Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7108

Symbiont activity impacts Mn/Ca distribution in foraminiferal calcite

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The chemical composition of fossil foraminiferal shells (tests) is widely used as tracers for past ocean chemistry. It is therefore important to understand how different (trace) elements are transported to the foraminiferal site of calcification and subsequently incorporated into the foraminiferal test carbonate from the seawater it is living in, and what processes affect this. To study role and impact of symbiont activity on the geochemistry of the test, we cultured specimens of the symbiont-bearing species *Amphistegina lessonii*, while tracking the day/night cycle using Sr spiking of the culture medium. The experiments were performed in hypoxic conditions, to focus on the incorporation of Mn in calcite. In our experiment, we demonstrate that under hypoxic conditions, banding of Mn through the chamber wall of symbiont-bearing species reflects the diurnal day/night cycle. We show that calcite formed at night has higher Mn/Ca values compared to calcite formed during the day. Based on these results we argue that symbiont activity during the day lowers Mn bioavailability due to processes like 1) uptake of Mn by symbionts and/or 2) complexation of Mn with organic ligands produced by symbionts. Oxidation of Mn into Mn-oxides is less likely to play a role due to the slow kinetics of Mn-oxides formation compared to the 12-hour day-night cyclicity. This implies that symbionts potentially impact bioavailability of Mn and consequently Mn/Ca distribution within and also overall incorporation into the shell. Results are important to take into account when applying Mn-based proxies, as well as that they provide an interesting possibility to track symbiont activity in hypoxic conditions in deep time.