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Lithium incorporation and isotopic fractionation in large benthic foraminifera under decoupled pH/DIC conditions

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The chemical weathering of continental silicate rocks removes CO_2 from the atmosphere and exerts a fundamental control on the Earth's climate over geological timescales. Characterizing silicate weathering in the past is therefore crucial for understanding the climate system. The lithium isotopic composition (δ^7Li) of carbonates is considered to be a reliable archive of past seawater δ^7Li values, which are useful as a tracer of silicate weathering. However, the Li isotopic fractionation during biogenic carbonate formation is complex, and local conditions such as carbonate system parameters could impact δ^7Li values in marine calcifiers. For example, δ^7Li values have been shown to be dependent on either pH or DIC in two studies using large benthic foraminifera. Those results are enigmatic, since both studies used similar species of the genus *Amphistegina* but reported differing controls on δ^7Li values.

The aim of this study was to address the earlier contradictory results on the Li isotope behaviour in the hyaline species *Amphistegina lessonii*. We performed culture experiments under decoupled pH/DIC conditions, and analysed the δ^7Li values and Li/Ca ratios in the foraminifera tests. Two different light treatments (light/dark and dark) were also implemented to investigate the potential role of the symbionts.

Contrary to the two previous studies, no links between either pH or DIC and δ^7Li or Li/Ca values were observed for any of the treatments in our experiments. Additionally, growth rates also did not seem to influence the Li incorporation or isotopic fractionation. However, an effect of different light treatments was observed, probably due to different physiological processes of the symbionts occurring in dark conditions. Overall, these findings appear to support the use of Li isotopes in large benthic foraminifera to reconstruct past seawater chemistry and to infer changes in chemical weathering during carbon cycle perturbations over the last several hundred million years of Earth history.

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