Proxy calibration of cultured cold water corals and application to fossil corals from the Southern Ocean

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With life-spans of decades to more than 1000 years and skeletons suitable for precise U-Th dating, cold-water corals have the potential to provide climate and environmental information with an unprecedented temporal resolution. We have embarked on long-term culturing experiments using *Desmophyllum dianthus* (solitary; lifespan ~100 yrs) to calibrate geochemical proxies for dissolved nutrients (P/Ca, Ba/Ca), the carbonate system (U/Ca), and calcification temperature (Li/Mg) by controlling seawater composition, temperature, and pH in flow-through aquariums. In order to assess skeletal extension rates and to identify lab-grown aragonite for analysis, dyes and Pb-isotopes were used as visual and chemical markers. While the culturing experiments are ongoing for future calibration, we improved protocols to analyze *D. dianthus* for P/Ca, Ba/Ca, U/Ca and Li/Mg (and U-Th 'speed-dating') by LA-ICPMS, and compared the results with data acquired by micromilling and solution ICP-MS. This analytical development was performed on fossil *D. dianthus* (U-Th ages 13-27 ka) collected from seamounts south of Tasmania. Initial results of Li/Mg thermometry are promising, yielding intermediate water temperatures of 4.0 – 5.5°C for Glacial age corals. Similarly, early results of U-Th 'speed-dating' by LA-ICPMS are very encouraging; derived ages are less precise but match, within error, conventionally measured U-Th ages. Preliminary proxy data from the Tasmanian corals indicate that they may contain a record of changes in nutrients in Antarctic Intermediate Water (AAIW) and Subantarctic Mode Water (SAMW) during the Last Glacial-Holocene period. This record will be expanded in a future study by analyzing a large collection of live-collected modern samples as well as an unexploited archive of ~400 fossil corals from waters around New Zealand.