SECULAR VARIATION IN MICROFOSSIL PRESERVATION: CAUSES AND CONSEQUENCES OF THE BIOGEOCHEMICAL EVOLUTION OF THE OCEANS

MARTIN, Ronald E., Department of Geology, University of Delaware, Newark, DE 19716, U.S.A.

Because of their abundance, composition, and widespread occurrence throughout the Phanerozoic, microfossils are ideal subjects for teasing apart the ecological, evolutionary, geochemical, and taphonomic controls on the fossil record, and for testing hypotheses of evolutionary paleoecology against secular change in ocean chemistry as evidenced by patterns of fossil preservation. The history of calcareous plankton is one of interaction between the evolutionary innovation of regulatory pathways in hardpart construction and the paleochemistry of the seas. Diversification of ancestral shelfal calcareous plankton lineages in the Mesozoic was related to sea level transgression, water column stratification, and habitat diversity, as evidenced by major expansions of these groups in association with Oceanic Anoxic Events. In the case of coccolithophorids (calcareous Haptophyceae), the origination of calcified lineages also appears to have been related to nutrient resuspension from bottom sediments and anoxic waters (which may have promoted calcification) advected into the photic zone over shallow shelves during transgressions. Invasion of pelagic habitats by Foraminifera was facilitated by the evolution of test secretory mechanisms (beginning in the Late Paleozoic) that conferred greater cellular control over shell microstructure and density. The beginnings of calcareous nannoplankton, however, are traceable to microfossil "Lagerstätten" that hint at the first attempts at calcification by naked haptophycean lineages much earlier in the Paleozoic. During the Early-Mid Paleozoic greenhouse phase, calcareous nannoplankton assemblages were unlikely to be preserved because high levels of atmospheric (and therefore oceanic) CO_2 and extraction of $CaCO_3$ in epeiric seas by calcareous biota resulted in a very shallow CCD. With the advent of the Late Paleozoic icehouse phase (and associated sea level fall), the locus of biogenic limestone deposition shifted seaward and the CCD deepened. Significant accumulations of calcareous pelagic sediments followed in the Late Jurassic in response to diversification of calcareous plankton. As deep pelagic oozes began to accumulate, a new component was added to the global carbon cycle: the metamorphic decarbonation of pelagic limestones that controls long-term (i.e., tens to hundreds-of-millions of years) global warming.

https://doi.org/10.1017/S2475262200007619 Published online by Cambridge University Press