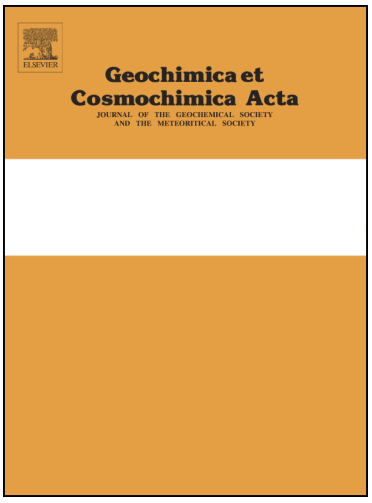

A universal multi-trace element calibration for reconstructing sea surface temperatures from long-lived *Porites* corals: Removing 'vital-effects'

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A universal multi-trace element calibration for reconstructing sea surface temperatures from long-lived *Porites* corals: removing 'vital-effects'

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Abstract

Trace element abundances in corals can potentially provide high-resolution seasonally resolved constraints on past sea-surface temperatures, much needed to improve our understanding of climate variability on interannual to centennial time scales. A major limitation to the general application of trace element (TE) paleo-thermometers to coral fossil records is the presence of 'vital effects', which result in the need for colony-specific temperature calibrations. Here we demonstrate that reliable proxy temperatures from massive *Porites* corals can be achieved by using a universal multi-trace element calibration scheme (UMTECS). Using modern massive *Porites* corals living in well characterized sea surface temperature (SST) environments we first confirm that Sr/Ca and Li/Mg ratios are the most robust SST proxies compared to other trace element ratios (Mg/Ca, U/Ca, B/Ca and Li/Ca). Importantly we find that the slopes (and intercepts) of the Sr/Ca vs SST relationship are linearly correlated with the slopes from the Li/Mg vs SST relationship and provide a simple mathematical explanation for this phenomenon based on the tendency for all coral data to cluster around a single common 'centroid'. Based on this tight empirical correlation between Sr/Ca and Li/Mg thermometers we show that a 'universal' calibration strategy can be applied that largely circumvents 'vital effects'. Using this approach, we show that accurate more reliable reconstructions of paleo-temperatures can be undertaken using fossil *Porites* corals without the need for *a priori* colony-specific temperature calibrations. The general viability of this approach is demonstrated