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Coccolith Sr/Ca ratios by ion probe analysis

N. SHIMIZU¹ AND H. STOLL²

¹Dept. Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole MA USA (nshimizu@whoi.edu)

²Geoscience Dept., Williams College, Williamstown MA USA (hstoll@williams.edu)

Marine algae coccolithophorids produce elaborate micron-scale calcite plates or coccoliths, entirely within their cell. The elemental chemistry of these coccoliths provides clues about the processes of biomineralization and rate of transport of ions to the sites of calcification, and may serve as a paleoceanographic proxy for the productivity of this key algal group. Previous study of coccolith chemistry was limited by the small number of species currently isolated in culture and challenges separating particular genera or species of coccoliths from diverse sediment populations. We describe a new technique for analysis of the Sr/Ca and Mg/Ca ratios of individually picked coccoliths using SIMS with the Cameca IMS 3f ion probe. Compared to other marine biogenic calcites, coccoliths exhibit very large interspecific differences in chemistry. Paleocene coccoliths analyzed with SIMS show a nearly sixfold range of Sr/Ca ratios among different genera from a given sample depth, with lowest ratios among *Discoaster multiradiatus* and highest ratios in the genus *Fasciculithus*. We will also describe the application of this ion probe method to coccoliths from modern plankton samples. We will assess the range of elemental chemistries in modern species and its relationship to different modes of crystallographic assembly in different coccolith species, and evaluate evidence for variable cellular Sr uptake and incorporation in calcite in response to nutrient-stimulated growth rates.

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The chemical inhomogeneity of brachiopod shell calcite – a spatial high resolution LA-ICP-MS investigation

E. GRIESSHABER¹, T. PETTKE², R. JOB³, J. VEIZER¹
AND W. SCHMAHL¹

¹Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, F.R. Germany,
(Erika.Griesshaber@ruhr-uni-bochum.de)

²Isotope Geochemistry and Mineral Resources, ETH Zentrum NO, Zürich, Switzerland (Thomas.Pettke@erdw.ethz.ch)

³LGBE, Fern-Universität Hagen, F.R. Germany
(Reinhart.job@fernuni-hagen.de)

Brachiopods are one of the most powerful tools for stable isotope paleotemperature analyses and the reconstruction of paleoenvironments. Their analytical popularity stems from the fact that they secrete low-magnesium-calcite shells, which are assumed to be precipitated in isotopic equilibrium with ambient sea water and are relatively stable in diagenetic environments. However, recent geochemical and isotope analyses reveal that even the secondary shell layer yields variable isotopic offsets from the expected equilibrium value [1, 2]. The predominant cause for this disequilibrium is kinetic fractionation and metabolic effects.

We have investigated major and minor element concentration variations of modern brachiopod shells by LA-ICP-MS applying a spatial resolution between 40 to 80 microns. We can show that large chemical variations exist within the shells. Chemical inhomogeneity occurs not only between the primary and the secondary shell layer, but also within the secondary layer as well as at distinct parts of the shell, such as the hinge, brachidium and foramen. The variations within the secondary shell layer seem to be generated by metabolic effects. Our results are in accordance with observations made by [3] deduced from stable isotope analyses.

References

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