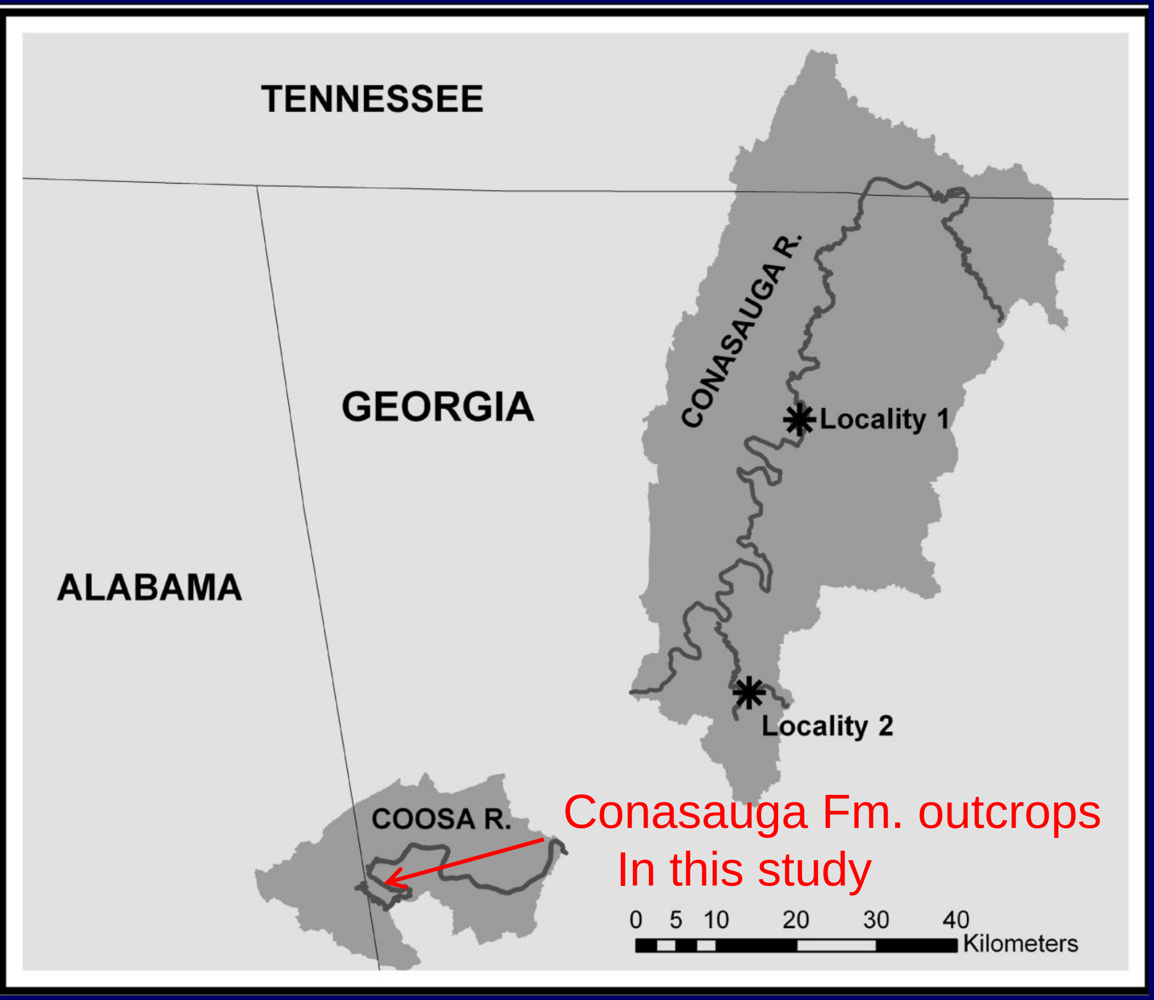
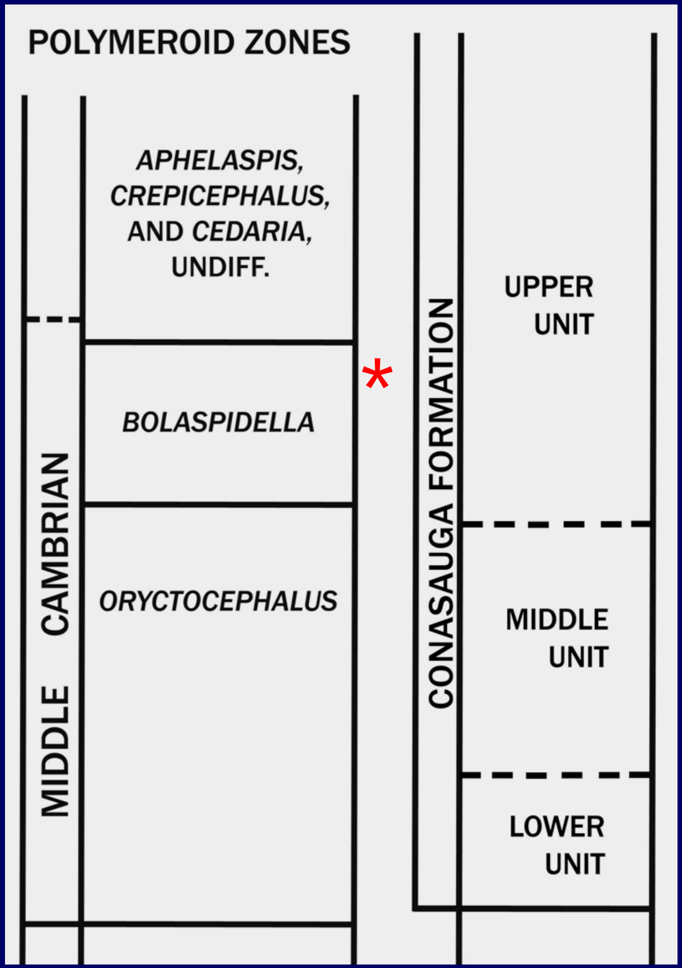
Paleobiology and Geochemistry of Siliceous Concretions in the Conasauga Formation, Middle Cambrian, Northwestern Georgia

David R. Schwimmer
William J. Frazier
Columbus State University

William M. Montante
Marsh USA, Inc.

Localities and Correlations





Age of the
concretion-bearing beds


GSA
CM
IN
mm

Masses of concretions in stream beds, cleared forest tracts

Fossils Preserved on Concretion Surfaces

Complete trilobite exoskeletons

Elrathia antiquata

Fossils in Conasauga concretions are often articulated and in full-relief, rather than flattened , typical in shales, or disarticulated as in most Cambrian limestones and sandstones

Elrathia antiquata (from adjacent strata)

Positive (left) and negative (right) trilobite dorsal exoskeletal preservation

Elrathia antiquata

Bolaspis labrosa

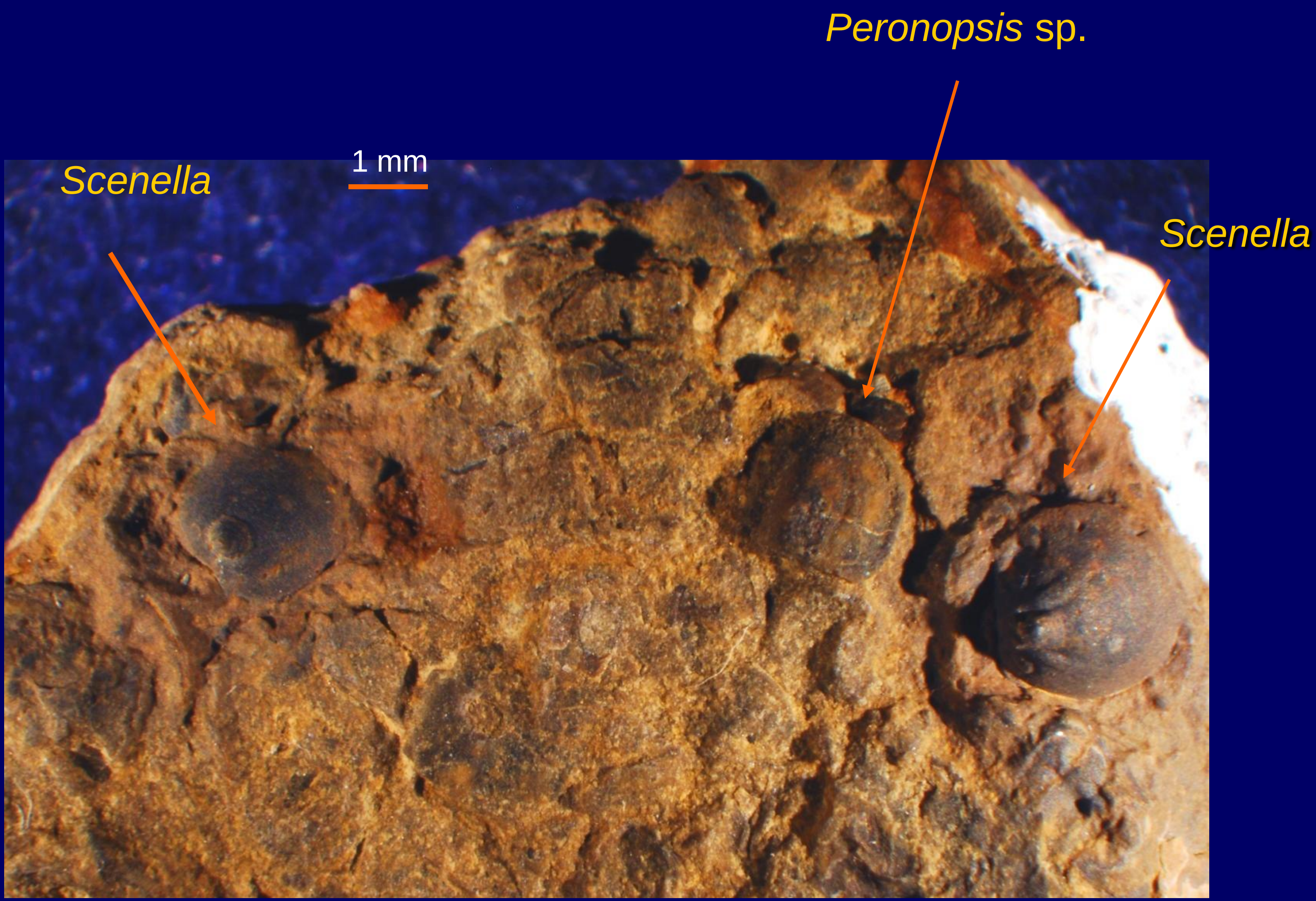
Rare Trilobites

Olenoides sp.

Isolated trilobite sclerites ("Cambrian trilobite hash")

Hyolithids, cf. *Haplophrentis carinatus*

Rare, smaller fossils
(*Scenella* and agnostoid trilobites)



Exceptional Preservation

Chlorophyte
(Green) Algae

Indeterminate structures on concretion surfaces, possibly lithistid spicules (demosponges)

Whole-body preservations in concretions

"*Brooksella*"

“*Brooksella*” symmetries:

pentameral

bilateral

History of *Brooksella (Laotira)* identifications

Walcott: 1896, 1898: Medusoid scyphozoams

Resser , 1938; Caster, 1945; Harrington & Moore, 1956 (Treatise…), Willoughby and Robison, 1979: still scyphozoans

Cloud, 1960: gas bubbles

Fűrsich and Bromley, 1985; Seilacher and Goldring, 1996; Rindsberg, 2000: ichnofossils, cf. *Dactyloidites asteroides*; (*Laotira,* a junior synonym, and *Brooksella* suppressed)

Ciampaglio, et al., 2005: hexactinellid sponges (resurrecting *Brooksella* as a valid poriferan genus)

Schwimmer and Montante, 2007: whatever.

What is "*Brooksella*" ?

The Pudding Hypothesis

Brooksella

Jello

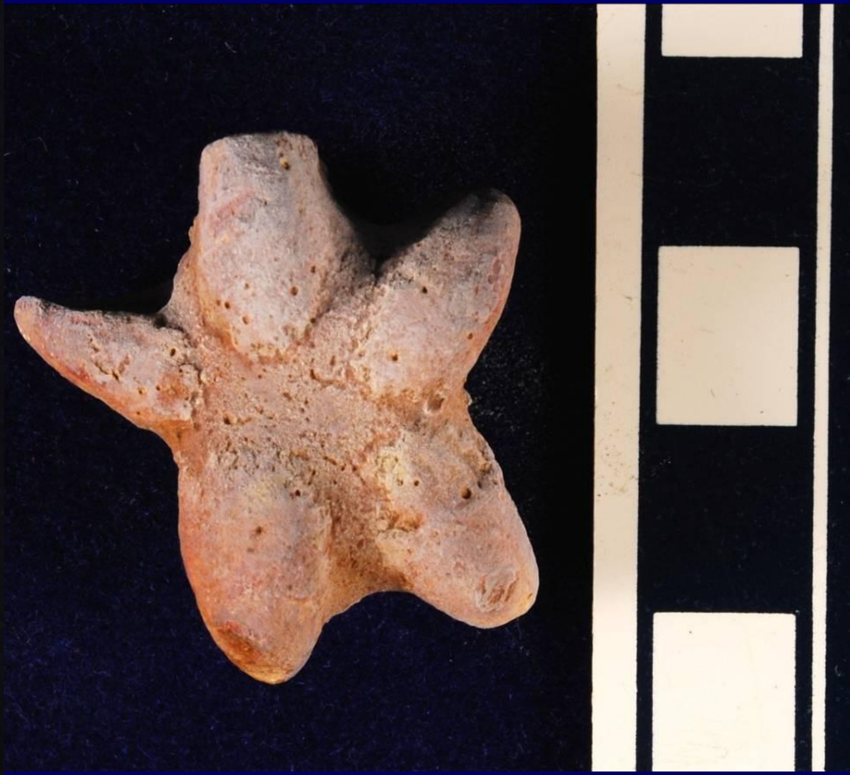
The Coprolite hypothesis

Cambrian

Cretaceous

Reinforcement of the poriferan hypothesis: evidence of poriferan identity (*fide*, Ciampaglio, et al, 2005, 2006) in symmetrical oscula at ends of lobes

However, these may represent several poriferan taxa



Other whole-body preservations

Calcisponges

Eifellia globosa

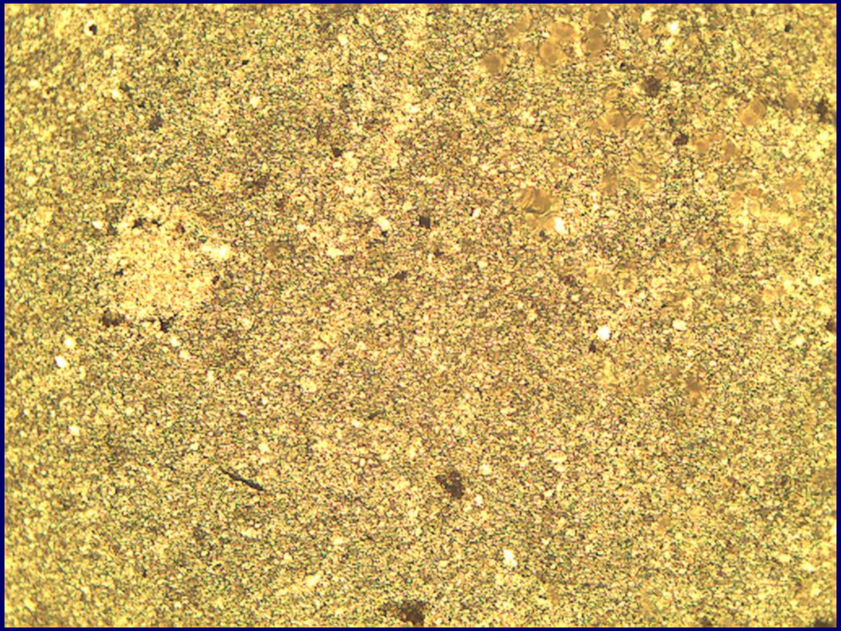
Concretion with *Eiffelia* partially exposed

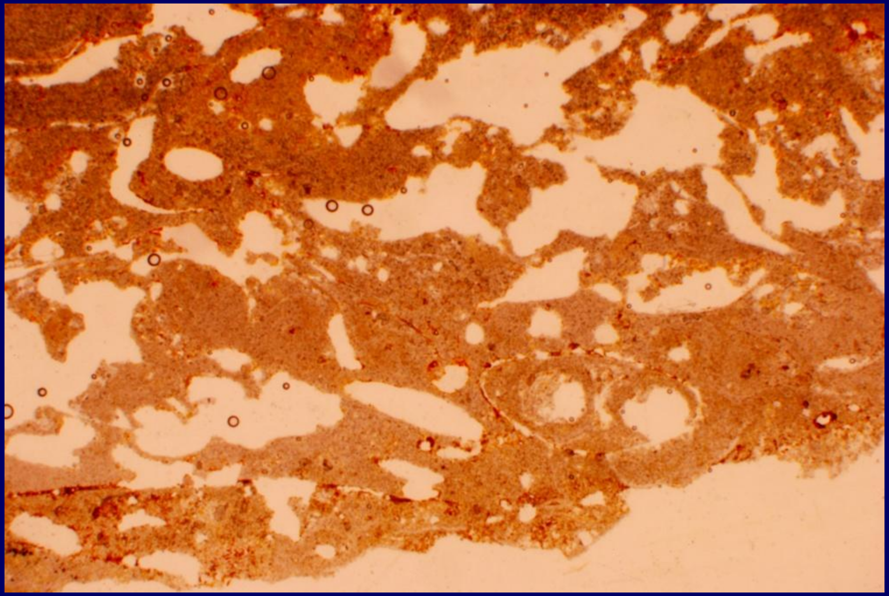
Eiffelia showing possible surface expression of spicules

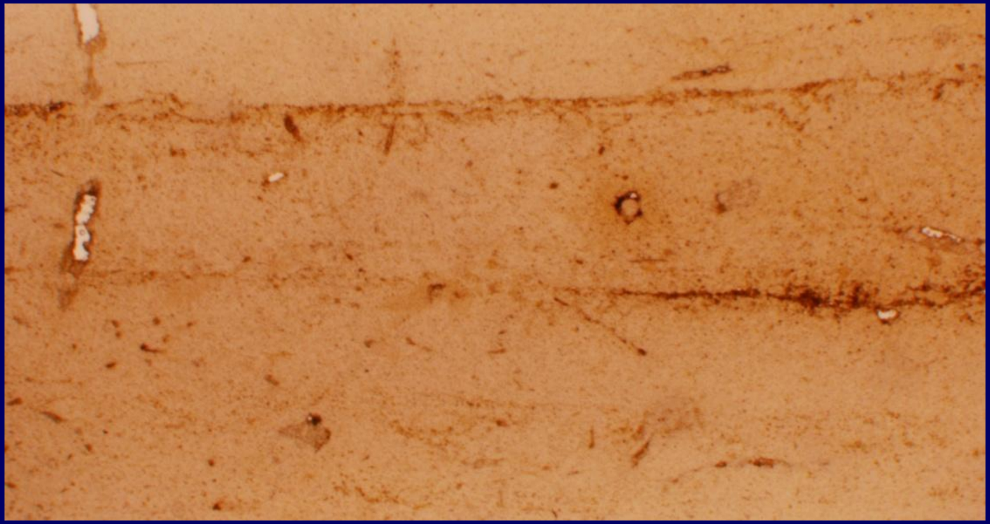
Coprolite or cololite (gut contents) of priapulid worm, cf. *Ottoia prolifica*, composed of oriented hyolithids

GEOCHEMICAL/SEDIMENTOLOGICAL OBSERVATIONS

Internally, concretions are microquartz-cemented clay with variable textures, ranging from nearly homogeneous to stratified, pelletized and porous

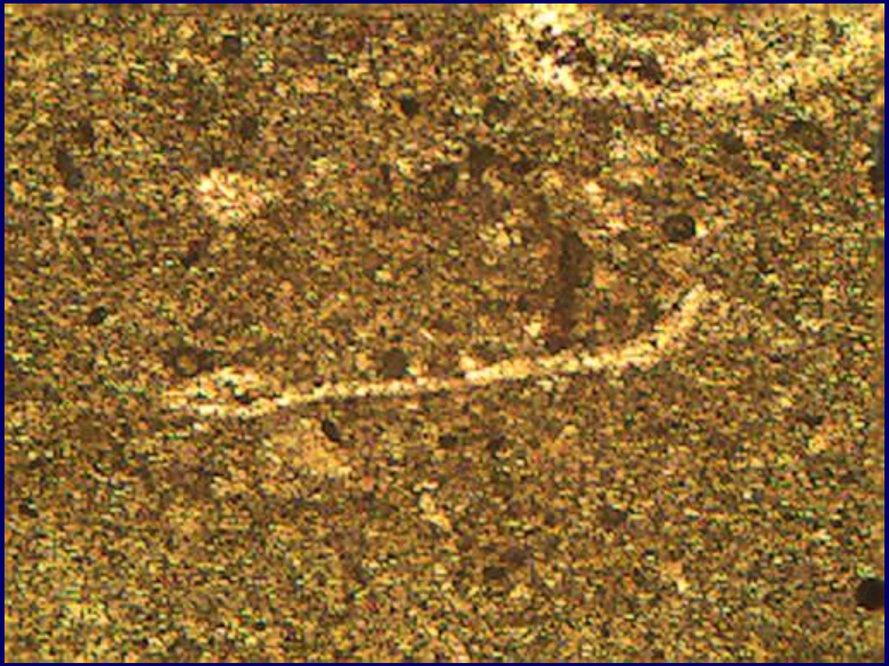


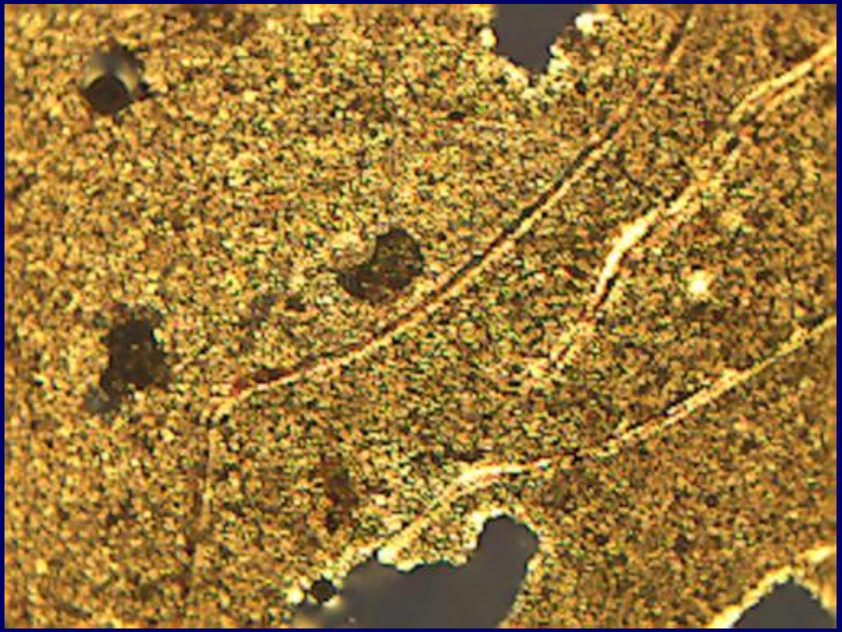




(All microscopic views at 40x)

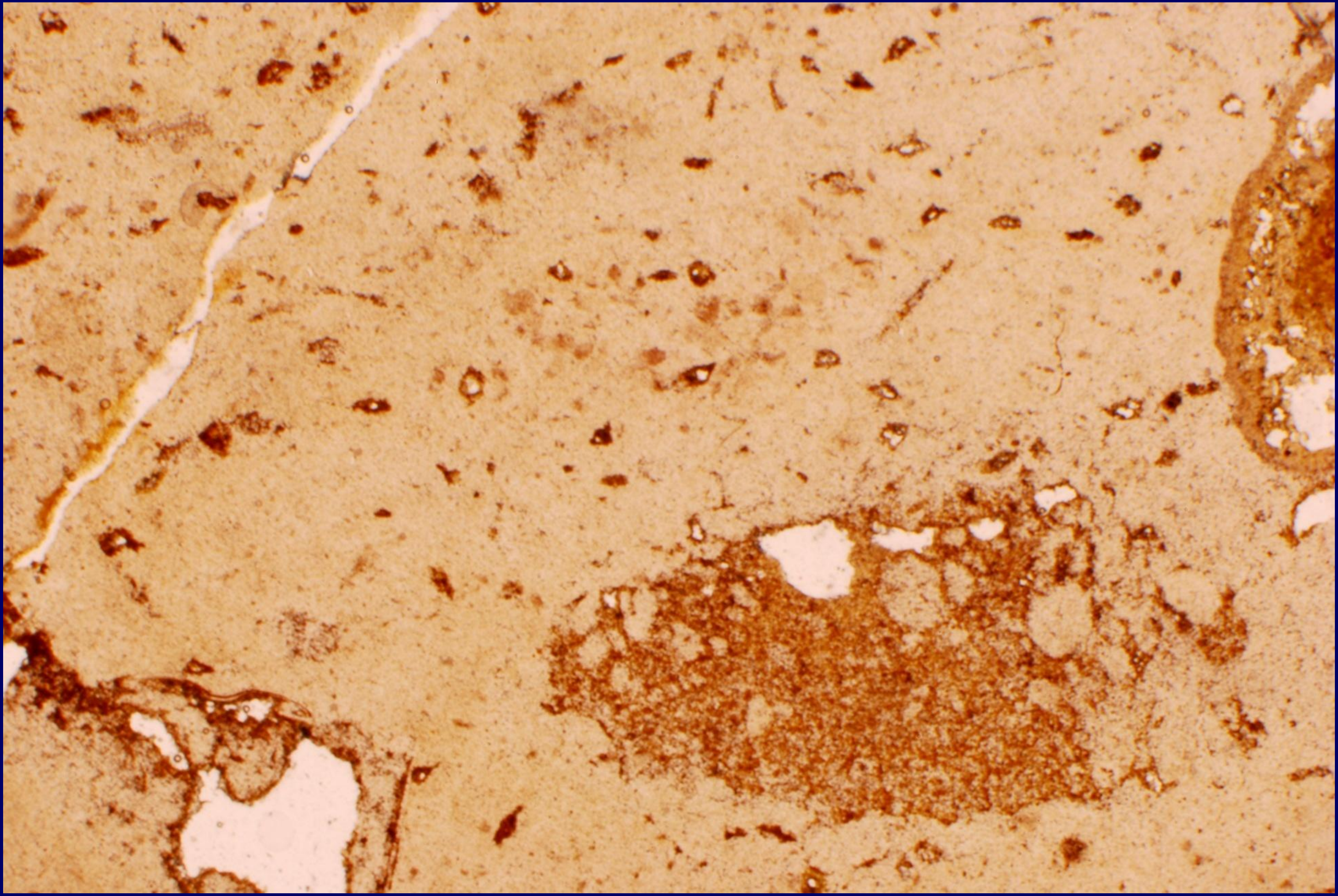
Many contain trilobite (and possibly other) sclerites. We did not observe clearly identifiable sponge spicules, but it is assumed these were dissolved and comprise the siliceous cement.





Trilobite sclerites are typically present inside concretions which show many sclerites on the surfaces, which also tend to have many voids.

Biogenic pellets are also common in concretions with external fossils



Some rare concretions show septarian structures apparently due to shrinkage contemporaneous with silicification. Note the well-preserved internal stratification which is cut by shrink-cracks.

Conclusions about mode of concretion formation:

Ecological:

1. Abundance of benthic fauna, especially sponges, trilobites and hyoliths, shows subtidal environment (middle to distal outer shelf) but in photic zone (given presence of algae).

2. The fine-grained sedimentary texture confirms accumulation below wave-base in low-energy, quiet-water conditions, but with occasional turbid flows.

3. Preservation of lightly-sclerotized arthropod limbs, *Scenella*, and *Brooksella,* results from silica-induration subsequent to pyrite fixation, which is commonplace in the enclosing shales (*fide* Schwimmer & Montante, 2007)

Geochemical and Sedimentological:

1. The clayey texture of the sediment allowed little diffusion of dissolved silica, thus accounting for the abundance of concretions

2. The thickness of enclosing sedimentary layers decreases at the margins of many concretions, indicating that silica cementation contemporaneous with compaction. Silica cementation was post-depositional but probably during early diagenesis

3. The concretionary horizon can be traced over a significant distance, suggesting that it represents a condensed stratigraphic section due to a period of sediment starvation.

Why the abundance of Siliceous Concretions in the Conasauga Fm?

The occurrence is the result of a serendipitous association of events:

1) the depositional environment was in relatively quiet water, but still shallow enough to be dominated by benthic fauna

2) the concretionary horizon in the Conasauga Formation represents a transgressive systems track, leading to low rates of sedimentation and optimum conditions for occupation by masses of sponges.
(*N.B*. The stratigraphic position of the concretionary horizon in the *Bolaspidella* zone makes it correlative with the Wheeler Formation in Nevada, which also formed as a result of a marine transgressive event, interpreted by Howley, *et al.* (2006) to represent a eustatic sea-level increase)

3) the large number of siliceous sponges deposited silica locally (i.e. the silica-secreting organisms were benthic, vs. later siliceous deposition dominated by planktonic diatoms)

Postscript:

Alternative explanation for the source of Conasauga concretions:

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