MICROBIAL MATS, METAZOANS, AND GRAZING AT THE PROTEROZOIC-PHANEROZOIC TRANSITION

HAGADORN*, James W., and BOTTJER, David J., Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740, U.S.A.

Although microbially-mediated structures dominated Earth's marine environments during much of the Proterozoic, they exhibited a decline in abundance and diversity of forms during the Riphean to Ordovician and subsequently were preserved primarily as post-mass extinction "disaster taxa" in the remainder of the Phanerozoic. Concomitant with this decline was a proliferation of metazoans in shallow marine environments. Effects of increased metazoan abundance and diversity, such as increases in the types, depth, and degree of bioturbation, are hypothesized to be linked to a decrease in the occurrence of stromatolites and other mat-related structures. At present, however, it is unclear how and/or if biotic changes in metazoan diversity are related to this decline in preservation of shallow-water microbial structures. This enigma partially stems from lack of direct evidence from this time interval of metazoan grazing on microbial mats.

Recently discovered horizons in uppermost Proterozoic and Lower Cambrian strata of Inyo County, CA, may aid in clarifying these relationships. These horizons contain a variety of distinct primary structures suggestive of microbial origin, and also contain evidence of metazoan grazing activity.

Unlike most fossilized microbial structures, which typically occur in carbonates or in cherts, these mat-bearing horizons occur in fine-grained siliciclastic strata and do not form structures which exhibit significant relief relative to surrounding sediments. Mat-bearing horizons are found in supratidal to subtidal facies and are characterized by patchy occurrences of very small (< 2 mm) irregularly shaped and oriented ripple-like marks. Similar textures are found in modern intertidal to supratidal environments where microbial binding of small grains forms uneven surface textures. Many of the studied horizons also contain structures indicative of folding and contorting of thin sediment layers, suggestive of microbial binding of sediments, and analogous to mat-deformation structures which occur in modern microbial mats.

Several of the mat-bearing horizons in this region are found in association with discrete traces of metazoan grazing and burrowing activity, including the presence of *Cruziana, Diplichnites*, *Palaeophycus*, *Planolites*, *Rusophycus*, and *Taphrehelminthopsis*, as well as a number of other trace fossils. In many cases, relationships between burrows and surrounding sediment suggest that tracemakers were ingesting mat-bearing horizons. At present, these associations are believed to be the oldest evidence indicating metazoan consumption of microbially-bound sediment.

Although similar physical sedimentary structures (e.g., Runzelmarken or "wrinkle-marks"), have been noted in previous studies of younger strata, they have not been identified as structures produced by microbial processes, nor have they been associated with trace fossils. Re-evaluation of these structures, (many of which may actually represent ancient microbial mat-grounds), suggests that they may represent an important, but overlooked feature which could be utilized to test hypotheses about microbial blanketing of early seafloor environments. Furthermore, paucity of these mat-structures in younger strata may reflect unique taphonomic conditions characteristic of the late Proterozoic-early Cambrian and/or the effects of metazoan proliferation on the consumption and disruption of mats and mat-structures during this interval.