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Paleomycology of the Princeton Chert

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Introductory remarks

Understanding fossil fungi can help us understand the environmental context and taphonomy of the Princeton Chert -- and *vice versa*?

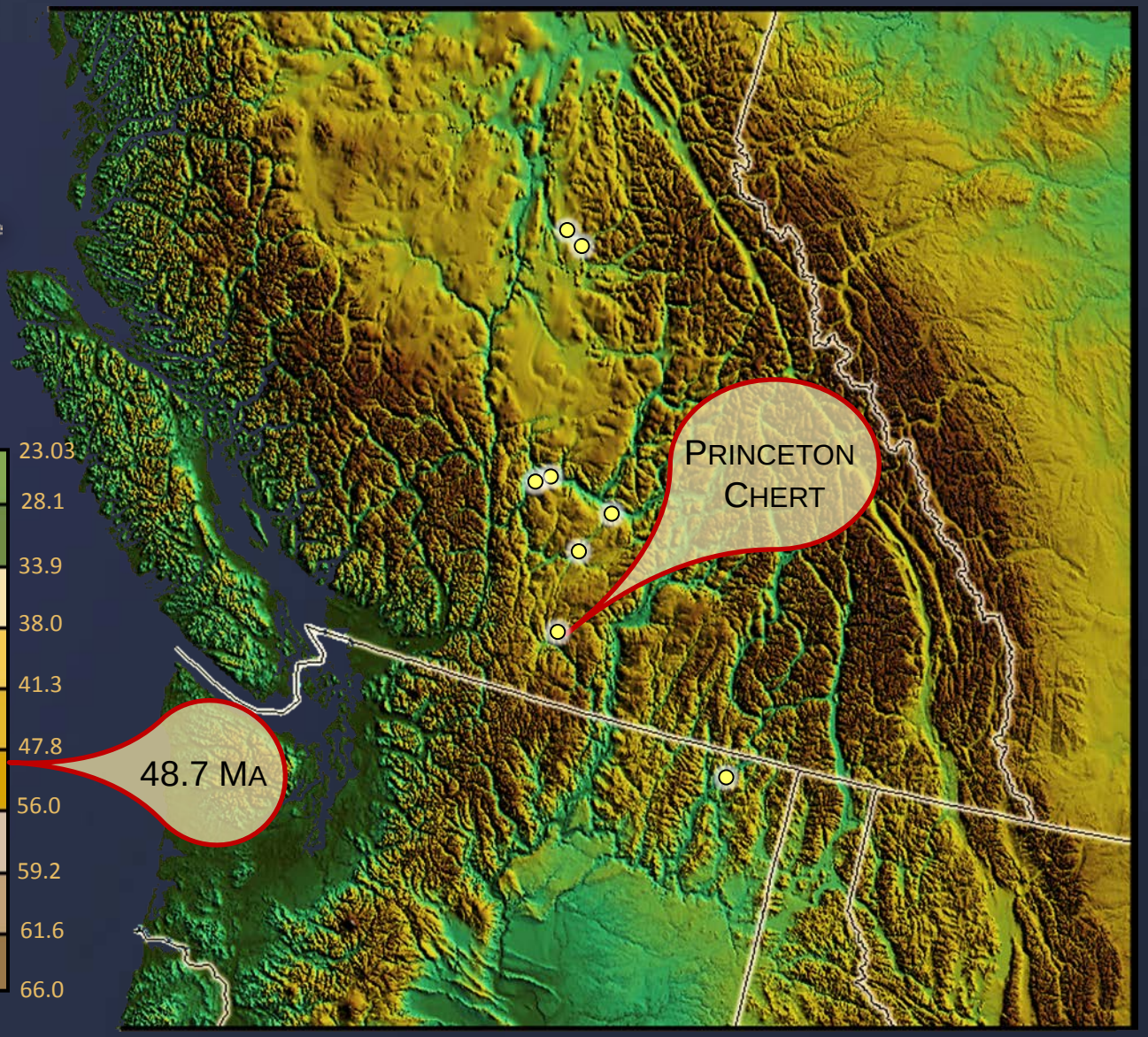
- Taphonomic filters
- Drivers of plant community dynamics
- Response to local environmental change

Introductory remarks

1) The Princeton Chert
    -regional and stratigraphic context
2) Paleomycological significance
    -techniques
    -fossil comparable to extant fungi
3) Insights into environmental context
    -silicification
    -comparisons with contemporary mires
    -fungi in extant aquatic plants
    -how much of the picture is missing?
    (taphonomic filtering **of** and **by** microbes)

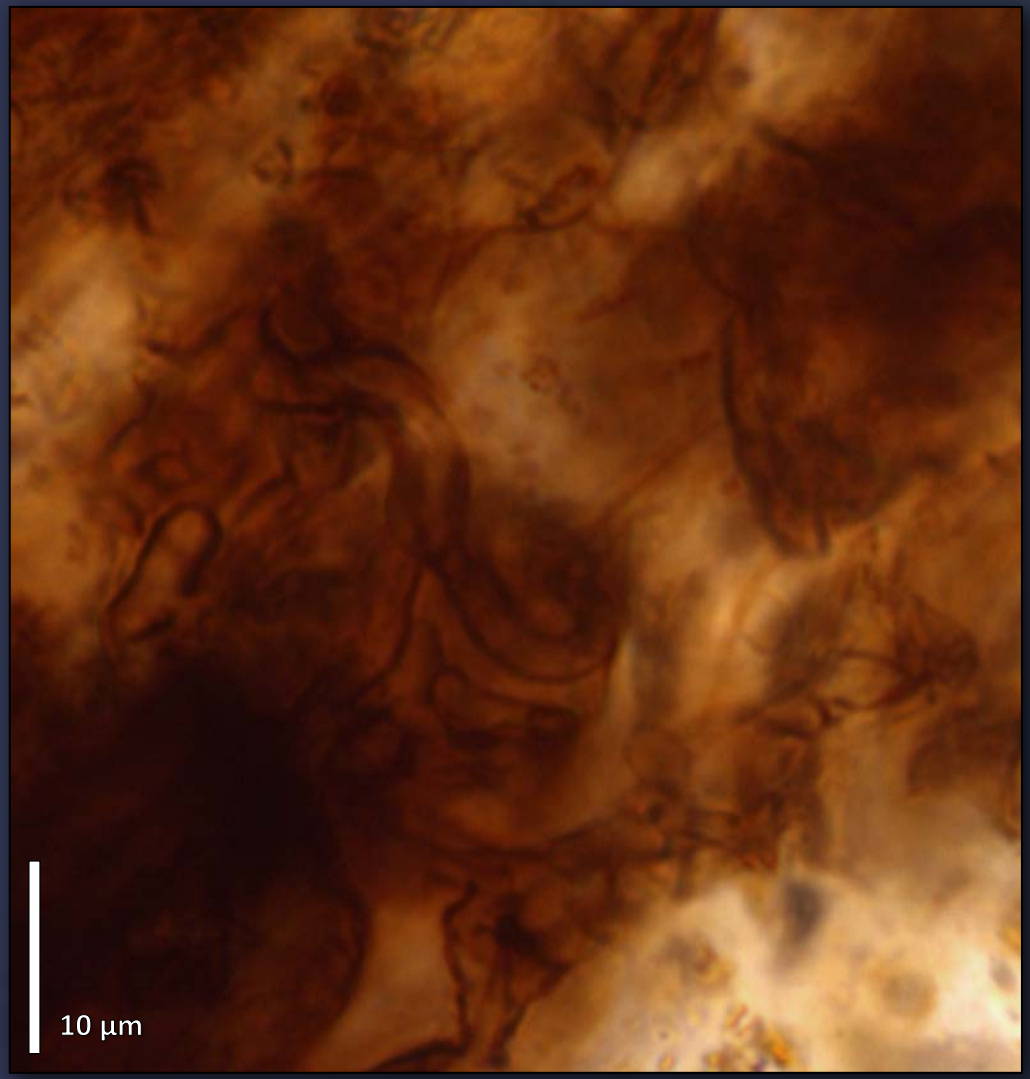
Regional context

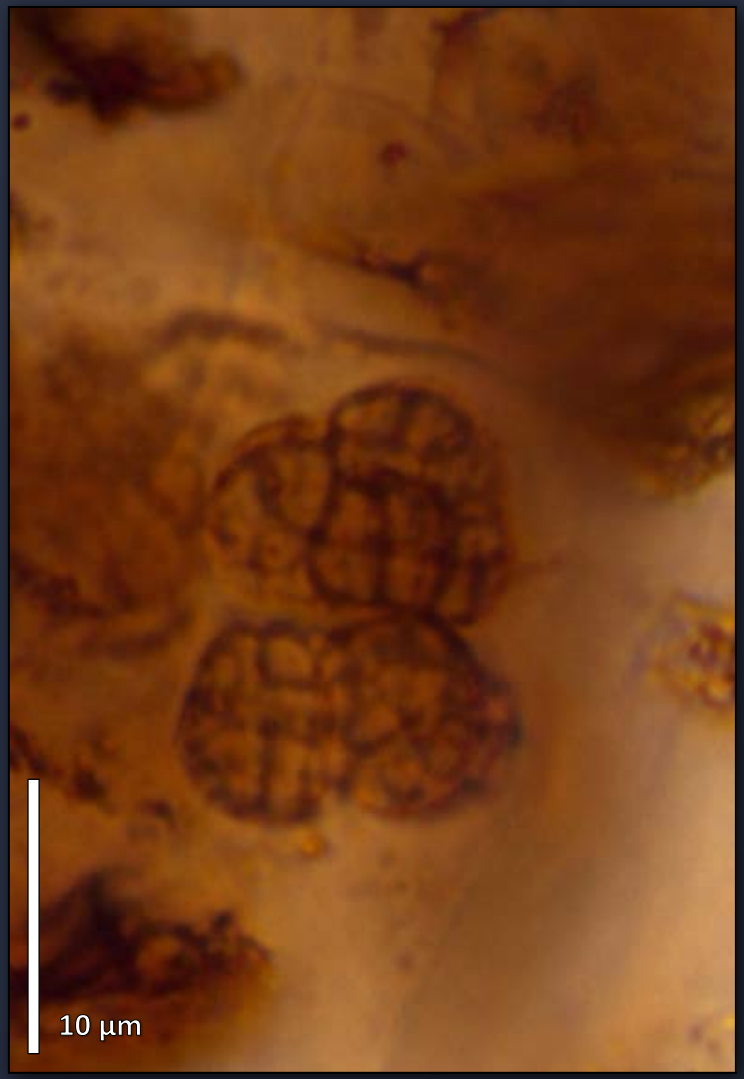
Paleogene			
	Oligocene	Chattian	23.03
		Rupelian	28.1
	Eocene	Priabonian	33.9
		Bartonian	38.0
		Lutetian	41.3
		Ypresian	47.8
	Paleocene	Thanetian	56.0
		Selandian	59.2
		Danian	61.6
			66.0



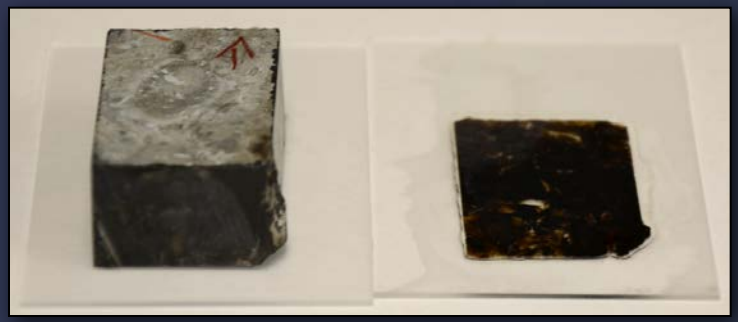
Stratigraphy and geology

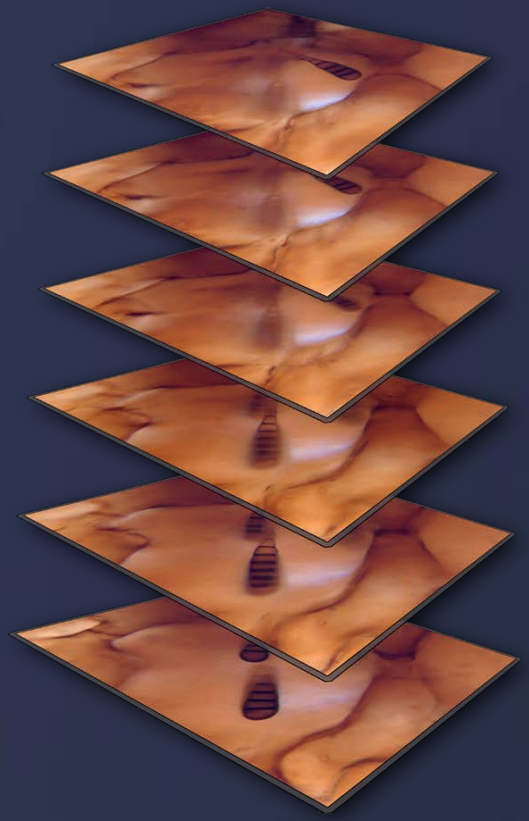
Fungi in the Princeton Chert



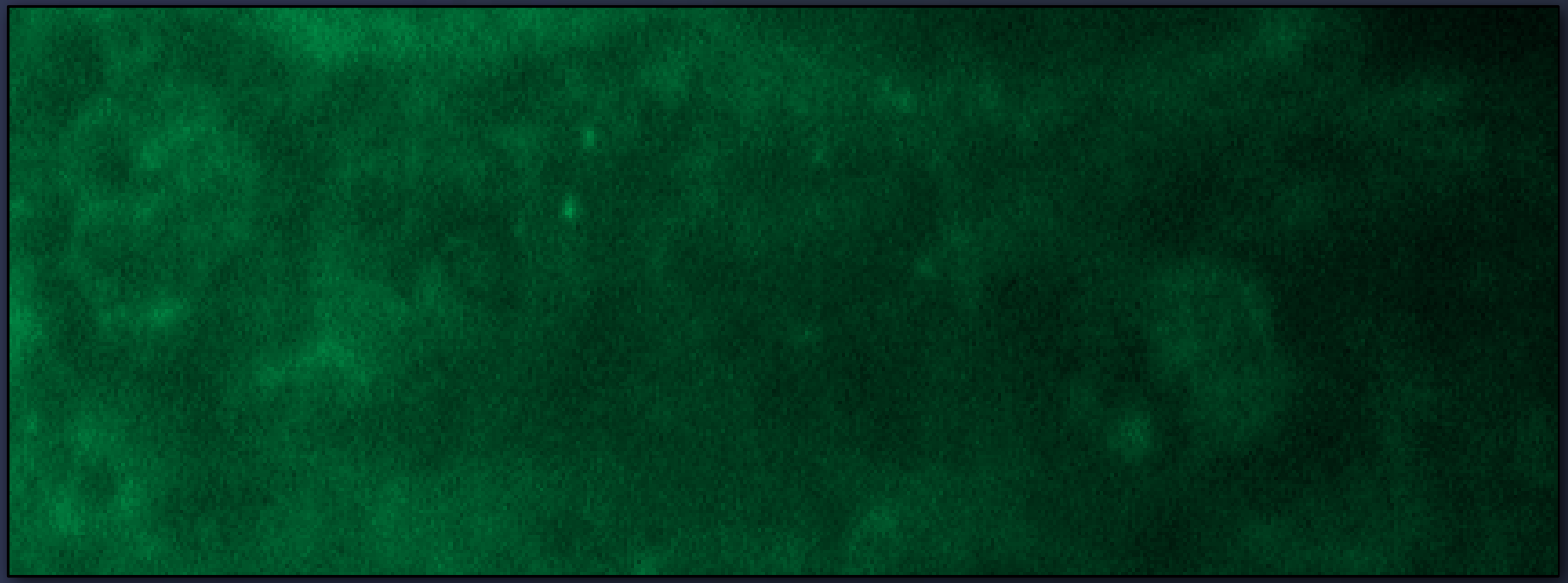


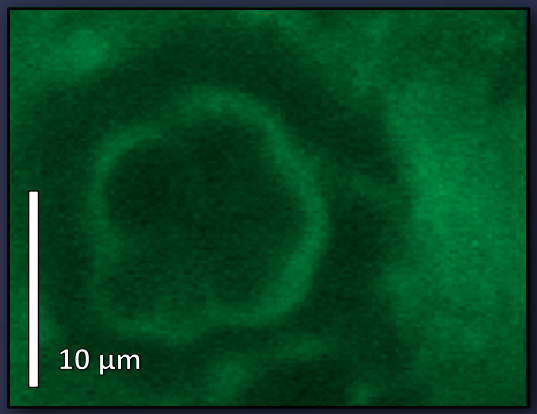
Methods: extended depth of field





Methods: confocal laser scanning

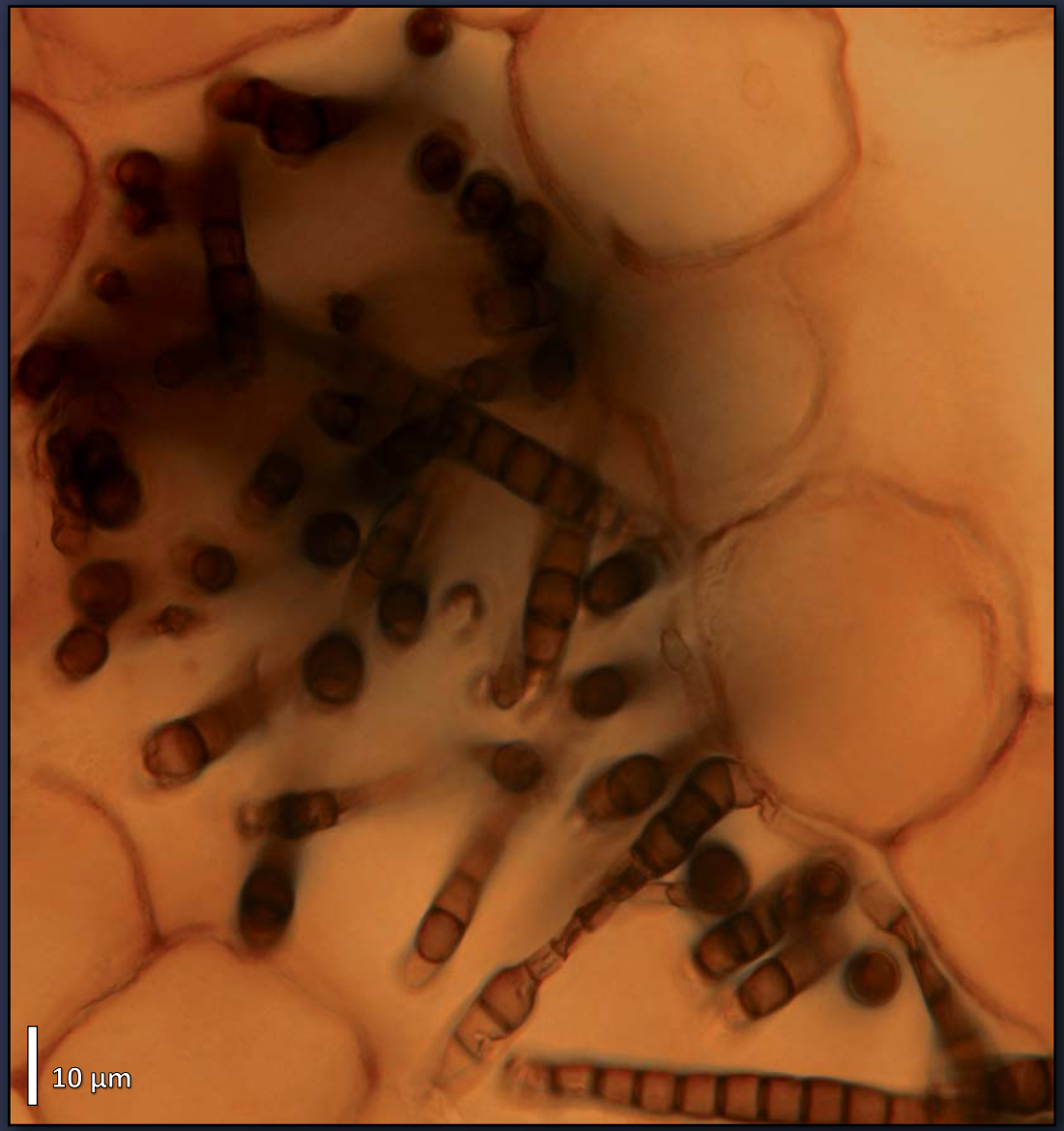




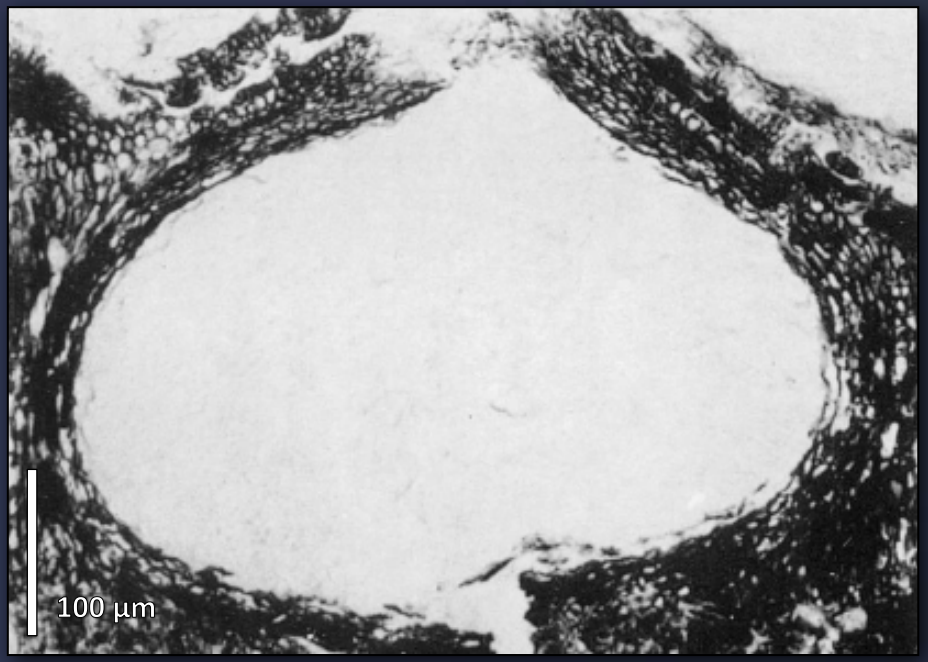
Olympus IX71 microscope with
Yokagawa CSU10 spinning disk

Excitation: 488 nm Coherent state laser
Emission: 561 nm Semrock longpass filter

Methods: look in the right place



Fungi preserved in fossil plants



Hosts of Parasites and/or Saprotrophs

Uhlia allenbyensis Erwin et Stockey

Currah et al. 1997. Mycologia 90:667–673.

Decodon allenbyensis Cevallos-Ferriz et Stockey

Allenbya collinsonae Cevallos-Ferriz et Stockey

Princetonia allenbyense Stockey

LePage et al. 1994. Int. J. Plant Sci. 155:828–836.

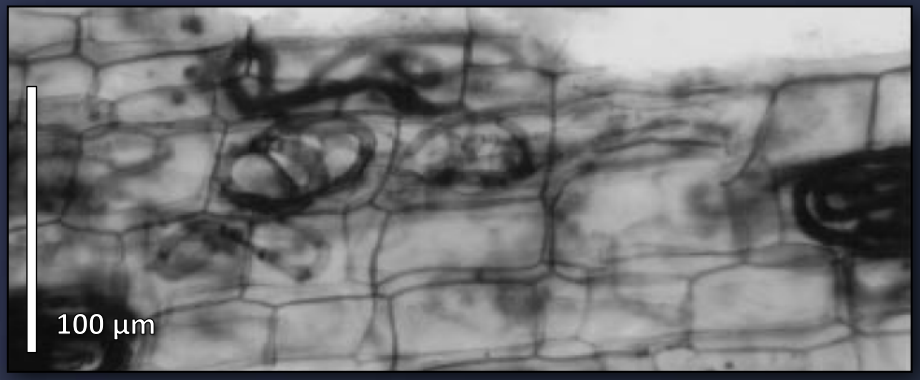
Eorhiza arnoldii Robison et Person

Robison et Person. 1973. Can J Bot 51:1373–1377.

LePage et al. 1994. Int. J. Plant Sci. 155:828–836.

Klymiuk et al. 2013. Mycologia, 105:521-529.

Dennsteadtiopsis aerenchymata *Arnold et Daugherty*



Hosts of Mutualists and Endophytes

Metasequoia milleri Rothwell et Basinger

Stockey et al. 2001. Mycol. Res. 105:202–205.

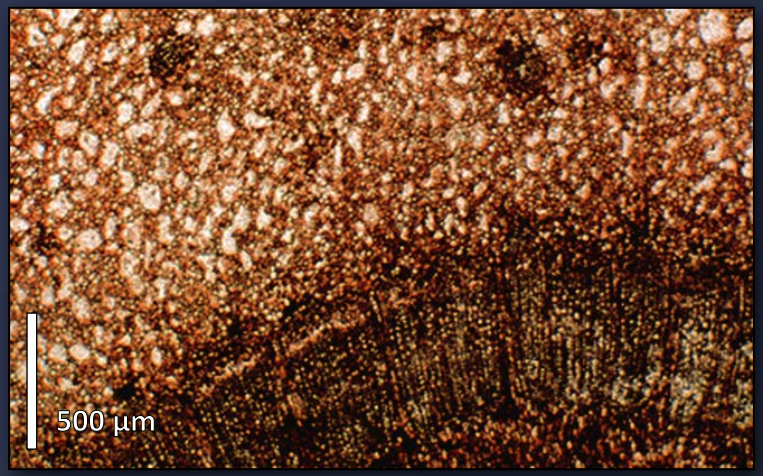
Pinus arnoldii Miller emend. Klymiuk, Stockey et Rothwell

LePage et al. 1997. Am. J. Bot. 84:410–412.

Eorhiza arnoldii Robison et Person

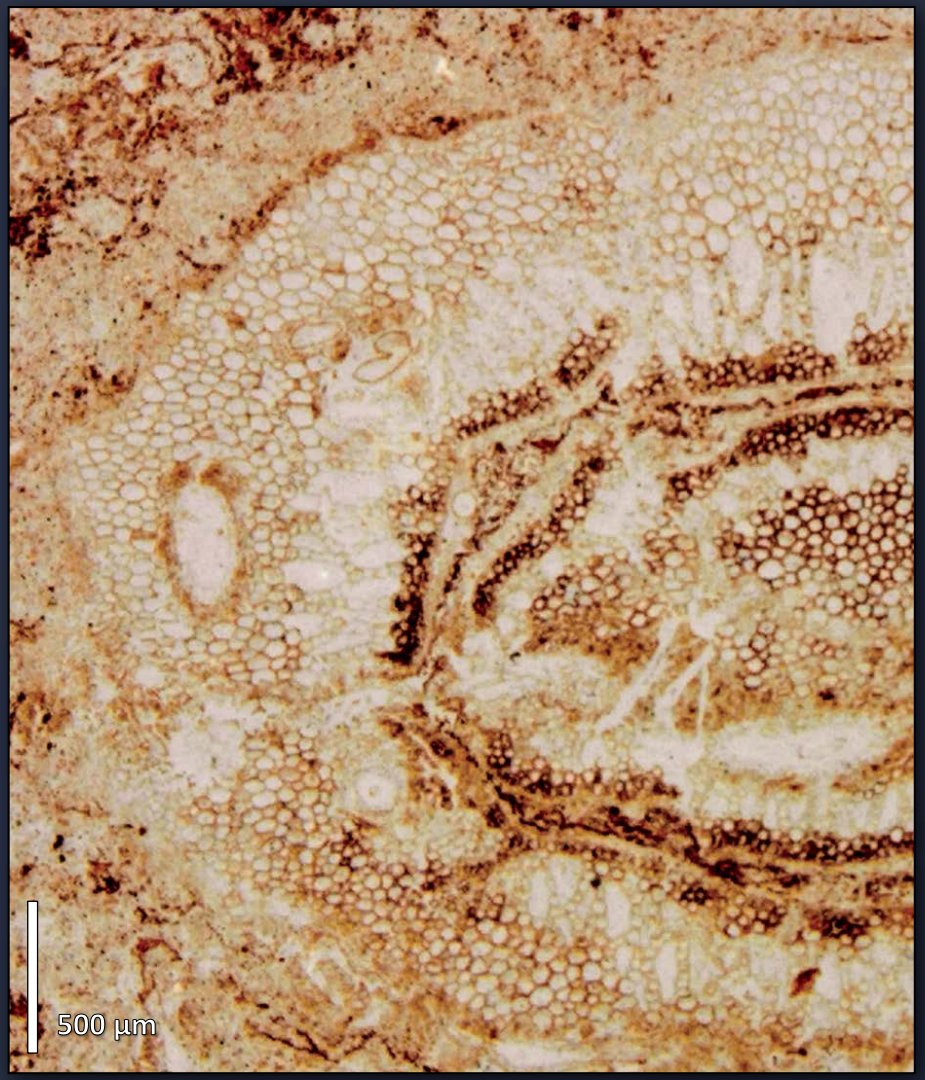
Klymiuk et al. 2013. Mycologia 105:1100-1109

Fungi in fossil aquatic plant rhizomes



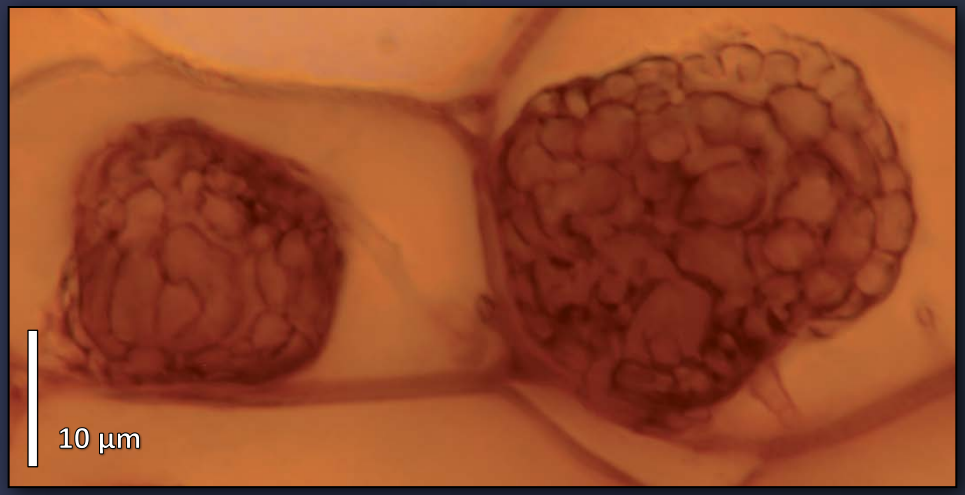
Eorhiza arnoldii Robison et Person

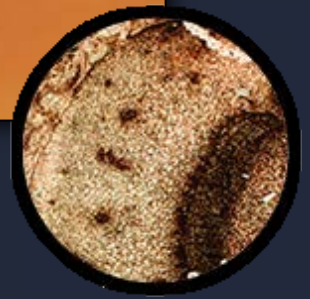
Images (above) courtesy Ruth Stockey



Dennsteadtiopsis aerenchymata Arnold et Daugherty

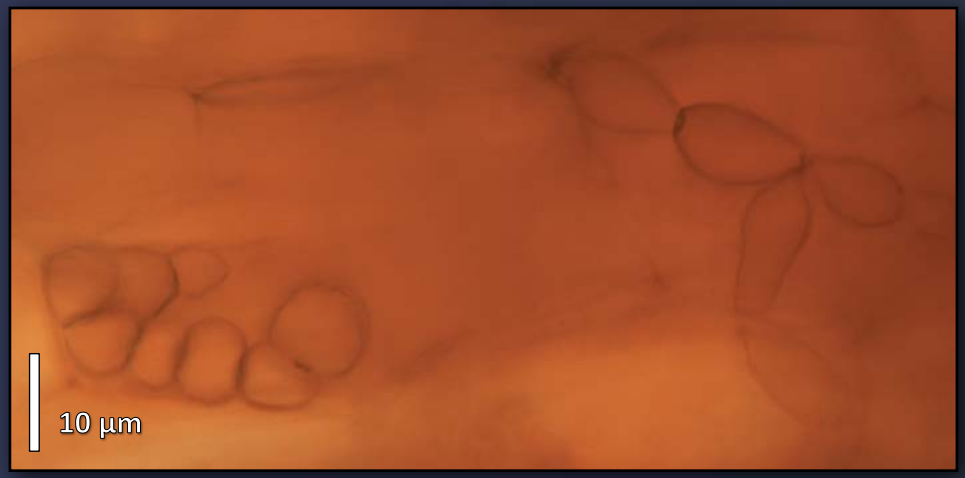
c.f. dark septate endophytes





Fernandez et al. 2008. Am. Fern J. 98:117–127.

c.f. *Leptodontidium*



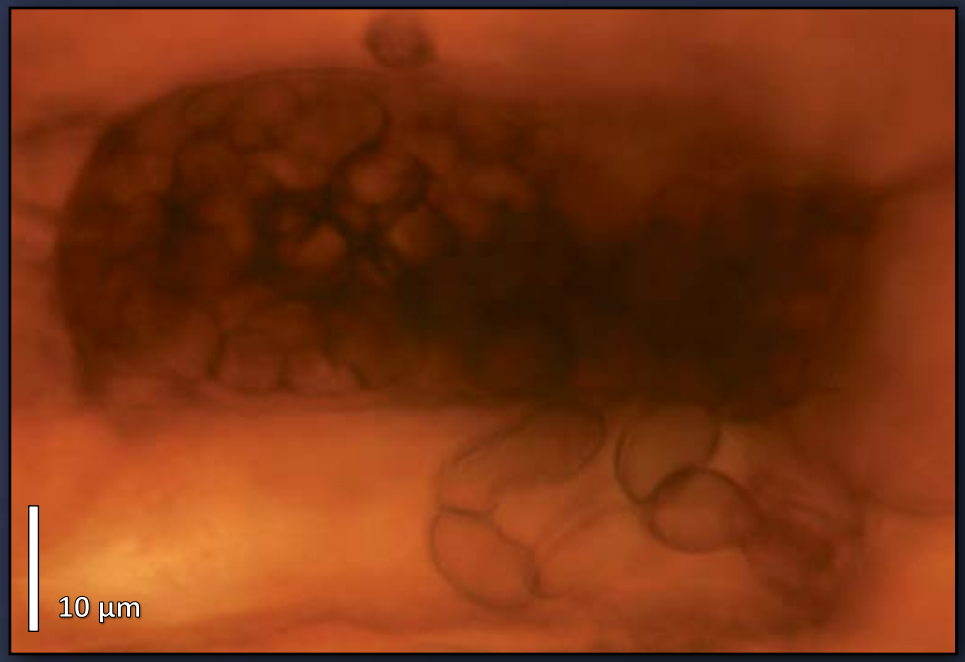
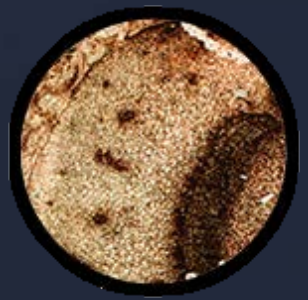
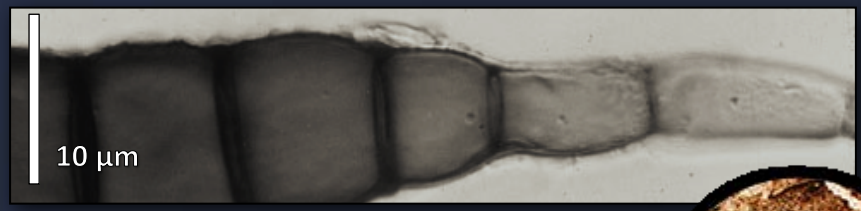


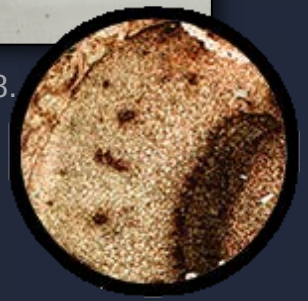
Image courtesy Michael Hough
(2008. MSc thesis, State Univ. NY)



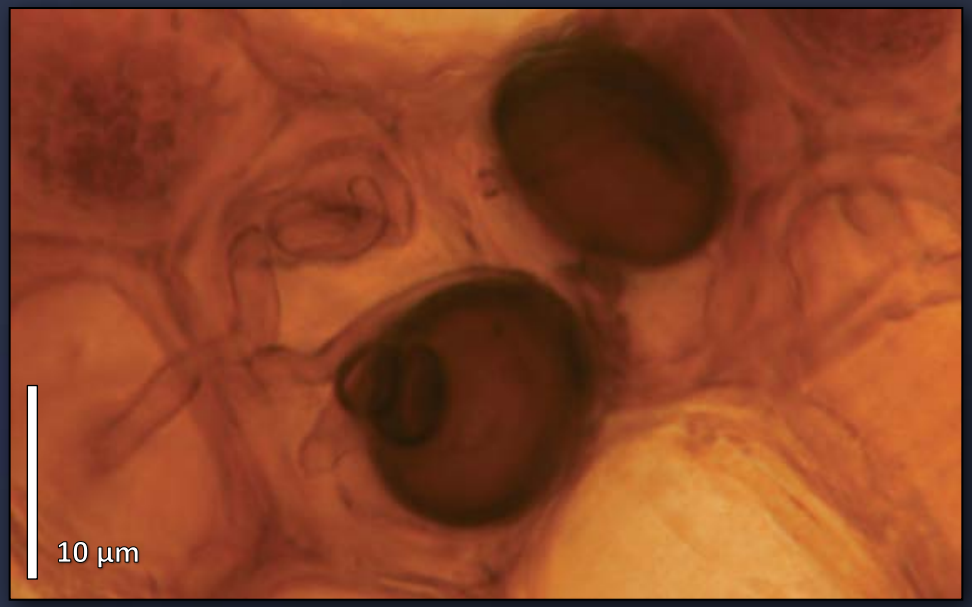
c.f. *Xylomyces giganteus*



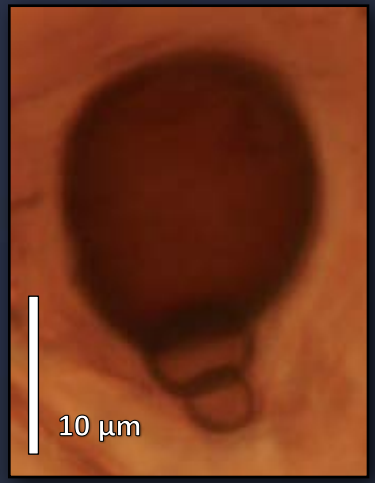
Goh et al. 1997. Mycol. Res. 101:1323-1328.

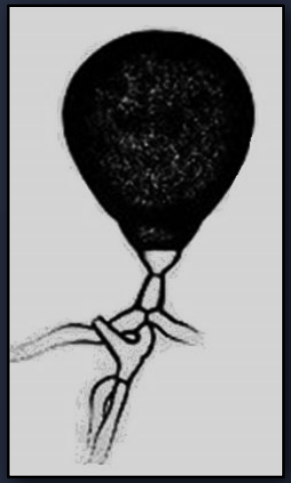


c.f. *Thielaviopsis*, c.f. *Brachysporiella*

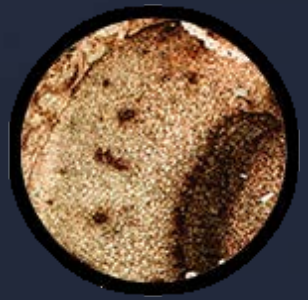


Paulin-Mahady et al. 2002. Mycologia 94:62-72.

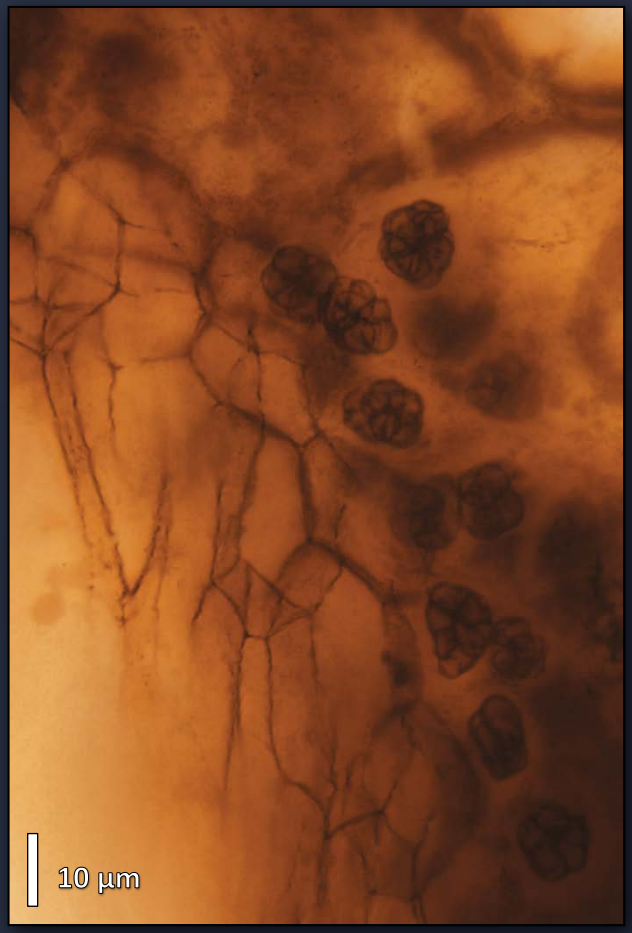


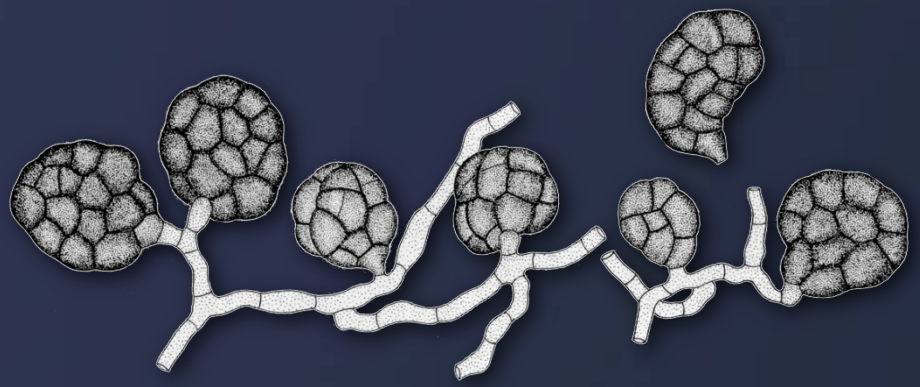


Rao and de Hoog. 1986. Stud. Mycol. 28:1–84.

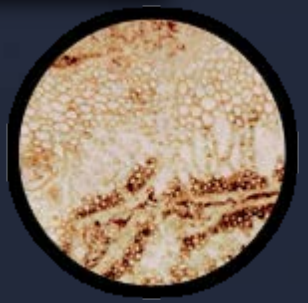


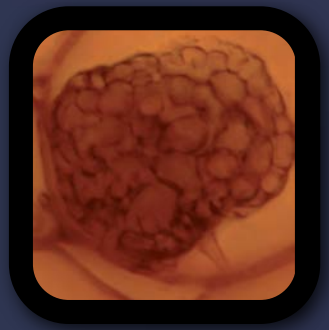
c.f. *Monodictys*

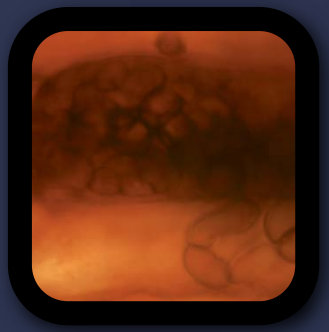




Seifert et al. 2011. CBS Biodiversity Series 9

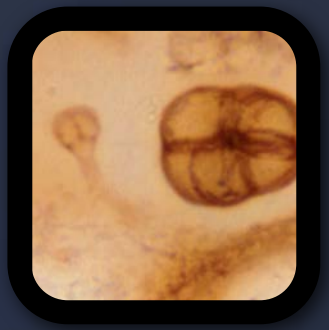




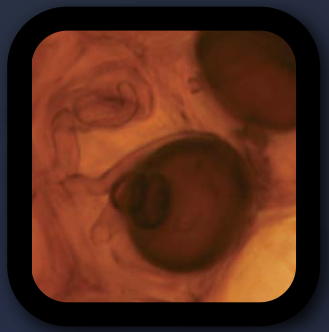


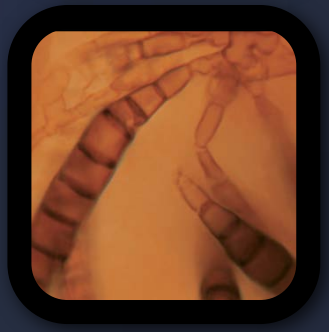
dark septate endophytes (N acquisition?)

root pathogen



saprotroph (moist soils)





saprotrophs (submerged substrates)

Silicification

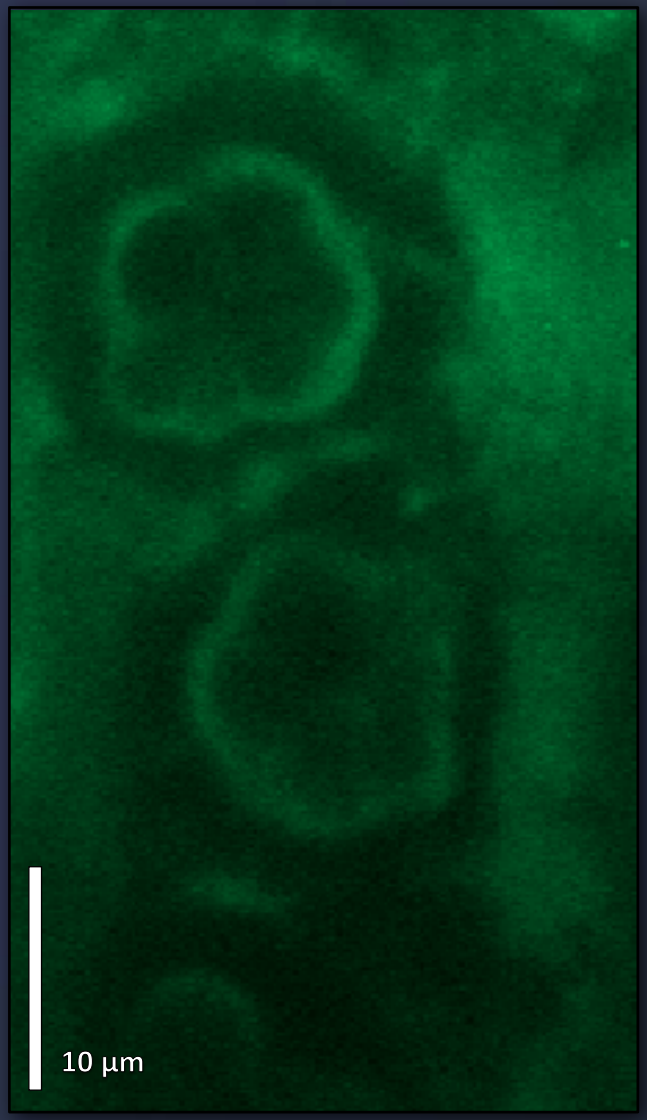
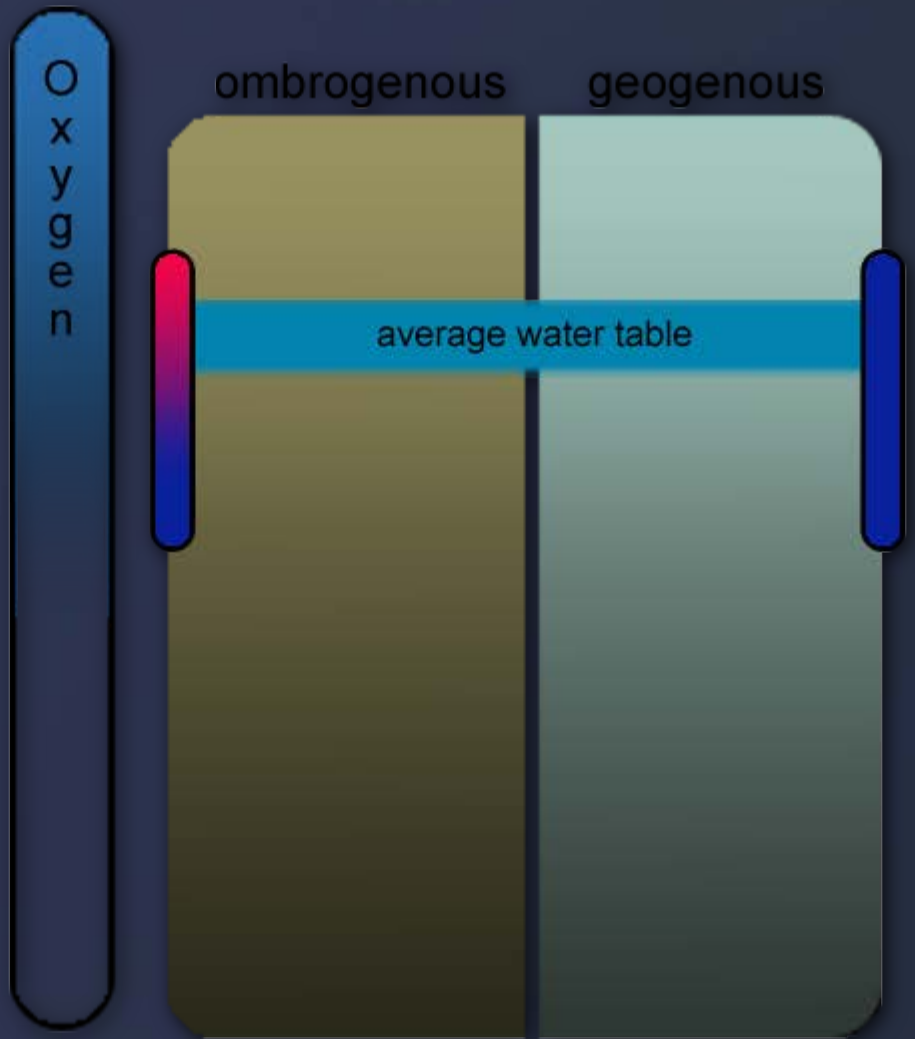


Table 4. Volatile trace element compositions. (ppm)

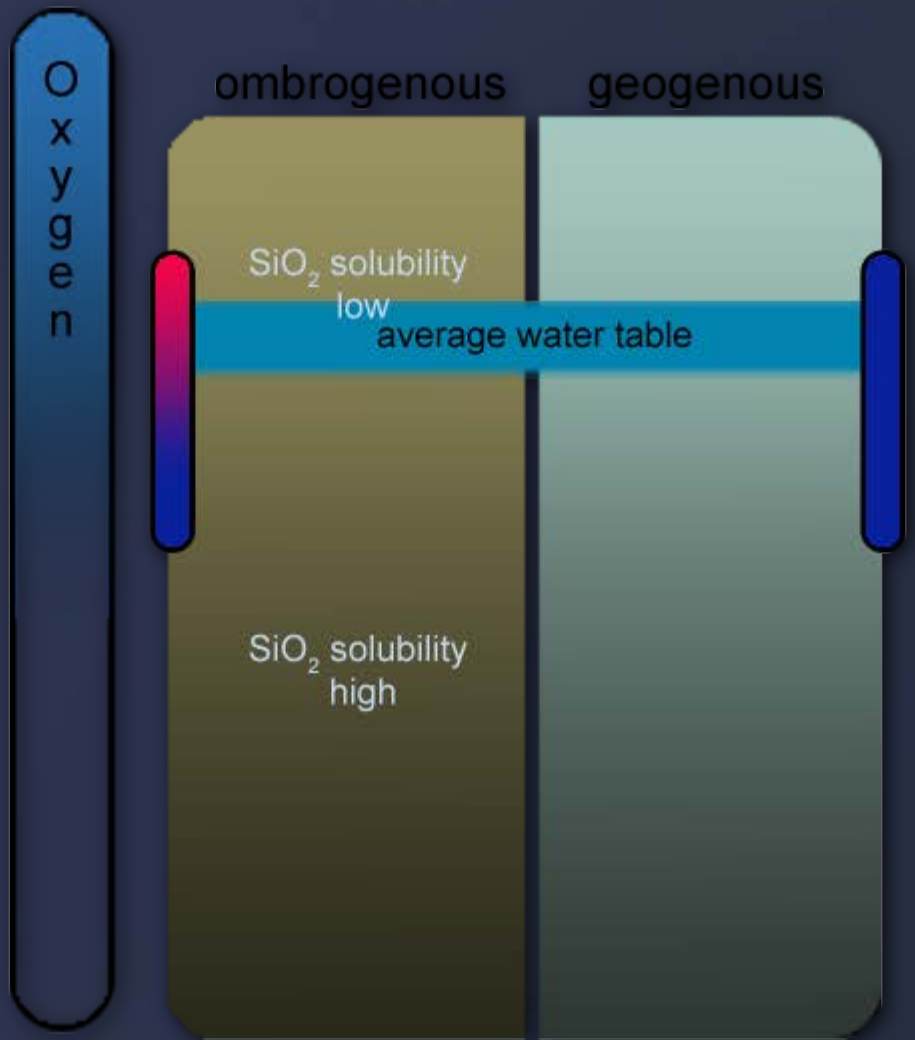
	Sb	As	Hg	Au
Allenby Formation: Princeton Chert site				
PC-10 chert	0.6	<2	<1	<0.005
PC-24 chert	0.4	<2	<1	<0.005
PC-32 chert	0.4	<2	<1	<0.005
PC-37 chert	0.4	<2	<1	<0.005
Average values from modern and ancient hot spring sediments				
Steamboat Hot Springs, Nevada[a] (n = 9)	1400	200	350	0.5
Yellowstone Park, Wyoming[b] (n = 24)	193	520	24	<0.1
Taupo volcanic zone, New Zealand[c] (n = 8)	235	356	ND	ND
Virgin Valley, Nevada (Miocene)[d] (n = 20)	21	140	1	<0.05
Rhynie Chert, Scotland (Devonian)[e] (n = 18)	<7	98	ND	20

modified from Mustoe 2011. Can J Earth Sci 48:25-43.

Modern mires



Modern mires



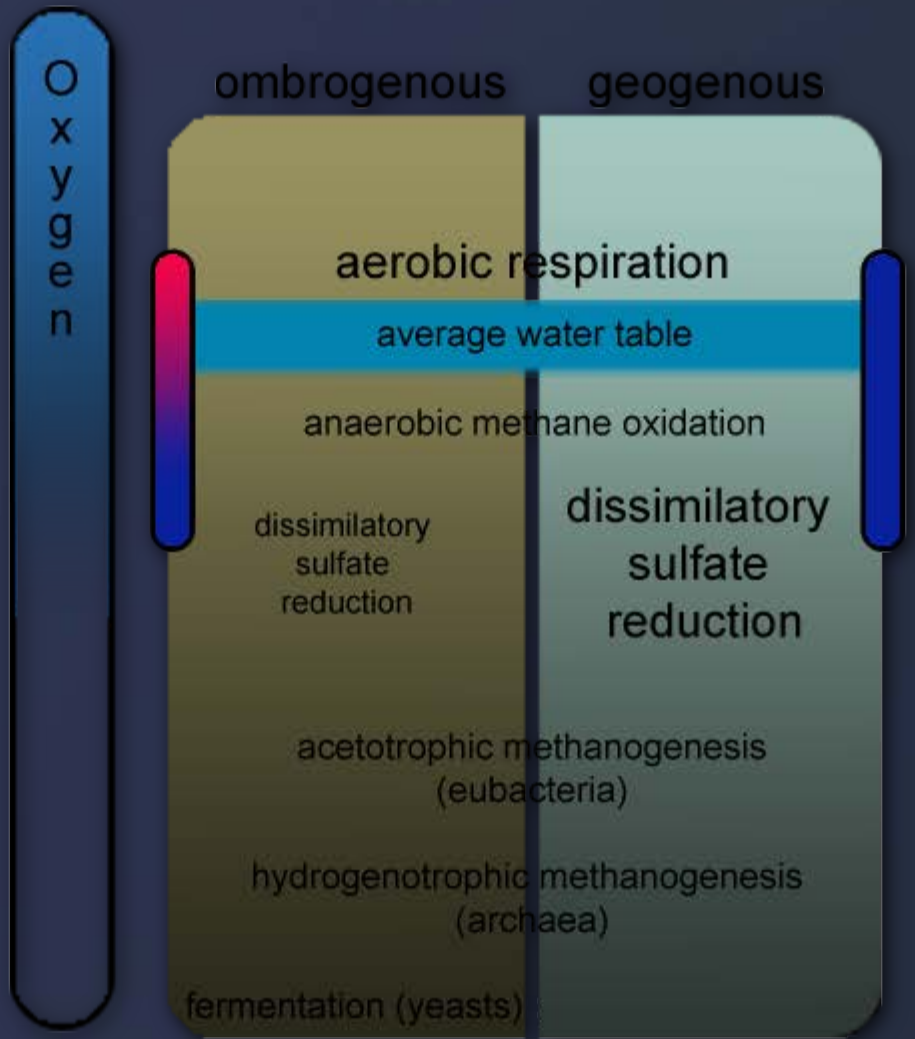
SiO_2 solubility is **decreased** by

- pressure/heat reduction
- evaporation
- lower pH
- presence of sulfate reducing bacteria

SiO_2 solubility is **increased** by

- complexation with humic substances
- higher pH (= circumneutral)

Modern mires



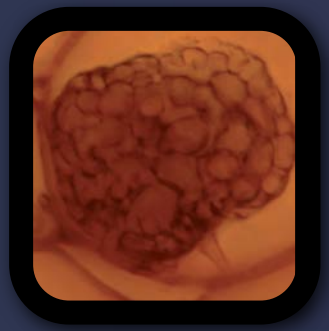
Arbuscular mycorrhizal fungi (Glomeromycota) in plant roots

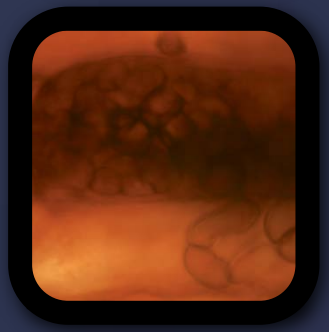
Mycelial saprotrophs (Ascomycota, Basidiomycota)

Yeasts (Ascomycota)

Predicting taphonomic sequences?

Colonized during life:

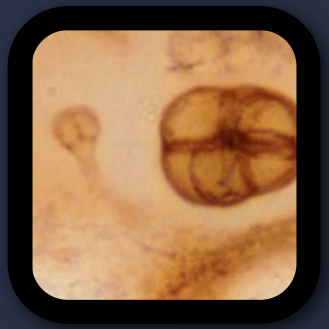




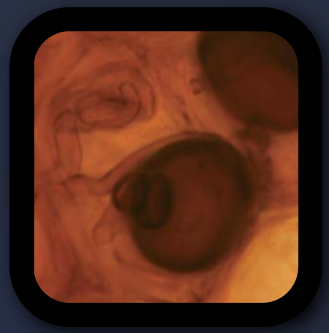
dark septate endophytes (N acquisition?)

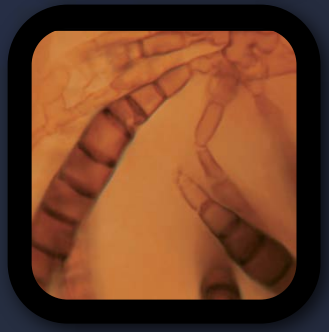
root pathogen

Colonized in senescence or post-mortem :



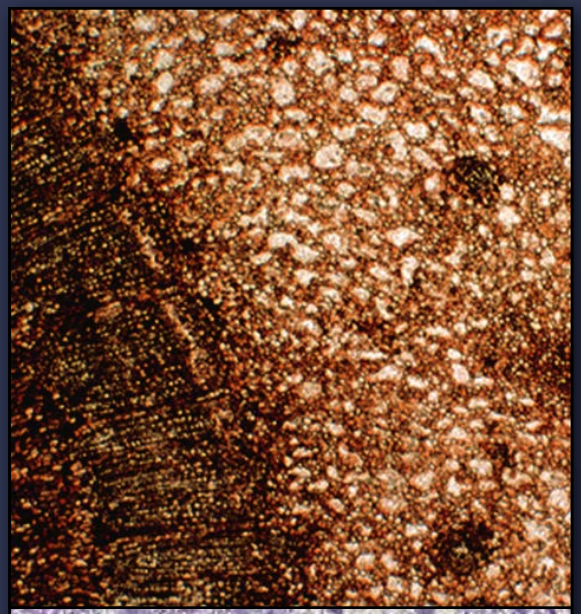
saprotroph (moist soils)

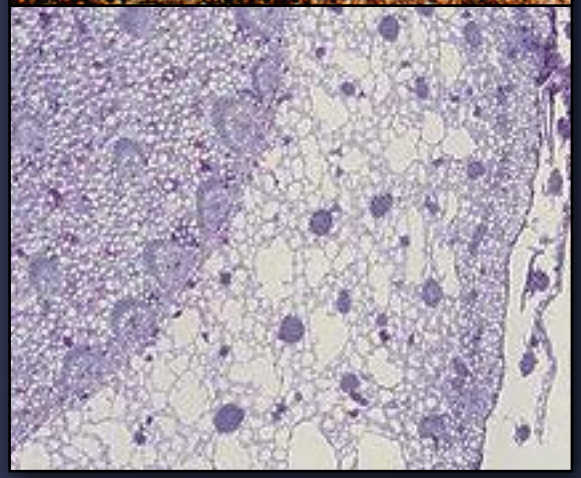




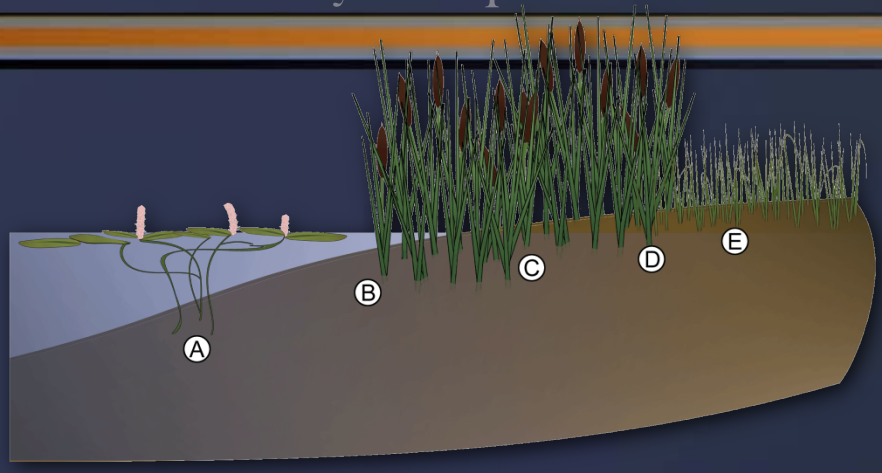
saprotrophs (submerged substrates)

Fungi in living aquatic plants?



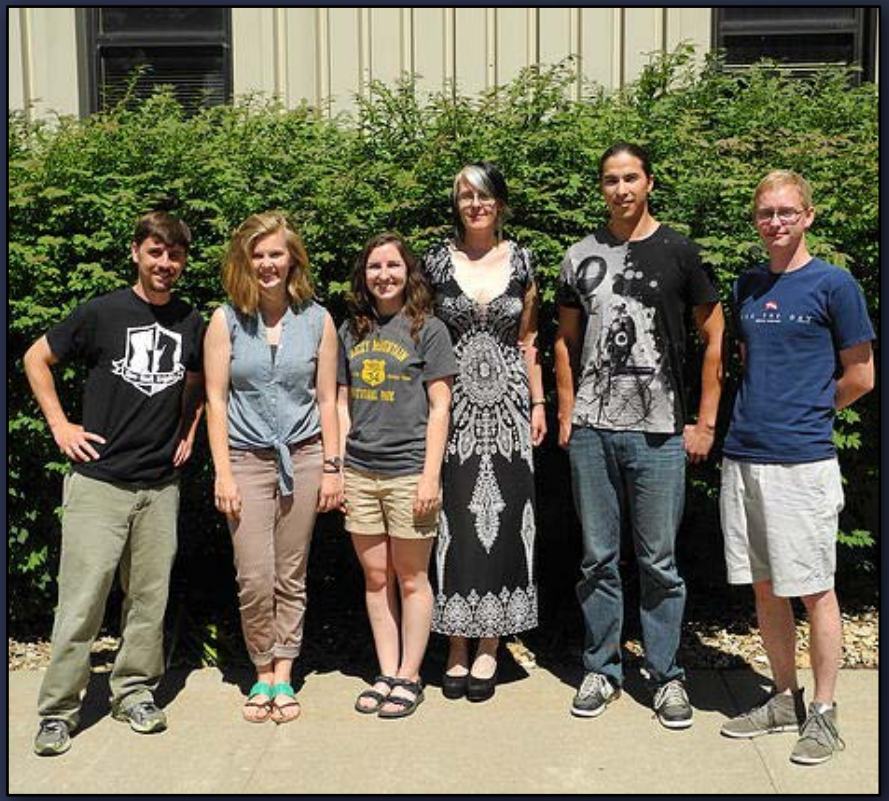


Baseline diversity in aquatic roots



Images (above) courtesy Abby Glauser

Concluding remarks



@AzKlymiuk

slideshare

ResearchGATE scientific network

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- Wayne Dickerson, Dept. Geology
- Heather Shinogle, Microscopy & Analytical Imaging Lab
- US Army Corps of Engineers, Melvern Lake KS
- KU Field Station

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NSF