microspheralic ordering.

We have observed three specimens of heavy-walled Polycystina from the Miocene of California and Eocene sediments of the Norwegian Sea that appear to be in a more advanced stage of dissolution. They display a highly ordered microspherulitic internal composition. After extensive observations of many specimens, we conclude that this structure is not unique to these three specimens and may be characteristic of robust polycystine skeletal elements in general.

Cross-sectional views of broken lattice bars and spines are composed of as many as 34 concentric lamellae consisting of beadlike strings of microspherules. The microspherules are oblong with their long axes parallel to the radius of the skeletal element, producing lamallae of about 0.5 μ thick. Lamellar thickness if remarkably uniform in both Spumullaria and Nassellaria. Dissolution of less resistant lamellae results in delamination, which may be followed by flaking of loose segments.

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Evolution of Three Trissocyclid Radiolaria Lineages Across "Terminal Eocene Event"

Twelve species (nine of which are new taxa) of trissocyclid radiolarians are arranged in three evolutionary lineages that have been traced through upper Eocene and lower Oligocene sediments from the Caribbean and central equatorial Pacific. The history of these radiolarians at and directly following the "terminal Eocene event" is obscured by hiatuses, but fine-scale correlation of seven sections provides an almost complete record of their evolution. Although the timing, evolutionary rate, and structural modifications differ, each lineage exhibits a similar phylogenetic trend in the early Oligocene, such that the skeleton underwent a significant inflation and assumed an approximately discoidal shape. This trend was of only short duration, however, and all three lineages reverted to their original morphology before the close of Oligocene time. These lineages have long independent Paleogene histories that are not considered here, but the oldest species at the base of the studied interval are: lineage I, *Phormospyris inferispina* (Goll); lineage II, *Trissocyclus geniculosus* (Goll); lineage III, *Phormospyris* sp.

Cephalic inflation has its simplest expression in lineage I, where the trend has its earliest appearance and longest duration. At the base of the Oligocene, the simple lattice shell abruptly expanded to completely enclose the sagittal ring (*Nephrospyris anthocyrtoides* morphology). The first appearance of *N. anthocyrtoides* is a good secondary marker for the base of the *Theocyrtis tuberosa* Zone.

The discoidal lattice shell modification occurred only very briefly in lineage II, and apparently it had no permanent impact. *Trissocyclus geniculosus* has a compact skeleton characterized by massive, regularly disposed lattice bars. For a brief episode during the early Oligocene, a morph abruptly appeared with a ribbonlike concentric ring of distal lattice in the plane formed by the vertical and lateral axes.

This evolution commenced later and proceeded at a slower pace in lineage III, with each successive stage appearing sequentially. The most extreme development of lattice inflation occurred briefly approximately 2 m.y. after the first indication that cephalic inflation impacted the lineage. Additionally, the thorax underwent inflation as well in this lineage and eventually surrounded the cephalis as a discoidal "cortical" chamber. Subsequently, a reversal of the trend is apparent in the occurrence of a morph with a small supracephalic chamber that is homologous to the apex of the "cortical" chamber of its precursor.

Two possible explanations are proposed for the evolution of these lineages. The approximate synchroneity with which this skeletal modification occurred suggests that this evolution is interrelated genetically. The development of "cortical" morphology in lineages II and III is analogous to spumellarian skeletal structure. Alternatively, lattice inflation could have been an adaptive response to changing pelagic environments of the Oligocene equatorial oceans.

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Microbial Endoliths: Benthic Overscript in Sedimentary Record

Microbial endoliths are known from intertidal and shallow water marine environments with only a few reports on their occurrence in greater oceanic depths. We find microbial endoliths and microborings in abundance down to depths of over 4,000 m (13,000 ft), which means that a significant portion of the ocean floor is the site of microbial endolithic activity. Microbial endoliths are a strictly benthic phenomenon, and no endolith activity takes place in the water column. Endoliths leave a specific and well-preservable overprint on the sedimentary record of the oceans. The taxonomic composition of endolith assemblages reflects their environmental requirements and is depth related. The extent of endolith activity is a function of their exposure time at the sediment-water interface, which in turn is a function of sedimentation rate. Thus, the endolithic signature in the sedimentary record contains information on the conditions at the site and time of sediment formation.

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Pyrolytic Generation of Oxidized Carbon Species Estimated from Rock-Eval FID Response

The hydrogen index is defined as the amount of the S2 pyrolysis peak (in mg hydrocarbons) normalized to grams of total organic carbon (TOC) obtained from the usual Rock-Eval procedure. This value has been used to determine the type and, in part, the maturity of the organic matter in source rocks. When the same S2 peak (in mg hydrocarbons) is normalized to the grams of reactive organic carbon (ROC) actually consumed in the pyrolysis (measured by difference), one should expect a reasonably constant value between 1,110 and 1,330 mg S2/g ROC if all of the products of pyrolysis are hydrocarbons. However, this is not the case. The values of S2/ROC range from 700 to 1,400 mg S2/g ROC for samples having hydrogen index values above 200 mg HC/g TOC. Below a hydrogen index of approximately 200 mg HC/g TOC, the value of S2/ROC decreases sharply. The low values of S2/ROC mean that FID-nondetectable carbon is being released probably as CO and CO_2. The sharp decrease of this value in samples with lower hydrogen indices indicates that a large proportion of the reactive carbon is transformed to the oxidized species. This is true not only for type III kerogens, but also for the more mature type II kerogens with lower hydrogen indices. The amounts of CO and CO_2 can be estimated from a plot of S2/ROC versus S2/TOC. The calculated amounts of CO and CO_2 produced exceed that of CH_4 in source rocks having a hydrogen index of 100 mg HC/g TOC. The effects of this phenomenon are significant both with respect to natural gas compositions and with respect to the role of CO_2 as a possible medium for hydrocarbon migration.