THE ROLE OF MICROBIAL MATS IN PHOSPHATIZATION: THE JURASSIC CERIN BIOTA OF FRANCE

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Microbial mats are one of the factors most widely invoked to explain exceptional fossil preservation. They are believed to act by preventing carcasses from floating, and by protecting them from scavengers and currents. Recent laboratory experiments suggest that microbial mats may also be sites of rapid mineralization. Their precise role in the fossilization process, however, has not been determined.

The Jurassic (Kimmeridgian) plattenkalks of Cerin in France provide the first analytical evidence to demonstrate a fundamental role for microbial mats in the preservation of soft tissues. Most of the fossils from this deposit occur on bedding plane surfaces where they were rapidly overgrown by mats. Phosphatized soft tissues occur in 17% (n=283) of the fish and 28% (n=61) of the crustaceans. The distribution of soft tissues throughout the sequence correlates well with the occurrence of prominent mats. Vertical chemical profiles through several beds (Figure 1) also indicate that the mats controlled phosphatization. P concentrations on the bedding planes where mats occur (and where fossils are preserved) may exceed 2.5 times that in the background sediment, but remain low at surfaces where mats are absent.

Laboratory experiments and evidence from Cerin suggest that microbial mats stimulate phosphatization of entrained carcasses by controlling the chemical environment (particularly pH and Eh) and by forming a "seal" that prevents P diffusing up through the sediment pile. Mats are likely to have acted in a similar manner in other deposits such as Solnhofen (Tithonian) and the Santana Formation (Albian) where they are also associated with phosphatized soft tissues. [Supported by NERC grant GR3/9090.]

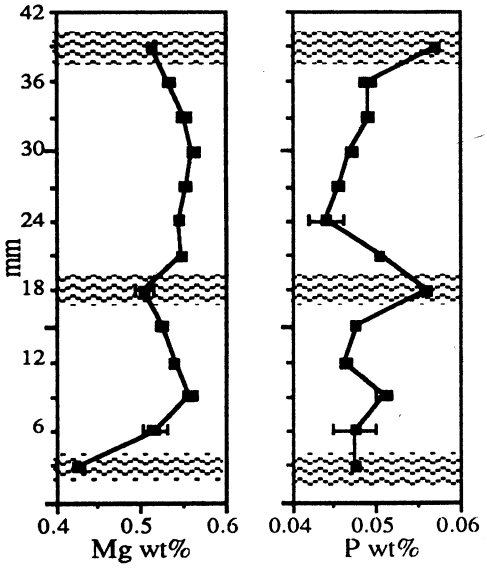

Fig. 1: Vertical profiles through 3 microbial mats (wavy fill) from bed 285, Cerin. P concentrations increase from a minimum just above each mat to a prominent maximum within the succeeding one. This is consistent with the mats having formed a "seal" that trapped P diffusing upwards from the underlying sediments. The maxima occur precisely where the fossils are located. In contrast, the vertical distribution of Mg through the sequence was probably diagenetically controlled. Its distribution suggests an affinity with the carbonate fraction of the beds.

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