

MICROENDOLITHIC STRUCTURES FROM THE FORT PAYNE FORMATION (LOWER MISSISSIPPIAN), KENTUCKY AND TENNESSEE: IMPLICATIONS FOR THE PALEOENVIRONMENT OF CARBONATE MUD-MOUNDS

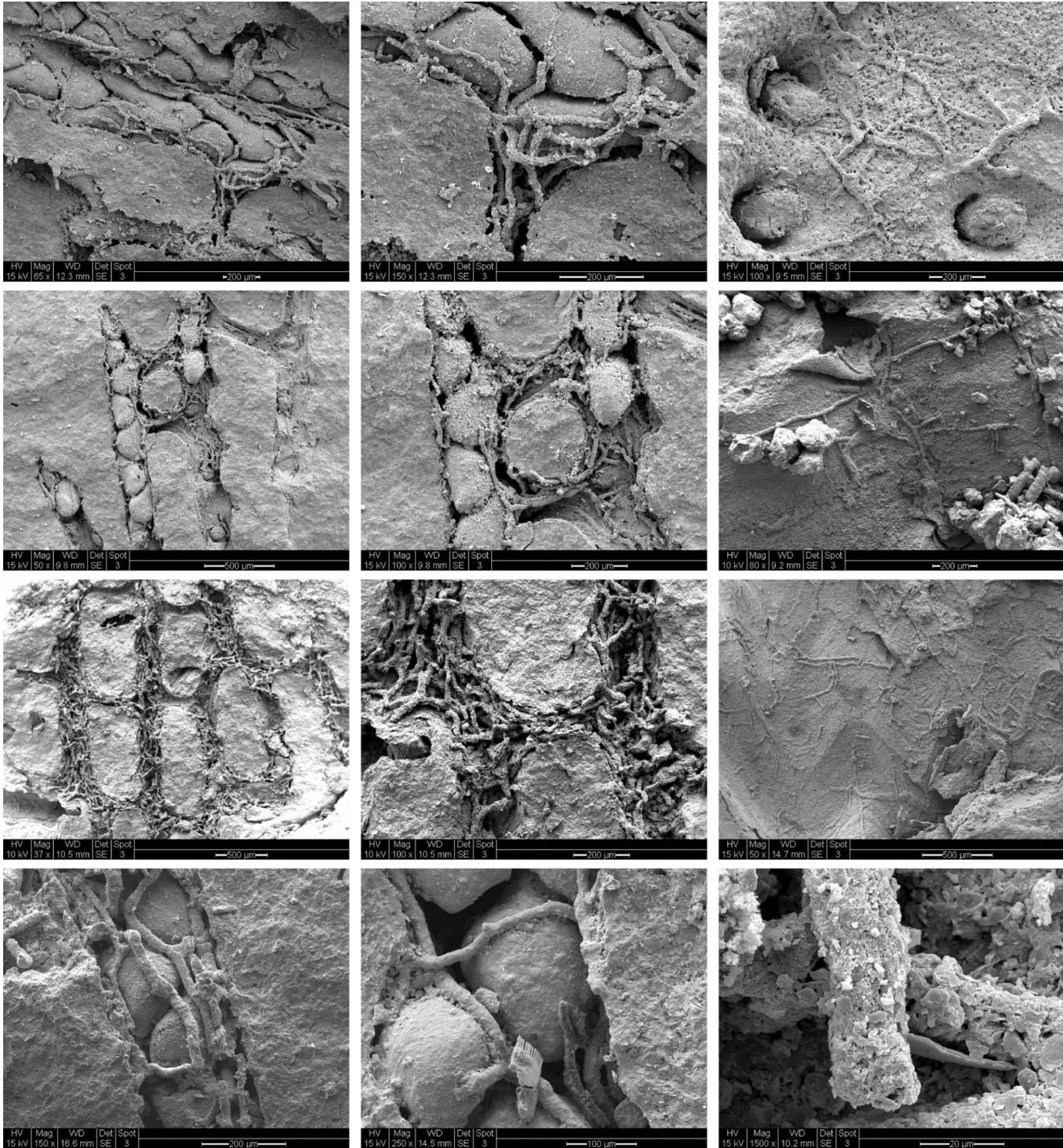
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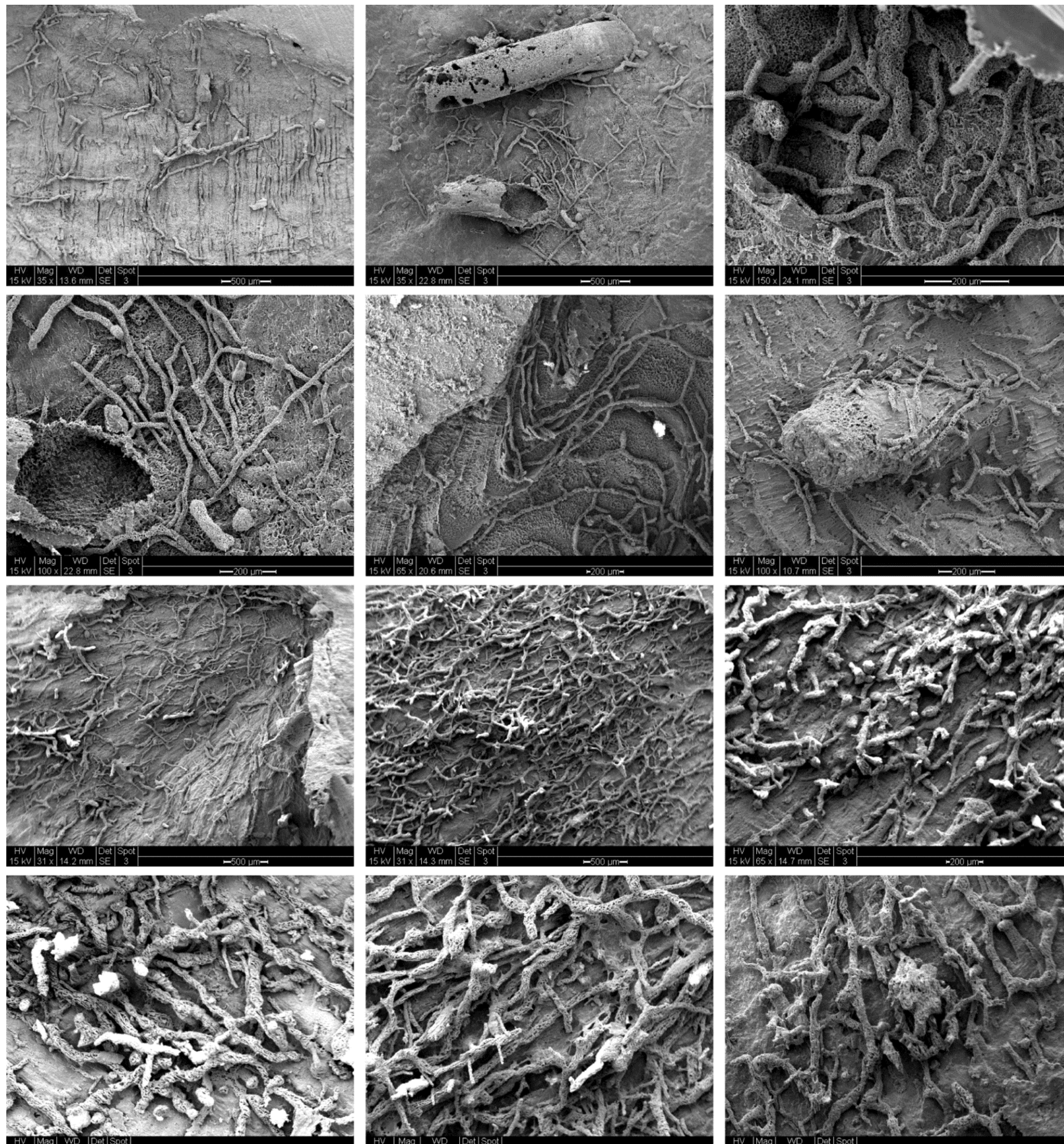
Abstract

Resin cast embedment and natural occurring casts have revealed for the first time a collection of microendoliths from the Early Mississippian Fort Payne Formation. Heterotrophic microendoliths *Orthogonum lineare*, *O. giganteum*, and *Saccomorpha clava* dominate this unit, as well as the phototrophic traces *Ichnoreticulina elegans* and *Fascichnus dactylus*, a chlorophyte (*Ostreobium quekettii*) and cyanobacteria (*Hyella caespitosa*), respectively, that were found within a variety of fossil substrates, including solitary corals, bryozoans, brachiopods, and gastropods, with a notable absence in all echinoderms. The Fort Payne from the Lake Cumberland/Dale Hollow region of southern Kentucky contains a suite of fossiliferous green shale deposits with isolated locations of enigmatic carbonate mud-mounds, commonly referred to as 'Waulsortian' mounds, which have been the center of much speculation in the past few decades (Krause, 2004). Paleoenvironmental parameters in which formation occurred have only been speculated. Using the aforementioned microendoliths, a sense of the light availability within the Illinois Basin can be determined. The ichnofaunal assemblage uncovered is representative of light conditions spanning from dysphotic to aphotic. Using previously constrained depth parameters that indicate a depth of no more than 100m, a dysphotic environment has the implication of a eutrophic water column, presumably due to high productivity within the Illinois Basin. This agrees with several factors, including the large amount of suspension feeding echinoderms, in addition to the restructuring of phytoplanktonic communities and increased nutrient flux from the rise of terrigenous land plants in the Early Mississippian.

Natural Internal Casts



Resin Cast Embedment



Implications

1. *Orthogonum lineare*, *Orthogonum giganteum*, and *Saccomorpha clava*, are clearly indicative of extremely low levels of light availability within the study sections, according to the Index ichnocoenoses chart (Glaub 1994). The chlorophyte trace *Ichnoreticulina elegans* is produced by *Ostreobium quekettii*, a microscopic green algae that can utilize specialized photoadaptations in order to photosynthesize under high levels of irradiance. A light availability indicating a **dysphotic zonation** and possibly breaching the **aphotic zone** is evident.
2. Dysphotic ichnofauna, coupled with a predetermined paleoshelf depth maximum of 100m, implies a eutrophic water column.
3. Extreme abundance of suspension feeders (crinoids) may have been instigated by the high levels of productivity within the epeiric basins of this time period.



Heterotrophic microborings

Orthogonum lineare

This heterotrophic trace is the most abundant ichnotaxa present in all samples, from all localities. The exact producer of this trace is unknown.

Orthogonum giganteum

A heterotrophic endolith that has a very close morphological resemblance to *O. lineare*. The exact producer of this is also unknown.

Saccomorpha clava

A heterotrophic fungal endolith with comparable traces produced by the fungus *Dodgella priscus*.

Phototrophic microborings

Ichnoreticulina elegans

An endolith produced by the chlorophyte *Ostreobium quekettii*. It can utilize photoadaptations to utilize high levels of irradiance.

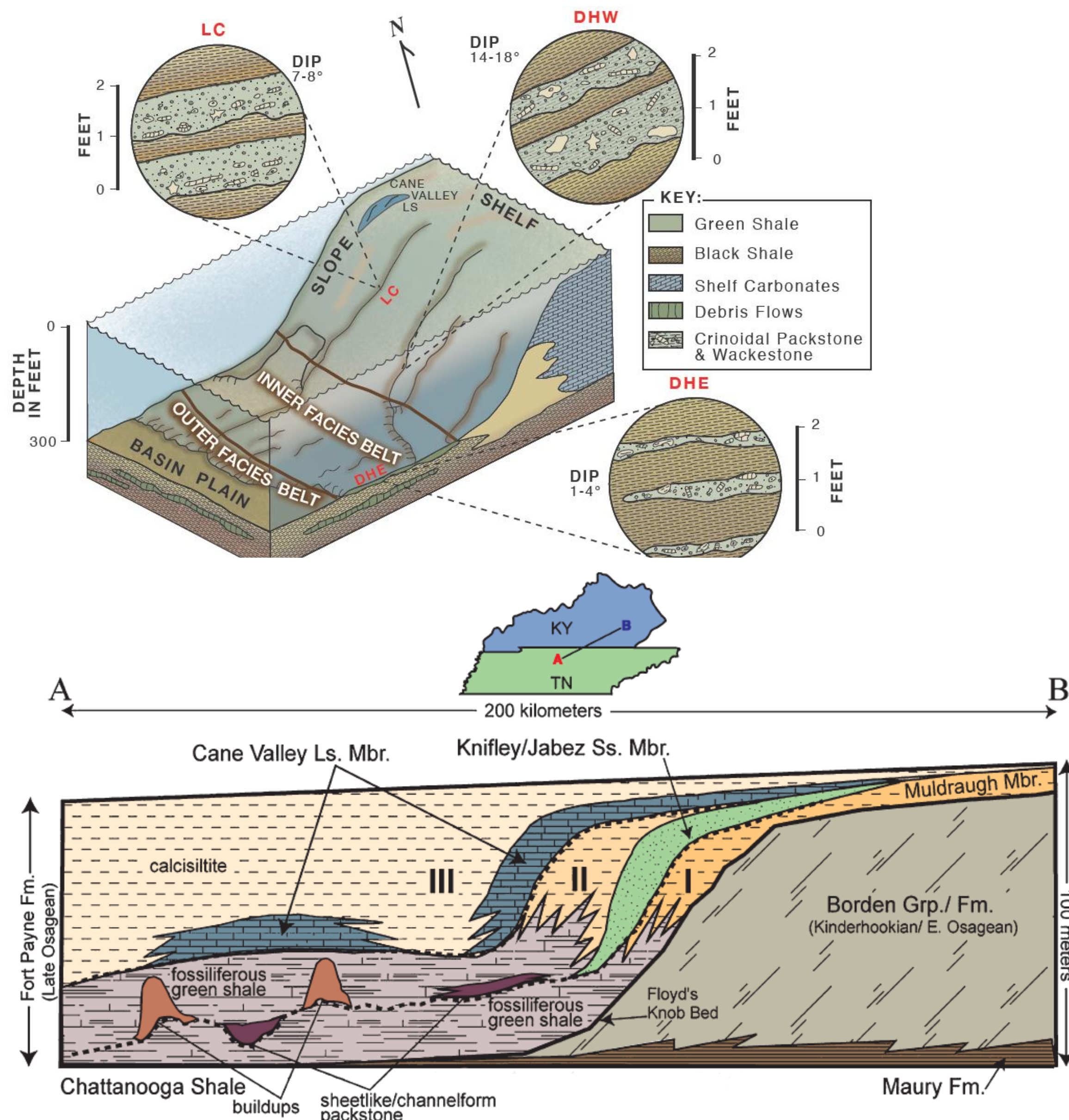
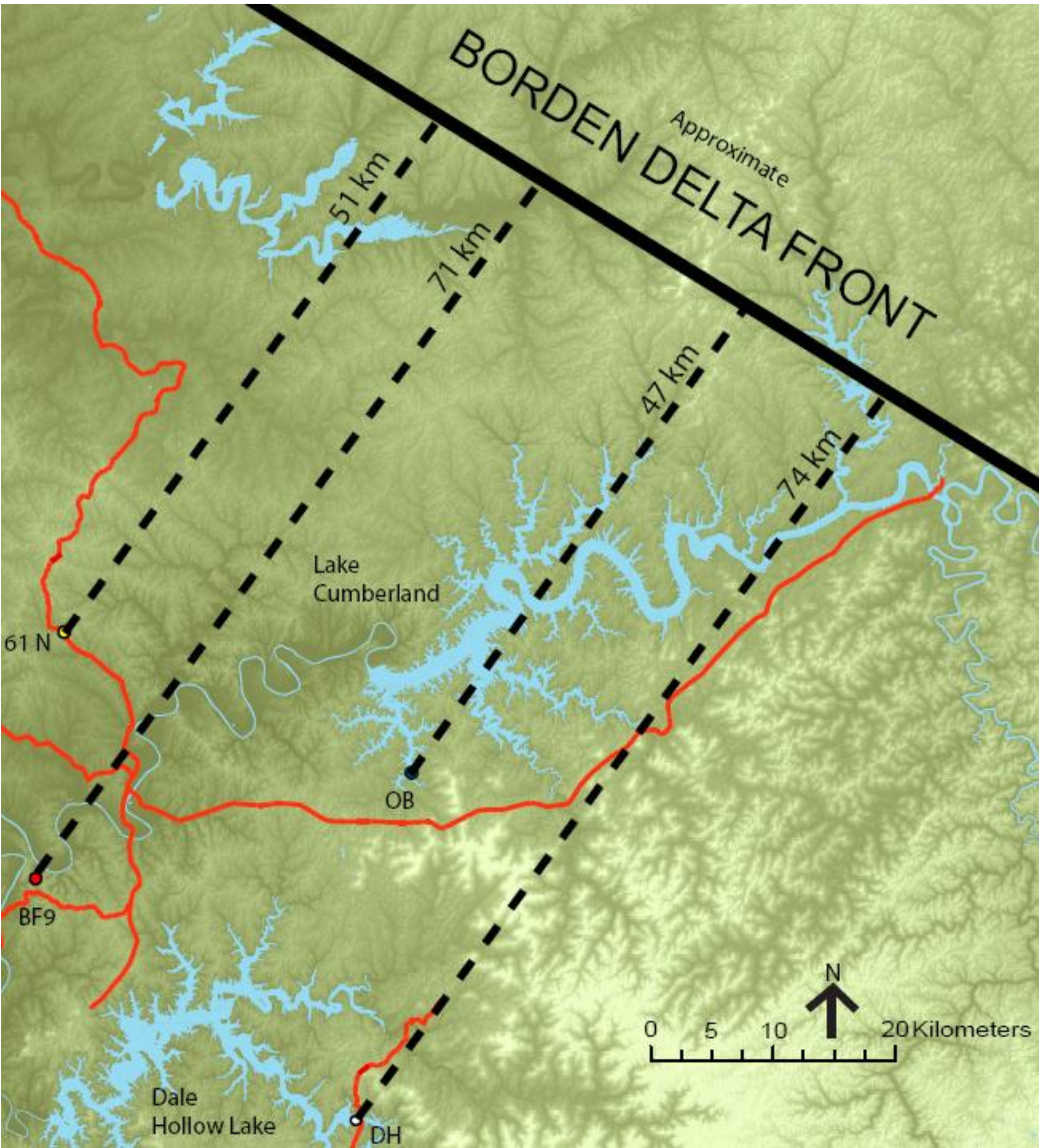
Fascichnus dactylus

An isolated occurrence of cyanobacterial endolithic structures. The presence is very rare and explanations include either robustness of cyanobacterial phototrophic abilities or transportation during low stand.

Macroborings

Macro tubular-form

A macroscopic endolith that is comparable to traces produced by modern day phoronid or polychaete worms.



SEM photograph of cyanobacterial endolith *Fascichnus dactylus* on a spiriferid brachiopod shell. The shell was highly infested with this trace, as can be seen in the lower left image.

Photic Zones	Index Ichnocoenoses of Microborings	General Characteristics
Euphotic Zone	Index ichnocoenosis not yet defined	Dominance of cyanobacteria with sheath pigmentation
	<i>Fasciculus acinosus</i> / <i>Fasciculus dactylus</i> - Ichnocoenosis	Dominance of cyanobacteria with vertical orientation of borings
	<i>Fasciculus dactylus</i> / <i>Palaeoarchaeocella stromachii</i> - Ichnocoenosis	Cyanobacteria abundant, + eucaryotes; change from vertical to horizontal orientation
Deep Euphotic Zone	<i>Palaeoarchaeocella stromachii</i> / <i>Reticulina elegans</i> - Ichnocoenosis	Dominance of eucaryotes mainly rhodophyta and chlorophylla; horizontal orientation, heterotrophic increasing, maximum of diversity
Dysphotic Zone	Index ichnocoenosis not yet defined	Dominance of heterotrophs, + <i>Actinodina elegans</i> and/or <i>Saccomorpha clava</i>
Aphotic Zone	<i>Saccomorpha clava</i> / <i>Orthogonum lineare</i> - Ichnocoenosis	Only heterotrophs

Fort Payne Ichnocoenoses
Taken from Glaub, 1994.

References

Glaub, I., 1994. Mikrobohrspuren in ausgewählten Ablagerungsräumen des europäischen Jura und der Unterkreide. Cour. Forsch.-Inst. Senckenberg 174, 1–324.

Krause, R.A., Jr., and Meyer, D.L., 2004. Sequence stratigraphy and depositional dynamics of carbonate buildups and associated facies from the Lower Mississippian Fort Payne Formation of Southern Kentucky, U.S.A.. Journal of Sedimentary Research, v. 74, p. 831-844.