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Fractionation processes of Calcium Isotopes in Marine Coccolithophores

N. Gussone (1), G. Langer (2), M. Geisen (2), A. Eisenhauer (3), U. Riebesell (3), G. Wefer (1) and S. Thoms (2)

(1) Research Centre Ocean Margins, Bremen, Germany (gussone@uni-bremen.de), (2) Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, (3) Leibniz Institute of Marine Science, Kiel, Germany

Coccolithophores are important marine primary producers and are responsible for about half of the global carbonate export production [1]. Since coccoliths are a significant sink of marine calcite, their Ca isotopic composition is important for modeling the isotopic Ca budget of the ocean. Their first occurrence dates back to the late Triassic, providing the potential to record long-term changes in ocean chemistry.

Here we report results of Ca isotope analysis of several coccolithophore species grown in mono-specific cultures under controlled laboratory conditions with changing environmental parameters such as temperature, carbonate chemistry, and illumination.

The investigated coccolithophores (*Emiliania huxleyi, Calcidiscus leptoporus, Syracosphaera pulchra, Umbilicosphaera foliosa and Helicosphaera carteri*) show a coherent temperature dependent Ca isotope fractionation, which is similar to the planktic foraminifera *Orbulina universa* [3] and in general agreement with a previously published value for cultured *E. huxleyi* at 16˚C [2]. In contrast, Quaternary coccolith oozes show considerably lighter Ca isotope values [4]. The origin of this discrepancy is not yet clear. It may be due to culturing artifacts, diagenetic alteration, or so far unknown effects controlling Ca isotope fractionation. Since all five investigated species show a coherent behaviour, a coccolithophore-species-dependent Ca isotope fractionation appears to be rather unlikely to explain this discrepancy.

Ca isotope ratios of *E. huxleyi* and *C. leptoporus* appear to be insensitive to changes in the carbonate concentration of the bulk seawater in contrast to inorganically precipitated calcite showing a strong dependence [5]. *E. huxleyi* cultured at different light

intensities showed no variation in Ca isotope fractionation. These observations indicate that intracellular Ca transport and Ca isotope fractionation is strongly regulated in coccolithophores.

Our results show that the fractionation coefficient of Ca isotopes in coccolithophores is rather constant and similar to several foraminifera species, implying a rather homogeneous Ca isotope sink in the ocean.

References

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