Coral Li/Mg thermometry : caveats and constraints

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The coral Li/Mg temperature proxy is revisited through an in-depth trace element analysis of scleractinians collected live from tropical to polar environments. The dataset consists of Li/Ca, Mg/Ca, Sr/Ca and Li/Mg ratios from 64 coral specimens belonging to 8 different taxa, including both reef-building zooxanthellate and cold-water non-zooxanthellate species, from a wide range water temperature (-1 to 29.5°C), salinity (34.71 to 38.61) and depth (3 to 670m).

Our results showed that the reliability of the Li/Mg temperature proxy is strongly limited by the organic matter associated with the coral skeleton, which is most evident within the green bands observed in tropical corals. Organic-rich bands can double the Mg content otherwise present in the skeleton, which may ultimately lead to a temperature overestimation exceeding 15°C. We found that this bias can be overcome by the tratment of coral skeletons with a specific oxidizing cleaning protocol. We also detected the presence of calcite deposits within the aragonite skeleton of some living coral specimens, which strongly affects the robustness of the Li/Mg proxy given its temperature sensitivity of 1.5°C/%Calcite. Therefore, to obtain reliable reconstructions a correction needs to be applied when organic matter and/or calcite contamination is present.

The integrated results across a wide temperature range, from extreme cold to tropical shallow waters, yield to an overall precision for the Li/Mg-temperature proxy of ±1.0°C, with slight differences on the uncertainties depending on the environment: ±0.9°C, ±1.5°C and ±2.6°C for deep, intermediate, and tropical shallow water corals, respectively. However, the uncertainty for tropical corals can be reduced to ±0.6°C if a Li/Mg and Sr/Ca multi-regression approach is applied.