Forum

Early Neoproterozoic origin of the metazoan clade recorded in carbonate rock texture: COMMENT

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Neuweiler et al. (2009) present petrographic work from three carbonate bioherms: from modern, Paleozoic, and Neoproterozoic aged material. They argue that, in the three case studies, there is textural evidence for calcification of sponge extracellular collagenous matrix (ECM), pushing back the earliest evidence for metazoan life by almost 200 million years. Neuweiler and others interpret polymud fabrics in the Neoproterozoic (ca. 875 Ma) Little Dal reefs as products of ECM calcification, and suggest that irregularly shaped voids containing multiple generations of authigenic carbonate precipitates and internal sediment can be definitively linked to metazoan-influenced calcification. I argue that this fabric is also commonly found in nonmetazaon bioherms.

Irregularly shaped, sediment and carbonate precipitate–filled voids are abundant in several modern sites of microbial carbonate accretion that do not have a sponge influence. Neuweiler et al. (2009) correctly argue that there is little potential for void formation during the initial calcification of microbial mats, unlike in sponge tissues. However, secondarily formed, millimeter- to decimeter-sized voids (equivalent to those in the Little Dal reefs) are common in a wide range of modern microbialites. At the two most extensively studied modern microbialite localities—Shark Bay, Western Australia, and Eastern Bahama Bank, Bahamas—there are abundant secondary voids linked to oxidation of bundles of microbial biomass or algae, carbonate dissolution, and winnowing due to differential cementation (Dill et al., 1986; Planavsky and Ginsburg, 2009; Reid et al., 2003). There are also networks of irregularly shaped secondary voids linked with carbonate dissolution and algal or cyanobacterial degradation in microbialites from Green Lake, United States (Monty, 1976); Lake Thetis, Australia (Reitner et al., 1996); and Stein am Rhein, Germany (Monty, 1976). The voids, in the cases listed above, partially or completely fill with carbonate precipitates and internal sediment during penecontemporaneous diagenesis (Monty, 1976; Planavsky and Ginsburg, 2009; Reitner et al., 1996). For example, the irregularly shaped voids in Bahamian microbialites are filled with a mixture of internal sediment, pelletoidal or micritic authigenic carbonate, and aragonite cements—creating a fabric similar to the Little Dal purported sponge fabrics (compare figure 1 to figure 4 of Neuweiler et al., 2009).

The work by Neuweiler et al. (2009) adds to growing evidence that the Cryogenian Period in the mid-Neoproterozoic was marked by environmental change and biological innovation, because polymud fabrics similar to those seen in Phanerozoic and Neoproterozoic reefs are absent in earlier Precambrian carbonates. However, currently there is not significant evidence to conclusively link this change in reef textures with metazoan emergence. The appearance of the Little Dal polymud fabrics may be linked to algae diversification, decreasing carbonate saturation state, or increasing oxygen levels. Increasing oxygen levels and decreasing marine carbonate saturation state would promote early diagenetic dissolution by increasing the potential for sulfide oxidation and aerobic respiration in microbial mats, and by lowering the acid buffering capacity, respectively. Interestingly, the Little Dal reefs host the earliest reefal calcified cyanobacterial filaments, the appearance of which has been suggested to mark a decrease in marine carbonate saturation state (Arp et al., 2001). The Little Dal reefs also host some of the earliest macroscopic fossils (Hofmann, 1985), which may mark a Cryogenian benthic algae diversification.

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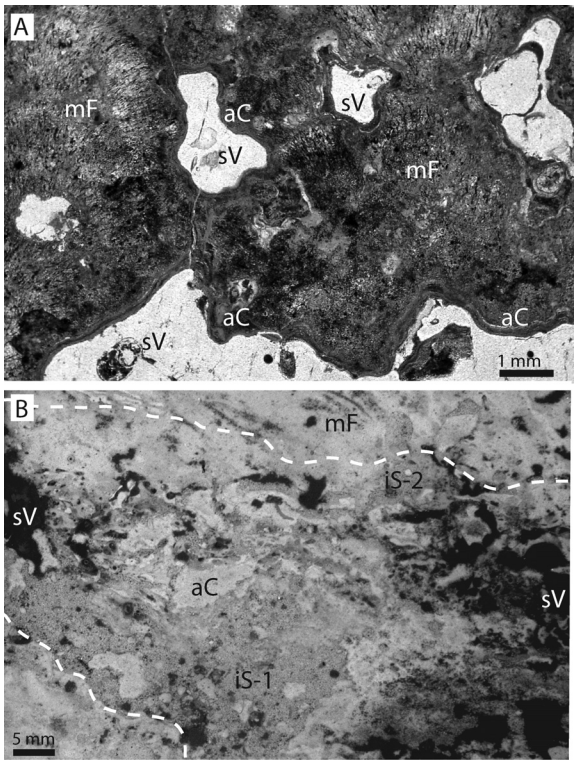

Figure 1. A: Example of partially cement-filled, irregularly shaped voids from a weakly laminated section of a modern microbialite at Lake Thetis, from Geological Survey of Western Australia Sample # F46287, Perth. B: Example of a void in a modern Bahamian microbialite partially filled with multiple generations of internal sediment and authigenic carbonate precipitates, from sample AC-1, stored at the Comparative Sedimentology Laboratory, Miami, Florida. aC—authigenic carbonate; iS—internal sediment; mF—microbial growth fabric; sV—secondary void; white line outlines filled void.

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