) Oryzoideae scooped bilobate (P. Ridged Field 2, 0-10 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Pooideae

Phytolith

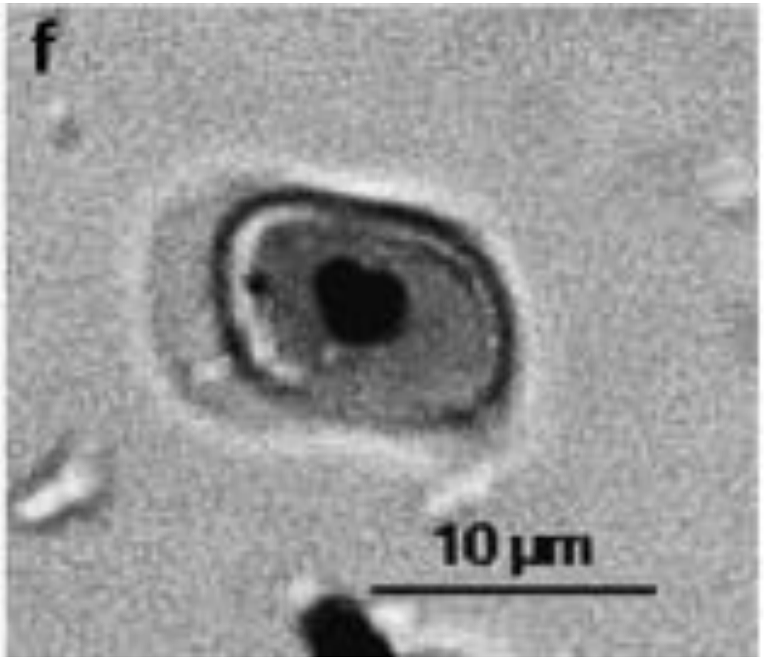


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. f) Pooideae oblong phytolith (BD M1, 40-50 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Olyreae

Phytolith

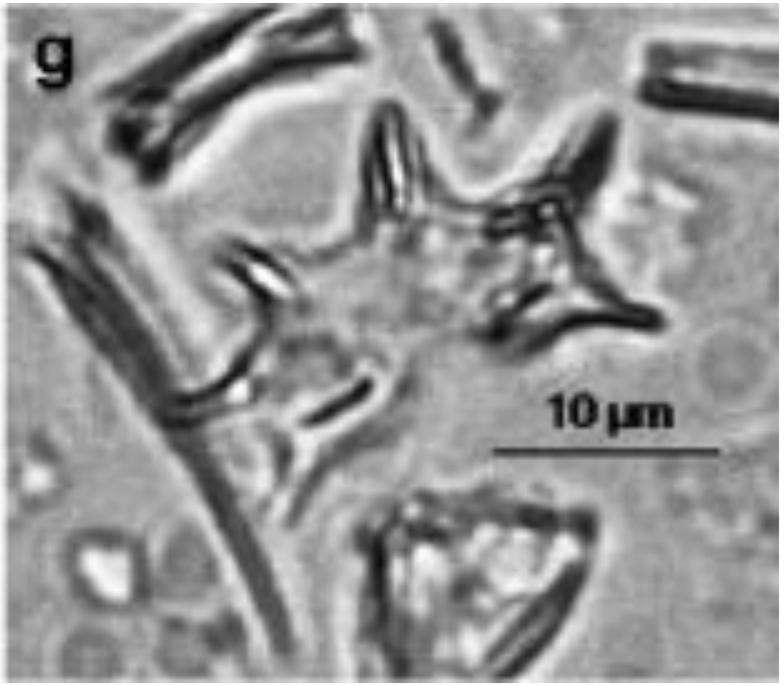


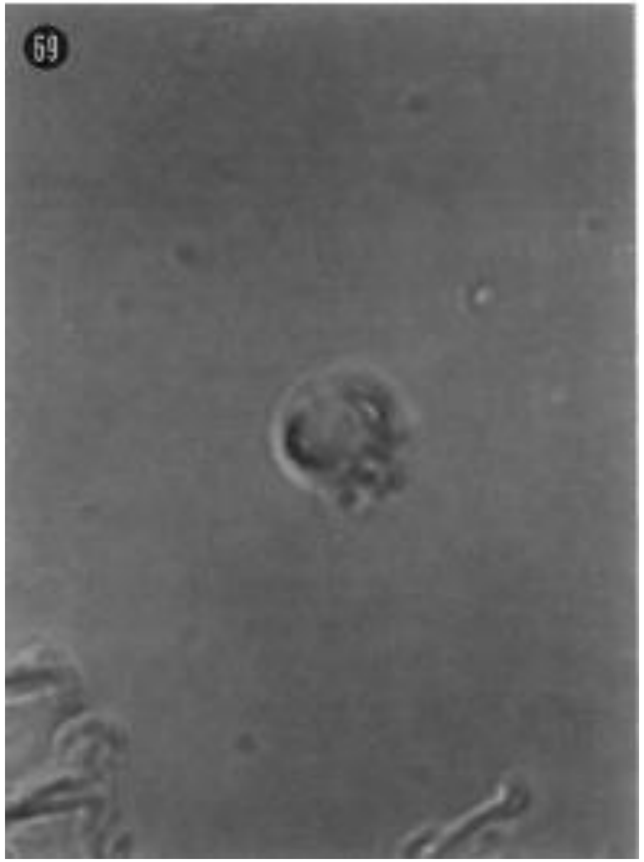
Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. g) Olyreae Phytolith with irregular concavities and pointed edges (K-VIII M 1.1. 0-10 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Actinocladum merticulatum

Phytolith

FIGURES 69-72.-69, A two-peaked conical siliceous body from Actinocladum merticulatum (x400).

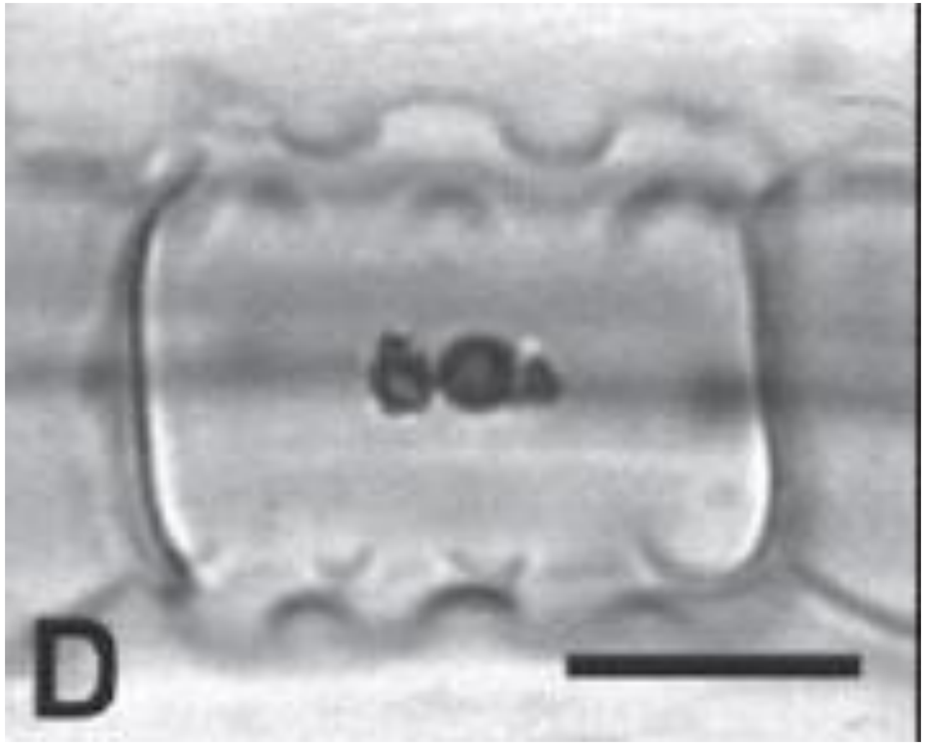


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aegilops triaristata

Phytolith

Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. D. Aegilops triaristata, a horizontally elongated silica body with sinuous outlines (bar = 10 µm).

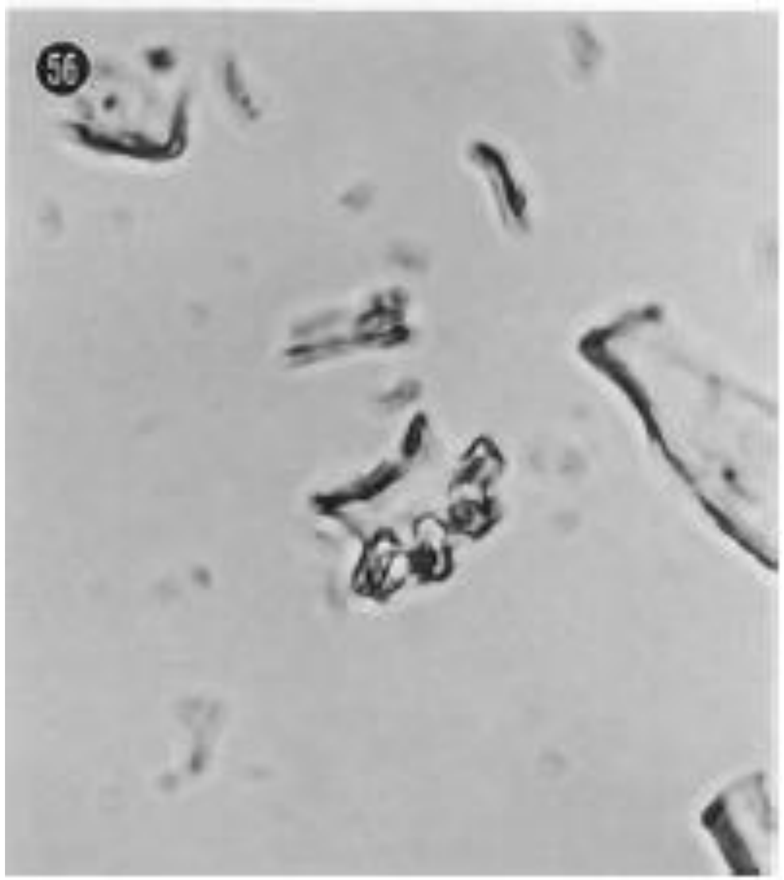


Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Aegopogon cenchroides

Phytolith

FIGURES 53-56.-56, A phytolith from Aegopogon cenchroides (x400)

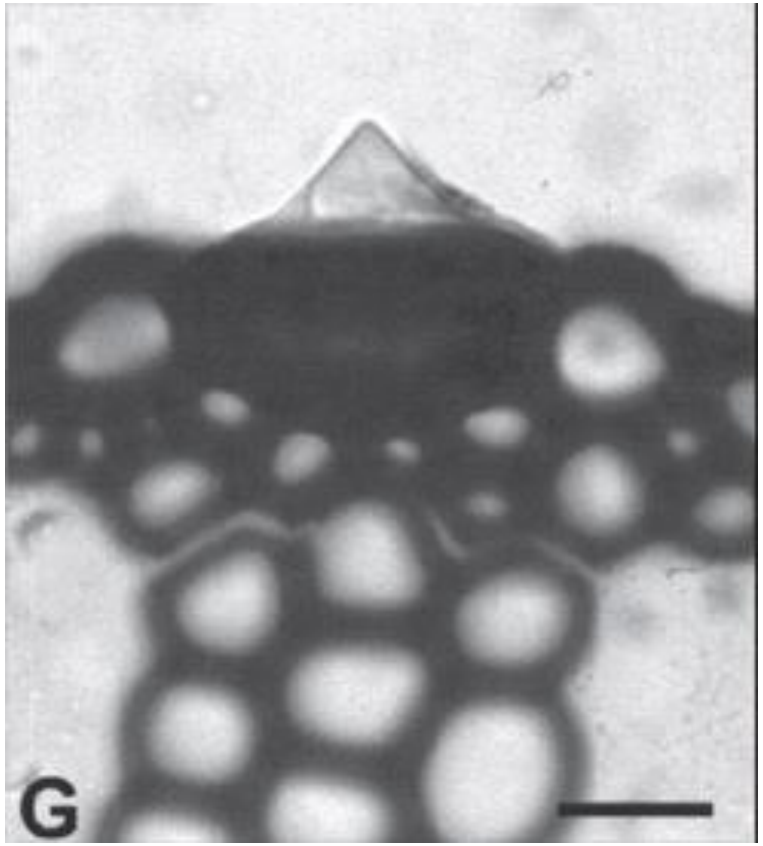


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Agropyron elongatum

Phytolith

Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. G. Agropyron elongatum, a conical silica body (bar = 20 µm).

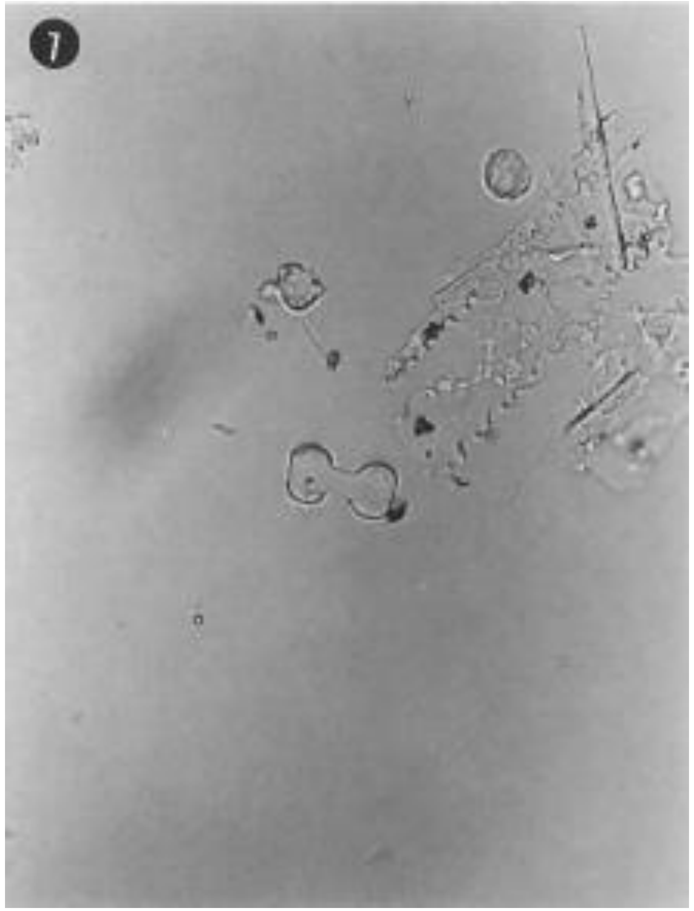


Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Andropogon bicornis

Phytolith

FIGURES 5-8. 7, Center, a bilobate with squared lobes and a distinct, moderately thin shaft from Andropogon bicornis (x200)



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Andropogon leucbostacbya

Phytolith

FIGURES 5-8. 5, Bilobates with semirounded lobes and long, thin shafts from Andropogon leucbostacbya (x200).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Anthochloa lepidula

Phytolith

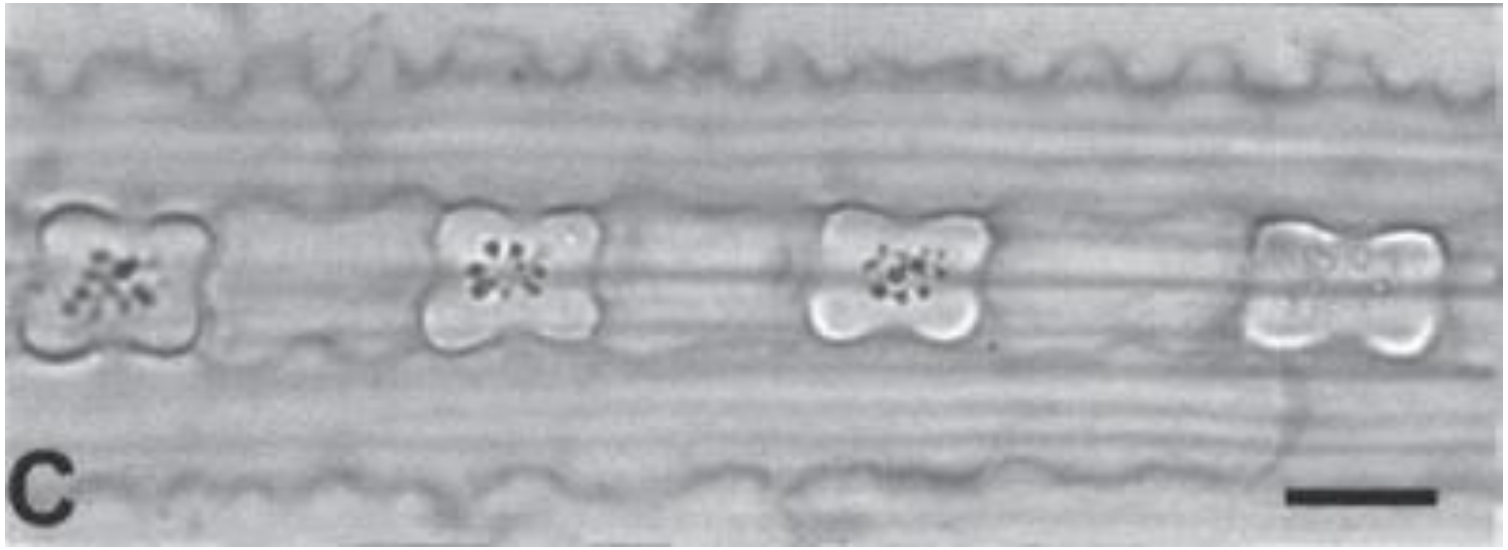
Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. E. Anthochloa lepidula, horizontally elongated bodies with smooth outlines (bar = 20 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Apochiton burttii

Phytolith

Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. C. Apochiton burttii, cross-shaped silica bodies (bar = 10 µm).

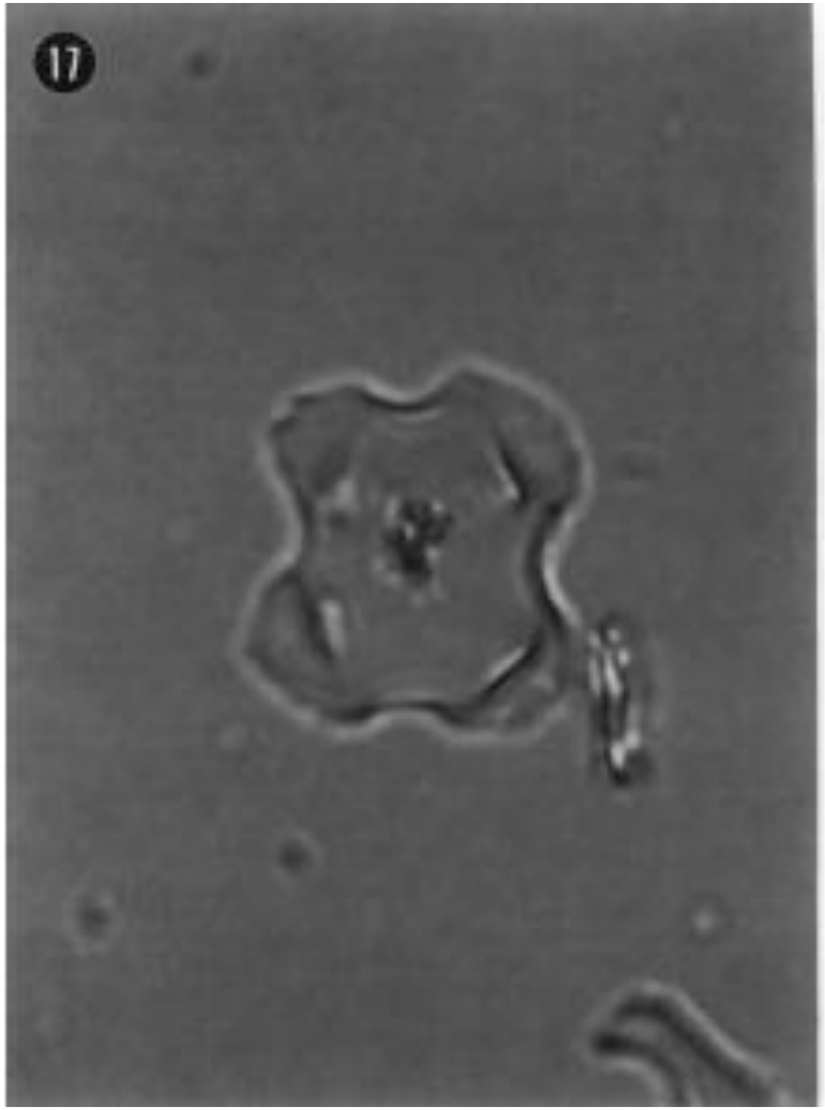


Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Arberella dressleri

Phytolith

FIGURES 17-20. 17, A Variant 3 cross-shaped phytolith from Arberella dressleri with conical protrusions on the upper face (x400).

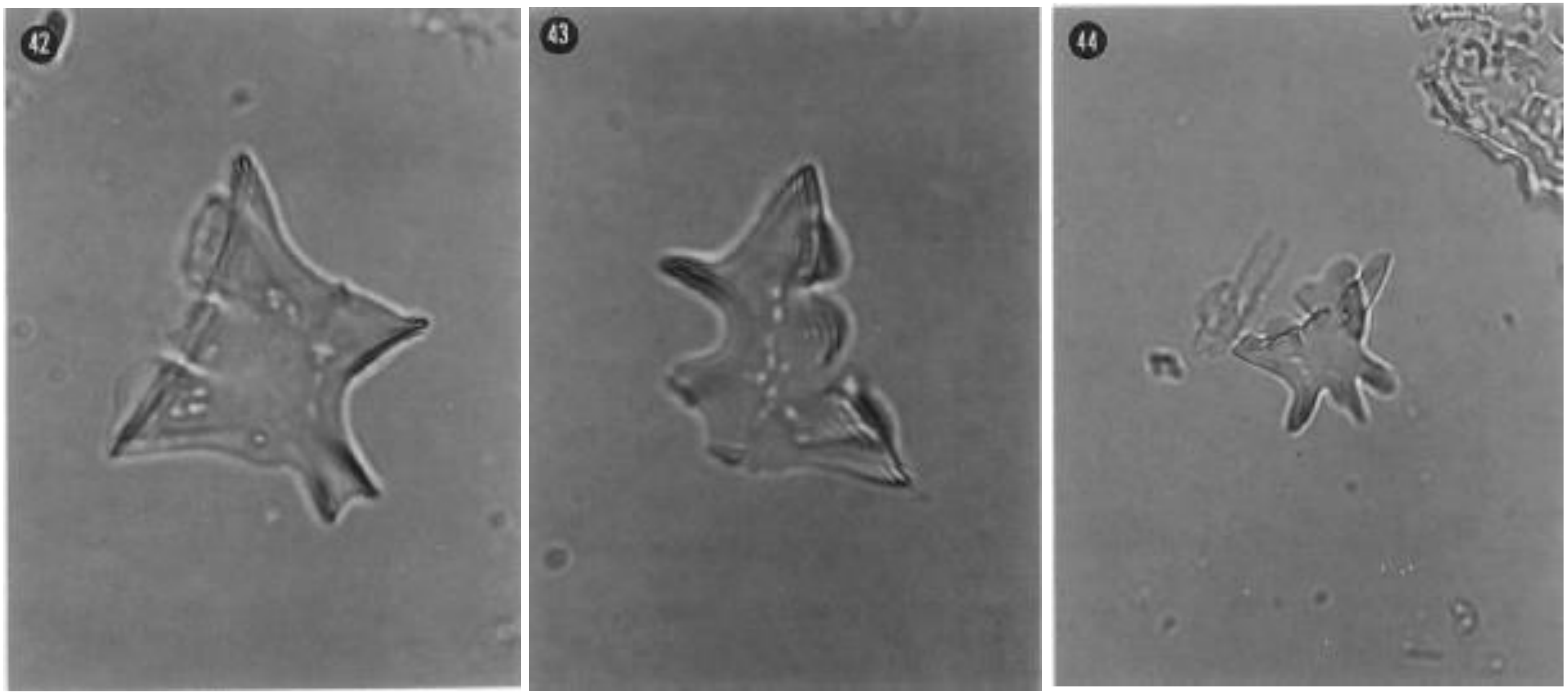


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Arberella dressleri

Phytolith

FIGURES 41-44. 42, A phytolith From Arberella dressleri with one sinuous and one concave, irregularly pointed edge (x400). 43, A phytolith from Arberella dressleri with one sinuous and one concave, irregularly pointed edge (x400). 44, A phytolith from Arberella dressleri with one sinuous and one irregularly pointed edge (x400)

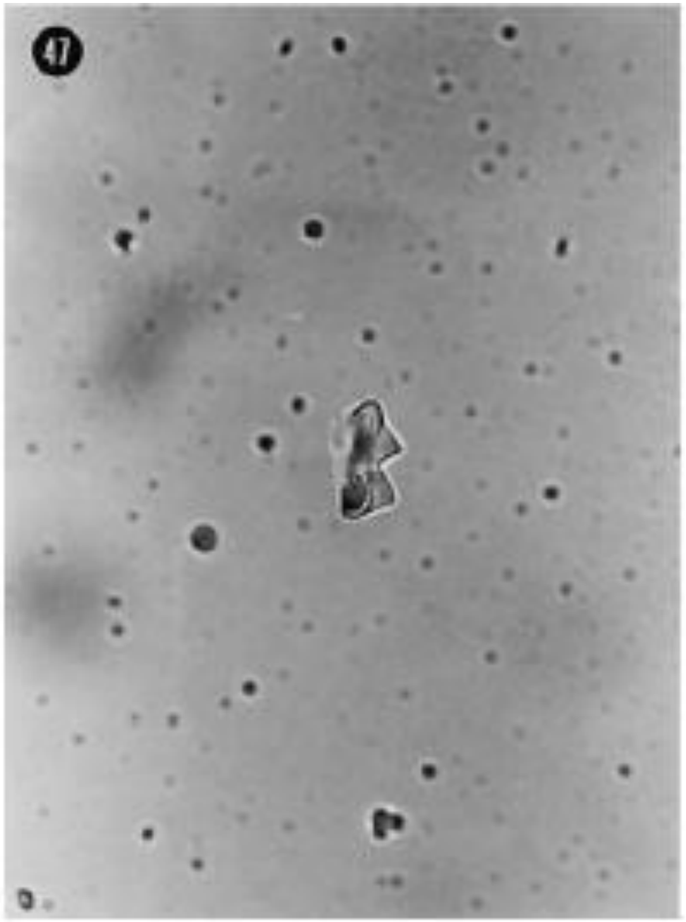


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Arberella dressleri

Phytolith

FIGURES 45-48.-47, A Variant 3 bilobate phytolith from Arberella dressleri. The phytolith is partially turned, revealing aspects of both of its faces (x400)



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida sp.

Phytolith

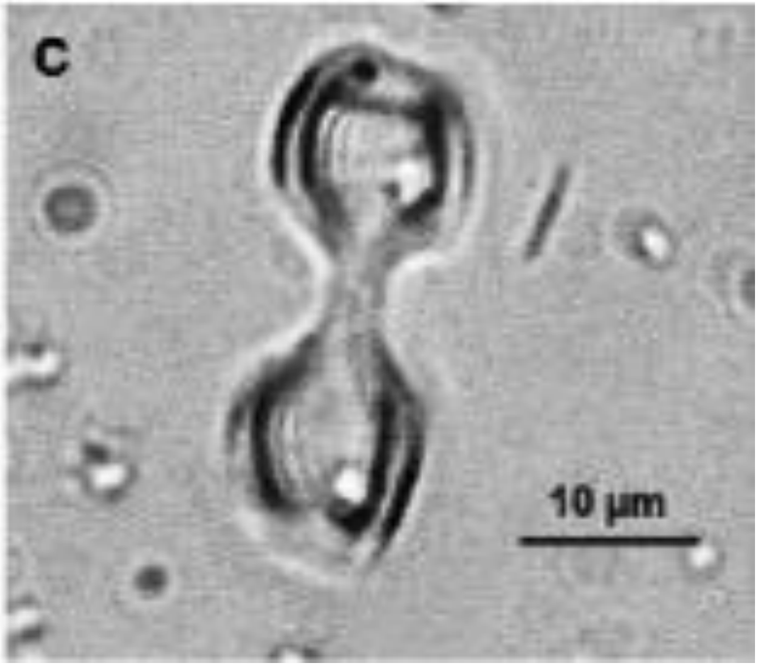


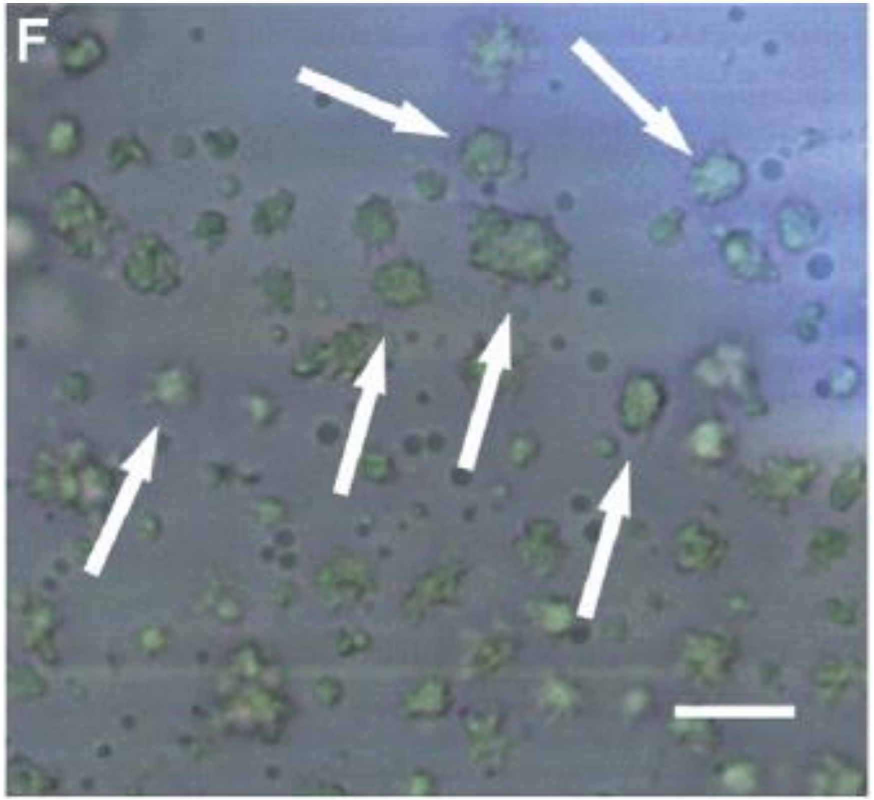
Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. c) Aristida sp. bilobate (GM RP, 0-15 cm)

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Aristida mendocina

Starch

Fig. 3. Pampean native wild grasses from reference collection. F-G: Compound starch grains, supernumerary aggregates of class b. F: Aristida mendocina. (Scale bars: 10 mm).

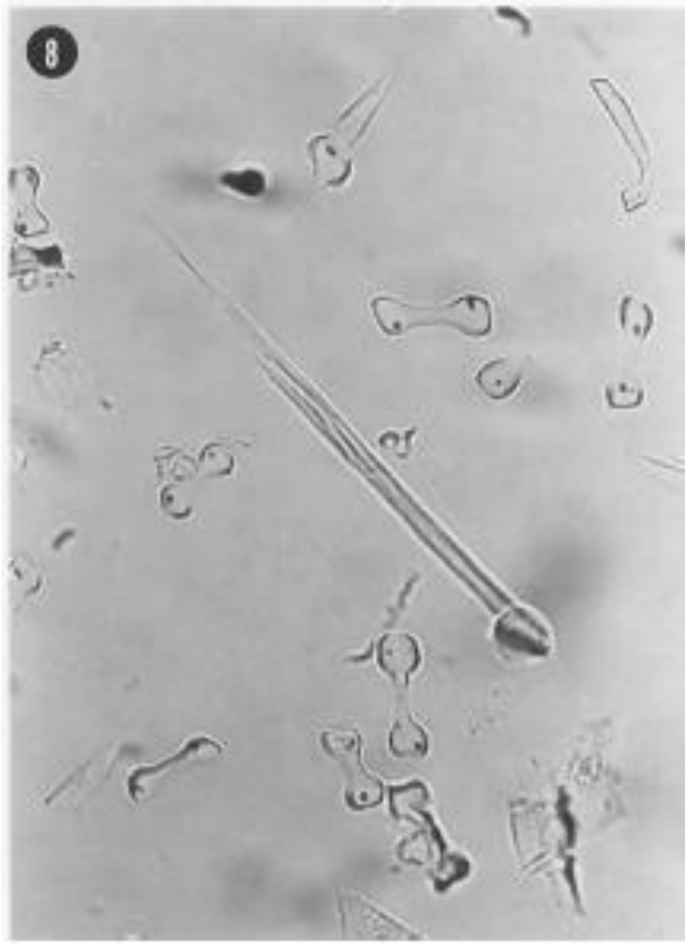


Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Aristida orizaliensis

Phytolith

FIGURES 5-8. 8, Bilobates with semirounded lobes and long, thin shafts from Aristida orizaliensis (x200)

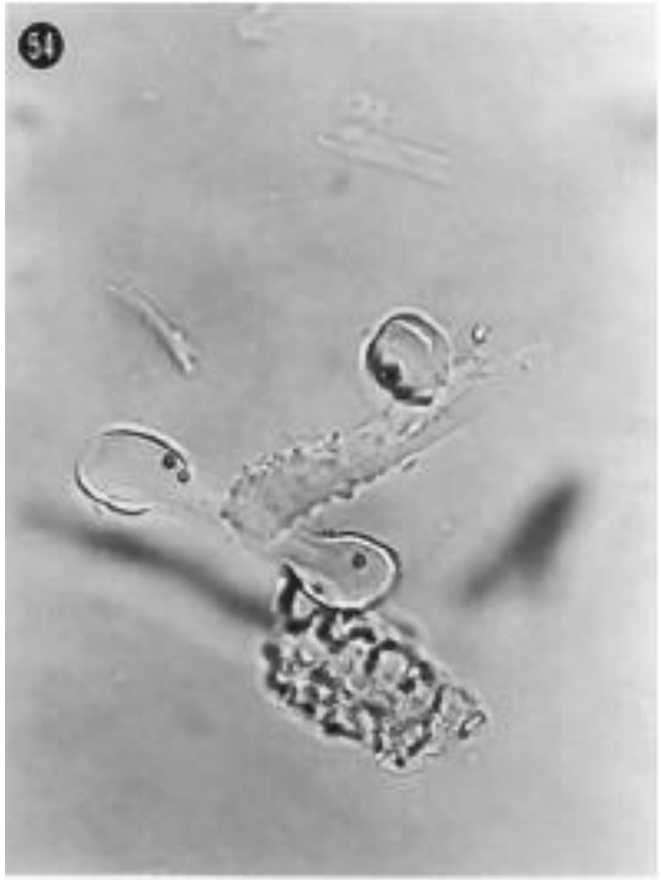


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida orizaliensis

Phytolith

FIGURES 53-56.-54, Top, a rondeloid/saddleloid phytolith from Aristida orizaliensis. Also present is a bilobate (x400).

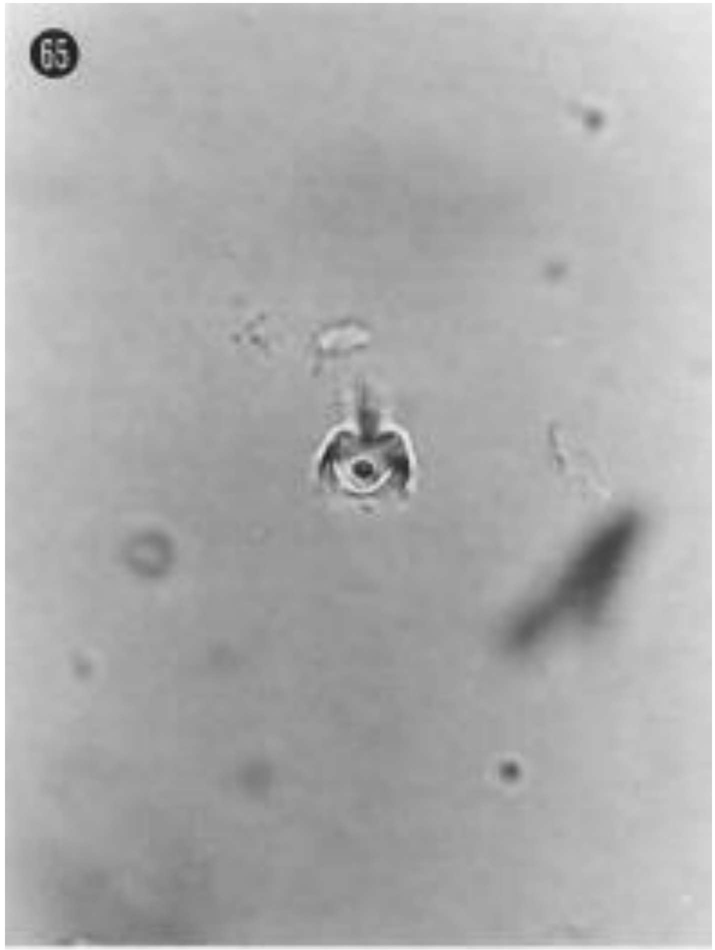


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida orizaliensis

Phytolith

FIGURES 65-68.-65, An odd silica body with saddle tendencies from the culm of Aristida orizaliensis (x400). 66, An unusual silica body from the inflorescence of Aristida orizaliensis (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida recurrata

Phytolith

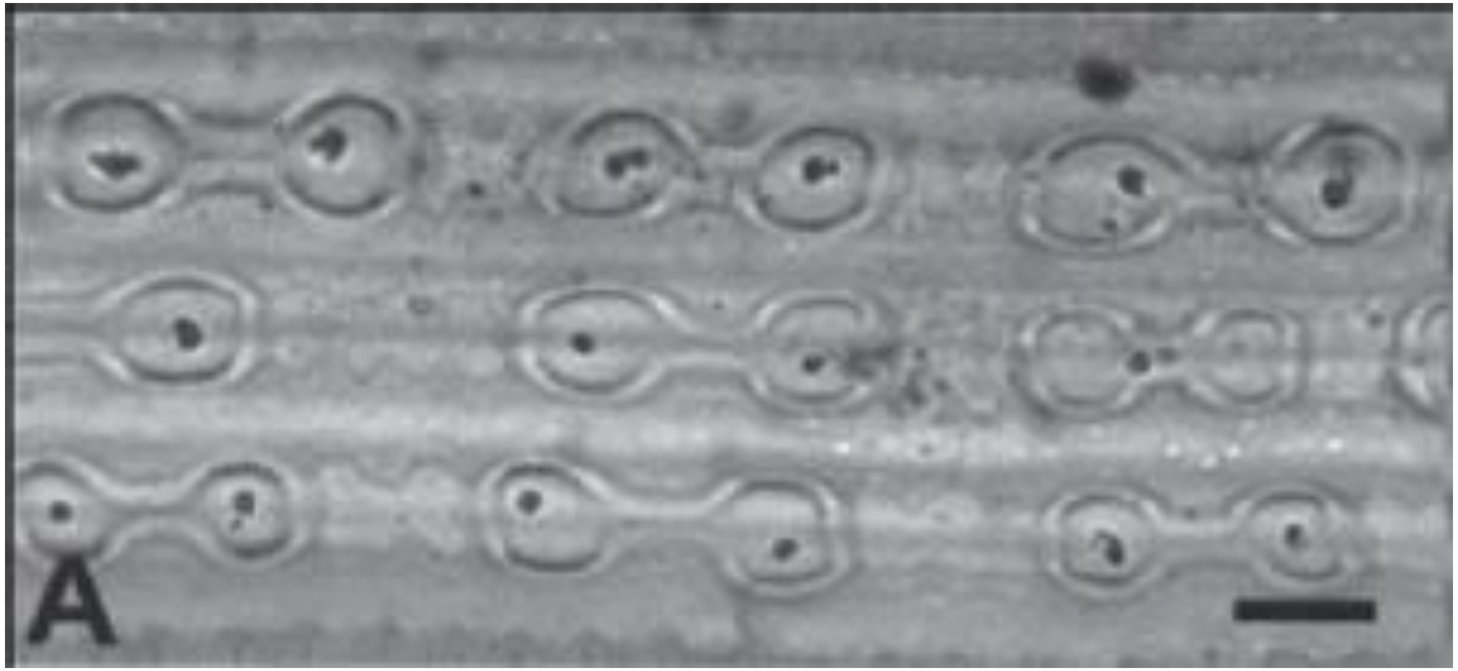
FIGURES 53-56.-53, A rondeloid/saddeloid phytolith from the inflorescence of Aristida recurrafa. As the name implies, it exhibits features characteristic both of phytoliths in the Pooideae and Chloridoideae (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida setigera

Phytolith

Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. A. Aristida setigera, costal dumbbell-shaped silica bodies (bar = 10 µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Aristida ternipes

Phytolith

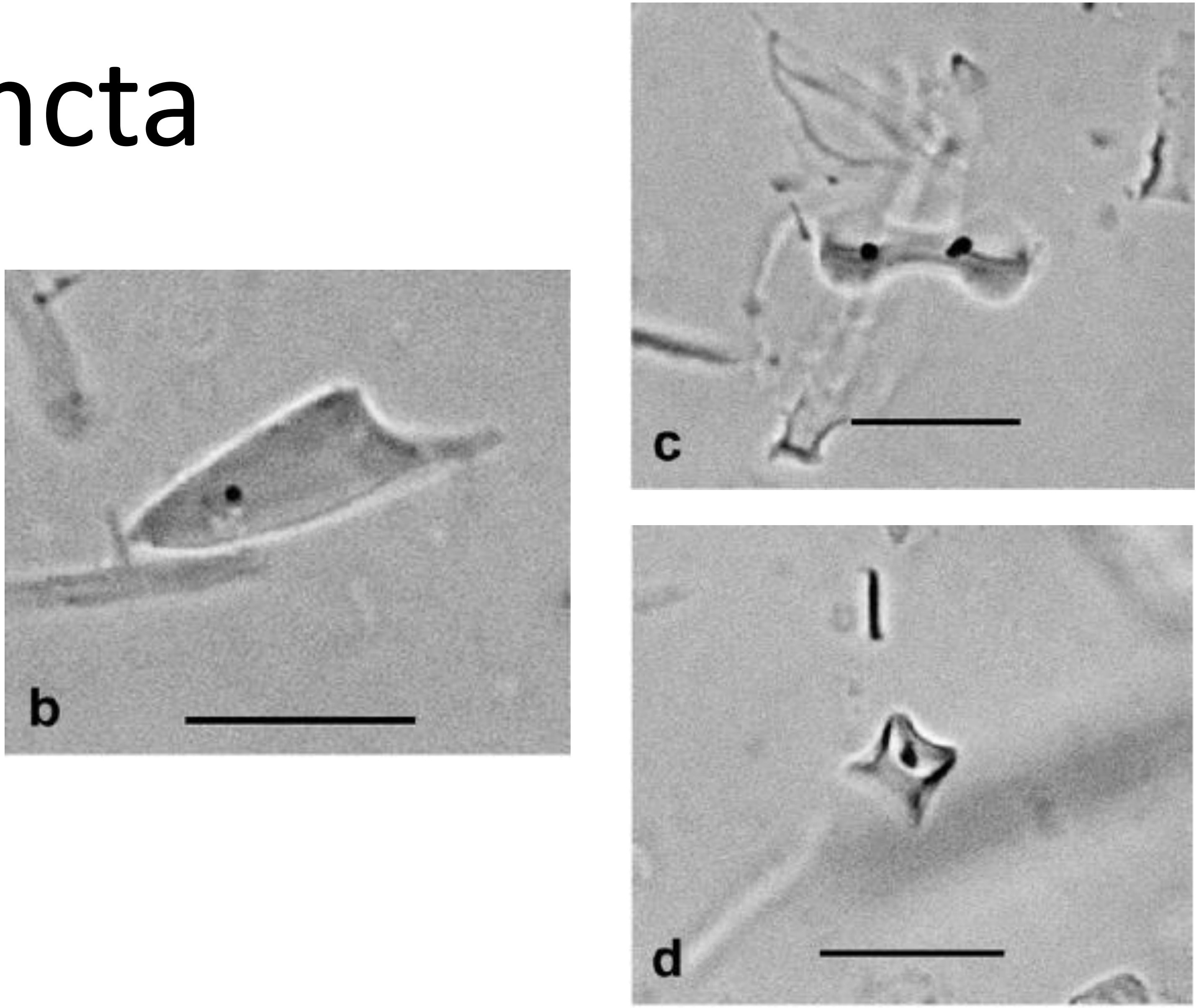
FIGURES 61-64.-64, An odd silica body from the culm of Aristida ternipes (x400)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Aristida tincta

Phytolith

Fig. 4. Phytoliths from Poaceae. b) Prickle-type hair from Aristida tincta, c) Aristida-type bilobate from Aristida tincta d) Rondeloid/saddleoid phytolith from A. tincta

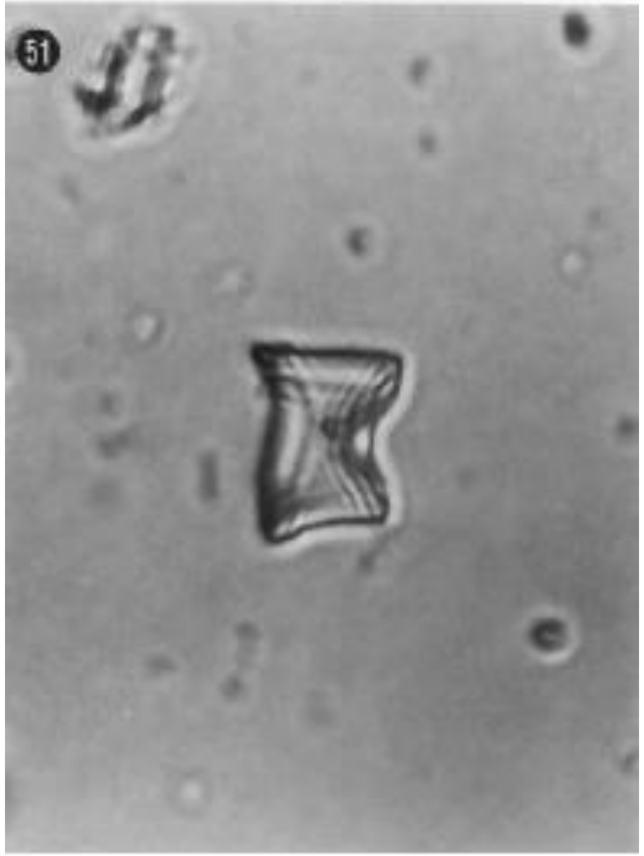


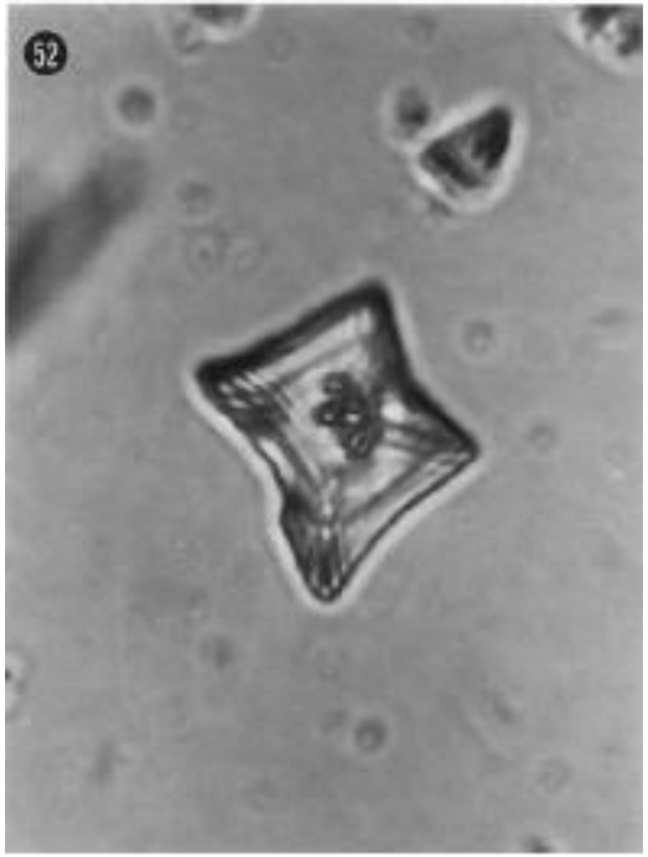
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Arundinella confinis

Phytolith

FIGURES 49-52.-51, A phytolith from Arundinella confinis marked by considerable width and the presence of one slightly concave and one somewhat sloping edge (x400). 52, A phytolith from Arundinella confinis marked by considerable width and the presence of one somewhat concave and one somewhat sloping edge (x400)



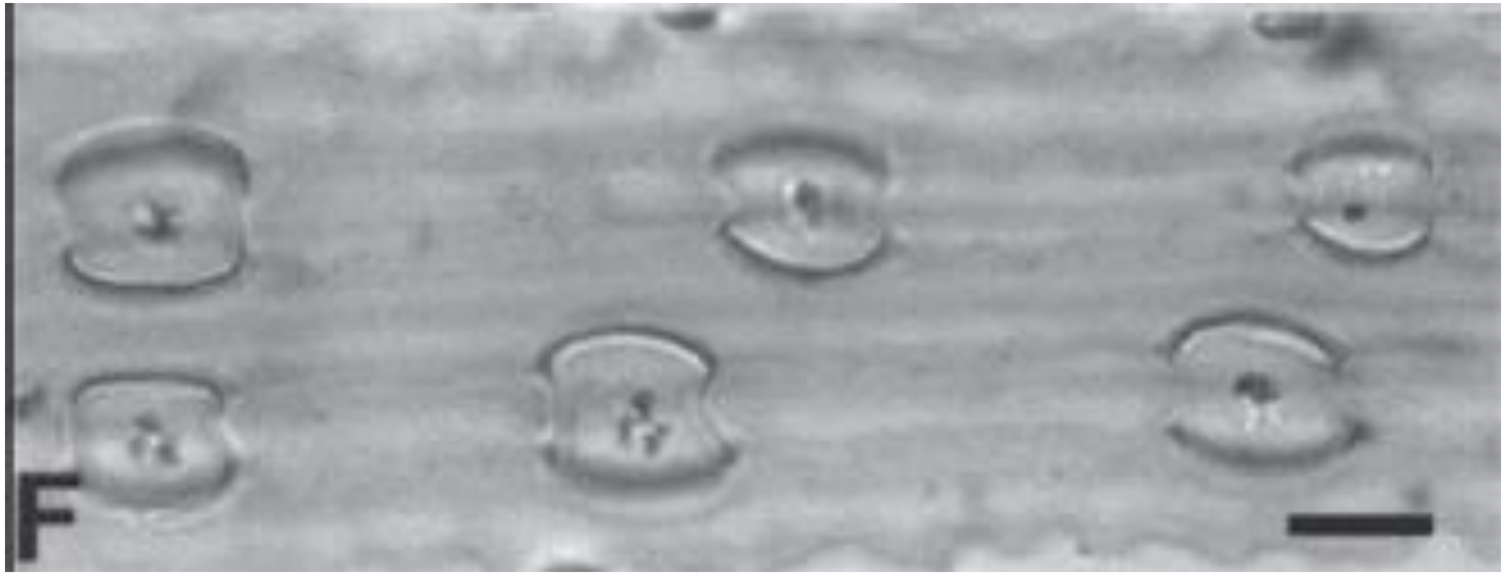


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Astrebla squarrosa

Phytolith

Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. F. Astrebla squarrosa, saddle-shaped silica bodies (bar = 10 µm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Avena sterilis

Starch

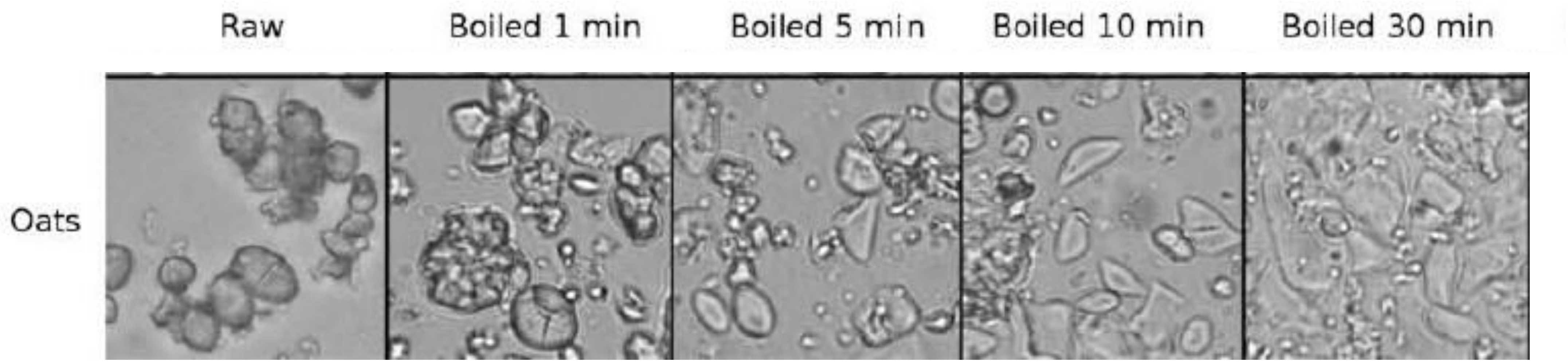


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Avena sterilis

Starch

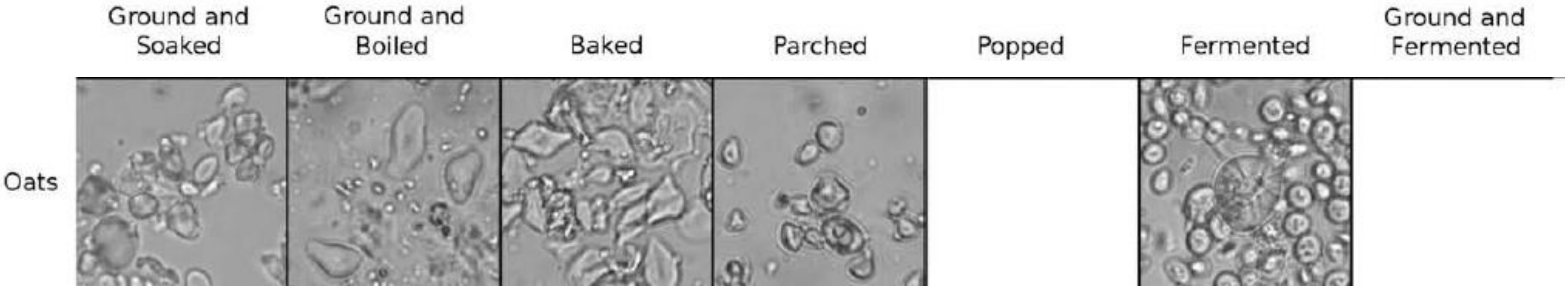


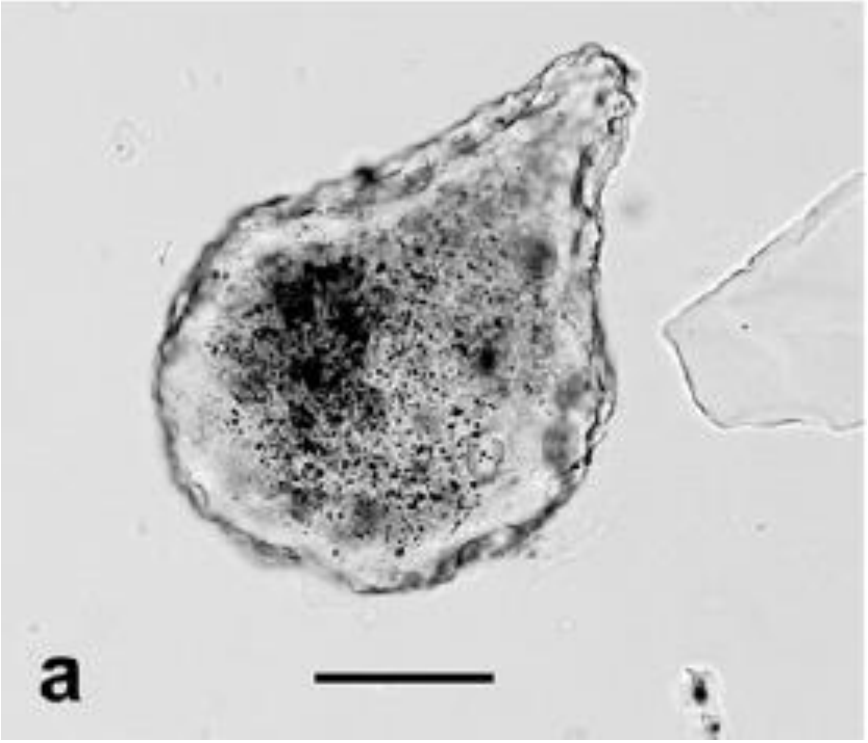
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Axonopus aureus

Phytolith

Fig. 4. Phytoliths from Poaceae. a) Bulliform cell from Axonopus aureus

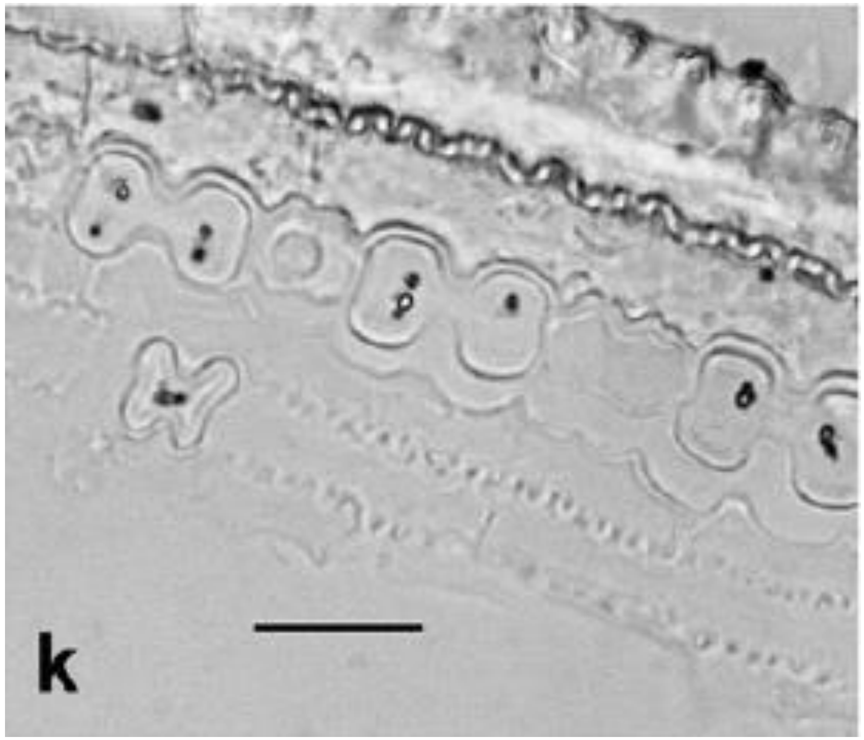


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Axonopus aureus

Phytolith

Fig. 4. Phytoliths from Poaceae. k) Bilobate from Axonopus aureus



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Bathriochloa ischaemum

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 7. Bathriochloa ischaemum

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Brachiaria jubata

Phytolith

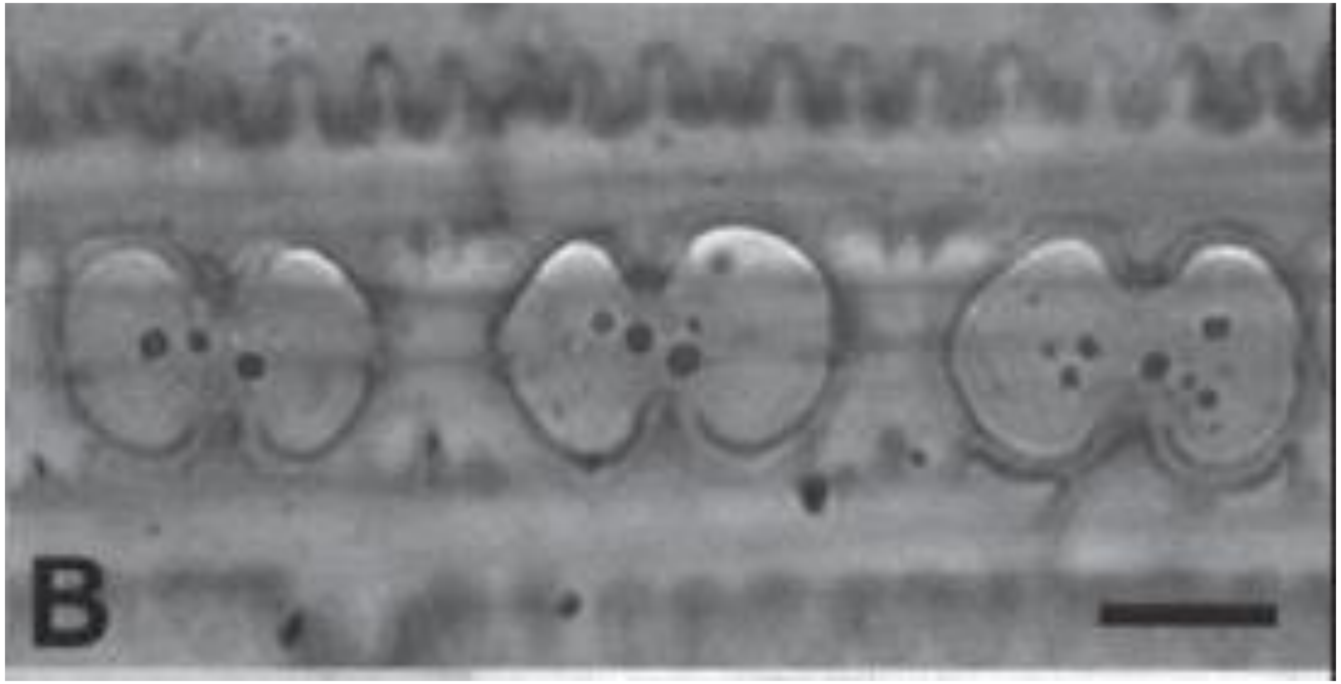


Fig. 6. Various silica body morphologies found in the epidermal cells of Poaceae. B. Brachiaria jubata, a form of silica intermediate between the dumbbell-shaped form and the cross-shaped form (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Bromus auleticus

Starch

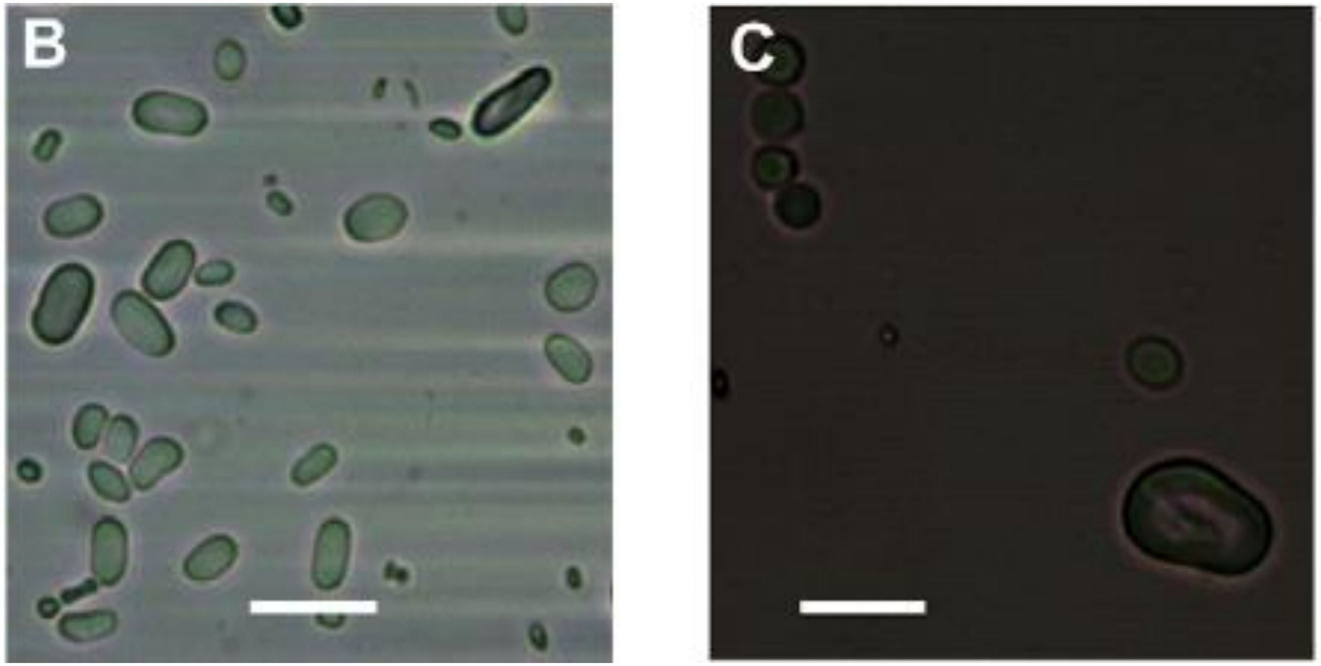


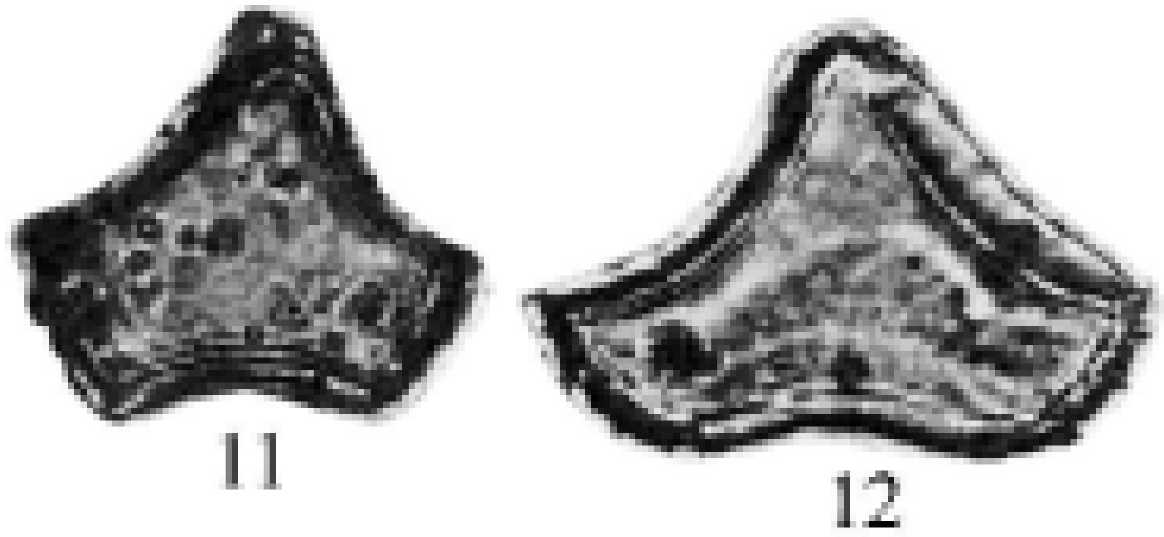
Fig. 3. Pampean native wild grasses from reference collection. A-C: Simple starch grains. B and C: Bromus auleticus. (Scale bars: 10 mm).

Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Buchloe dactyloides

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 11, 12. Buchloe dactyloides



Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Cencrus echinatus

Starch

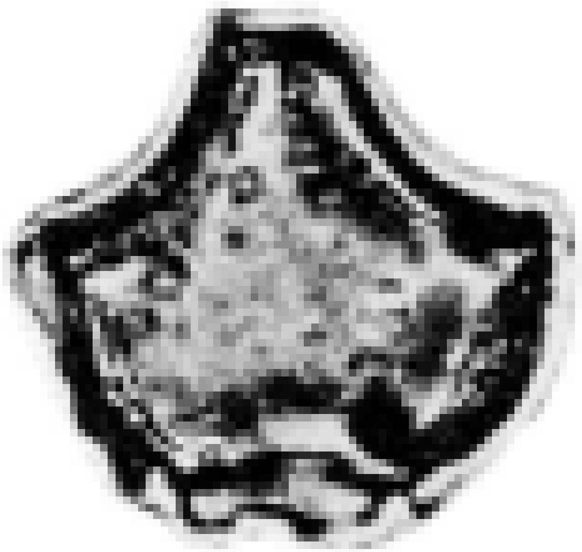
APPENDIX:
Cencrus echinatus. Compound grains, with many pressure facets. The double border is visible on part of the grain. The hilum is centrally located and the central fissures can be deep and distinct. Indistinct radiating fissures are present. Size: 10–16 microns long.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Chimonobambusa quagrangularis

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 9. Chimonobambusa quagrangularis



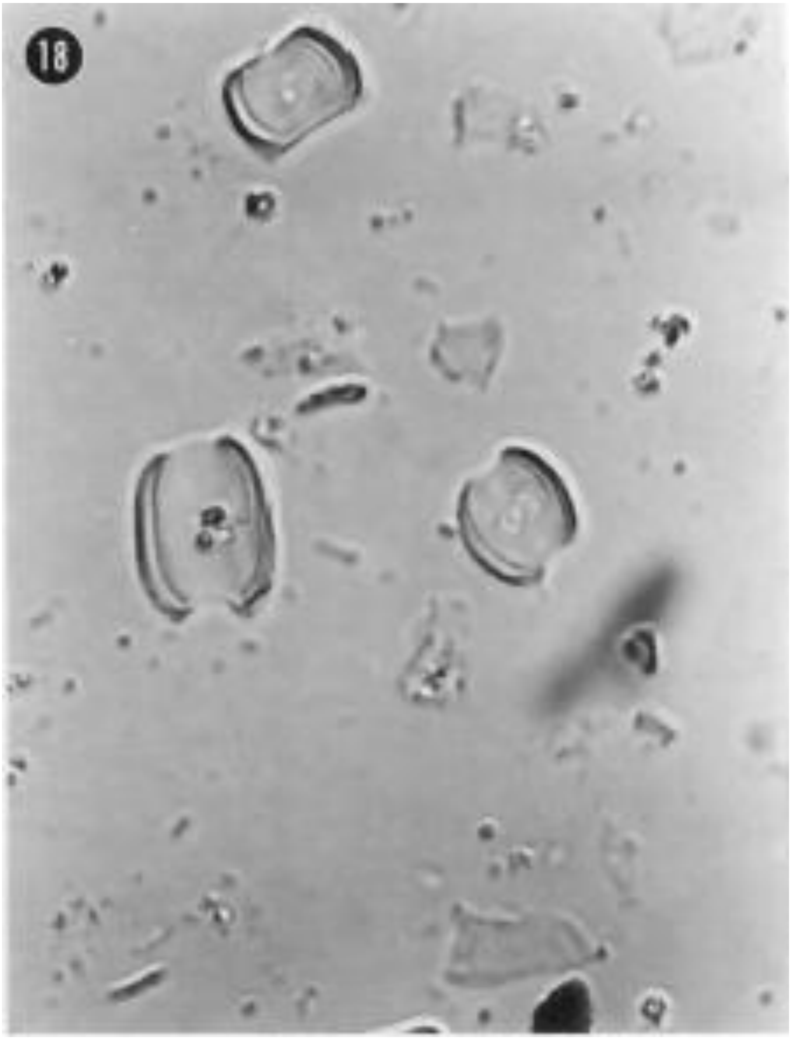
9

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Chloris eiliata

Phytolith

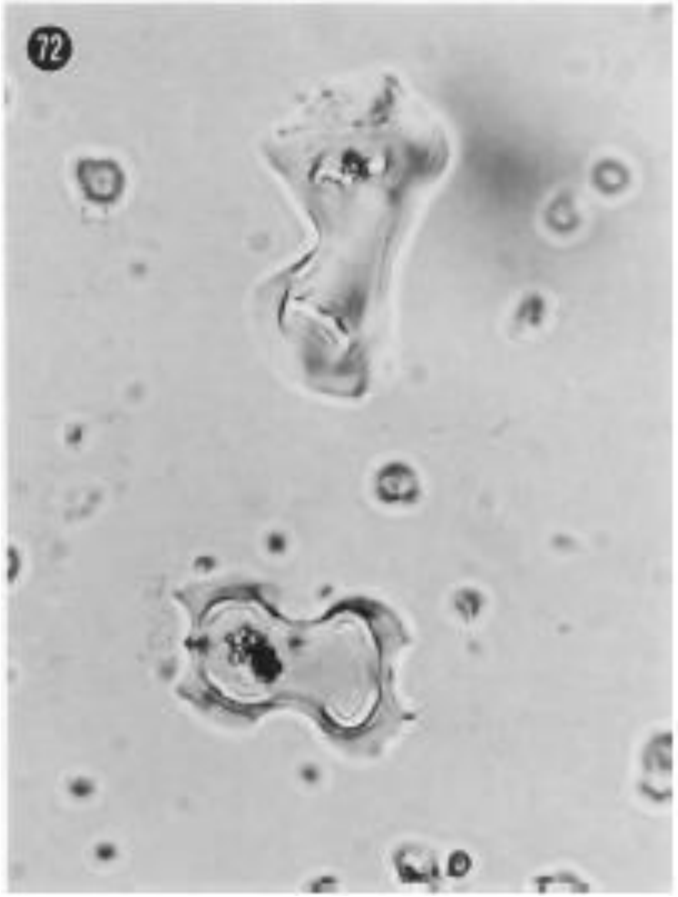
FIGURES 17-20. 18, Center, two squat saddles, and top, a tall saddle from Chloris eiliata (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea sp.

Phytolith



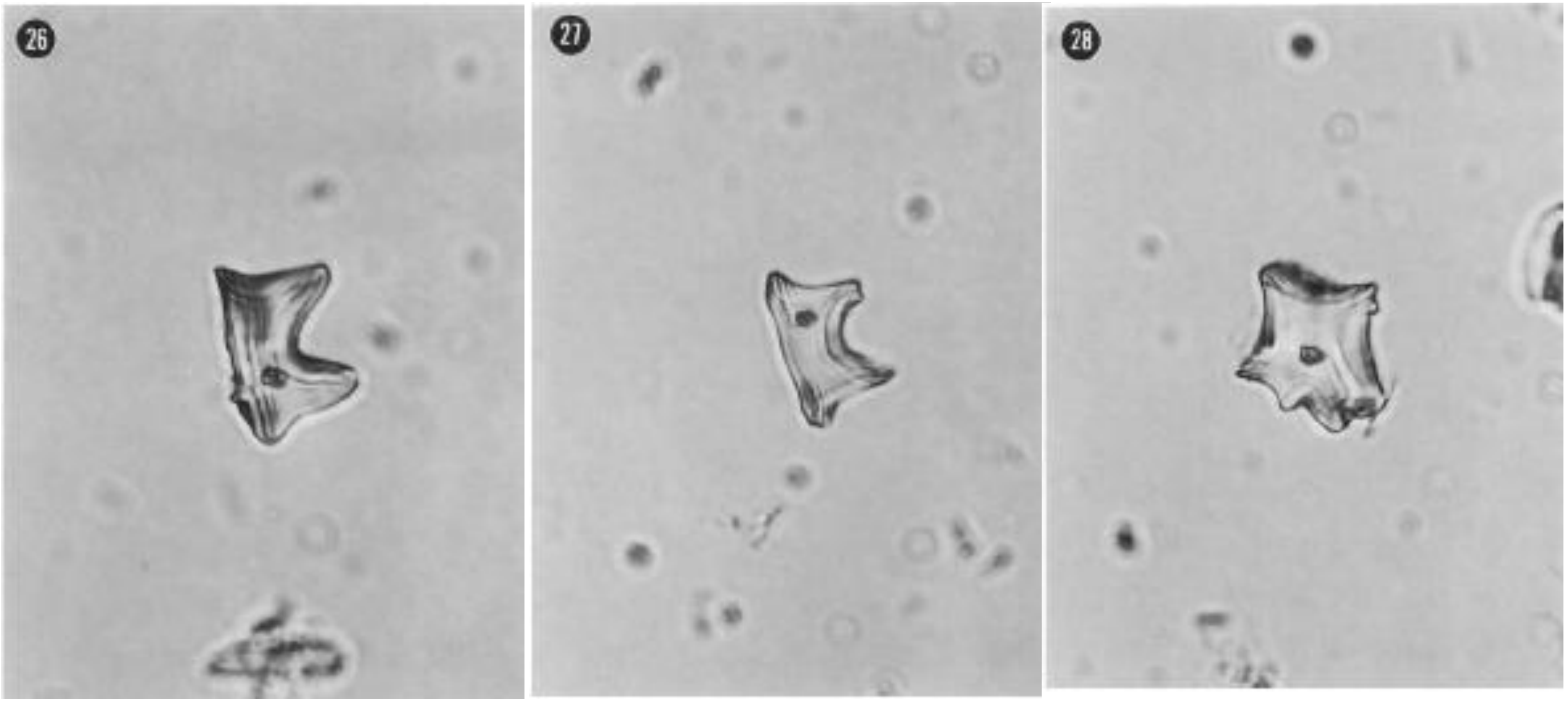
FIGURES 69-72.-72, Top, a Chusquea-body phytolith as it would appear in leaf tissue. Below is a Chusquea-type bilobate (x400)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea grandiflora

Phytolith

FIGURES 25-28. 26, A collapsed saddle from Chusquea grandiflora (x400). 27, A partially collapsed saddle from Chusquea grandiyora (x400). 28, A two-spiked-side phytolith from Chusquea grandiflora. Spikes are present on the bottom of the phytolith (x400).

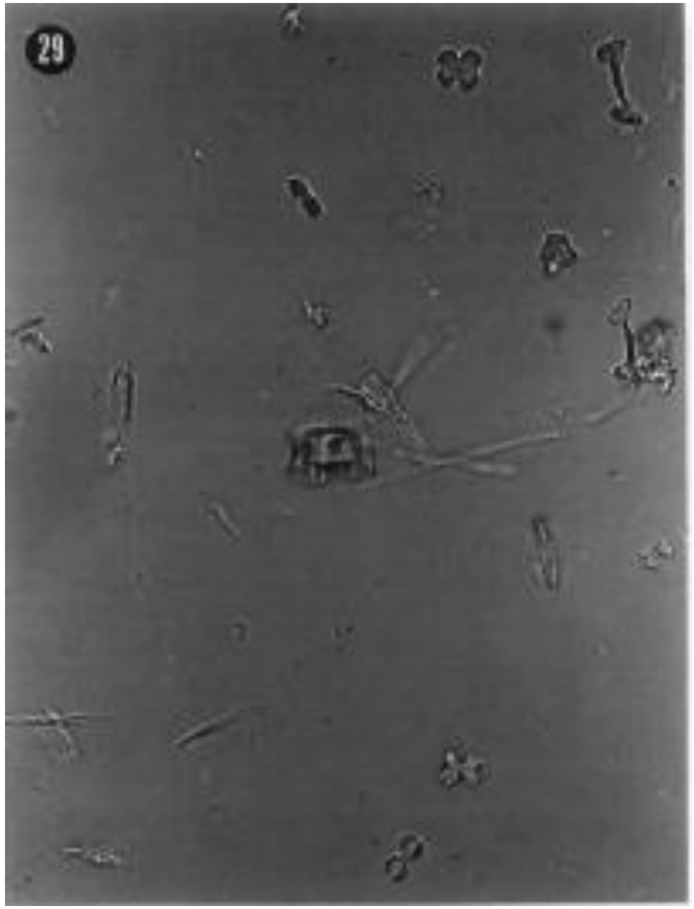


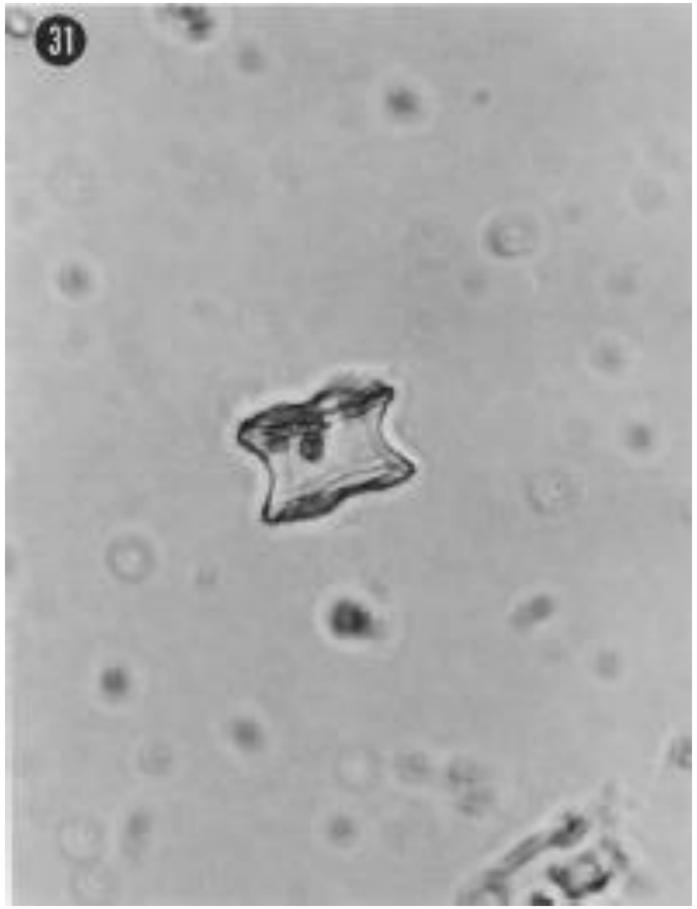
Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea grandiflora

Phytolith

FIGURES 29-32.-29, Center, a saddle with a ridged platform from Chusquea grandiflora (x400). 31, A saddle bilobate both sides type of phytolith from Chusquea grundiflora (x400).

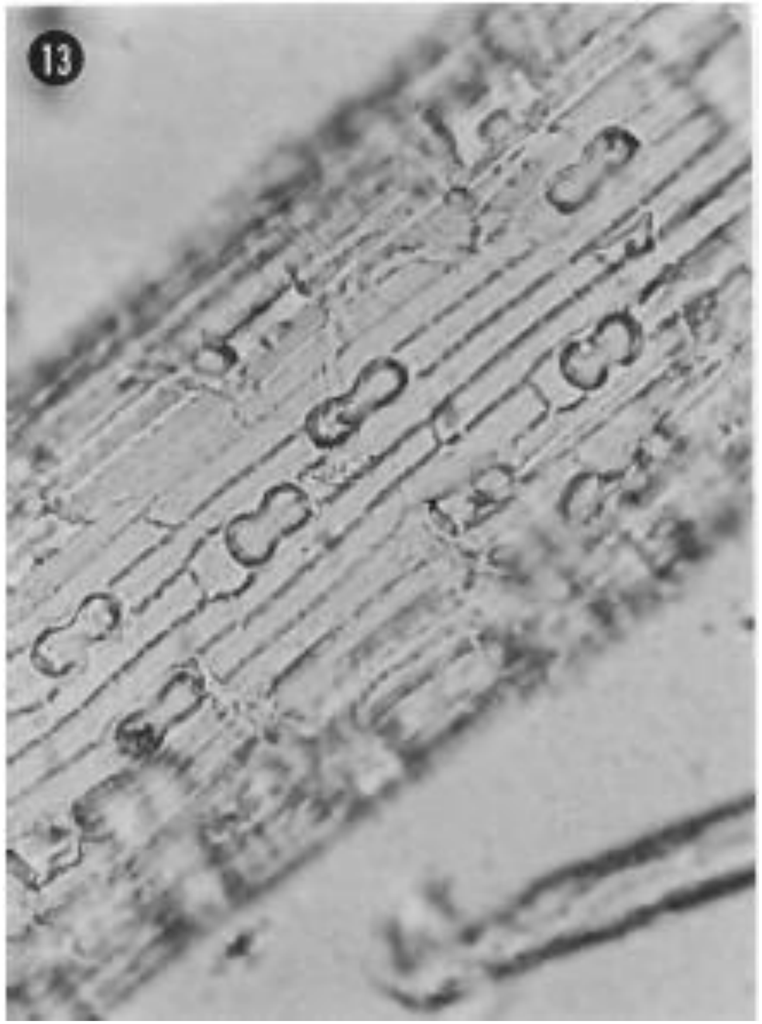




Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea longifolia

Phytolith



FIGURES 13-16. 13, Bilobates from the culm of Chusquea longifolia (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea longifolia

Phytolith

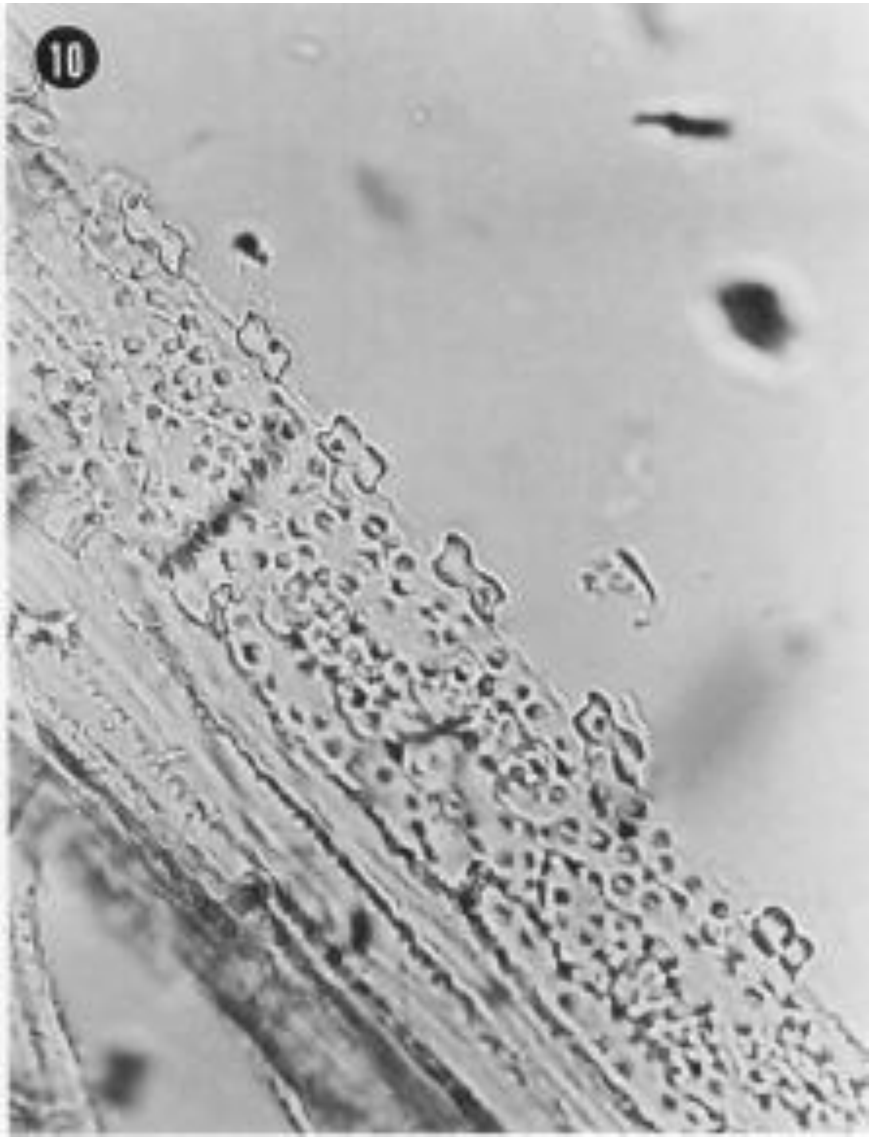
FIGURES 57-60.-59, Center, bilobates from the inflorescence of Chusquea longifolia. They are attached to two elongated phytoliths (x200).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea patens

Phytolith

FIGURES 9-12. 10, A row of bilobates from Chusquea patens (x200). Their morphology, although not ovelapping the panicoid types, is unusual for bamboos



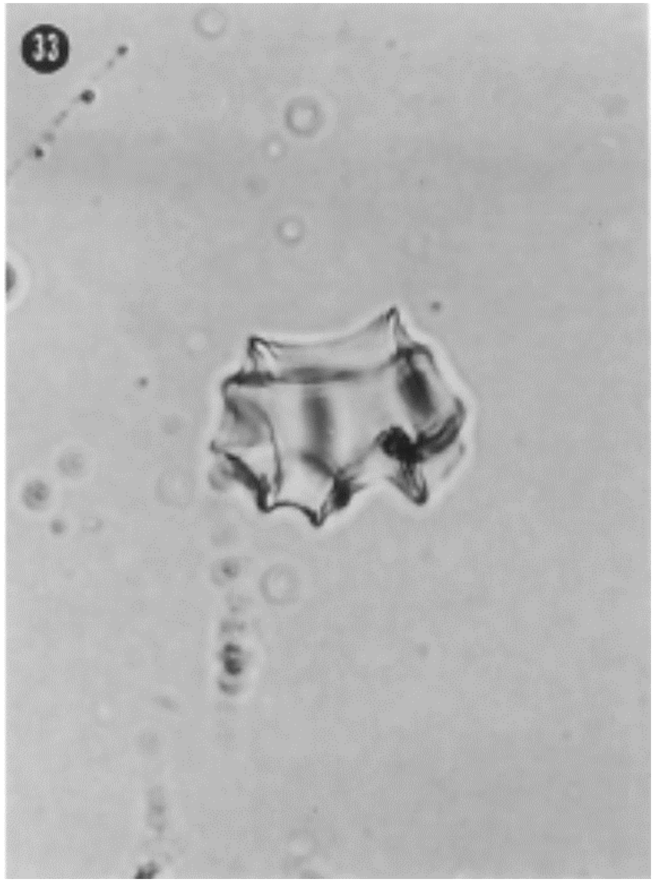
Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

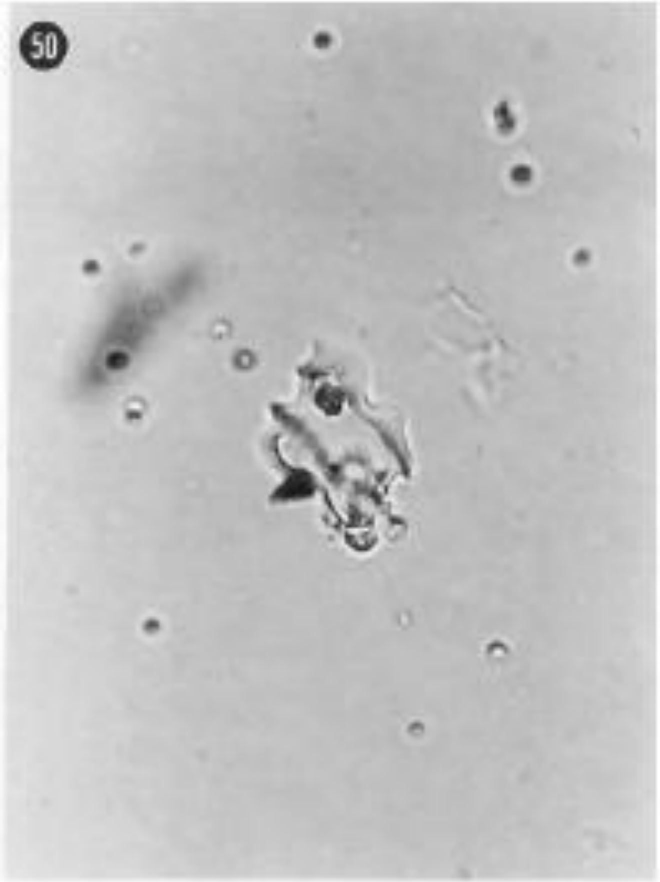
Chusquea pittieri

Phytolith

FIGURES 33-36.-33, A multifaceted Chusquea-body phytolith from Chusquea pittieri (x400).

FIGURES 49-52.-50, A cross-shaped phytolith from Chusquea pittieri with serrated short axes, three indentations, and a concave face (x400). This phytolith is not as
thick as is usual in the genus.

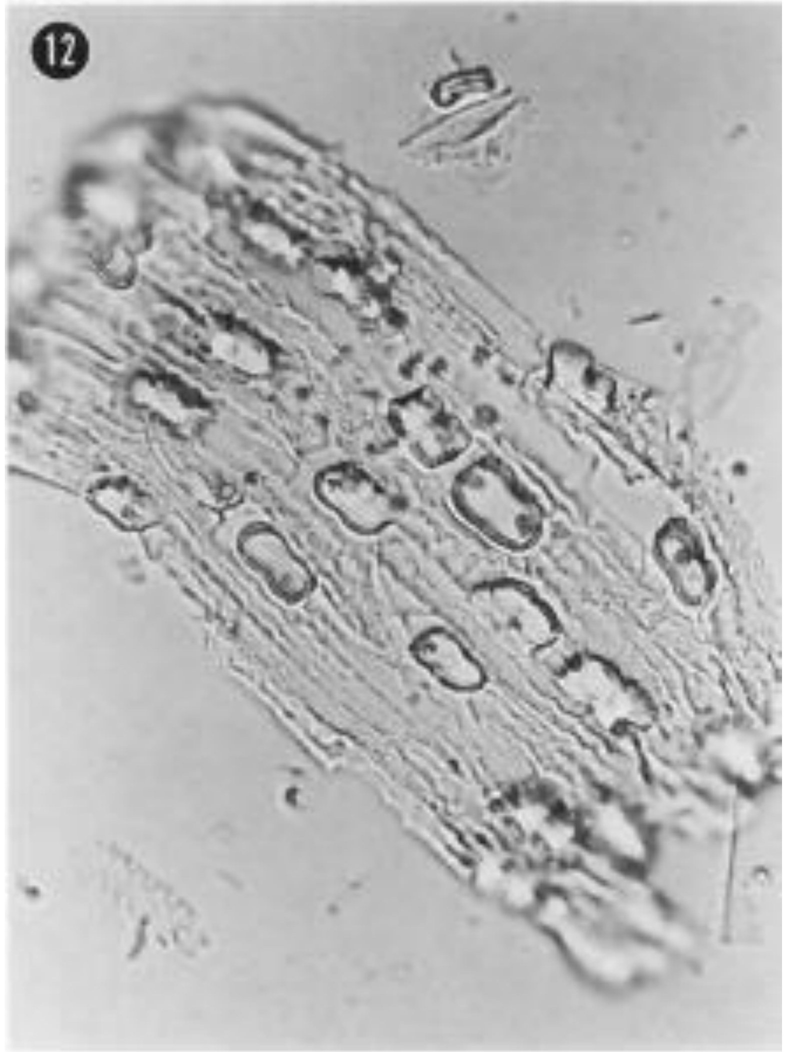




Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea pohlii

Phytolith



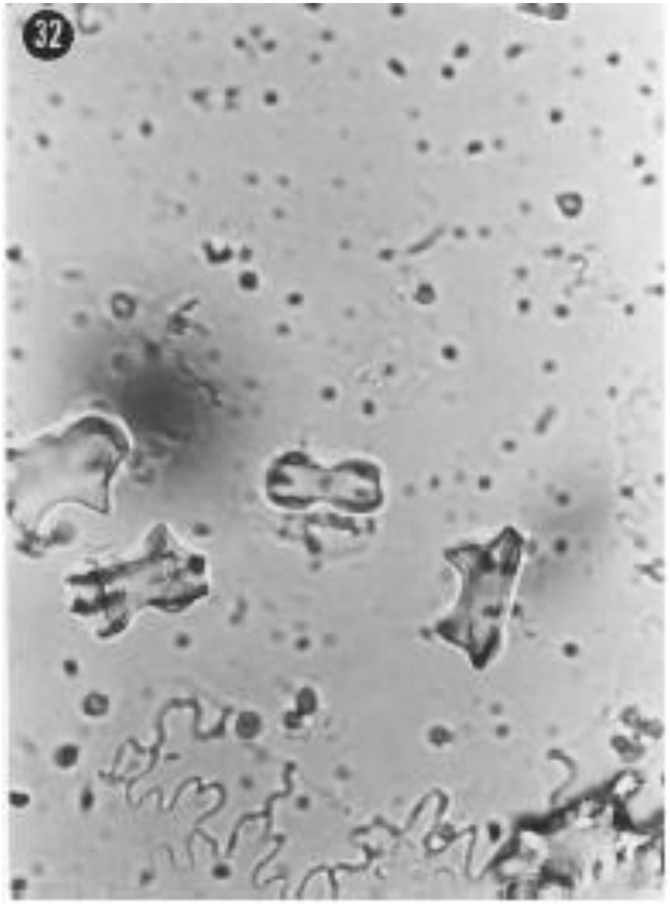
FIGURES 9-12. 12, Bilobates in tissue from Chusquea pohli (x200).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Chusquea simpliciflora

Phytolith

FIGURES 29-32.-32, Right and left, Chusquea-body phytoliths diagnostic of this genus from Chusquea simpliciflora. The phytolith on the bottom left is still orientated as it would appear in the leaf (x200). The center phytolith is a bilobate



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Coix lacryma-jobi var. ma-yuen

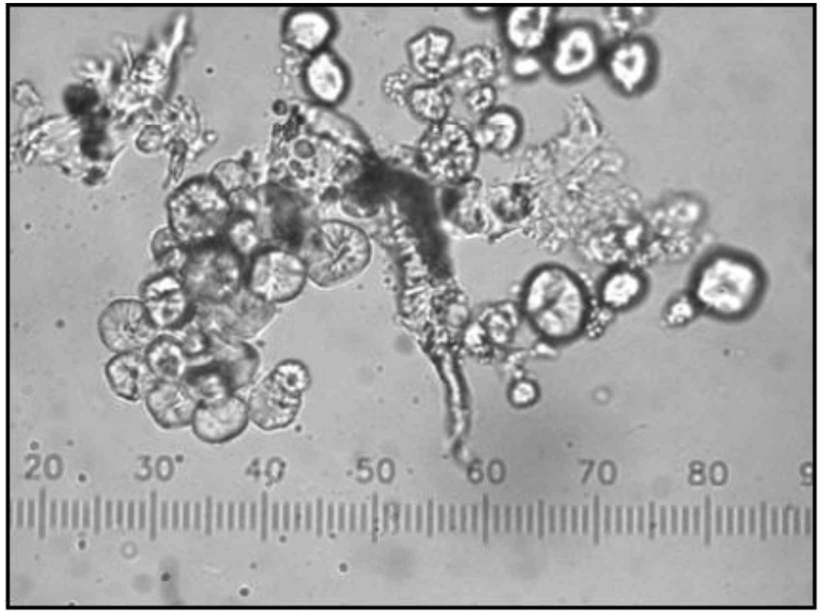
Phytolith

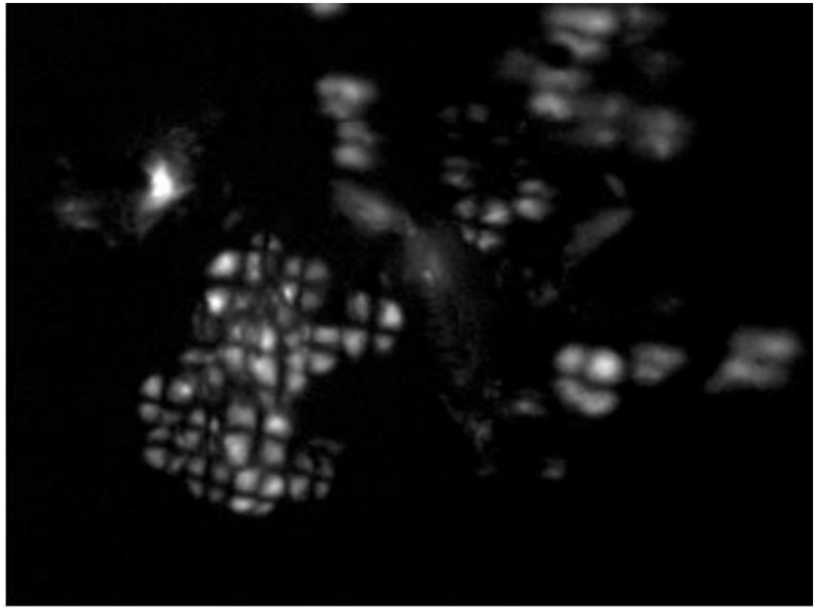
Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 8. Coix lacryma-jobi var. ma-yuen

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Coix lacryma-jobi

Starch





Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Cortaderia speciosa

Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

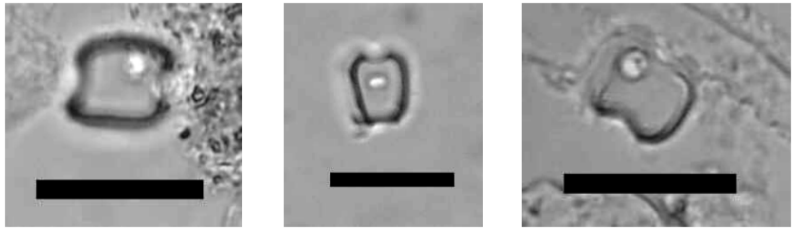
Poaceae *Cortaderia speciosa* "cortadera"

Phytolith assemblage characterization

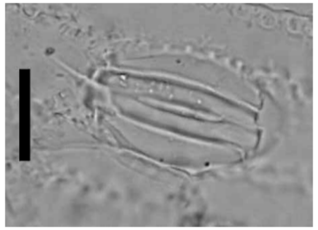
leaf

Non diagnostic phytoliths:

a) Bilobate (saddle) silica phytolith. Very common.



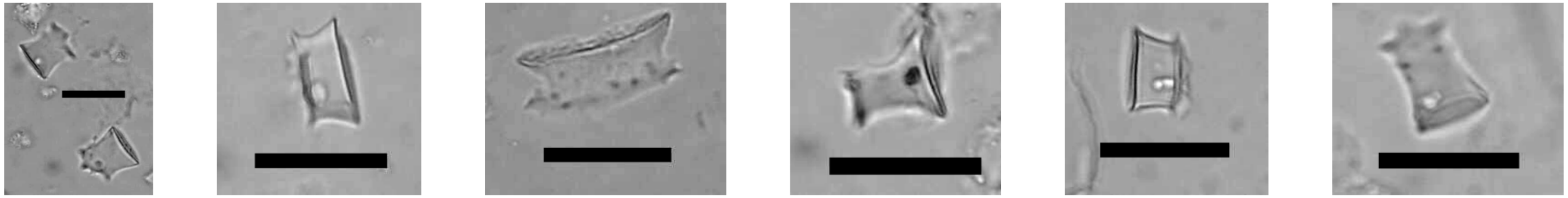
c) Silica stomata. Common.



References: Reported in Zucol 1999 for *Cortaderia selloana*.

b) Round silica phytolith, different lengths.
Very common.

Lateral view.



Scale bar = 20µm.

Criciuma asymmetrica

Phytolith

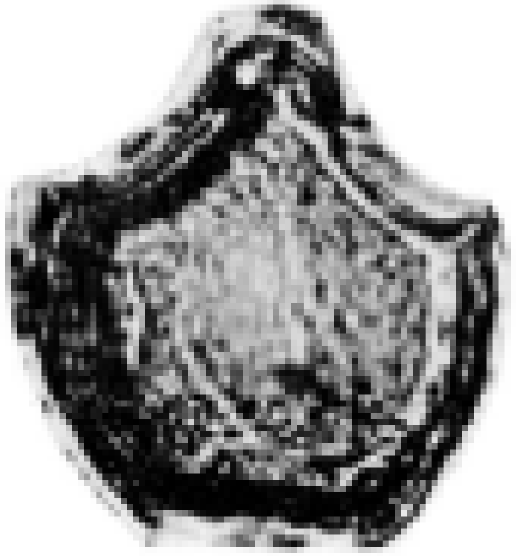
FIGURES 29-32.-30, A
Chusqoid body from Criciuma asymmetrica. This phytolith, unlike the Chusquea body, is fairly widely distributed in bamboos (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Cynodon dactylon

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 5, 10. Cynodon dactylon



5

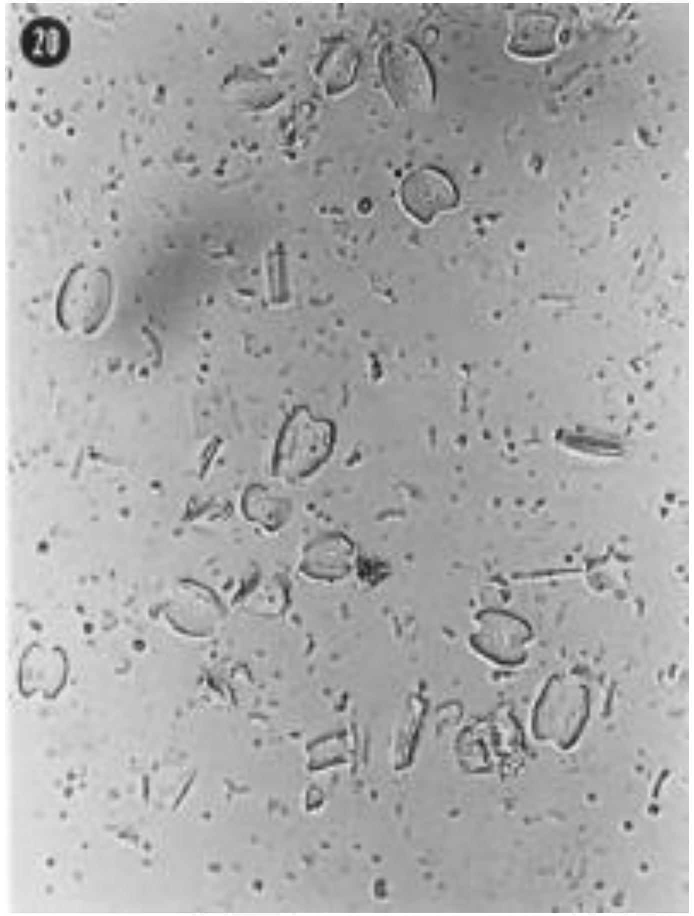
10

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Dactyluctenium aegpticum

Phytolith

FIGURES 17-20. 20, Saddle-shaped phytoliths from Dactyluctenium aegpticum. Many of them are squat (x200).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Distichlis spicata

Phytolith

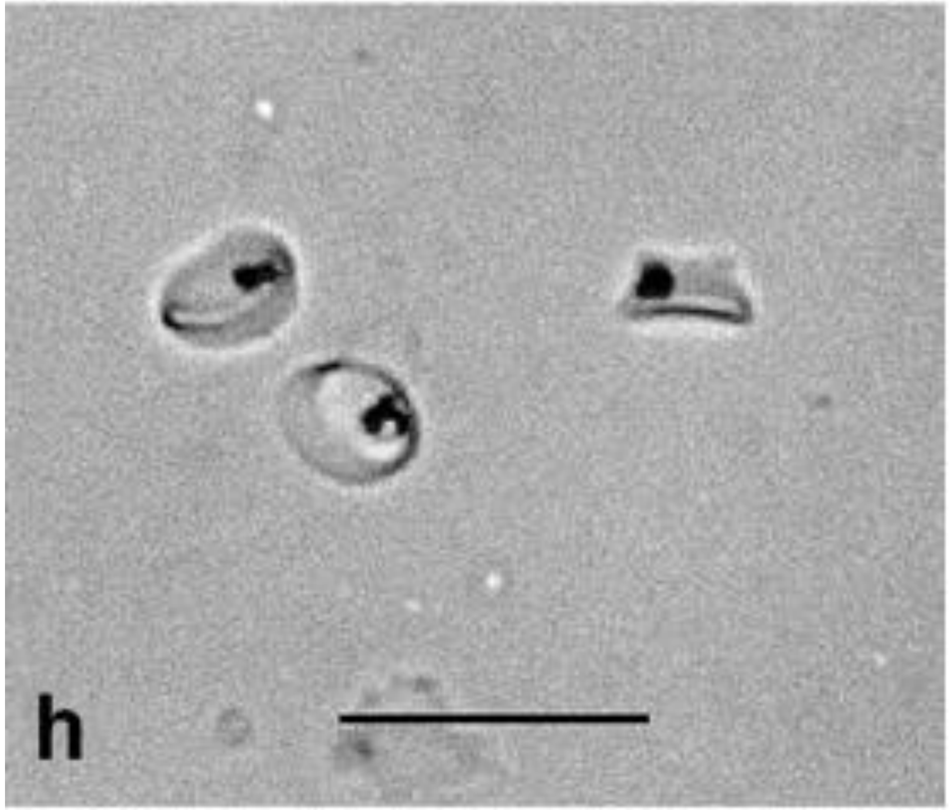


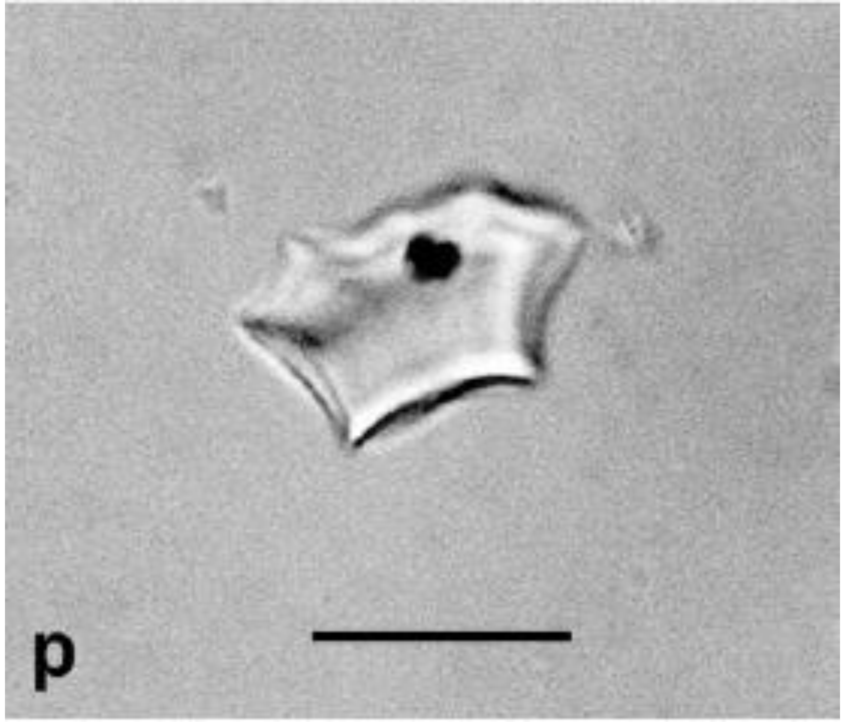
Fig. 4. Phytoliths from Poaceae. h) Spooled/horned towers from Distichlis spicata

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Echinolaena inflexa

Phytolith

Fig. 4. Phytoliths from Poaceae. p) Fan-shaped rondel from Echinolaena inflexa

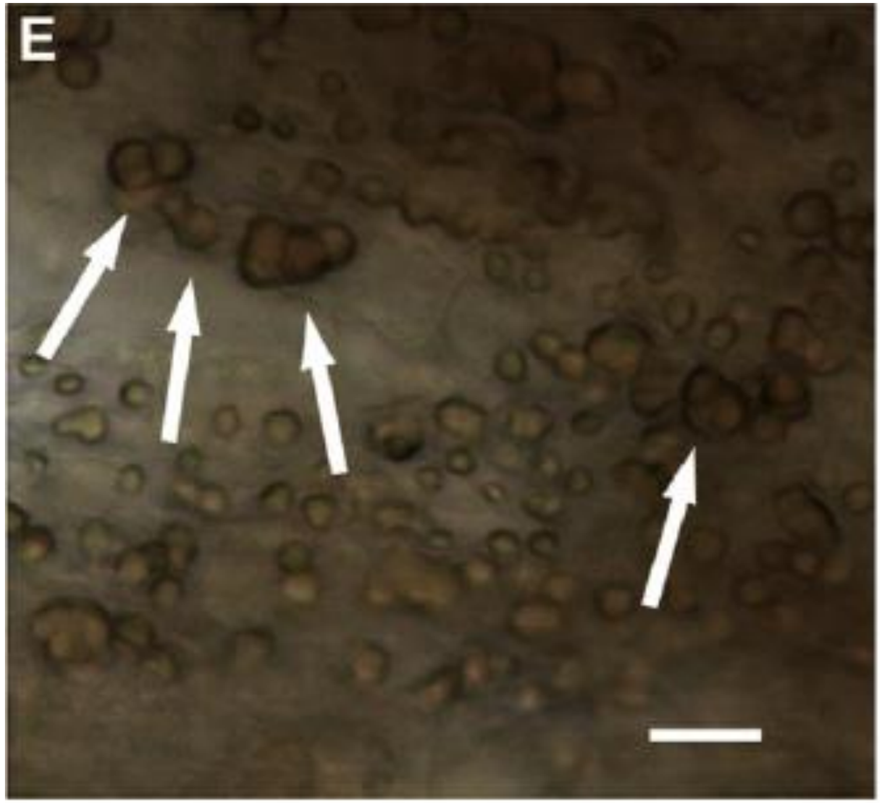


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Elionorus muticus

Starch

Fig. 3. Pampean native wild grasses from reference collection. D-E: Compound starch grains as discrete aggregates of class a. E: Elionorus muticus. (Scale bars: 10 mm).

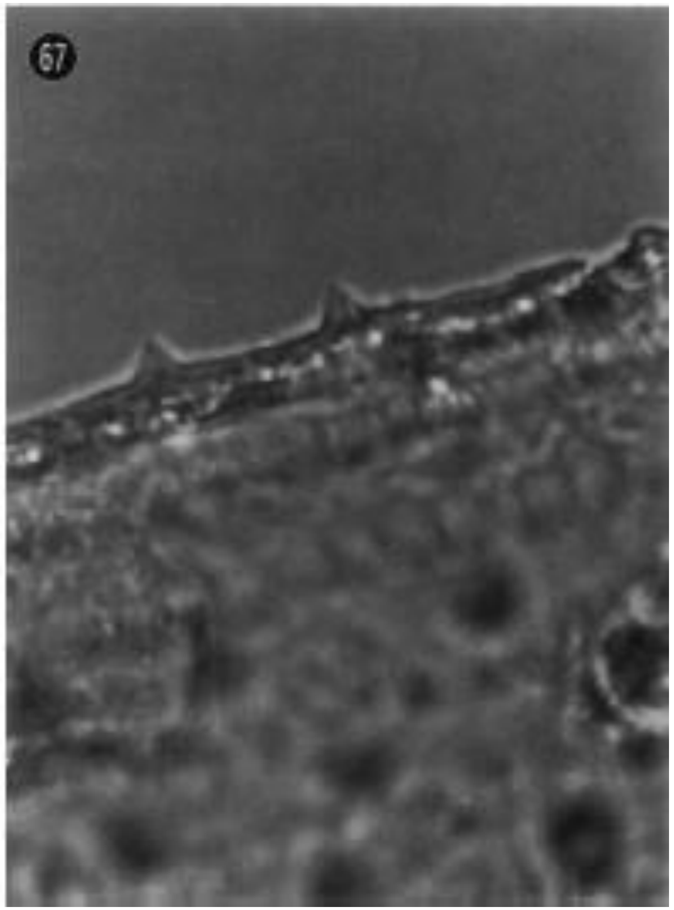


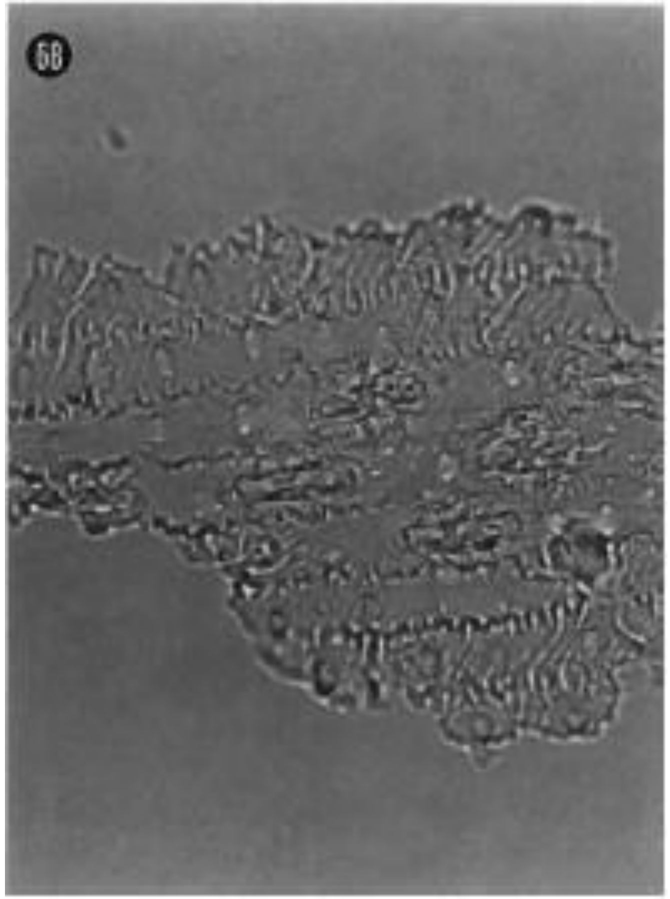
Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Elytrostachys clanisera

Phytolith

FIGURES 65-68.-67, Top, conical siliceous bodies emerging from the leaf epidermis of Elytrostachys clanisera (x400). 68, Two-peaked conical siliceous bodies in epidermis from Elytrostachys clanisera (x200).



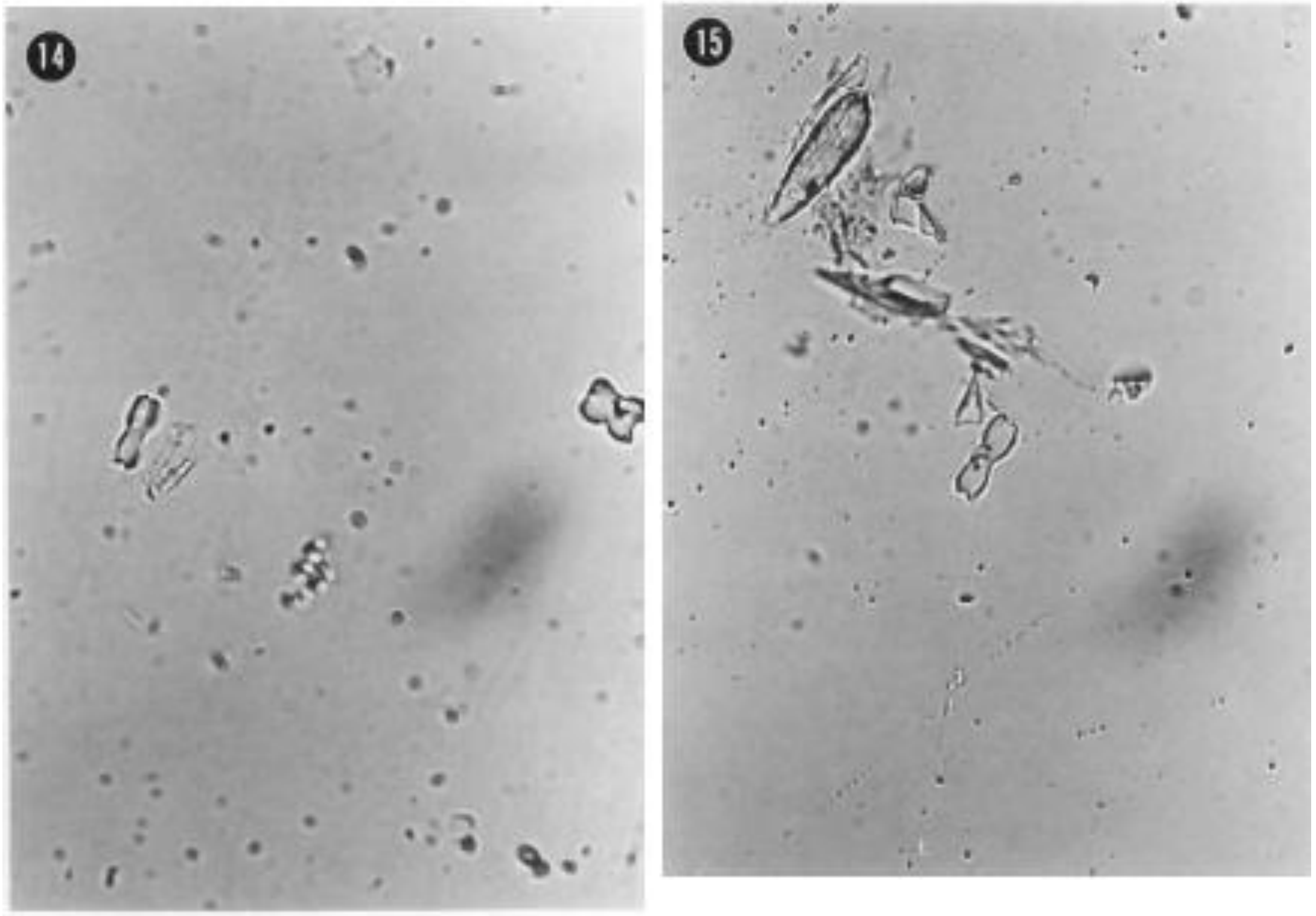


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Eragrostis mexicana

Phytolith

FIGURES 13-16. 14, A bilobate (left) and a cross-shaped phytolith (right) from Eragrostis mexicana (x200). The bilobate has four indentations and both phytoliths have the flared edges typical of the Chloridoideae. 15, Center, a complex bilobate from Eragrostis mexicana with multiple indentations (x200).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Guadua amplexifolia

Phytolith

FIGURES 21-24.-21, Saddle-shaped phytoliths from Guadua amplexifolia. All but one are tall (x200). 22, Saddle-shaped and narrow-elliptical phytoliths from Guadua ampiexifolia. All of the saddles are very tall (x200)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Guadua amplexifolia

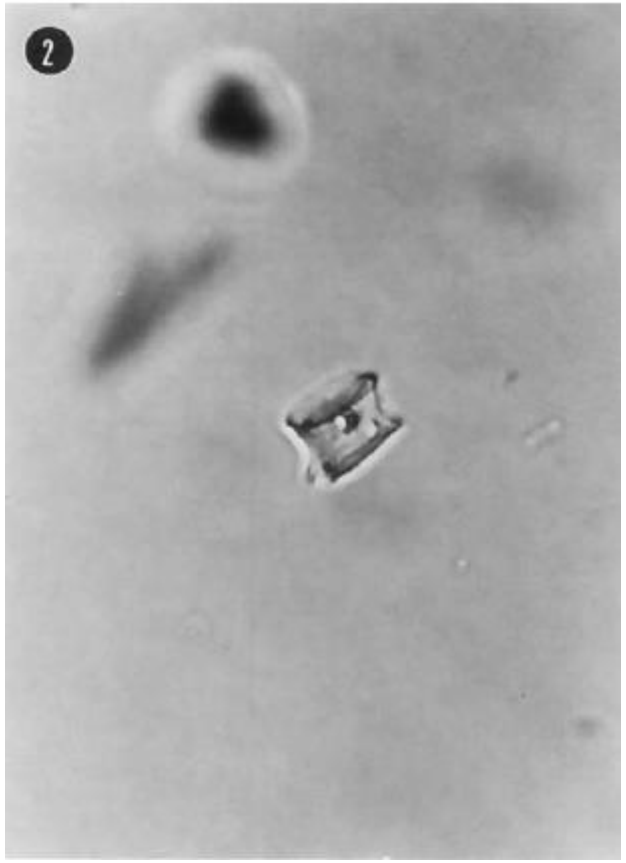
Phytolith

FIGURES 73-76.-75, Right, a thick, collapsed saddle from Guadua amplexifolia (x400). 76, A phytolith with both saddle and bilobate characteristics from Guadua amplexifolia (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Guadua angustifolia

Phytolith



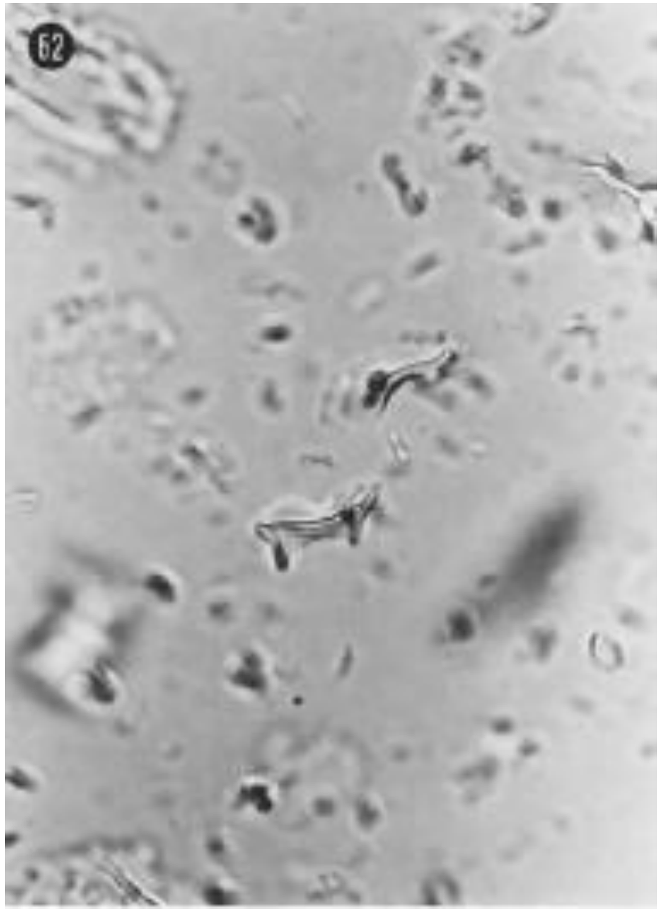
A rondel from the culm of Guadua angustifolia (400x)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Guadua angustifolia

Phytolith

FIGURES 61-64.-62, Narrow elliptate phytoliths from Guadua angustifolia removed from tissue (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Guadua latifolia

Phytolith

Center, 3 rondels from the inflorescense of Guadua latifolia. The phytolith at the top is a bilobate (400x)

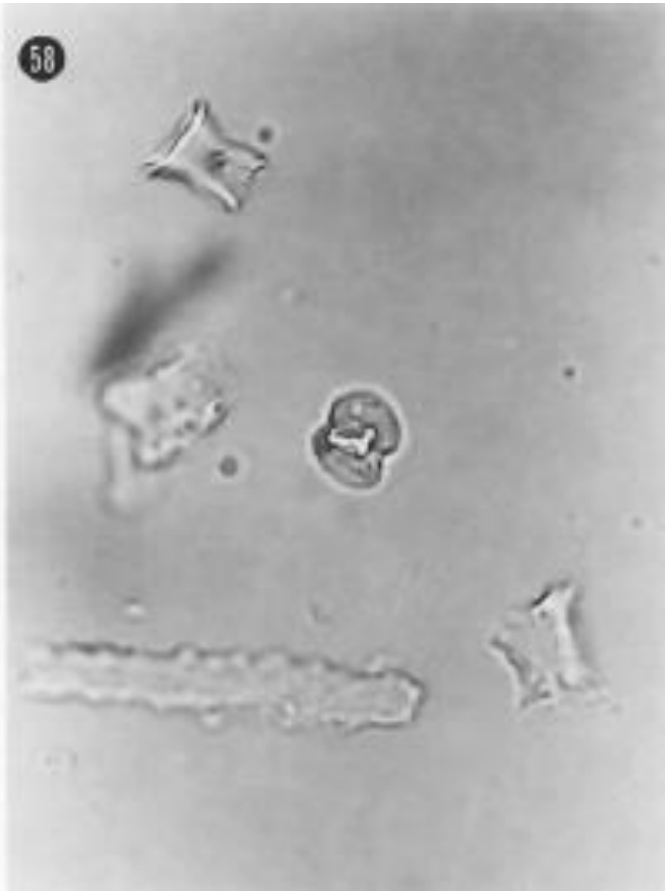
Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

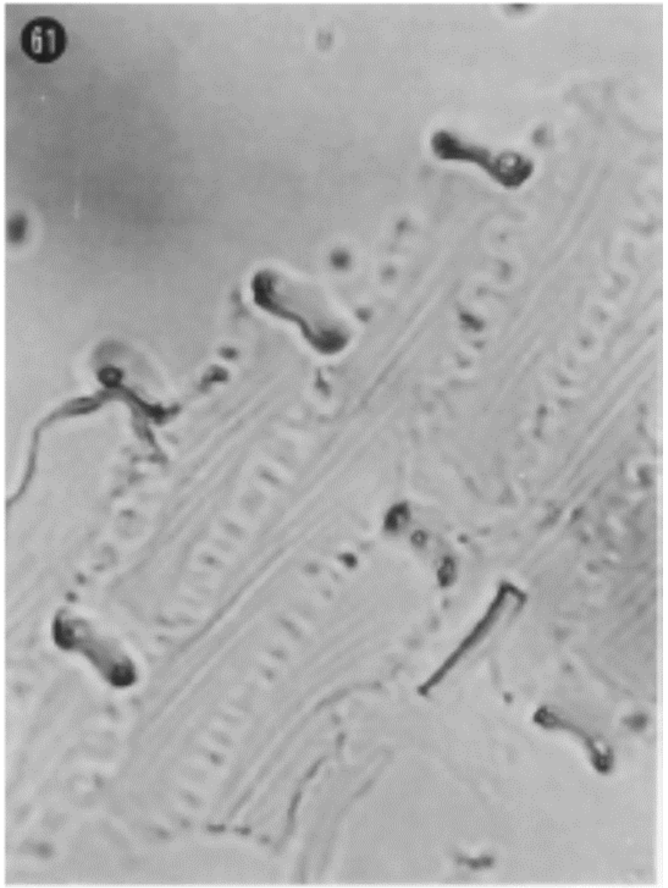
Guadua latifolia

Phytolith

FIGURES 57-60.-58, Center, a bilobate from the inflorescence of Guadua latifolia (x400).

FIGURES 61-64.-61, Narrow elliptate phytoliths from Guadua latifolia still enclosed in tissue (x400).





Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

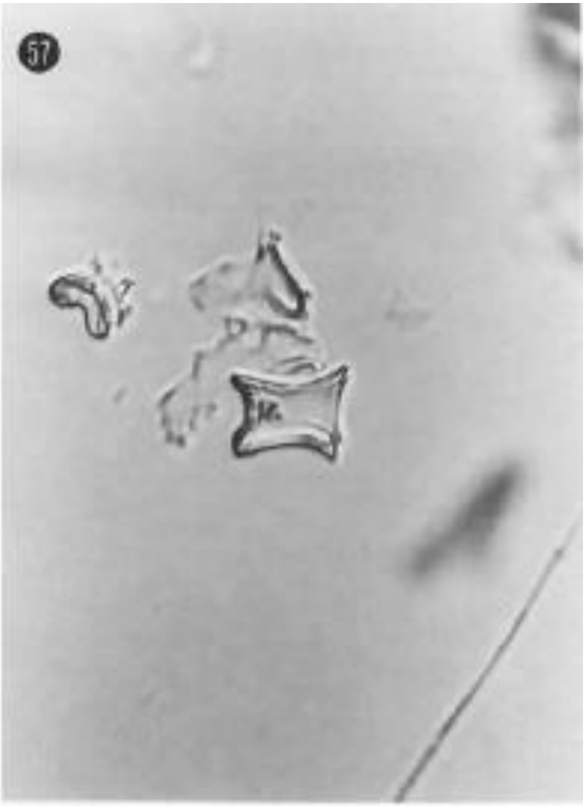
Gynerium sagittatum

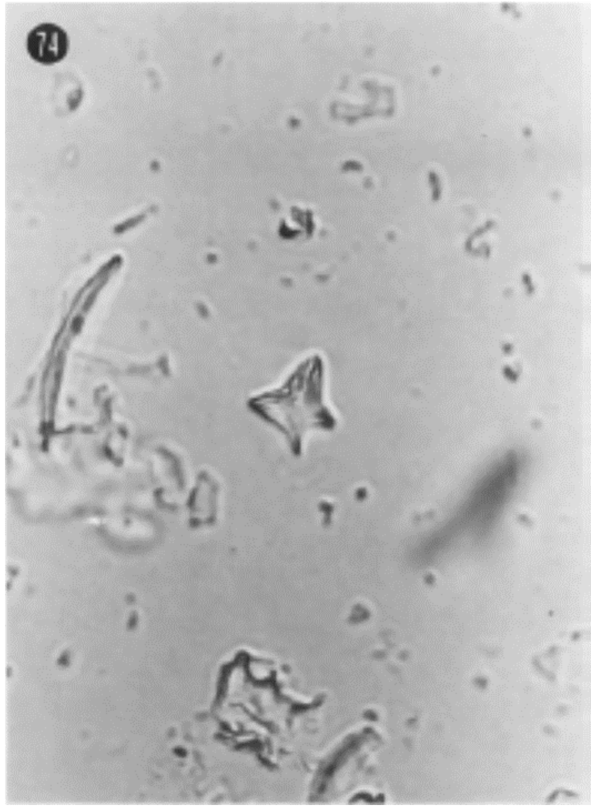
Phytolith

FIGURES 57-60.-57, A phytolith typically produced in the leaves of Gynerium sagittatum (x400).

FIGURES 61-64.-63, A narrow elliptate phytolith from Gyneriurn sagittatum (x400).

FIGURES 73-76.-74, A typical phytolith from Gynerium
saggitatum (x400).



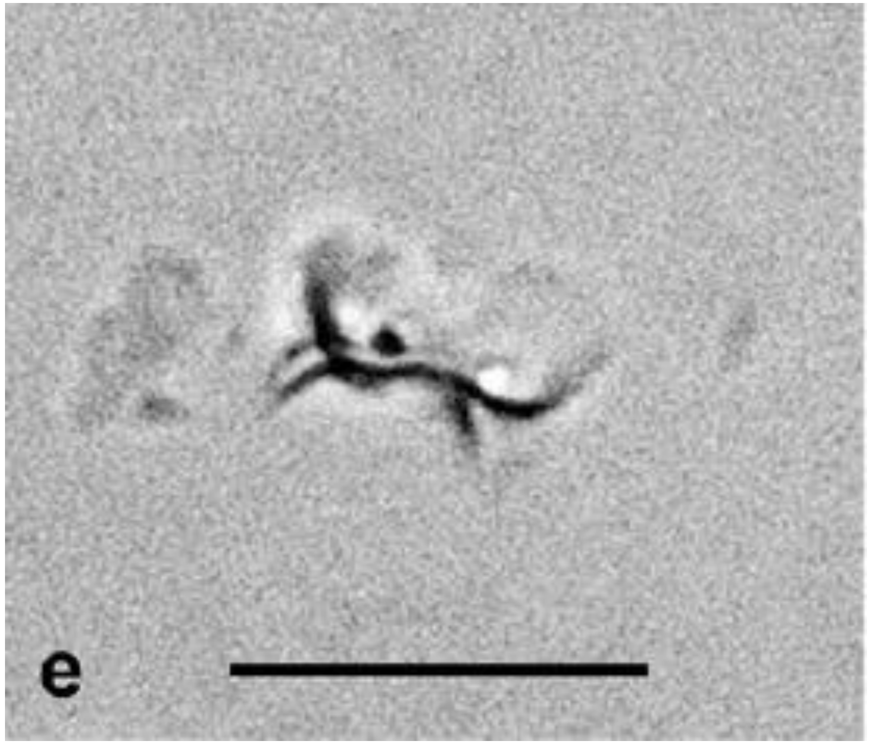


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Gynerium sagittatum

Phytolith

Fig. 4. Phytoliths from Poaceae. e) Elliptoid/biloboid phytolith from Gynerium sagittatum



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Hordeum sp.

Phytolith

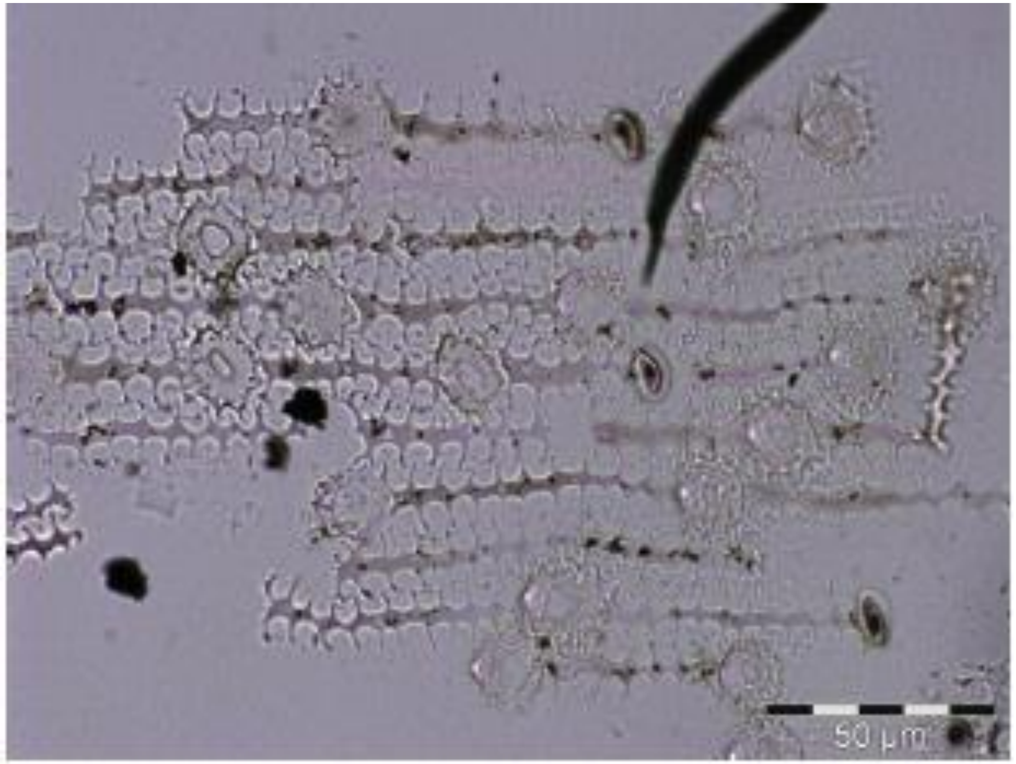


Fig. 10. An articulated aggregation of inflorescence bract phytoliths from Hordeum vulgare showing the long cell wave patterns and papillae characteristic of Hordeum sp. Photo by Arlene M. Rosen from modern plant phytolith reference collection at ICREA, University of Barcelona, courtesy of Rosa M. Albert

Ball, T. B., K. Chandler-Ezell, R. Dickau, N. Duncan, T. C. Hart, J. Iriarte, C. Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. https://doi.org/10.1016/j.jas.2015.08.010.

Hordeum vulgare

Starch

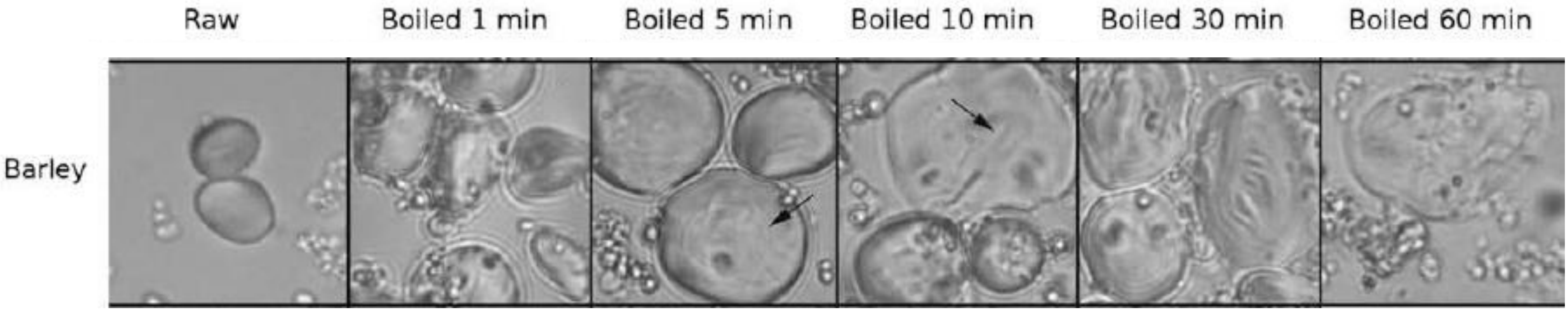


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Hordeum vulgare

Starch

Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Indocalamus tessellates

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 13. Indocalamus tessellates

13

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Isachne arundinaceae

Phytolith

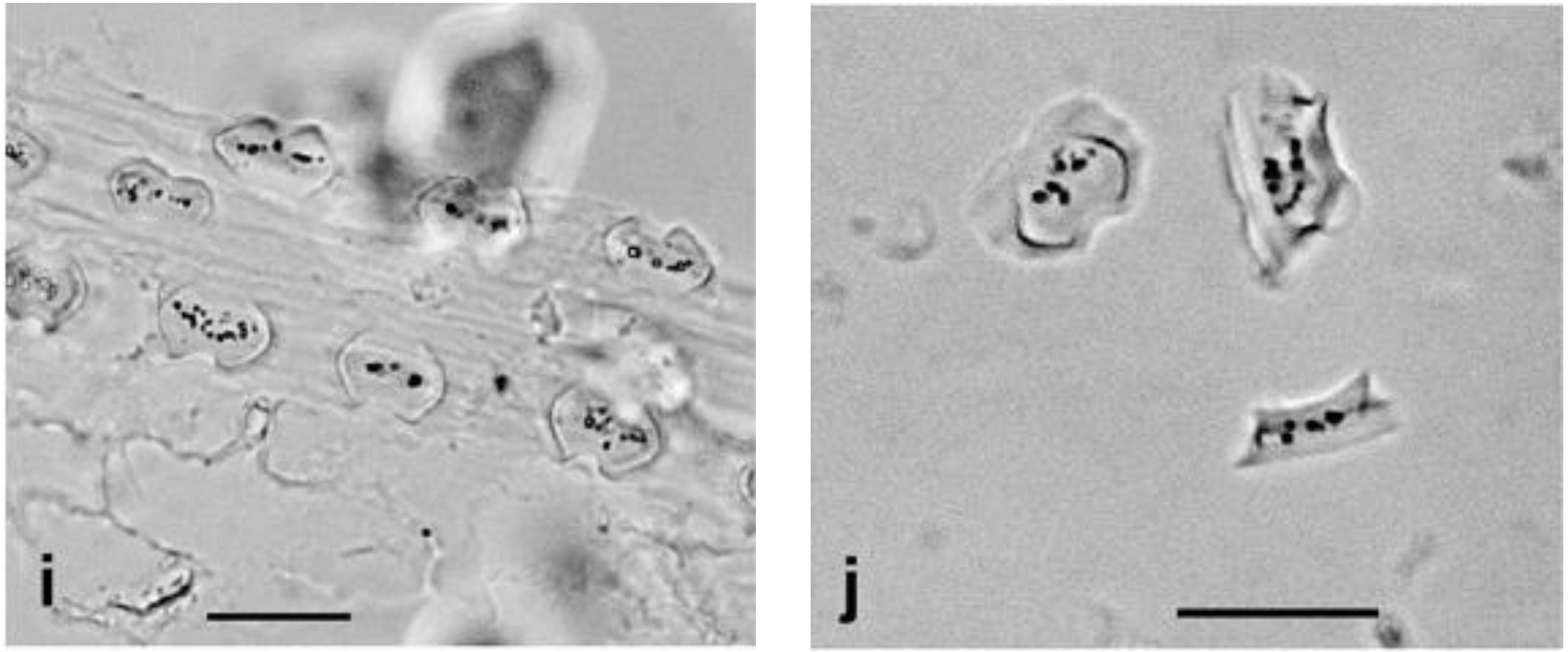
FIGURES 73-76.-73, A tall saddle from Isachne arundinaceae (x400). 74,)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Isachne polygonoides

Phytolith

Fig. 4. Phytoliths from Poaceae. i) Tall saddles from Isachne polygonoides, j) Saddleoid/biloboid phytoliths from Isachne polygonoides



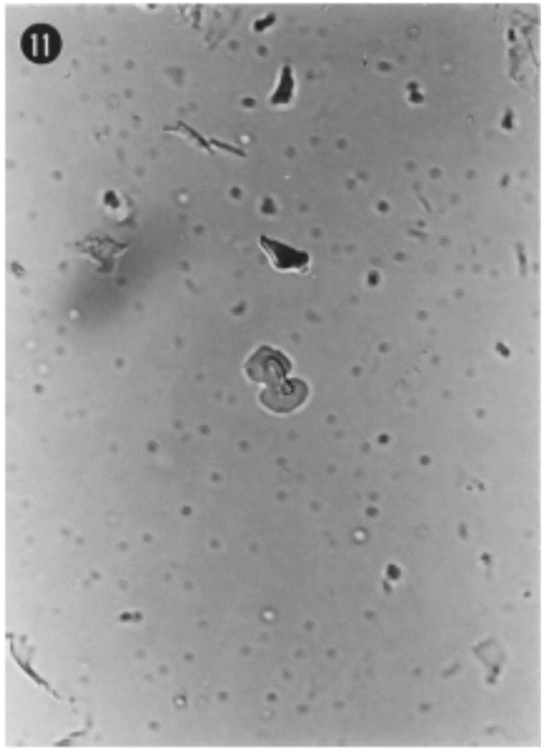
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

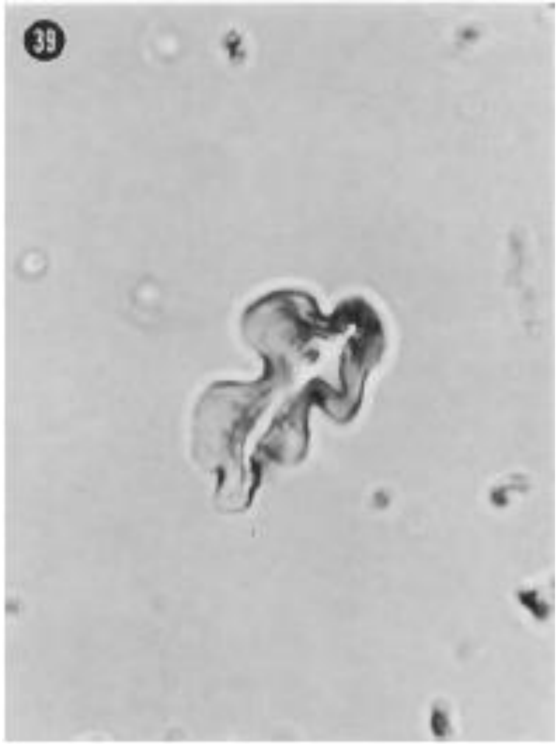
Maclurolyra tecta

Phytolith

FIGURES 9-12. 11, A bilobate from Maclurolyra tecta (x200).

FIGURES 37-40.-39, An irregular, complex short-cell phytolith from Maclurolyra tecta orientated as it would be in leaf tissue (x400). Compare with Figure 40. 40, An irregular, complex short-cell phytolith from Maclurolyra tecta exhibiting extreme width and one sinuous and one sloping edge (x400).





Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Miscanthus floridulus

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 4. Miscanthus floridulus

4

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Msicanthus sinensis

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 14. Msicanthus sinensis

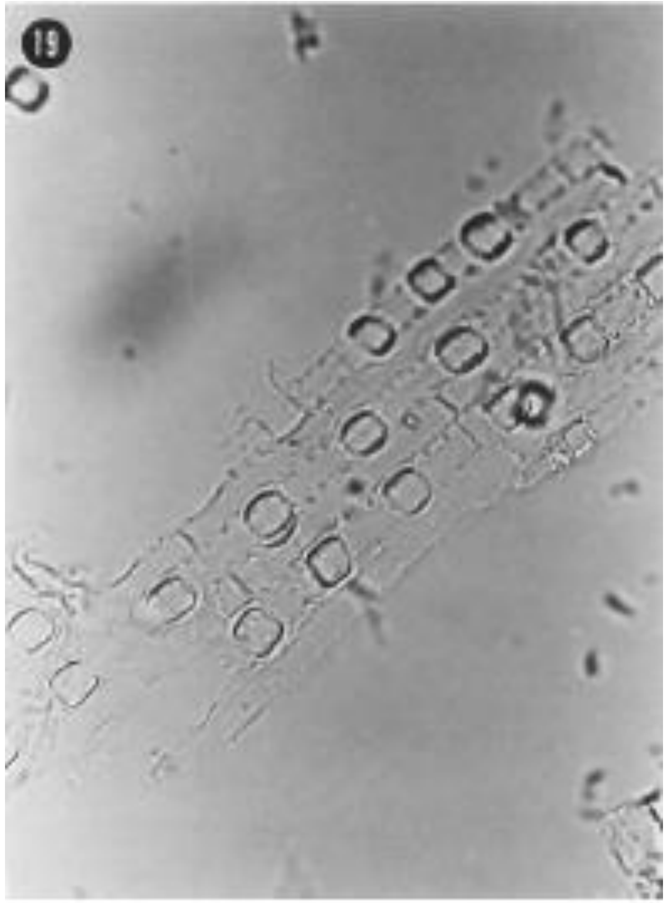
14

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Muhlenbergii emersleyi

Phytolith

FIGURES 17-20. 19, Saddle-shaped phytoliths from Muhlenbergii emersleyi. Many of them are squat saddles (x200).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Nasella clarasii

Starch

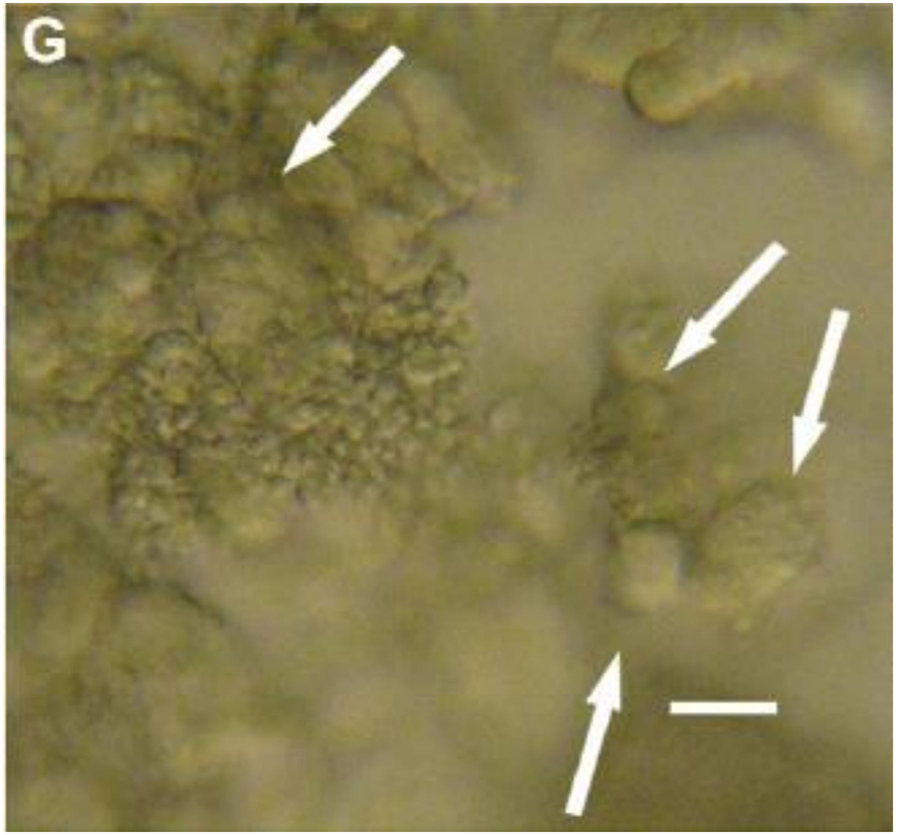


Fig. 3. Pampean native wild grasses from reference collection. F-G: Compound starch grains, supernumerary aggregates of class b. G: Nasella clarasii. (Scale bars: 10 mm).

Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Neurolepis pittiera

Phytolith

FIGURES 33-36.-35, A small, wide, tent-shaped body from Neurolepis pittiera (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Olyra latifolia

Starch

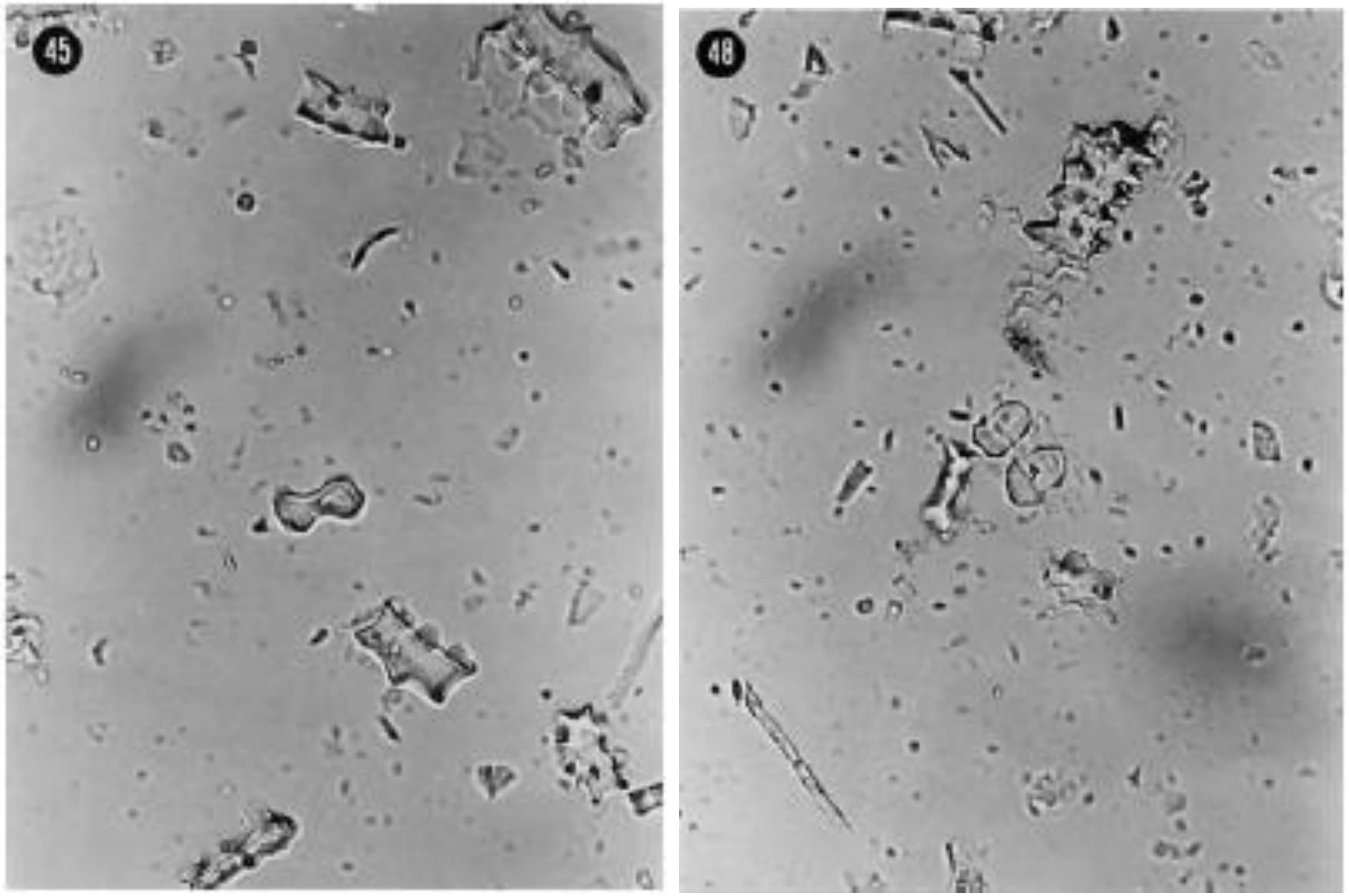
APPENDIX:
Olyra latifolia. Compound grains, with pressure facets. A double border is visible and a cavity is usually found at the hilum. Size: 4–8 microns.
Panicum

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Olyra latifolia

Phytolith

FIGURES 45-48.-45, Top and bottom, irregular, complex short-cell phytoliths from Olyra latifolia. These phytoliths are characteristic of the tribe Olyreae. The phytolith in the center is a bilobate (x200). 48, Center, two Variant 8 bilobates from Olyra latifolia (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Oplismenus compositus

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 16. Oplismenus compositus.

16

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Oplismenus undulatifolius

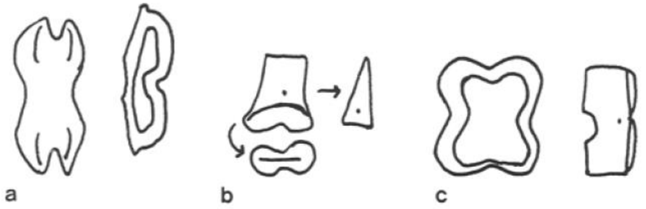
Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 15. Oplismenus undulatifolius

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Oryzeae tribe

Phytolith



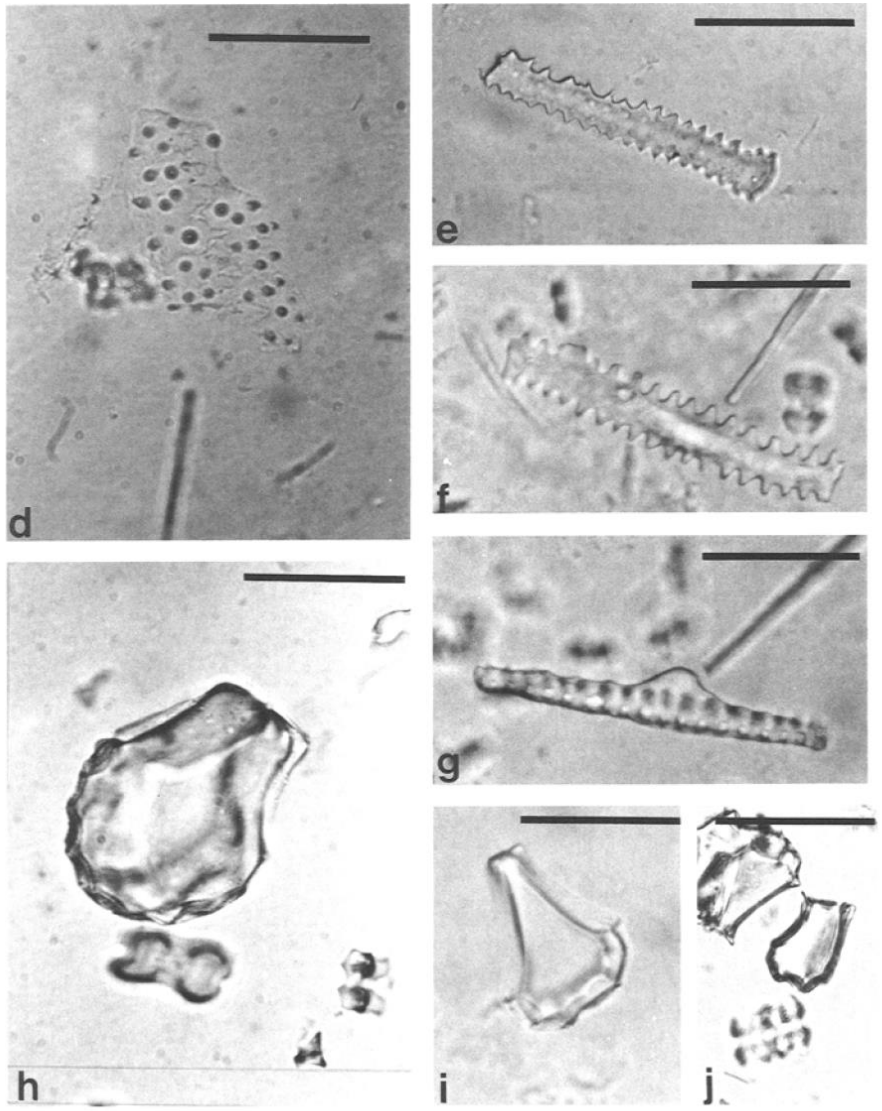


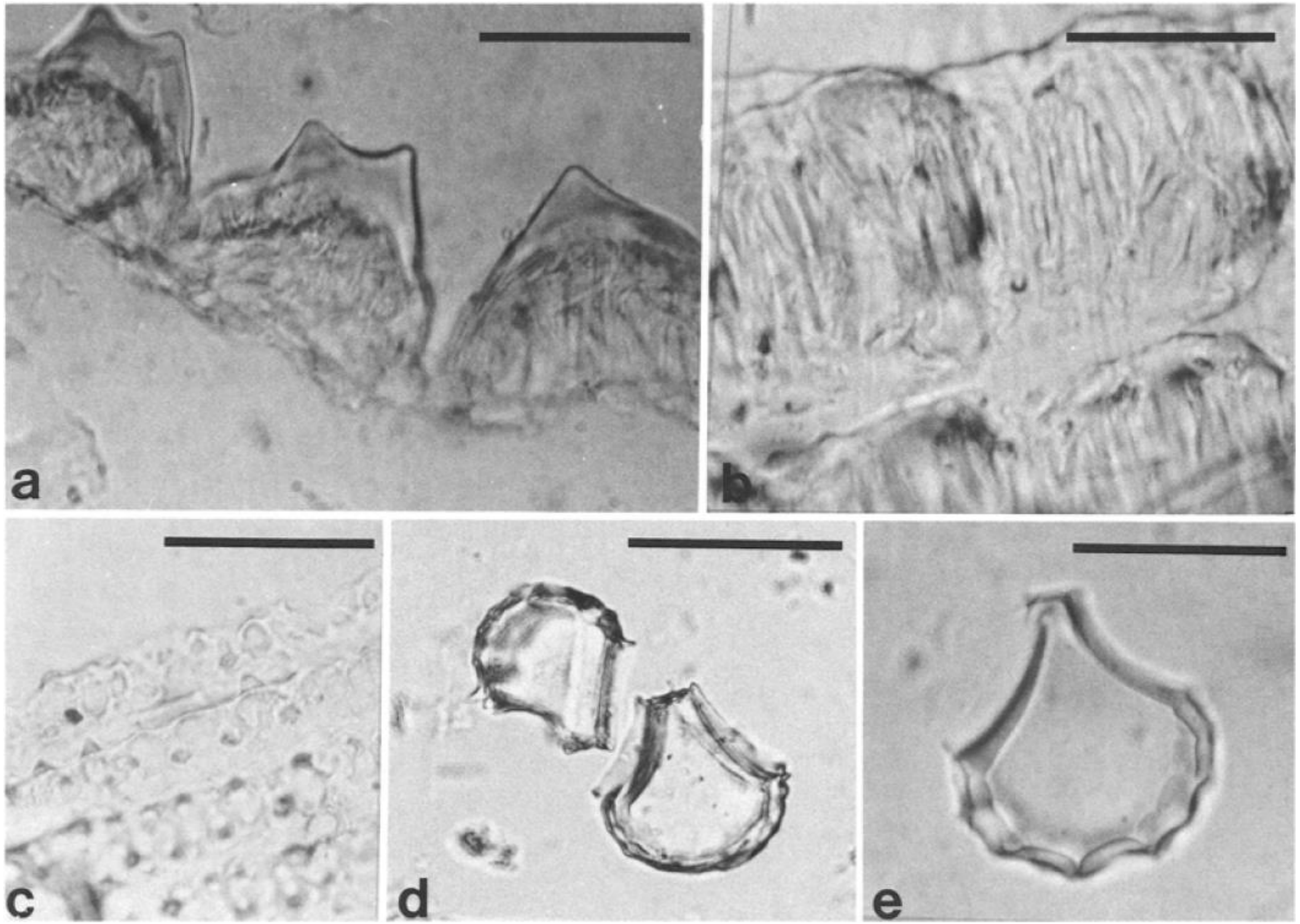
Fig. 2. Phytolith types distinguishing the Oryzeae tribe, a: Type 1 dumbbell with scooped ends, curved and lobed in side view (fight), thick. The most common short cell in many taxa in the tribe. Grades into a scooped cross-like form; b: Type 8a short cell with a dumbbell on one tier (bottom view, lower), and a thin plate extending perpendicular to the dumbbell-type tier (side view, right); c: Type 5 thick cross, lobed in side view (fight), with raised corners. Common in two genera (a--c short cells not drawn to scale. Size 15-25 micrometers); d: 10IIEf epidermal long cell, weakly silicified, with regular, well-silicified, rounded projections (example from Oryza sativa); e: I lllICa. 1 lIIICa--Cc are blockly epidermal cells with numerous projections of variable size, and sometimes with one prominent projection (example from Oryza manilensis); f: 1 llIICc, top view (example from Oryza sativa); g: same as f, side view; h: 50IIIAc. 50IIIAa, b, and c are keystone bulliform types, sometimes thick and with multiple ridges (example from Oryza meyeriana); i: 50IIIAb (example from Oryza minuta); j: 50IIIAa (example from Oryza manilensis). Scale bar = 20 micrometers.

Pearsall, Deborah Marie, Dolores R. Piperno, Elizabeth H. Dinan, Marcelle Umlauf, Zhijun Zhao, and Robert A. Benfer. 1995. Distinguishing Rice (Oryza Sativa Poaceae) from Wild Oryza Species through Phytolith Analysis: Results of Preliminary Research. *Economic Botany* 49 (2):183–96.

Oryza sp.

Phytolith

Fig. 3. Epidermal and bulliform types distinguishing the genus Oryza.a:22IIIAa and 22IIIAb. Seed epidermis with large conical hairs (22IIIAa: 1 peak, 22IIIAb: two peaks) arising from very deeply serrated cells. Large hairs may be flanked by smaller projections (example from Oryza sativa); b: 22IVA. Seed epidermis, very deeply serrated, with pointed serrations (example from Oryza sativa); c: 22IVB. Seed epidermis, very deeply serrated, with sinuous-edged serrations (example from Oryza sativa); d: 50IIIAcl and 50IIIAc2. Very widely flared keystone bulliform cells, a number of forms, varying by the extent of flaring and width of top. Bases symmetrical (example from Oryza sativa); e: 50IIIAb301. Small, moderately flared keystone bulliform cells (example from Oryza minuta). Scale bar = 20 micrometers.



Pearsall, Deborah Marie, Dolores R. Piperno, Elizabeth H. Dinan, Marcelle Umlauf, Zhijun Zhao, and Robert A. Benfer. 1995. Distinguishing Rice (Oryza Sativa Poaceae) from Wild Oryza Species through Phytolith Analysis: Results of Preliminary Research. *Economic Botany* 49 (2):183–96.

Oryza sp.

Phytolith

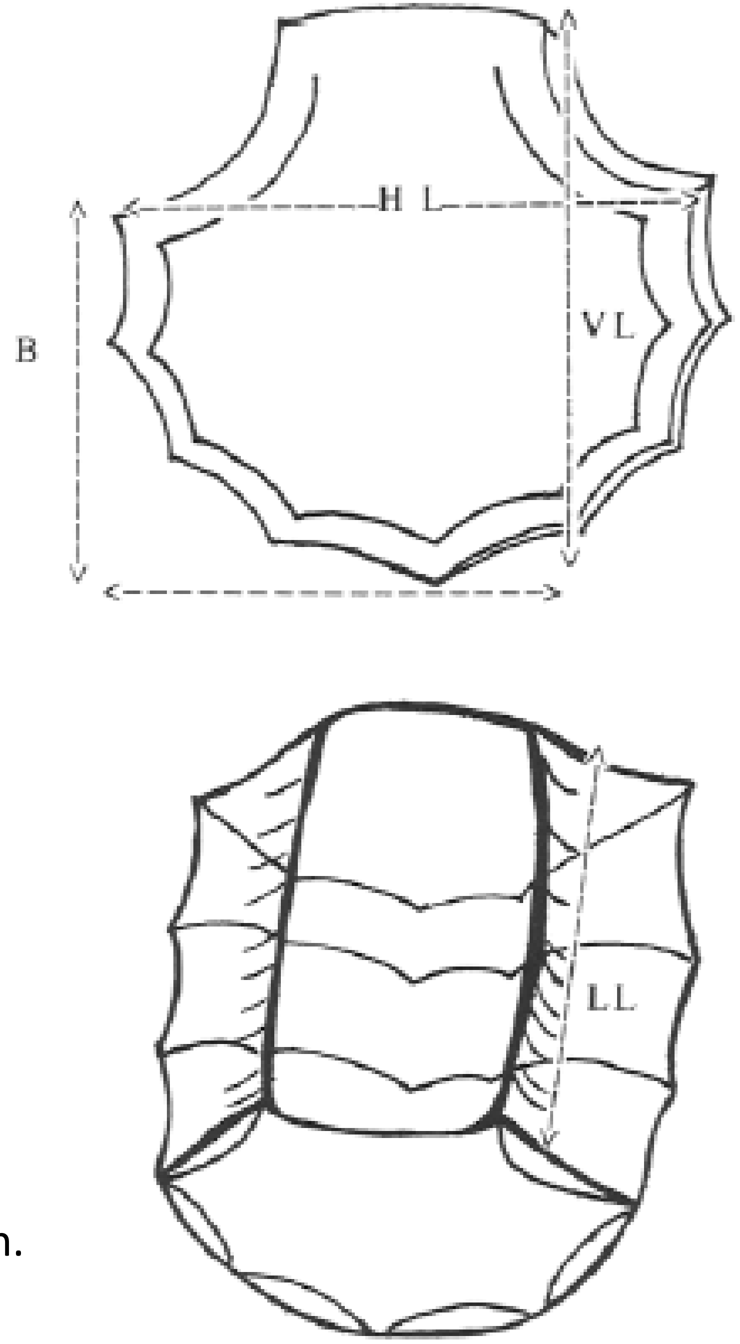


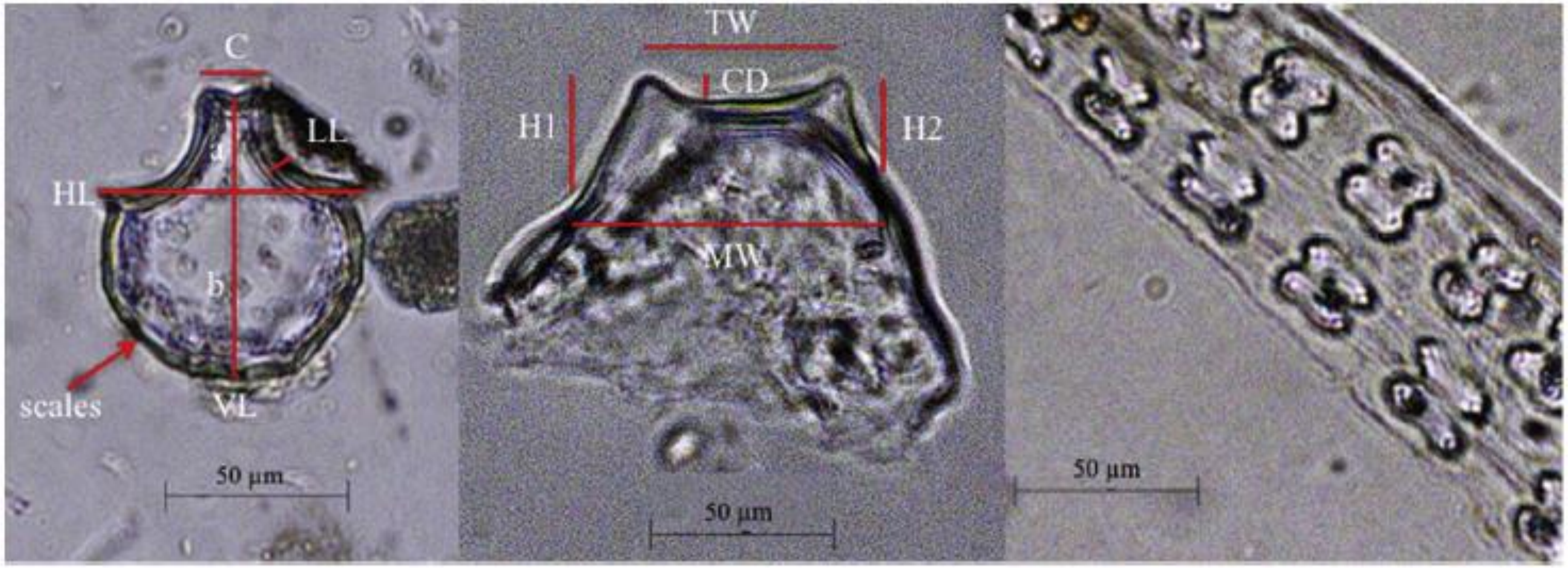
Fig. 4. Measurements of keystone bulliforms, shown from side view (upper) and top view (lower). HL: horizontal length (length of base); LL: lateral length (width of side); VL: vertical length; B: length of base portion.

Pearsall, Deborah Marie, Dolores R. Piperno, Elizabeth H. Dinan, Marcelle Umlauf, Zhijun Zhao, and Robert A. Benfer. 1995. Distinguishing Rice (Oryza Sativa Poaceae) from Wild Oryza Species through Phytolith Analysis: Results of Preliminary Research. *Economic Botany* 49 (2):183–96.

Oryza sp.

Phytolith

Fig. 2. Phytolith types from rice and morphological parameters: bulliform (left); double-peaked (center); bilobate (right). Abbreviations in bulliform: HL (horizontal length); VL (vertical length); LL (lateral length); a (vertical length of the non-base portion); b (vertical length of the base por- tion). Abbreviations in double-peaked: TW (top width); MW (middle width); H1, H2 (height 1, height 2); CD (curve depth).

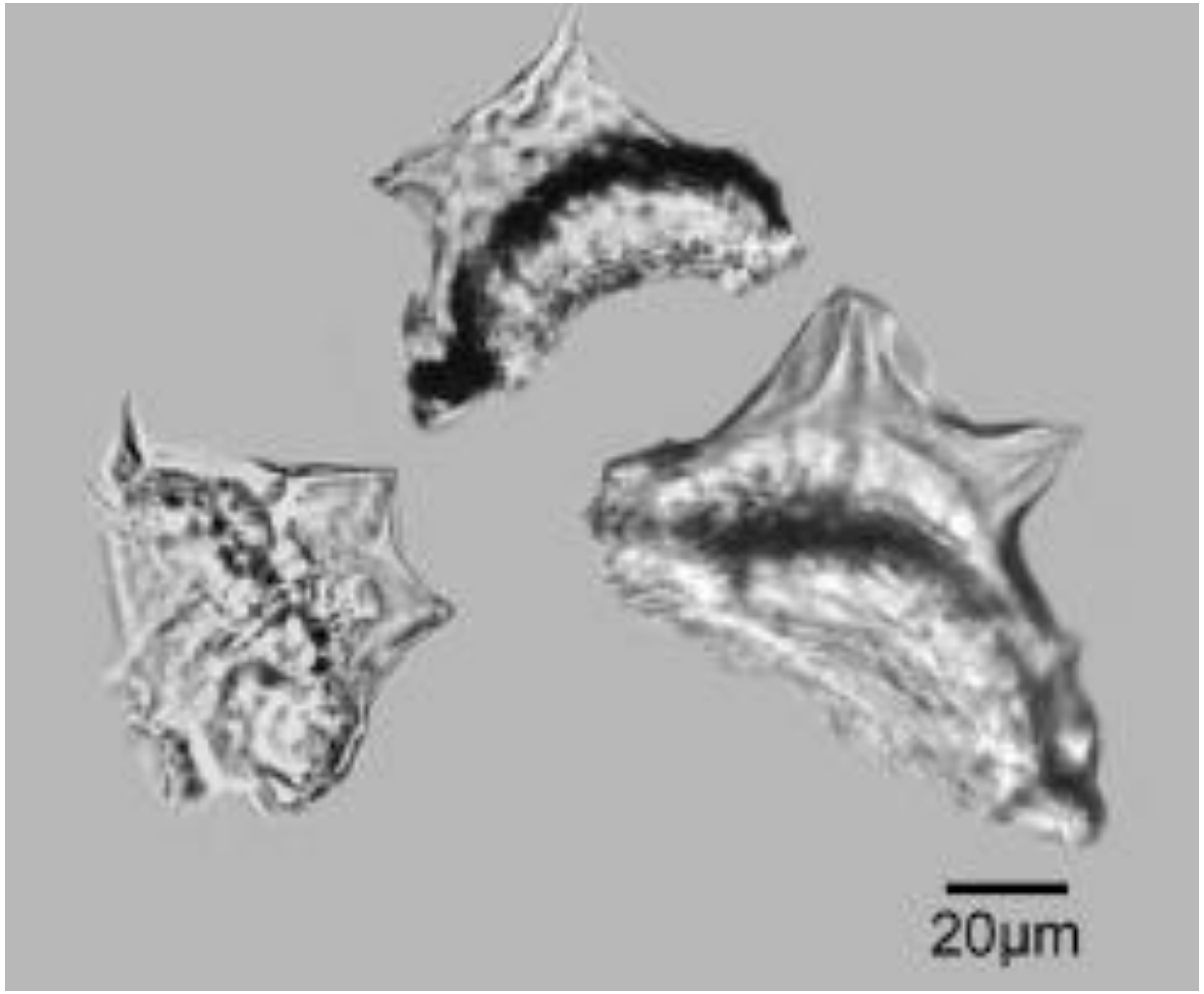


Pasqua, Alessandro, Liovando Marciano da Costa, and Ervan Garrison. 2017. Phytolith Evidence of Historical Rice Cultivation at Wormsloe Historic Site, Georgia, USA. *Journal of Archaeological Science: Reports* 14 (June). Elsevier:557–74. http://linkinghub.elsevier.com/retrieve/pii/S2352409X17300159.

Oryza sp.

Phytolith

Fig. 13. Double-peaked glume cell phytoliths from Oryza. From Piperno, 2006. Originally re-printed from Zhao et al., 1998

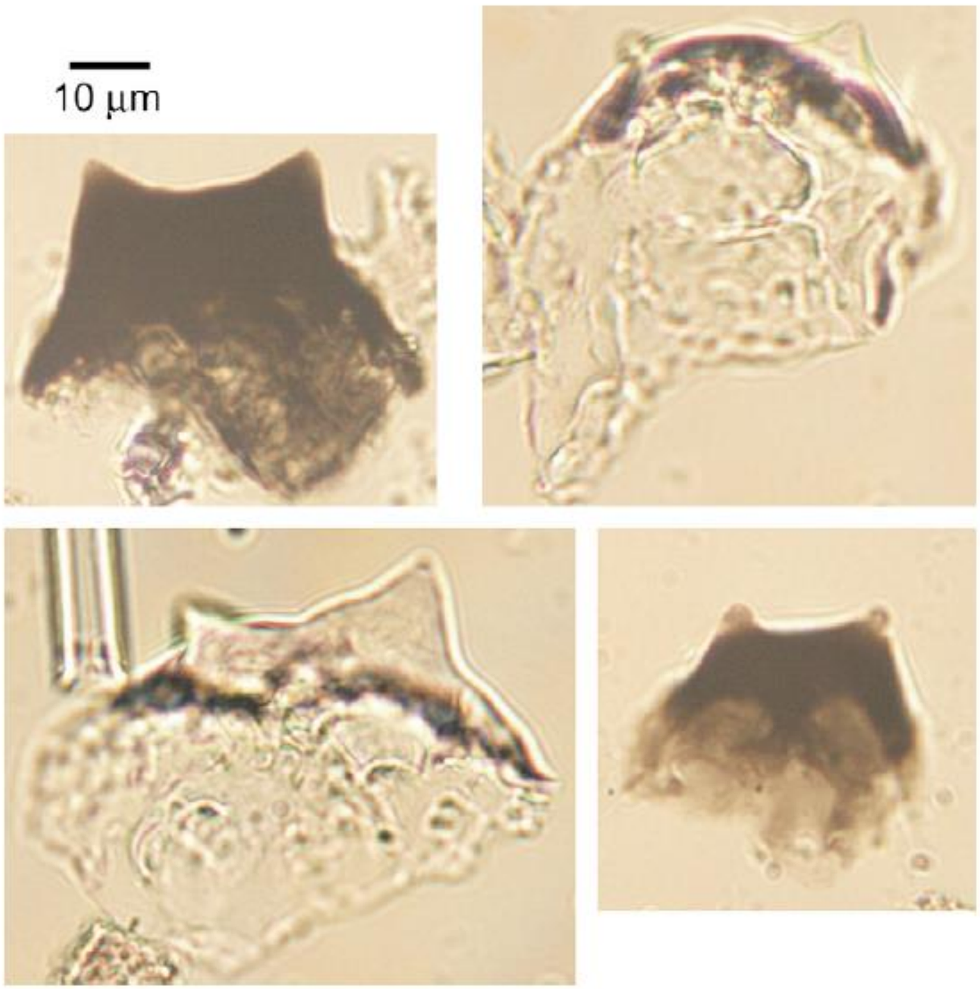


Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Oryza sp.

Phytolith

Fig. 2. Oryza double-peaked husk cells from Qingpu. (A) and (D) 68e70 cm, 1870 BP, darker colour suggests likely burnt; (B) 82 cm, ca. 1940 BP; (C) 98 cm, ca. 2010 BP.

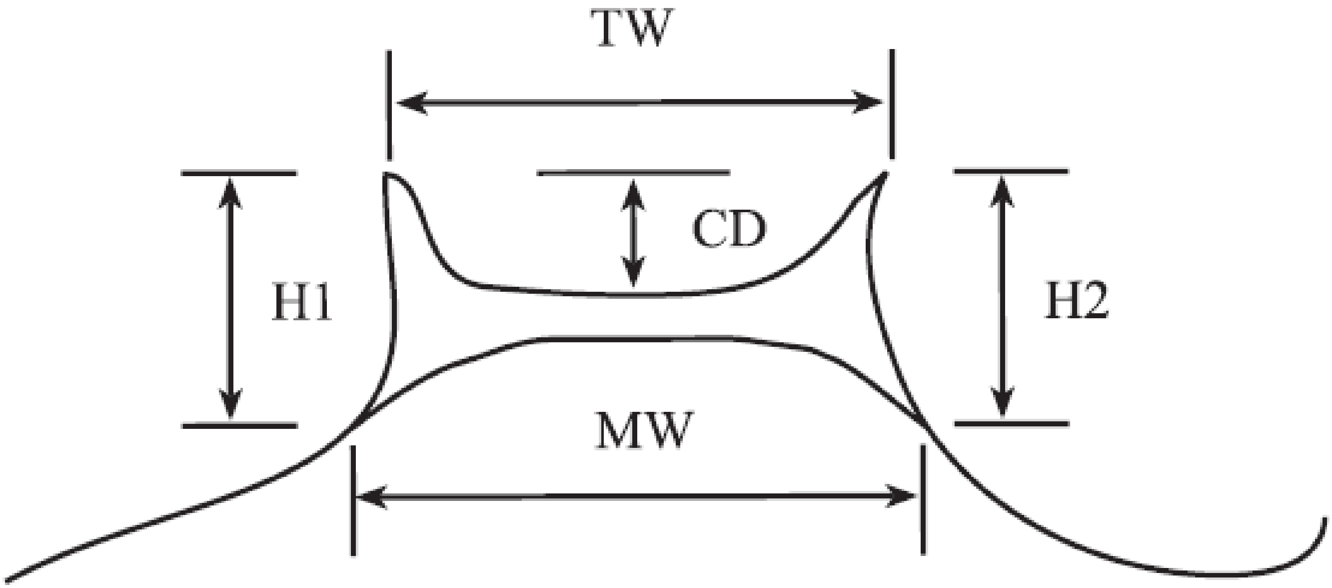


Itzstein-Davey, Freea, David Taylor, John Dodson, Pia Atahan, and Hongbo Zheng. 2007. Wild and Domesticated Forms of Rice (Oryza Sp.) in Early Agriculture at Qingpu, Lower Yangtze, China: Evidence from Phytoliths. *Journal of Archaeological Science* 34 (12):2101–8.

Oryza sp.

Phytolith

Fig. 3. Measurements of double-peaked rice Oryza husks required to distinguish between wild, domesticated or indeterminate varieties based on discriminant function formulas developed by Zhao et al. (1998). TW, distance between the two peaks; MW, width at the point where the hair attaches to the base; H1, height of largest peak, measured from the tip to the base of the hair; H2, height of smallest peak, measured from the tip to the base of the hair; CD, depth of the curve (adapted from Zhao et al., 1998).

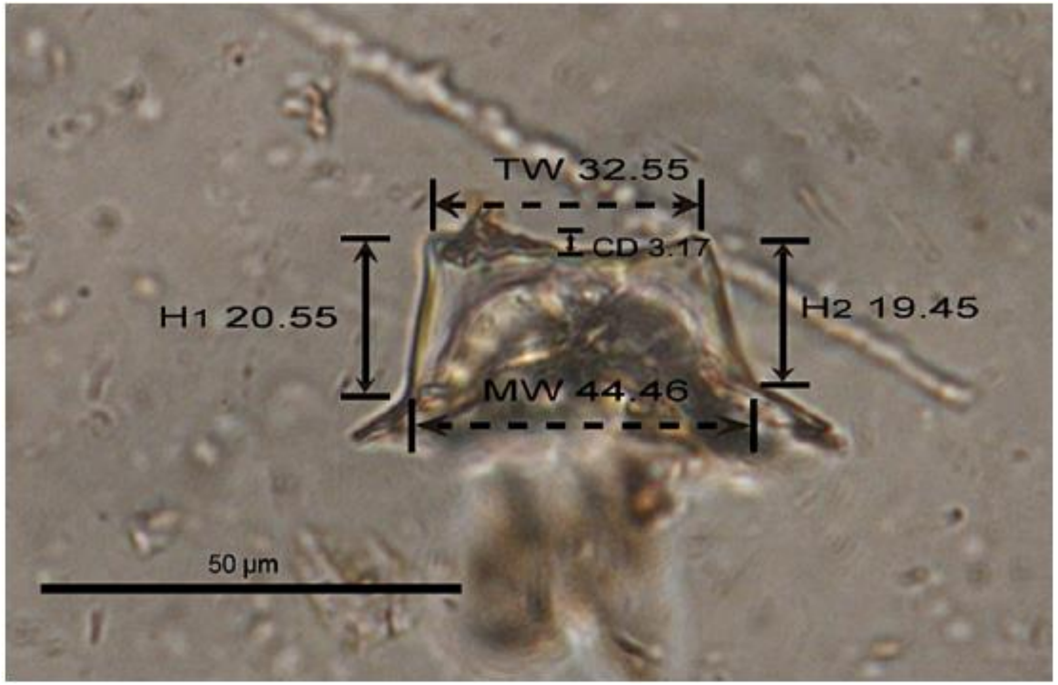


Itzstein-Davey, Freea, David Taylor, John Dodson, Pia Atahan, and Hongbo Zheng. 2007. Wild and Domesticated Forms of Rice (Oryza Sp.) in Early Agriculture at Qingpu, Lower Yangtze, China: Evidence from Phytoliths. *Journal of Archaeological Science* 34 (12):2101–8.

Oryza sp.

Phytolith

Fig. 2. 3-D scattered plots for morphological parameters of double-peaked glume cells from Shangshan Period (TW) Top width. (MW) Width of the middle. (H) Mean height of two peaks. (CD) The depth of the curve Scale bars ¼ 20 μm



Wu, Yan, Leping Jiang, Yunfei Zheng, Changsui Wang, and Zhijun Zhao. 2014. Morphological Trend Analysis of Rice Phytolith during the Early Neolithic in the Lower Yangtze. *Journal of Archaeological Science* 49 (1). Elsevier Ltd:326–31. http://dx.doi.org/10.1016/j.jas.2014.06.001.

Oryza sp.

Phytolith

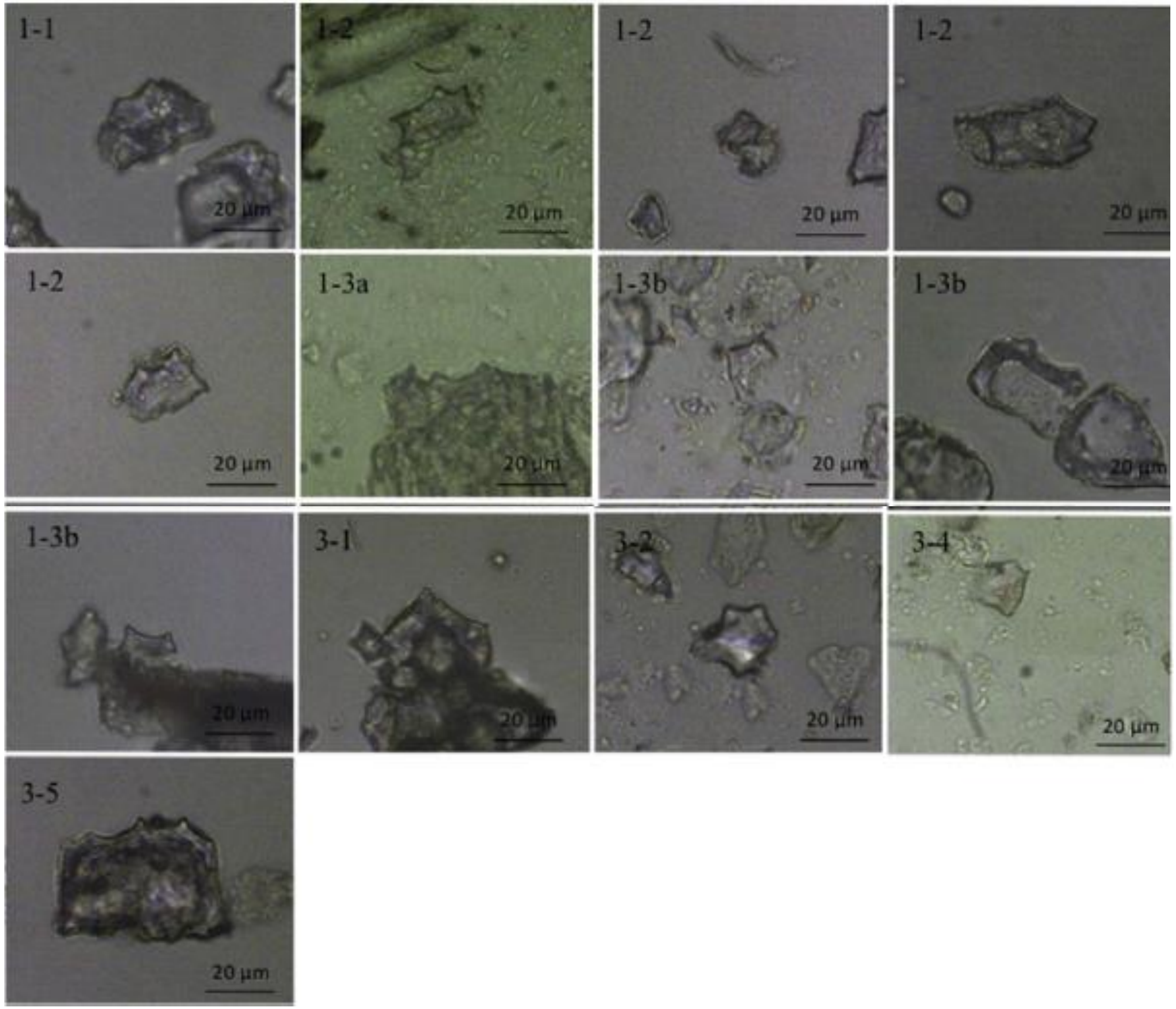


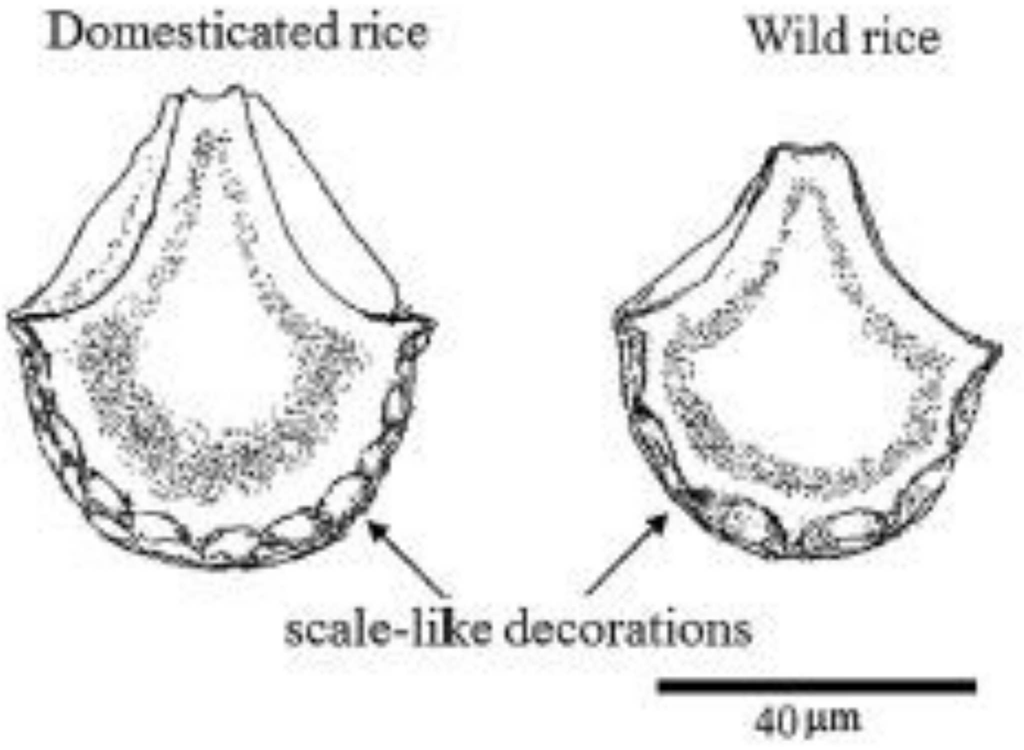
Fig. 6. Domesticated double-peaked phytoliths from Wormsloe.

Pasqua, Alessandro, Liovando Marciano da Costa, and Ervan Garrison. 2017. Phytolith Evidence of Historical Rice Cultivation at Wormsloe Historic Site, Georgia, USA. *Journal of Archaeological Science: Reports* 14 (June). Elsevier:557–74. http://linkinghub.elsevier.com/retrieve/pii/S2352409X17300159.

Oryza sp.

Phytolith

Fig. 14. Comparison of the scale-like decorations on bulliform phytoliths in domesti- cated and wild rice. Modified from Fujiwara (1976)



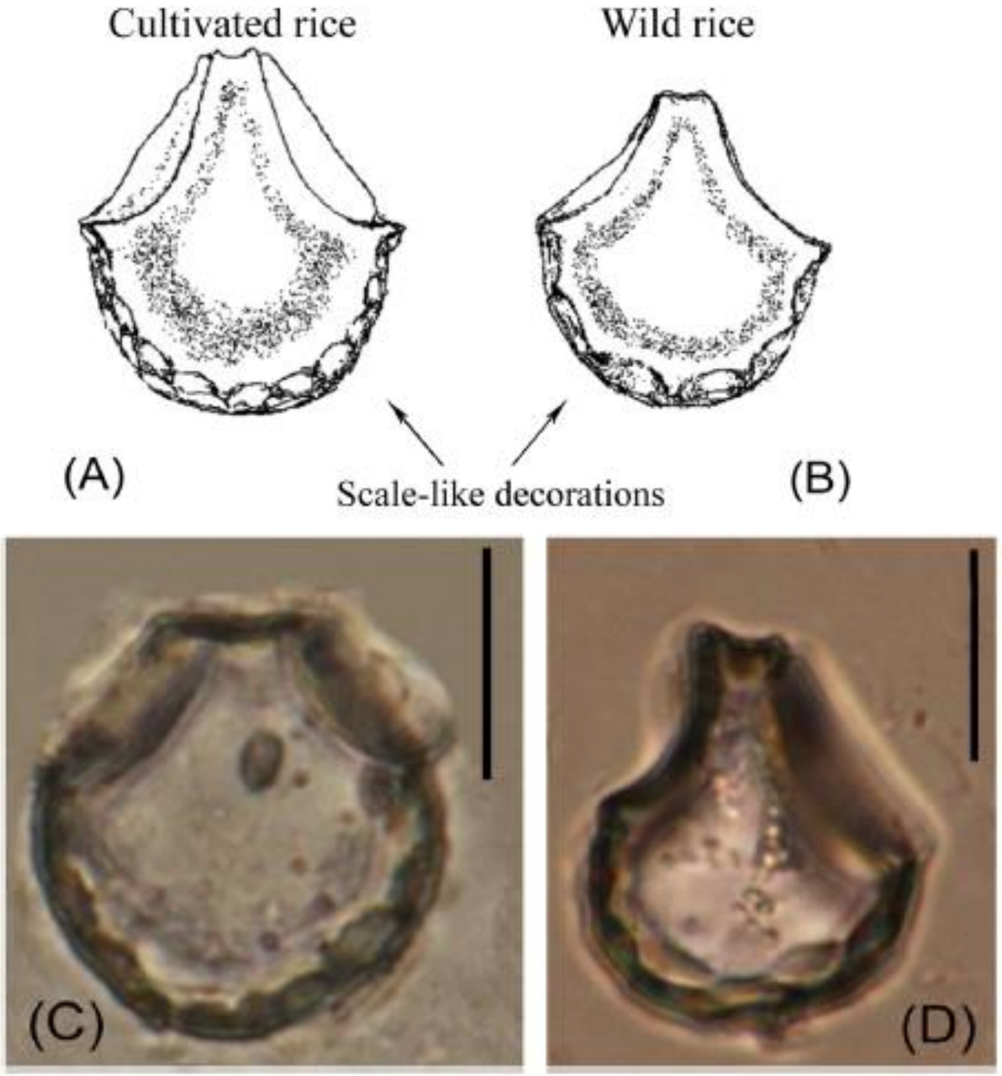
Ball, Terry B., Karol Chandler-Ezell, Ruth Dickau, Neil Duncan, Thomas C. Hart, José Iriarte, Carol Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. http://dx.doi.org/10.1016/j.jas.2015.08.010.

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Oryza sp.

Phytolith

Fig. 5. Scale-like decorations on cuneiform bulliform cells phytoliths. A,B modified from Lu et al. (17)A. domestic rice with 11 scale-like decorations; B. Wild rice with 6 scale-like decorations. C, D. cuneiform bulliform cells phytoliths extracted from the Shangshan Period (around c. 11,000e9000 cal. BP). C. shows 11 scale-like decorations; D. shows 6 scale-like decorations. Scale bars ¼ 20 µm



Wu, Yan, Leping Jiang, Yunfei Zheng, Changsui Wang, and Zhijun Zhao. 2014. Morphological Trend Analysis of Rice Phytolith during the Early Neolithic in the Lower Yangtze. *Journal of Archaeological Science* 49 (1). Elsevier Ltd:326–31. http://dx.doi.org/10.1016/j.jas.2014.06.001.

Oryza sp.

Phytolith

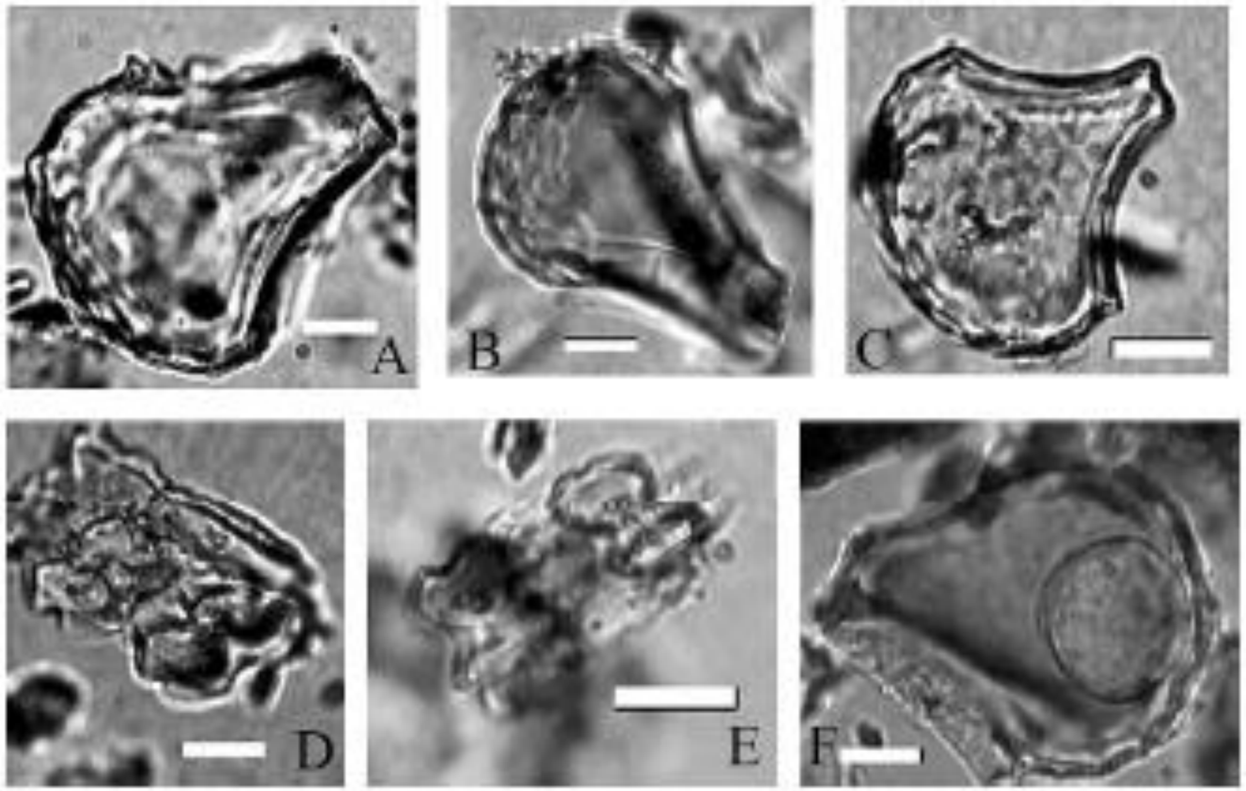


Fig. 4. Optical micrographs of fossil rice phytoliths from the DG9603 core. A, B, C, F. Bulliform phytolith (fan-shaped) with more than nine small shallow scale-like decorations on the half round side. D, E. Dumbbell- shaped with scooped ends, paralleled arrangement . Scale bar = 10 µm.

Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Oryza sp.

Phytolith

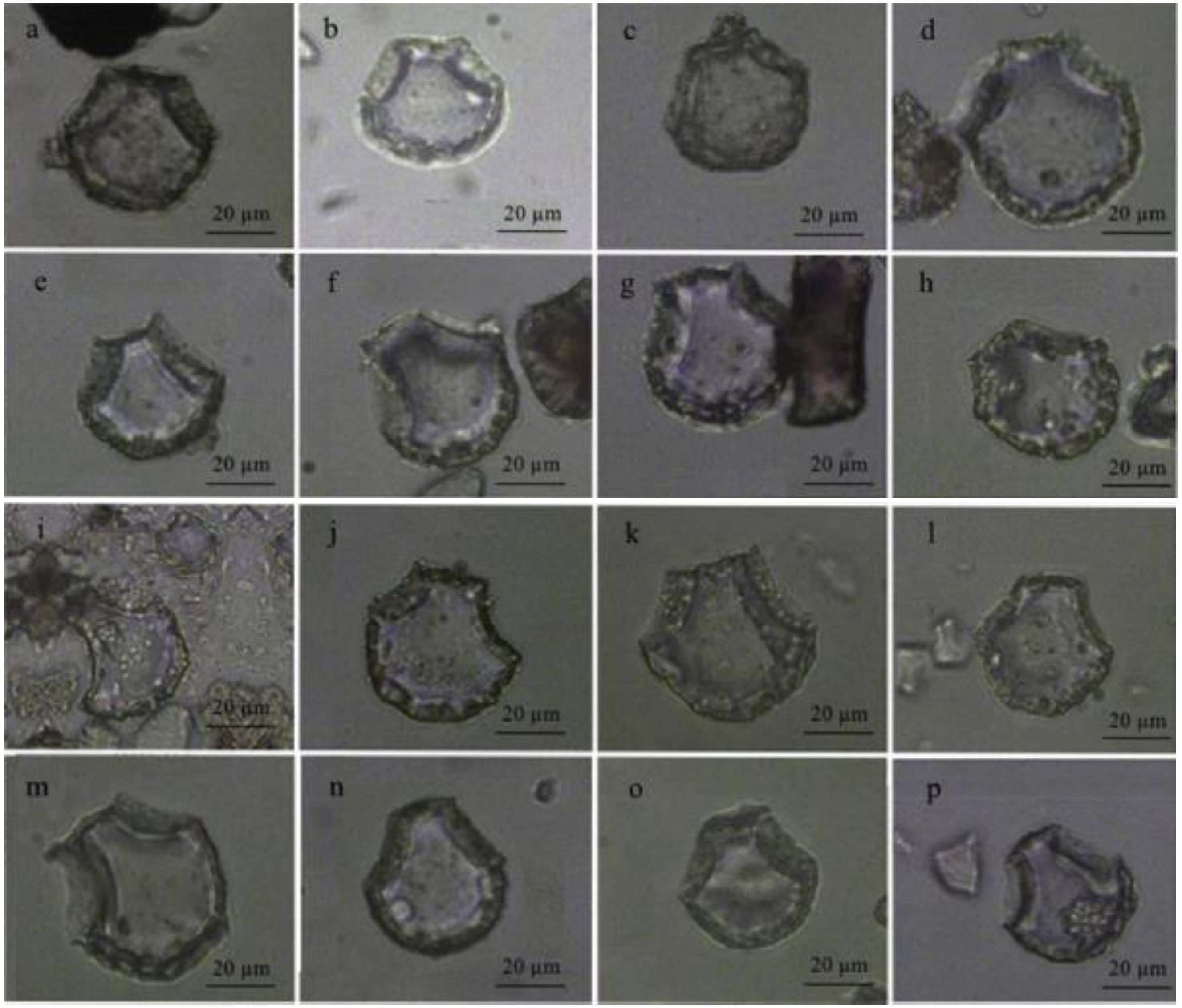


Fig. 4. Domesticated bulliform phytoliths from Wormsloe.

Pasqua, Alessandro, Liovando Marciano da Costa, and Ervan Garrison. 2017. Phytolith Evidence of Historical Rice Cultivation at Wormsloe Historic Site, Georgia, USA. *Journal of Archaeological Science: Reports* 14 (June). Elsevier:557–74. http://linkinghub.elsevier.com/retrieve/pii/S2352409X17300159.

Oryza sp.

Phytolith

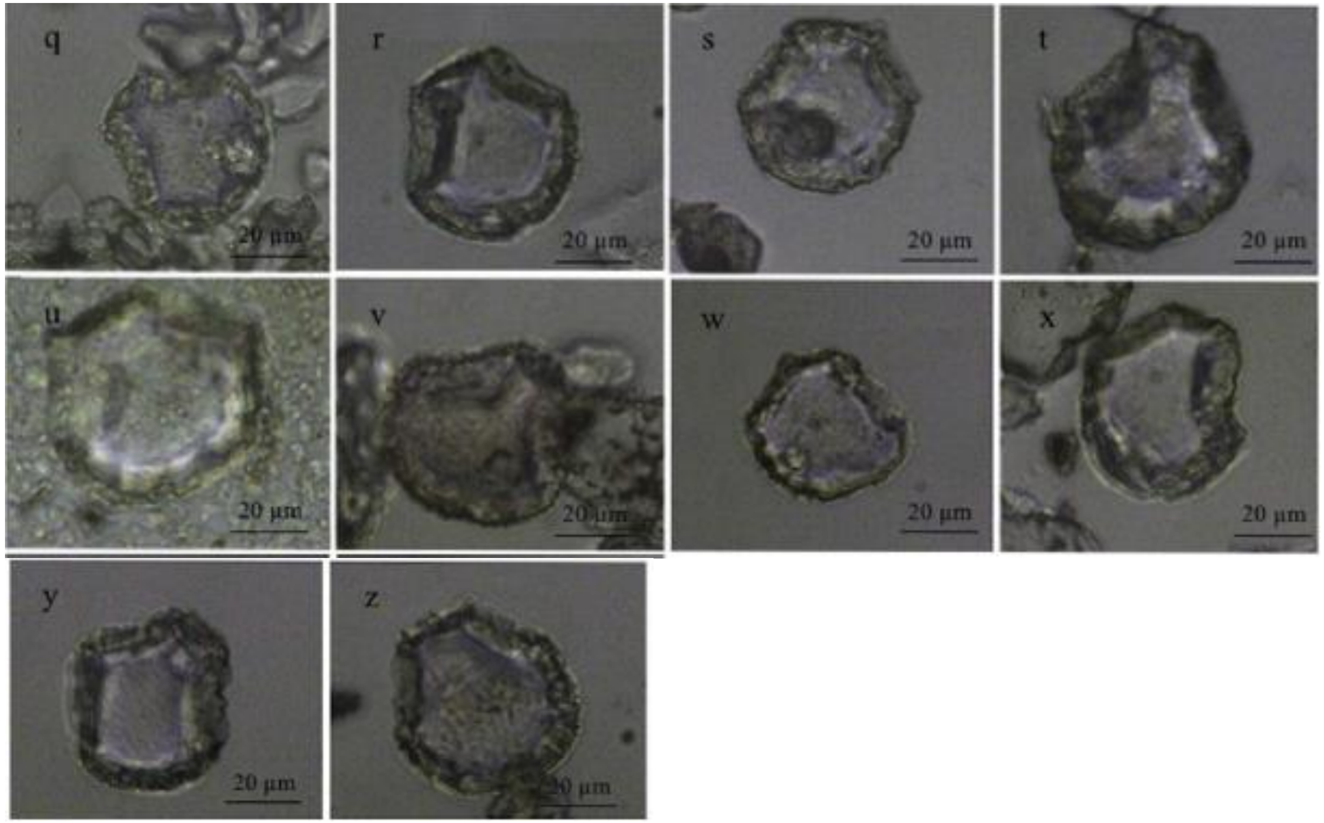
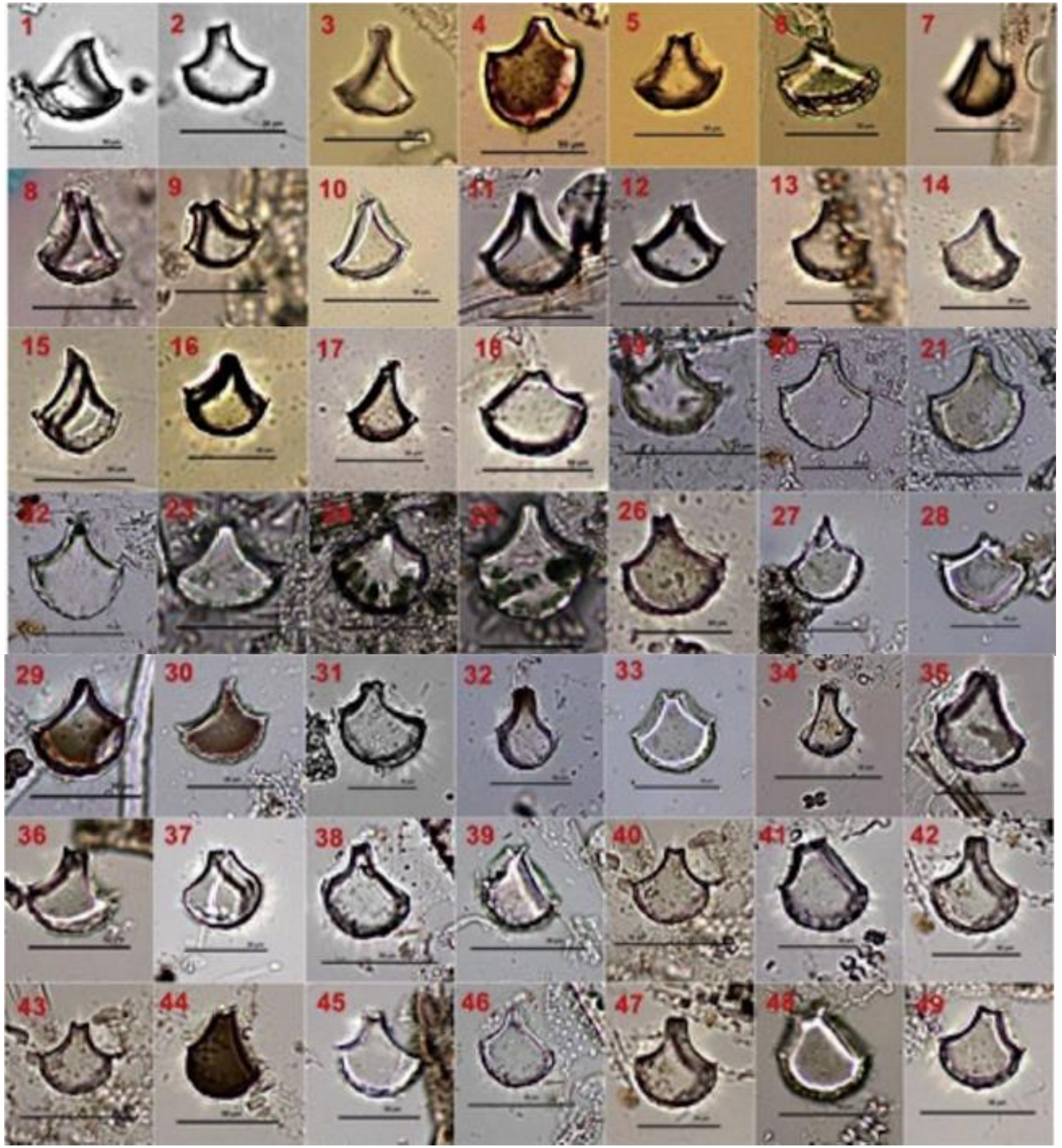


Fig. 4. Domesticated bulliform phytoliths from Wormsloe.

Pasqua, Alessandro, Liovando Marciano da Costa, and Ervan Garrison. 2017. Phytolith Evidence of Historical Rice Cultivation at Wormsloe Historic Site, Georgia, USA. *Journal of Archaeological Science: Reports* 14 (June). Elsevier:557–74. http://linkinghub.elsevier.com/retrieve/pii/S2352409X17300159.

Oryza sp.

Phytolith



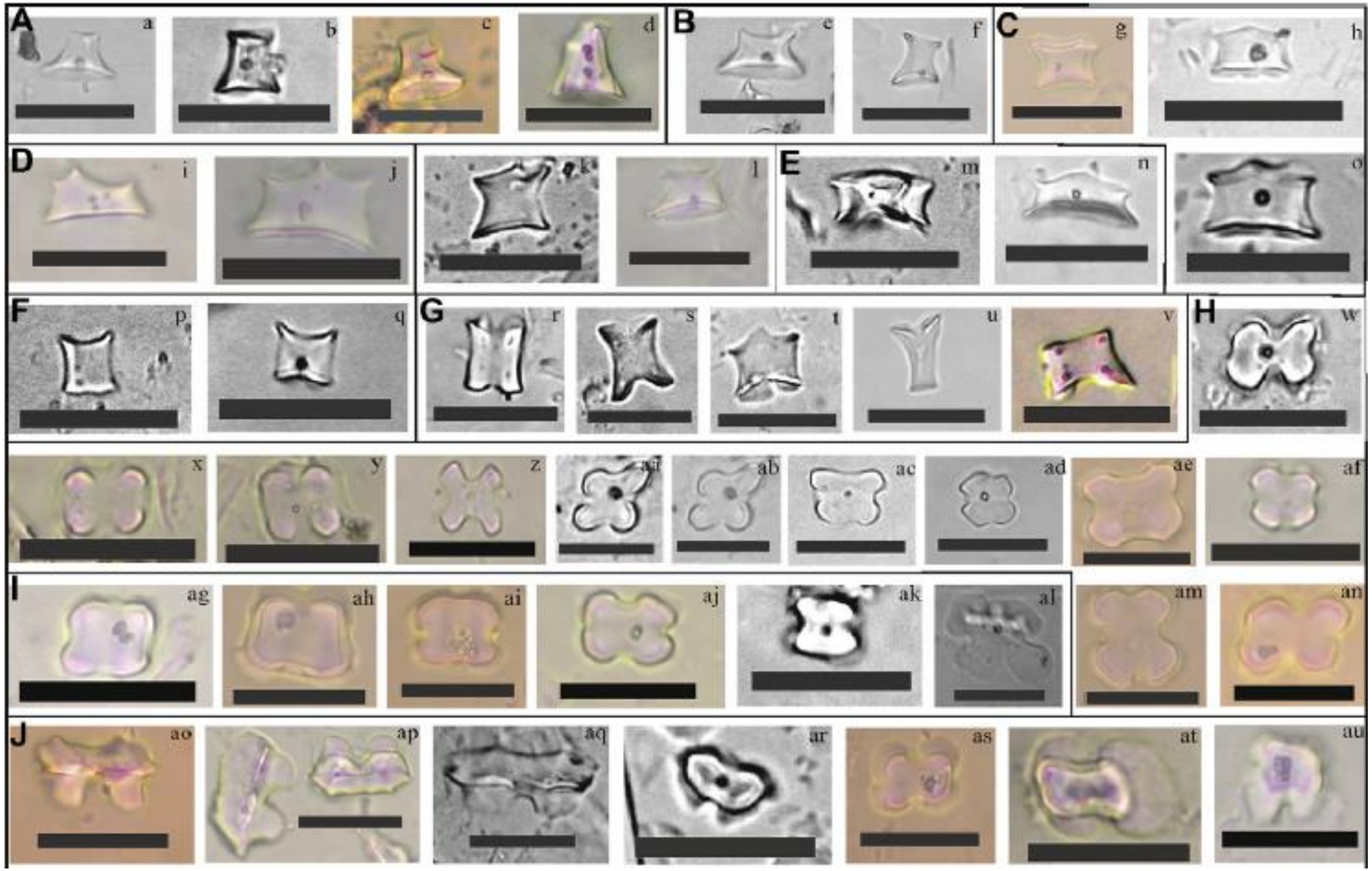
Brazilian rice bulliforms. Scale bar is 50 µm

Pasqua, Alessandro, Liovando Marciano da Costa, and Ervan Garrison. 2017. Phytolith Evidence of Historical Rice Cultivation at Wormsloe Historic Site, Georgia, USA. *Journal of Archaeological Science: Reports* 14 (June). Elsevier:557–74. http://linkinghub.elsevier.com/retrieve/pii/S2352409X17300159.

Oryza sp.

Phytolith

Fig. 1. Rondels, crosses, and complex saddles in the domesticated and wild rice species. (A) mirror-image rondels (flat cone, less than 15 mm). (B) Two-spiked rondels (the solid, less than 15 mm). (C) Wavy-top rondels (less than 20 mm). (D) Three-spiked rondels (less than 20 mm). (E) Rondeloid/saddloid types (less than 20 mm). (F) Two-spiked rondels (the hollow, less than 10 mm). (G) Complex rondels (the hollow, less than 20 mm). (H) Variant 1 crosses (less than 20 mm). (I) Irregular trapezoidal crosses (less than 20 mm). (J) Complex saddles (less than 25 mm). a, e, h, i, l, n, at, au: O. longiglumis,inflorescence; b, o, q, ab, ad, ar: O. sativa,inflorescence; c, ao-ap, as: O. granulata, leaf; d, j, aj: O. ridleyi,inflorescence; f: O. minuta,inflorescence; g: O. meyeriana,inflorescence; k, m, p, reu, w-aa, ac, ak, aq: O. sativa, leaf; v, ag: O. ridleyi, leaf; x-y: O. longiglumis, leaf; Z: O. rufipogon, leaf; ae, af, ah, al: O. meyeriana, leaf; ai: O. minuta, leaf. Scale bar ¼ 20 mm.



Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

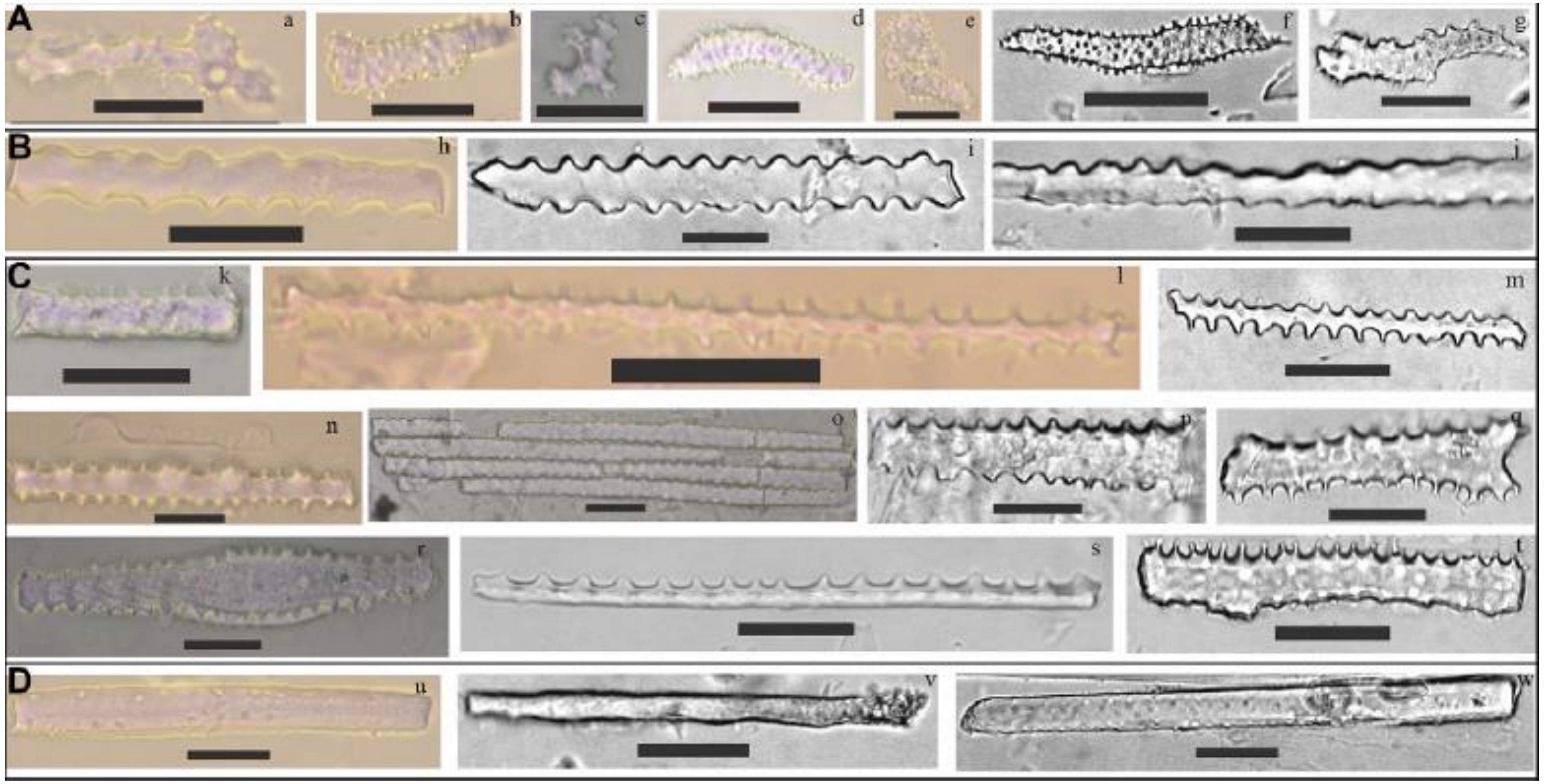


Fig. 2. Long cells in domesticated and wild rice species. (A) Irregular elongate with short protrusions. (B) Elongate sinuate. (C) Elongate echinate. (D) Elongate smooth. a: O. minuta, inflorescence; b: O. granulata, inflorescence; c, h: O. rufipogon, inflorescence; d, k: O. longiglumis, inflorescence; e, l: O. meyeriana, inflorescence; f-g, i-j, m: O. sativa, inflorescence; n, u: O. minuta, leaf; o: O. longiglumis, leaf; p-q, r-t, v, w: O. sativa, leaf. Scale bar ¼ 20 mm

Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

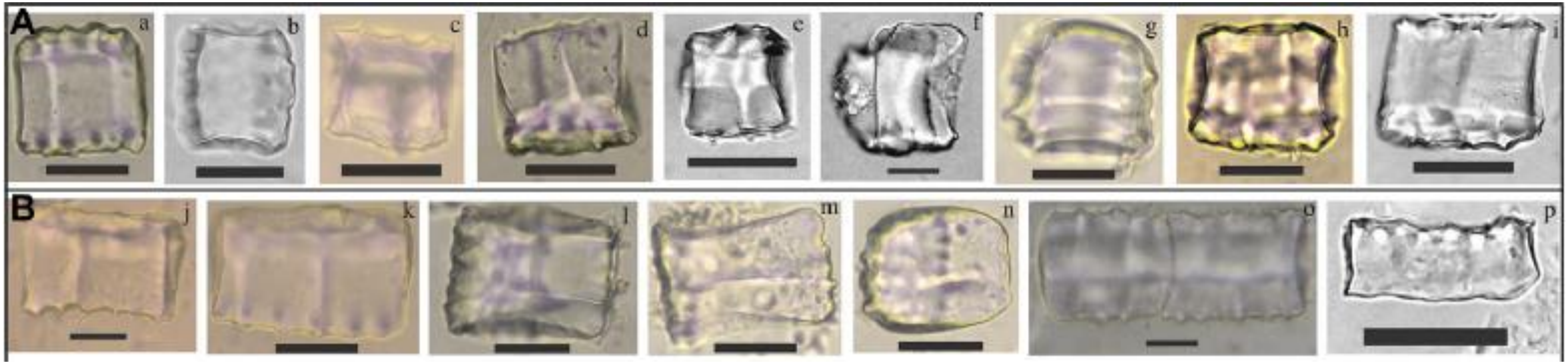


Fig. 3. Parallepipedal bulliform cells from the leaves of eight rice species in East Asia. (A) Parallepipedal bulliform cells. (B) Parallepipedal bulliform cells. a, c: O. minuta; b,d-f, i, p: O. sativa; g-h: O. ridleyi; j: O. granulata; k: O. meyeriana; l: O. Officinalis; m-n: O. rufipogon; o: O. longiglumis. Scale bar ¼ 20 mm.

Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

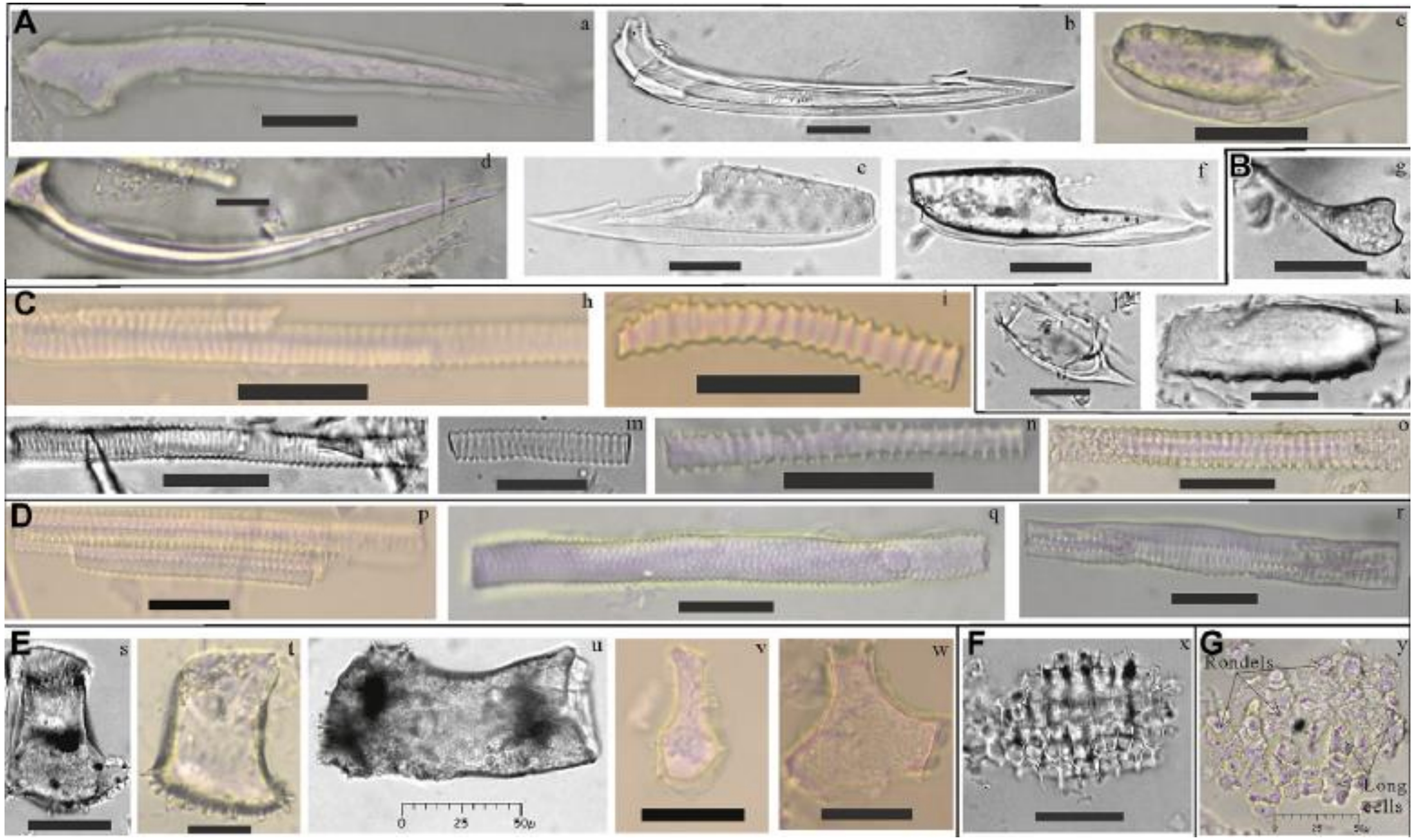


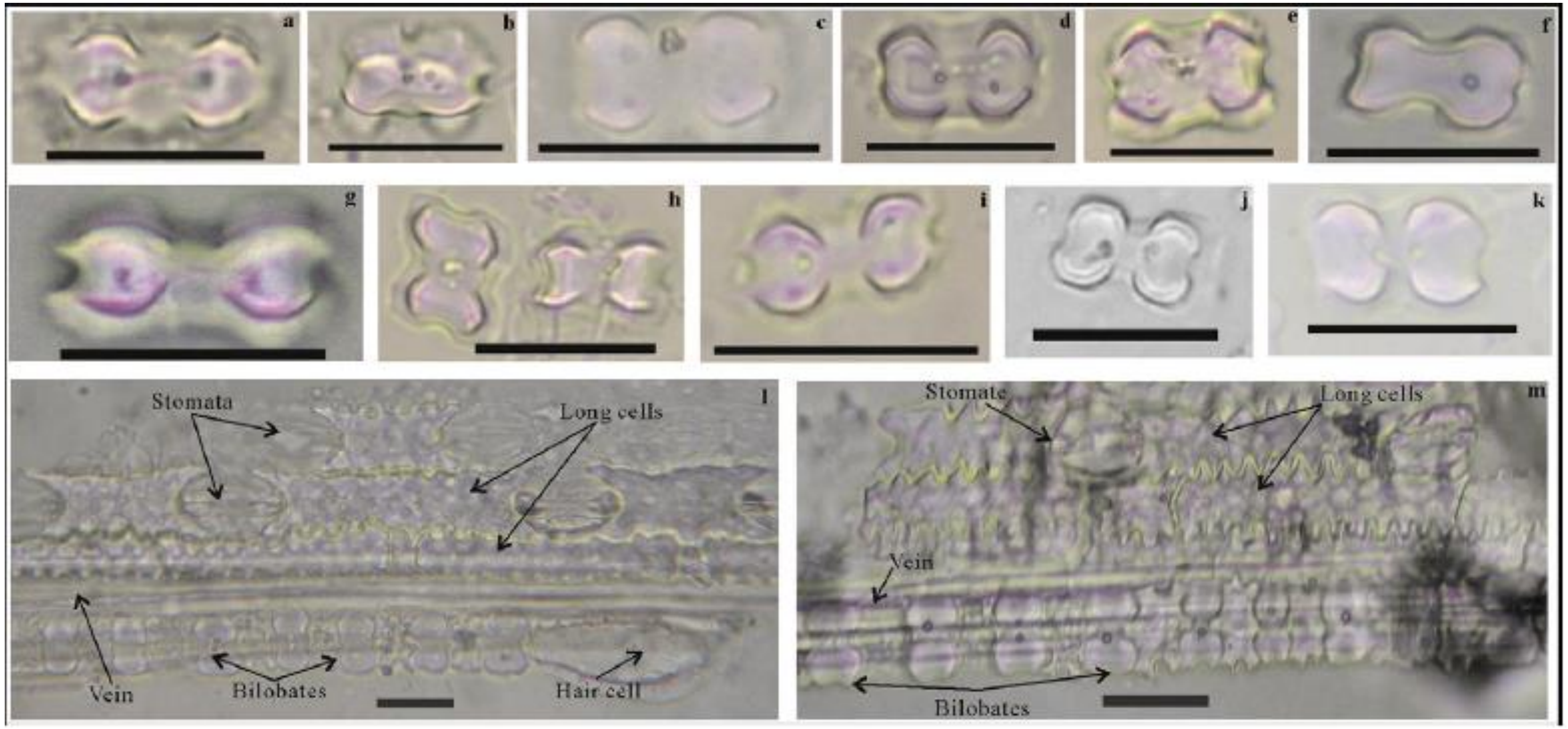
Fig. 4. Hair cells, papillae cells, tracheid and vascular tissue and other phytoliths in domesticated and wild rice species. (A) Hair cells. (B) Papillae cells. (C) Cylindric sulcate tracheids. (D) Vascular tissues. (E) Irregular epidermal phytoliths. (F) Mesophyll tissue, O. sativa, leaf. (G) Silicified epidermal tissue with rondels and irregular long cells, O. ridleyi, inflorescence. a, n: O. ridleyi, inflorescence; b, g, l, s, u: O. sativa, inflorescence; c, o: O. granulate, leaf; d-f, j-k, m, r, x: O. sativa, leaf; h, i: O. minuta, inflorescence; p, v, w: O. meyeriana, inflorescence; q, t, y: O. rufipogon, inflorescence. Scale bar ¼ 20 mm

Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

Fig. 5. Bilobates from the leaves of O. sativa and wild rice species in East Asia. a, b: O. granulata; c: O. longiglumis; d O. meyeriana; e, g: O. officinalis; f: O. ridleyi; h: O. rufipogon;i: O. minuta; j-k: O. sativa; l: Parallelled arrangement for bilobates in the silicified issue from the leaf of O. longiglumis; m: Parallelled arrangement for bilobates in the silicified issue from the leaf of O. sativa parallelled bilobates. Scale bar ¼ 20 mm.

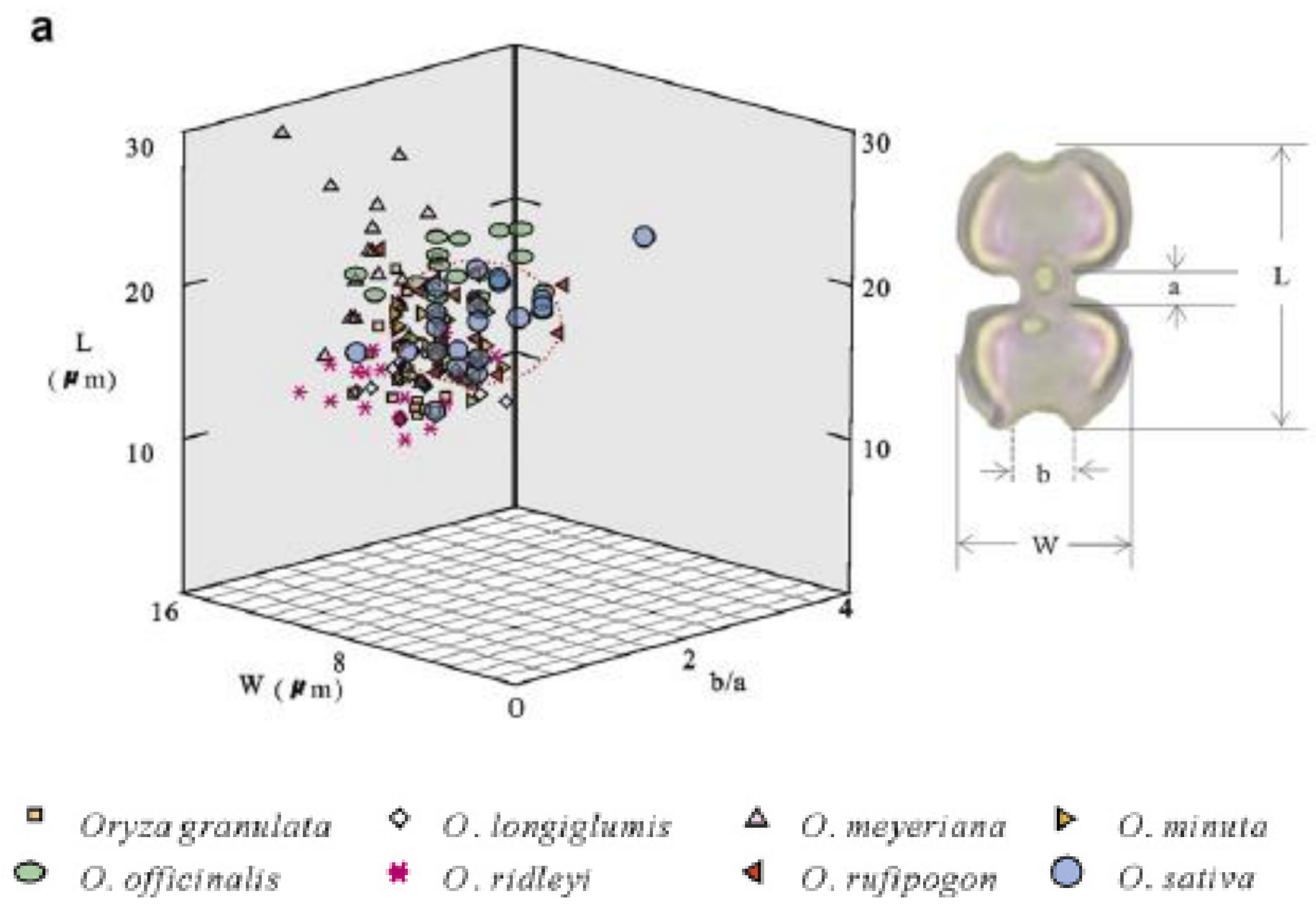


Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

Fig. 6. 3-D scattered plots for morphological parameters of bilobates (a), cuneiform bulliform cells (b) and double-peaked glume cells (c) in Oryza species. (L) Vertical length. (W) Width of the lobe. (a) Width of the shank. (b) Width of the scooped end at the top of the lobe. (HL) Horizontal length. (LL) Lateral length. (VL) Vertical length. (B) Length of base portion. (A) Length of non-base portion. (TW) Top width. (MW) Width of the middle. (H) Mean height of two peaks. (CD) The depth of the curve.



Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

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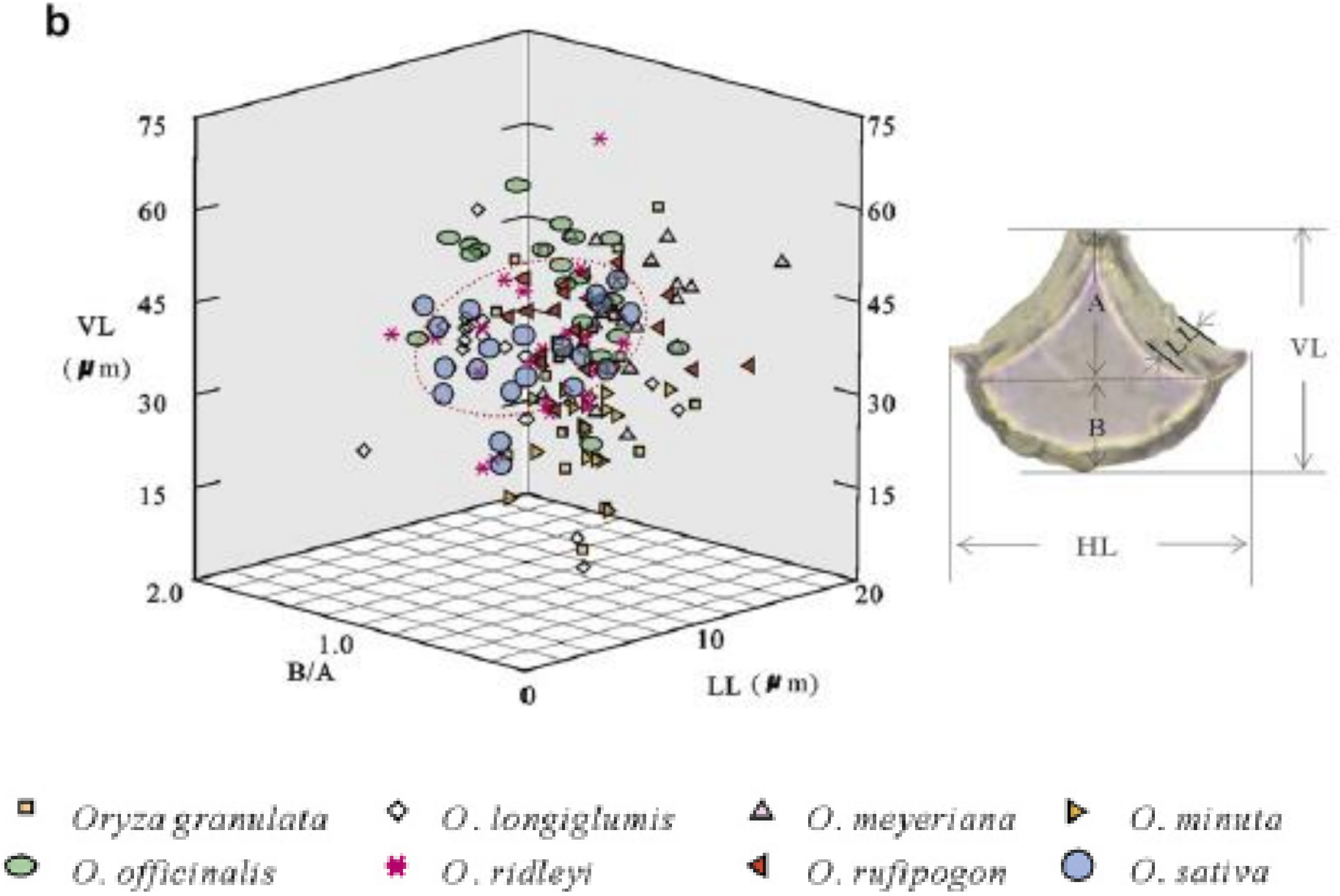
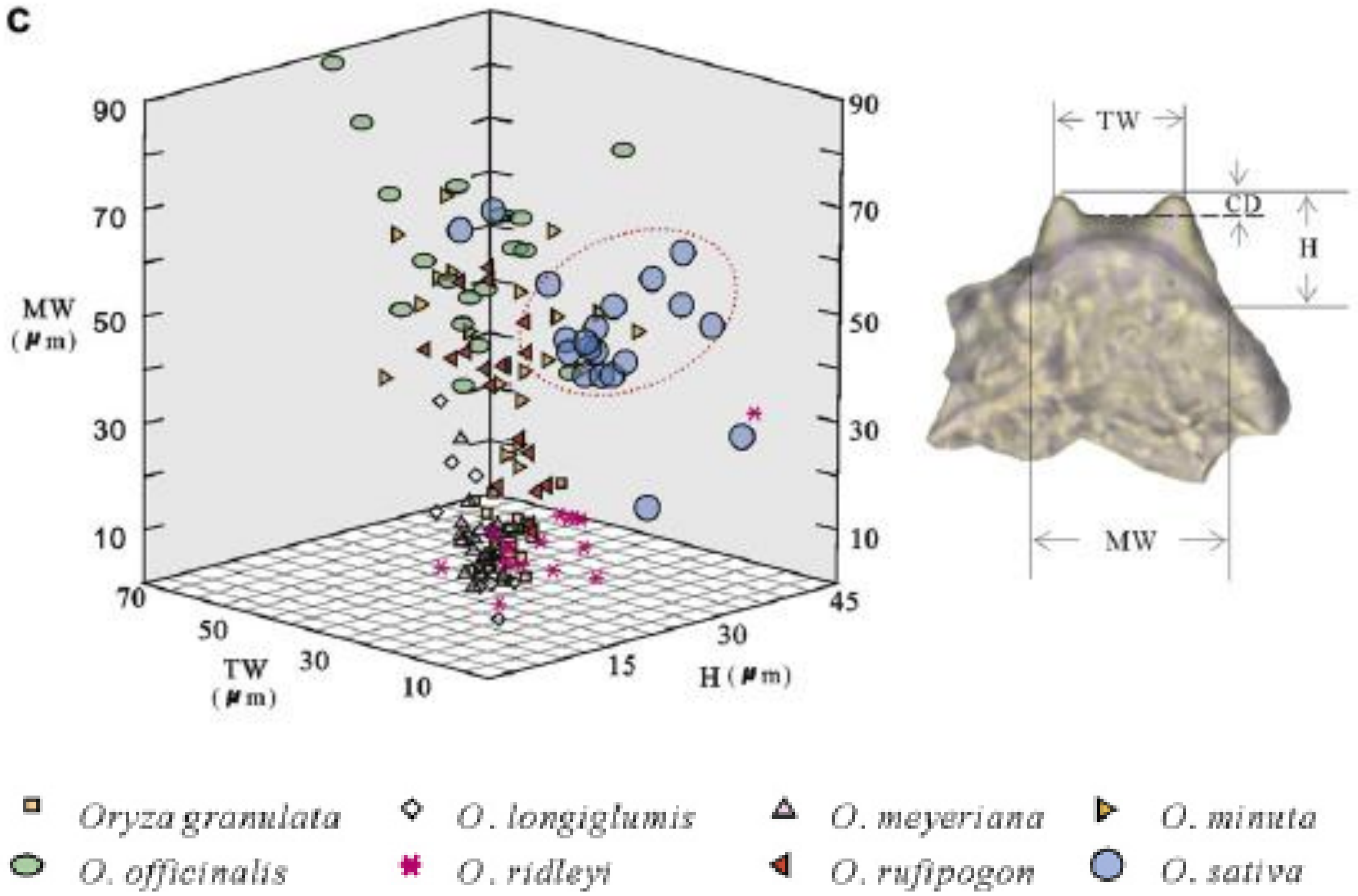


Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sp.

Phytolith

Fig. 6. 3-D scattered plots for morphological parameters of bilobates (a), cuneiform bulliform cells (b) and double-peaked glume cells (c) in Oryza species. (L) Vertical length. (W) Width of the lobe. (a) Width of the shank. (b) Width of the scooped end at the top of the lobe. (HL) Horizontal length. (LL) Lateral length. (VL) Vertical length. (B) Length of base portion. (A) Length of non-base portion. (TW) Top width. (MW) Width of the middle. (H) Mean height of two peaks. (CD) The depth of the curve.

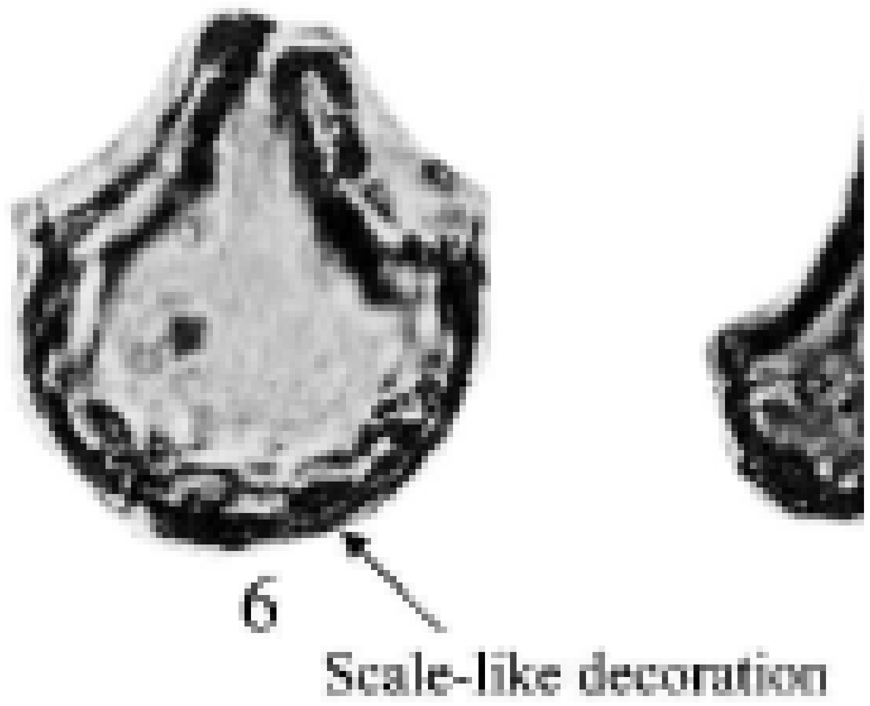


Gu, Yansheng, Zhijun Zhao, and Deborah Marie Pearsall. 2013. Phytolith Morphology Research on Wild and Domesticated Rice Species in East Asia. *Quaternary International* 287. Elsevier Ltd and INQUA:141–48. http://dx.doi.org/10.1016/j.quaint.2012.02.013.

Oryza sativa

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 6. Oryza sativa



Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Oryza sativa

Starch

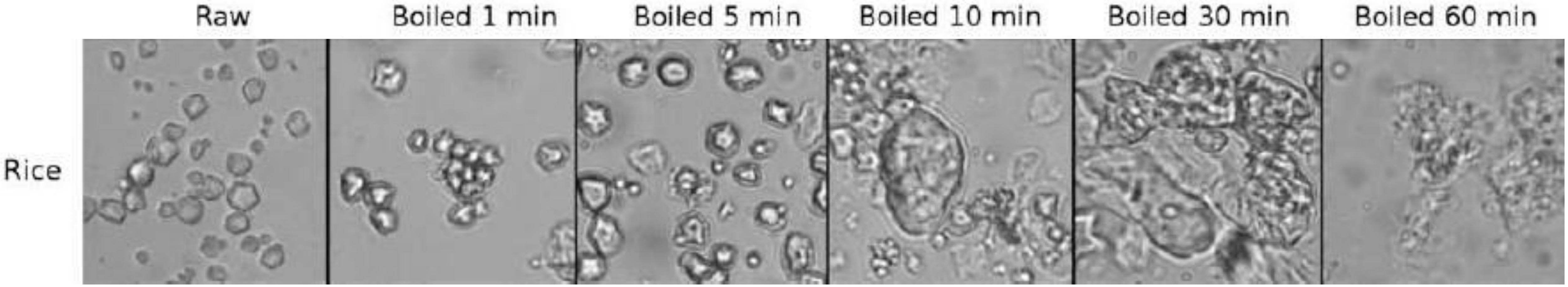


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Oryza sativa

Starch

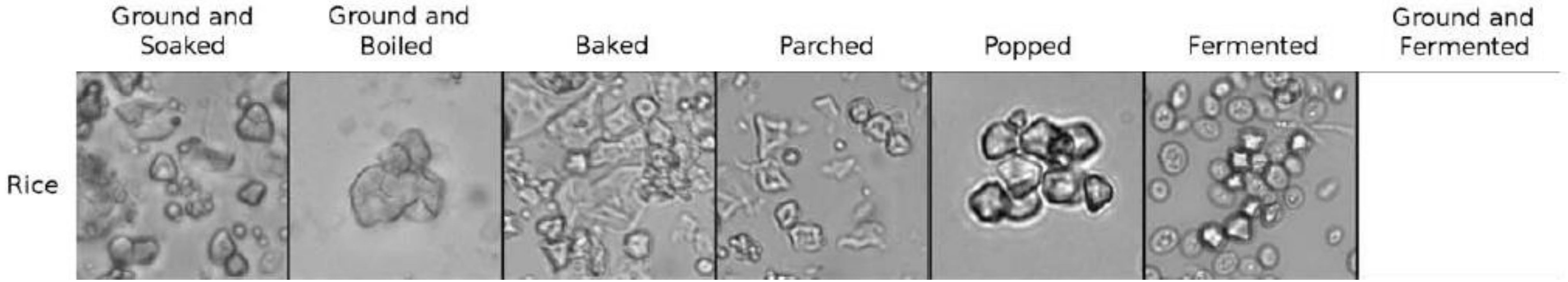


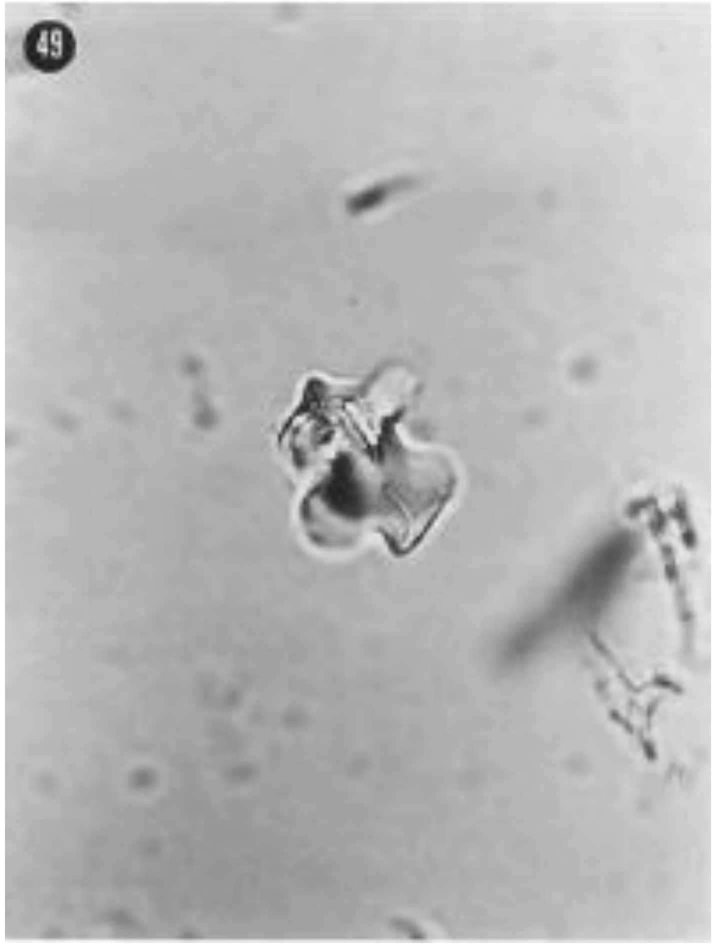
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Otatea fimbriata

Phytolith

FIGURES 49-52.-49, A thick, cross-shaped phytolith with a concave face from Otatea fimbriata (x400). Most cross-shaped phytoliths from this species have only three indentations.



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Panicum cyanescens

Phytolith

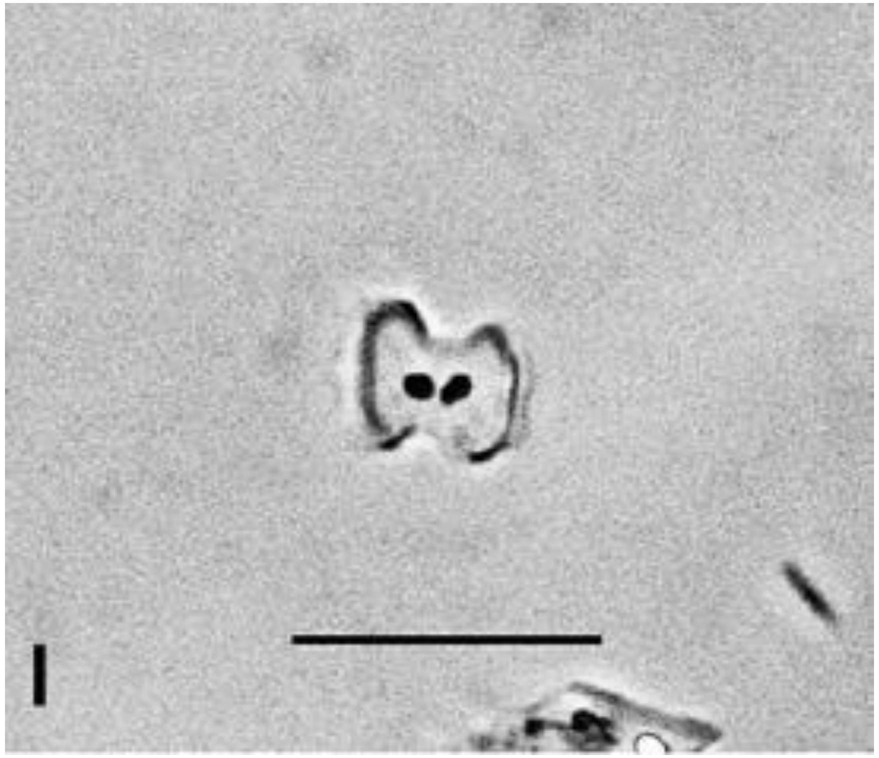
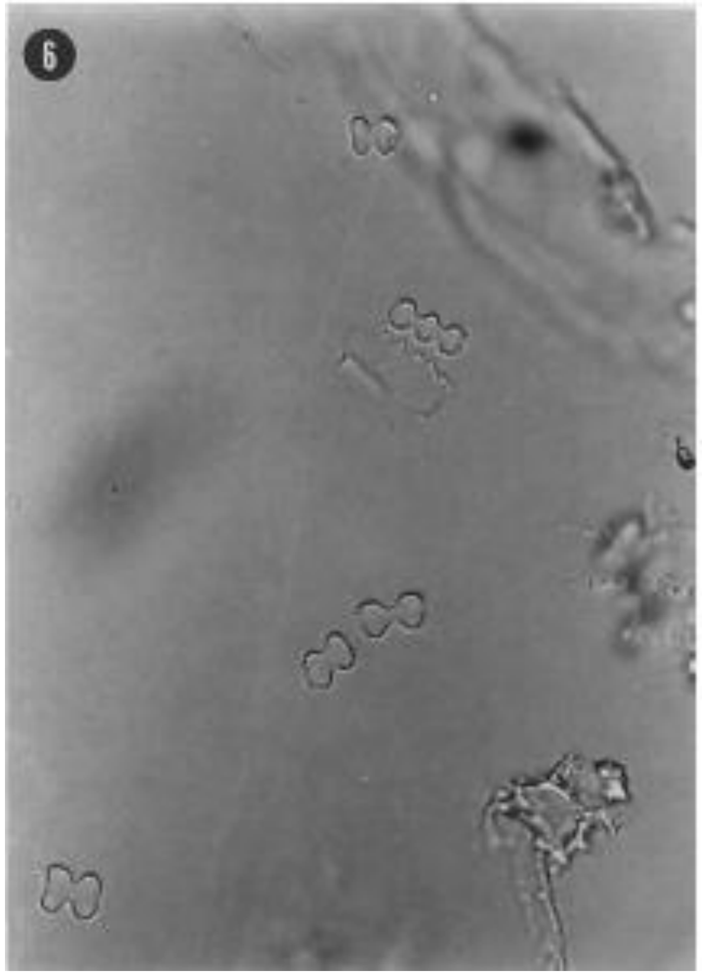


Fig. 4. Phytoliths from Poaceae. l) Squat bilobate from Panicum cyanescens

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Panicum fasciculatum

Phytolith



FIGURES 5-8. 6, Bilobates and a complex bilobate from Panicum fasciculatum (x200).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Panicum mertensii

Starch

APPENDIX:
Panicum mertensii. Simple and compound grains, spherical, very often with an ornamented border. Indistinct radiating fissures are present and a double border may be prominent. Size: 4–10 microns.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Panicum miliaceum

Starch

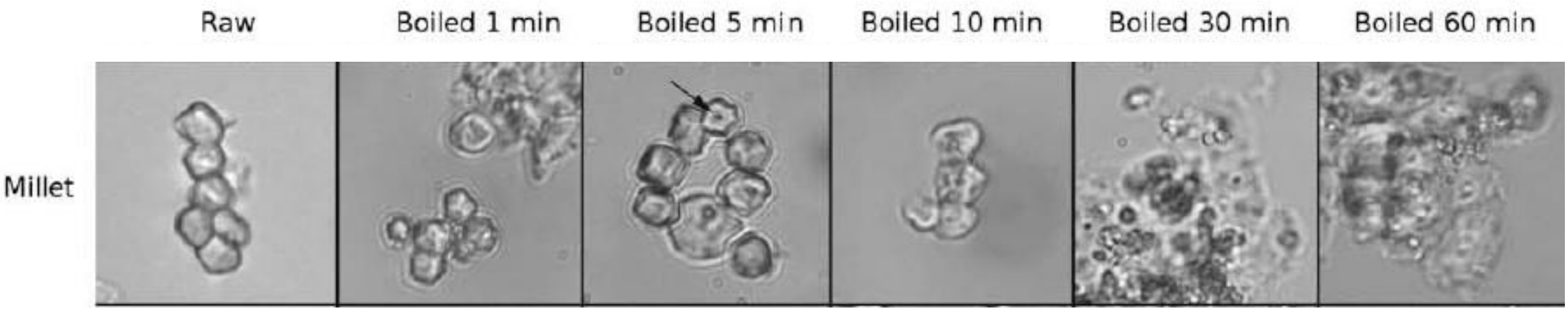


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Panicum miliaceum

Starch

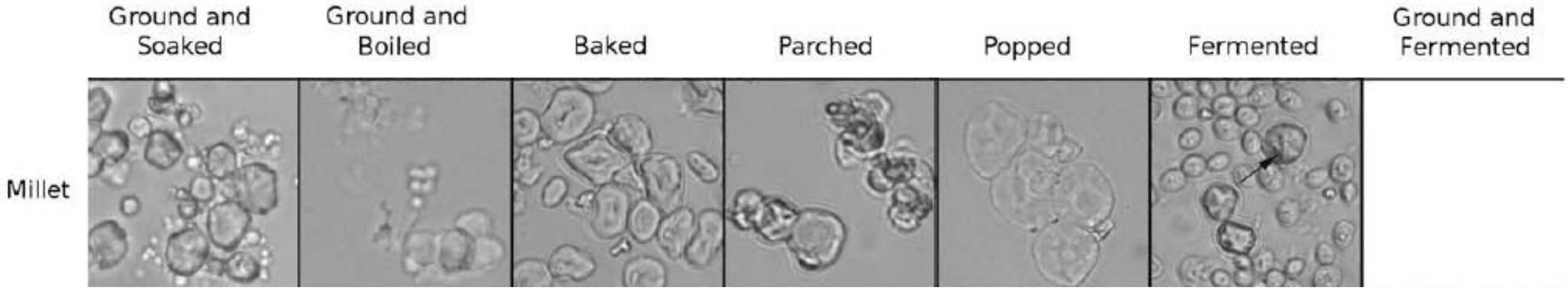


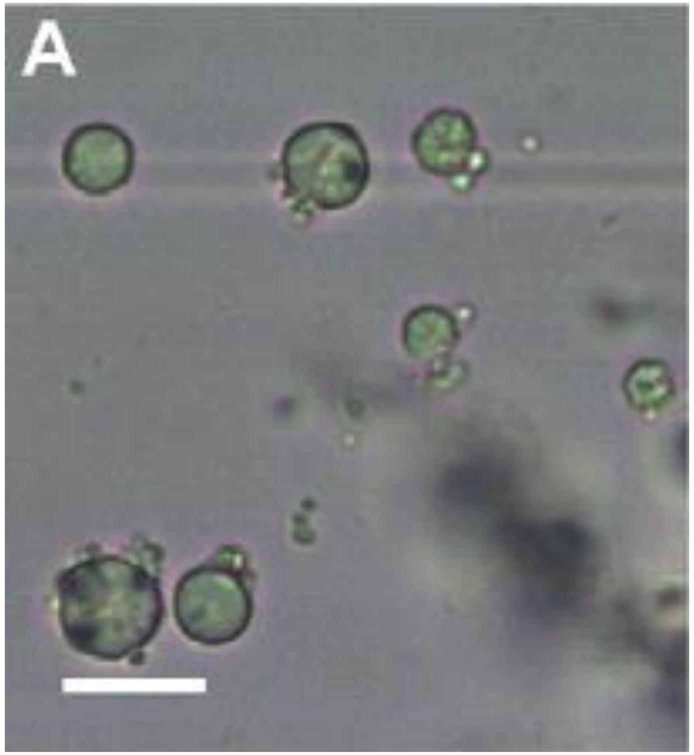
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Panicum urvilleanum

Starch

Fig. 3. Pampean native wild grasses from reference collection. A-C: Simple starch grains. A: Panicum urvilleanum. (Scale bars: 10 mm).

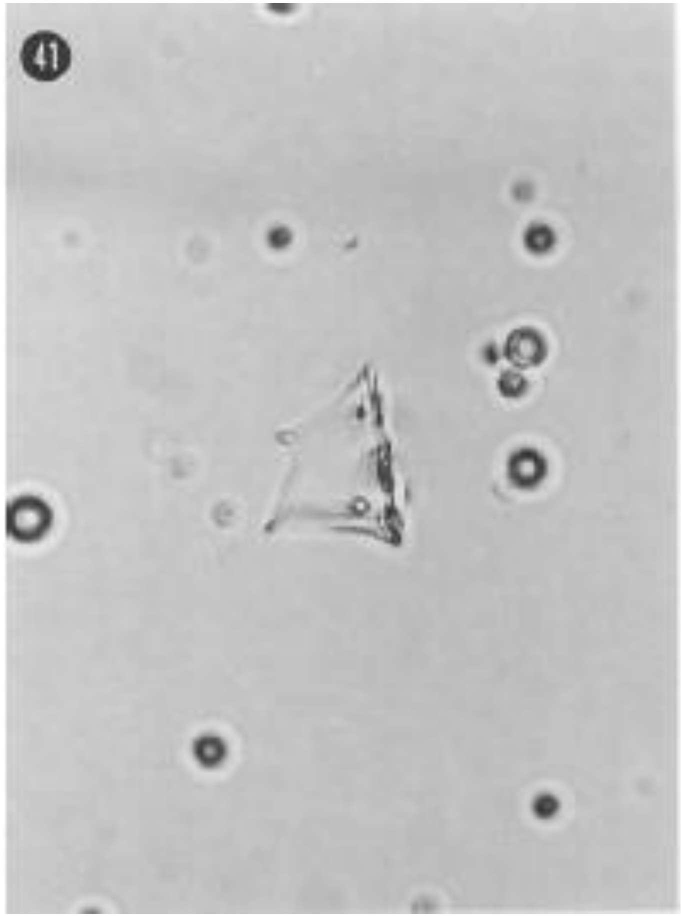


Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Pariana campestris

Phytolith

FIGURES 41-44.-41, A phytolith from Pariana campestris with one sinuous and one sloping edge. It is neither as tall nor as wide as that from Maclurolyra tecta (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Pariana campestris

Phytolith

FIGURES 45-48.-46, An irregular, complex short-cell phytolith from Pariana campestris (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Parodiolyra luetzelbergii

Phytolith

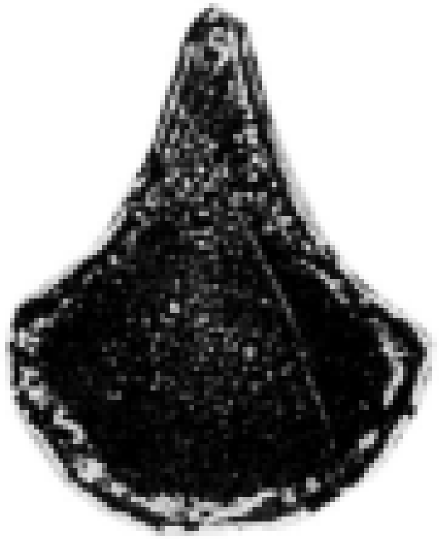
Fig. 4. Phytoliths from Poaceae. f) Irregular/complex phytoliths (1) from Parodiolyra luetzelbergii. Bilobate (2) to the right is variant 3/8

Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Paspalum sp.

Phytolith

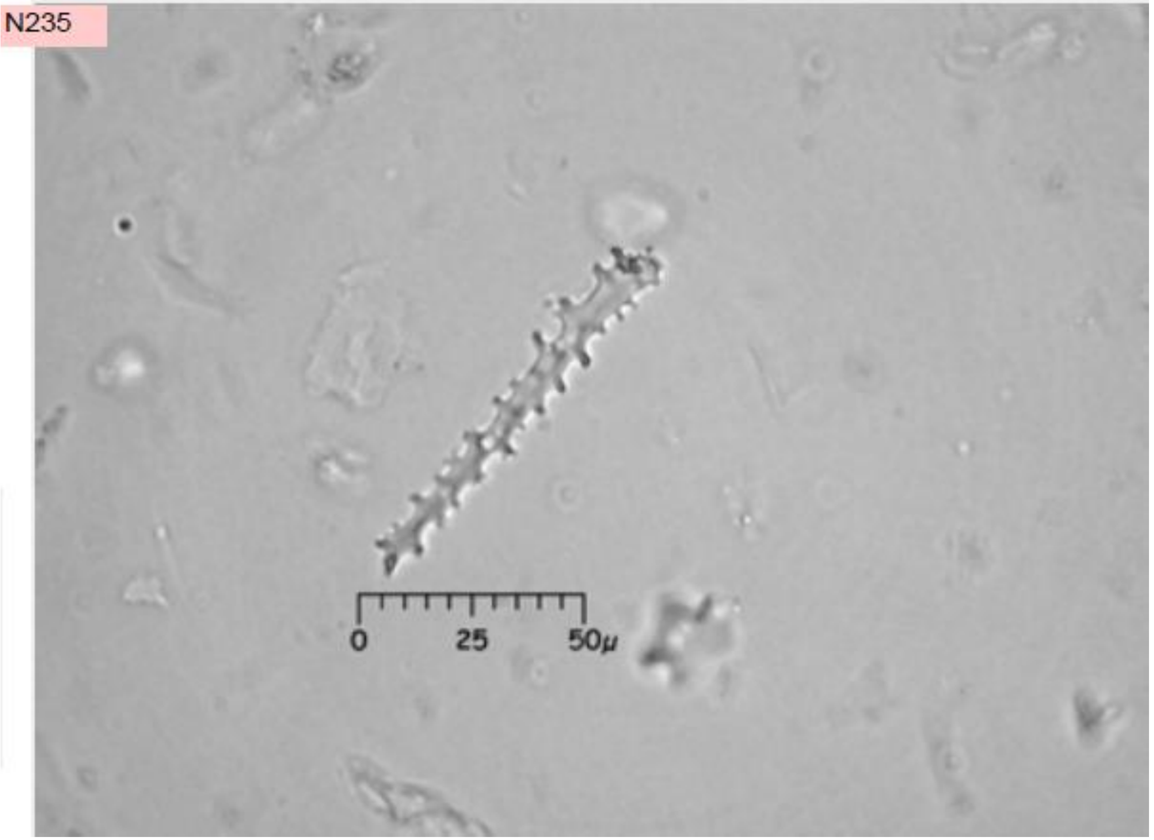
Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 3. Paspalum sp.



Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Paspalum lividum

Phytolith



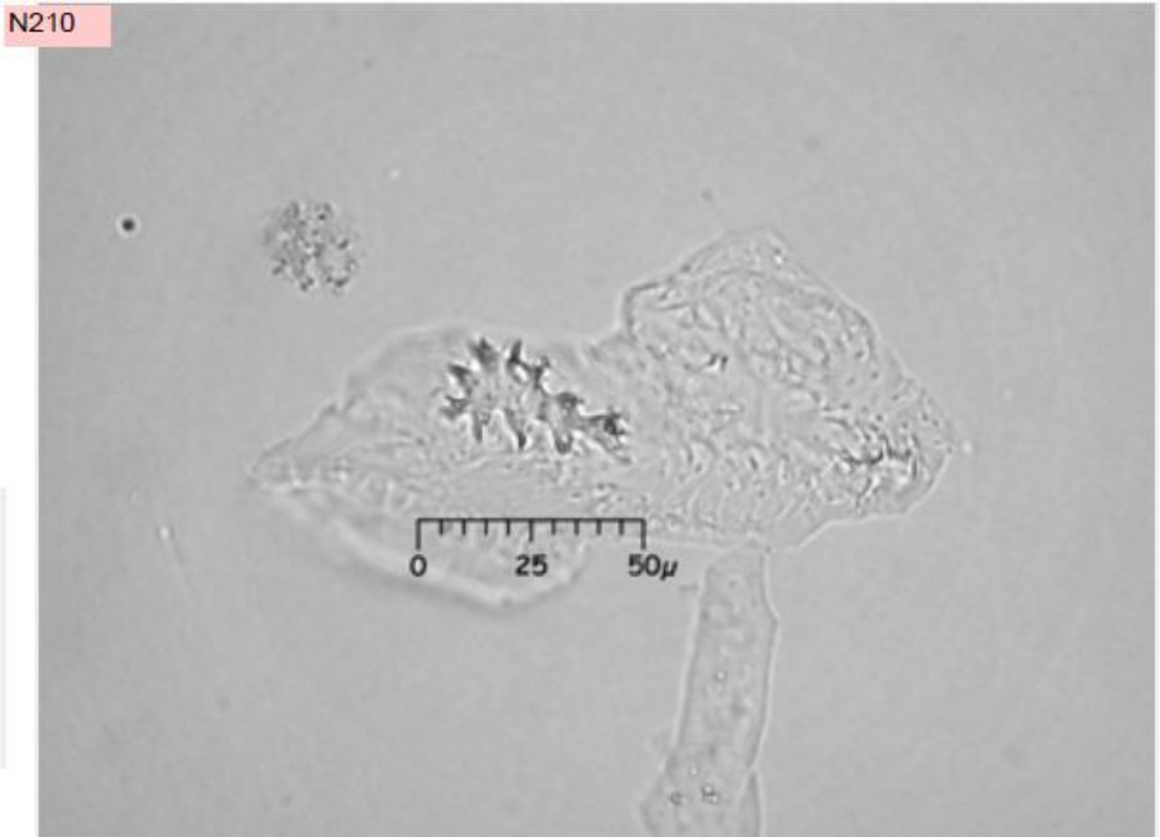
Tubular body
These bodies are very similar to the narrow rectangular IRP, but are tubules, not flattened pieces. These occur mostly in non-Zea grases and rarely in Zea spp. Diagnostic level: wild Poaceae

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Paspalum lividum

Phytolith

Burr-like spheres and elongate bodies with needle projections.
Occur mainly in Digitaria spp. and in Arundinella hispida, but not in Zea spp.
Diagnostic level: wild Poaceae

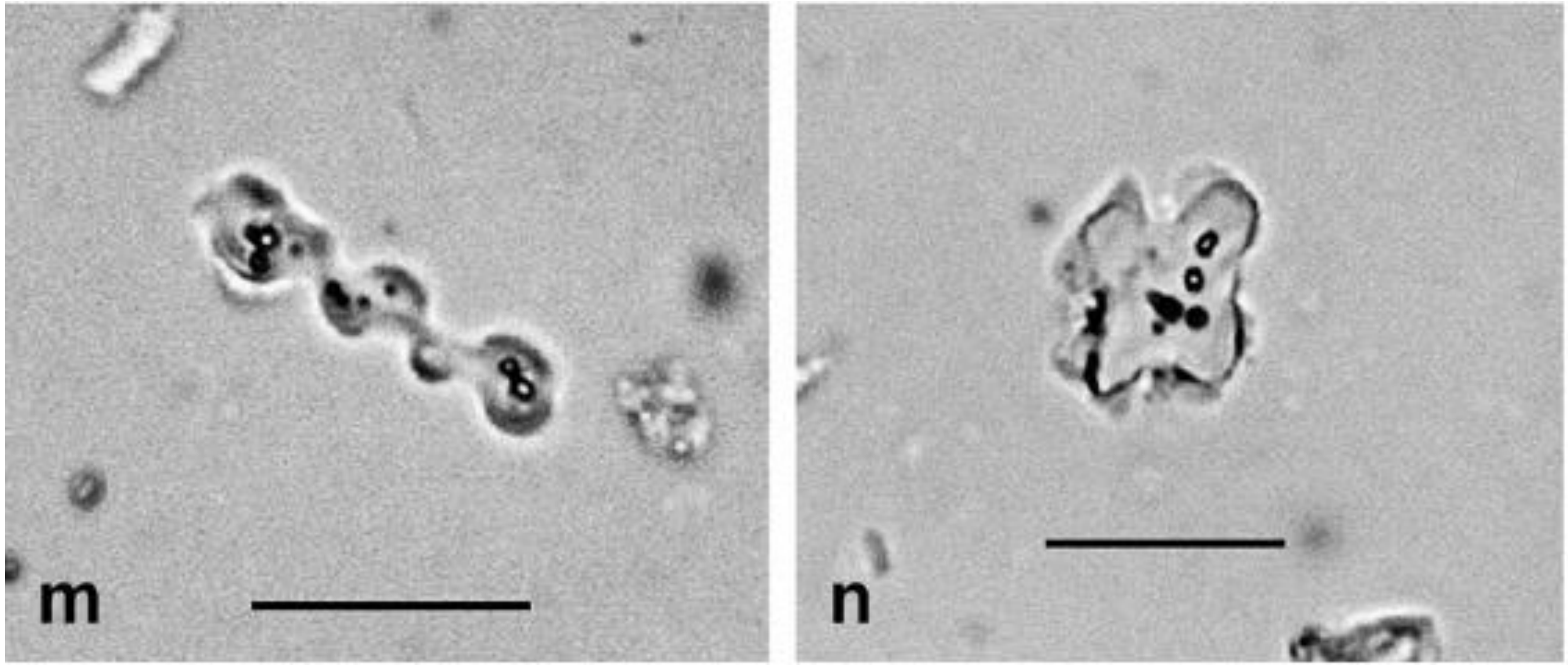


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Paspalum parviflorum

Phytolith

Fig. 4. Phytoliths from Poaceae. m) Polybate from Paspalum parviflorum, n) Cross from P. parviflorum

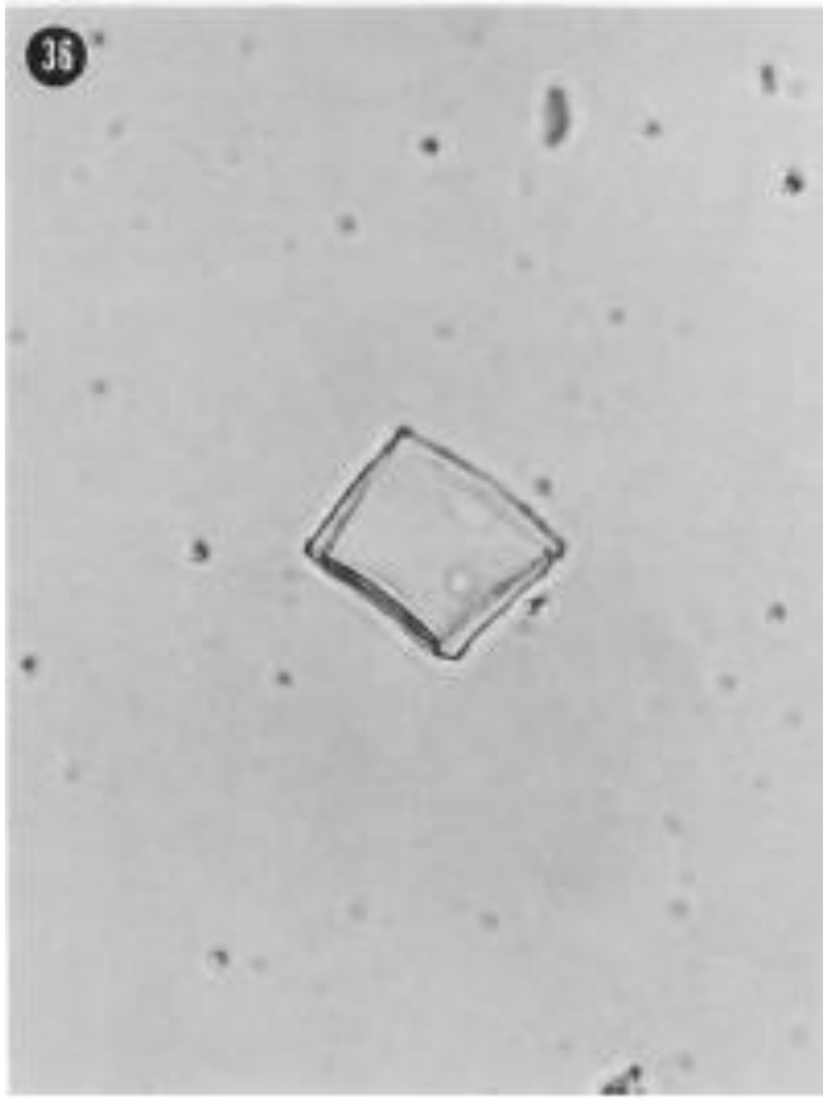


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Pharus sp.

Phytolith

FIGURES 33-36.-36, A Pharus body characterized by its flatness, considerable width, and presence of (bottom left) dumbboid and (upper right) rectanguloid lateral edges (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Phragmites sp.

Phytolith

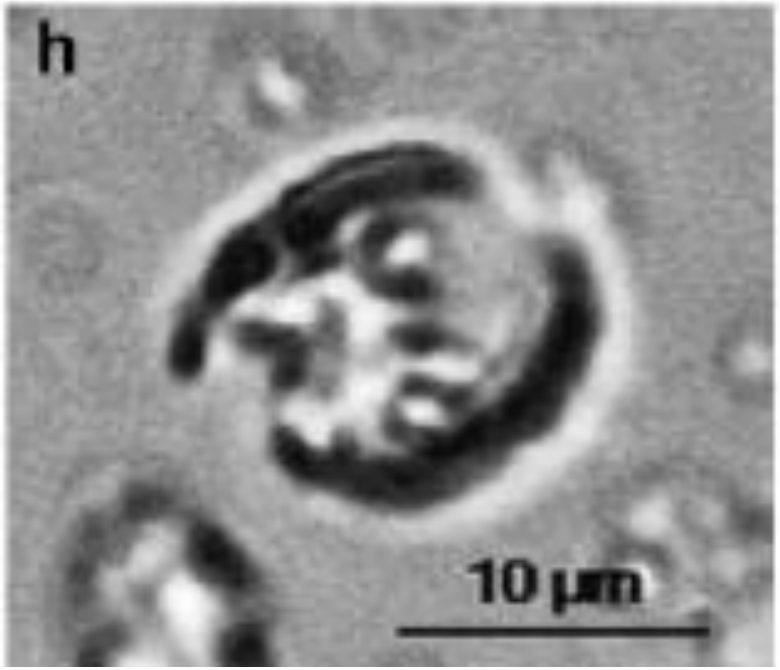


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. h) Phragmites large ridged saddle (P Ridged Field 2, 10-20 cm).

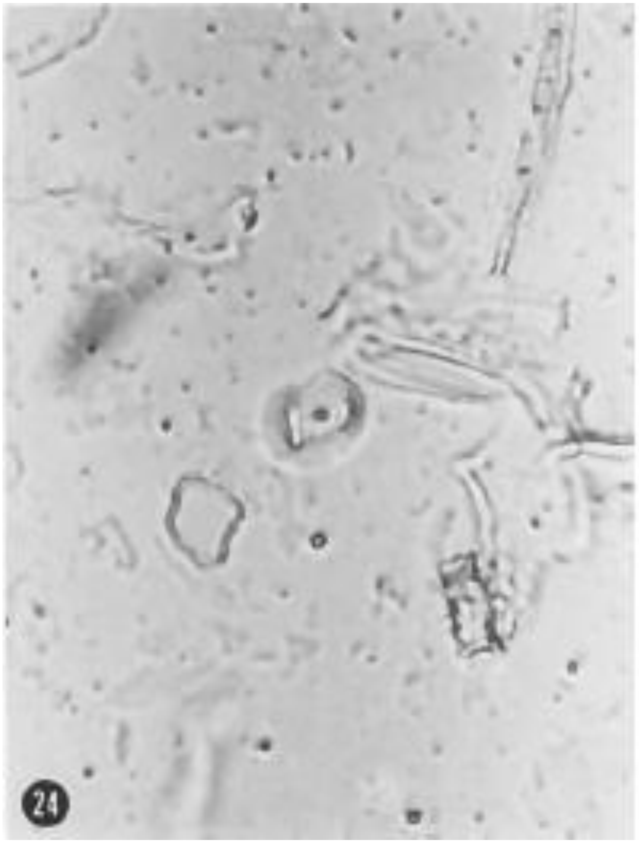
Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

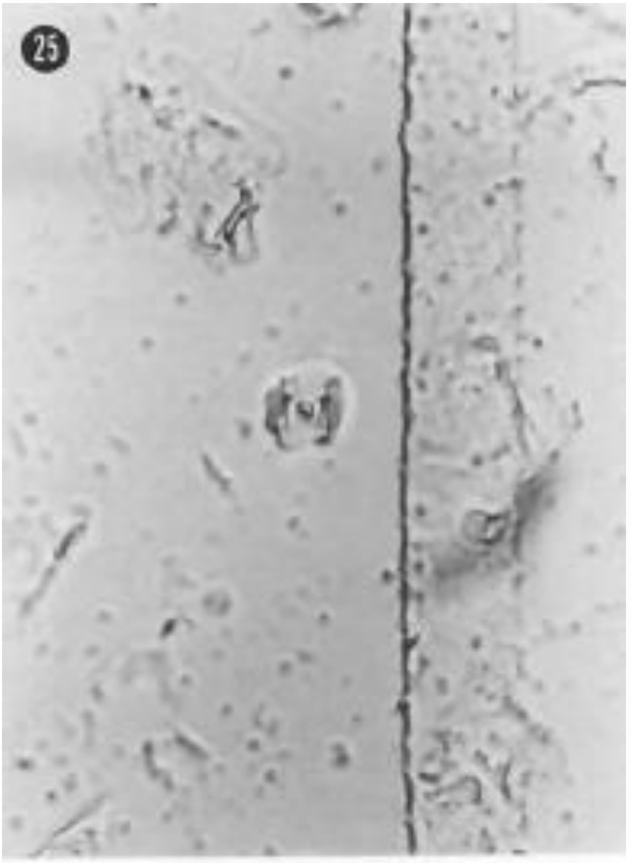
Phragmites australis

Phytolith

FIGURES 21-24.- 24, Center, a plateaued saddle from Phragmites australis (x400)

FIGURES 25-28.-25, A plateaued saddle from Phragmites australis (x400)



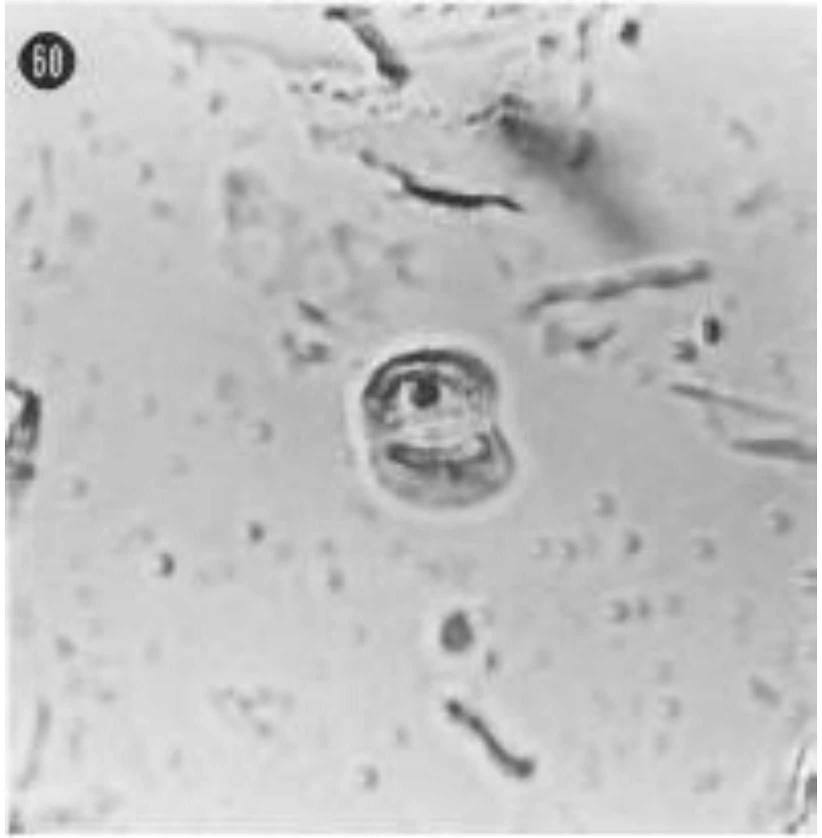


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Phragmites australis

Phytolith

FIGURES 57-60.-60, A tall saddle from Phragmites australis (x400)

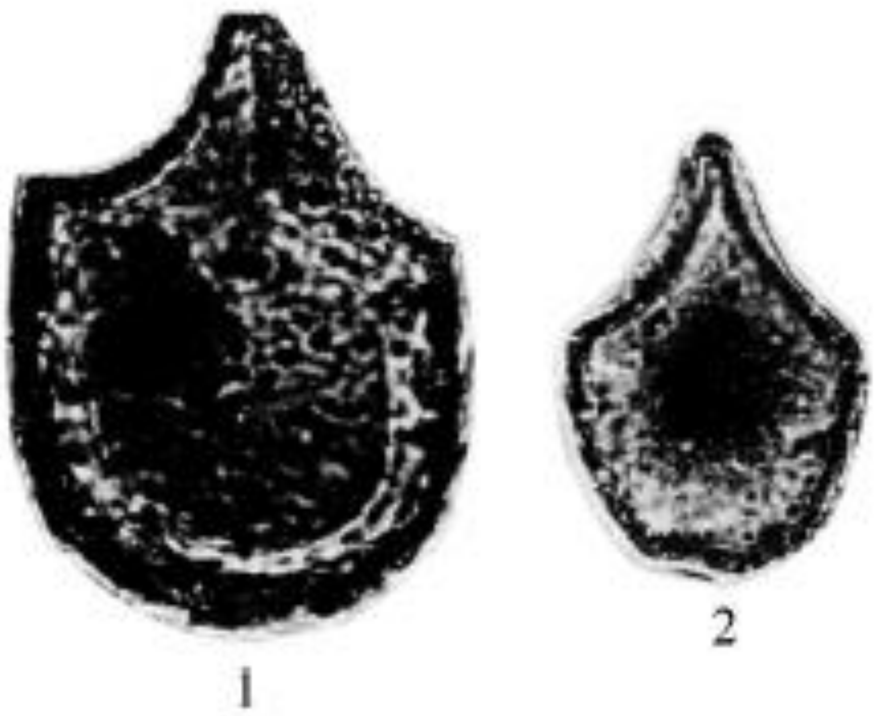


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Phragmites australis

Phytolith

Fig. 2. Characteristic s of bulliform phytoliths from 16 grasses showing rice phytoliths with scale-like decoration. 1, 2. Phragmites australis



Lu, Houyuan, Zhenxia Liu, Naiqin Wu, Serge Berné, Yoshiki Saito, Baozhu Liu, and Luo Wang. 2002. Rice Domestication and Climatic Chang: Phytolith Evidence from East China. *Boreas* 31:378–85.

Polypogon elongatus

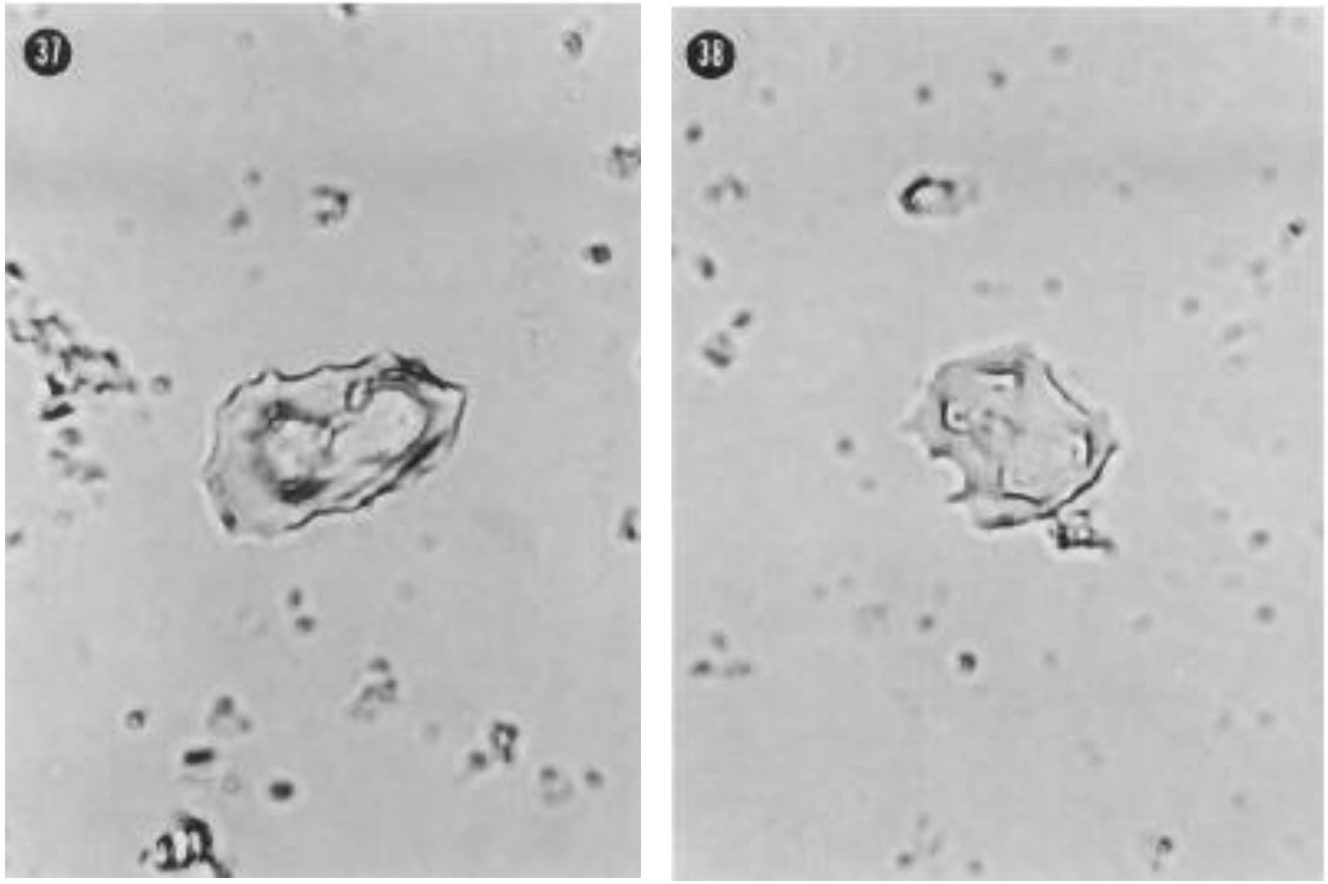
Phytolith

FIGURES 53-56.-55, A unique type of cross-shaped phytolith, from Polypogon elongatus, in which one side of the phytolith has a saddle- or bilobate-like structure that extends only about two-thirds the length of the longer, cross-shaped side. It is also very wide. The phytolith is slightly turned, thus both faces may be seen (x400). Bilobates from this grass also carry the same features.

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Raddiela nana

Phytolith

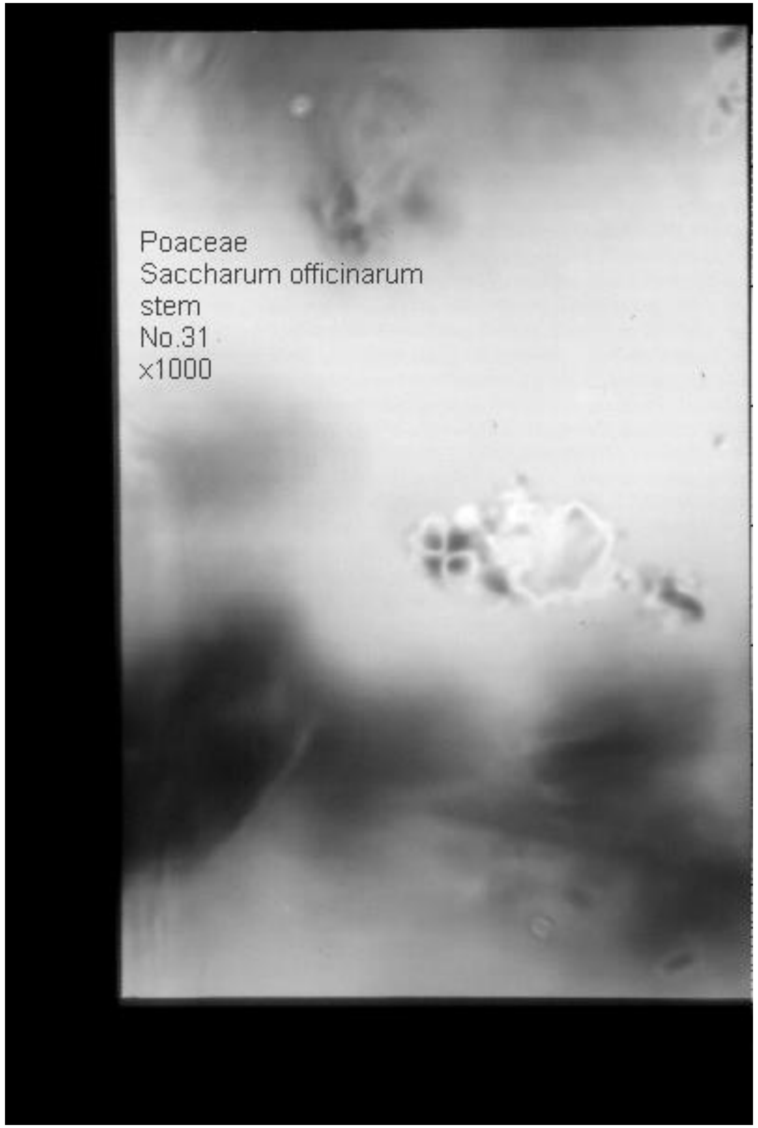


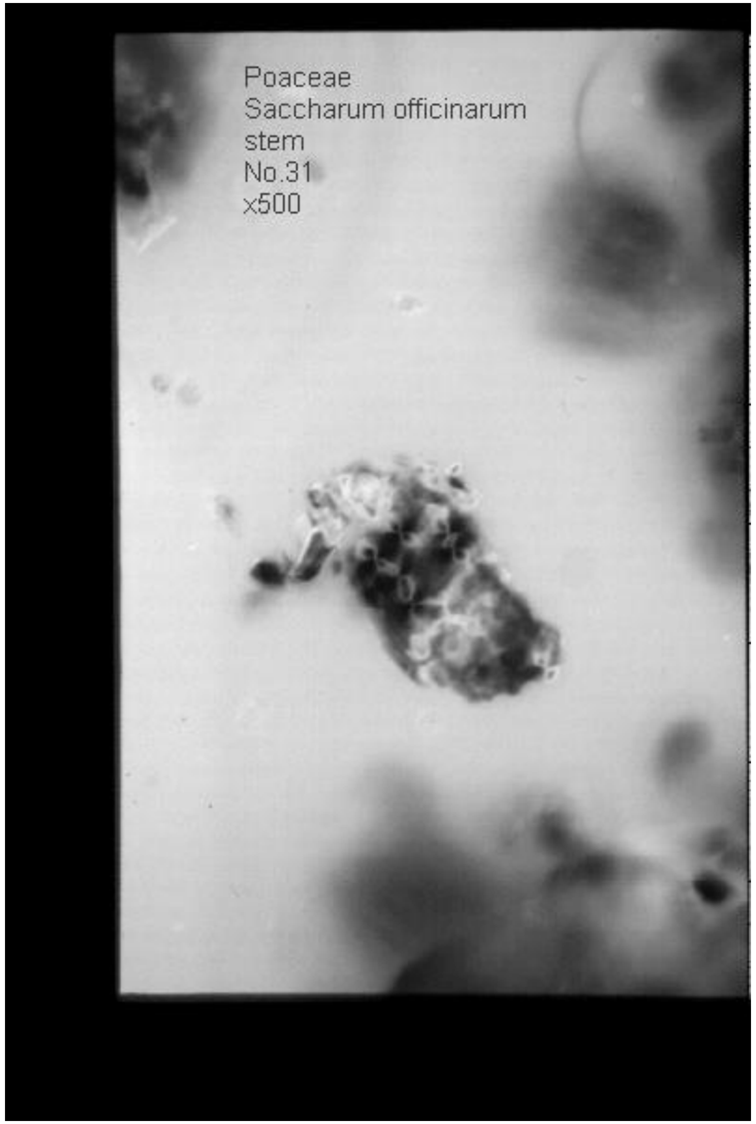
FIGURES 37-40.-37. A biloboid from Raddiela nana enclosed in a siliceous plate (x400). 38, A cross-shaped-like phytolith from Raddiela nana enclosed in a siliceous plate (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Saccharum officinarum

Australian Museum,
McCown Archaeobotany
Laboratory Collection





Sorghastrum pellitum

Starch

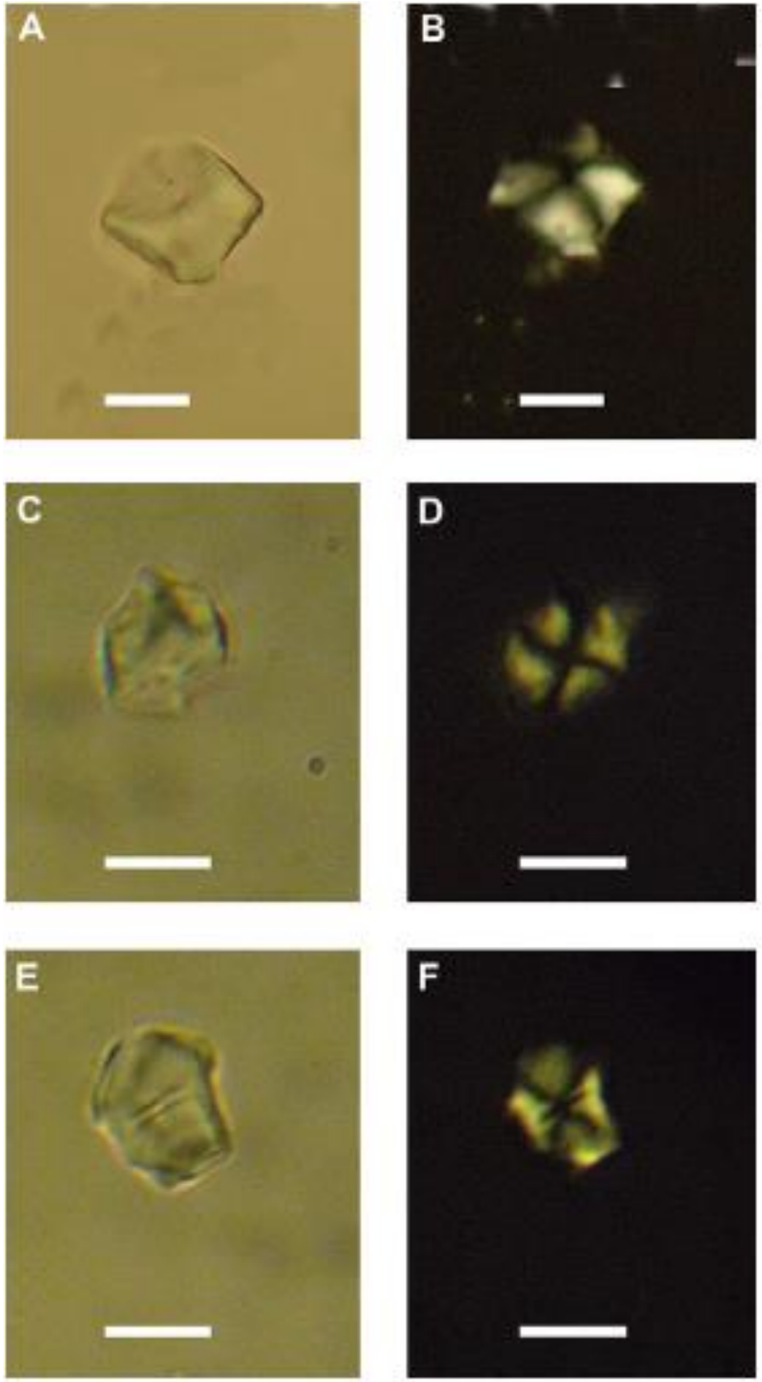


Fig. 4. Classic Panicoid starch grain morphotype of Sorghastrum pellitum. A: Example of centric hilum as a deep depression. B: Same starch grain with polarized light. C: Example of facetted shapes with angular edges. D: Same starch grain with polarized light. E: Example of simple starch grains with transverse fissures. F: Same starch grain with polarized light (Scale bars: 10 mm)

Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Sorghum bicolor

Starch

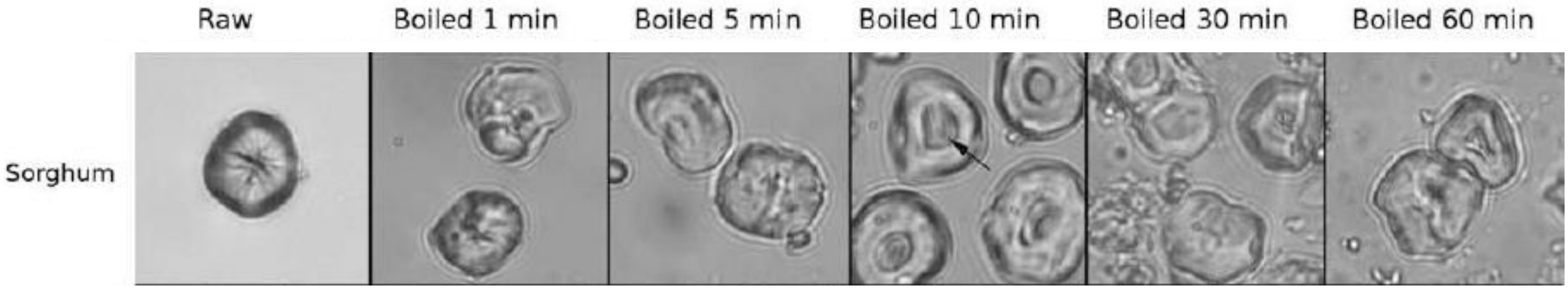


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Sorghum bicolor

Starch

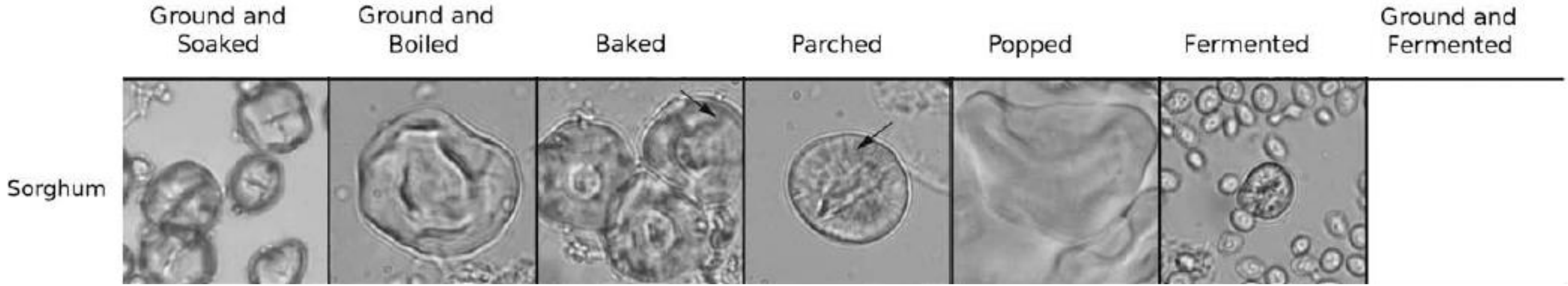


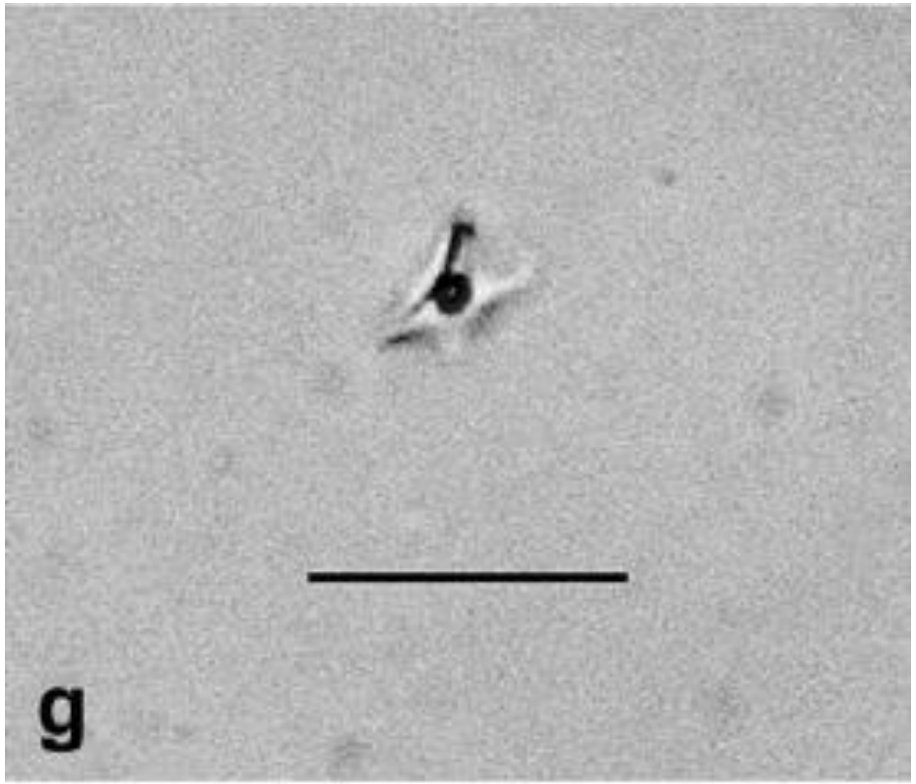
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shown at 10 min, barley at 5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Spartina alterniflora

Phytolith

Fig. 4. Phytoliths from Poaceae. g) Rondeloid/saddleoid phytolith from Spartina alterniflora

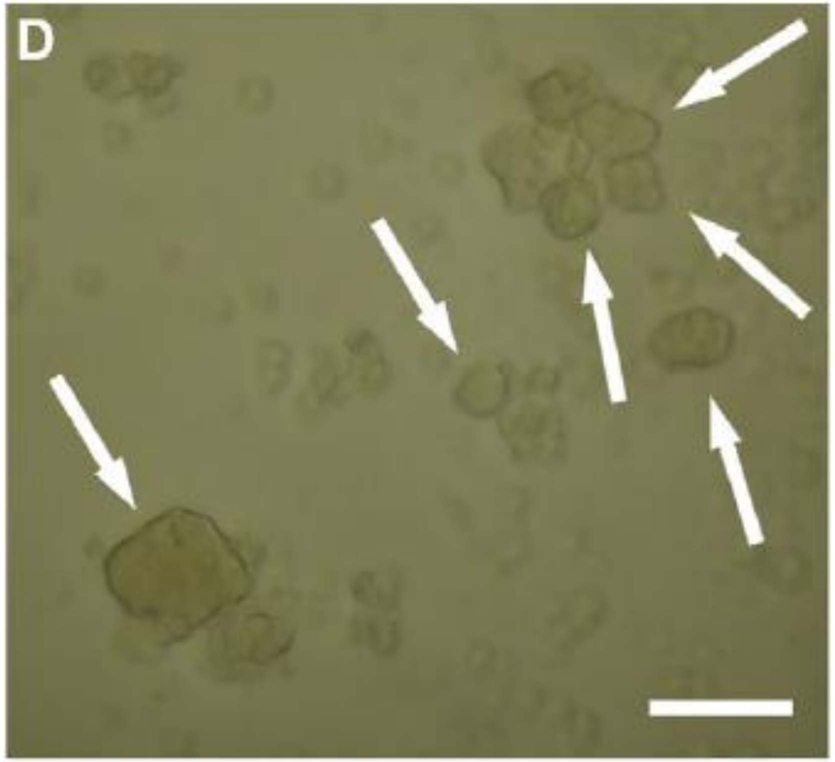


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Sporobolus rigens

Starch

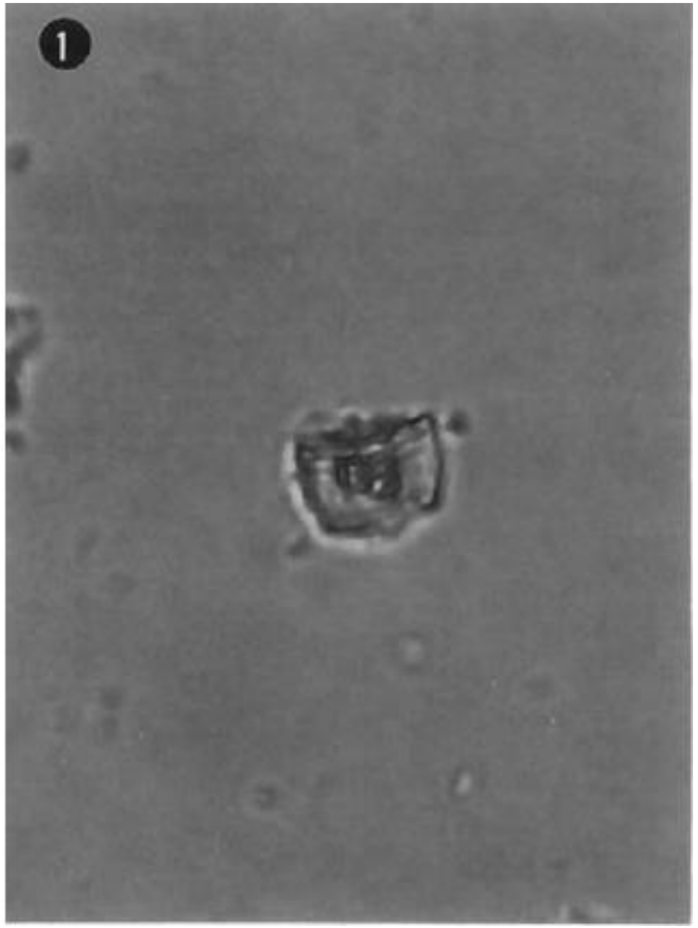
Fig. 3. Pampean native wild grasses from reference collection. D-E: Compound starch grains as discrete aggregates of class a. D: Sporobolus rigens. (Scale bars: 10 mm).



Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Stipa ichu

Phytolith



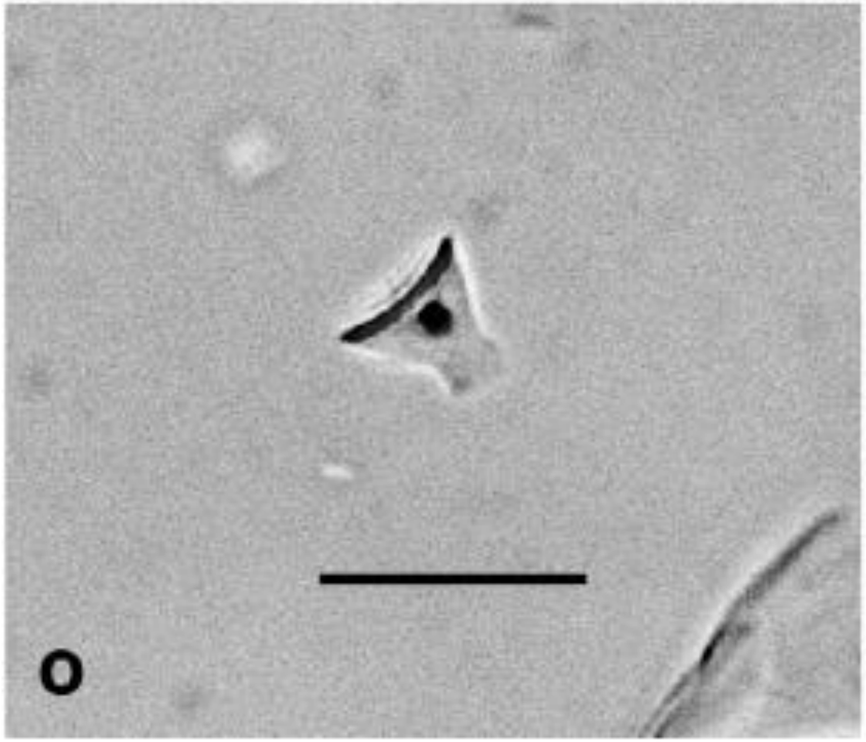
A rondel from Stipa ichu (400x)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Trachypogon spicatus

Phytolith

Fig. 4. Phytoliths from Poaceae. o) Spooled/horned towers from Trachypogon spicatus



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Tripsacum dactyloides

Starch

Starch grains from seeds of modern Tripsacum dactyloides. They have prominent radiating fissure 400x

APPENDIX:
Tripsacum dactyloides (Figure 8). Simple and compound grains, spherical, with one or more slight depressions. The hilum is large in relation to the size of the grain. The radiating fissures are very prominent. The double border is not conspicuous and often not continuous. Size 2–10 microns long.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Tripsacum lanceolatum

Phytolith

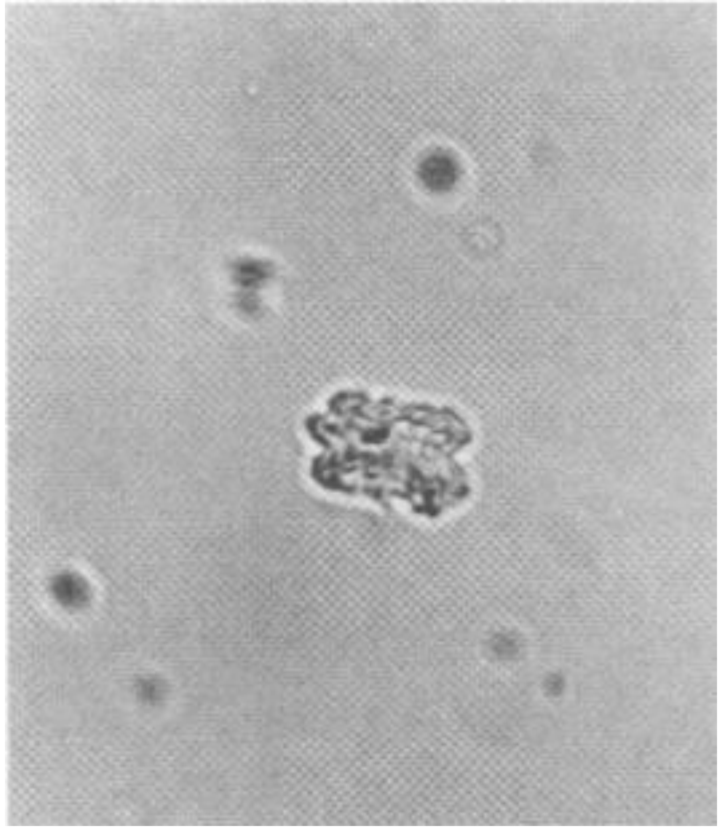


Fig. 7. A Tripsacum-specific fruitcase phytolith from T. lanceolatum. It has markedly serrated edges and possesses ridges on the top.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Tripsacum lanceolatum

Phytolith

FIGURES 69-72.-70, A genus-specific epidermal-cell phytolith from the fruitcase of Tripsacum lanceolatum (x400).

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Tripsacum sp.

Phytolith

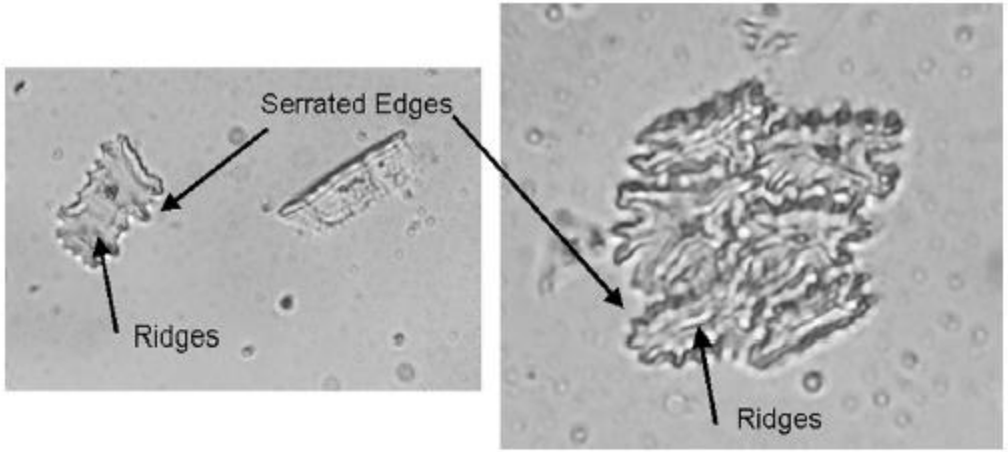


Fig. 4. Tripsacum fruitcase phytoliths. Unlike those of teosinte or maize, they have serrated edges and ridges across the top. Piperno 2006

Ball, T. B., K. Chandler-Ezell, R. Dickau, N. Duncan, T. C. Hart, J. Iriarte, C. Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. https://doi.org/10.1016/j.jas.2015.08.010.

Piperno, Dolores R. 2006. *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*. Oxford: Alta Mira Press.

Triticum sp.

Phytolith

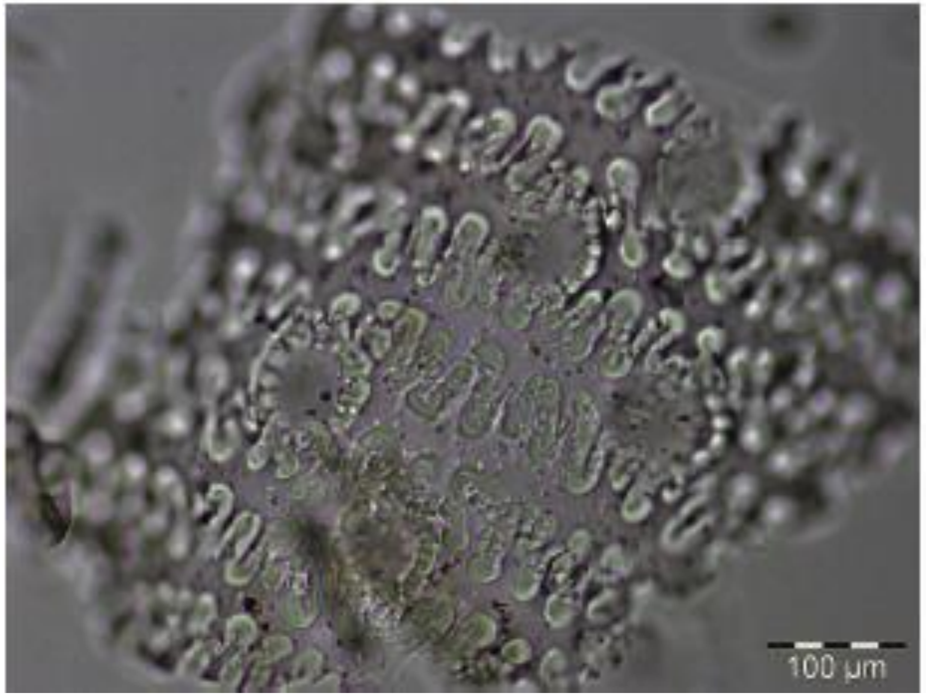


Fig. 9. An articulated aggregation of inflorescence bract phytoliths from Triticum aestivum showing the long cell wave patterns and papillae characteristic of Triticum sp. Photo by Arlene M. Rosen from modern plant phytolith reference collection at ICREA, University of Barcelona, courtesy of Rosa M. Albert

Ball, T. B., K. Chandler-Ezell, R. Dickau, N. Duncan, T. C. Hart, J. Iriarte, C. Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. https://doi.org/10.1016/j.jas.2015.08.010.

Triticum aestivum

Starch

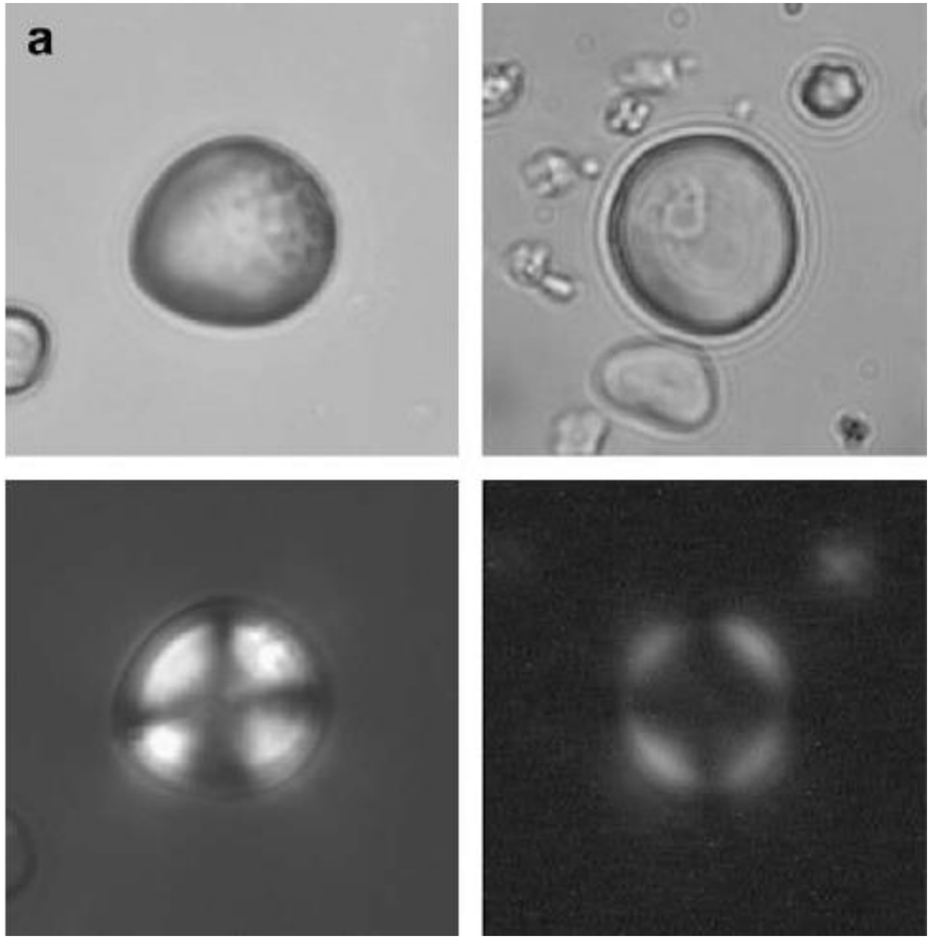


Fig. 1. Comparisons of raw and boiled starch grains showing damage to extinction crosses. (a) Wheat starch grains. Left side, raw wheat starch grain; right side, wheat starch grain boiled for 10 min. Notice there is very little change to the grain under regular light, but the extinction cross is much faded and with a very wide center. Each image is 50 mm wide.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Triticum aestivum

Starch

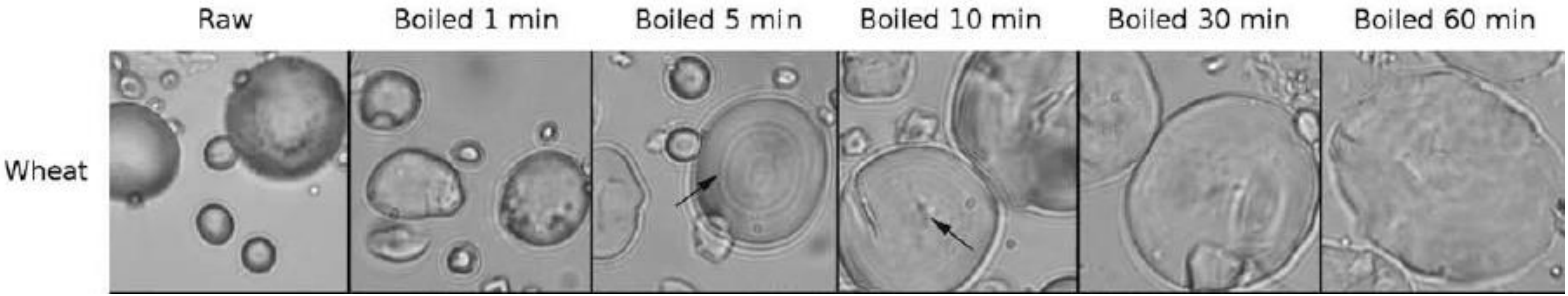


Fig. 2. Ten starch grain types shown raw, and from whole caryopses/pulses cooked for 1, 5, 10, 30 and 60 min. There were no visibly recognizable starch grains in whole oats boiled for 60 min, therefore there were no images included. Each individual image is 50 mm wide. See text for details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Triticum aestivum

Starch

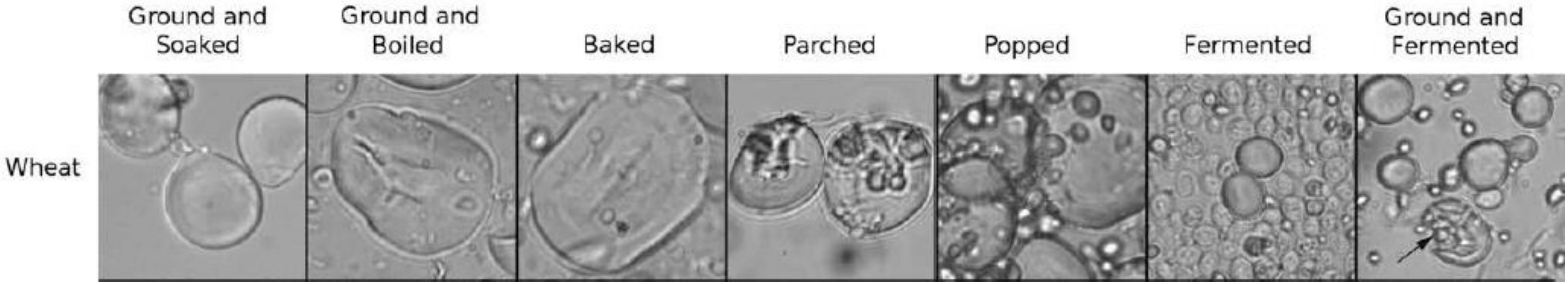


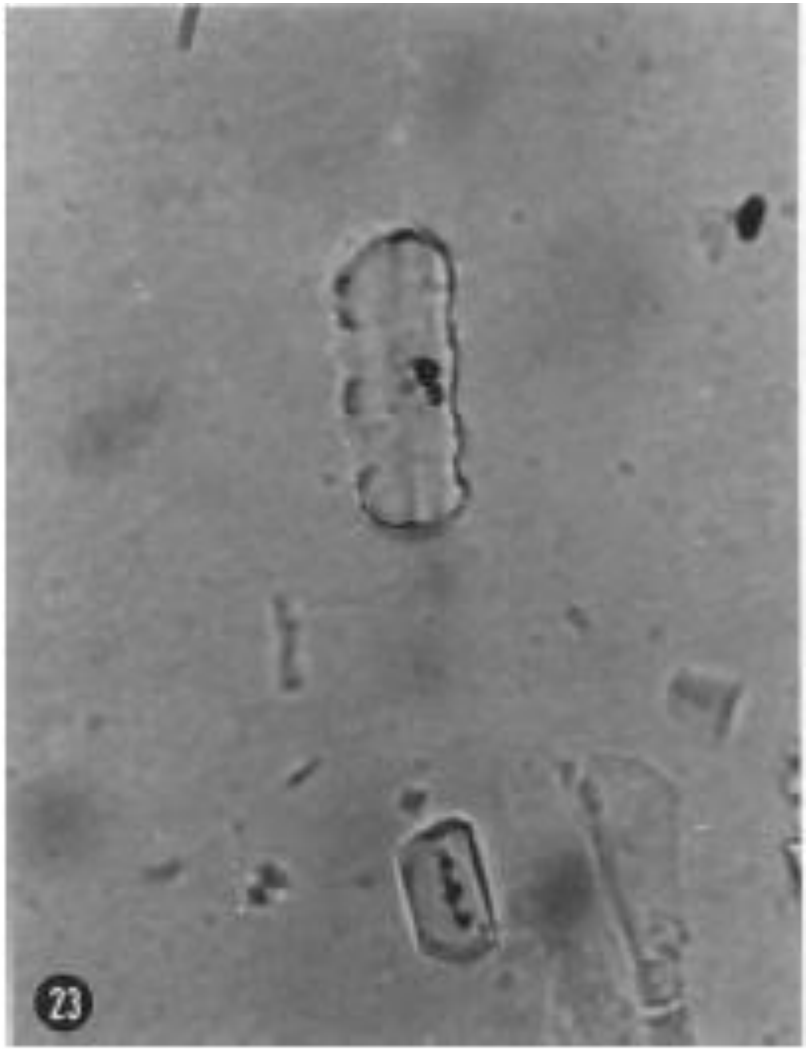
Fig. 3. Ten starch grain types shown ground and soaked, ground and boiled until gelatinized, baked, parched, popped, fermented and ground and fermented. The boiled ground images show the shortest time at which the starch grains have lost their defining characteristics, which varies from plant to plant. Wheat is shownat10 min,barleyat5 min, oats at1 min, millet at 1 min, sorghum at 1 min, rice at 10 min, lentils at 1 min, green peas at 1 min, chick peas at 10 min, mung beans at 1 min. None of the legumes were popped. The oats were steel-cut before purchase and were therefore unsuitable for popping. Only wheat, barley and chick peas were ground and fermented. Each individual image is 50 mm wide. See text for more details.

Henry, Amanda G., Holly F. Hudson, and Dolores R. Piperno. 2009. Changes in Starch Grain Morphologies from Cooking. *Journal of Archaeological Science* 36 (3). Elsevier Ltd:915–22. http://dx.doi.org/10.1016/j.jas.2008.11.008.

Triticum aestivum

Phytolith

FIGURES 21-24.- 23, Top, a long, wavy trapezoid from Triticum aestivum (x400).

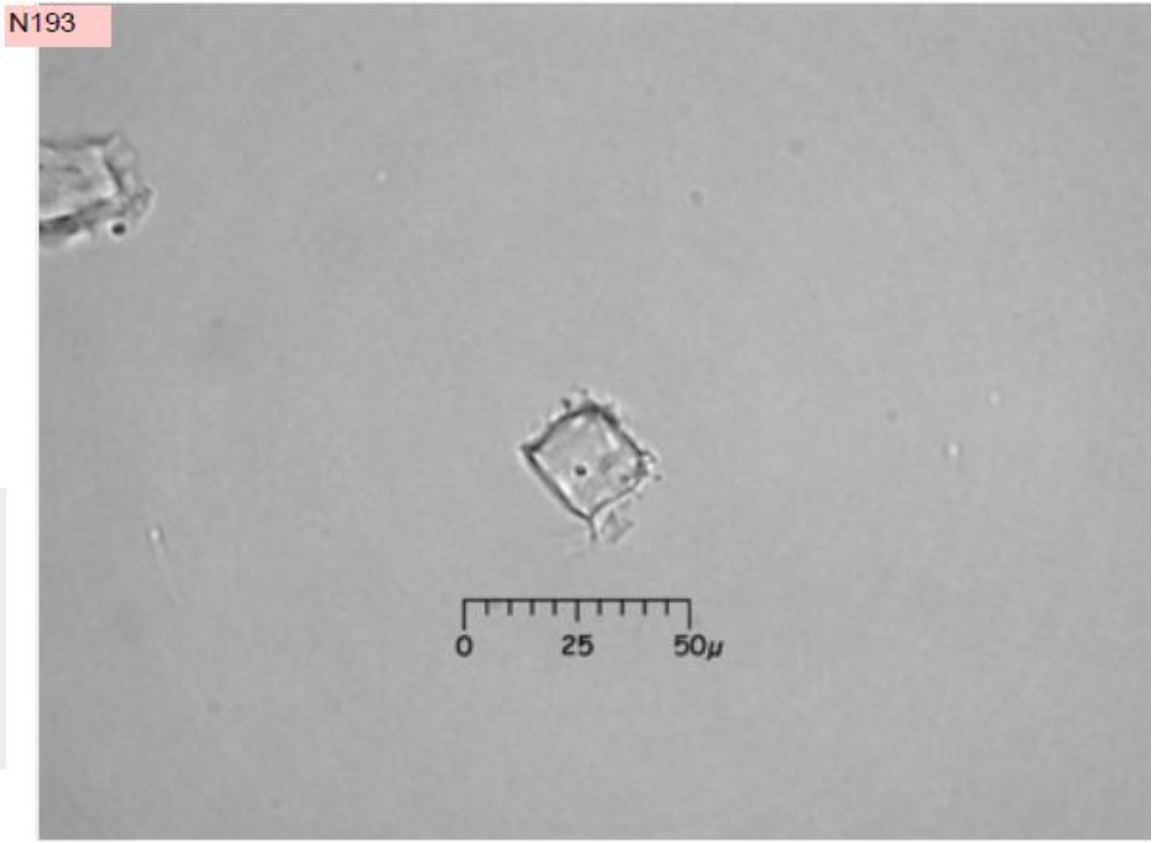


Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Zea luxuriens

Phytolith

Diagnostic level: genus
Half-decorated rondel. Found in high numbers in teosinte fruit cases, and in very low numbers in some types of maize. A good Zea indicator, and is especially characteristic of teosinte and primitive maize. The body illustrated shows very long speculate projections. See other illustration for range of variation.

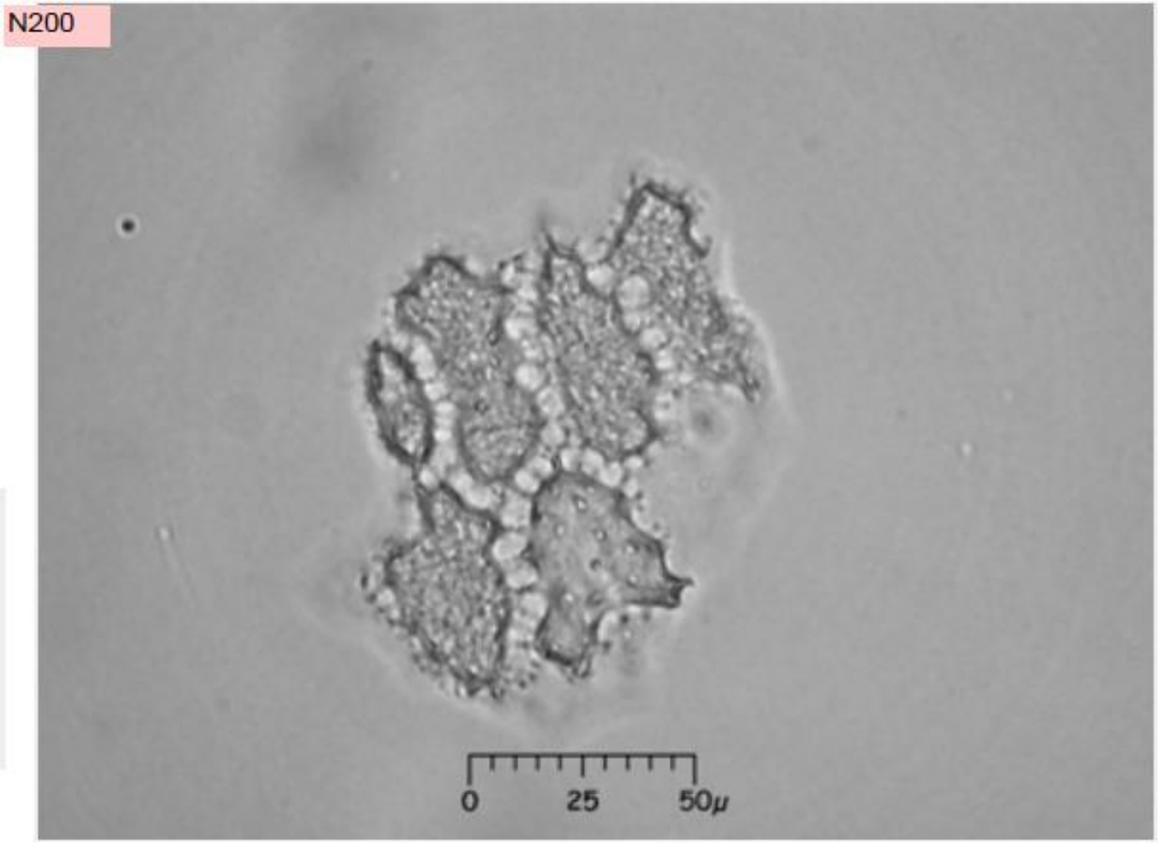


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea luxuriens

Phytolith

Sheet of robust globular bodies. Robust globular bodies occur in maize and teosinte only, and are good Zea spp. indicators.
Diagnostic level: genus

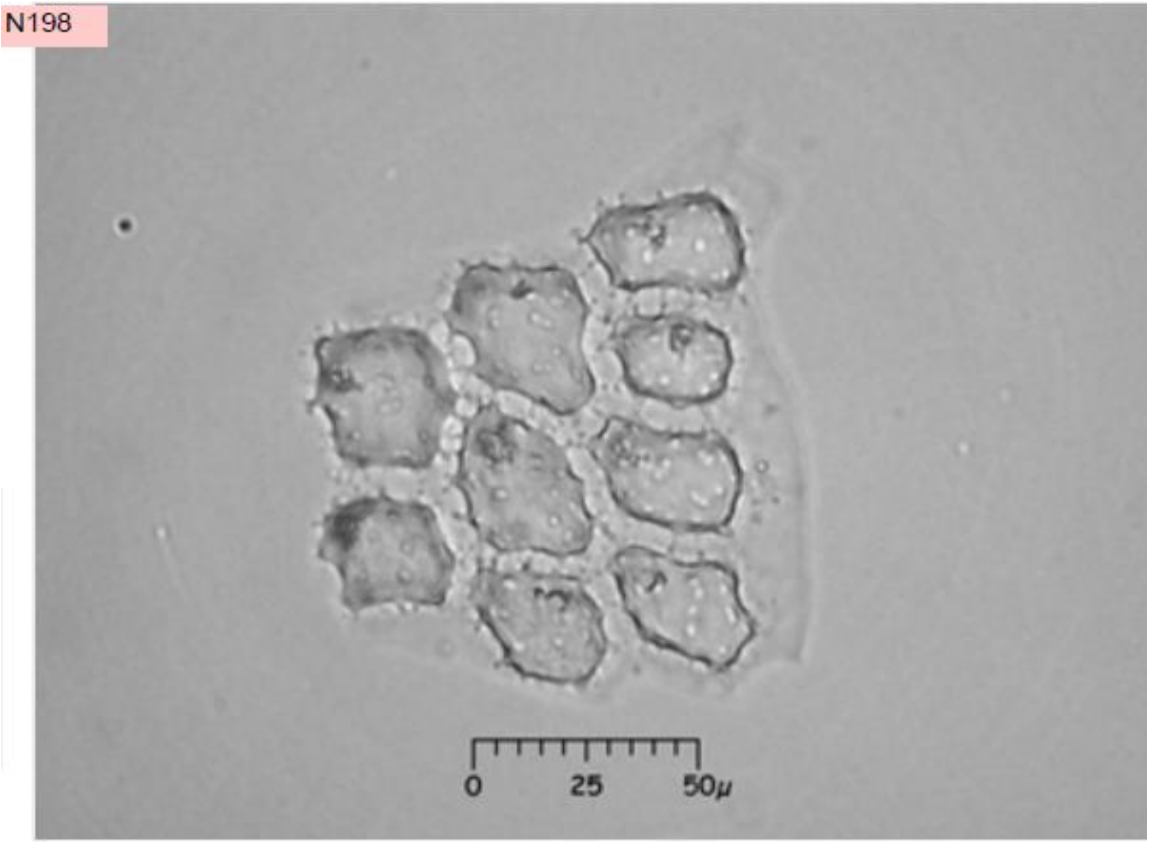


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea luxuriens

Phytolith

Diagnositic level: genus
Robust globular body.
Long sides are roughly parallel . Body may be two-dimensional and flattened, or more three-dimensional (i.e. thickness may vary considerably). Sides may be undulating, but may not be crenate.
Projections may be distributed regularly or irregularly, as long as they are along

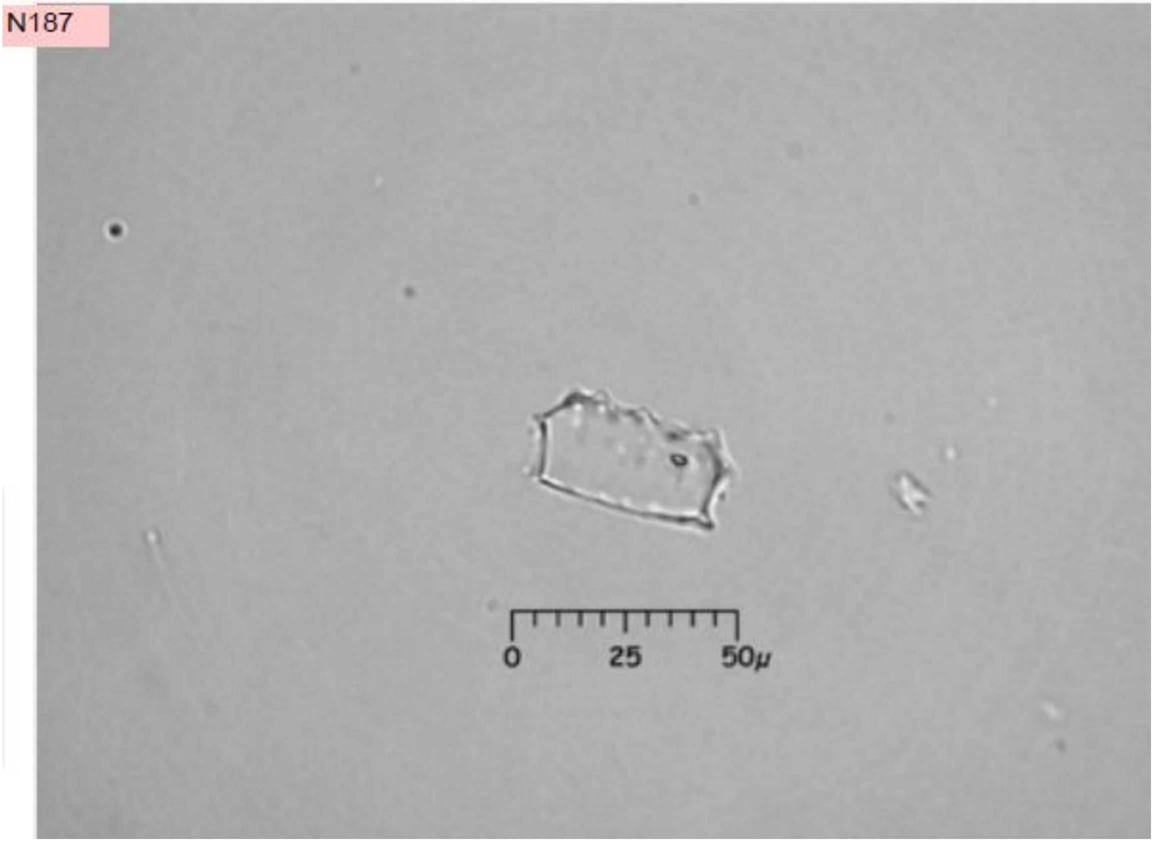


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea luxuriens

Phytolith

Half-decorated oblong body Differs from the 1/2 decorated rondel only in that their bases are blocky, square or rectangular, not a rondel. Often occur in dense sheets in teosinte.
Diagnostic level: genus

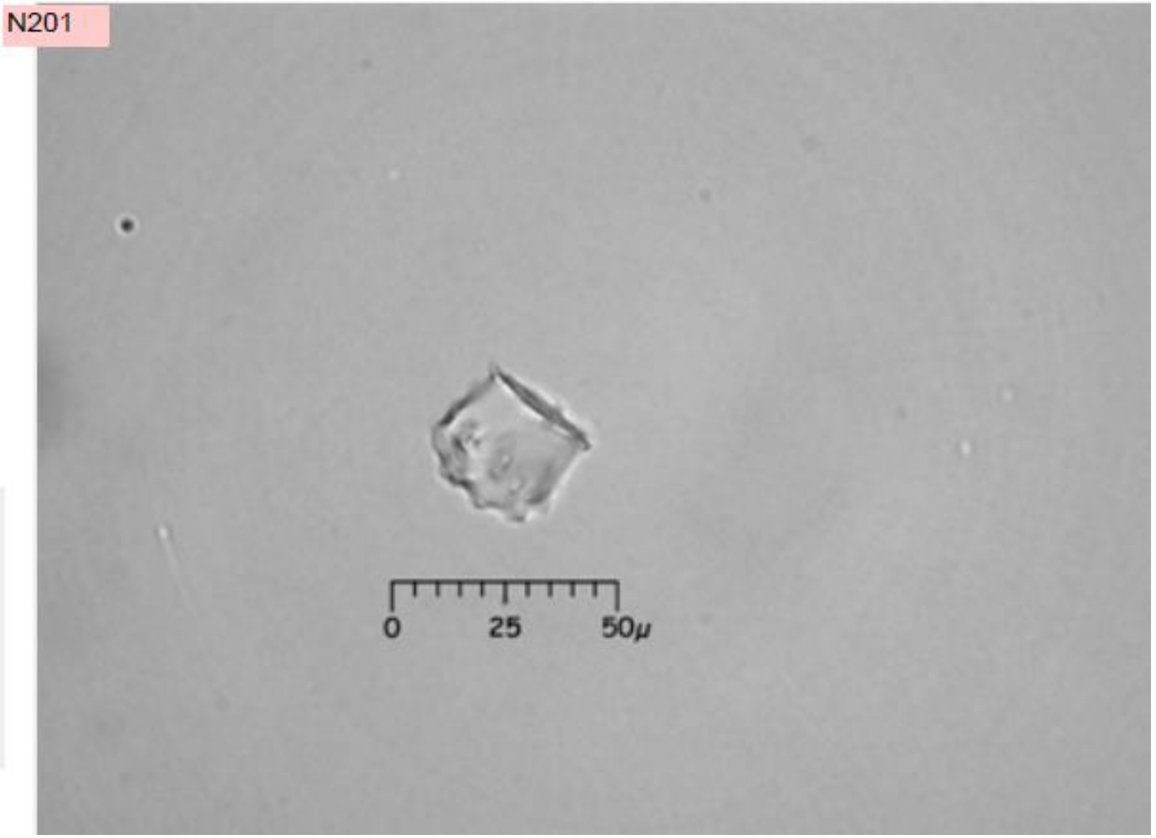


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea luxuriens

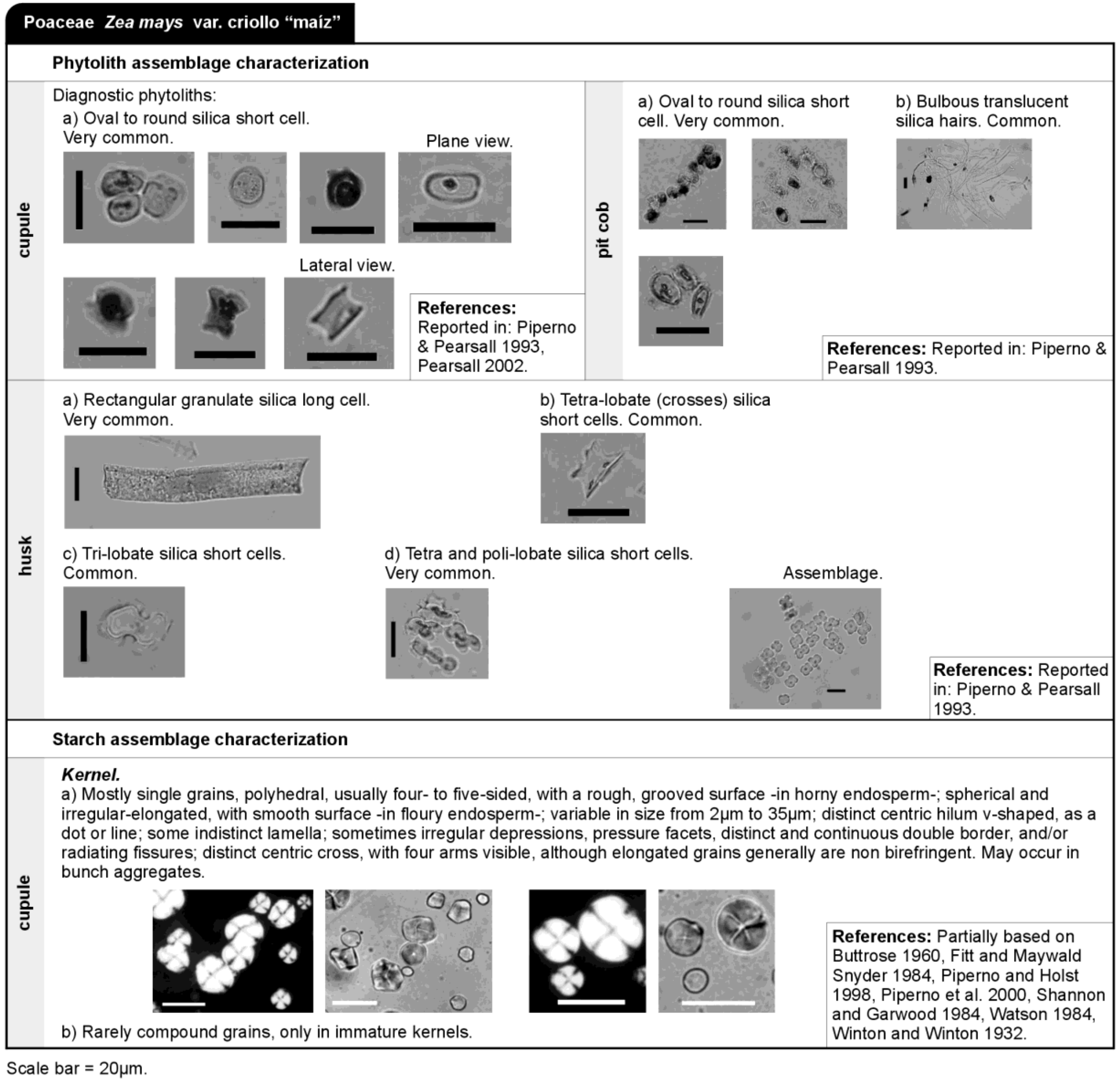
Phytolith

Diagnostic level: genus Half-decorated rondel
Found in high numbers in teosinte fruit cases, and in very low numbers in some types of maize.
This is a good Zea indicator, and is especially characteristic of teosinte and primitive maize.
The body illustrated here shows the beadlike projections. See other



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays



Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Zea mays

Starch

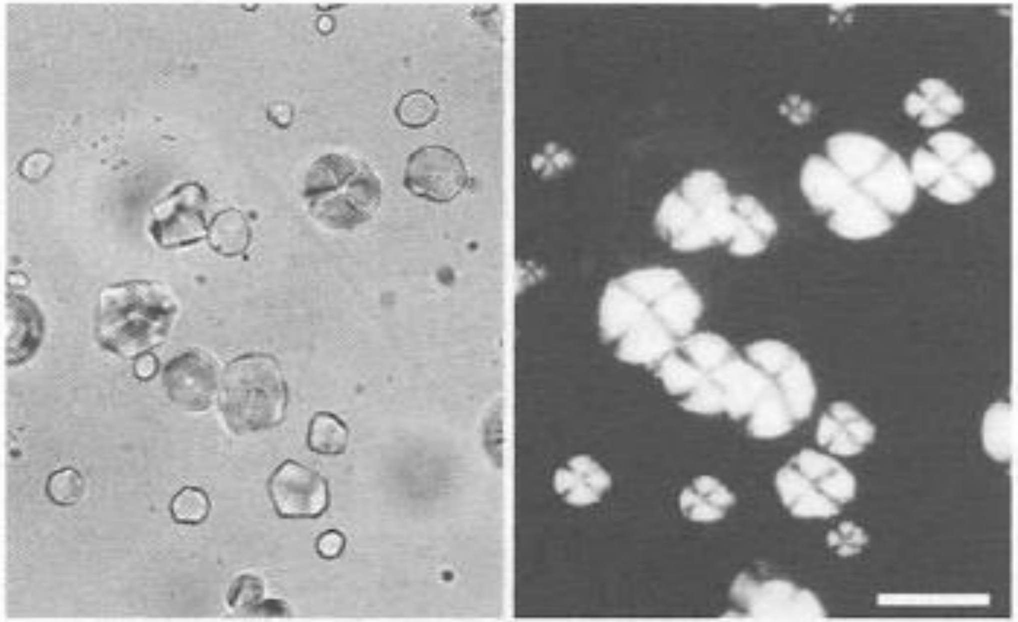


Figure 1. Maize non-processed starch grains. Views with normal (left) and polarised light (right). Scale bar = 20μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Zea mays

Starch

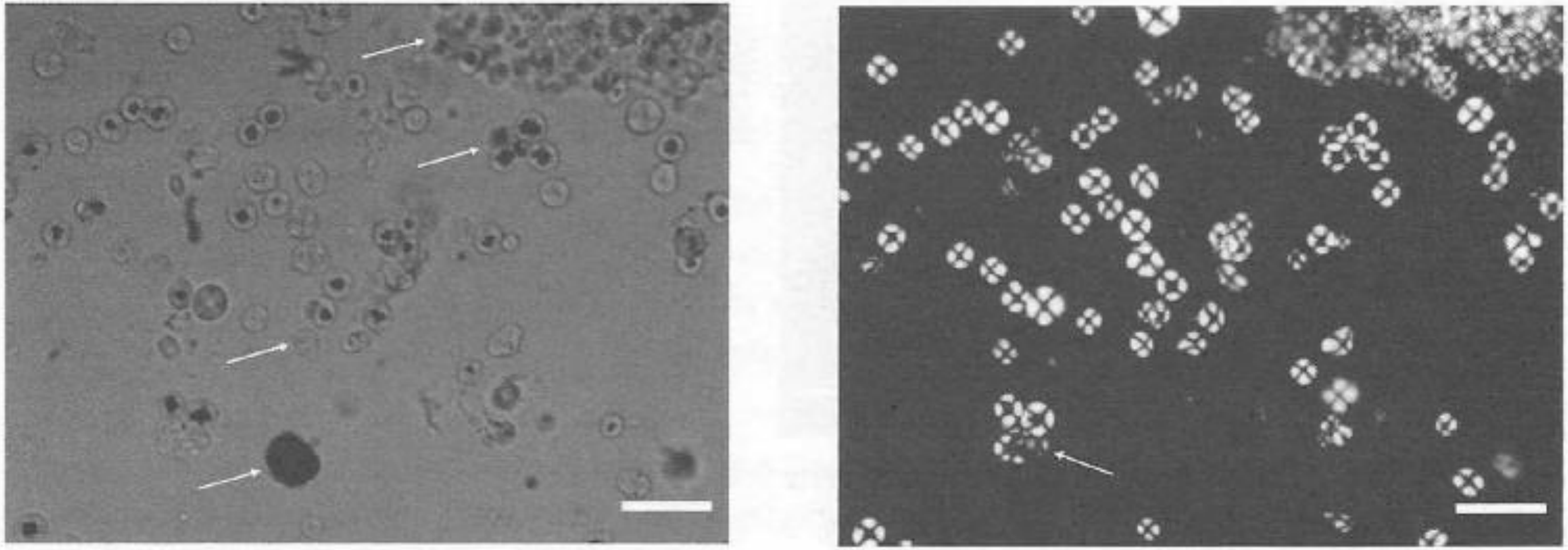


Figure 6. Starch of maize *tostado* showing roasting effects. (a) A charcoal particle, a very flat relief grain, clumps of gelatinised granules and grains with pronounced projections at the hilum are marked with arrows. View with normal light (left). (b) A starch grain with weak birefringence is marked with an arrow. View with polarised light (right). Scale bar = 40μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Zea mays

Starch

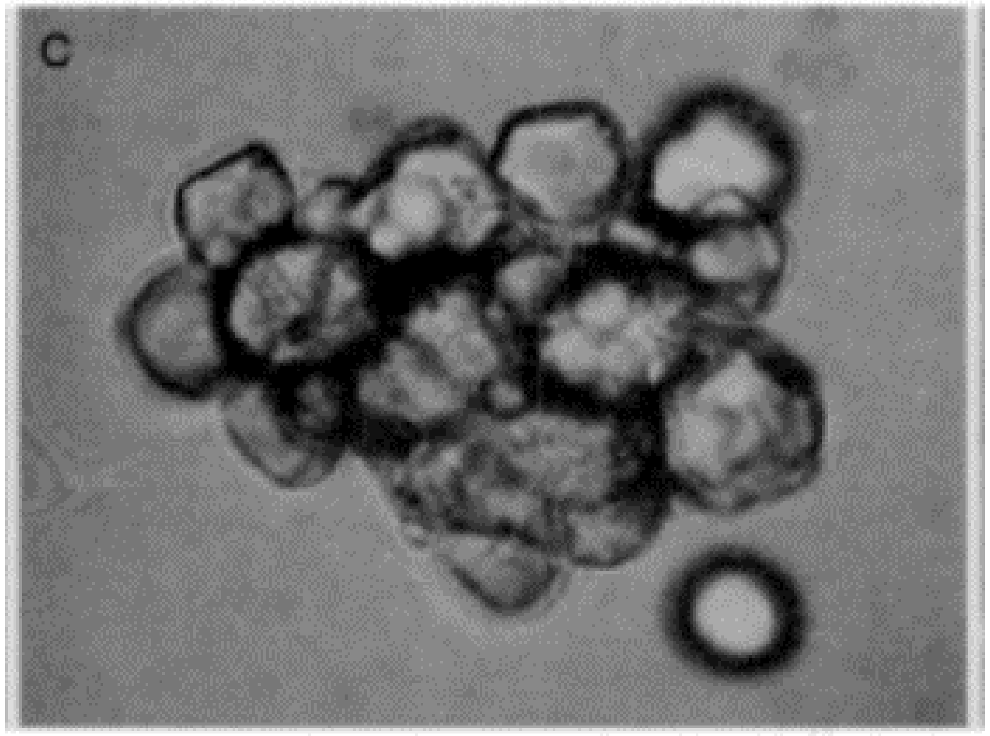


Figure 3. Light micrographs of archaeological starch granules representative of the recovered assemblage. c: Starch granule cluster of Zea mays recovered from flake 3

Perry, Linda. 2002. Starch Analyses Reveal Multiple Functions of quartz “manioc” Grater Flakes from the Orinoco Basin, Venezuela. *Interciencia* 27 (11):635–39.

Zea mays

Starch

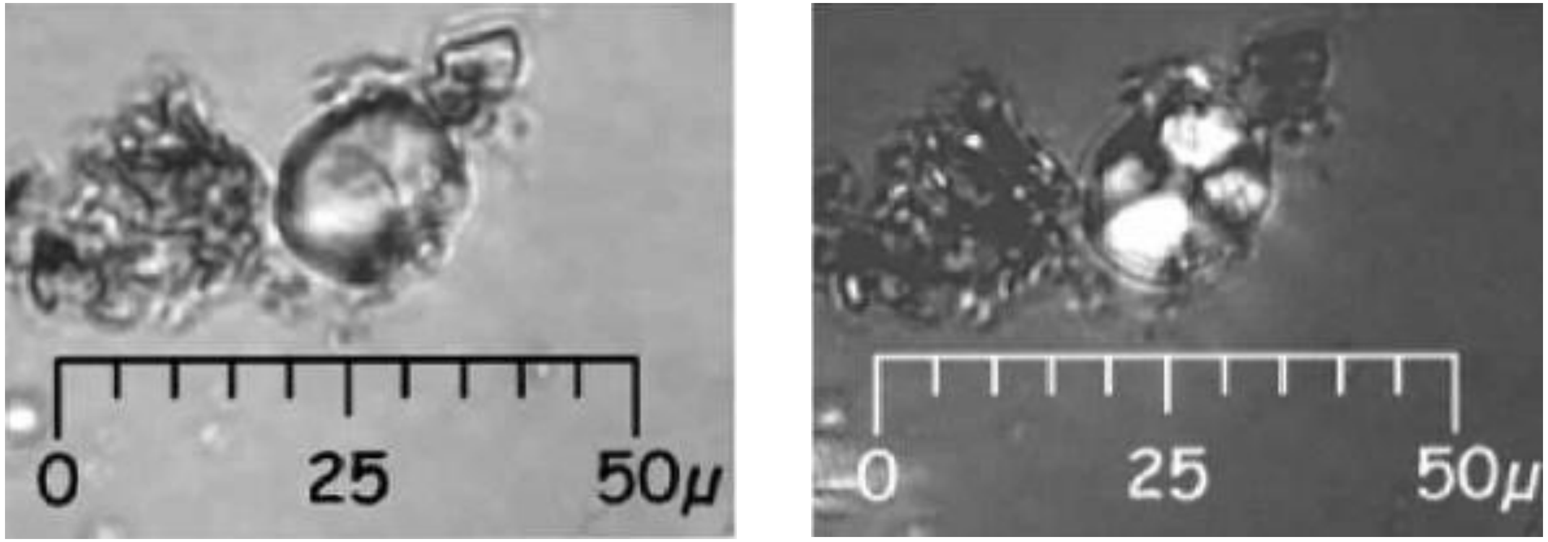
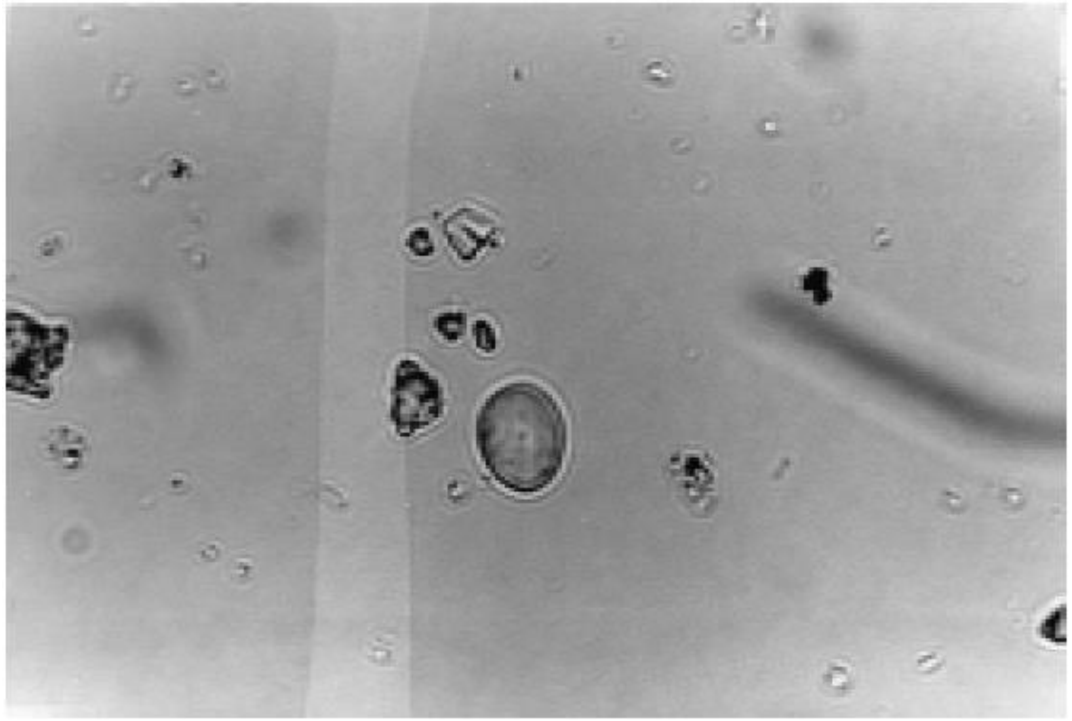


Figure 5. Example of maize starch grain on mano from Chiripa Quispe (Locus 3132), in transmitted (left) and polarized (right) light.

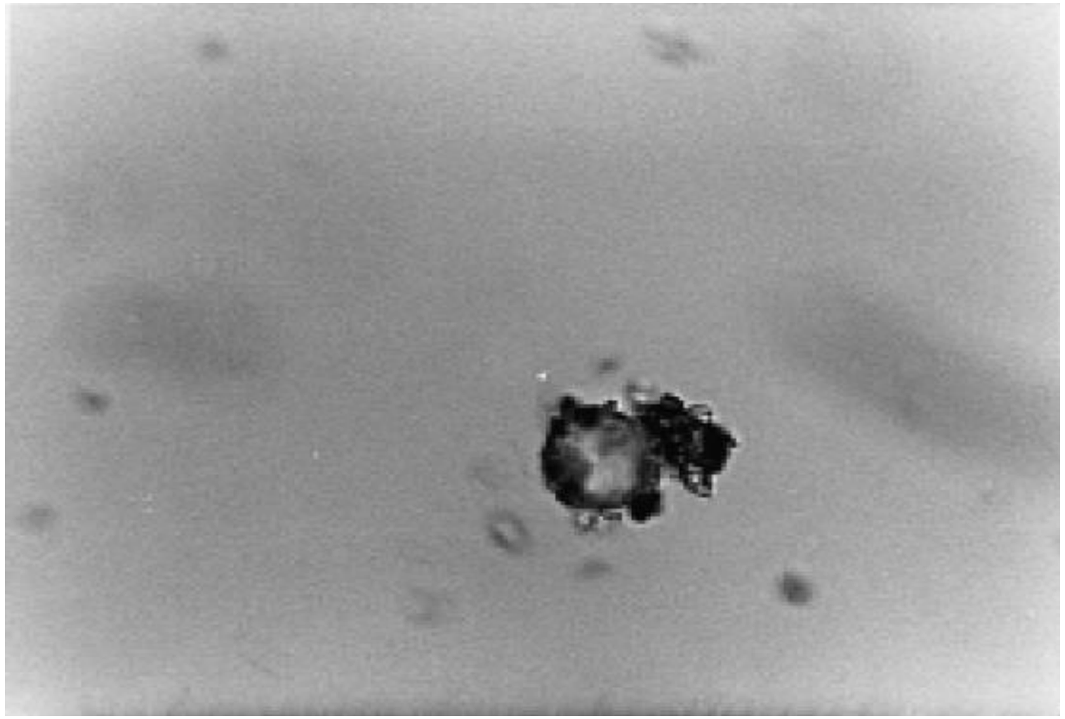
Logan, Amanda L., Christine A. Hastorf, and Deborah Marie Pearsall. 2012. "Let's Drink Together": Early Ceremonial Use of Maize in the Titicaca Basin. *Latin American Antiquity* 23 (3):235–58.

Zea mays

Starch



A maize starch grain from La Mula. 160x. The grain measures 12 microns by 10 microns.



A maize starch grain from the Aguadulce shelter. 160x. The grain measures 14 microns by 14 microns.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Zea mays

Starch

APPENDIX:
Zea mays (maize) (Figures 9 and 10). Simple and compound grains, spherical, or with irregular depres- sions and pressure facets. The grains often have a distinct and continuous double border and radiating fissures. Deep, central fissures may be present. Size: 6–14 microns long (Race Pepetilla), 4–18 microns long (Argentine popcorn), 4–14 microns long (modern cobs from Panama).

Zea mays ssp. parviglumis (teosinte). Simple and compound grains, spherical to bell-shaped, with slight depressions or pressure facets. Double border is indis- tinct and discontinuous, and radiating fissures are not as defined as in other grasses. The hilum is central and the central fissures are deep and distinct. Size: 4–14 microns long

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Zea mays

Starch

Fig. 5. Selected microbotanical remains. Starch grains: a) Zea mays (SAL 06-10-1642)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Zea mays

Starch

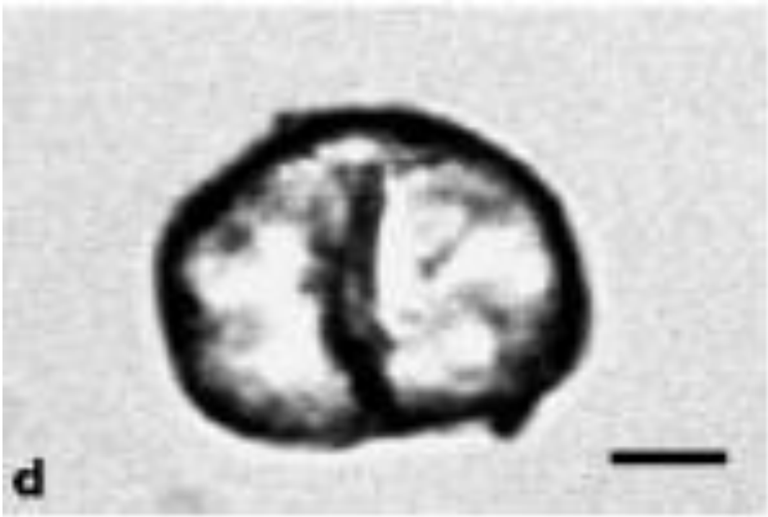


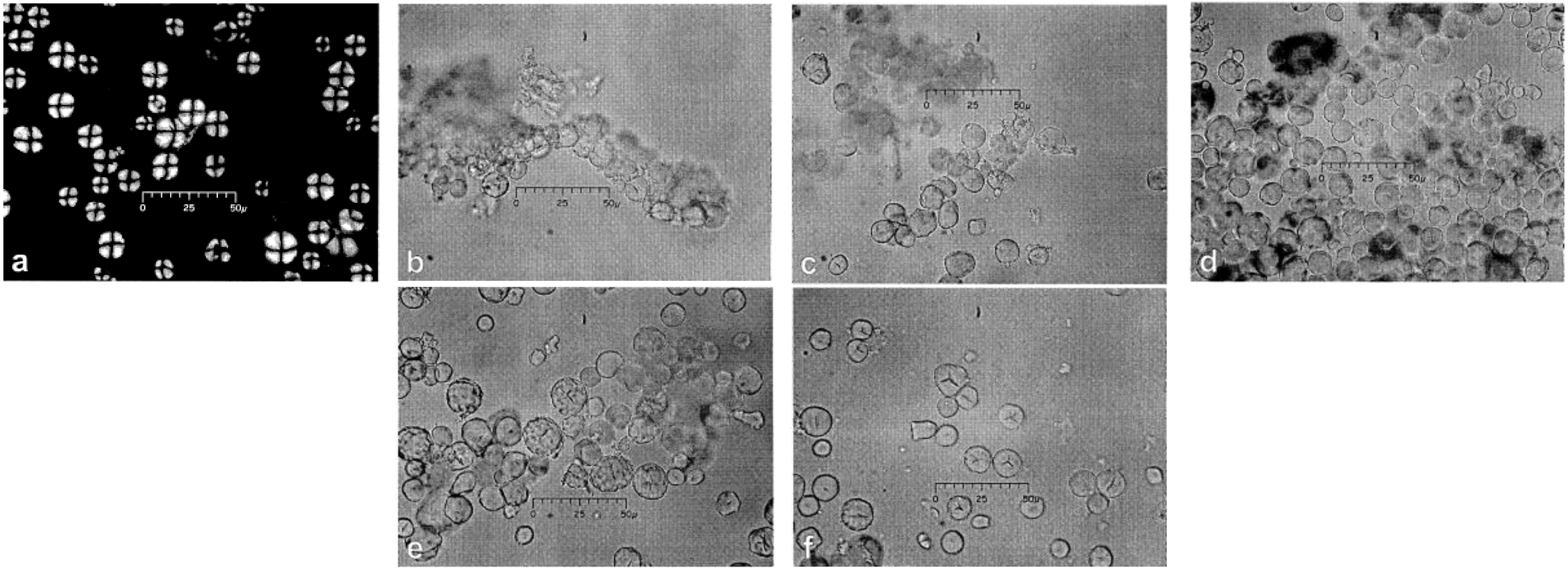
Figure 1. Various starch grains. d, A starch grain from maize from milling stone 42. This type is unique to maize and is found in Race Jala from Mexico. Scale 5 µm.

Piperno, Dolores R., Anthony J. Ranere, Irene Holst, and Patricia Hansell. 2000. Starch Grains Reveal Early Root Crop Horticulture in the Panamanian Tropical Forest. *Nature* 407:894–97.

Zea mays

Starch

Fig. 5. Comparative maize starch, a: polarized light view of Peruvian sweet corn; b: Reventador popcorn; c: Chapalote flint corn; d: Guatemalan red flour corn; e: Cuzco flour corn; f: Peruvian sweet corn.

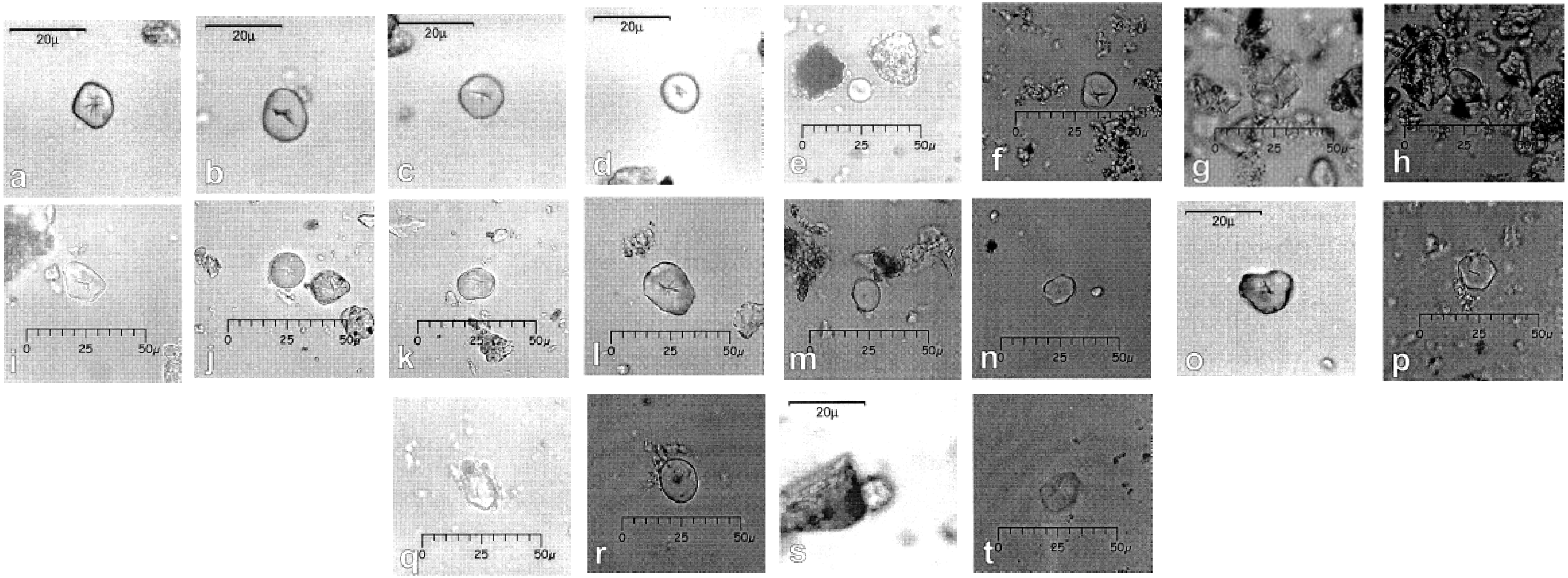


Pearsall, Deborah Marie, Karol Chandler-Ezell, and James A. Zeidler. 2004. Maize in Ancient Ecuador: Results of Residue Analysis of Stone Tools from the Real Alto Site. *Journal of Archaeological Science* 31:423–42.

Zea mays

Starch

Fig. 7. Archaeological maize starch, a, b, c, d, from 3290-A; e: 3290-B; f: 3293-A, g: 3293-B, h: 3294-A; i, j, k: 3294-B;1, m, n: 3331-A; o: 3383-A, p: 3383-B, q: 3386; r: 3415-A, s: 3415-B, t: 3417-A.

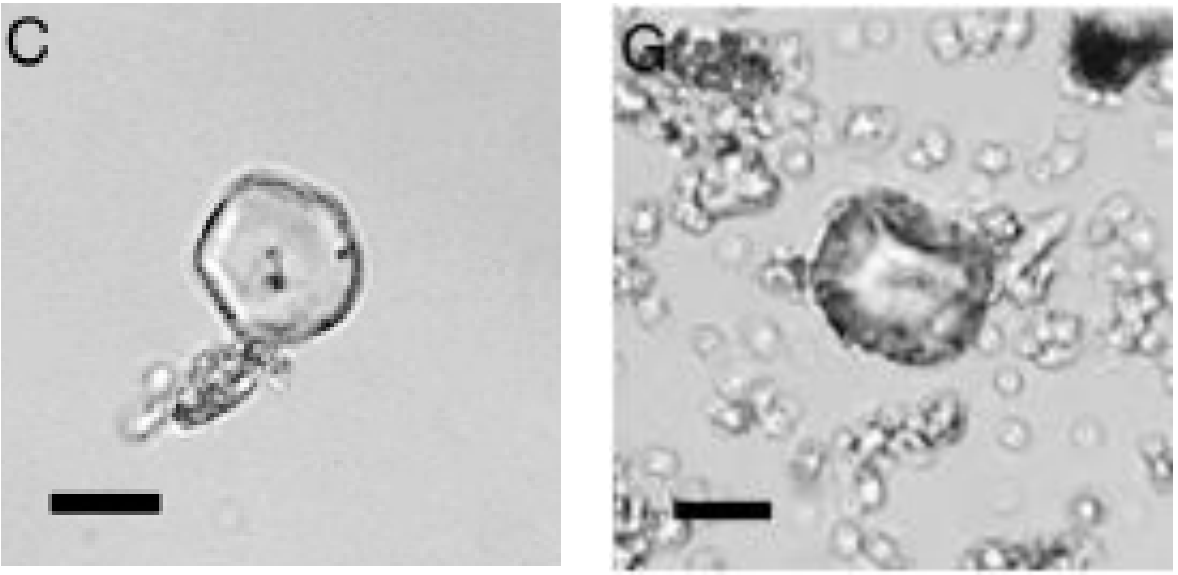


Pearsall, Deborah Marie, Karol Chandler-Ezell, and James A. Zeidler. 2004. Maize in Ancient Ecuador: Results of Residue Analysis of Stone Tools from the Real Alto Site. *Journal of Archaeological Science* 31:423–42.

Zea mays

Starch

Fig. 2. Selected archaeological starch grains. (C) Maize (Z. mays) starch from Hornito, wedge 77-1, ?7000 cal BP. (G) Maize starch from Ladrones, triangular grinding stone CL-82b,?7800 cal BP. Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8.



Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Zea mays

Starch

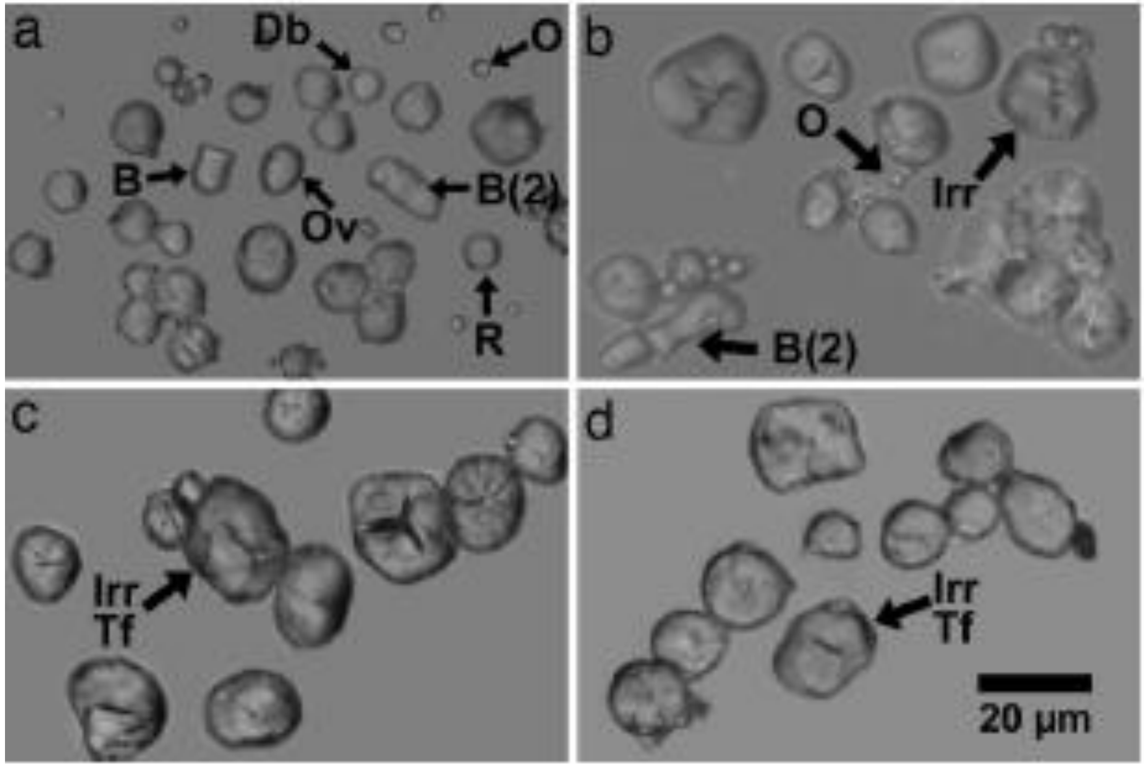
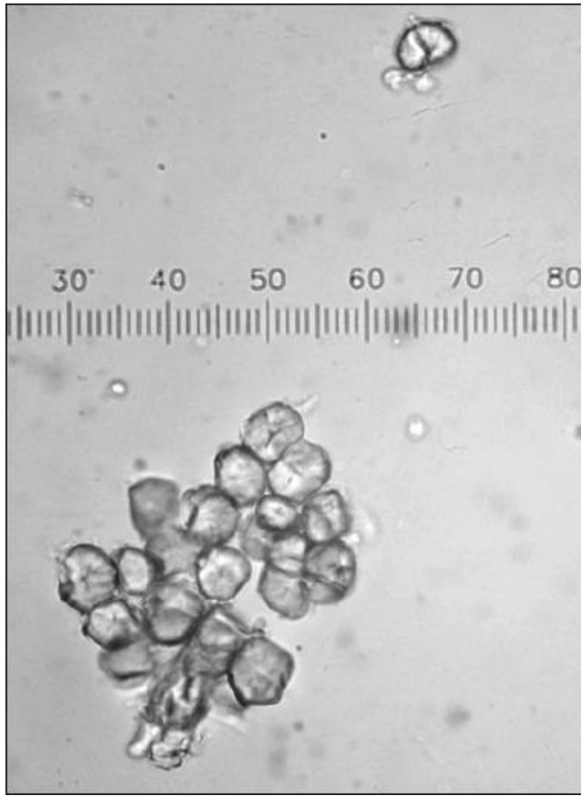


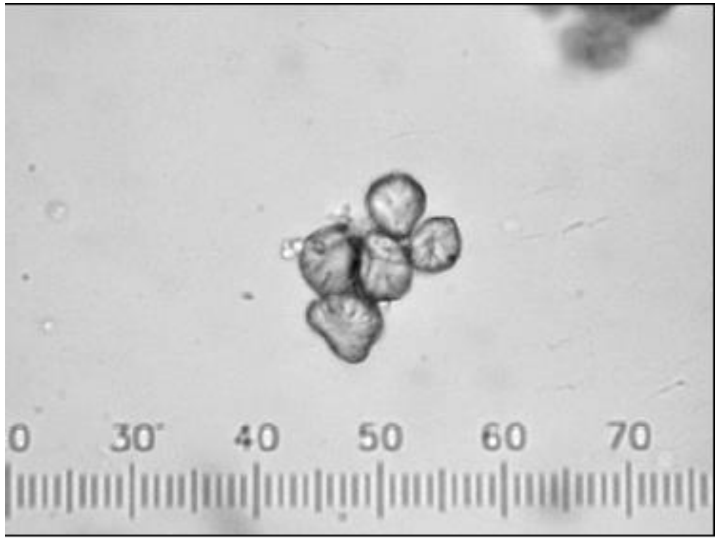
Fig. 1. Starch grains from teosinte and maize. (a) Starch grains from Zea mays ssp. parviglumis. It can be seen that in contrast to maize (c and d) the majority of grains are oval to round, not irregular, and bell-shaped grains are present. The tiny spheres are oil droplets. Letters next to grains indicate the following: B, bell-shaped; Db, with a double border on the edge; Ov, oval in shape; B (2), two bell-shaped grains joined together as they were formed in the amyloplast; R, round in shape; o, oil droplet. Most of the oil droplets that occurred with the starch grains were not included in the figure. (b) Starch grains from Zea mays ssp. mexicana (Chalco teosinte). This race of teosinte has a greater proportion of grains that are more like those in maize, but differ- ences are still apparent in morphology when compared with maize. Irr, irregular in shape.Mostof the oil droplets that occurred with the starch grains were not included in the figure. (c) Starch grains from the maize race Reven- tador. As is typical of maize, many grains are irregular, and oval, round, and bell-shaped grains are absent or nearly so. In this race, many grains also have transverse fissures. Irr, irregular in shape; Tf, transverse fissure. (d) Starch grains from the maize race Bolita

Holst, Irene, J Enrique Moreno, and Dolores R. Piperno. 2007. Identification of Teosinte, Maize, and Tripsacum in Mesoamerica by Using Pollen, Starch Grains, and Phytoliths. *Proceedings of the National Academy of Sciences of the United States of America* 104 (45):17608–13. http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2077075&tool=pmcentrez&rendertype=abstract.

Zea mays

Starch

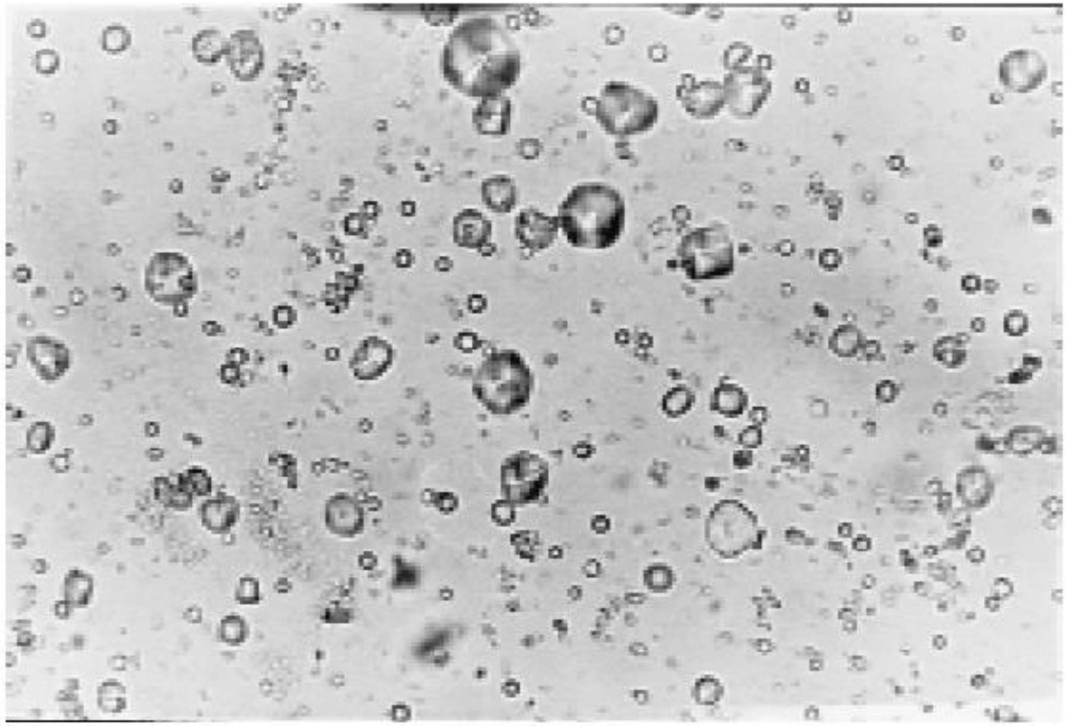




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, Race Argentine popcorn

Starch

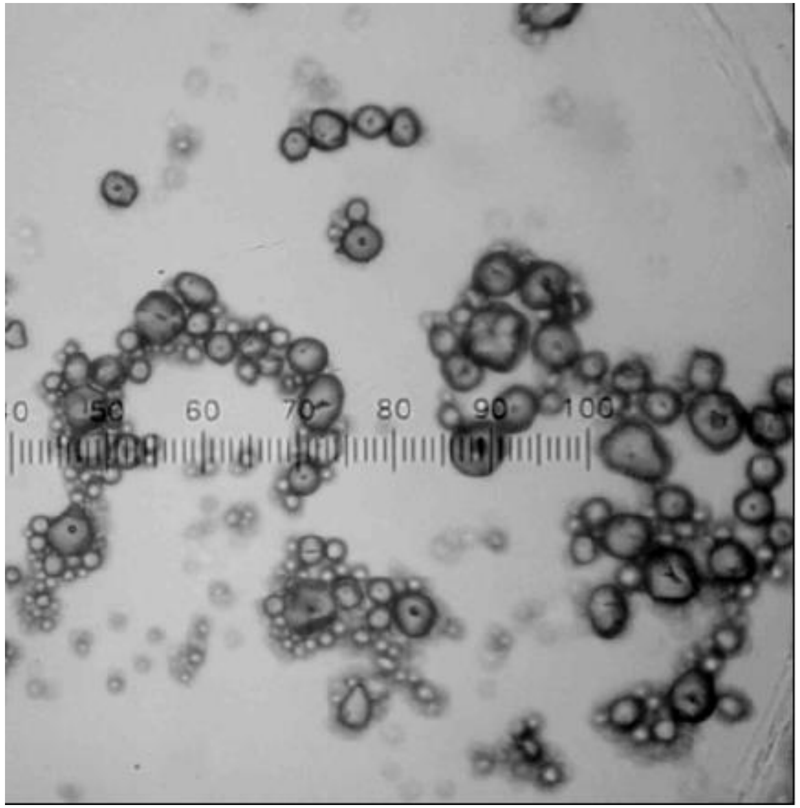


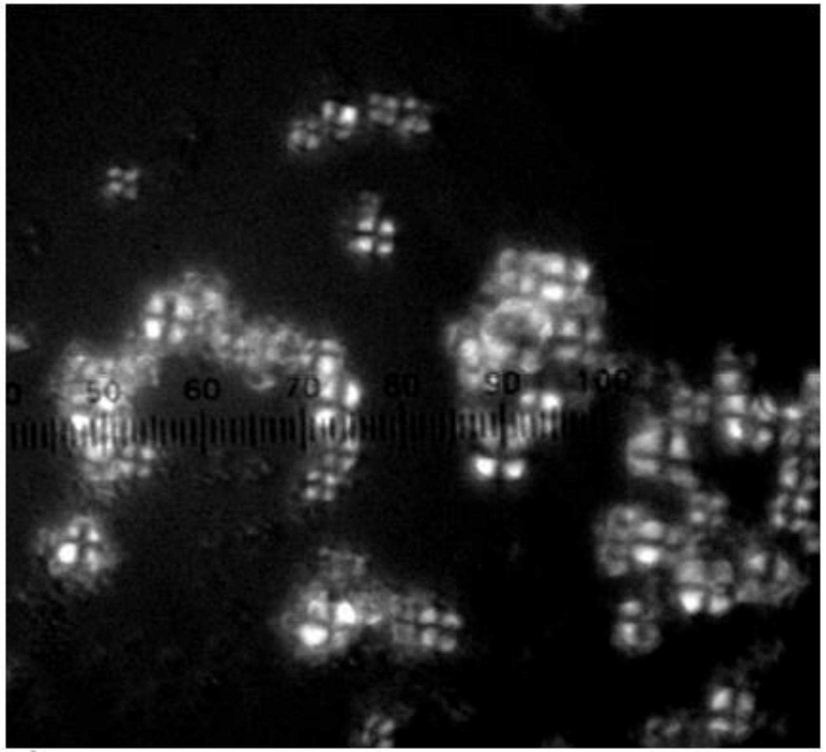
Starch grains from maize kernels, Race Argentine popcorn. 80x

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Zea mays, raza Cateto cristalino

Starch

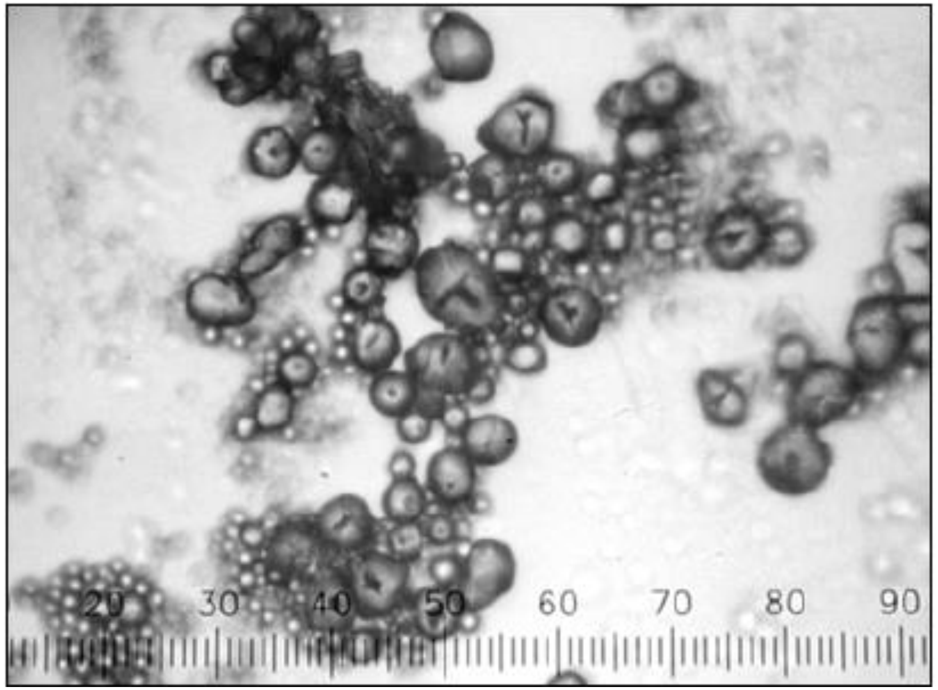


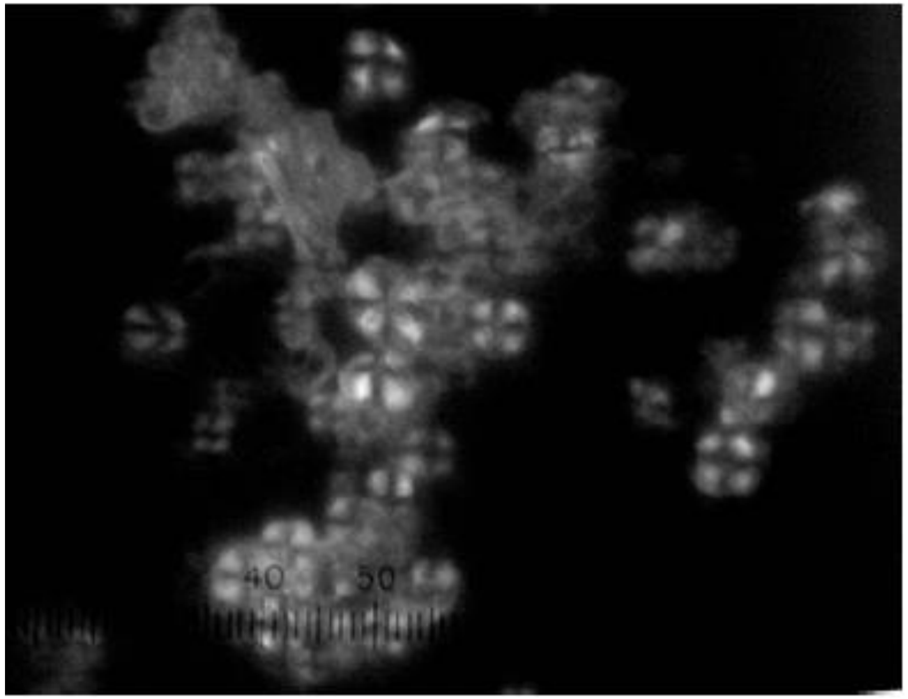


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, raza Caribe temprano (Early Caribbean)

Starch

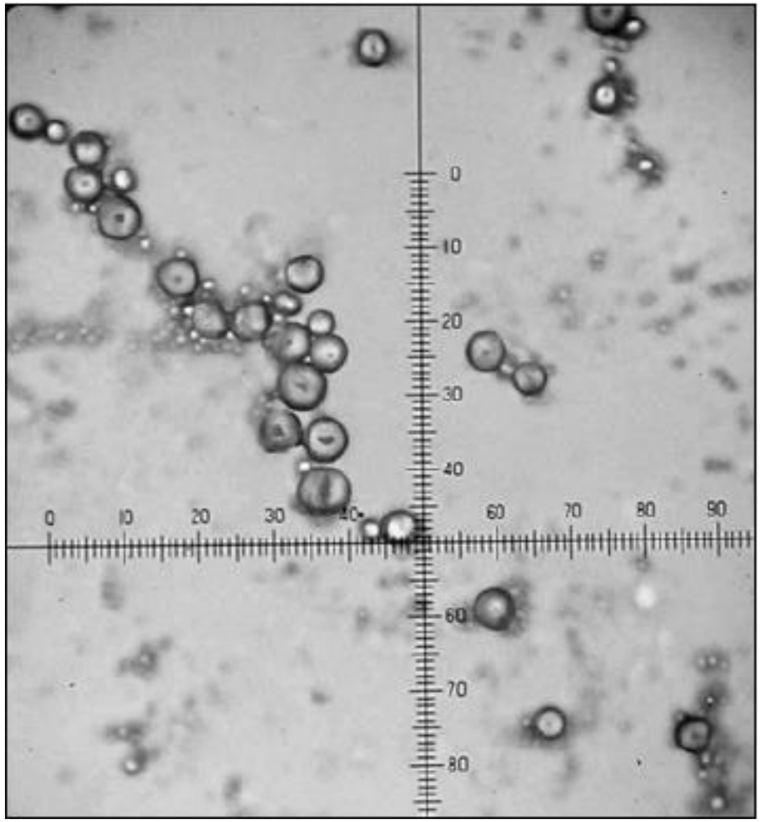




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, raza Chandelle (Canilla en Cuba y Venezuela)

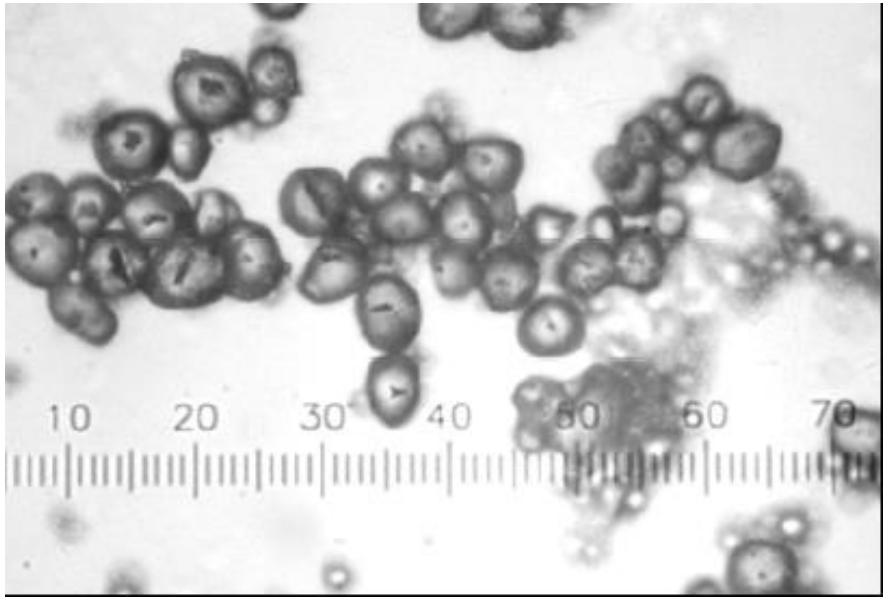
Starch

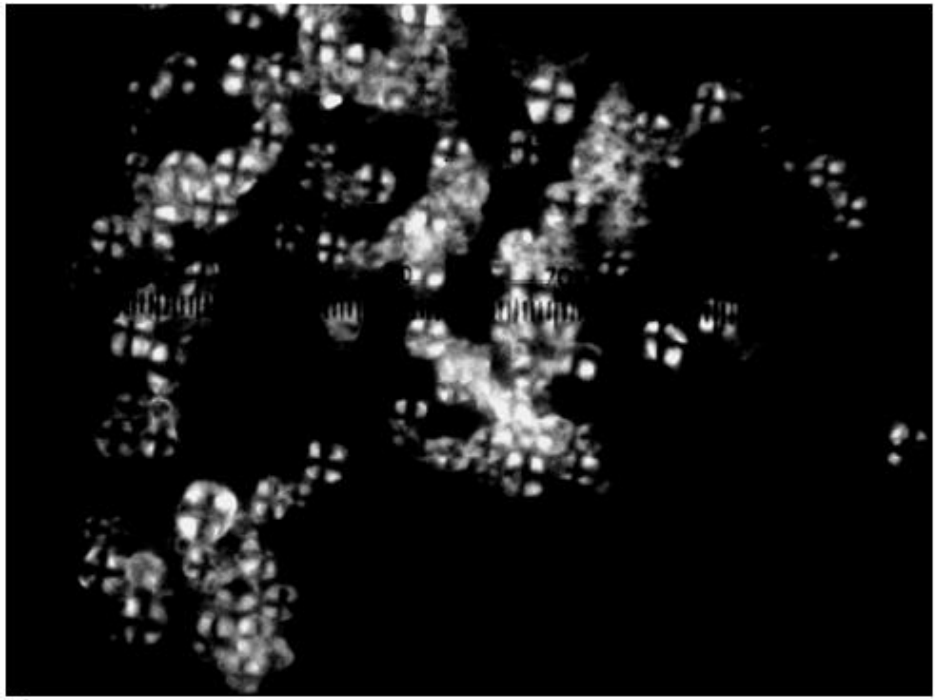


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, raza Negrito de Colombia

Starch

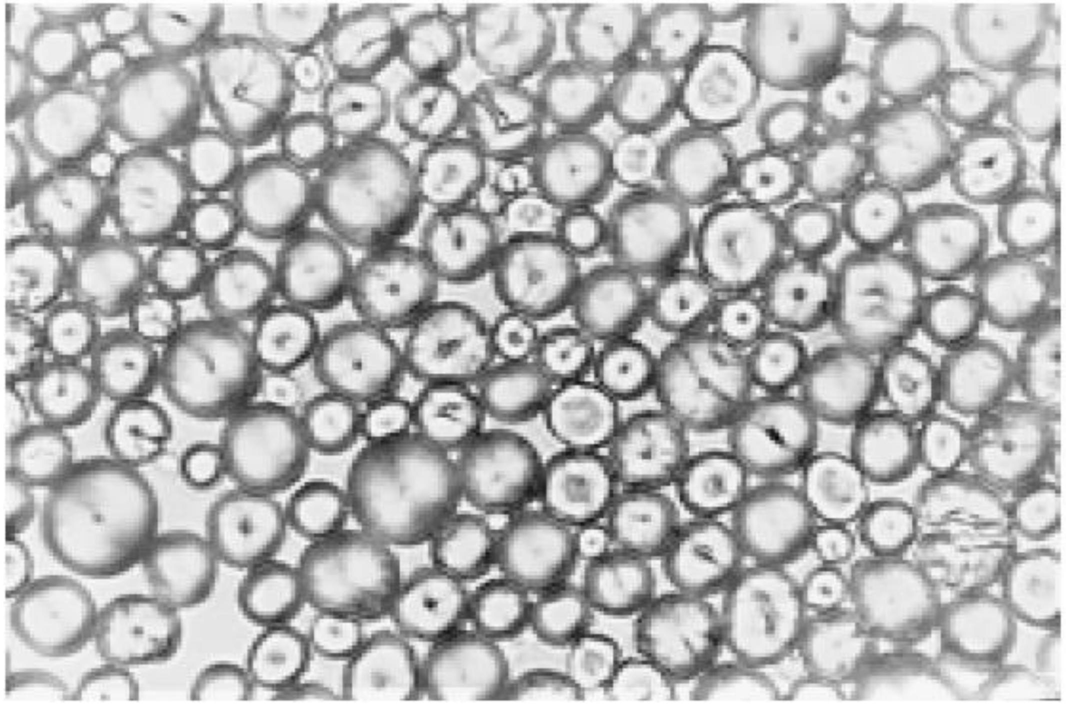




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, Race Pepetilla

Starch

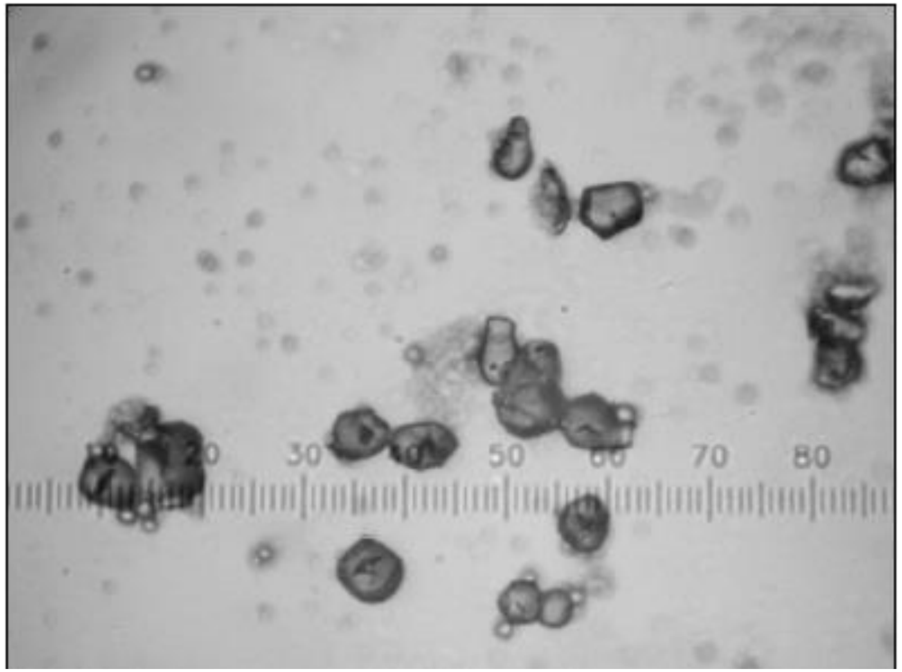


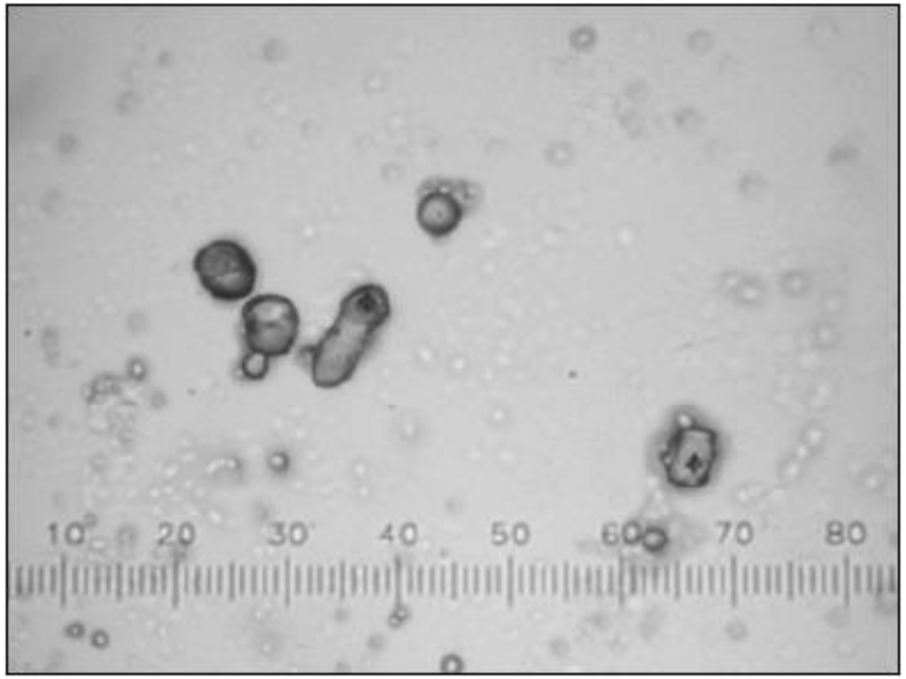
Starch grains from maize kernels, Race Pepetilla. 160x

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Zea mays, raza Pollo

Starch

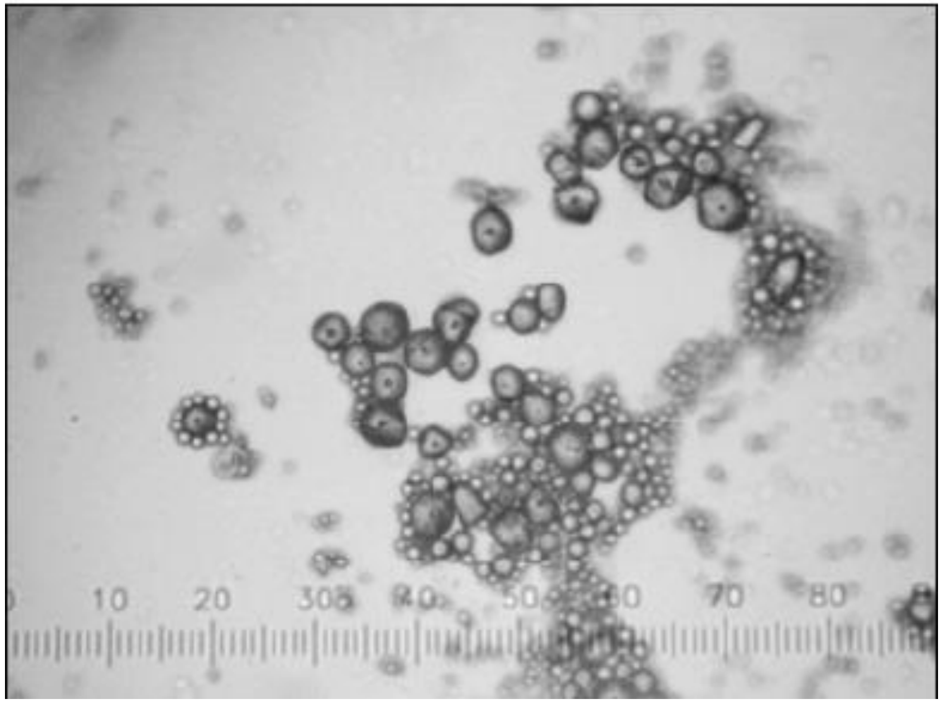


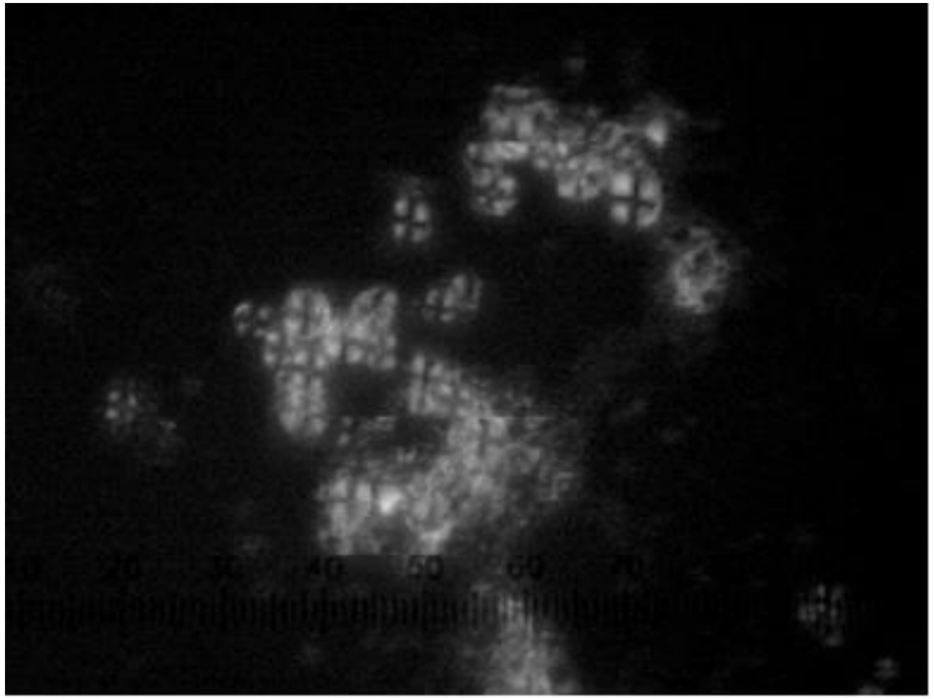


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays, raza Tusón (Tuśon)

Starch



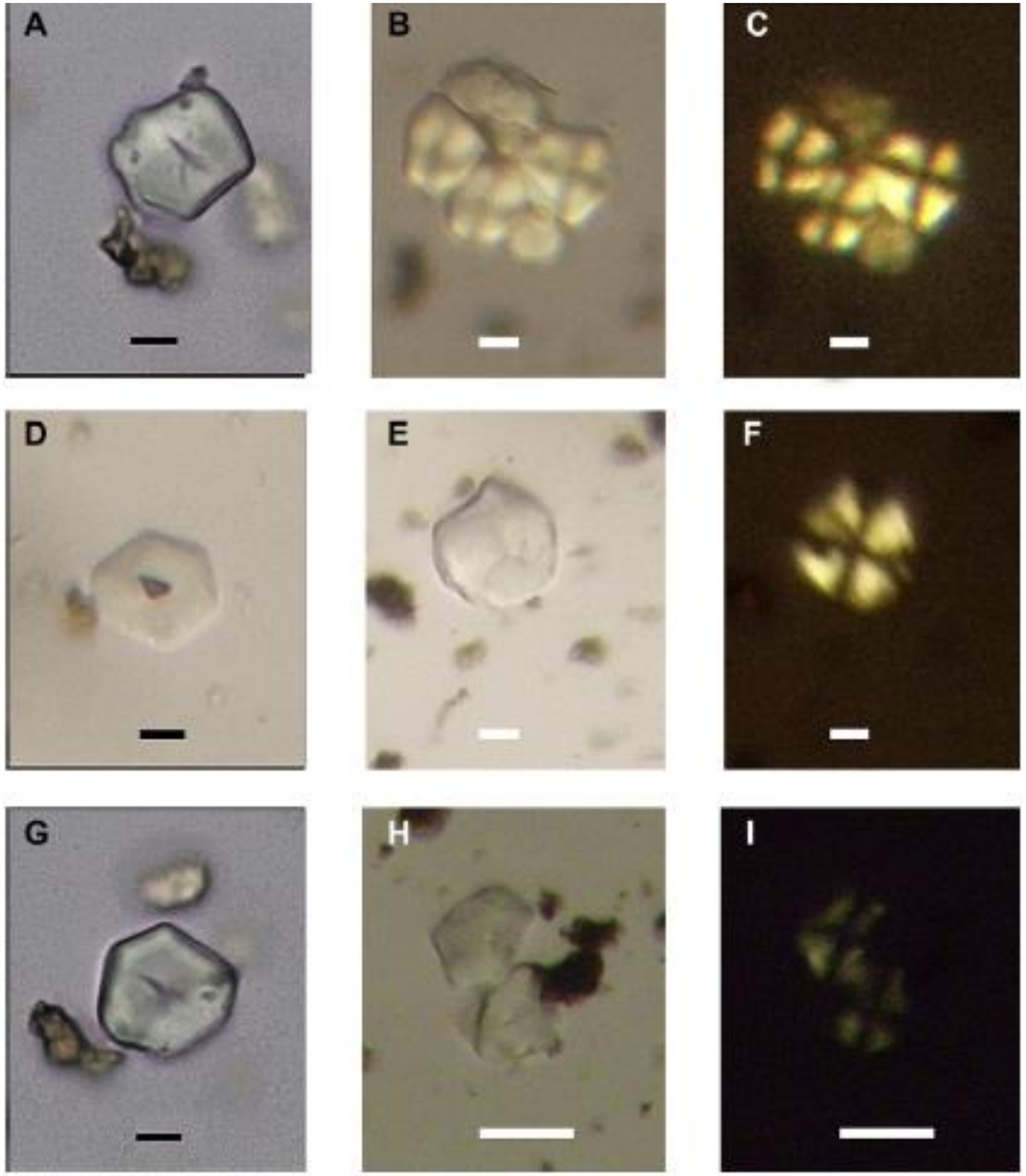


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zea mays

Starch

Fig. 2. Range of variation in archaeological maize starch. A, D and G: Simple starch grains, five to six two-dimensional polygonal sides. B: Assemblage of simple starch grains. C: Same starch grains with polarized light. E: Irregular starch grain with deep compression facets. F: Same starch grain with polarized light. H: Assemblage of simple starch grains. I: Same starch grains with polarized light (Scale bars: 10 mm)



Musaubach, María Gabriela, Anabela Plos, and María Del Pilar Babot. 2013. Differentiation of Archaeological Maize (Zea Mays L.) from Native Wild Grasses Based on Starch Grain Morphology. Cases from the Central Pampas of Argentina. *Journal of Archaeological Science* 40 (2). Elsevier Ltd:1186–93. http://dx.doi.org/10.1016/j.jas.2012.09.026.

Zea mays

Starch

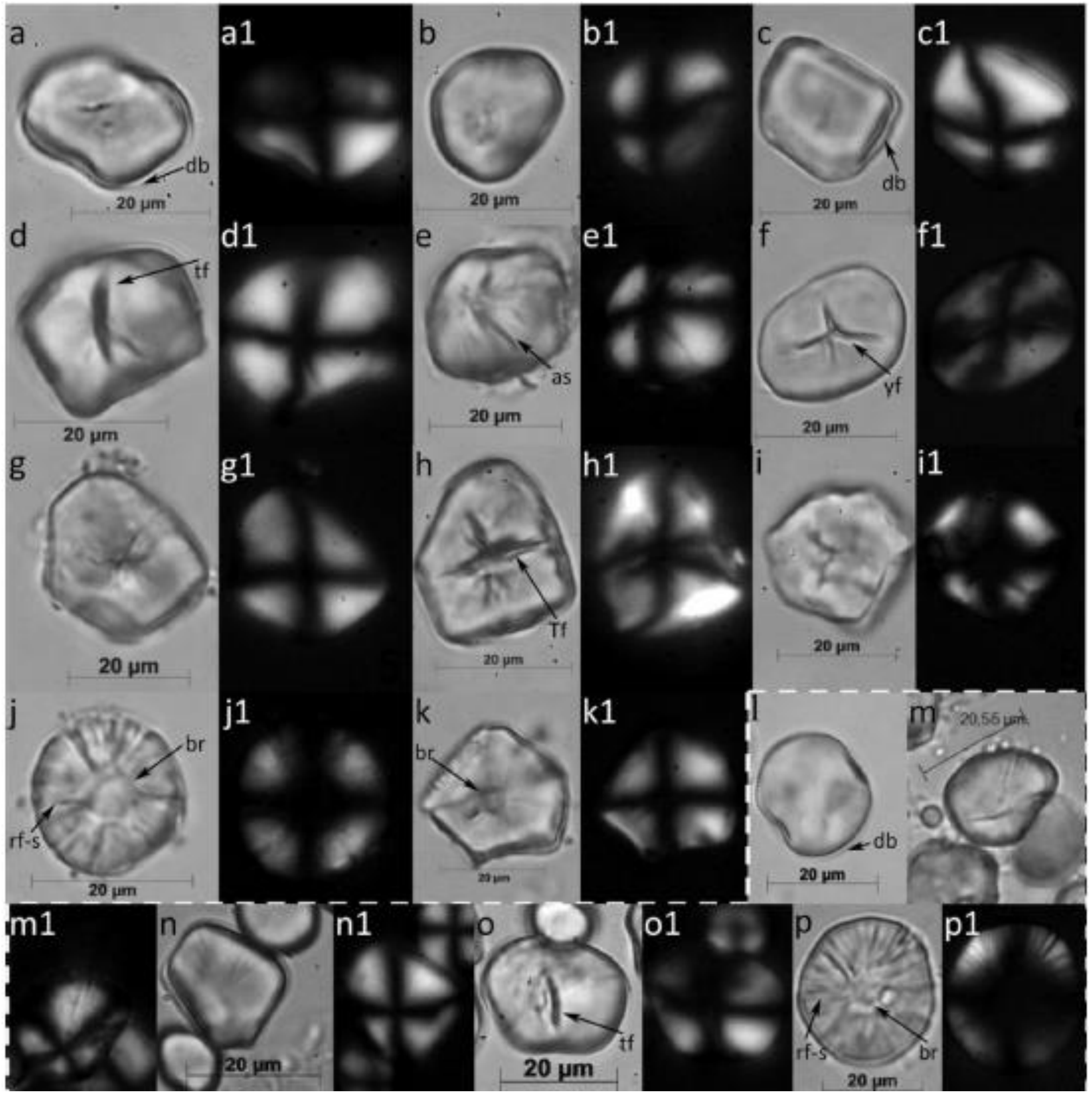


Fig. 4. Ancient (a-k) and modern (l-p, framed by a dashed line) maize starch grains. a-h, and k are secure identifications; i and j are tentative identifications due to surface damaging. a1-k1 are the same ancient maize starches labeled with unnumbered letters, but under polarized light and dark field. Provenances: starches a-b (artifact E-1); h (artifact E-3); c, e, f (artifact SJ-4); d, g, i, j and k (artifact SJ-5). Modern maize starch grains come from comparative indigenous landraces (Pagan-Jimenez reference collection): l, n-o (Pollo, Colombia); m (Cabuya, Colombia); p (Nal-Tel, Mexico, intentionally affected by heavy grinding experiments). m1-p1 are the same modern maize starches labeled with unnumbered letters, but under polarized light and dark field. Figure legend: “tf” ¼ transverse fissure; “Tf” ¼ fissure with a “T” shape; “as” ¼ asymmetric fissure; “yf” ¼ fissure with a “Y” shape; “rf-s” ¼ radial fissure/striation; “db” ¼ double-border; “br” ¼ bright ring.

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Zea mays

Starch

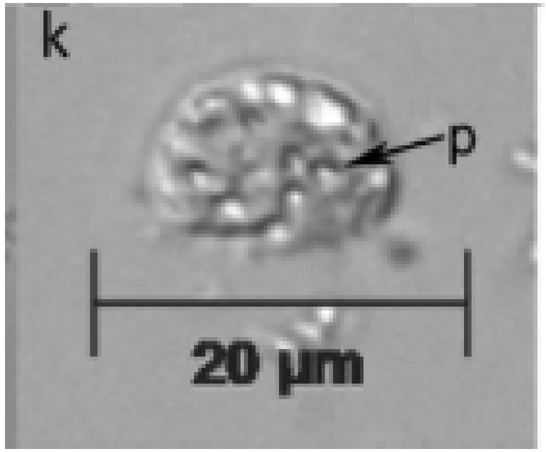


Fig. 9. k, modern maize starch with pits made by enzymatic (amylase) digestion during fermentation with saliva (Pagan-Jimenez lab notes).

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Zea mays

Phytolith

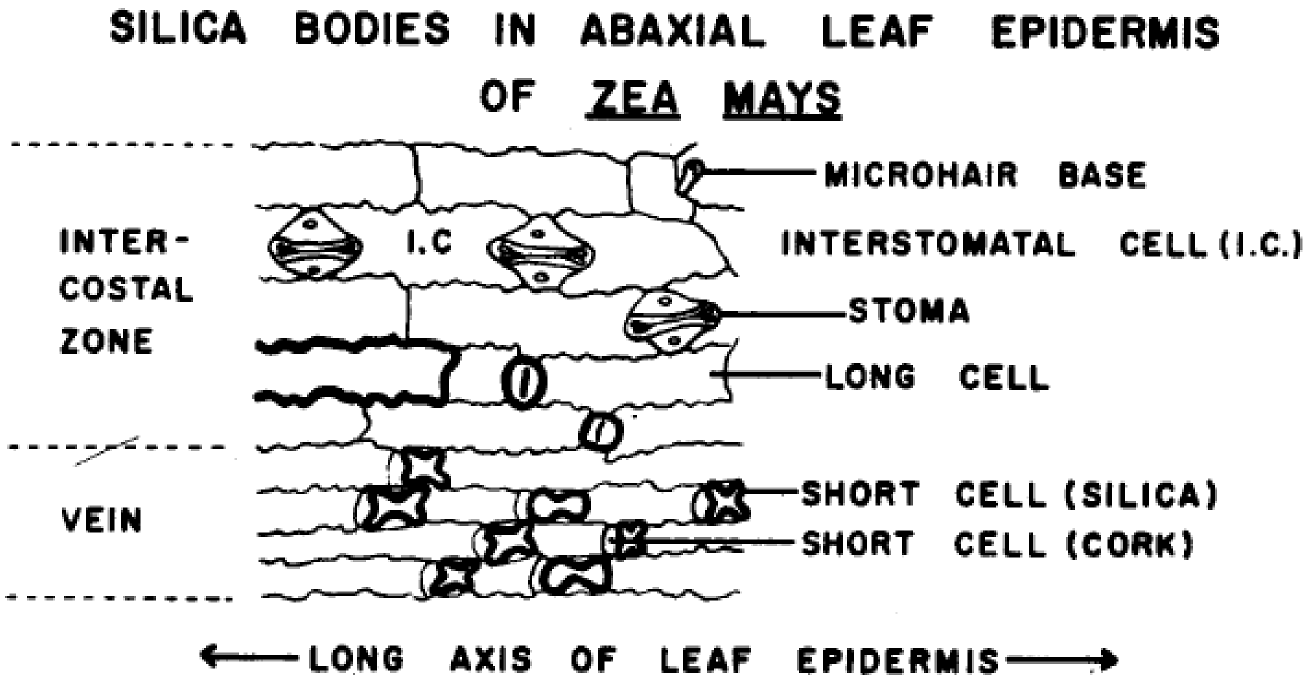


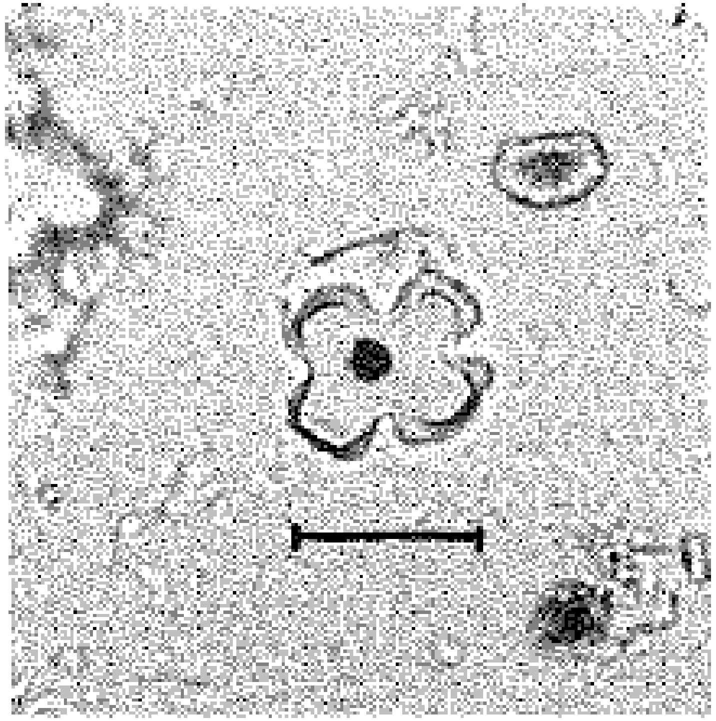
Fig. 1—Spodogram of *Zea mays* L. (after Metcalfe, 1960).

Twiss, Page C., Erwin Suess, and Robert M. Smith. 1969. “Morphological Classification of Grass Phytoliths.” In *Soil Science of America Proceedings*, 33:109–15. Madison, Wisconsin. doi:10.1007/s00702-011-0732-4.

Zea mays

Phytolith

a



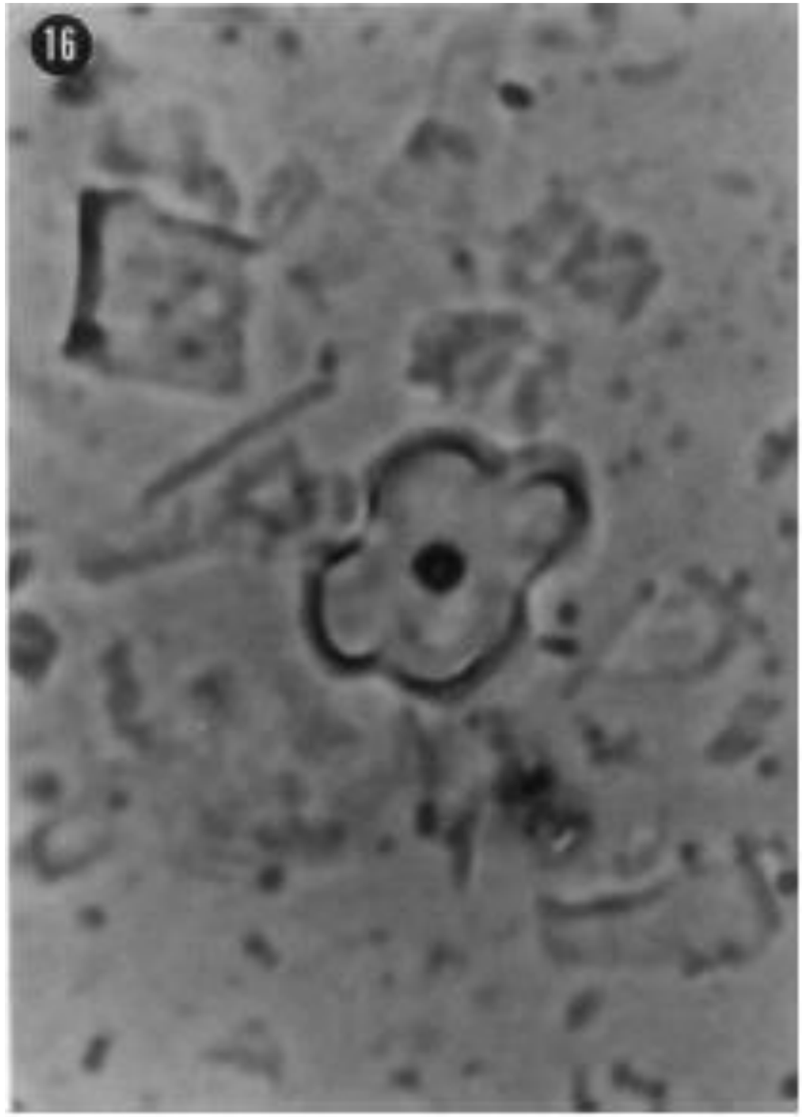
a. Variant 1 cross of Zea mays

Pearsall, Deborah Marie. 1993. Contributions of Phytolith Analysis for Reconstructing Subsistence: Examples from Research in Ecuador. *Current Research in Phytolith Analysis: Applications in Archaeology and Paleoecology*. MASCA.

Zea mays

Phytolith

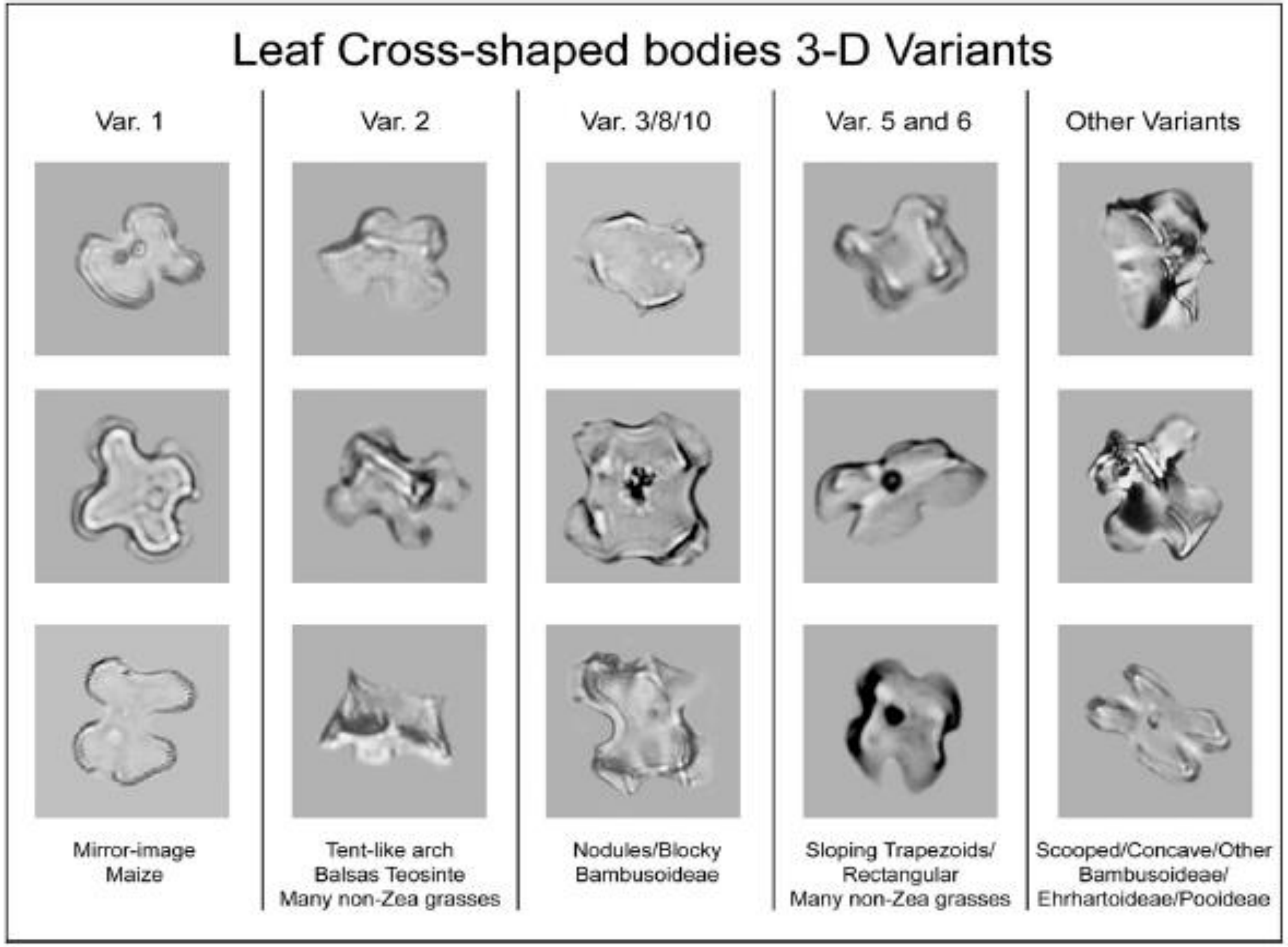
FIGURES 13-16. 16, A Variant 1 (mirror-image) cross-shaped phytolith from Zea mays (x400).



Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Zea mays

Phytolith



Ball, T. B., K. Chandler-Ezell, R. Dickau, N. Duncan, T. C. Hart, J. Iriarte, C. Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. https://doi.org/10.1016/j.jas.2015.08.010.

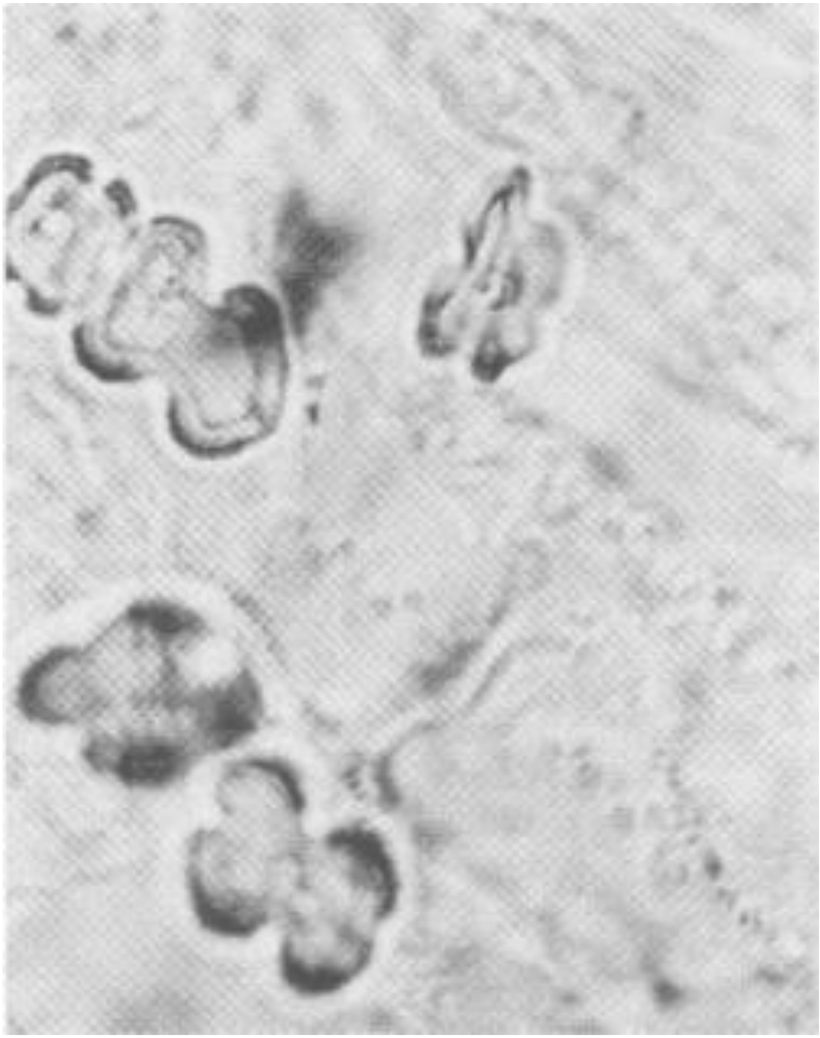
Piperno, D. R. 2006. *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*.

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Zea mays

Phytolith

Fig. 21. Top center and bottom, three cross-shaped phytoliths enclosed in the leaf epidermis of maize. The two Variant 1 cross-bodies at the bottom are wider than the Variant 6 cross body at the top. This difference in the size of different cross-body variants typifies maize and other grasses, and also contributes to accurate identification archaeologically.

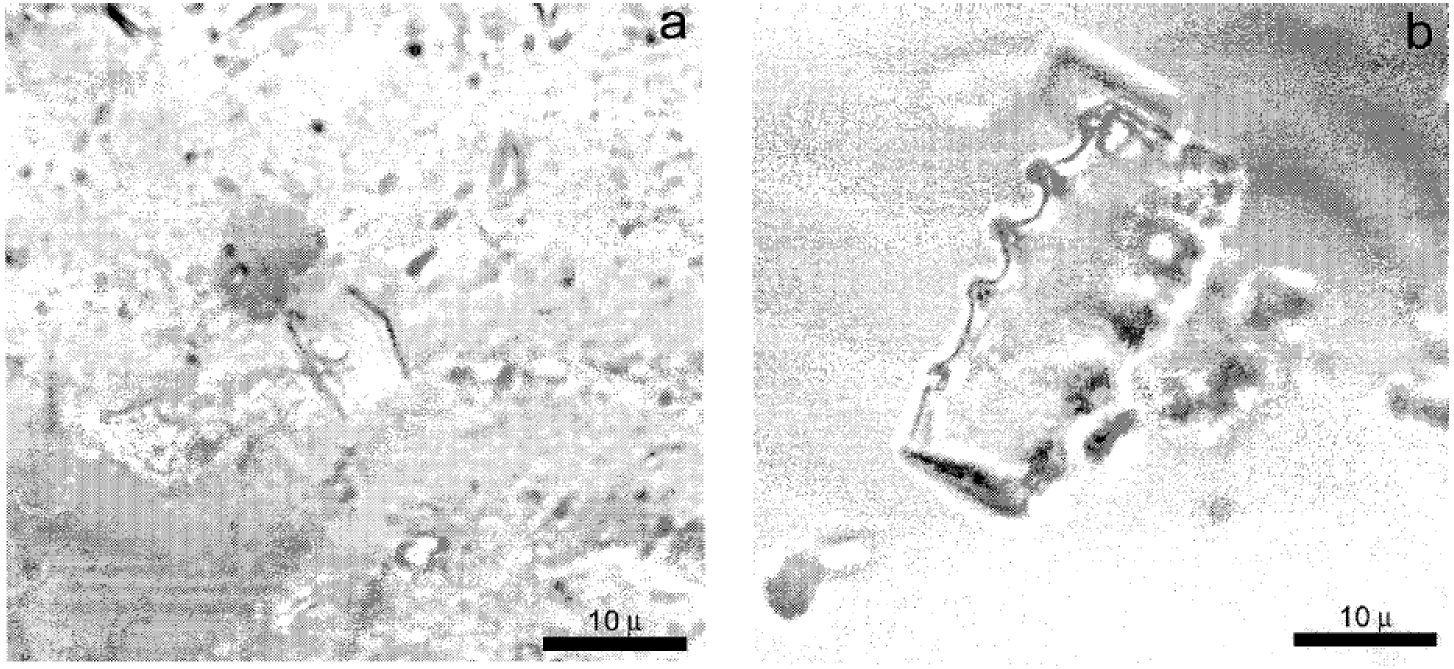


Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Zea mays

Phytolith

Figure 3. Cob bodies from Real Alto samples. A, wavy top rondel; B, wide rectangular IRP. Photographs taken at 400 x.



Pearsall, Deborah Marie. 2002. “Maize Is Still Ancient in Prehistoric Ecuador: The View from Real Alto, with Comments on Staller and Thompson.” *Journal of Archaeological Science* 29: 51–55. doi:10.1006/jasc.2001.0736.

Zea mays

Phytolith

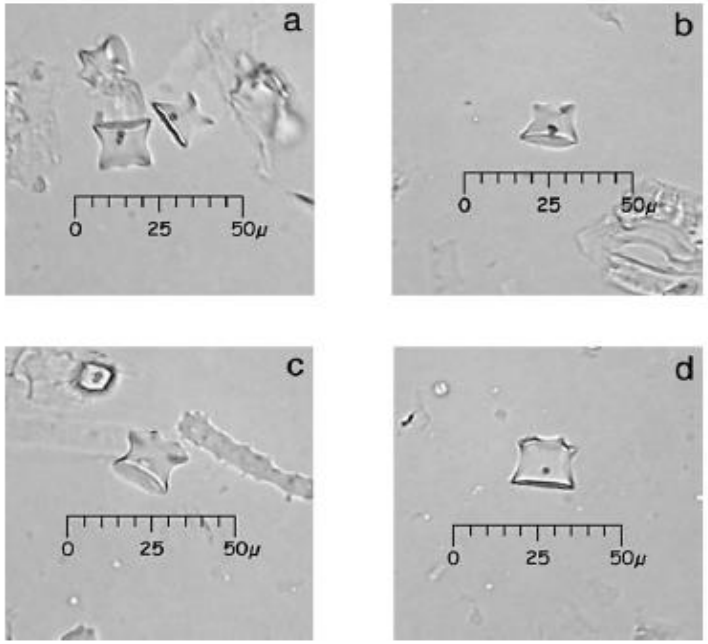


Fig. 2. Potential ‘confuser’ rondels from G. angustifolia. (a) Side view of three-spiked rondel. Note the solid, darkened lines of the edge spikes indicating their solid nature; (b) rotation of a three-spiked rondel showing the solid upper surface with solid spikes; (c) solid- topped decorated rondel showing angular edges and solid surface of the top; (d) solid-topped decorated rondel in side view, showing the angularity of the top edge.

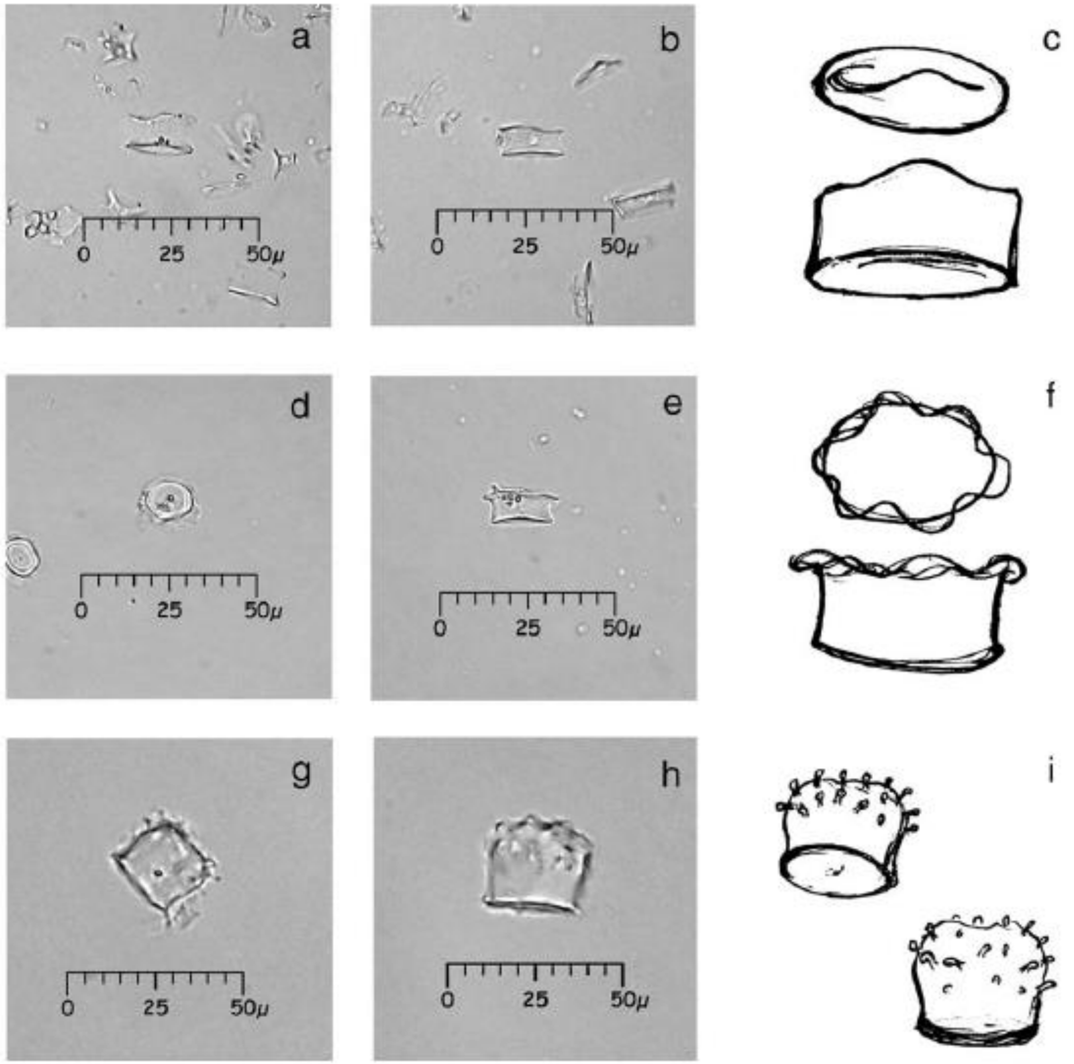


Fig. 1. Zea rondel phytoliths, bottom and side views of each type. (a–c) Wavy-top rondel; (d–f) ruffle-top rondel; (g–i) half-decorated rondel. See text for diagnostic features.

Pearsall, Deborah Marie, Karol Chandler-Ezell, and Alex Chandler-Ezell. 2003. “Identifying Maize in Neotropical Sediments and Soils Using Cob Phytoliths.” *Journal of Archaeological Science* 30 (5): 611–27. doi:10.1016/S0305-4403(02)00237-6.

Zea mays

Phytolith

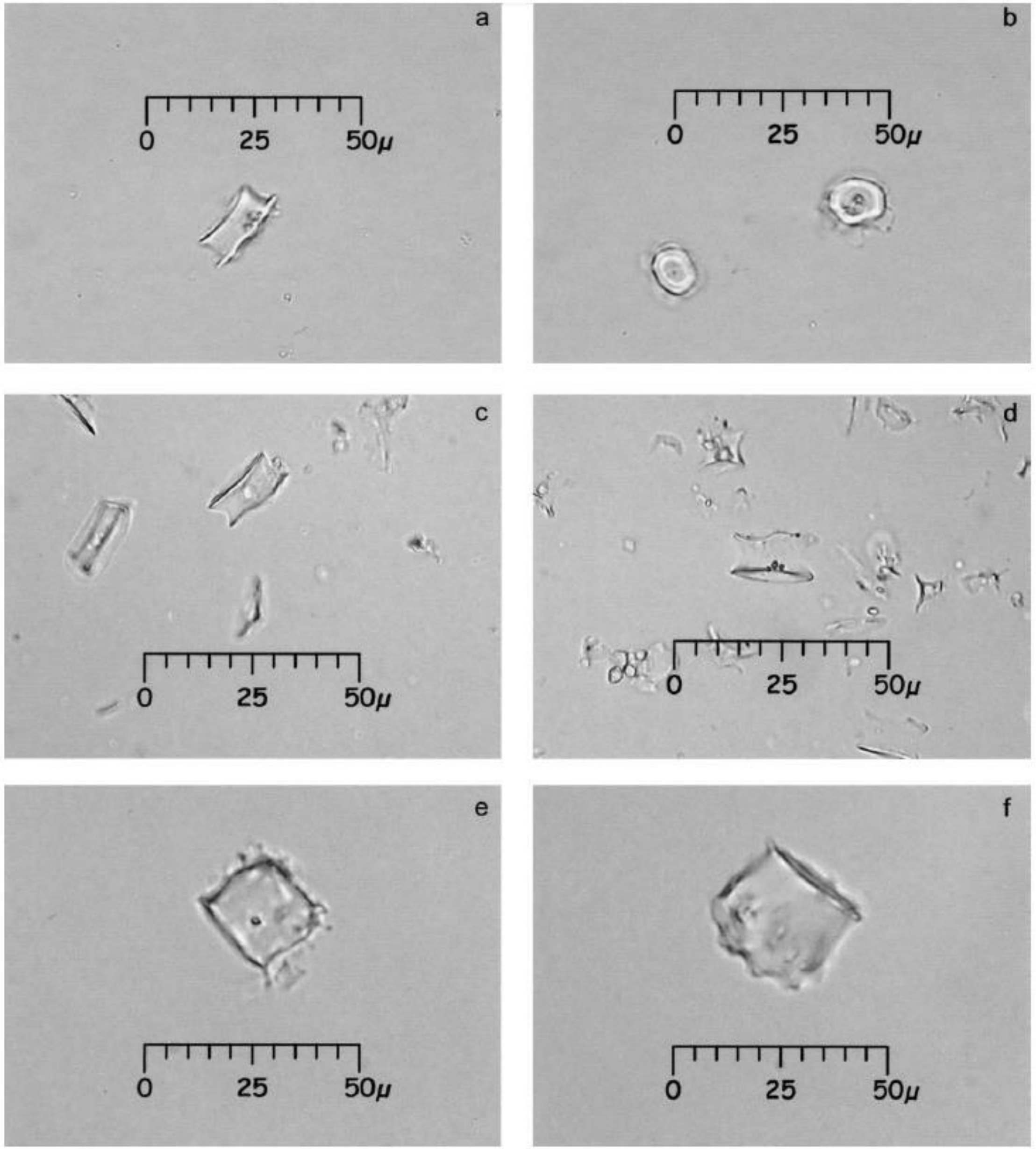


Fig. 2. Examples of wavy-top rondels, ruffle-top rondels, and half-decorated rondels, which were the subject of the study by Pearsall et al. [17].a: ruffle top rondel, side view, ruffled top is to the right; b: ruffle-top rondels, rondel faces are up (sharp focus), ruffled faces are down; c: wavy-top rondel, wavy top is to the right; d: wavy-top rondel, wavy top is up; e, f: half-decorated rondels.

Pearsall, Deborah M., Karol Chandler-Ezell, and Alex Chandler-Ezell. 2004. “Maize Can Still Be Identified Using Phytoliths: Response to Rovner.” *Journal of Archaeological Science* 31 (7): 1029–38. doi:10.1016/j.jas.2003.11.007.

Zea mays

Phytolith

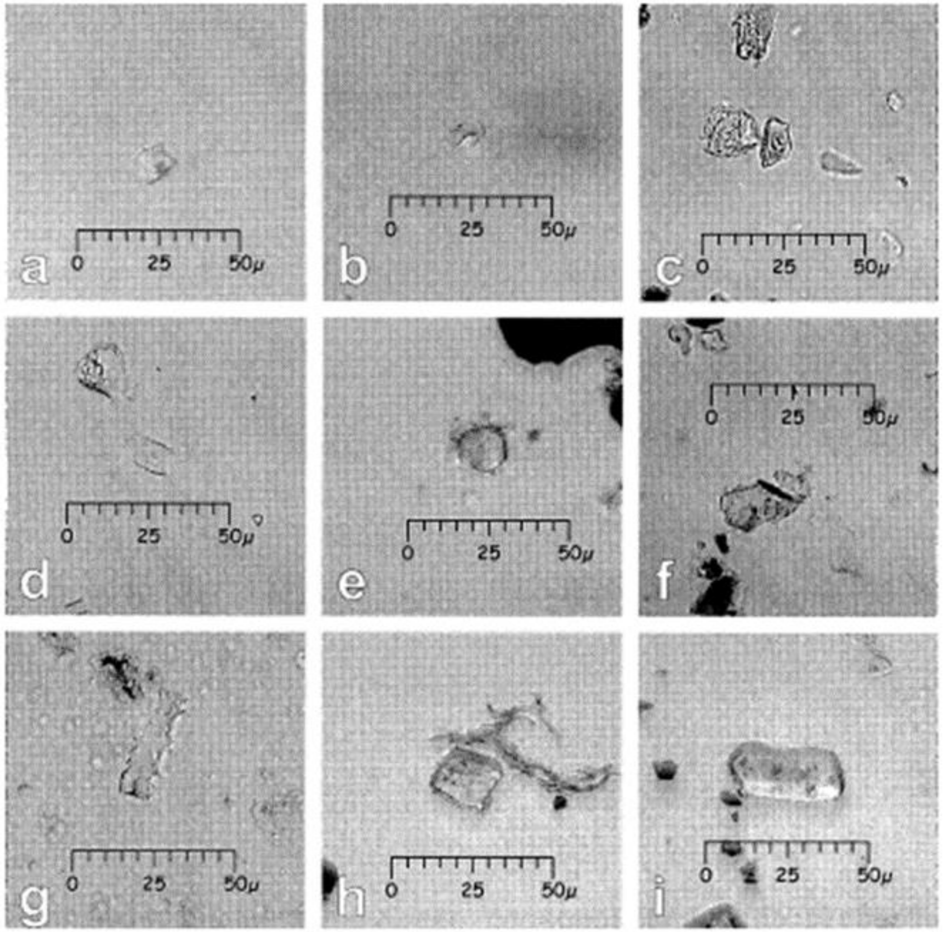
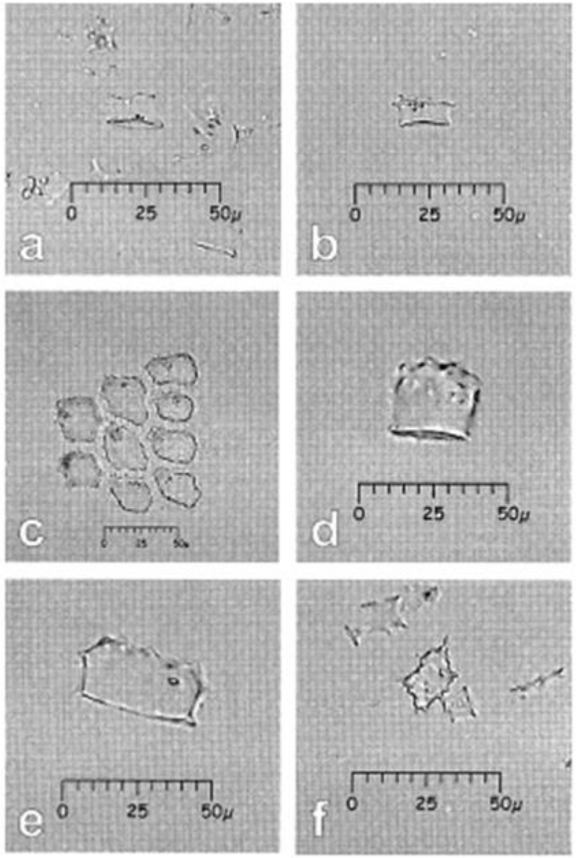


Fig. 8. Archaeological maize cob phytoliths, a: wavy top rondel, side view, from 3294-A; b: wavy top rondel, top view, 3415-A; c: wavy top rondel, house floor sample; d: ruffle top rondel, 3294-B, e: ruffle top rondel, top view, 3415-B; f: wide IRP, 3331-B; g: wide IRP, house floor sample; h: half-decorated rondel, 3292-A; is half-decorated oblong, 3292-A.



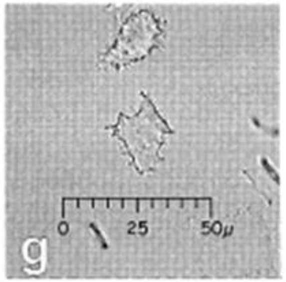


Fig. 6. Comparative maize cob phytoliths, a: wavy top rondel; b: ruffle top rondel; c: robust globular; d: half-decorated rondel; e: half-decorated oblong; f: wide IRP; g: irregular IRP.

Pearsall, Deborah Marie, Karol Chandler-Ezell, and James A. Zeidler. 2004. “Maize in Ancient Ecuador: Results of Residue Analysis of Stone Tools from the Real Alto Site.” *Journal of Archaeological Science* 31: 423–42. doi:10.1016/j.jas.2003.09.010.

Zea mays

Phytolith

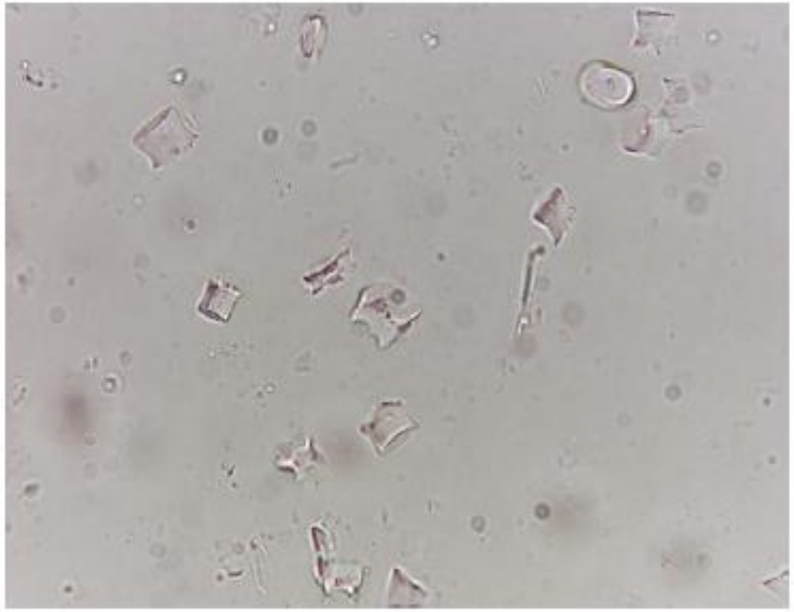


Fig. 7. Phytoliths from the glumes and cupules of maize, Race Amarillo. In contrast to teosinte, phytolith assemblages under the control of the maize allele of Tga1 predominantly contain short cell phytoliths (rondels) with few to no other types present.

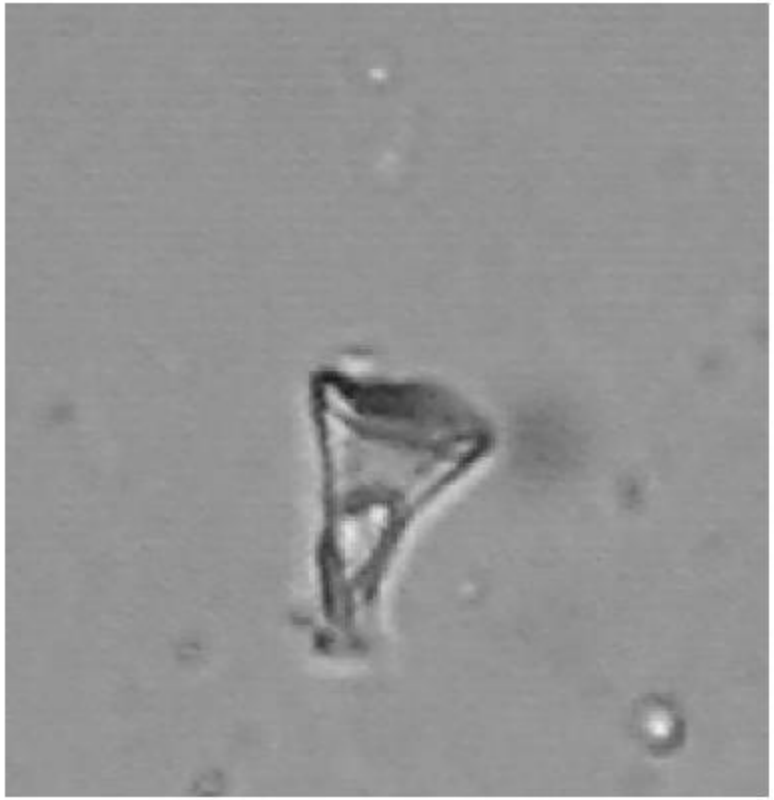


Fig. 11. A ‘‘spooled’’ type of rondel phytolith recovered from a maize cob from San Andre´ s, Mexico. It is like phytoliths typically found in modern maize races.

Piperno, Dolores R. 2009. “Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence.” *Quaternary International* 193 (1–2): 146–59. doi:10.1016/j.quaint.2007.11.011.

Zea mays

Phytolith

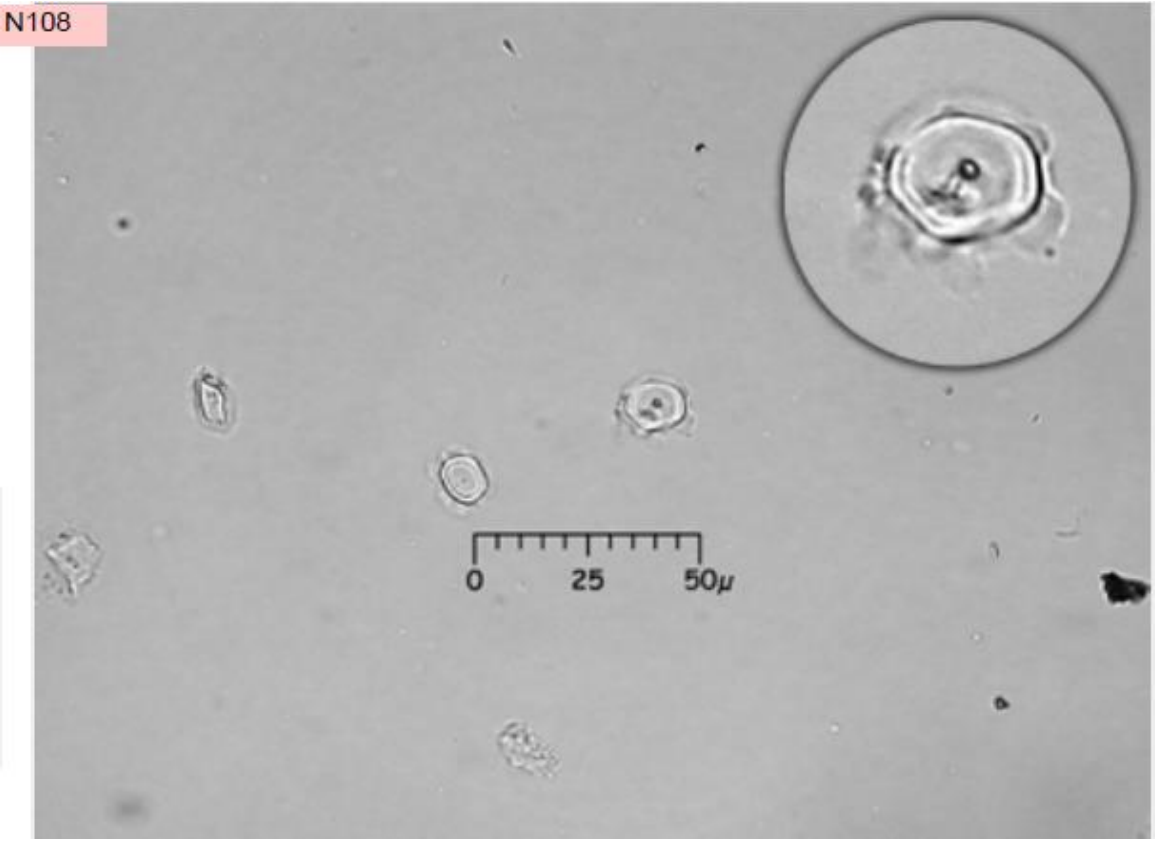
wavy top rondel:
Rectangular bases, bilobate bases, and saddle bases are excluded from this type.
Occur only in maize.
Good maize indicator even within the range of teosinte.
Diagnostic level: species, domesticated

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays

Phytolith

Ruffle-top rondel
Descrubed by Bozarth (1993) Occurs in genus Zea. Diagnostic level: genus

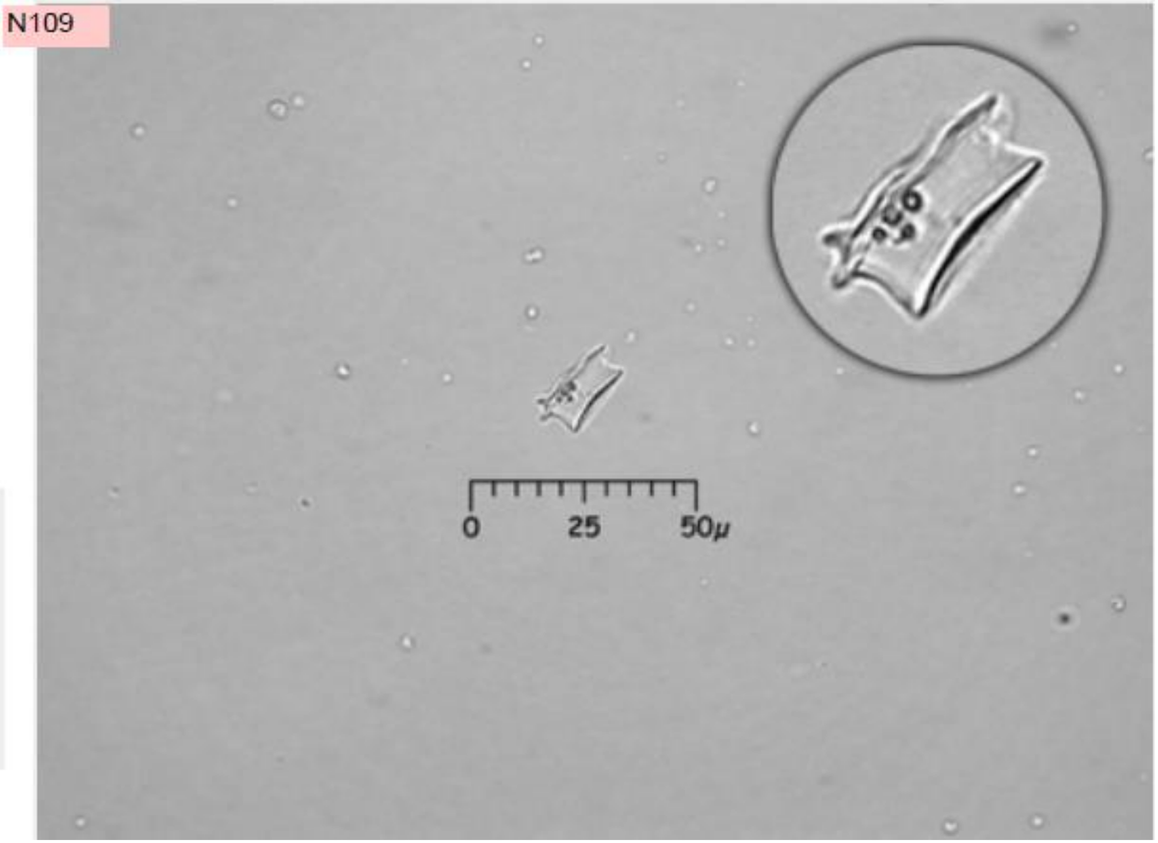


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays

Phytolith

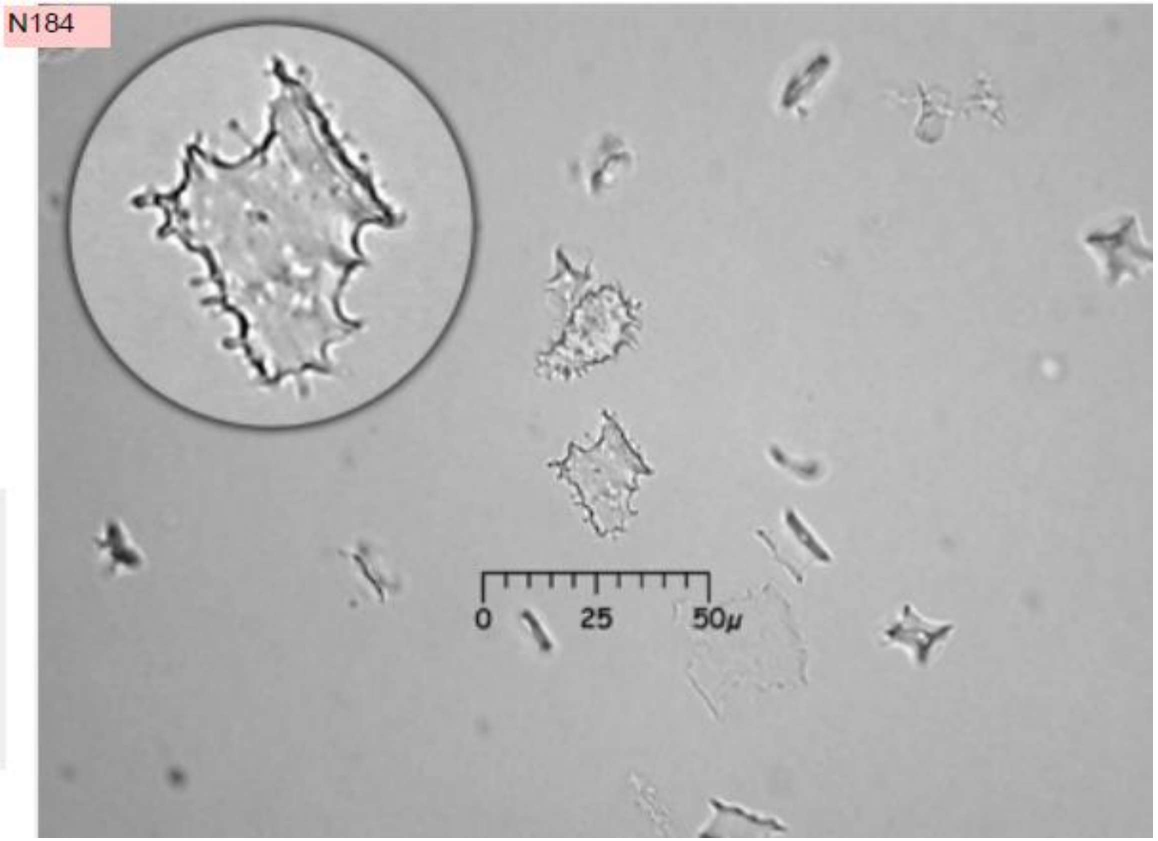
Ruffle-top rondel
Descrubed by Bozarth (1993) Occurs in genus Zea. Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays

Phytolith



Diagnostic level: Zea spp. and some other panicoid grasses. Irregular IRP, IRP type was first described by Piperno and Pearsall (1993). IRP bodies are the product of epidermal silicification in the fruitcase, cupule, glume, and other infl. tissues. Found in Zea spp., Panicum bulbosum, and Lasiacis spp. (panicoid grasses), and Neurolepis pittieri (bamboo)

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays mays

Phytolith

wavy top rondel:Described by Bozarth (1993). Rectangular bases, bilobate bases, and saddle bases are excluded from this type. Occur only in maize. Good maize indicator even within the range of teosinte.
Diagnostic level: species, domesticated

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays mays

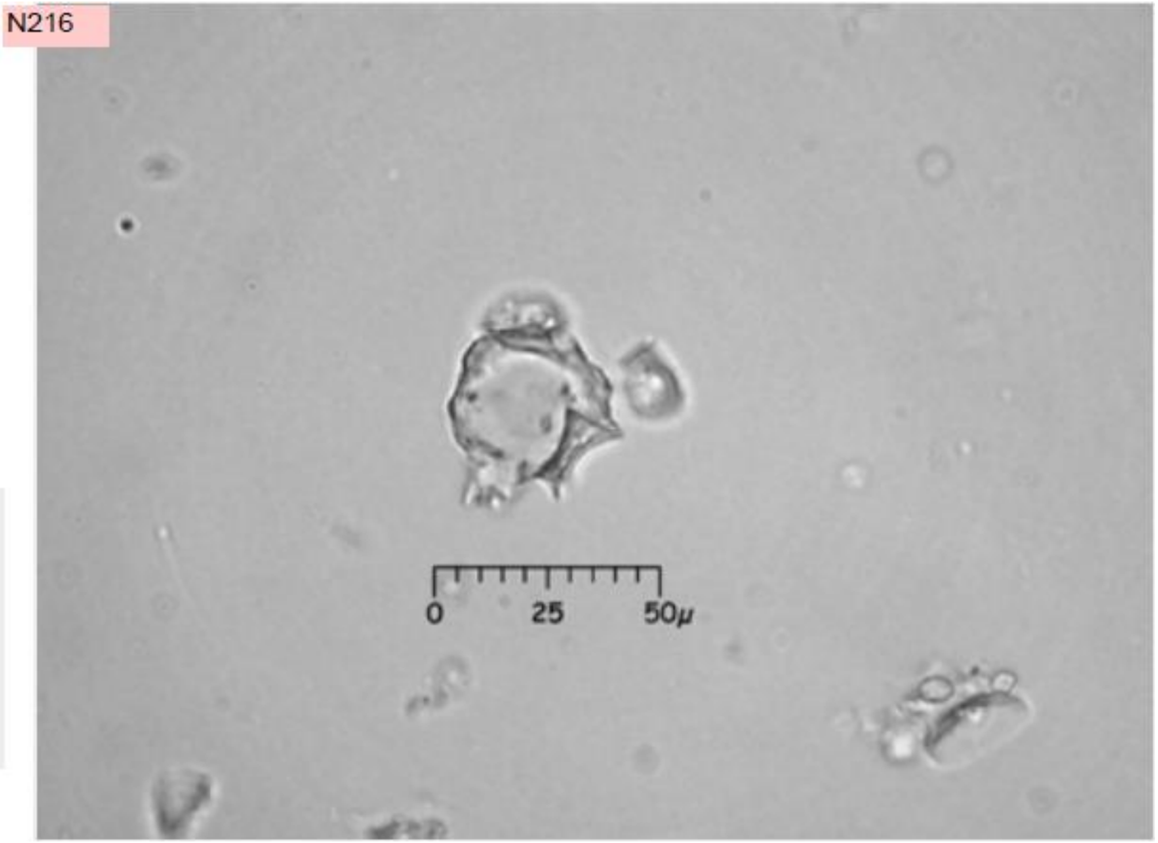
Phytolith

wavy top rondel: Described by Bozarth (1993). Rectangular bases, bilobate bases, and saddle bases are excluded from this type. Occur only in maize. Good maize indicator even within the range of teosinte.
Diagnostic level: species, domesticated

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays mays

Phytolith



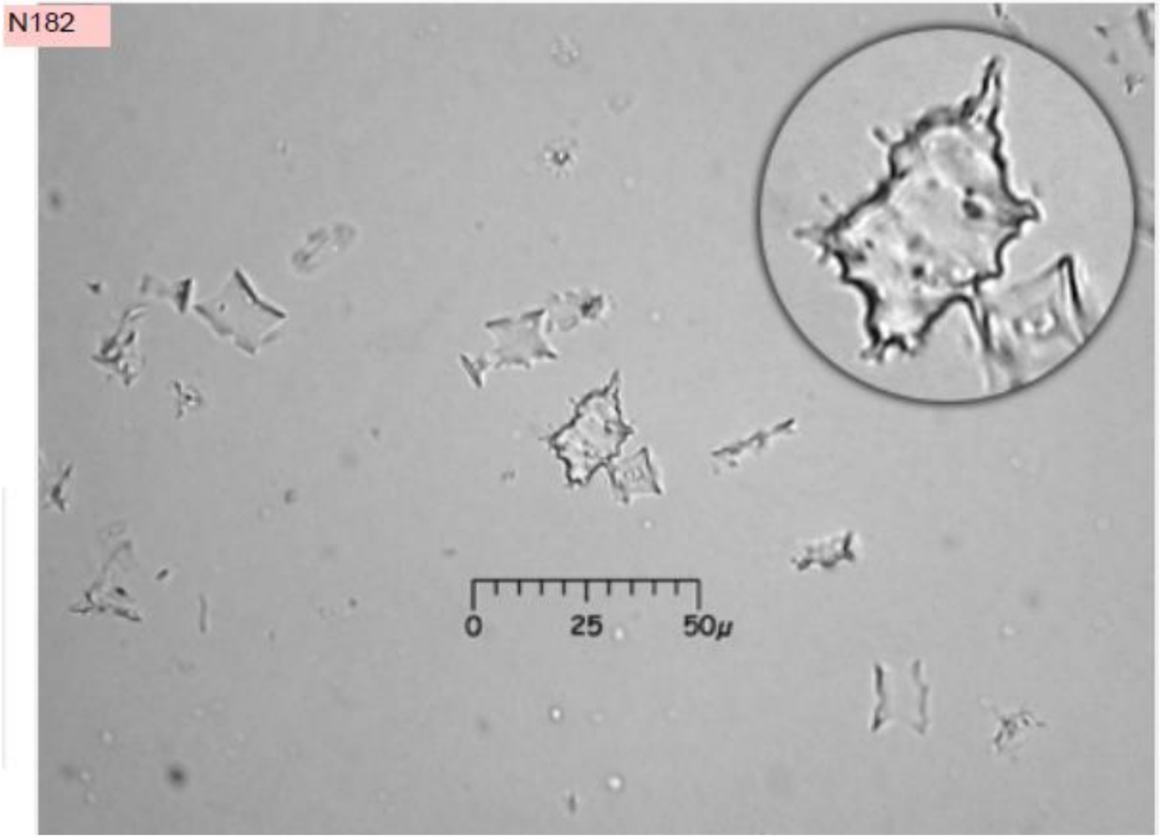
Diagnostic level: species, domesticated
Gracile spherical body
This is a relatively rare type that occurs in maize, and not in teosinte or other wild panicoid grasses.
Compare to their robust cousins (Robust globular bodies) in size, nature of projections, and degree of silicification

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays, race “pepitillo”

Phytolith

Rectangular IRP, Wide (>7.5 microns width). IRP type was first described by Piperno and Pearsall (1993). IRP bodies are the product of epidermal silicification in the fruitcase, cupule, glume, and other infl. tissues. Diagnostic level: Zea spp. and some other panicoid grasses

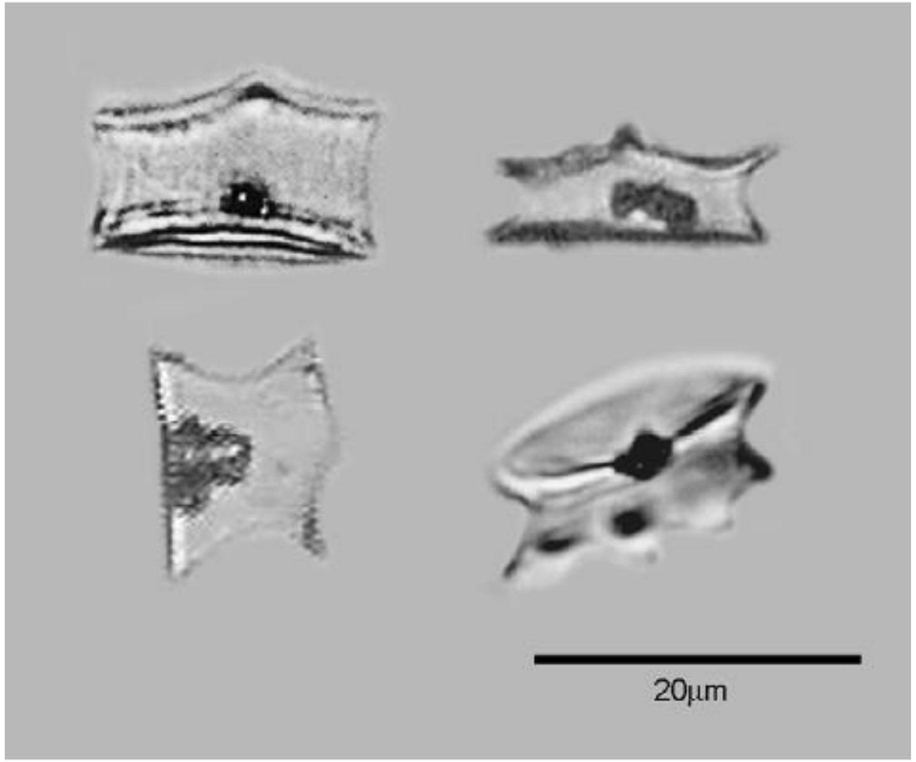


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Zea mays

Phytolith

Fig. 8. Examples of wavy-top rondels from maize. The phytolith on the bottom right is a ruffle-top rondel from maize, for comparison. Reprinted from Piperno (2006a), Copyright AltaMira Press.



Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Zea mays

Phytolith

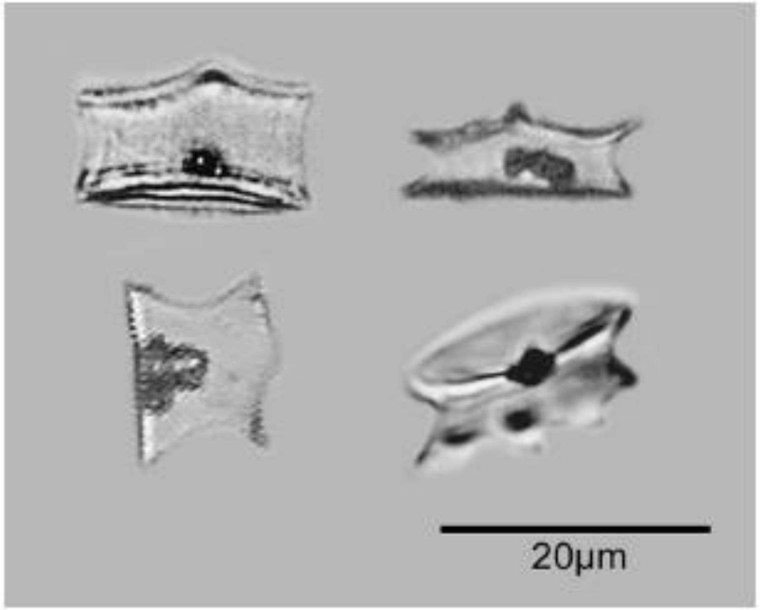


Fig. 2. Wavy-top (top, bottom left) and ruffle-top rondels (bottom, right) from maize. Ruffle-top rondels occur much more frequently in teosinte than maize. From Piperno, 2006

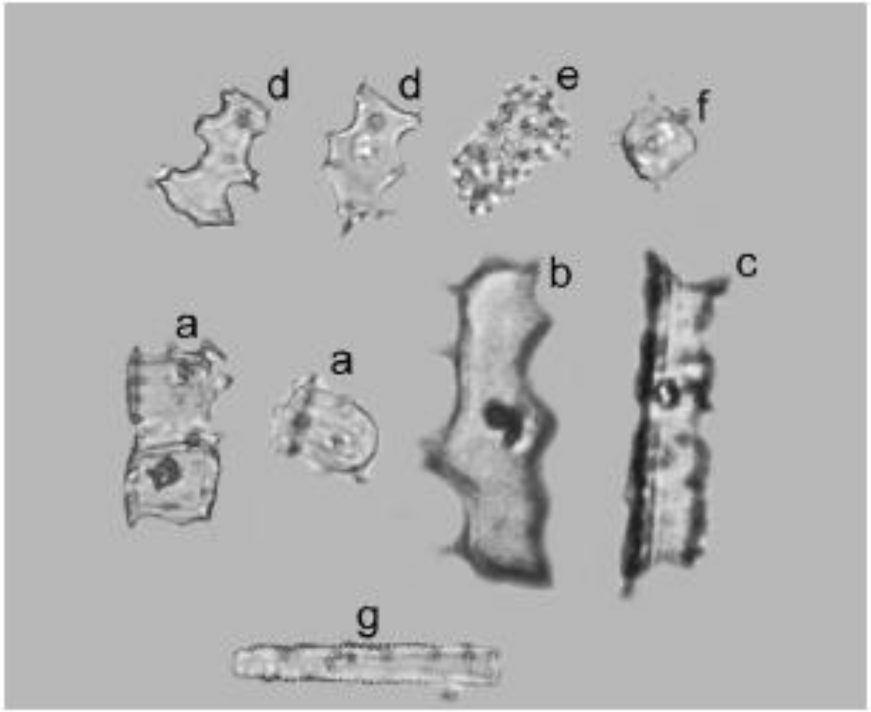


Fig. 3. The various kinds of non-rondel phytoliths found in teosinte fruitcases. Those diagnostic of teosinte are in the center (a, oblong, one-half decorated; b, elongated spiney; c, elongated with one wavy and one serrated edge). Phytoliths aef occur in some non-Zea grasses, but they like the others are always produced in teosinte and can be used to rule out its presence if absent from samples. The phytoliths range in size from about 10 (phytolith f) to 35 mM in diameter (phytolith b). From Piperno, 2006.

Ball, T. B., K. Chandler-Ezell, R. Dickau, N. Duncan, T. C. Hart, J. Iriarte, C. Lentfer, et al. 2016. Phytoliths as a Tool for Investigations of Agricultural Origins and Dispersals around the World. *Journal of Archaeological Science* 68. Elsevier Ltd:32–45. https://doi.org/10.1016/j.jas.2015.08.010.

Zea mays

Phytolith

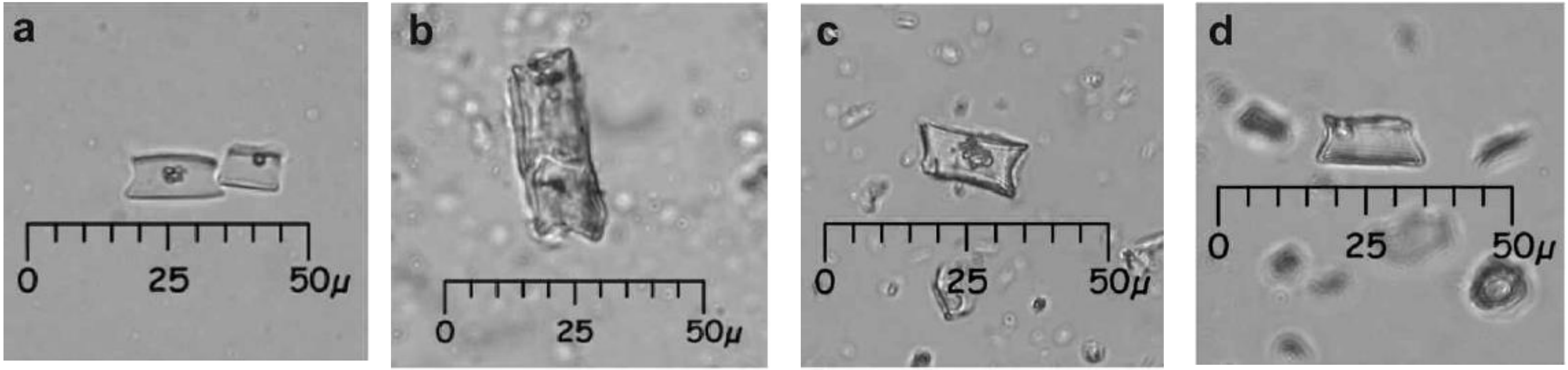


Figure 3. Maize diagnostic phytolith (narrow elongate rondel) for Andes: (a) narrow elongate rondel from modern reference maize; (b) two narrow elongate rondels in tissue from teeth of possible human sacrifice (Locus 5282) from Kala Uyuni; (c) and (d) narrow elongate rondels from manos (Loci 3132, 3110) from Chiripa Quispe.

Logan, Amanda L., Christine A. Hastorf, and Deborah Marie Pearsall. 2012. "Let's Drink Together": Early Ceremonial Use of Maize in the Titicaca Basin. *Latin American Antiquity* 23 (3):235–58.

Zea mays

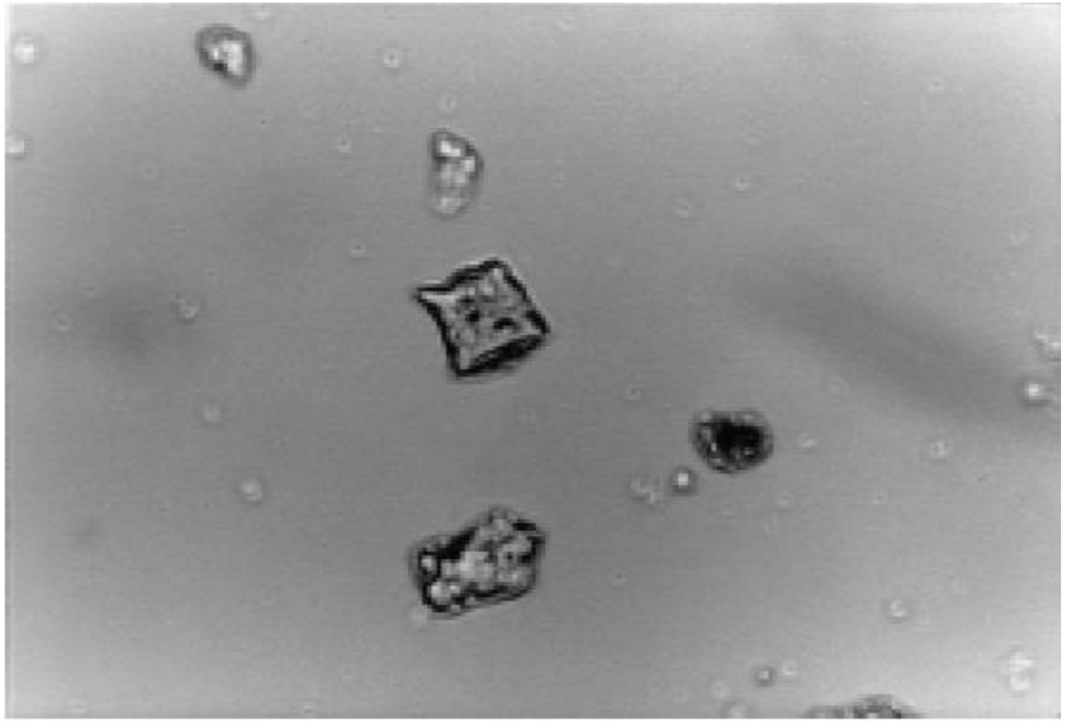
Phytolith

Rondels from the cob of Zea mays L., race Maiz Ancho (400x). As the rondel phytoliths from maize, and especially bamboos tend to be thick when formed in plant, the rondel daces that are oriented toward the investigator in plant tissue become the lateral edges of the phytoliths after they are removed from the plant and mounted on slides

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Zea mays

Phytolith

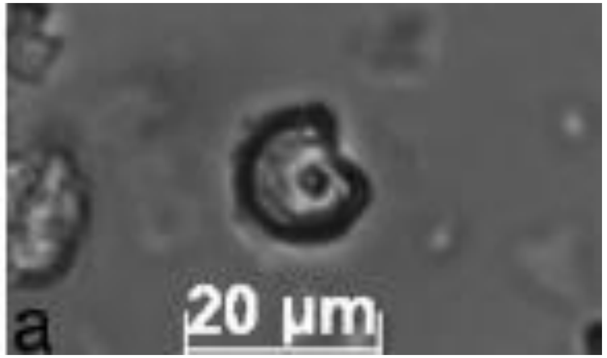


A phytolith from the glumes of maize cobs from the Aguadulce shelter. 160x. The phytolith is 14 microns long.

Piperno, Dolores R., and Irene Holst. 1998. The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–76.

Zea mays

Phytolith



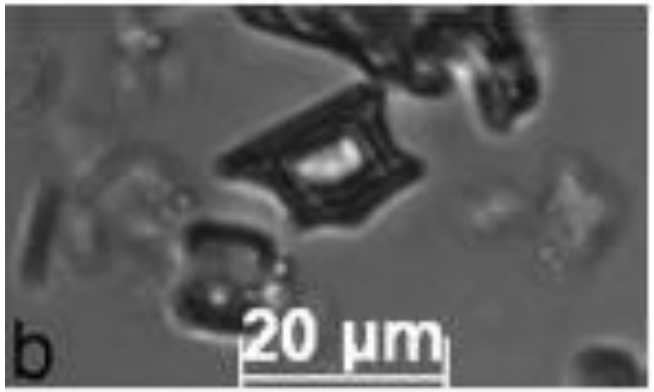
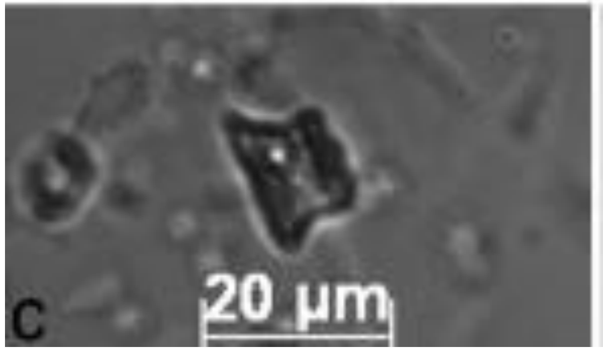


Fig. 3. Phytoliths from San Andre ´s. (a–c) Maize cob phytoliths. (a) A ruffle top rondel from 1,115 cm. (b)A wavy top rondel from 1,115 cm. (c)A ruffle top rondel from 1,140 cm.



Pohl, Mary E. D., Dolores R. Piperno, Kevin O. Pope, and John Glendon Jones. 2007. Microfossil Evidence for Pre-Columbian Maize Dispersals in the Neotropics from San Andres, Tabasco, Mexico. *Proceedings of the National Academy of Sciences* 104 (16):6870–75. http://www.pnas.org/cgi/doi/10.1073/pnas.0701425104.

Zea mays

Phytolith

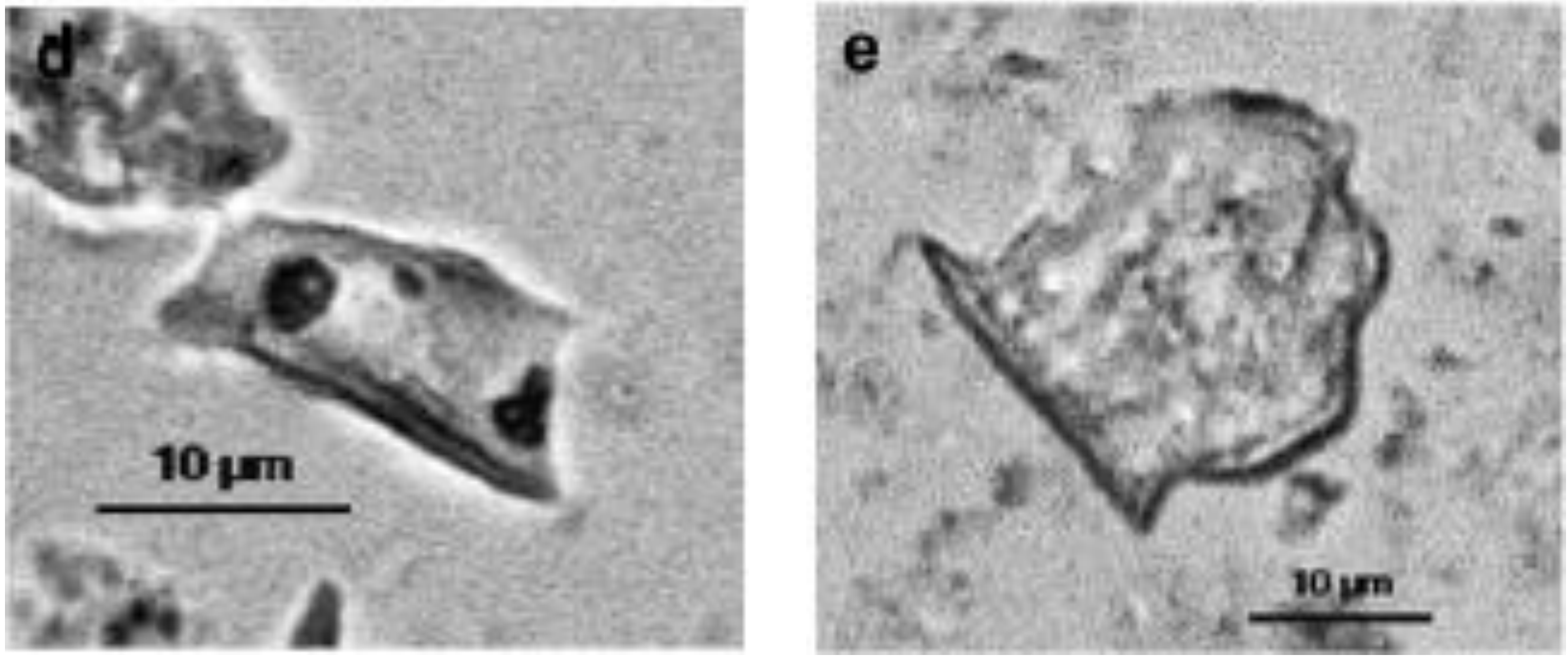


Fig. 3. Scale photomicrographs of phytolith morphotypes defined in the analysis. d) Z. mays cobwavy-top rondel (K-VIII M. 1.1, 0e10 cm). e) Z. mays cob half-decorated rondel (P Ridged Field 2, 0e10 cm).

Iriarte, José, Bruno Glaser, Jennifer Watling, Adam Wainwright, Jago Jonathan Birk, Delphine Renard, Stéphen Rostain, and Doyle B. McKey. 2010. Late Holocene Neotropical Agricultural Landscapes: Phytolith and Stable Carbon Isotope Analysis of Raised Fields from French Guianan Coastal Savannahs. *Journal of Archaeological Science* 37. Elsevier Ltd:2984–94. http://dx.doi.org/10.1016/j.jas.2010.06.016.

Zea mays

Phytolith

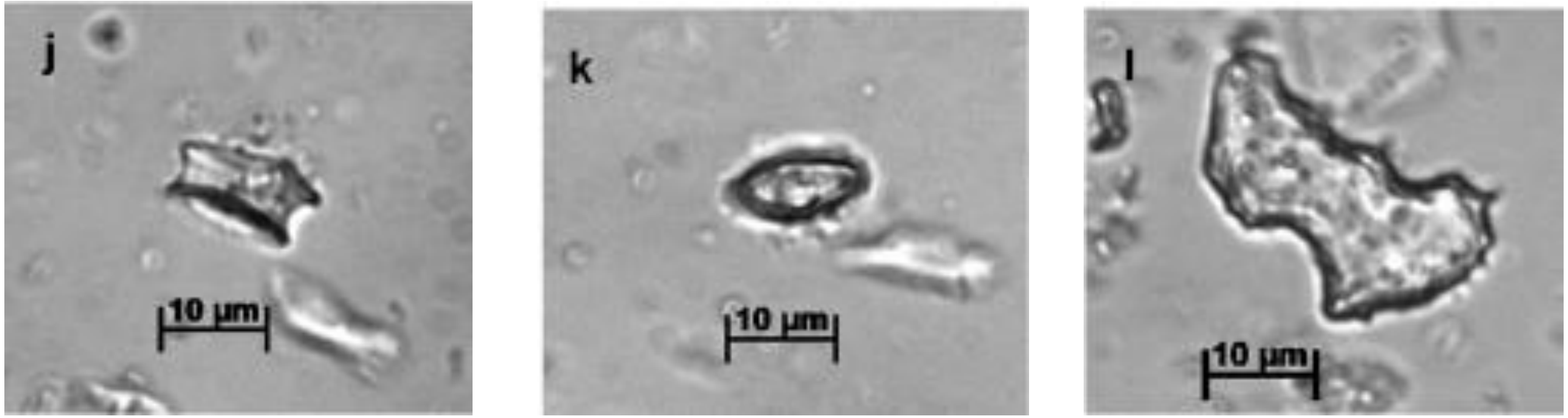


Fig. 5. Selected microbotanical remains. Phytoliths: j) Z. mays cob wavy-top rondel, profile view (Sed. Sample 4), k) The same phytolith, rotated to top view, l) Z. mays cob IRP (Sed. Sample 3)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Zea mays

Phytolith

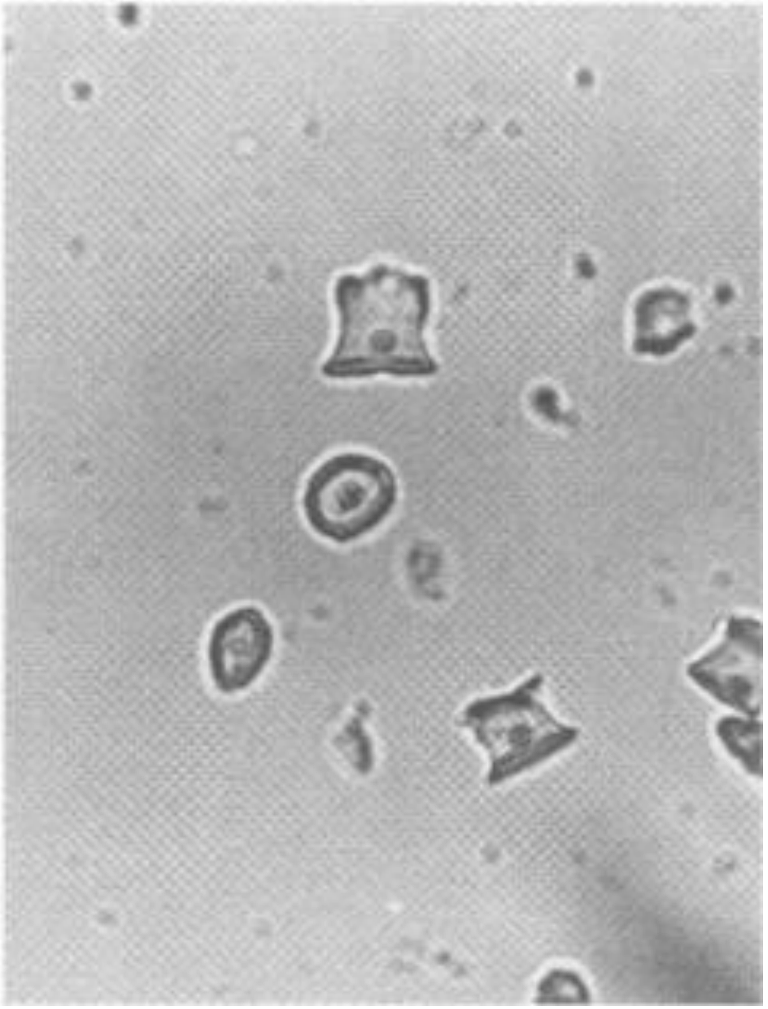


Fig. 10. Undecorated circular phytoliths from a cob of maize, Race Maiz Ancho from Mexico.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Zea mays ssp. parviglumis

Phytolith

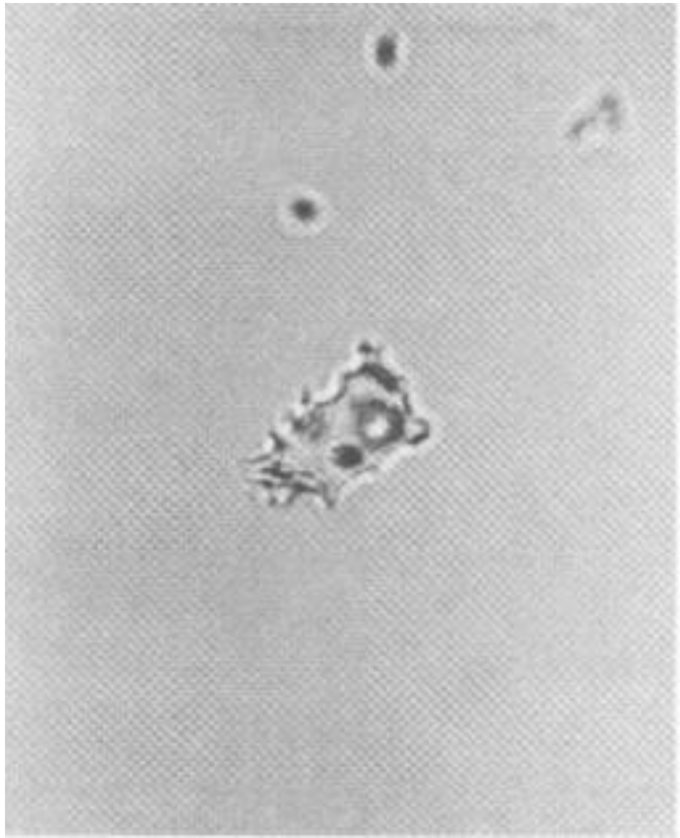


Fig. 8. A fruitcase phytolith from Balsas teosinte. It is produced in the same tissue as phytolith illustrated from Tripsacum but lacks serrated edges and ridges along the top.

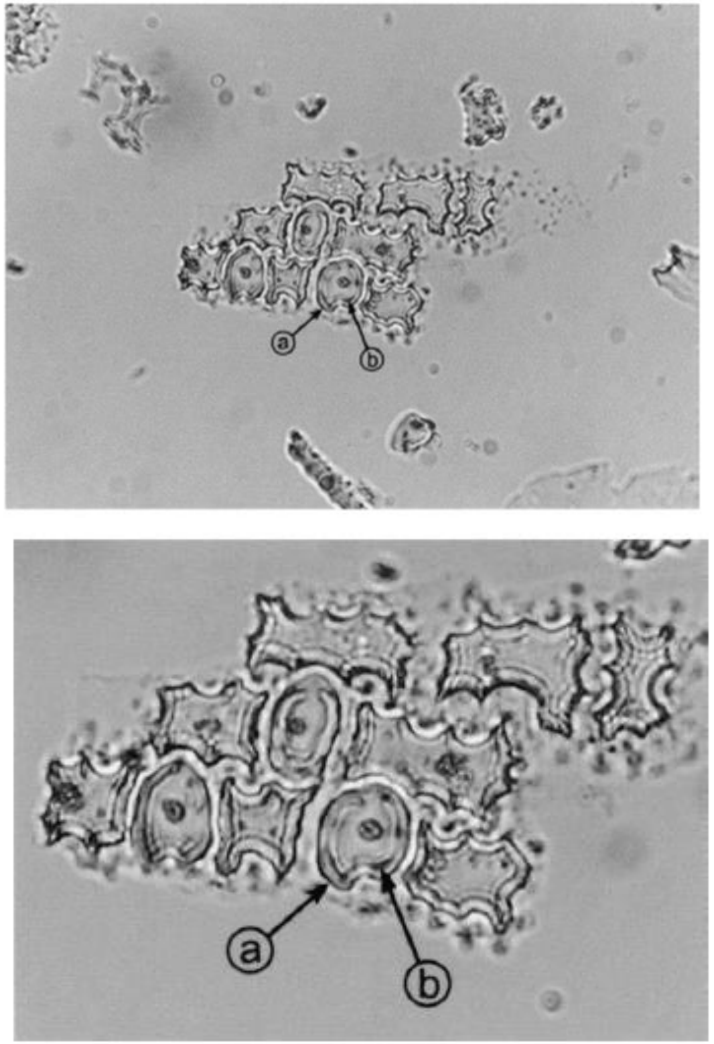
Fig. 9. A decorated circular phytolith from the fruitcase of Balsas teosinte.

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Zea mays ssp. parviglumis

Phytolith

Fig. 5. Articulated phytoliths from a teosinte fruitcase. The lower image is a magnified view of the upper image. The “a” arrow points to the upper face of the rondel (sharp focus): this is the ruffle-top, which extends out beyond the base. The “b” arrow points to the lower face of the rondel, which is the rondel base. Photograph courtesy of I. Holst, Smithsonian Tropical Research Institute, Panama.



Pearsall, Deborah Marie, Karol Chandler-Ezell, and Alex Chandler-Ezell. 2004. “Maize Can Still Be Identified Using Phytoliths: Response to Rovner.” *Journal of Archaeological Science* 31 (7): 1029–38. doi:10.1016/j.jas.2003.11.007.

Zea mays ssp. parviglumis

Phytolith

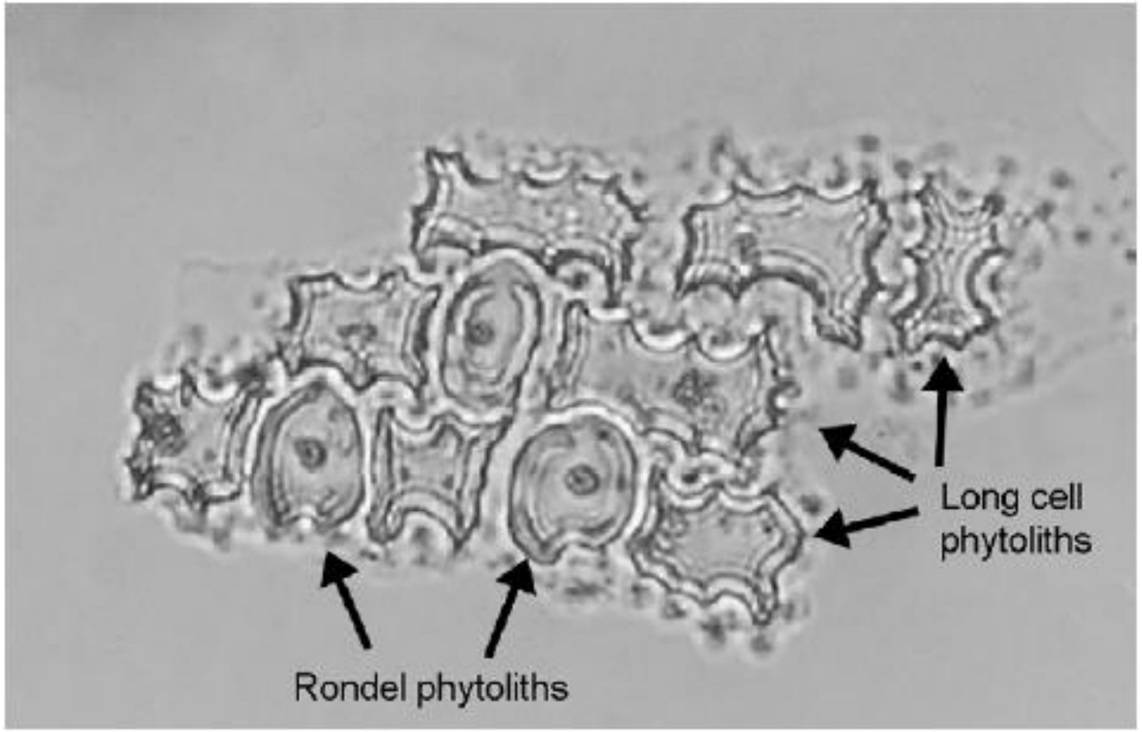
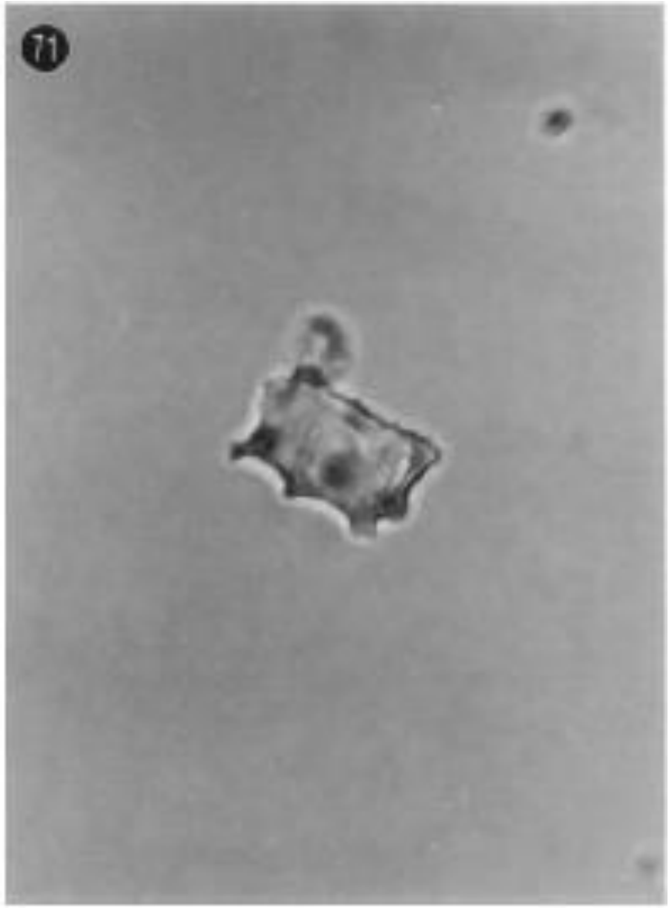


Fig. 6. Phytoliths from the fruitcases of teosinte, Race Balsas (Zea mays ssp. parviglumis). Both the long and short cells (producing rondel phytoliths) are silicified. This process is under the control of the gene tga1. Reprinted from Piperno (2006a), Copyright AltaMira Press

Piperno, Dolores R. 2009. Identifying Crop Plants with Phytoliths (and Starch Grains) in Central and South America: A Review and an Update of the Evidence. *Quaternary International* 193 (1–2):146–59.

Zea mays ssp. parviglumis var. parviglumis



Phytolith

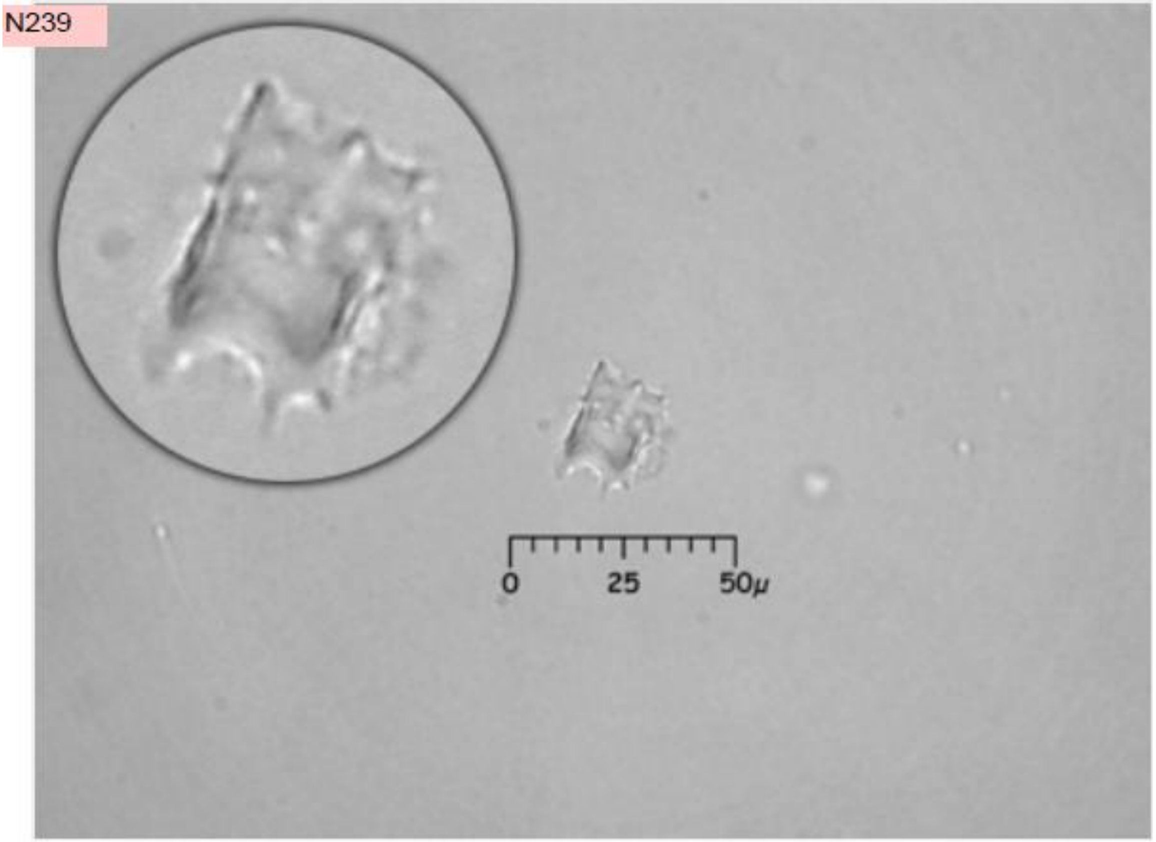
FIGURES 69-72.-71, A teosinte-specific epidermal-cell phytolith from the fruitcase of Balsas teosinte (Zea mays ssp. parviglumis var. parviglumis) (x400)

Piperno, Dolores R., and Deborah Marie Pearsall. 1998. The Silica Bodies of Tropical American Grasses: Morphology, Taxonomy, and Implications for Grass Systematics and Fossil Phytolith Identification. *Smithsonian Contribution to Botany* 85:1–40.

Zea perennis

Phytolith

Body with semi-circular cuts. Teosinte indicator.
Diagnostic level: wild Zea spp.



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

PTERIDACEAE

Pityogramma calomelanos

Phytolith

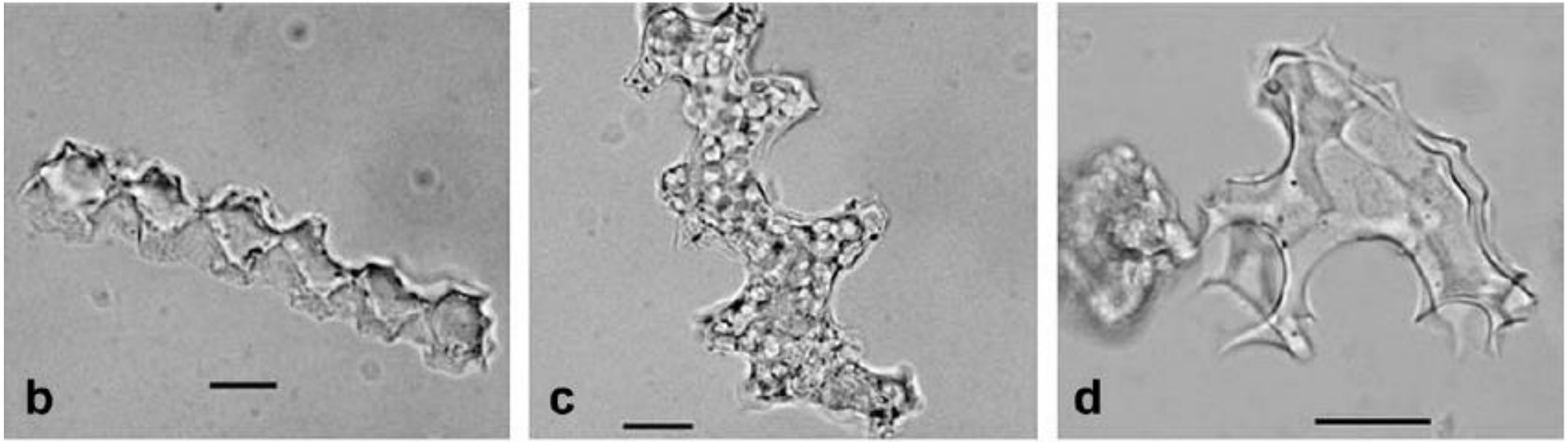


Fig. 6. Phytoliths from Pteridophytes. b) Elongated undulating body from Pityogramma calomelanos, c-d) Pitted bodies from P. calomelanos

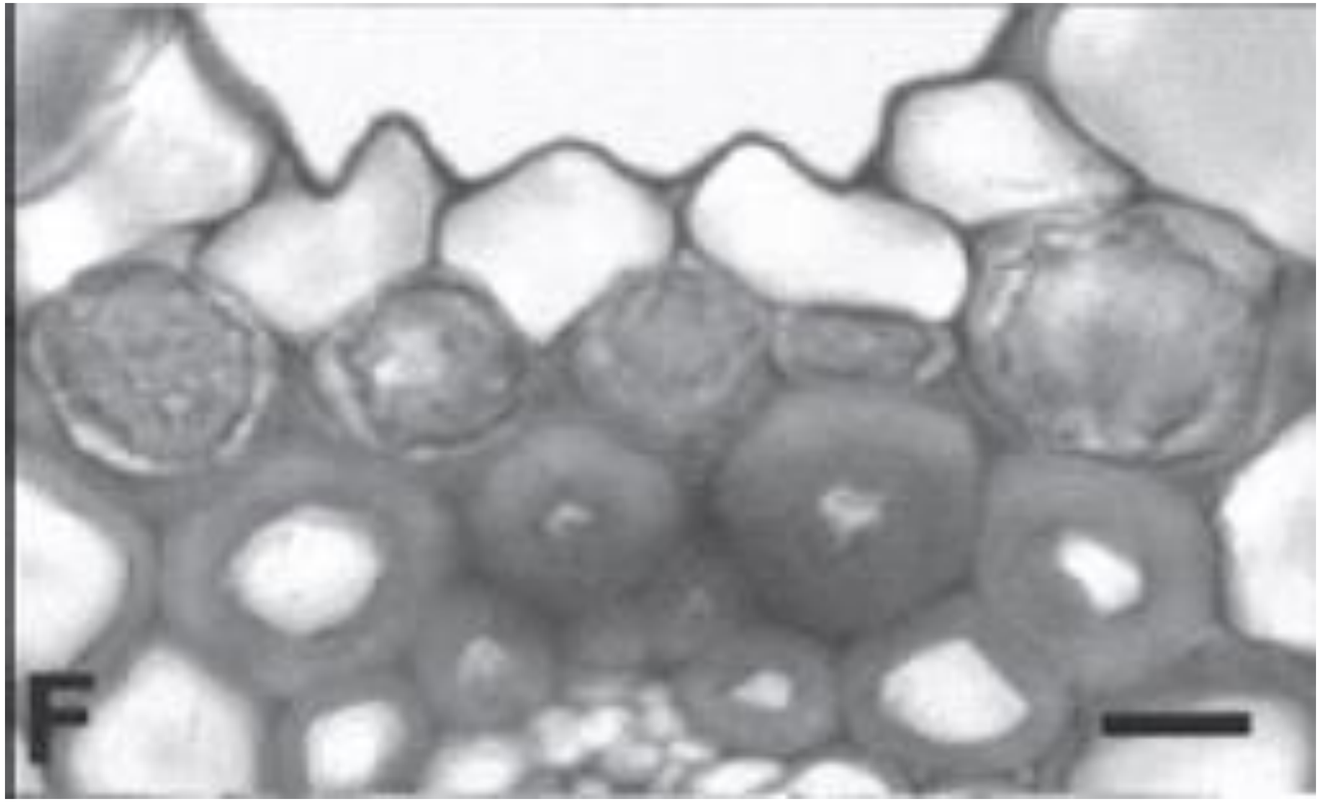
Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

RESTIONACEAE

Anthochortus ecklonii

Phytolith

Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. F. Anthochortus ecklonii (Restionaceae), spherical silica bodies overlying the sclerenchymatous bundle sheath (bar = 10μm).



Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Thamnochortus floribundus

Phytolith

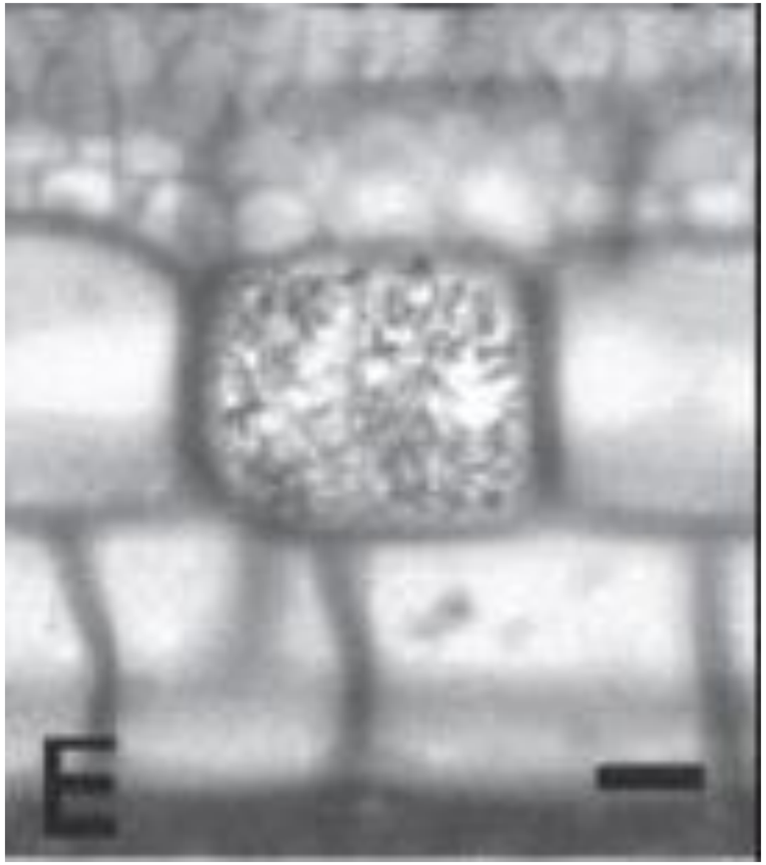


Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. E. Thamnochortus floribundus (Restionaceae), an irregular or granular form of silica observed in epidermal cells (bar = 10µm).

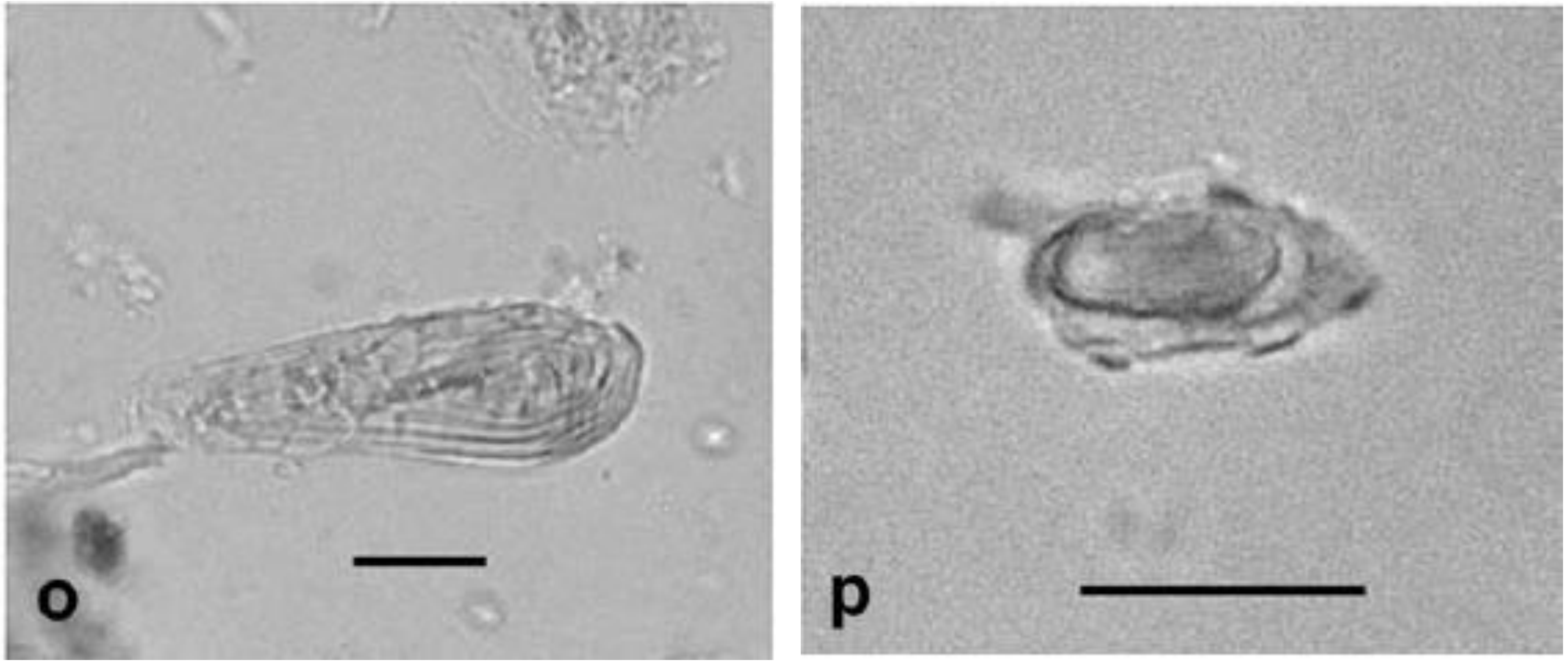
Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

SIMAROUBACEAE

Simarouba amara

Phytolith

Fig. 2. Phytoliths with little or no taxonomic value. n) Trichome with V1 material from S. amara o) Vesicular infilling from Simarouba amara.

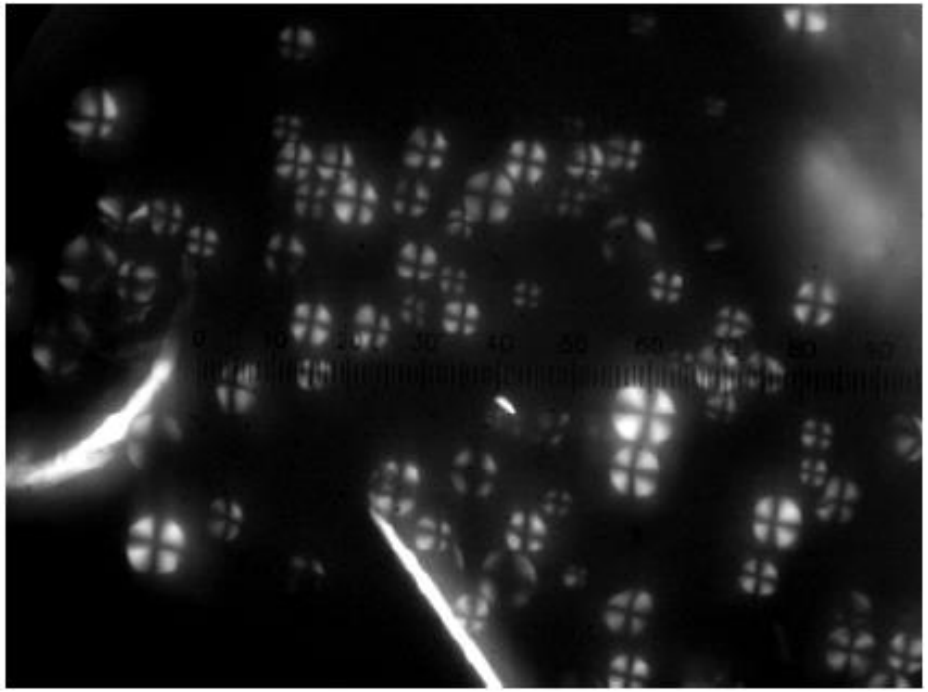


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

SMILACACEAE

Smilax dominguensis

Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

SOLANACEAE

Capsicum annum

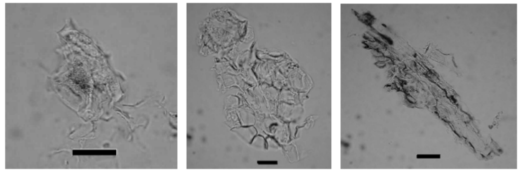
Solanaceae *Capsicum anuum* "ají"

Phytolith assemblage characterization

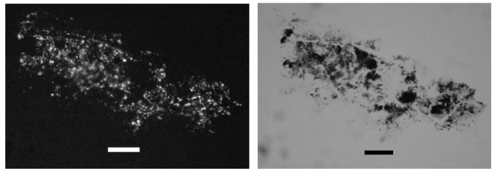
flower

Non diagnostic phytoliths:

a) Irregular epidermal silica cells.



b) Sub-spherical calcium oxalate phytoliths.



References: Reported as not present in Piperno 1988:35 (no specific part mentioned).

stem

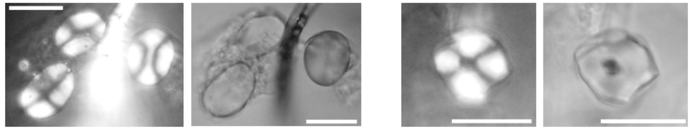
No phytoliths.

References: Reported as not present in Piperno 1988:35 (no specific part mentioned).

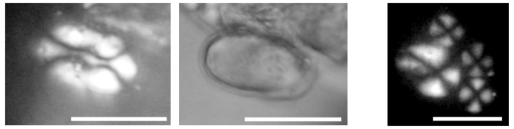
Starch assemblage characterization

fruit and seed

a) Mainly single grains, variable in shape, commonly oval, but also spherical, ellipsoidal, kidney-shaped, polyhedral and triangulate, with rounded sides; variable in size from 10µm to 23µm long length; rarely distinct hilum as a dot; not visible lamella; centric cross, with four arms visible, intersecting at a point or line, or meeting two by two.



b) Some compound grains, oval, *ca.* 22µm, compounded by two granula, with a single external packing. Granula different in size, ranging from 12µm to 15µm, distinct cross with four arms visible, meeting two by two.



Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Capsicum sp.

Starch

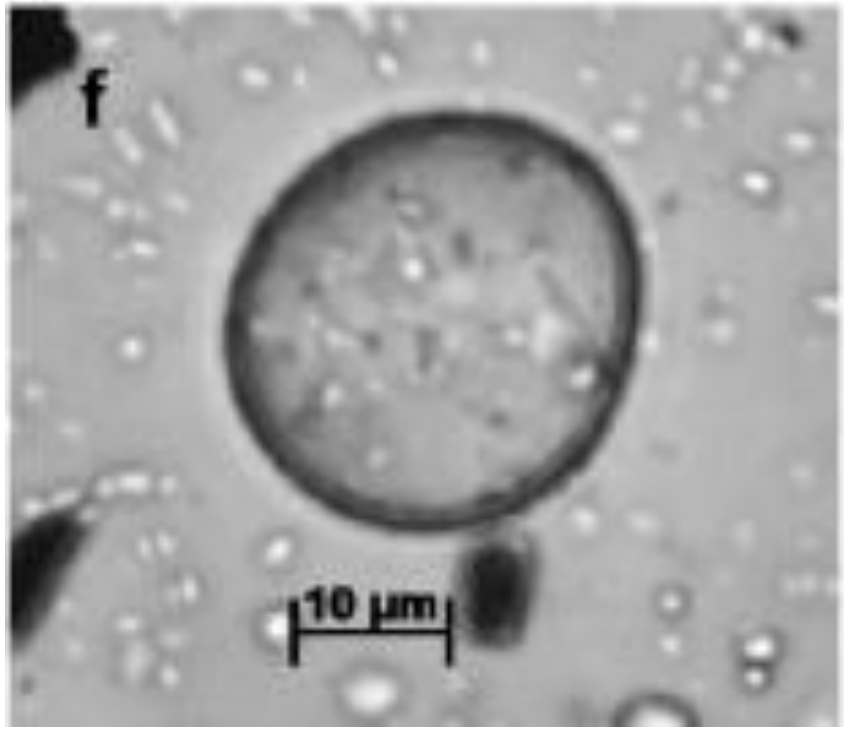


Fig. 5. Selected microbotanical remains. Starch grains: f) cf. Capsicum sp. (SAL 06-2-1671)

Dickau, Ruth, Maria C. Bruno, José Iriarte, Heiko Prümers, Carla Jaimers Betancourt, Irene Holst, and Francis E. Mayle. 2011. Diversity of Cultivars and Other Plant Resources Used at Habitation Sites in the Llanos de Mojos, Beni, Bolivia: Evidence from Macrobotanical Remains, Starch Grains, and Phytoliths. *Journal of Archaeological Science*. Elsevier Ltd, 1–14.

Capsicum sp.

Starch

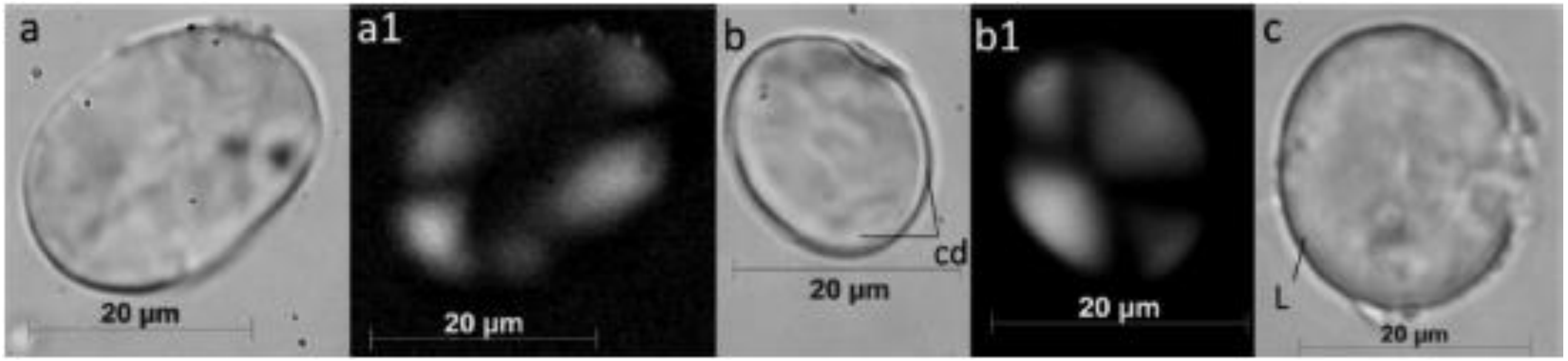
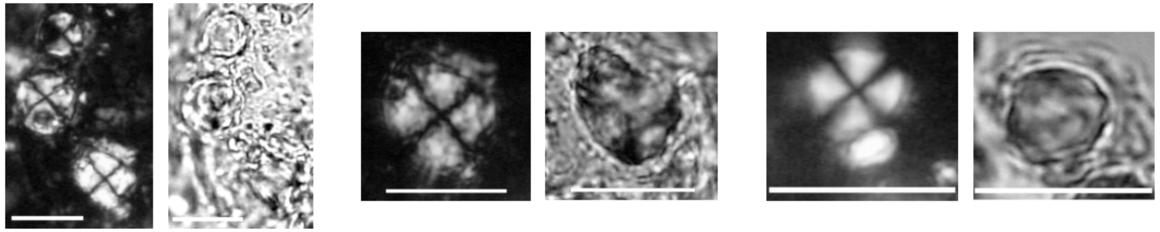


Fig. 7. Chili pepper starch grains from St. John and Eva 2. a, lenticular starch showing a lightly rough surface; a1, the same starch with smooth extinction cross; b, lenticular starch with a big central depression (“cd”); b1, the same starch with bright extinction cross; c, lenticular starch with partially exposed lamellae (“L”). Provenances: starches a and b (artifact E-4); c (artifact SJ-4).

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Nicotiana tabacum

Solanaceae *Nicotiana tabacum* "tabaco"

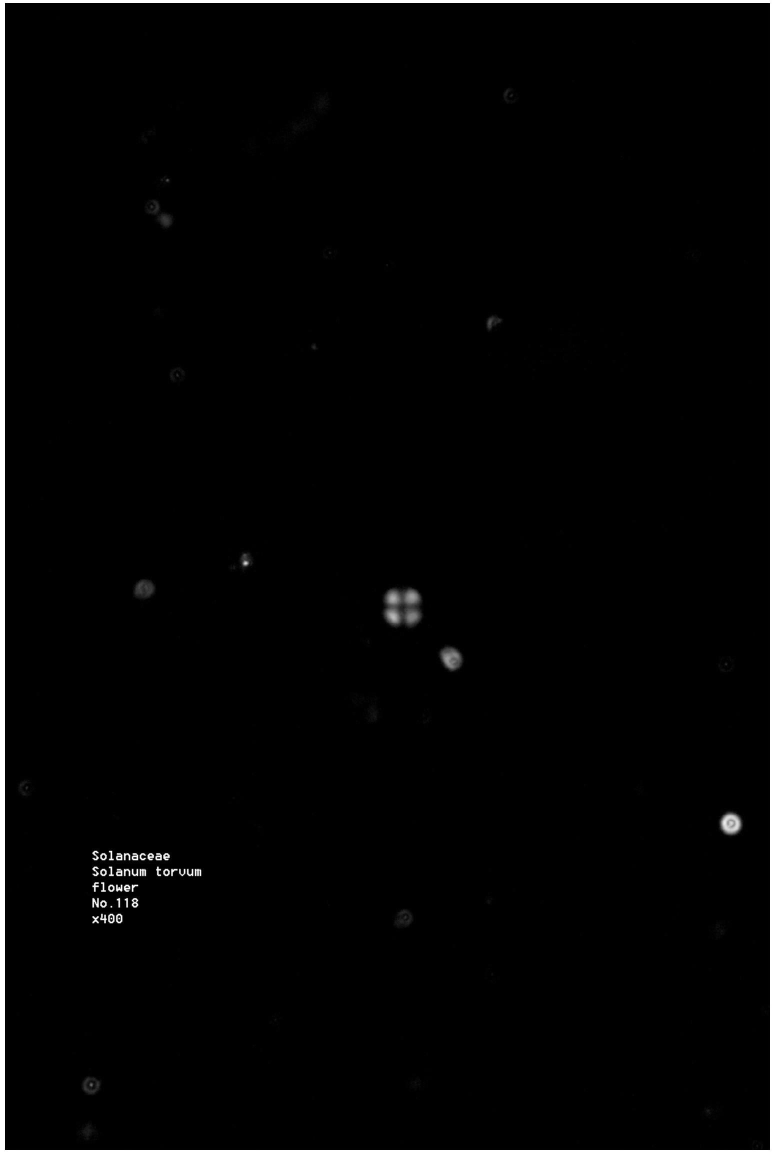
	Phytolith assemblage characterization
leaf	No silica phytoliths. **References:** Mentioned but not reported in Bozarth 1987 and 1990.
	Starch assemblage characterization
leaf	a) Single grains, oval, spherical, polyhedral, and bell-shaped grains, with wavy end; variable in size from 12µm to 20µm long length; not visible hilum and lamella; centric cross, with four arms visible. 

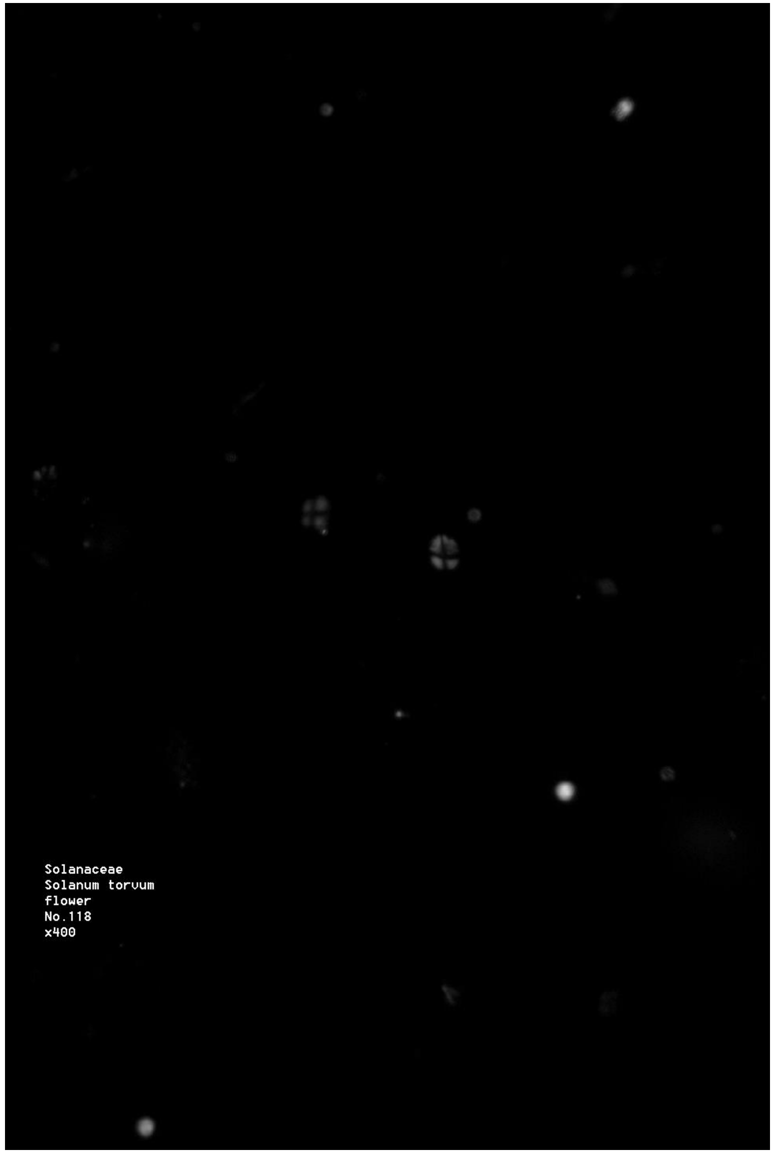
Scale bar = 20µm.

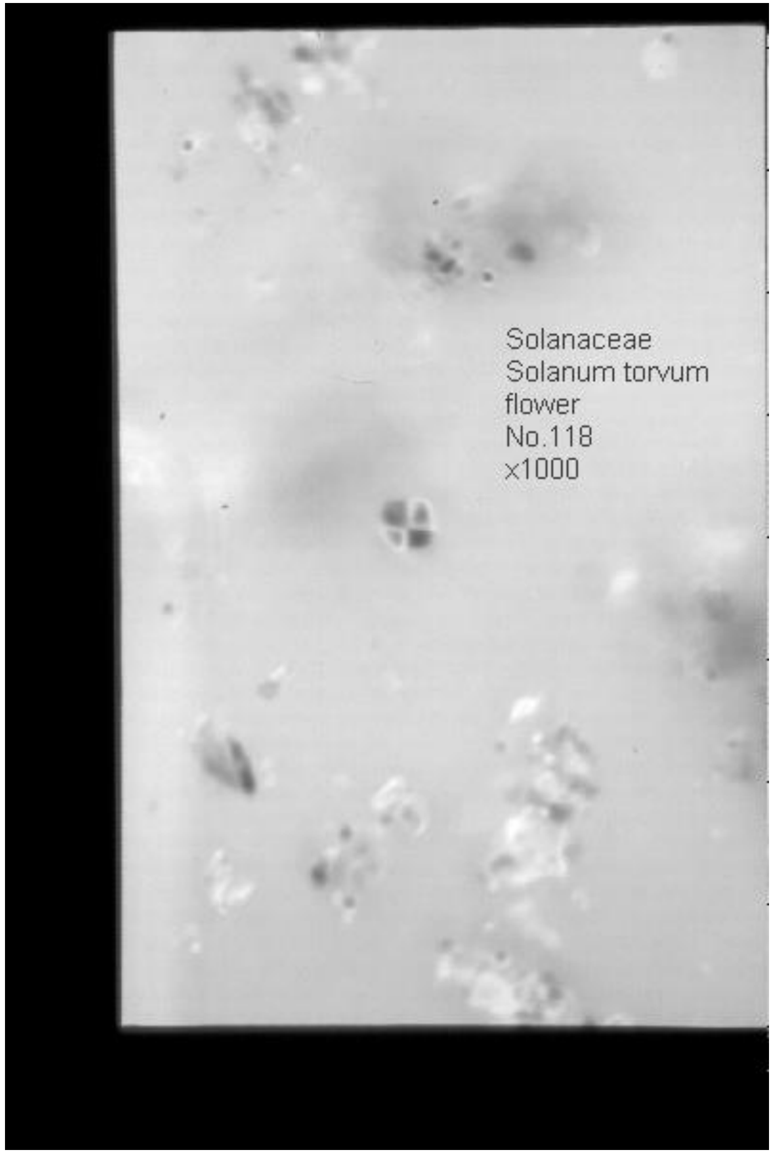
Korstanje and Babot,
McCown Archaeobotany
Laboratory Collection

Solanum torvum

Australian Museum,
McCown Archaeobotany
Laboratory Collection







Solanum tuberosum

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

Solanaceae *Solanum tuberosum* "papa"

Phytolith assemblage characterization

tuber, stem and leaf

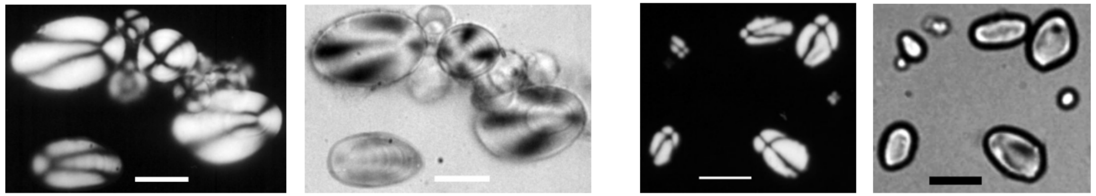
No silica phytoliths.

References: Reported as not present for *Solanum nigrum* (no specific part mentioned) (Piperno 1988:35).

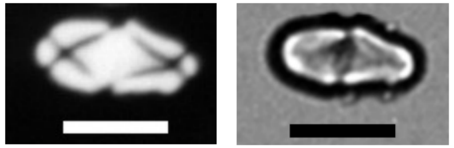
Starch assemblage characterization

tuber

a) Single grains, oval, ellipsoidal, ovoid, spherical, sausage- and pear-shaped, with a narrow end generally rounded or truncated; variable in size, frequently over 100μm, to 120μm long length; distinct highly eccentric hilum, usually at rounded end, occasionally double, as a circle or line; very distinct lamella; distinct eccentric cross, to the broader end, with four arms visible, two long and two short.



b) Compound grains, compounded by two granula. Granula similar in shape and size, bell- and bowl-shaped, with one truncated, concave or convex end.



References: Partially based on Fitt and Maywald Snyder 1984, Reichert 1913, Shannon and Garwood 1984, Winton and Winton 1932.

Scale bar = 20μm.

Solanum tuberosum

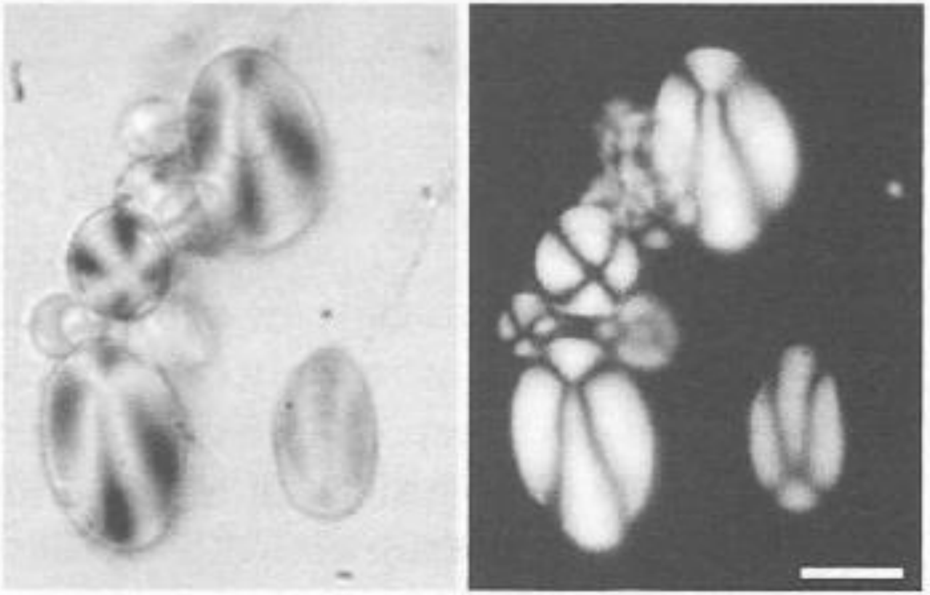
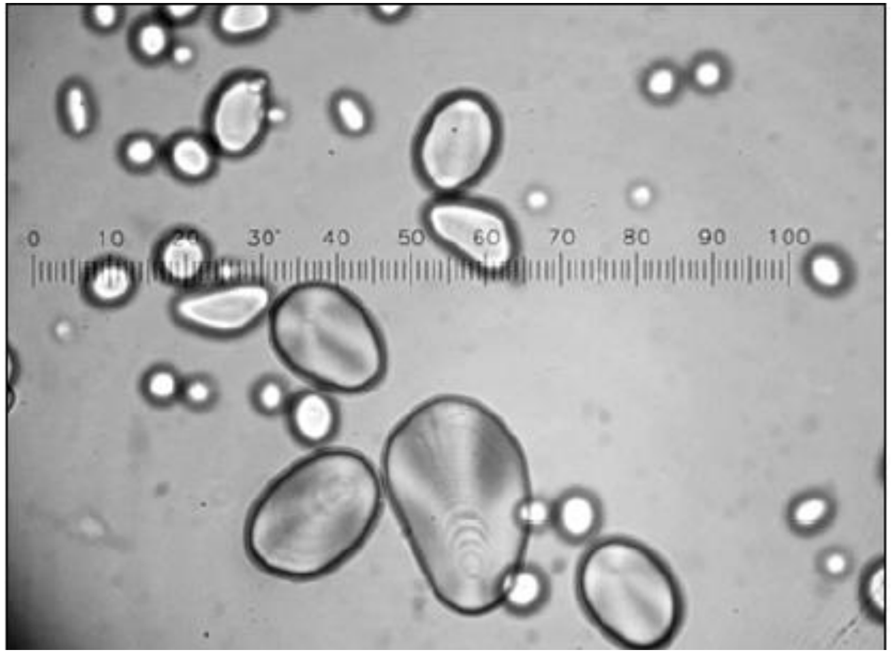


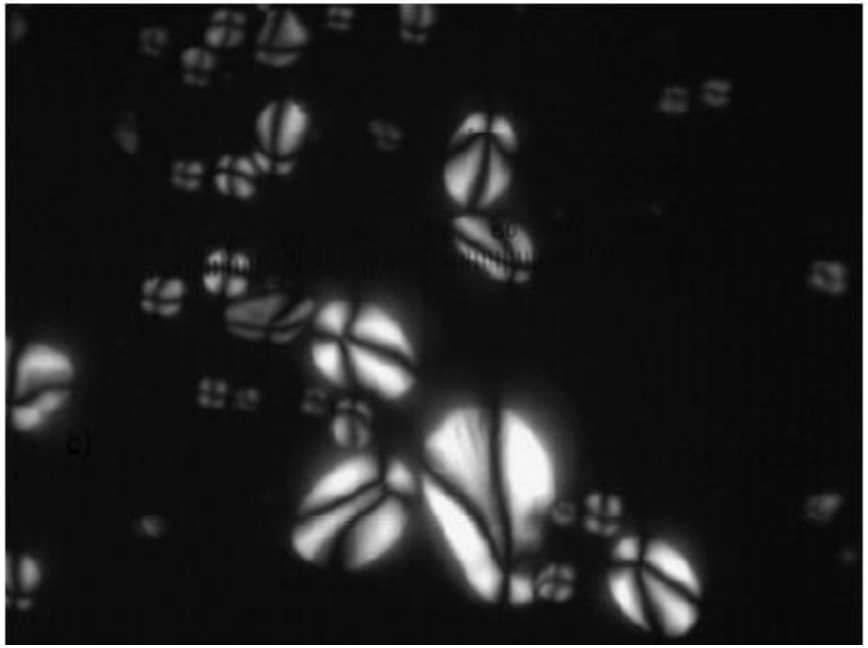
Figure 4. White potato non-processed starch grains. Views with normal (left) and polarised light (right). Scale bar = 20μm.

Babot, María del Pilar. 2003. Starch Grain Damage as an Indicator of Food Processing. In *Phytolith and Starch Research in the Australian-Pacific-Asian Regions: The State of the Art*.

Solanum tuberosum

Starch



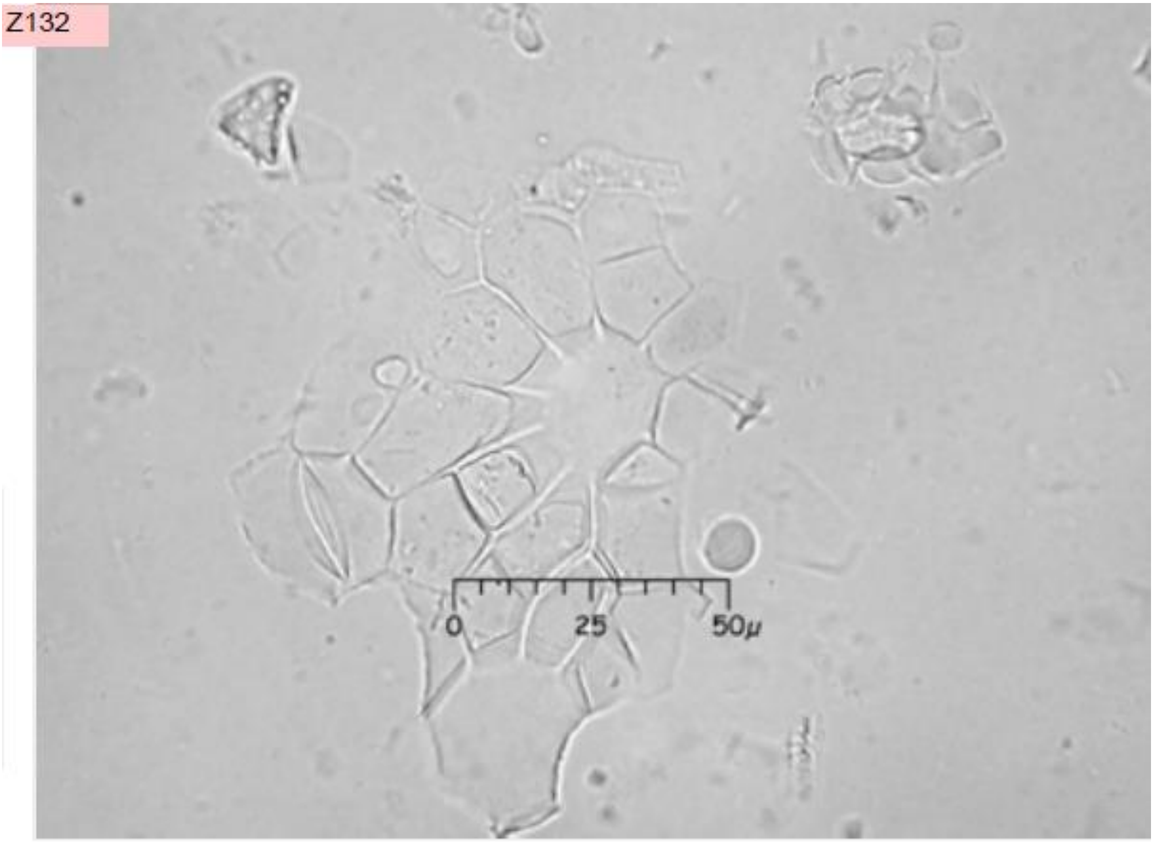


Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

STERCULIACEAE

Guazuma ulmifolia

Phytolith



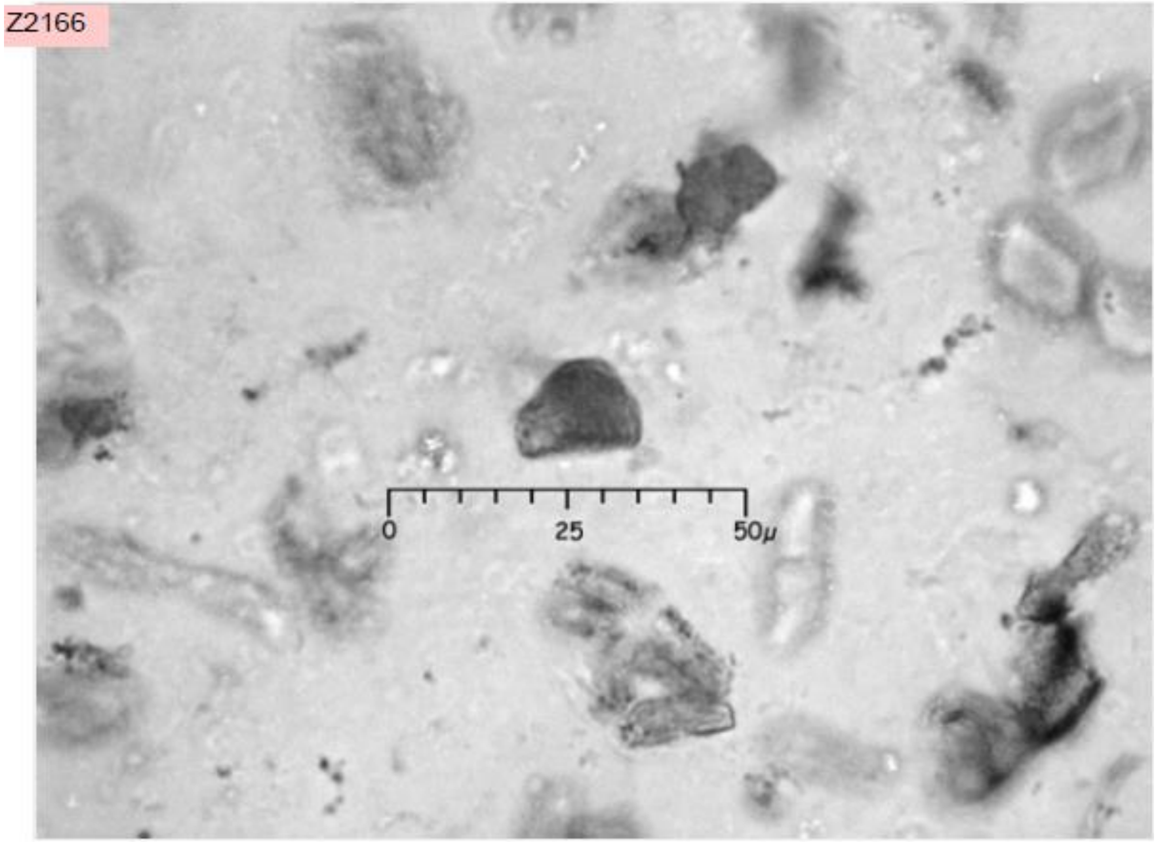
Hair base. Lightly silicified. First described by C. Veintimilla, 1991. Diagnostic level: mixed Guazuma, Erythrina, Lithospermum

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Guazuma ulmifolia

Phytolith

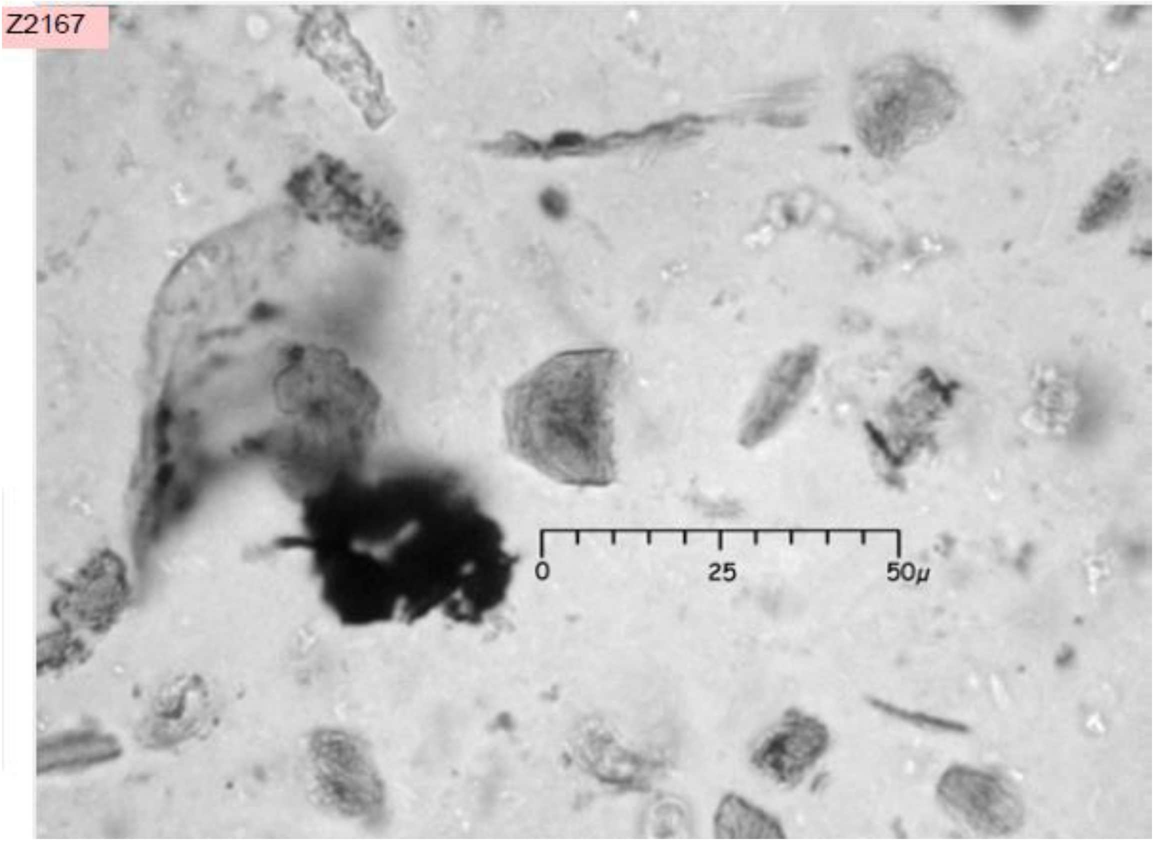
PC 2870, wood specimen
Diagnostic level: under study



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Guazuma ulmifolia

Phytolith



PC 2870, wood specimen
Diagnostic level: under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Guazuma ulmifolia

Phytolith

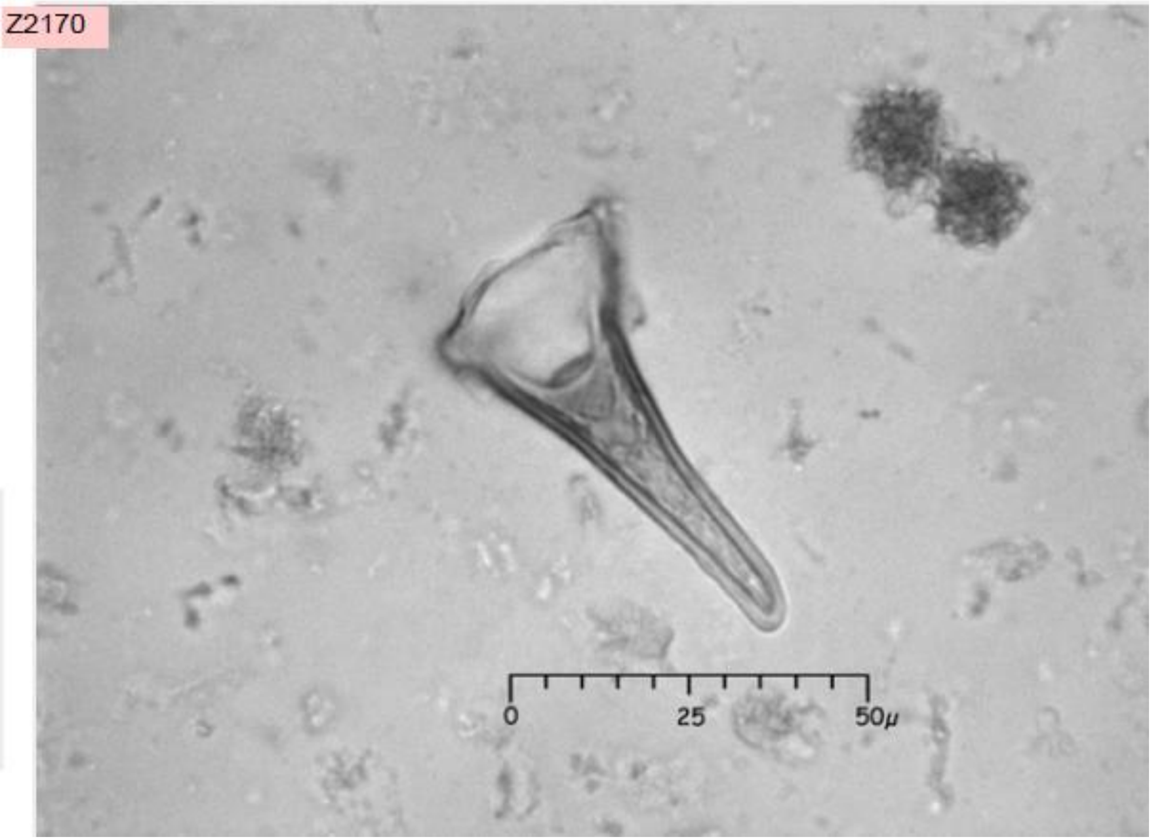
PC 2870, wood specimen
Diagnostic level: under study

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Wattheria americana

Phytolith

PC Clark 33
Diagnostic: Watteria, Sterculiaceae



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Waltheria indica

Phytolith

4. Silicified tracheid from Waltheria indica (400 x).

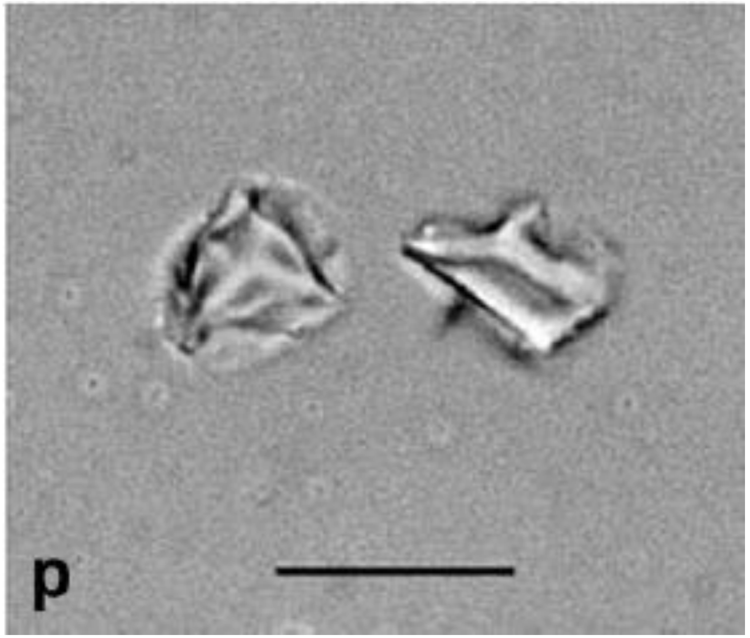
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

STRELITZIACEAE

Phenakospermum guianensis

Phytolith

Fig. 3. Phytoliths from non-grass monocots. p) Druse-like bodies from Phenakospermum guianensis

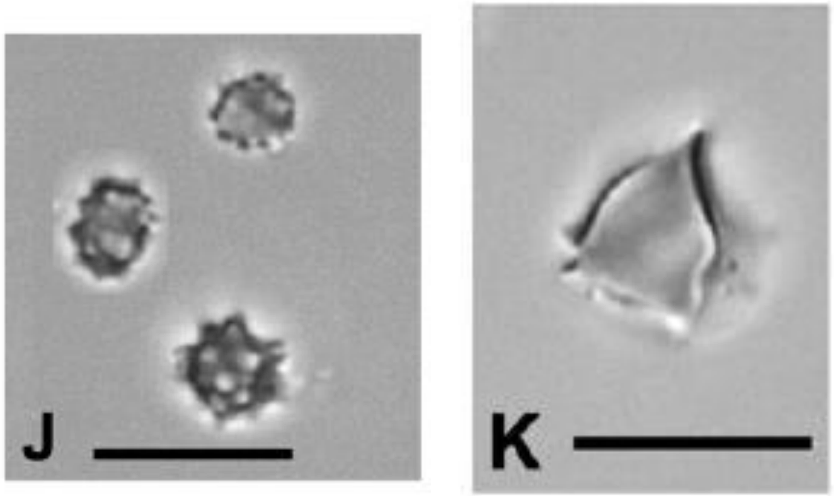


Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

Phenakospermum guyannense

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). J, globular-microechinate from Phenakospermum guyannense floral bract. K, non-fringed D1 druse from Phenakospermum guyannense floral bract. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Ravenala madagascariensis

Phytolith

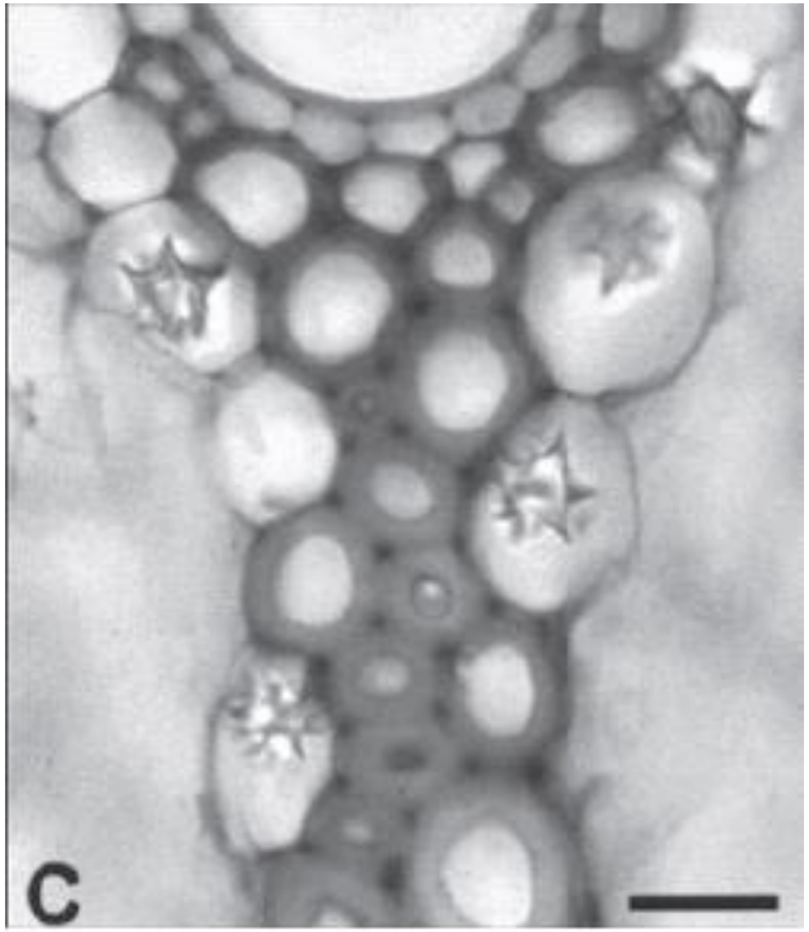


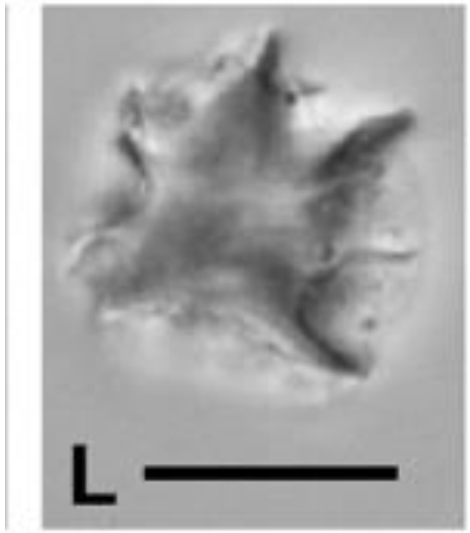
Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. C. Ravenala madagascariensis (Strelitziaceae), spiny silica bodies in vascular bundle-sheath cells (bar = 10µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Ravenala madagascariensis

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). L, fringed D1 druse from Ravenala madagascariensis leaf. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Strelitzia augusta

Phytolith

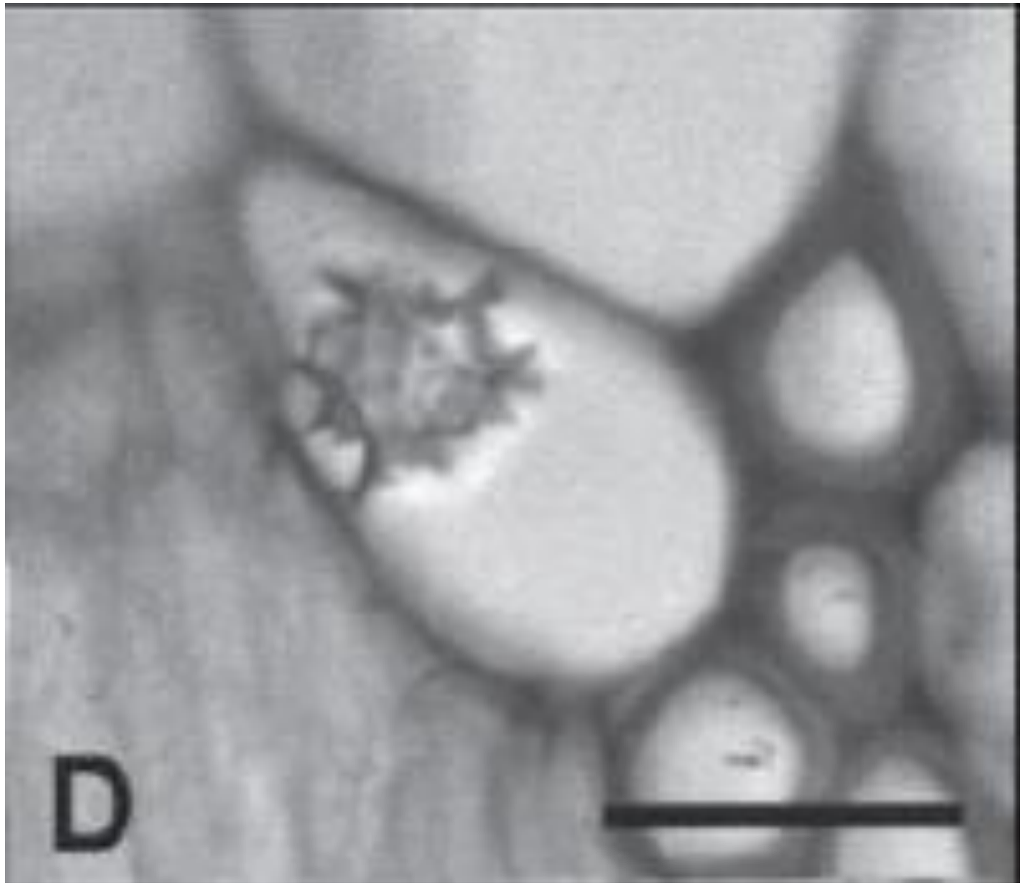


Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. D. Strelitzia augusta (Strelitziaceae), a bundle-sheath cell containing a druse-like silica body (bar= 20µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Strelitzia reginae

Phytolith

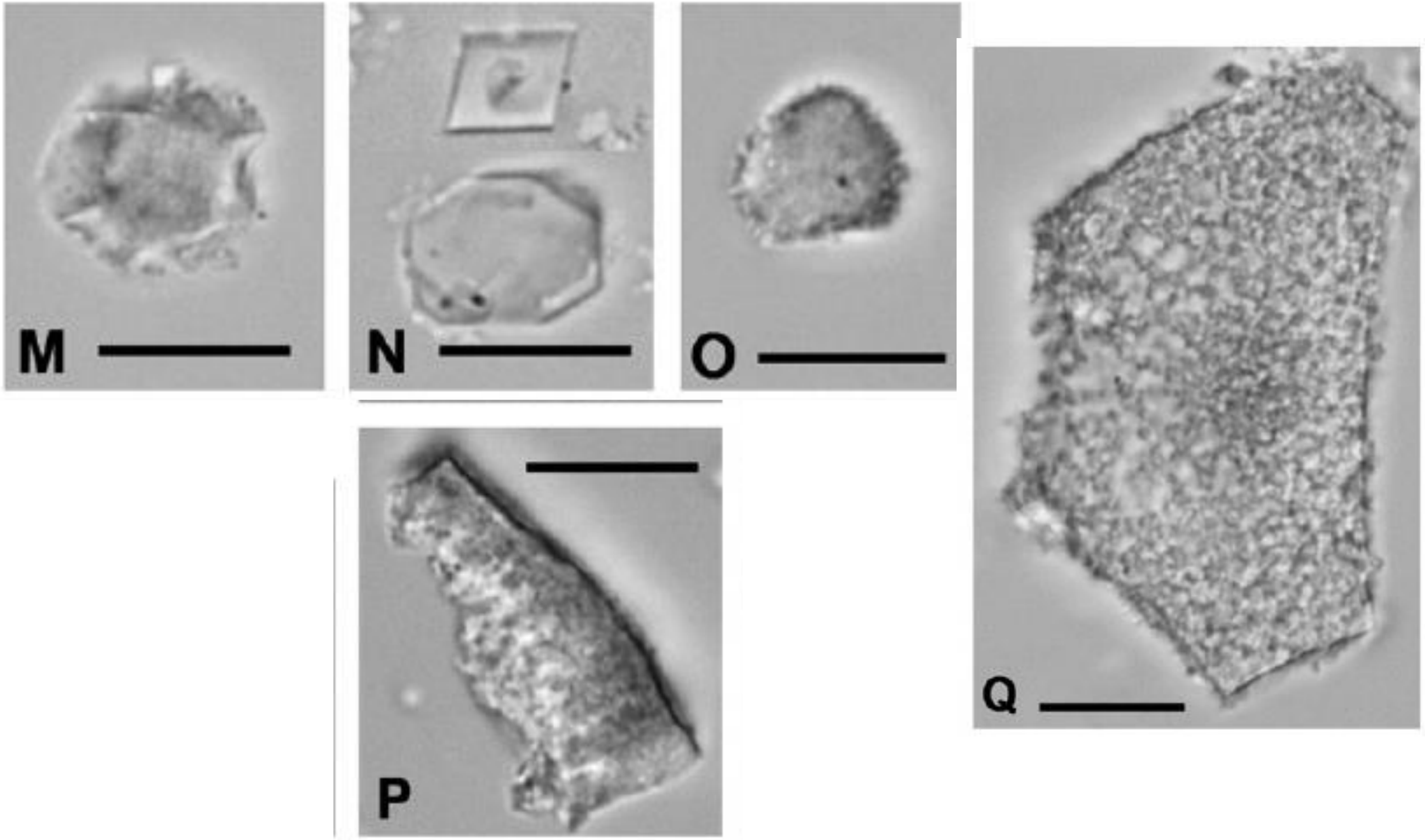


Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). M, D2 druse from Streltizia reginae leaf. N, small, Ta4 (tabular-psilates) from Streltizia reginae leaf. O, globular-microrugulate from Strelitzia reginae seed. P, side-view of Ta2 (tabular-ruminate) from Strelitzia reginae seed. Q, top-view of Ta2 tabular from Strelitzia reginae seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

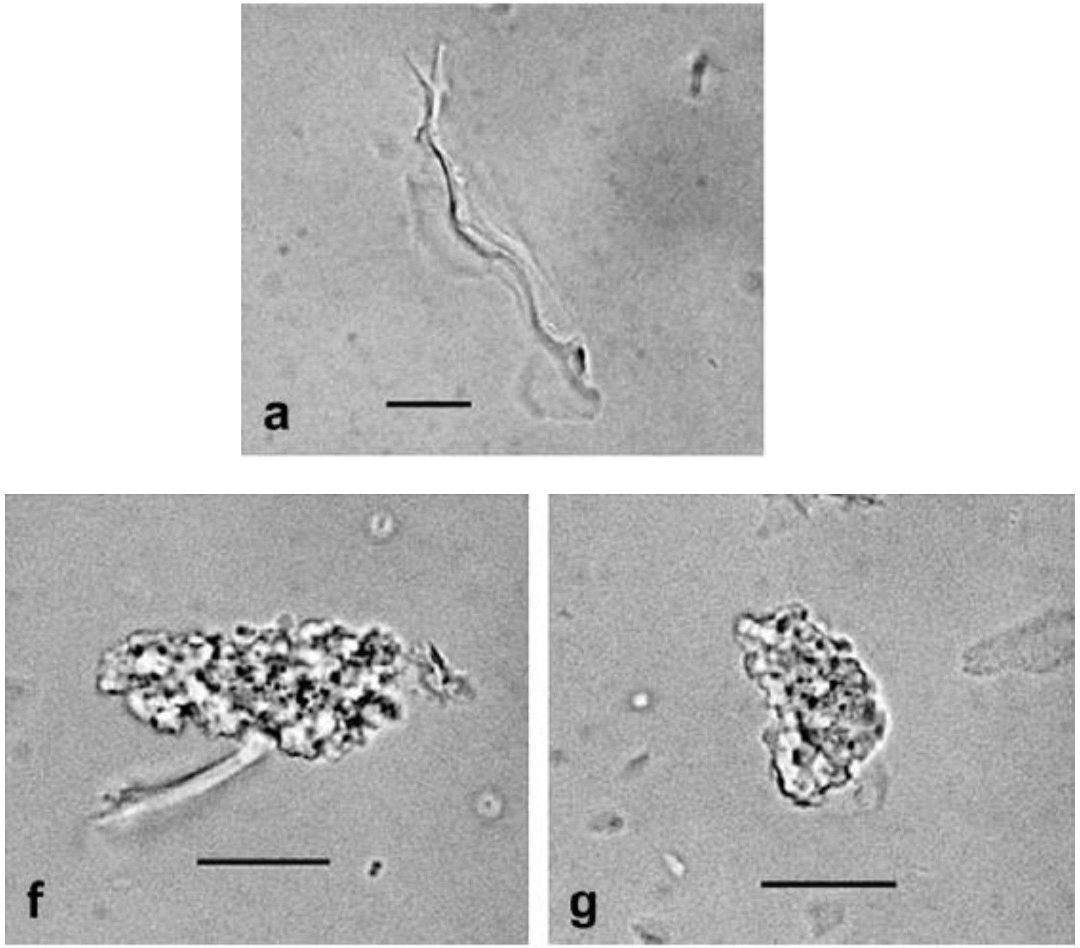
Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

THELYPTERIDACEAE

Thelypteris confluens

Phytolith

Fig. 6. Phytoliths from Pteridophytes. a) Epidermal phytolith from Thelypteris confluens, f-g) Aspherical granulate bodies from T. confluens



Watling, Jennifer, and José Iriarte. 2013. Phytoliths from the Coastal Savannas of French Guiana. *Quaternary International* 287:162–80.

THURNIACEAE

Thurnia jenmanii

Phytolith

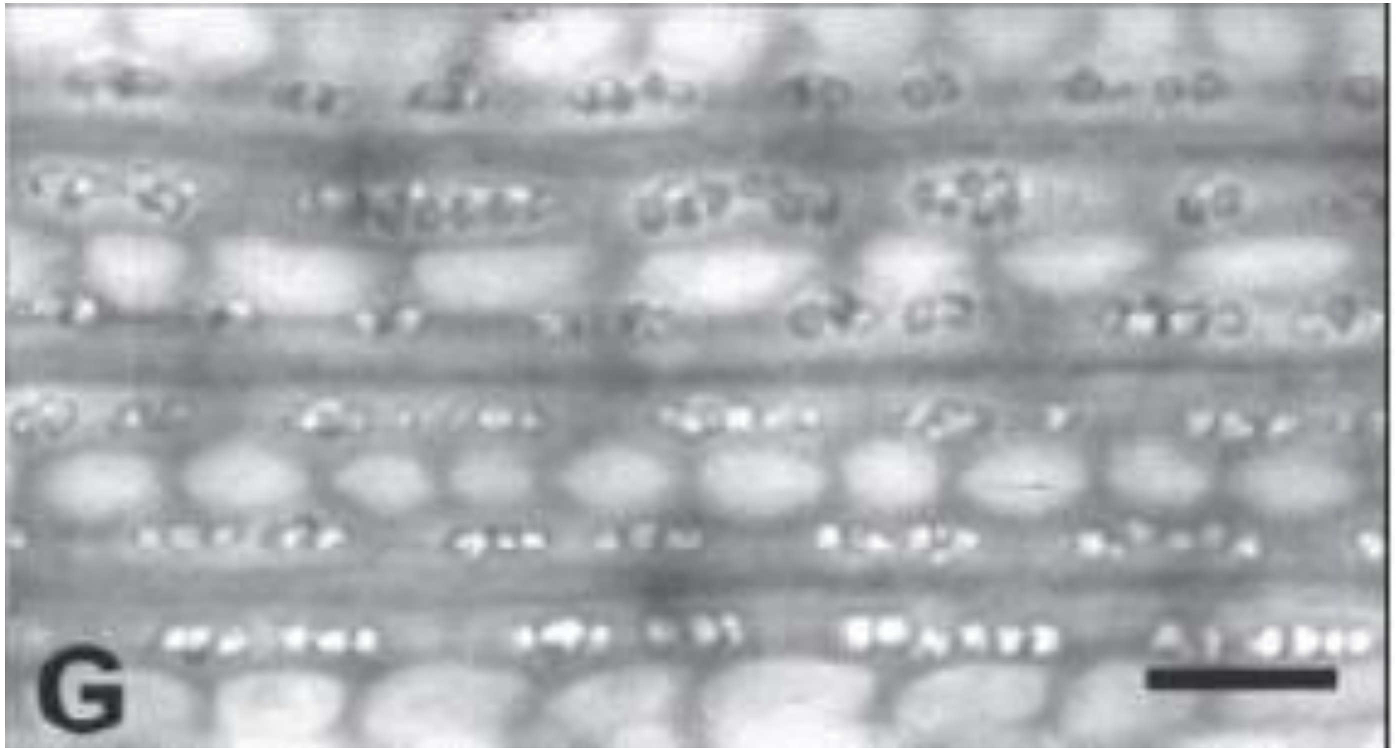


Fig. 5. Various silica body morphologies found in the order Poales and in Dasypogonaceae. G. Thurnia jenmanii (Thurniaceae), numerous small spherical/nodular bodies in epidermal cells (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

TROPEOLACEAE

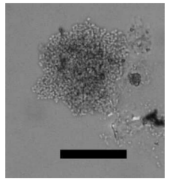
Tropeolum tuberosum

Tropeolaceae ***Tropaeolum tuberosum*** **“mashua”**

Phytolith assemblage characterization

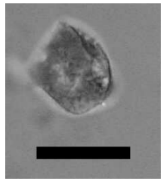
tuber

No silica phytoliths **(*):**
a) Amorphous granulate oxalates. Rare.



stem

No diagnostic phytoliths **(*):**
a) Semi-spherical dense silica phytolith.



leaf

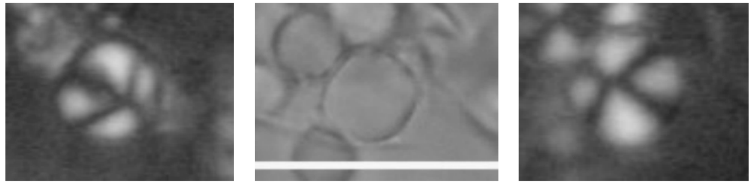
No phytoliths **(*).**

Starch assemblage characterization

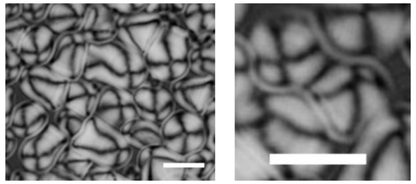
tuber

a)Single grains, globular or subglobular; less than 7µm.

b)Single grains, generally symmetrical, globular, subglobular, truncated, ovoid, spherical and bell-shaped; from 4µm to 28µm long length; very distinct lamella; distinct eccentric cross to the rounded end, with well definite dark arms intersecting at one point, two long and two short.



c) Compound grains compounded by two-three granula. Granula, generally unequal, with at less a symmetry axis.



References: Partially based on Cortella and Pochettino 1995.

Scale bar = 20µm.

Korstanje and Babot, McCown Archaeobotany Laboratory Collection

ULMACEAE

Altis spinosa

Phytolith

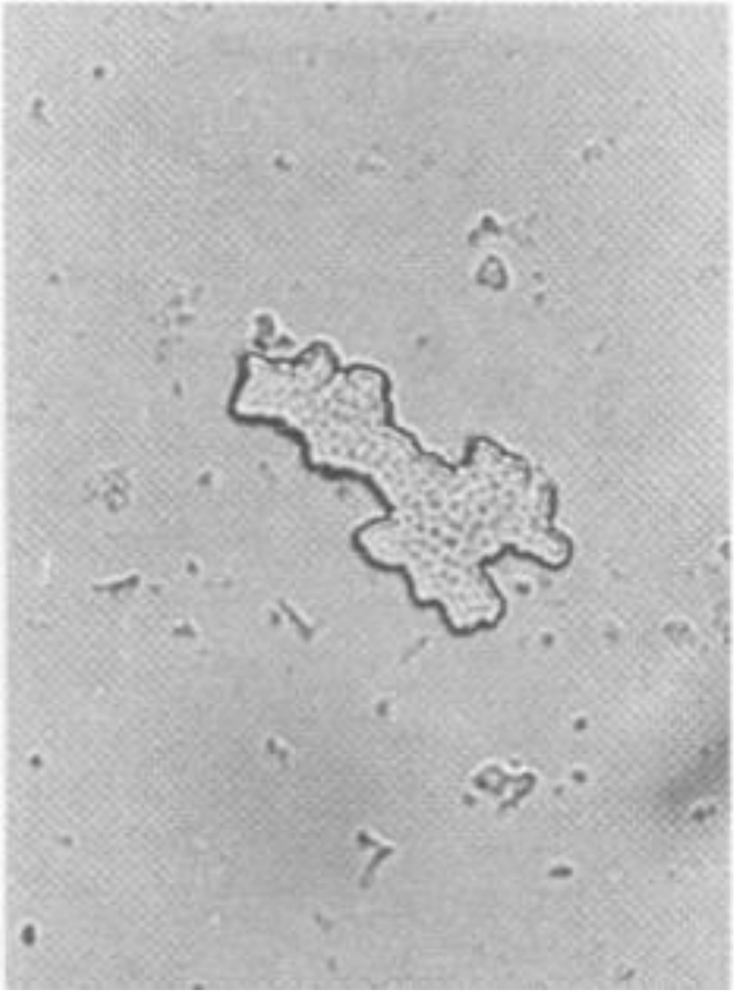


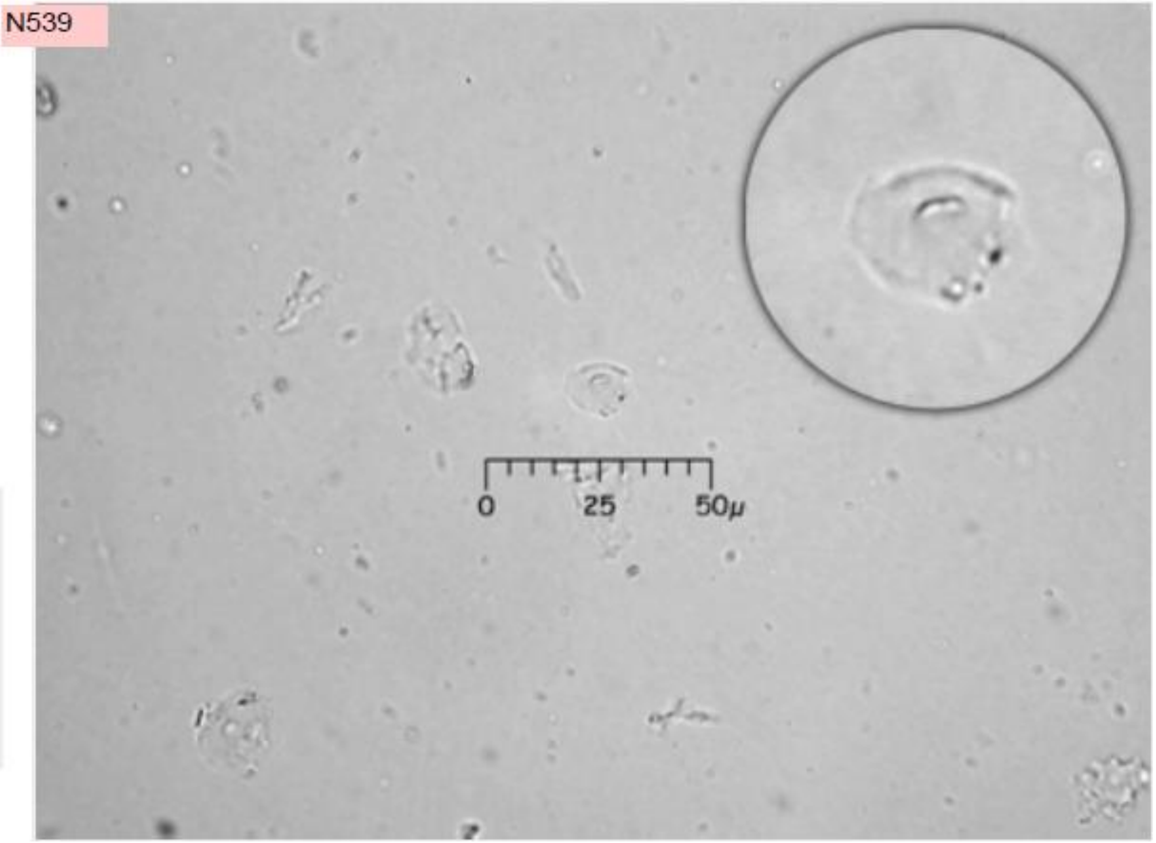
Fig. 6. A family-specific phytolith from the fruit of Altis spinosa (Ulmaceae).

Piperno, Dolores R. 1998. Paleoethnobotany in the Neotropics from Microfossils: New Insights into Ancient Plant Use and Agricultural Origins in the Tropical Forest. *Journal of World Prehistory* 12 (4):393–449. http://www.tandfonline.com/doi/abs/10.1080/07352680490273220.

Celtis schippii

Phytolith

20 V a,b, and c separated only by arrangement of conical bodies. 20 V Ca describes when these conical bodies occur singly. Diagnostic level: species

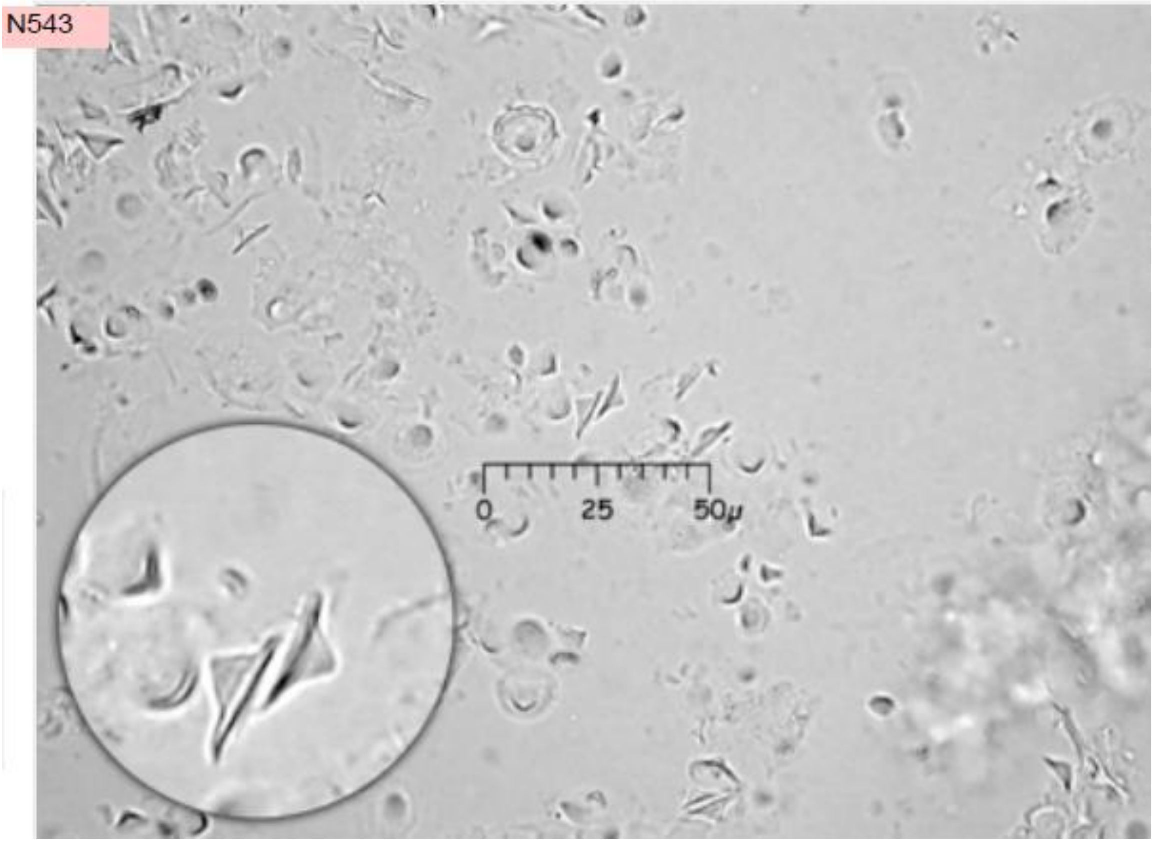


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

Occurs singly in Celtis schippii leaf and fruit.
20 V a,b, and c separated only by arrangement of conical bodies. 20 V Ca descibes a singly occuring conical body. 20 V Cb describes when 2 of these bodies are fused along their flat surfaces. 20 V Cc describes when these conical

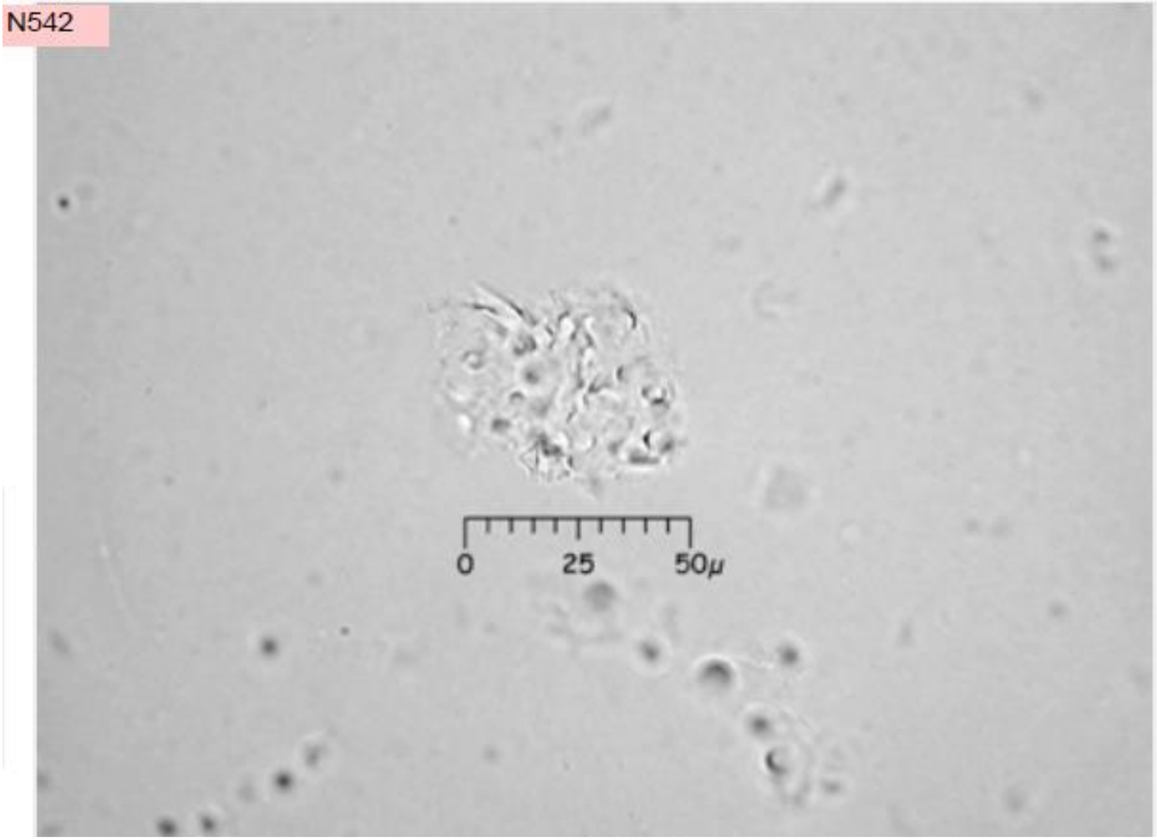


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

20 V a,b, and c separated only by arrangement of conical bodies. 20 V Cc describes when these conical bodies occur in fused masses. Diagnostic level: species

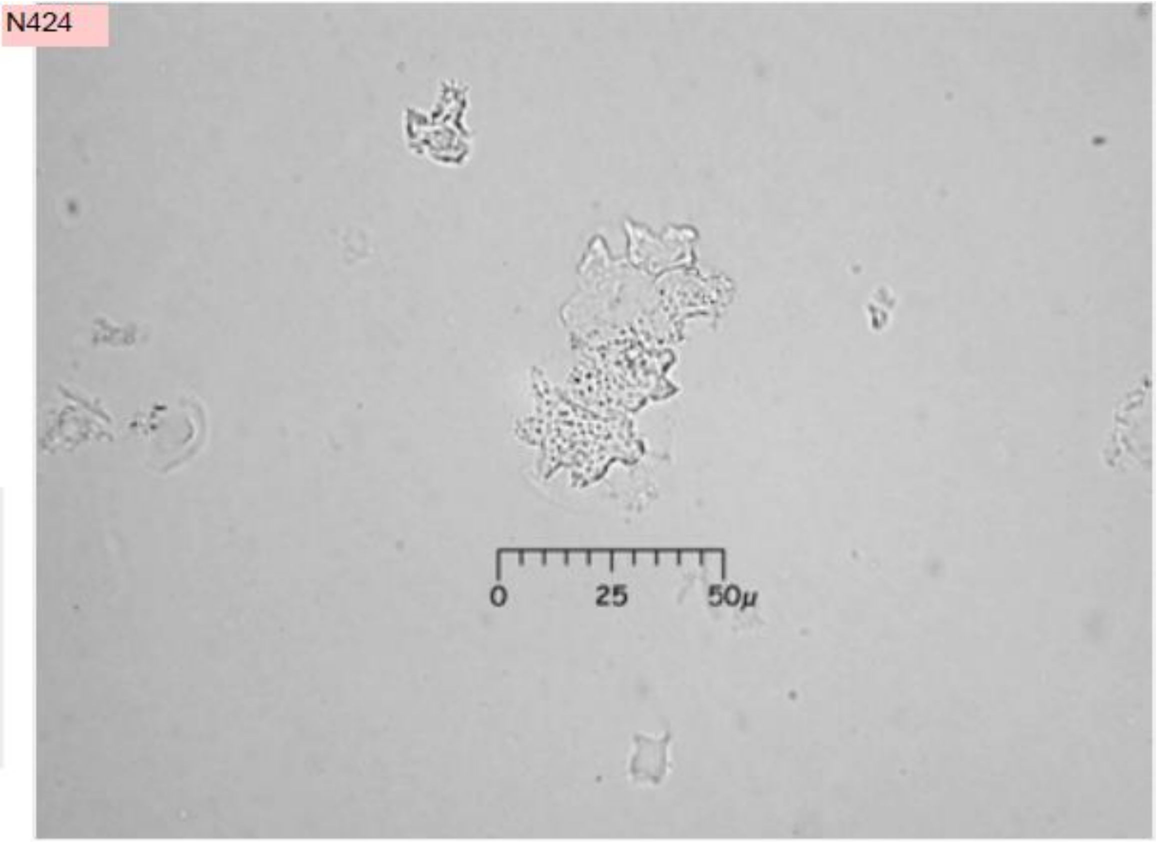


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

Seed or fruit epidermal cells. Diagnostic level: species

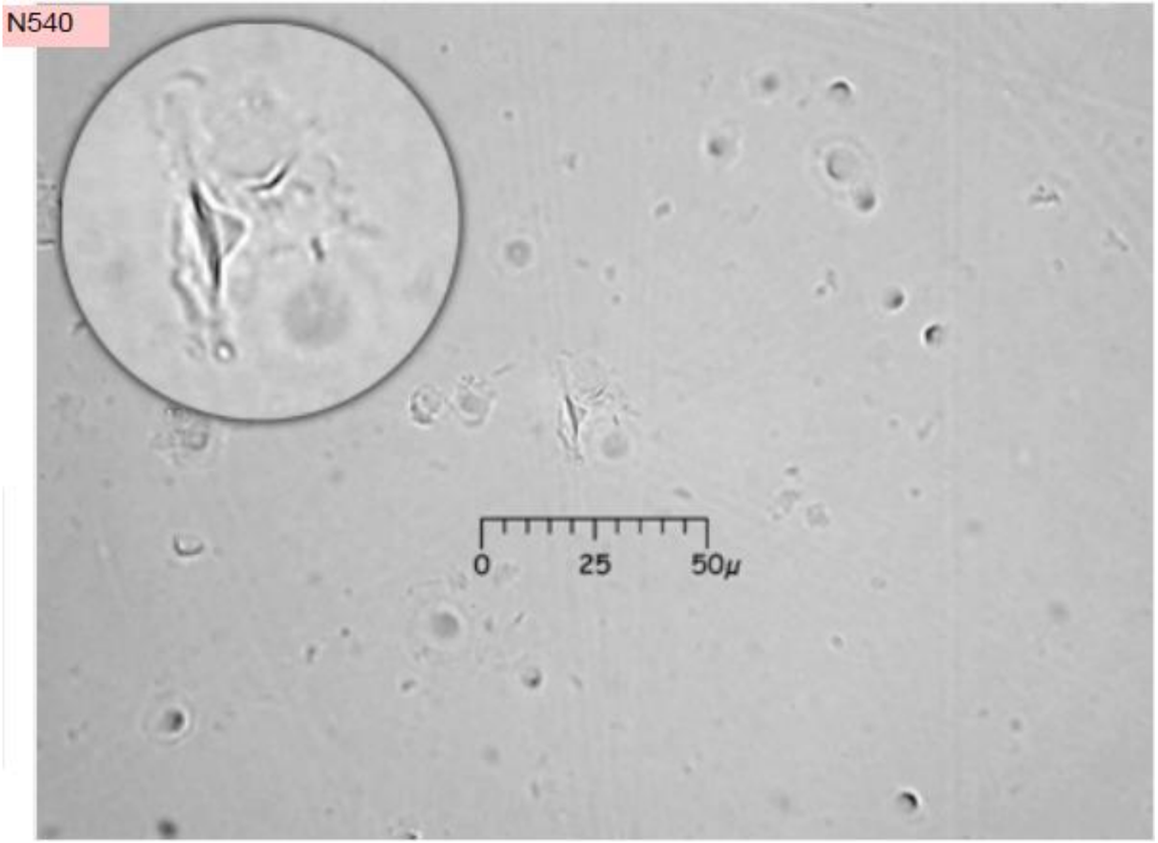


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

See Record #61 for another view. 20 V a,b, and c separated only by arrangement of conical bodies. 20 V Ca describes when these conical bodies occur singly. Diagnostic level: species

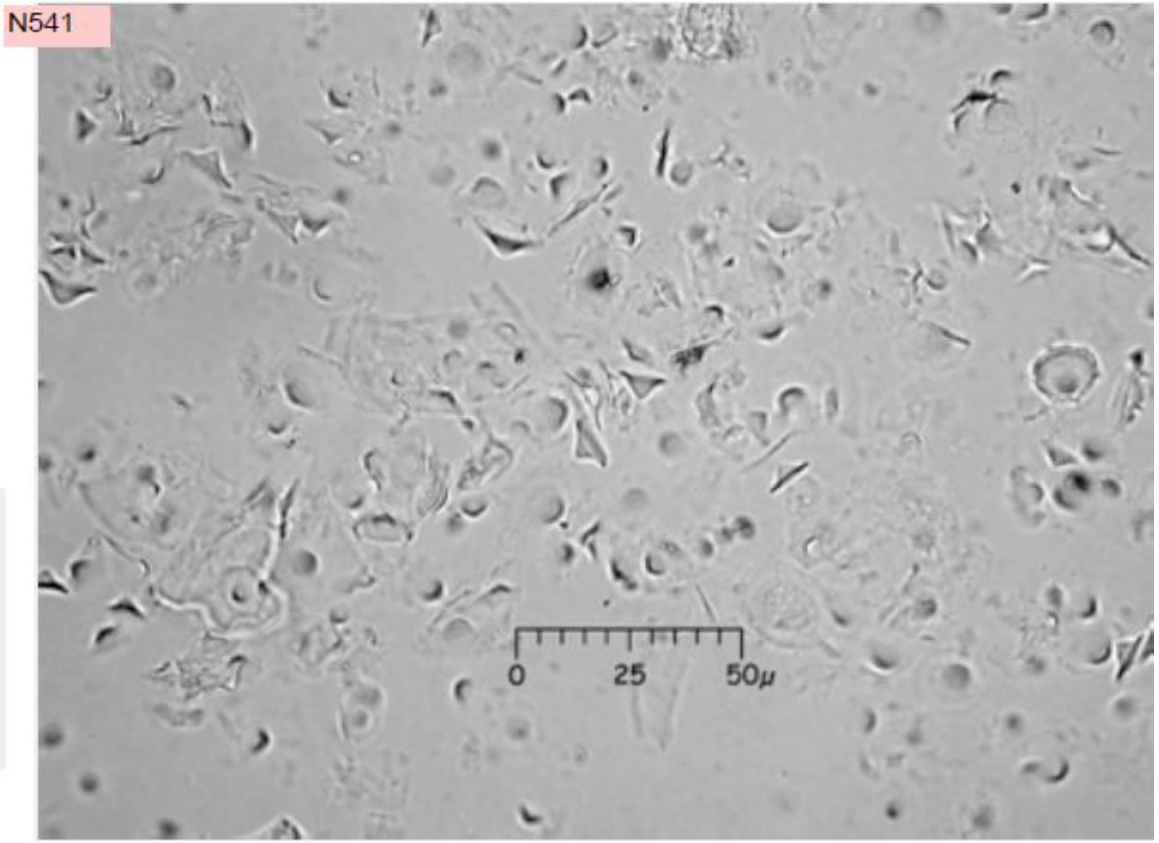


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

See Record #63 for another view. 20 V a,b, and c separated only by arrangement of conical bodies. 20 V Cc describes when these conical bodies occur in fused masses. Diagnostic level: species

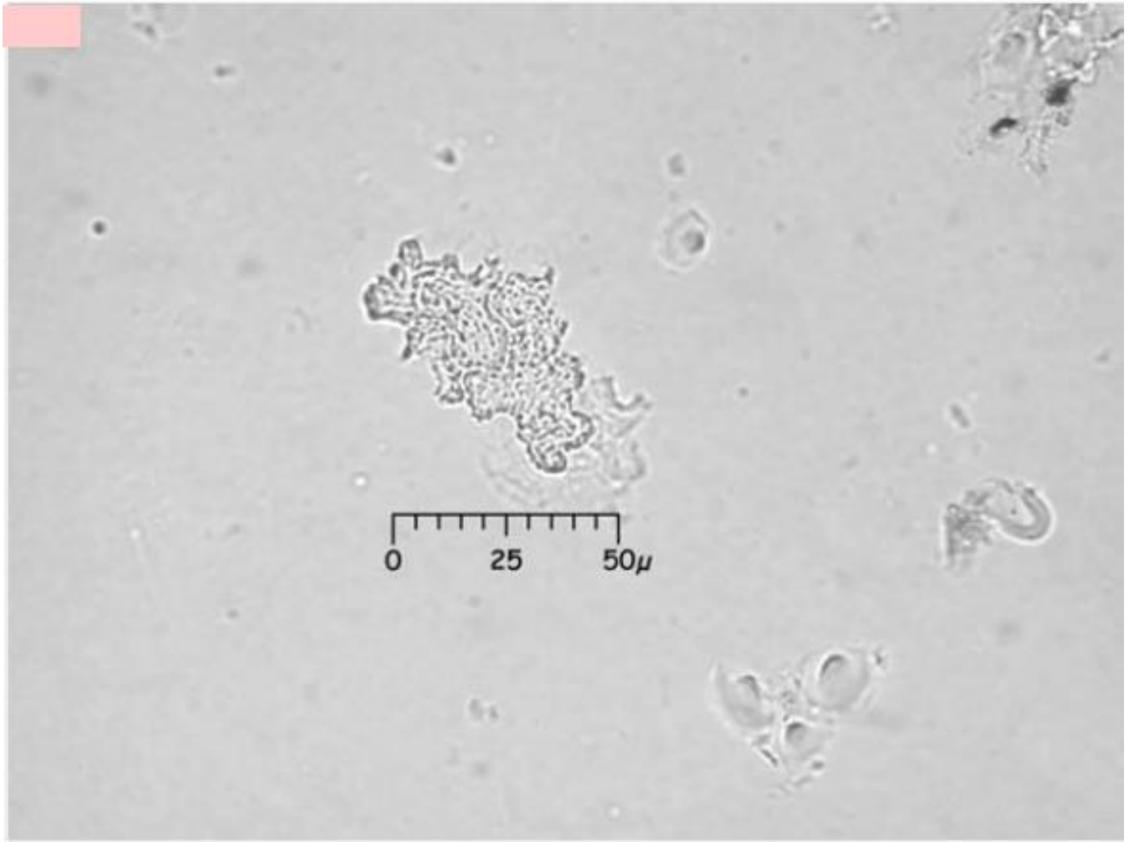


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Celtis schippii

Phytolith

Occurs in fruit. Type defined by Cesar Veintimilla 05/1991. Diagnostic level: species



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema integerrima

Phytolith

Type defined by Cesar Veintimilla 06/1991.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema integerrima

Phytolith

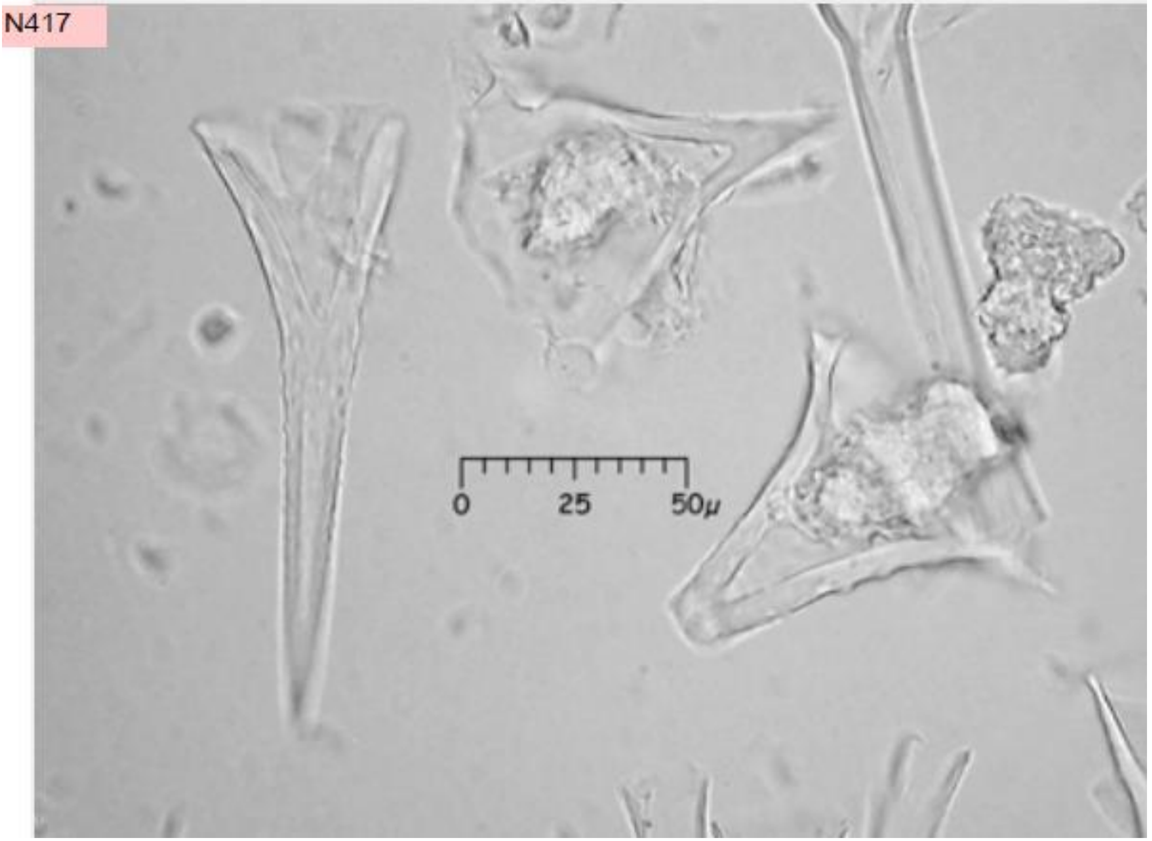
Type defined by Cesar Veintimilla 06/1991.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema micrantha

Phytolith

Hair often has cystoliths inserted in base. Some examples have slight surface texturing, but most are smooth.
Diagnostic level: genus

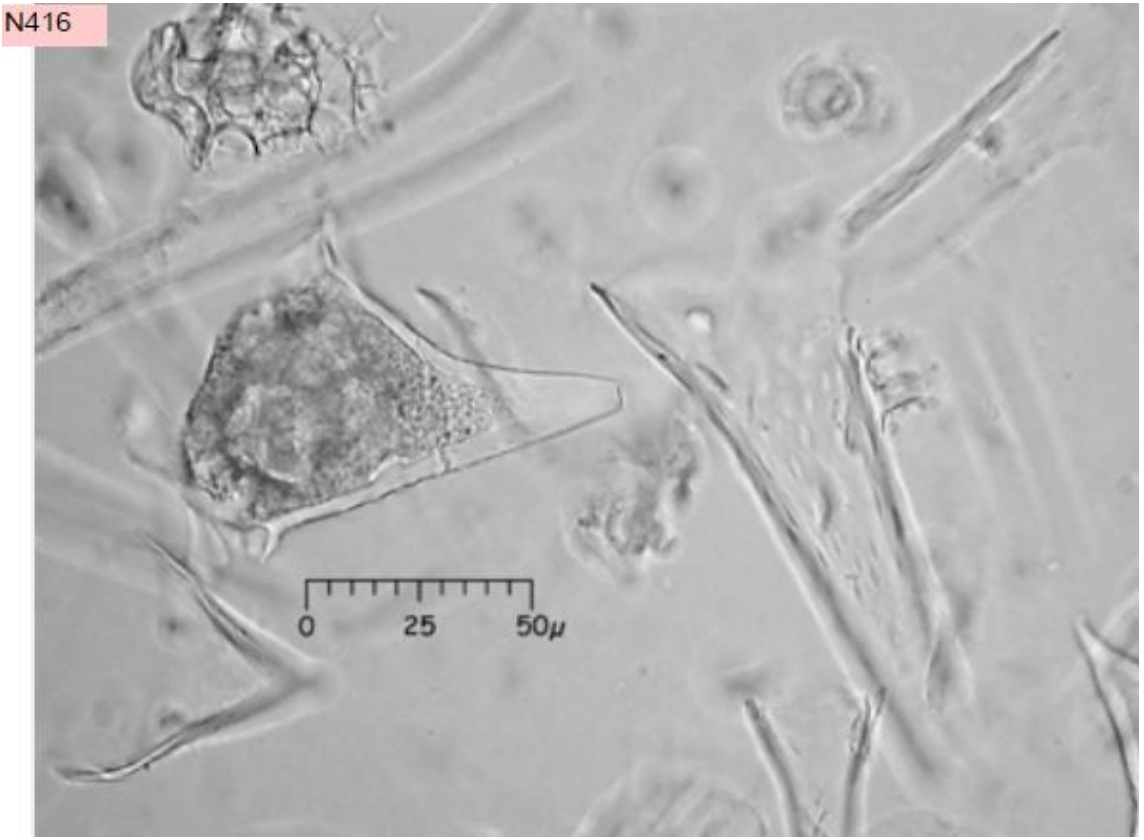


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema micrantha

Phytolith

Hair. Note cystoliths inserted in the base.
Diagnostic level: genus



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema micrantha

Phytolith

Hair base. Only some of the smaller cells are still with the hair base in this example.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema micrantha

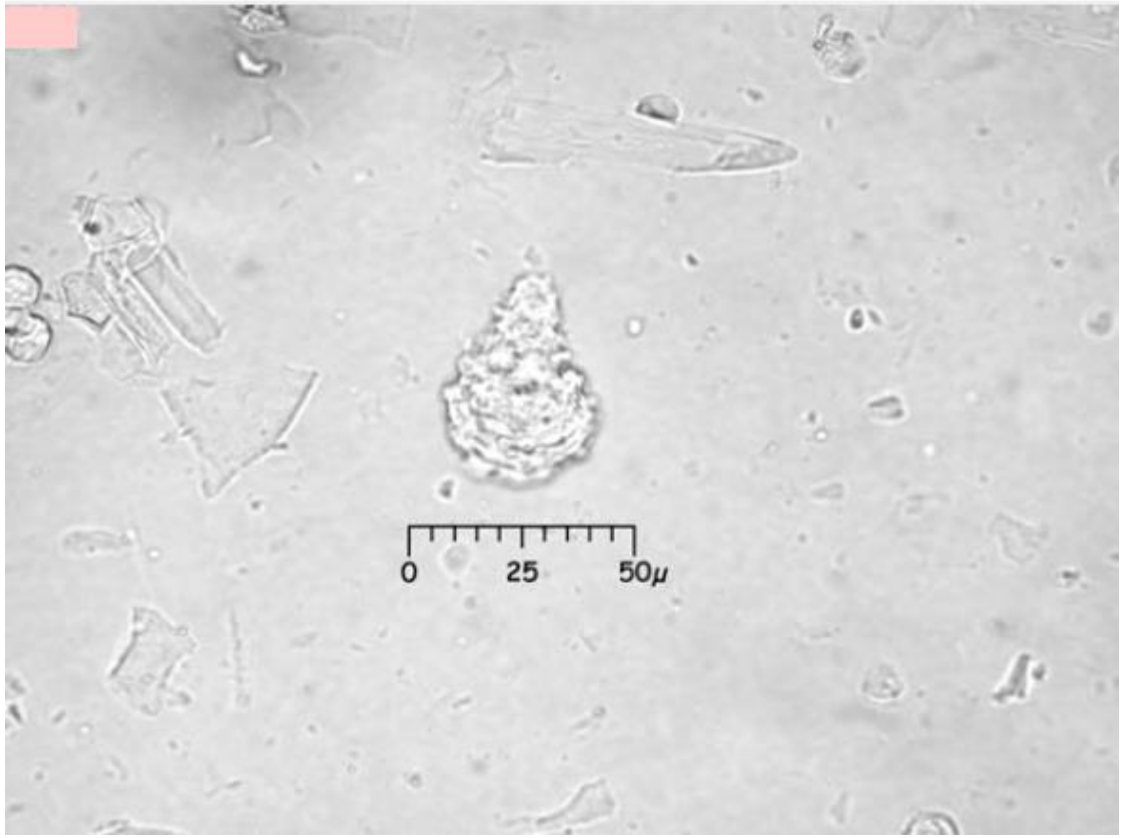
Phytolith

Type defined by Cesar Veintimilla 05/1991.
Diagnostic level: genus

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Trema micrantha

Phytolith



Slide 466 leaf.
Diagnostic level: generalized arboreal

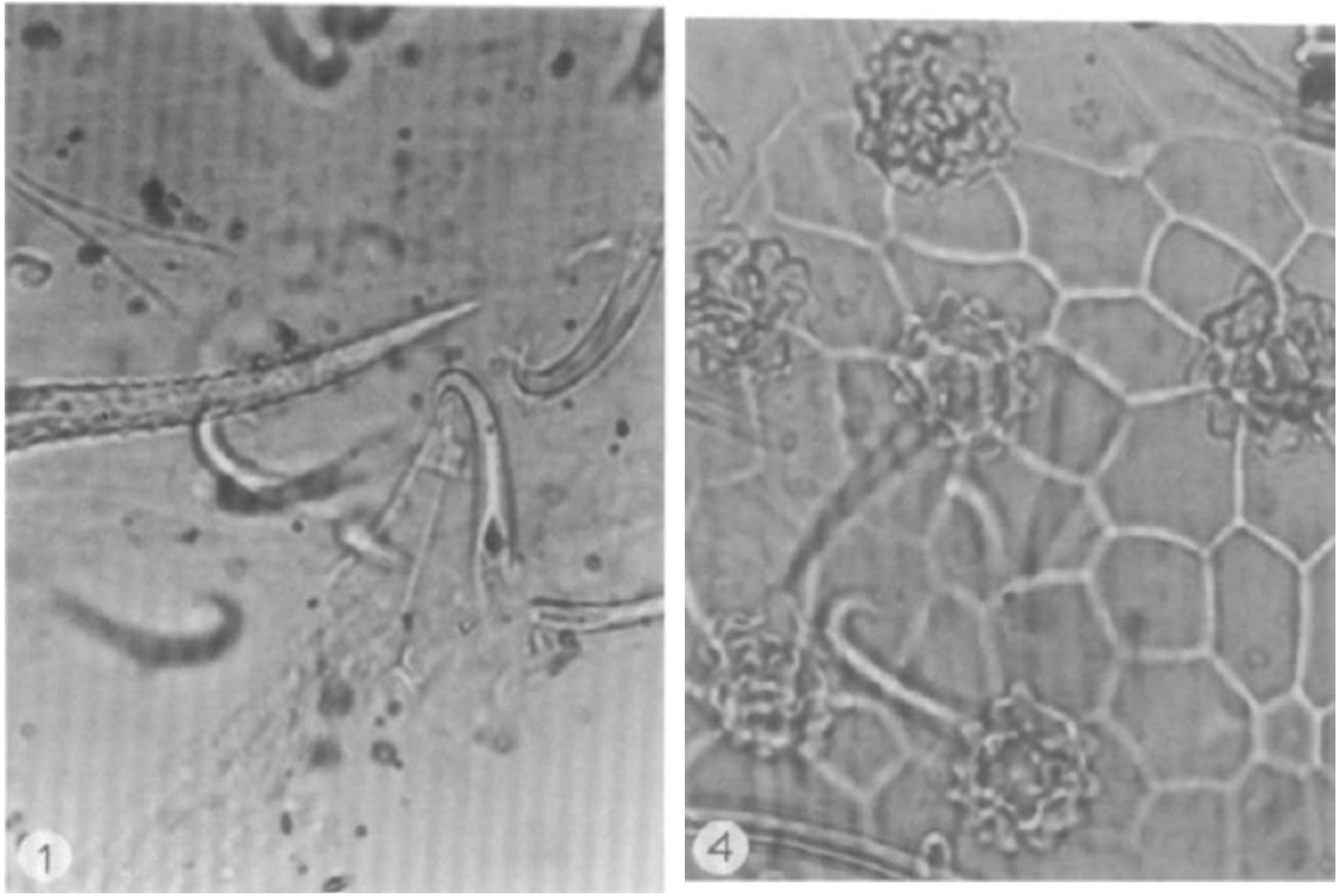
Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

URTICACEAE

Boehmeria aspera

Phytolith

1. Thin, curved hairs from Boehmeria aspera (200 x). Also present is a partially armed hair.
4. Spherical nodular cystoliths from Boehmeria aspera. They are attached to polyhedral epidermis (200 x).

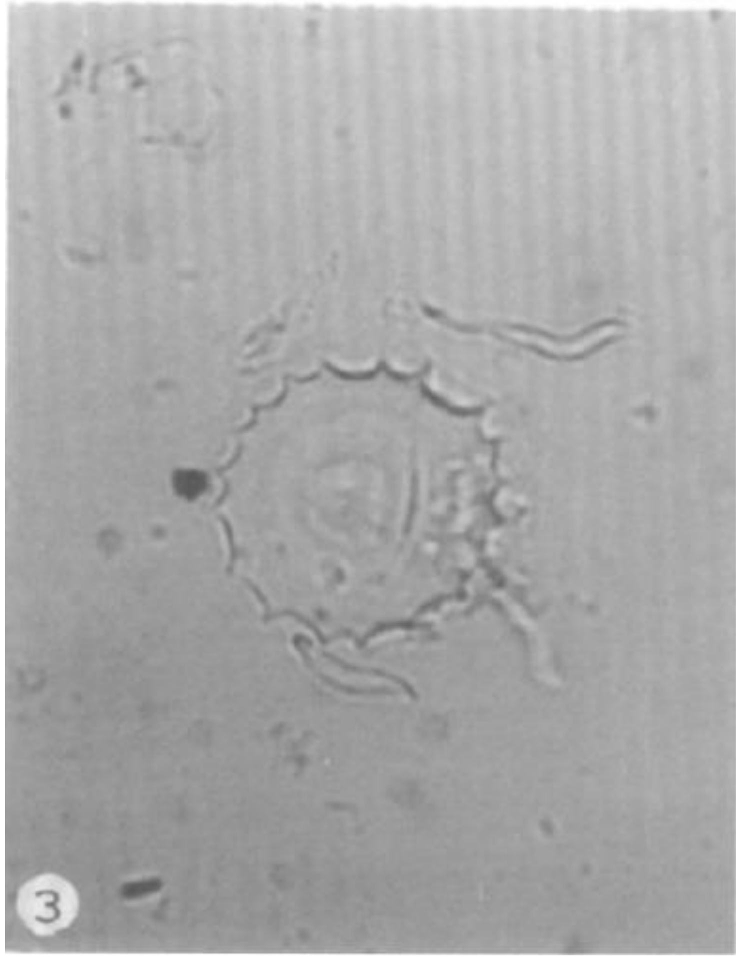


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Cecropia peltata

Phytolith

3. Hair base with short lines projecting from the perimeter from Cecropia peltata (200x)

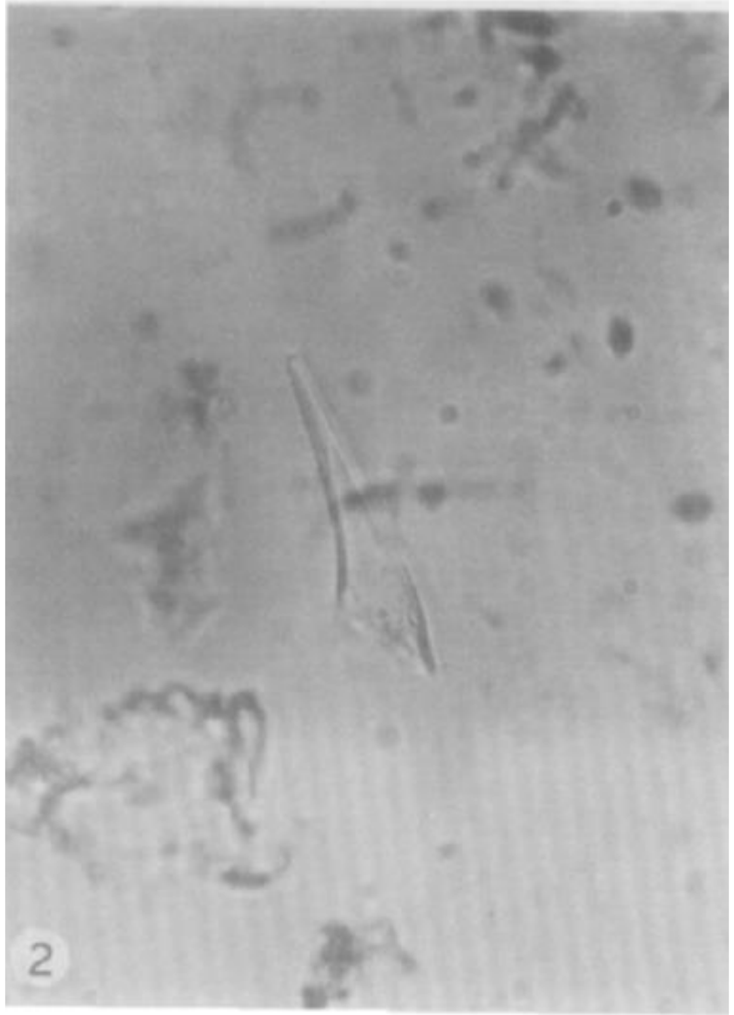


Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Laportea aestuans

Phytolith

2. A non-segmented hair cell
from Laportea aestuans (400 ×).

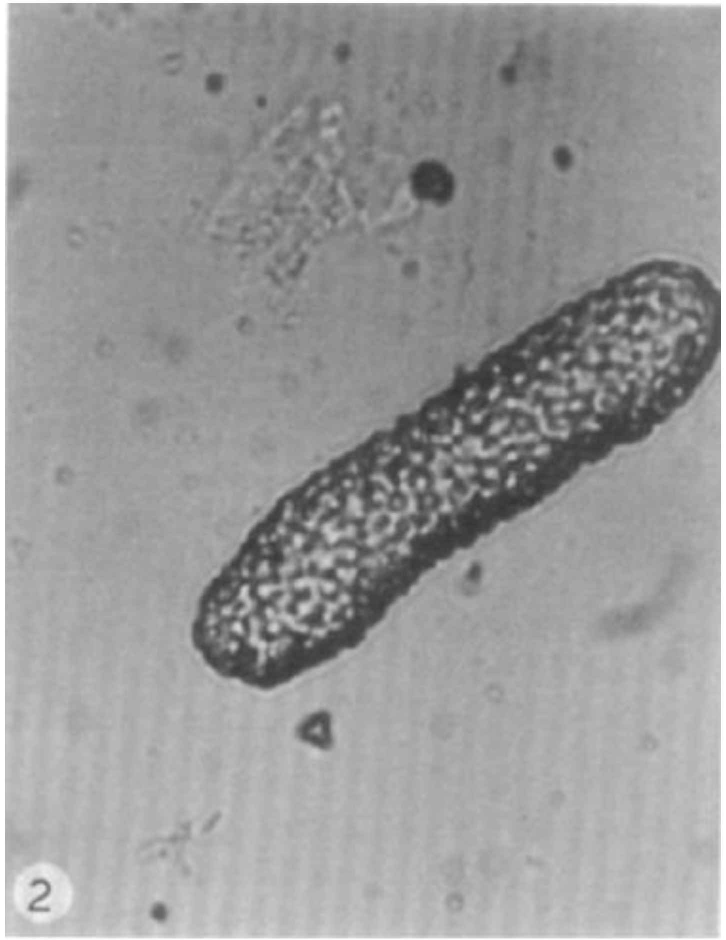


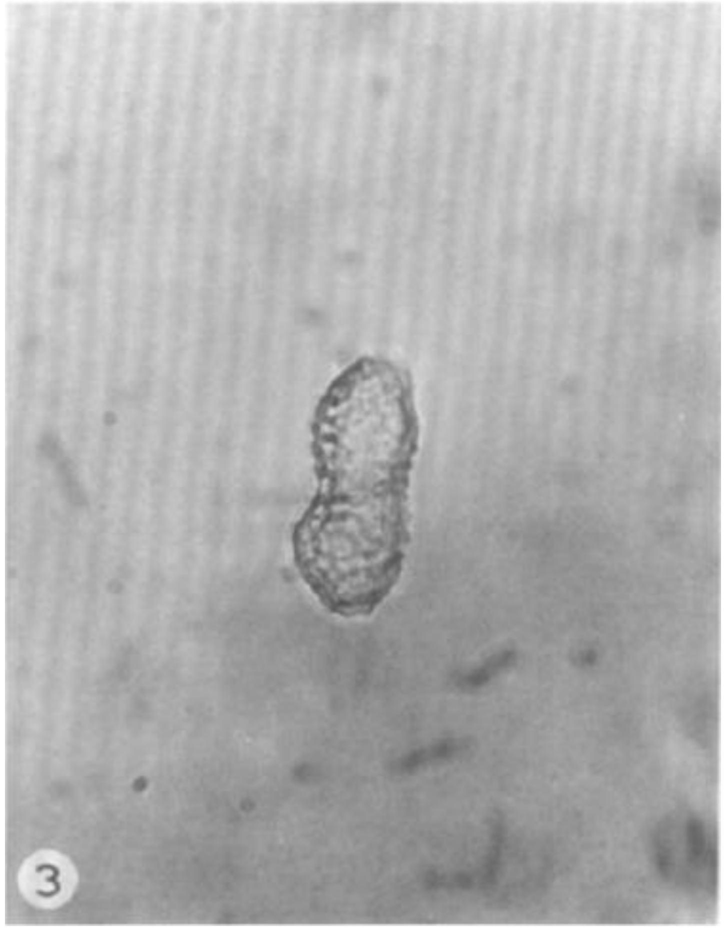
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Laportea aestuans

Phytolith

2. An elongate cystolith with two blunt ends and dense surface nodulation from Laportea aestuans (400 X).
3. An elongate cystolith with an indented middle from Laportea aestuans (400 x).





Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Pilea acuminata

Phytolith

1. A curved, nodular cystolith from Pilea acuminata (250 X)

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Pouzolzia obliqua

Phytolith

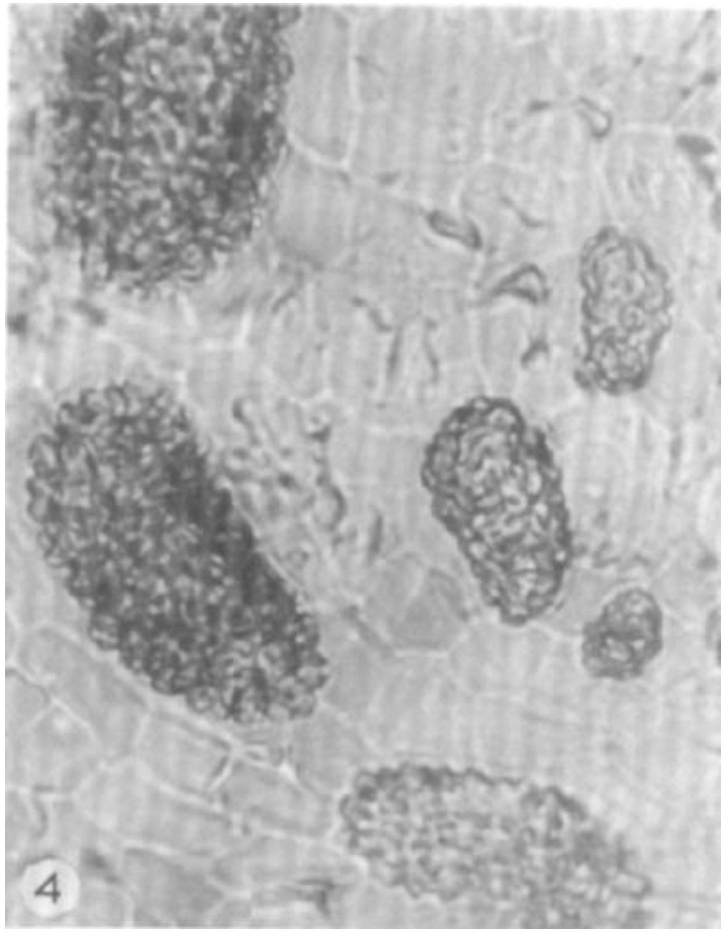
3. Non-segmented armed hairs from Pouzolzia obliqua. Also present are unarmed hairs, and in the middle a cystolith (156 ×)

Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

Urera elata

Phytolith

4. Cystoliths from Urera elata
(156 x).



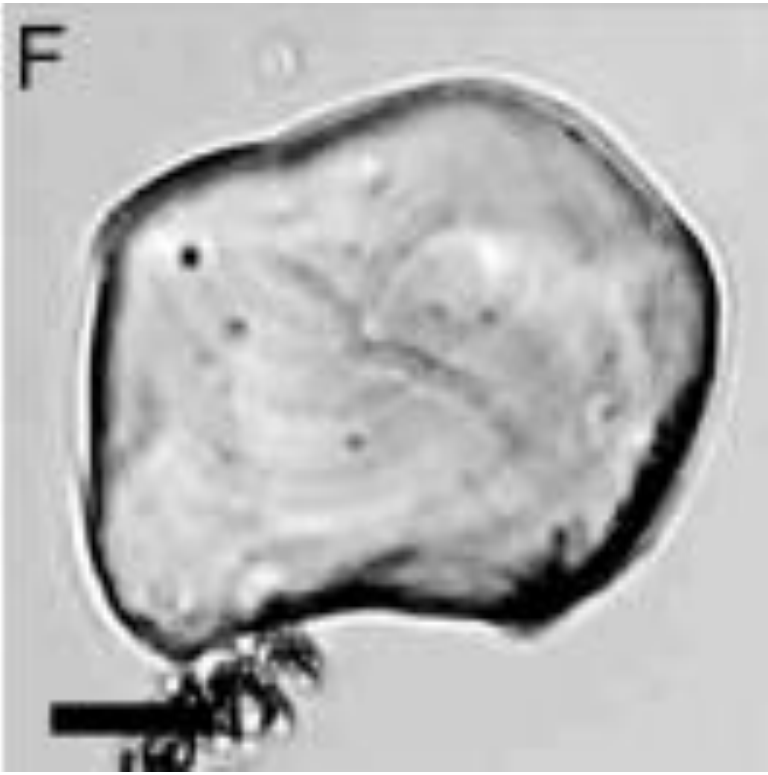
Piperno, Dolores R. 1985. Phytolith Analysis and Tropical Paleo-Ecology: Production and Taxonomic Significance of Siliceous Forms in New World Plant Domesticates and Wild Species. *Review of Palaeobotany and Palynology* 45:185–228.

ZAMIACEAE

Zamia sp.

Starch

Fig. 2. Selected archaeological starch grains. (F) Zamia sp. starch from Hornito, scraper E18, ?7000 cal BP. Additional examples of starch grains from the sites are provided in supporting information (SI) Figs. 3–8.



Dickau, Ruth, Anthony J. Ranere, and Richard G. Cooke. 2007. Starch Grain Evidence for the Preceramic Dispersals of Maize and Root Crops into Tropical Dry and Humid Forests of Panama. *Proceedings of the National Academy of Sciences of the United States of America* 104 (9):3651–56.

Zamia sp.

Starch

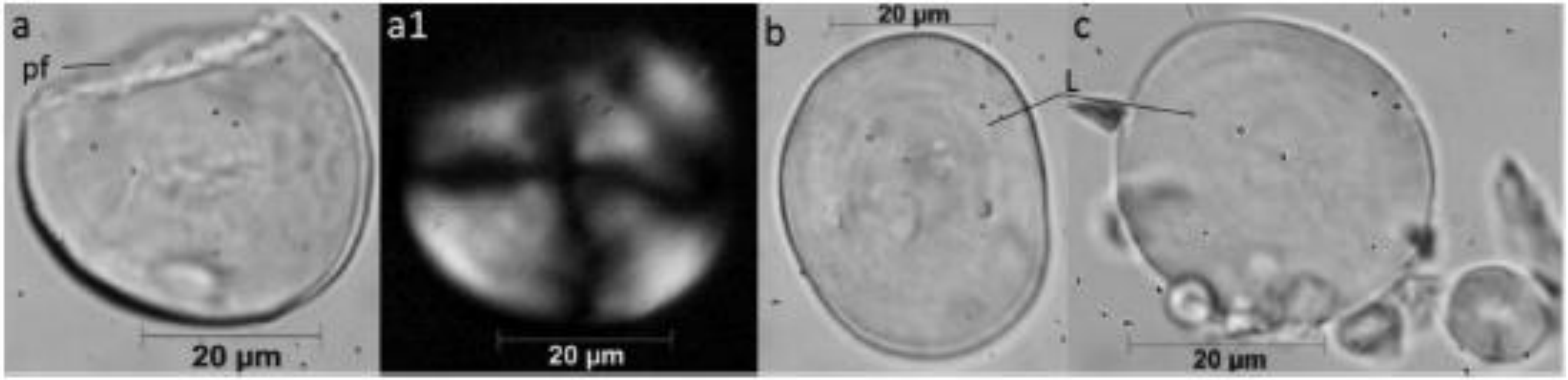
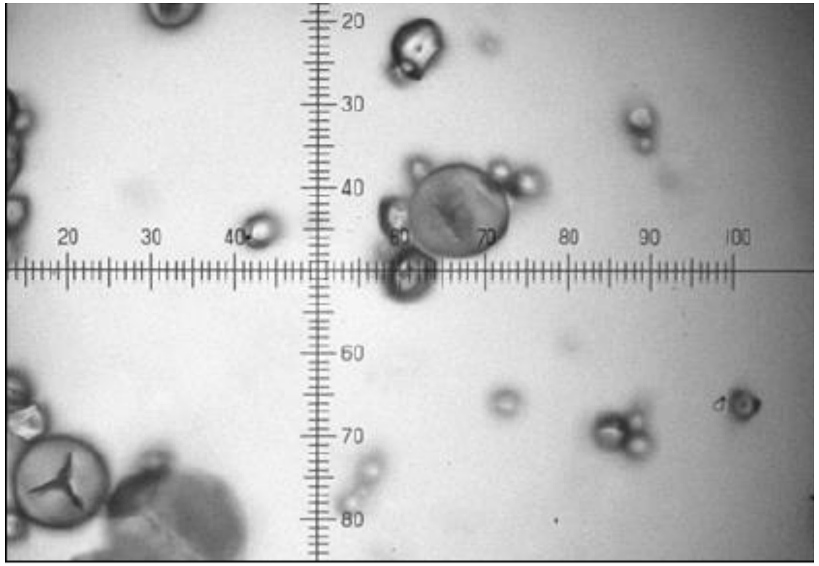


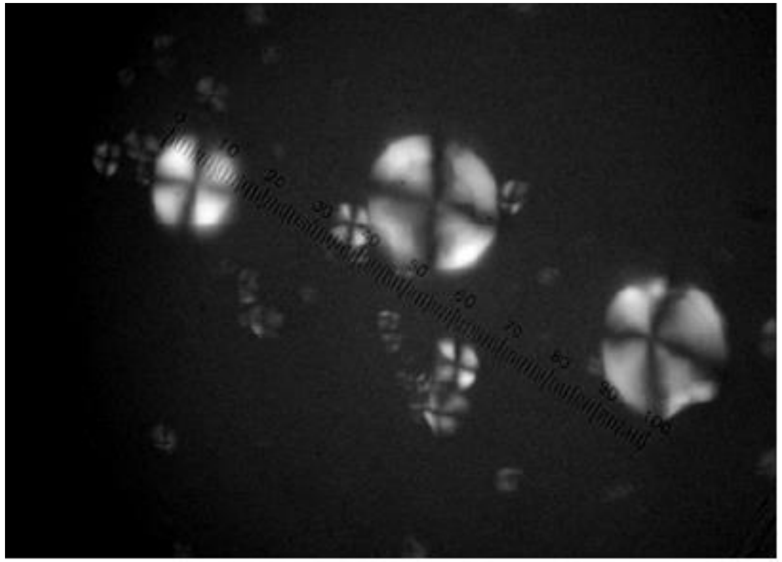
Fig. 8. Marunguey starch grains from Eva 2. a, truncated starch diagnostic to the genus showing smooth lamellae and a single pressure facet ("pf") at the distal end; a1, the same starch showing the particular extinction cross defined for the genus; b, oval starch with concentric rings or lamellae ("L") lightly undulated; c, oval starch of cf. Zamia spp. showing undulated lamellae ("L") and 5 smaller starches partially attached. Provenances: a (artifact E-1); b and c (artifact E-2).

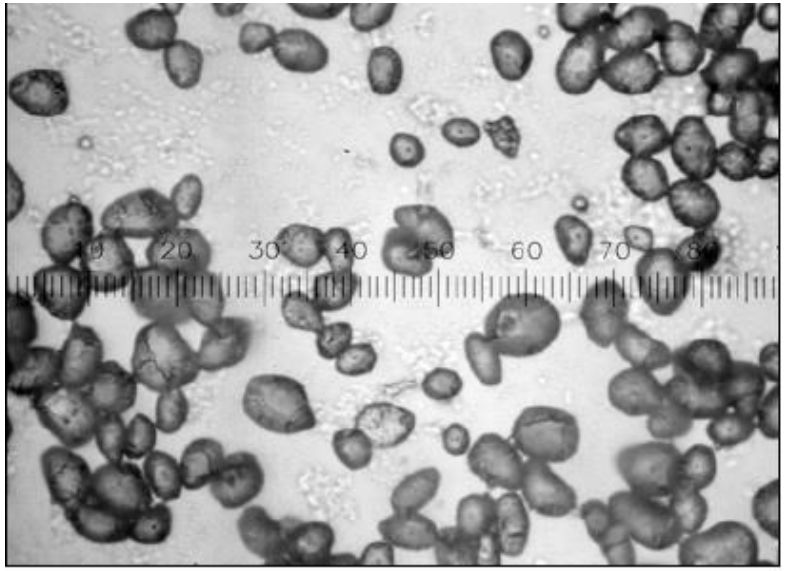
Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Zamia amblyphyllidia

Starch



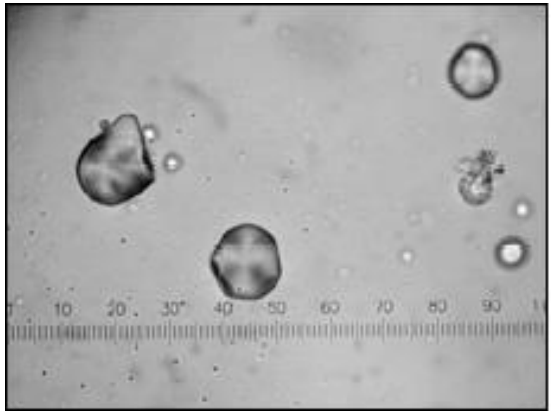
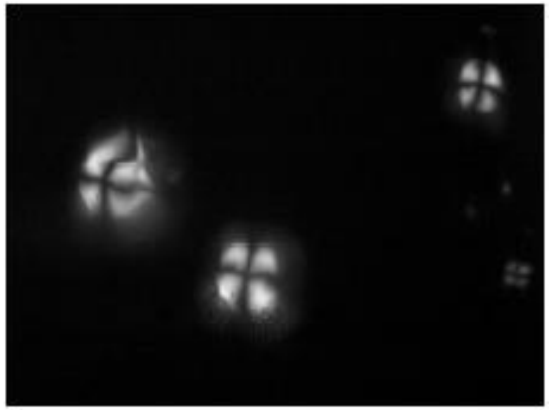
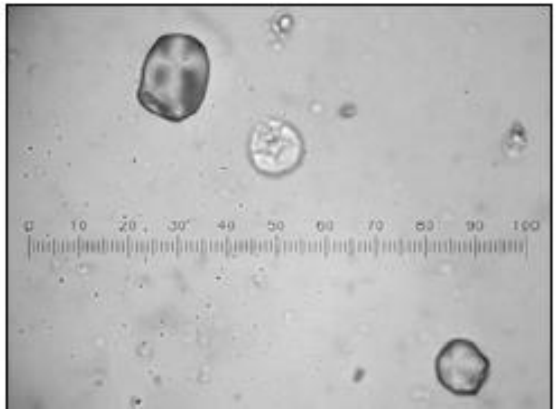
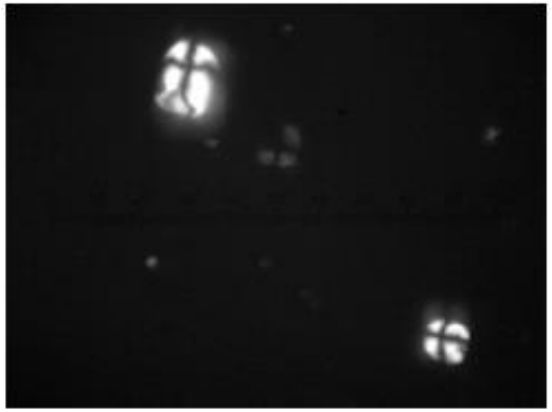




Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zamia portoricensis

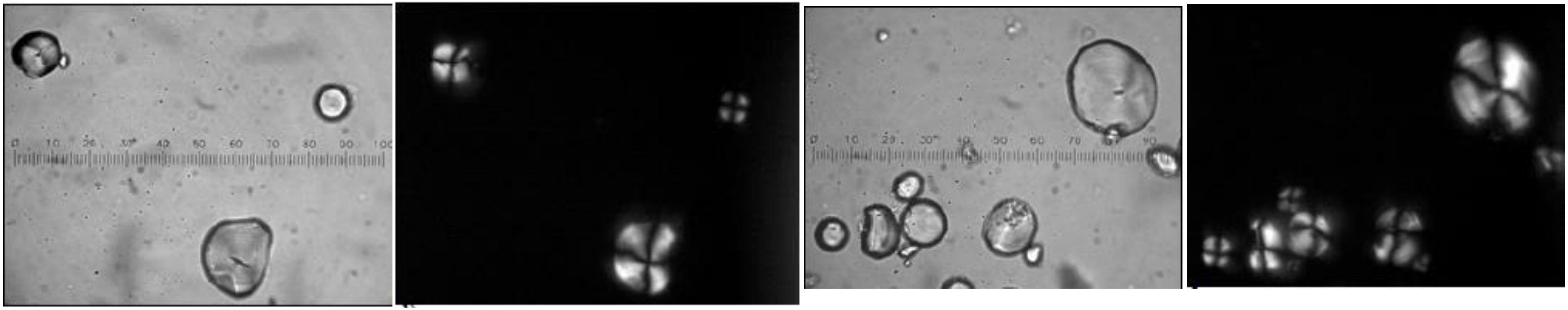
Starch

Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

Zamia pumila

Starch



Pagán-Jiménez, Jaime R. 2007. De Antiguos Pueblos y Culturas Botánicas En El Puerto Rico Indígena: El Archipiélago Borincano y La Llegada de Los Primeros Pobladores Agroceramistas. Vol. 1067. Oxford: British Archaeological Reports Limited.

ZINGIBERACEAE

Zingiberaceae cf.

Starch

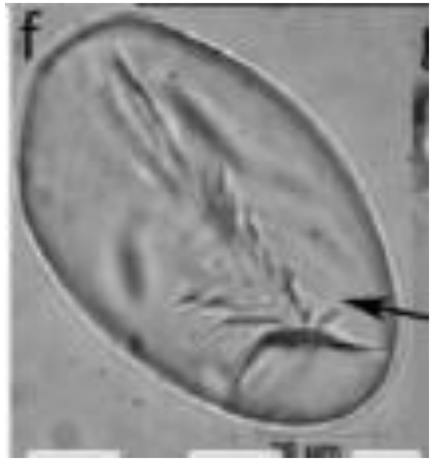


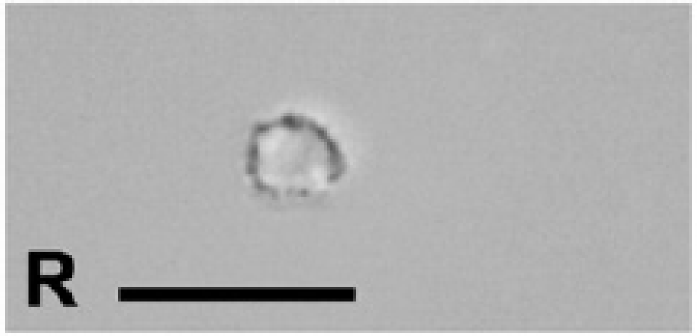
Fig. 9. Other ancient starch grains (a-g) recovered at St. John and Eva 2. f, cf. Zingiberaceae starch with multiple crackings and fissures on the surface, and remarkable lamellae.

Pagán-Jiménez, Jaime R., Reniel Rodríguez-Ramos, Basil A. Reid, Martijn van den Bel, and Corinne L. Hofman. 2015. Early Dispersals of Maize and Other Food Plants into the Southern Caribbean and Northeastern South America. *Quaternary Science Reviews* 123:231–46. http://www.sciencedirect.com/science/article/pii/S0277379115300445.

Aframomum angustifolium

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). R, globular-microgranulate from Aframomum angustifolium leaf. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

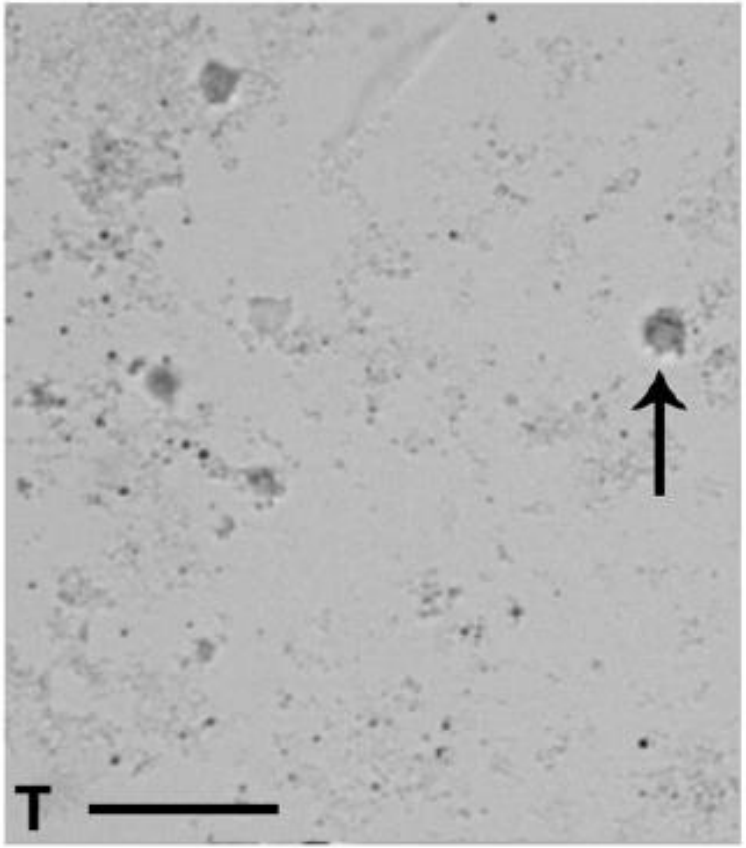


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Alpinia blepharocalyx

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). T, globular-microrugulates (arrow) and silica sand from Alpinia blepharocalyx leaf. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Alpinia conchigera

Phytolith

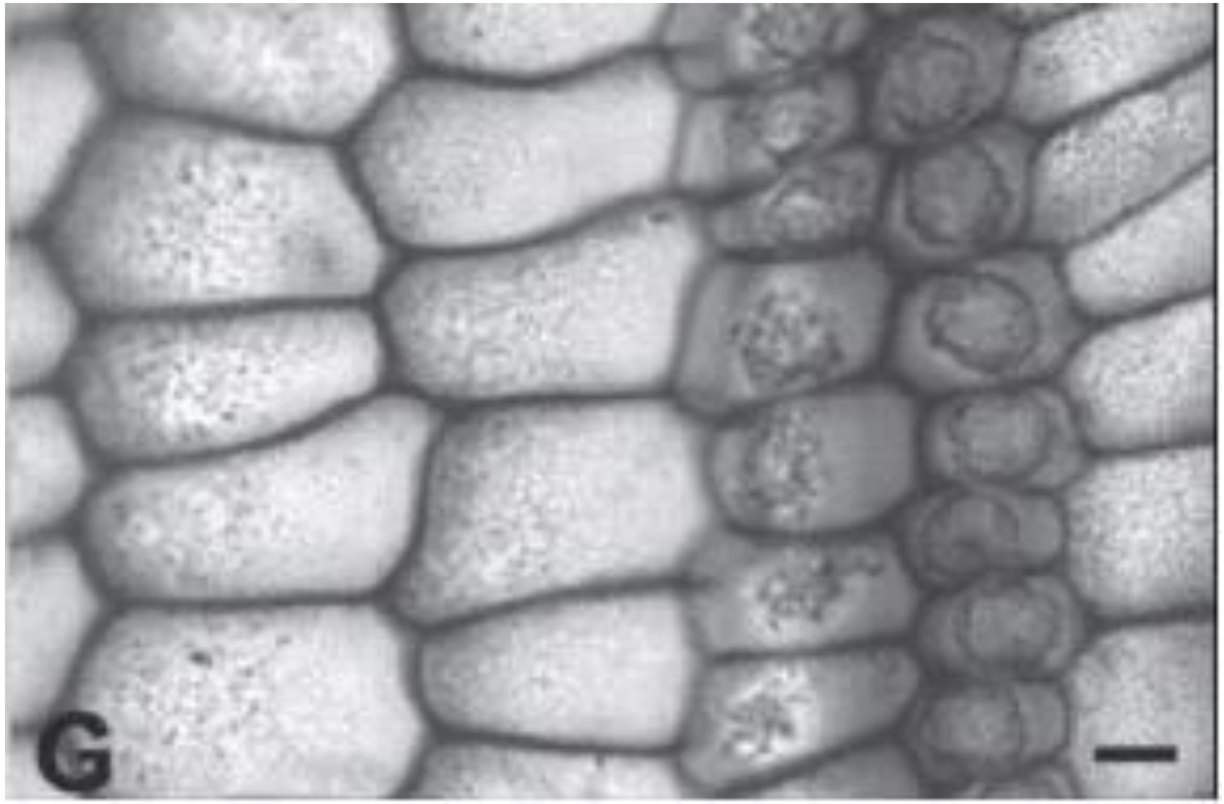


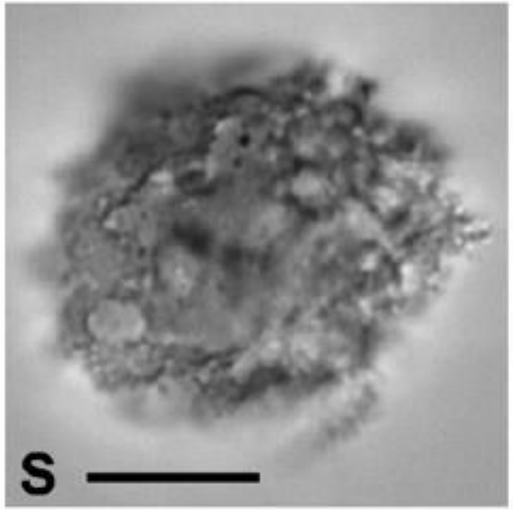
Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. G. Alpinia conchigera Zingiberaceae), two forms of silica: intercostal silica sand and costal spherical bodies in epidermal cells (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Alpinia galanga

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). S, globular-rugulate from Alpinia galanga fruit. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Amomum lepicarpum

Phytolith

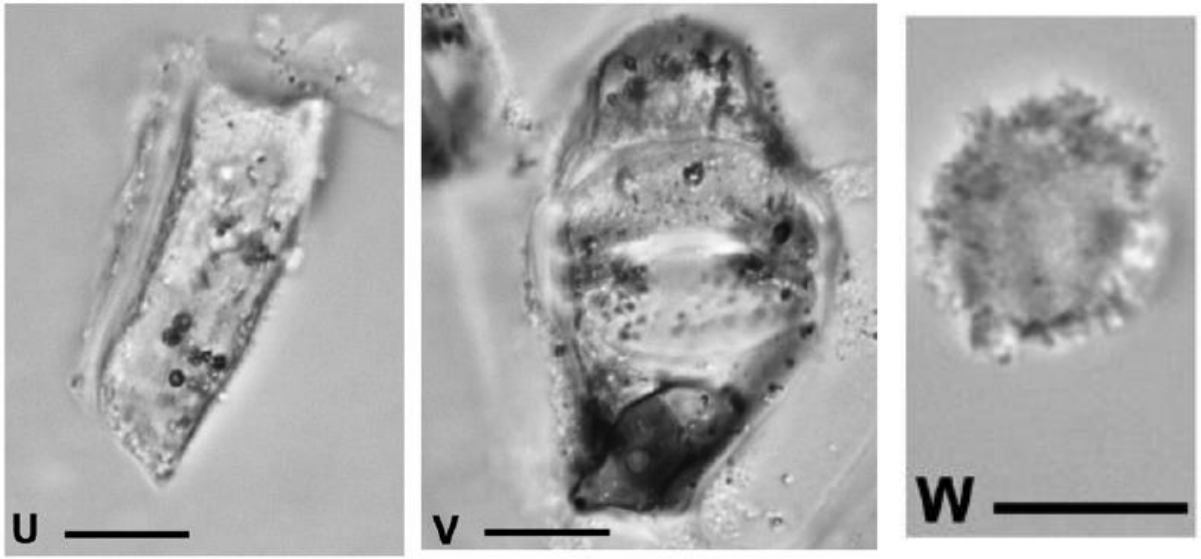


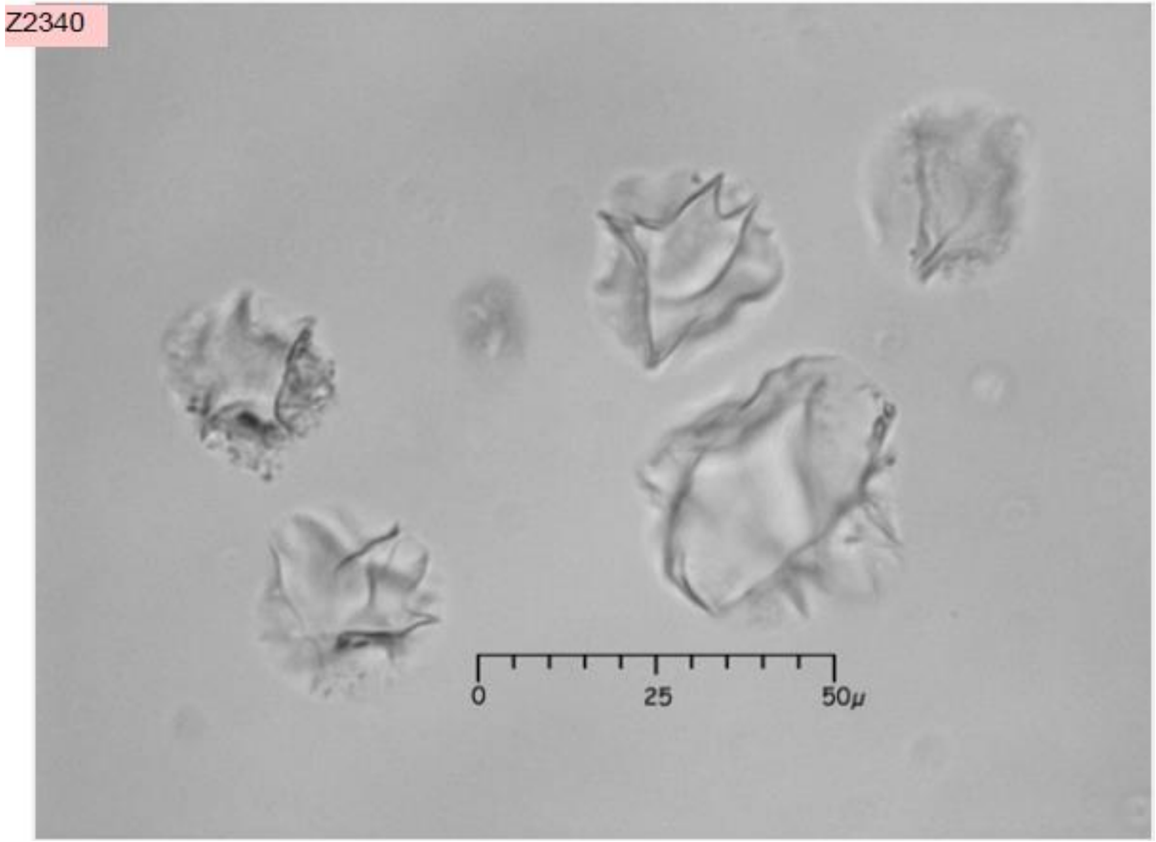
Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). U, Ta4 (tabular-psilate) from Amomum lepicarpum leaf. V, stomatal complex from Amomum lepicarpum leaf. W, globular-rugulose-granulate from Amomum lepicarpum fruit+seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Costus guanaienis

Phytolith

Diagnostic level: Potential species-level diagnostic, under study. Type overlaps with 80IKa, but is distinguished by larger size.
Occurs in rhizome

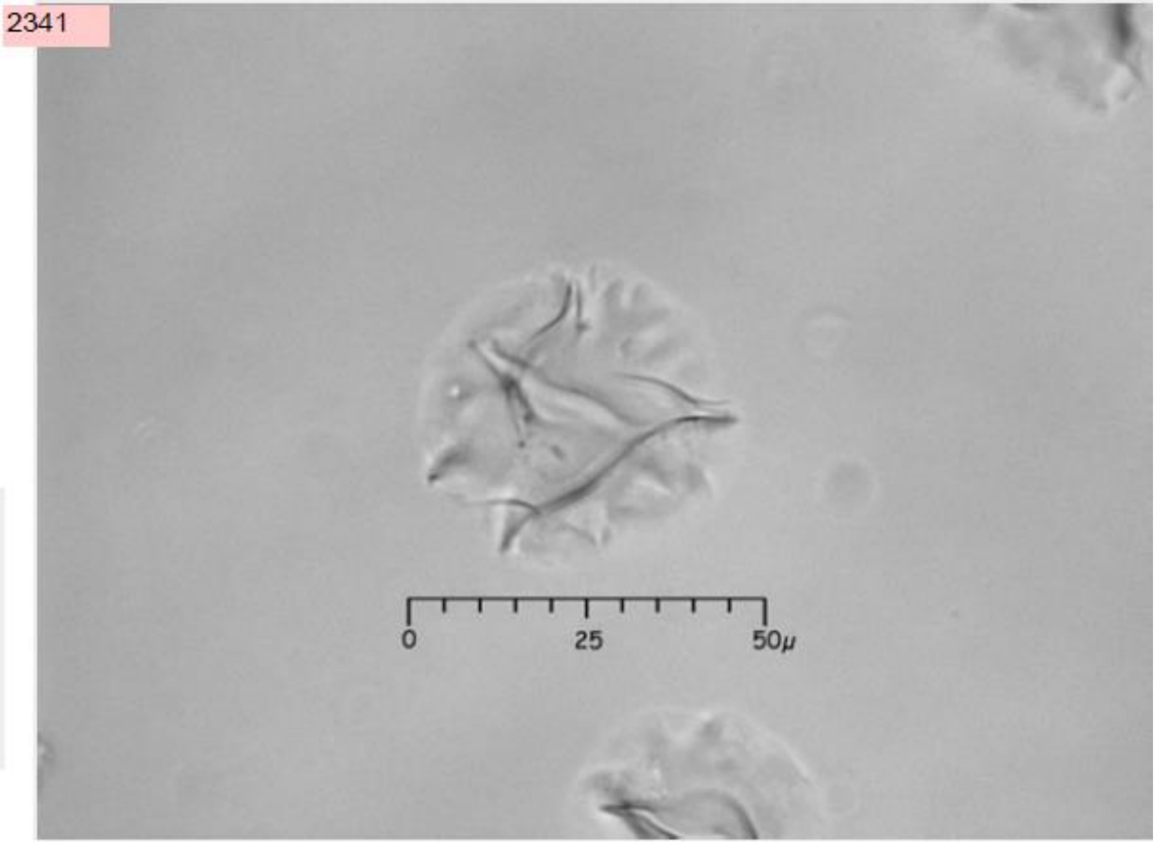


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Costus guanaienis

Phytolith

Diagnostic level: Potential species-level diagnostic, under study. Type overlaps with 80IKa, but is distinguished by larger size.
Occurs in rhizome.

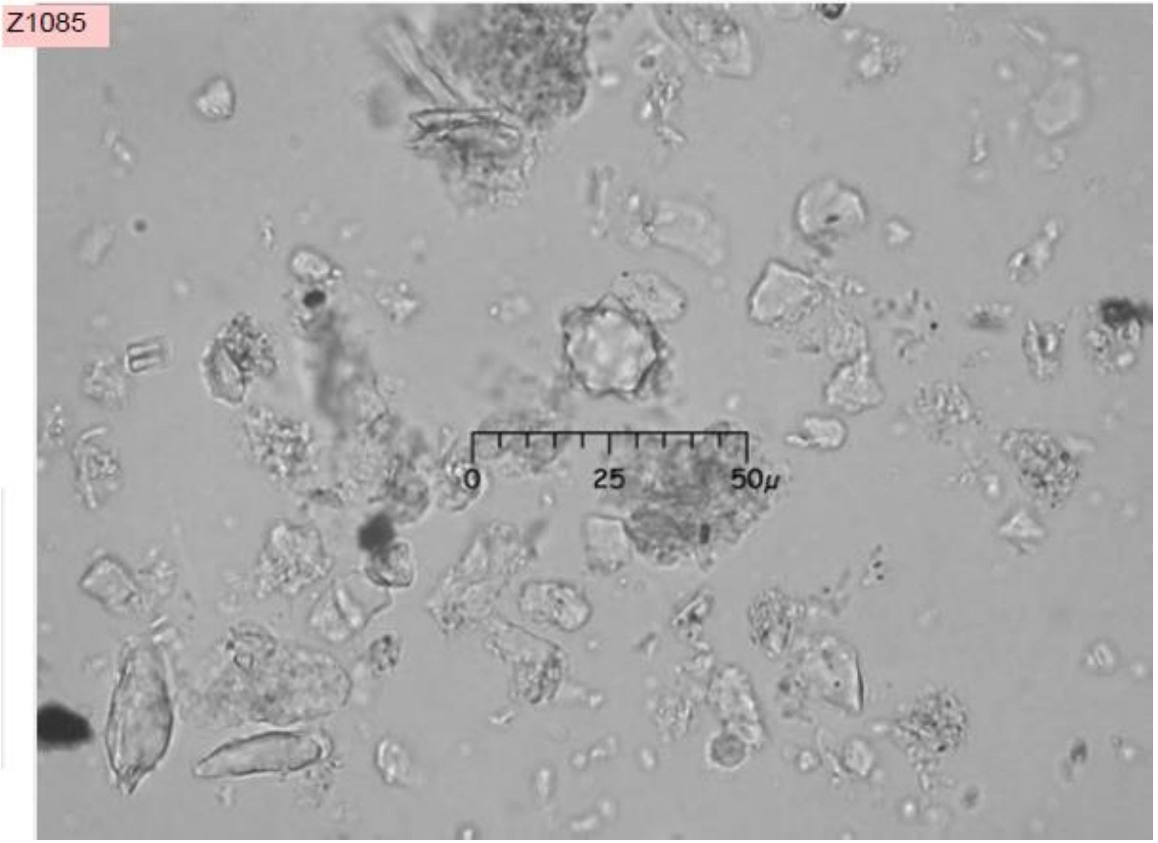


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Costus guanaienis

Phytolith

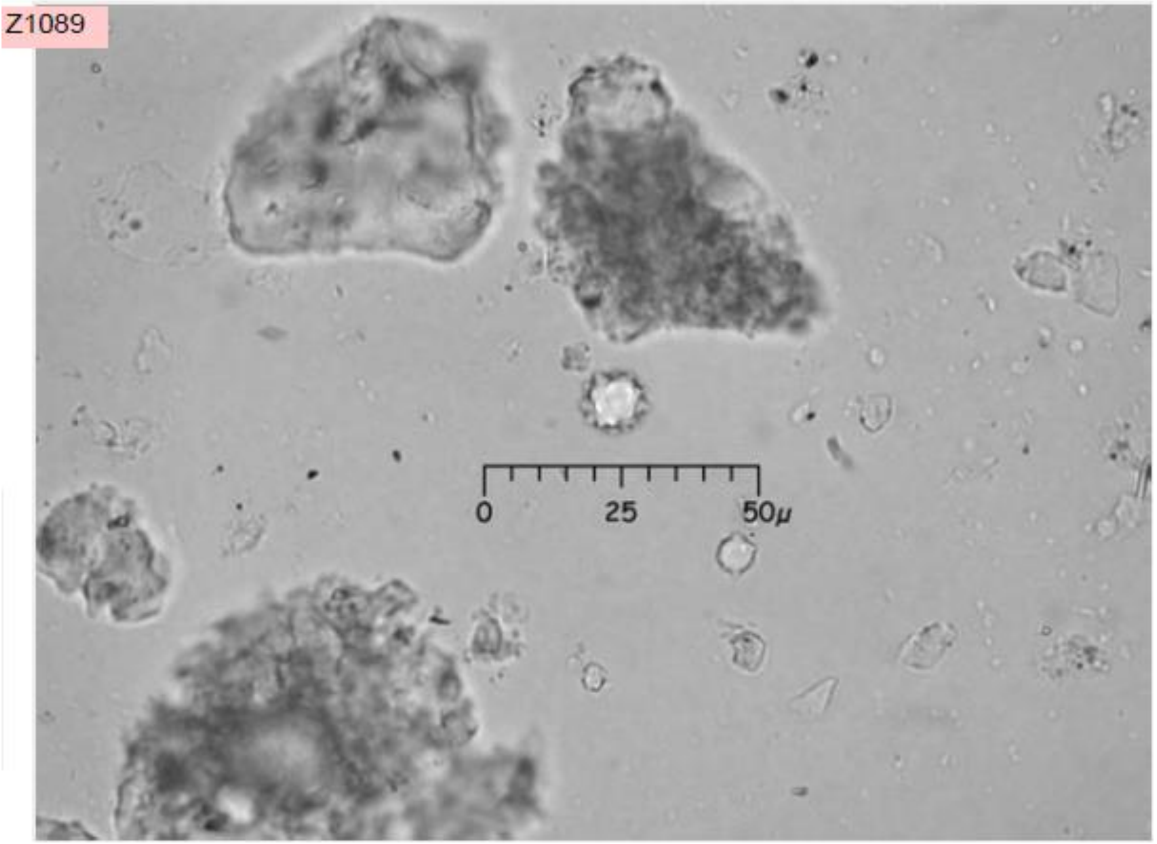
Large nodular sphere, 18 microns and larger in size, with short projections with large basal diameter. Sphere can be slightly irregulariy shaped.
Diagnostic level: Family



Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Costus guanaienis

Phytolith



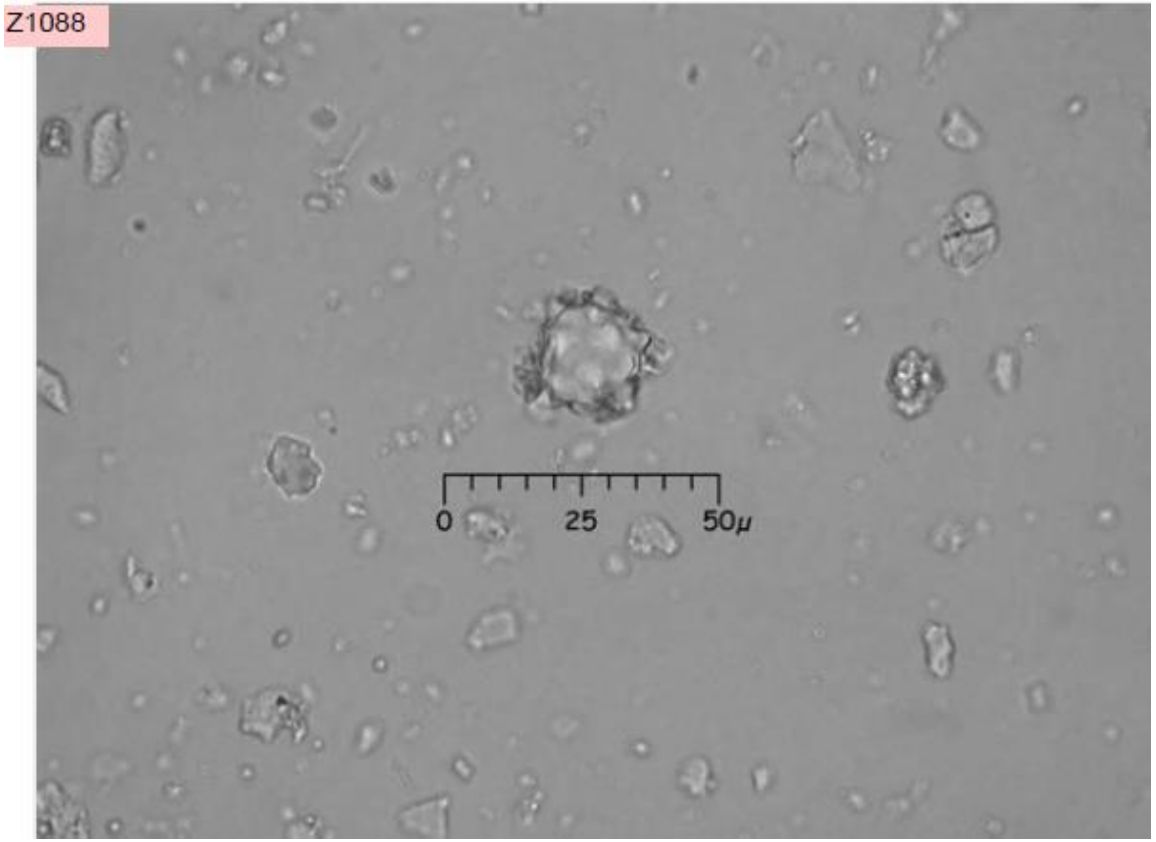
These spheres have nodular and spinulose projections or silia. Nodular projections outnumber spinulose or cilia. Projections are tightly spaced. Diagnostic level: Under investigation.

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Costus scaber

Phytolith

Also occurs in the Bombacaceae. Diagnostic level: mixed, Zingiberaceae, Bombacaceae. There are subtle differences in the smoothness and abundance of nodules between the two families.

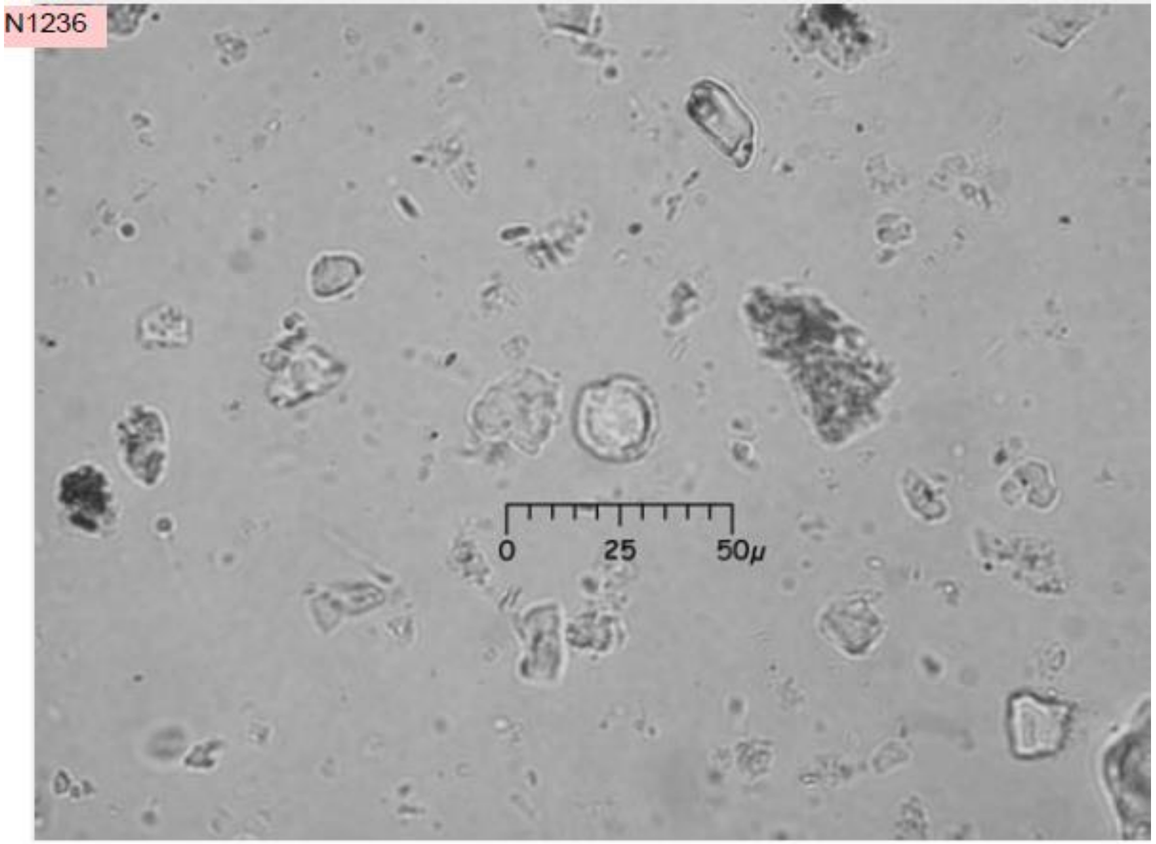


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Costus scaber

Phytolith

PC2744, root
Type originally defined by Karol Chandler-Ezell.
Image shows top view; note the narrow rim.
Diagnostic level: under study

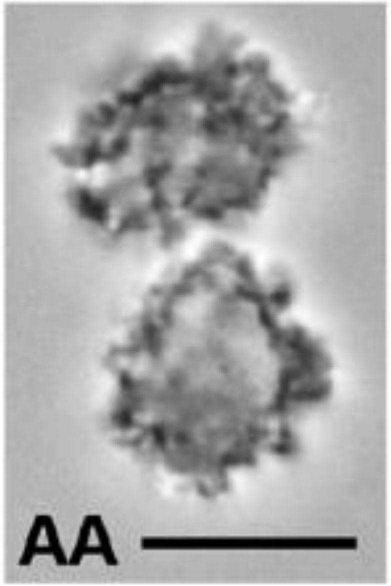


Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Globba maculata

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). AA, globular-rugulose-granulates from Globba maculata leaf. Scale bars=A, C–S, U–AA=12 μm; B, T, BB=23 μm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Hornstedtia conica

Phytolith

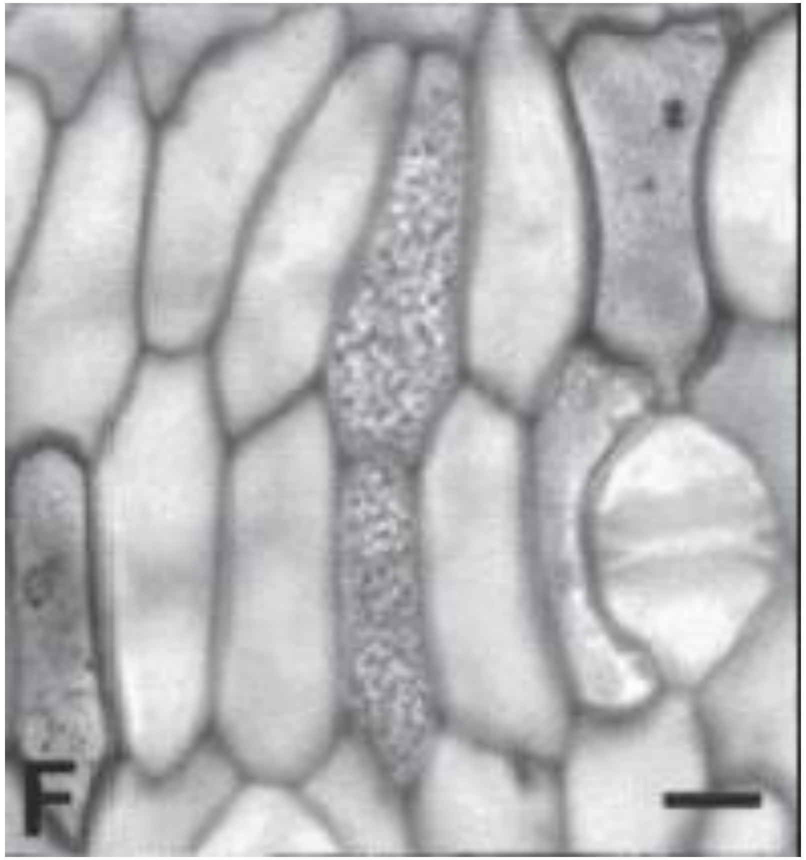


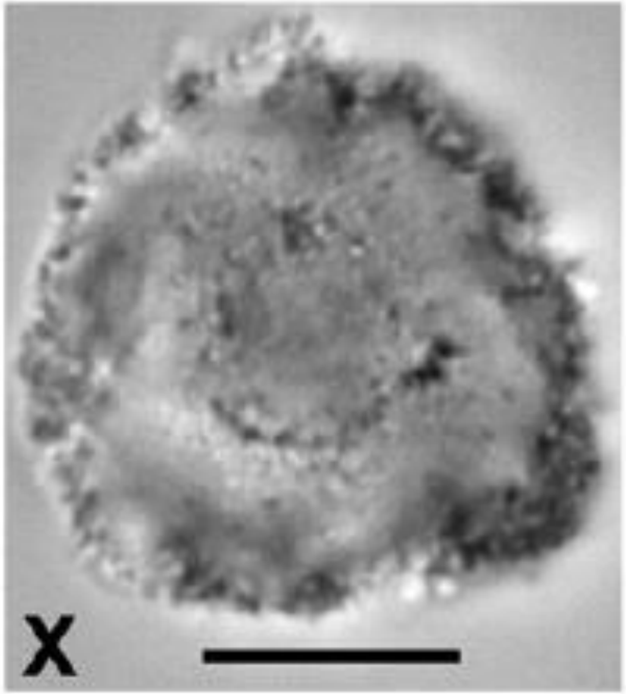
Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. F. Hornstedtia conica (Zingiberaceae), epidermal, intercostal silica sand (bar = 10 µm).

Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Hornstedtia spathulata

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). X, globular-rugulose-granulate from Hornstedtia spathulata fruit+seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

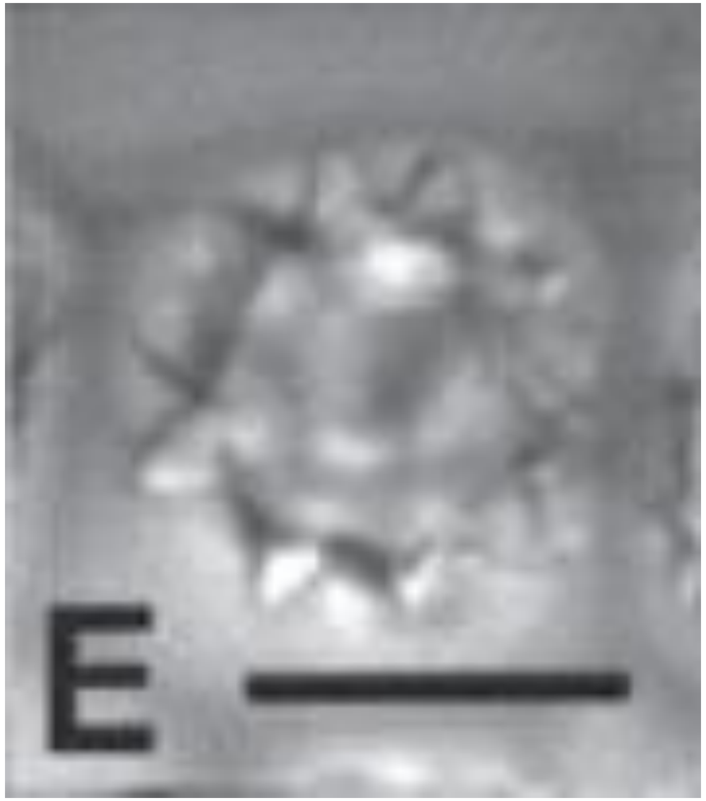


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Kaempferia aethiopia

Phytolith

Fig. 4. Various silica body morphologies found in the order Zingiberales, continued. E. Kaempferia aethiopia (Zingiberaceae), an internal costal silica body (bar = 10µm).

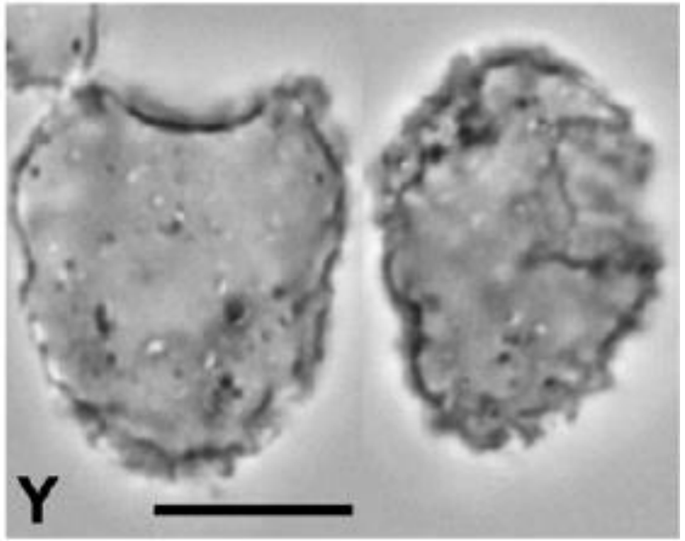


Prychid, Christina J., Paula J. Rudall, and Mary Gregory. 2004. Systematics and Biology of Silica Bodies in Monocotyledons. *The Botanical Review* 69 (4):377–440.

Renealmia occidentalis

Phytolith

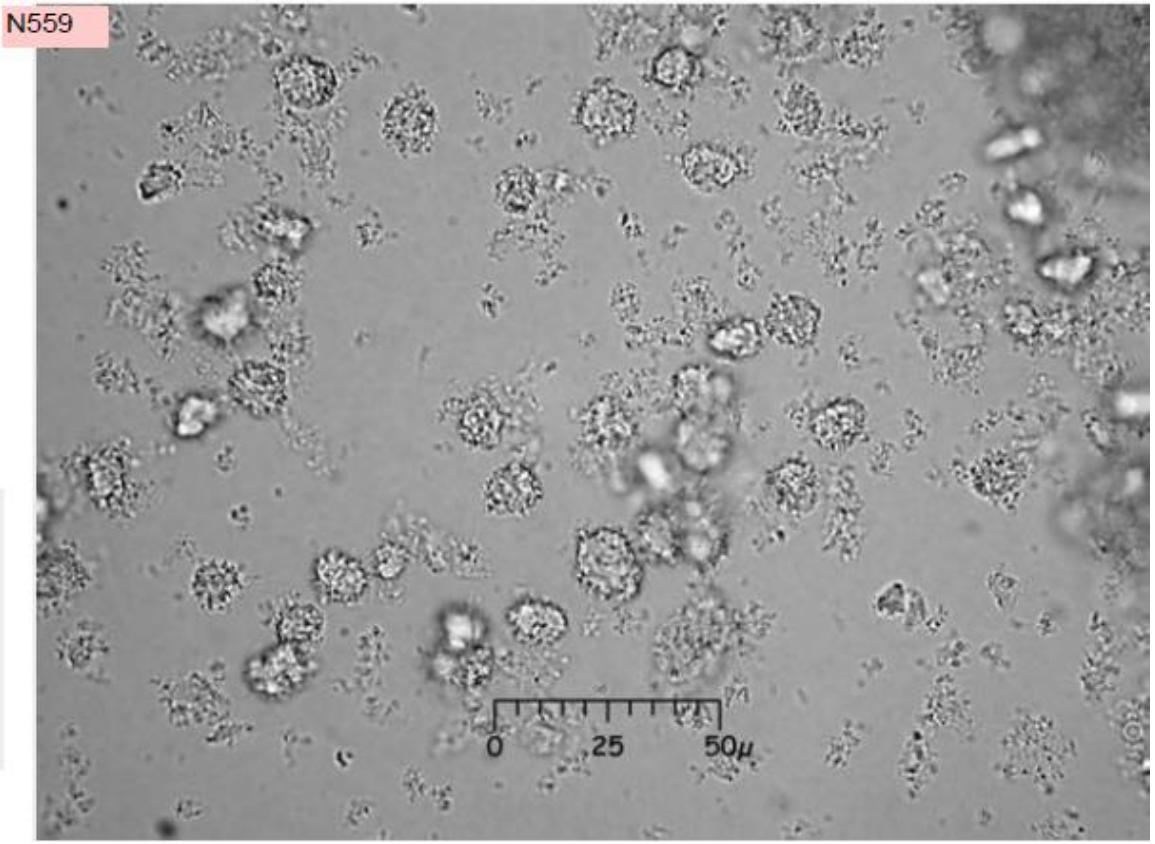
Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). Y, globular-rugulose-granulates from Renealmia occidentalis fruit+seed. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.



Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Renealmia oligosperma

Phytolith



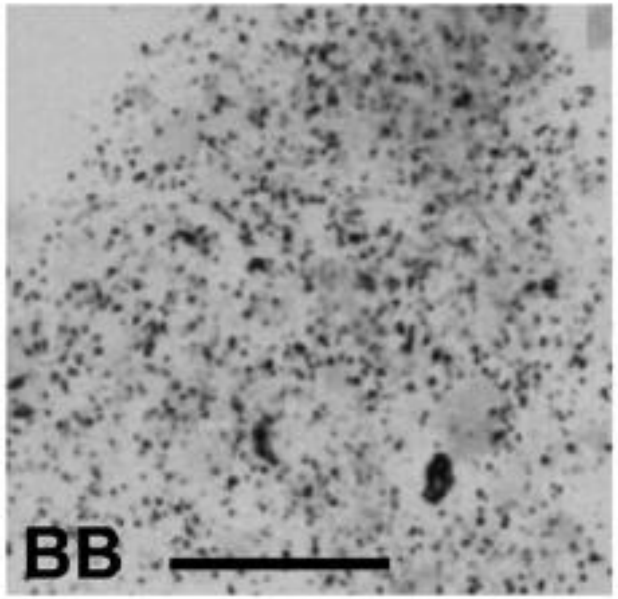
Diagnositc level: under study. Also observed in Donax, Thalia (Marantaceae)

Pearsall, Deborah Marie. "Phytoliths in the Flora of Ecuador: The University of Missouri Online Phytolith Database." [http://phytolith.missouri.edu]. With contributions by Ann Biddle, Dr. Karol Chandler-Ezell, Dr. Shawn Collins, Dr. Neil Duncan, Bill Grimm, Dr. Thomas Hart, Dr. Amanda Logan, Meghann O'Brien, Sara Stewart, Cesar Veintimilla, and Dr. Zhijun Zhao.

Spirematospermum sp.

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). BB, silica sand from Spirematospermum seed (Fasterholtz, Germany). Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

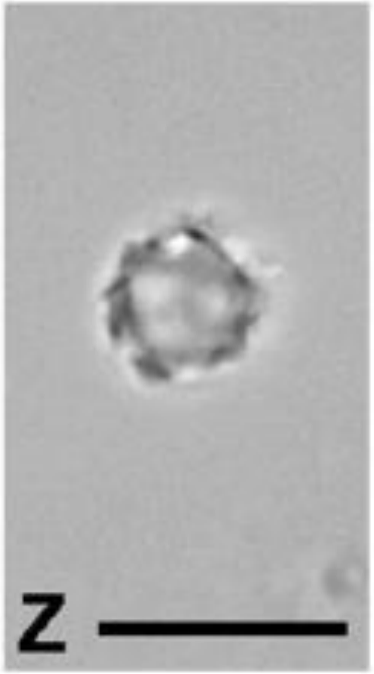


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Zingiber officinale

Phytolith

Fig. 4. Musaceae (A–I), Strelitziaceae (J–Q), Zingiberaceae (Alpineae: R–Y, Zingibereae: Z, Globbeae: AA), and Spirematospermum (BB). Z, globular-microechinate from Zingiber officinale rhizome. Scale bars=A, C–S, U–AA=12 µm; B, T, BB=23 µm.

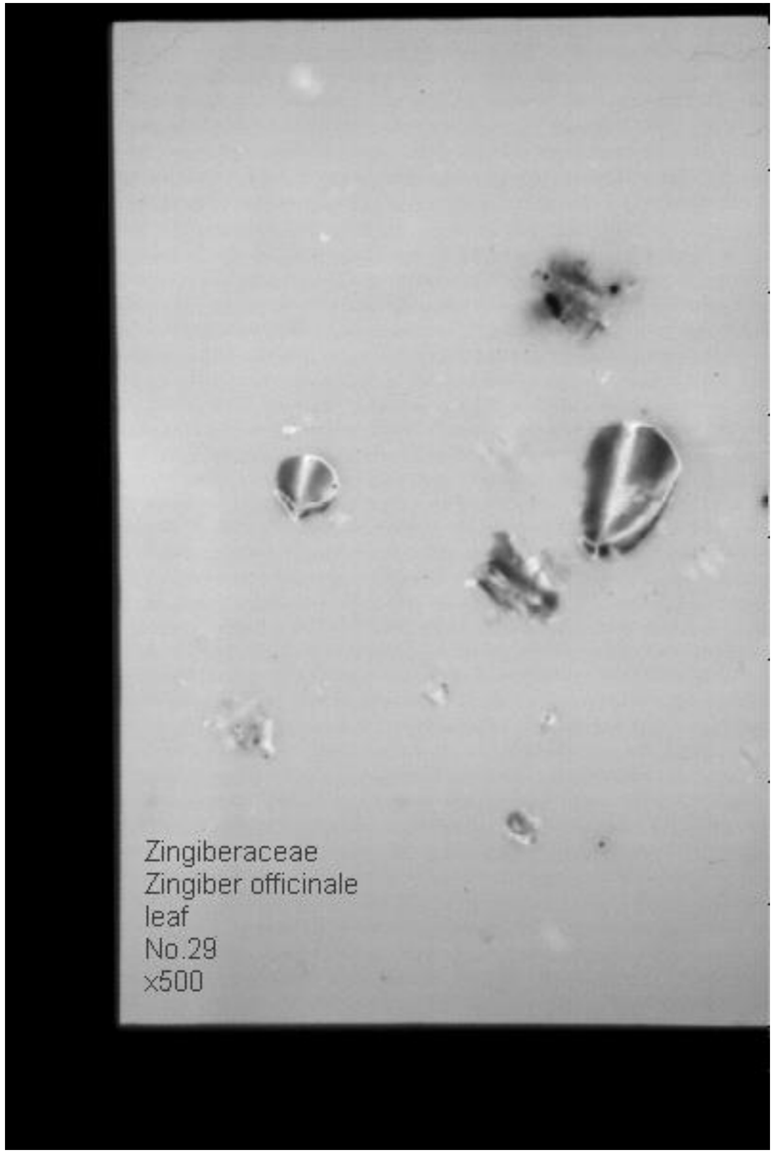


Chen, Stephanie T., and Selena Y. Smith. 2013. Phytolith Variability in Zingiberales: A Tool for the Reconstruction of Past Tropical Vegetation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 370.

Zingiber officinale

Australian Museum,
McCown Archaeobotany
Laboratory Collection

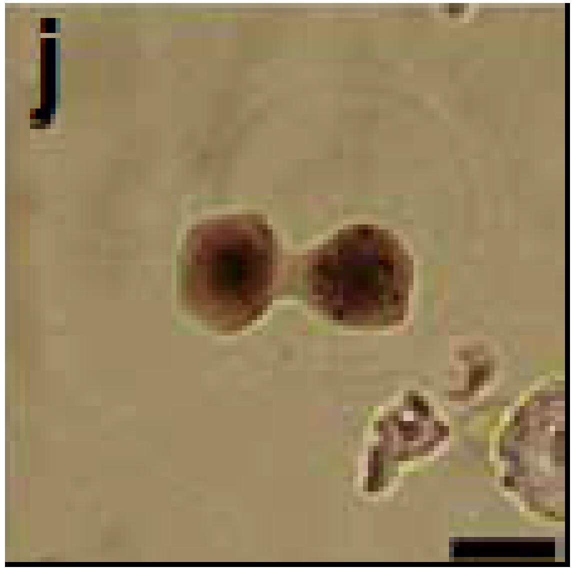
Zingiber officinale



Australian Museum,
McCown Archaeobotany
Laboratory Collection

Zingiberales

Phytolith



j. Irregularly angled rugulose chain fragment diagnostic of the order Zingiberales, and possibly derived from *Canna*.

Abramiuk, Marc A., Peter S. Dunham, Linda Scott Cummings, Chad Yost, and Todd J. Pesek. 2011. Linking Past and Present: A Preliminary Paleoethnobotanical Study of Maya Nutritional and Medicinal Plant Use and Sustainable Cultivation in the Southern Maya Mountains, Belize. *Ethnobotany Research and Applications* 9:257–73.

Zingiberales **Phytolith**

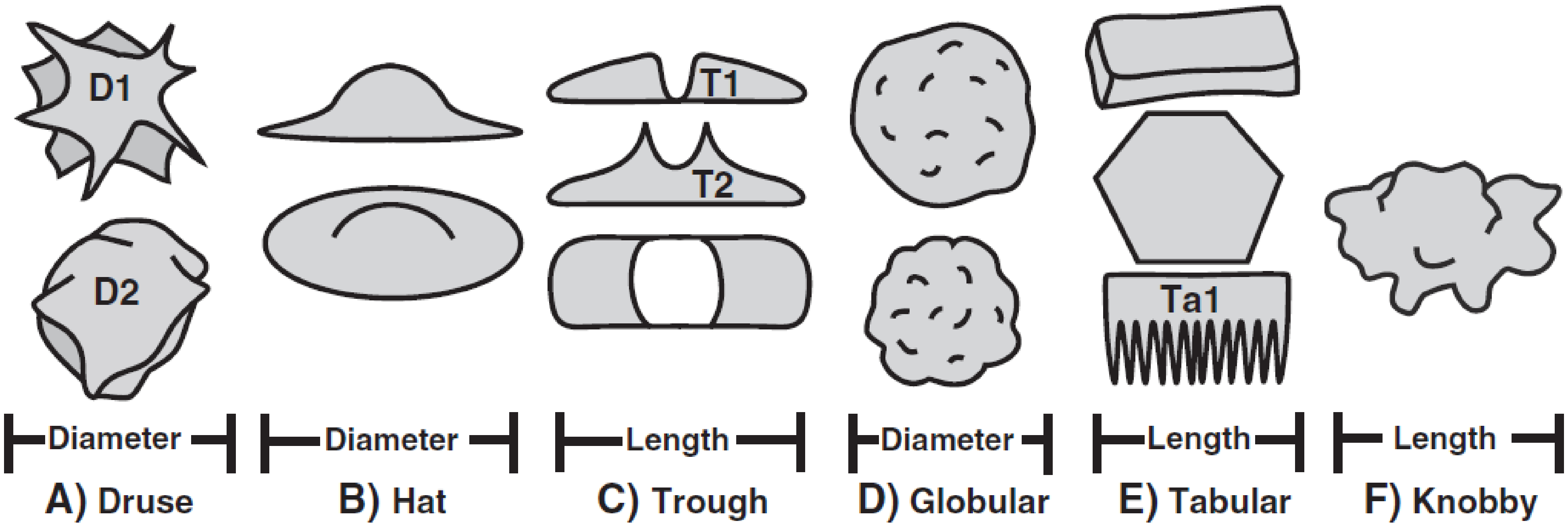


Fig. 1. Stylized drawings of selected phytolith morphotypes. A, D1 and D2 druses, distinguished by visible spikes on D1 druses. B, hat-shapes, defined by a relatively flat and trans- lucent base. C, T1 and T2 troughs, identified by height of central process. T1 troughs are generally flat while T2 rise rapidly. D, two textures of globulars, although they can exist in a larger range of textures. E, tabular-type phytoliths, with Ta1 example. F, knobby-type phytoliths, with Kn2 example. All reported measurements are made along the longest axis

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Zingiberales

Phytolith

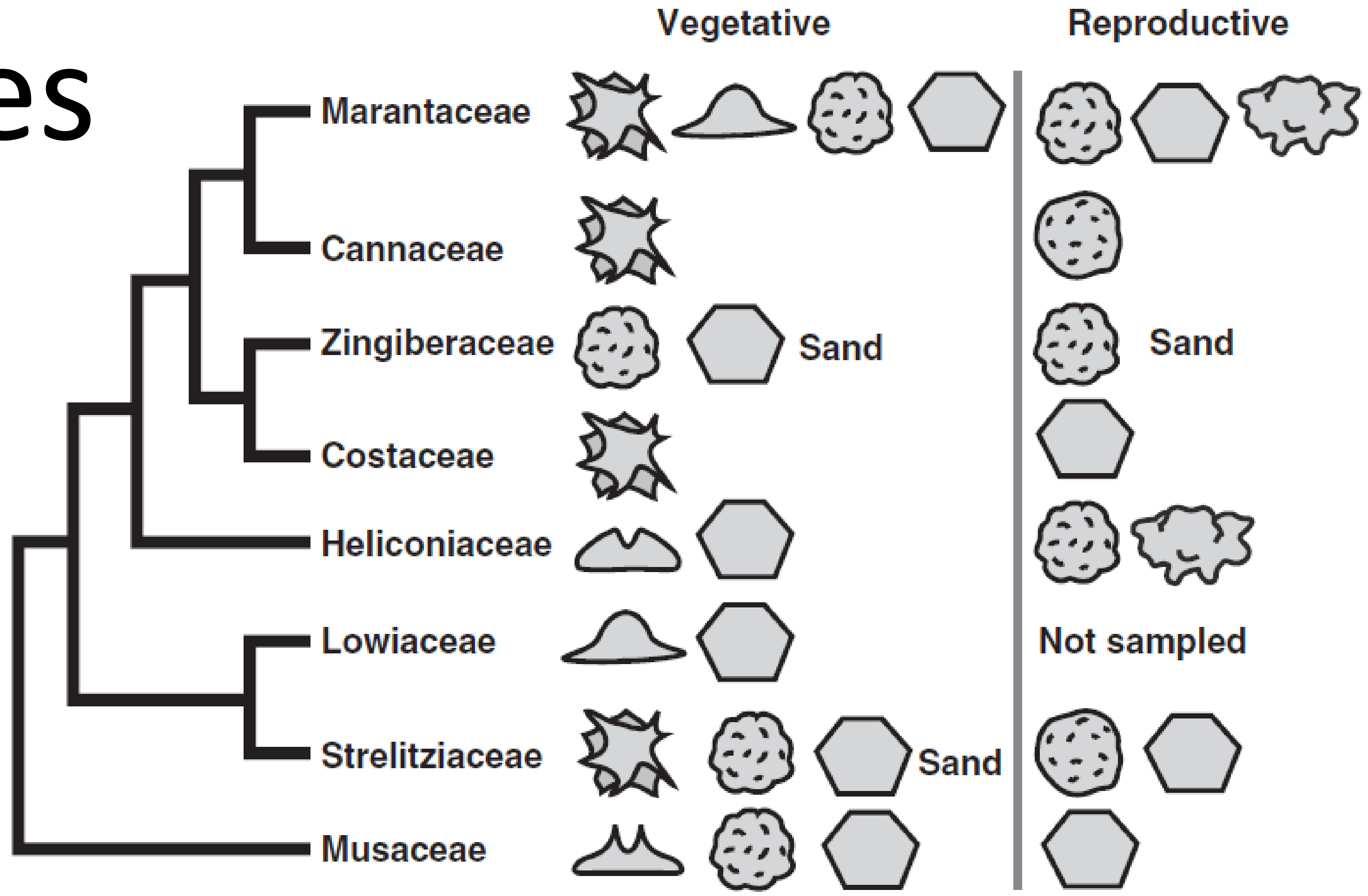

Fig. 5. A comparison of family-level morphotype production against phylogeny. There is no apparent correlation of morphotype to phylogenetic relationship. Phylogenetic tree based on Kress et al. (2001). Symbols are as in Fig. 1, except differences within tabular and druse morphotypes was not made as the subcategories often intergrade.

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