Rapid Processing of High Resolution Bamboo Coral Barium/Calcium Records from the California Margin

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Deep sea bamboo corals have the ability to record past changes in ocean chemistry and climate. Bamboo corals are long-lived cold water corals that are found at intermediate depths – most often 400 – 3000 meters. These corals grow radially throughout their lifespan and form growth rings as they expand outwards. Geochemical information about the local ocean conditions is preserved in these growth bands. Therefore, a cross section of the coral from the center to edge provides a record of coral skeletal material deposited from the coral's juvenile stages to the date of collection of the sample – the lifespan of the organism. Because there are few available in-situ measurements of the intermediate to deep ocean, the paleoceanographic records preserved in bamboo corals are capable of reconstructing past ocean conditions on interannual to decadal time scales.

My research focuses specifically on the incorporation of barium into the calcite skeletons of bamboo corals from the California Margin. Barite is formed during the decay of organic matter in the surface waters before being exported to the deep ocean. Thus, Ba_{sw} has been proposed as an indicator of primary productivity as well as a marker of deep water masses. And understanding how barium varies with depth and time provides insight into the global carbon cycle. Given the recent fluctuations in ocean conditions as a result of global warming, it is essential to understand the effects of past climate change in order to better understand present and future changes. Ba/Ca ratios preserved in bamboo corals have the potential to serve as a proxy for Ba_{sw}. Past research has shown that Ba/Ca ratios in the outermost band of bamboo corals agree with known Ba_{sw} values. In addition, Gabriela Serrato Marks '15 found that Ba/Ca records within an individual coral are reproducible. The next step in validating this proxy is to compare the Ba/Ca records from co-located corals in order to verify that corals from the same location are recording the same external signals in Ba_{sw}.

This study aims to 1) developed Python code to efficiently process LA-ICP-MS data and 2) assess if deep sea bamboo corals can be used to obtain decadal to centennial records of barium levels in intermediate to deep water masses. First, I developed code to more efficiently process bamboo coral data and thus prepare data for the comparison of co-located corals. To obtain the raw data, we ran ten bamboo coral samples using LA-ICP-MS (Laser Ablation - Inductively Coupled Plasma - Mass Spectrometry) at the UC Davis Stable Isotope Laboratory. This method produces thousands of data points for each several millimeter long coral radius. Because there is no commercial data analysis software available to perform this analysis, all data had previously been processed by hand using excel. The Python code developed for the project allows for rapid processing of data and has been validated by comparison with manual calculations.

Using this code to efficiently process LA-ICP-MS data, I was then able to compare Ba/Ca records in co-located corals. After applying a Ba_{SW} calibration developed by LaVigne et al. (2011), I found that the baseline values of these co-located records agree with each other as well as in-situ measurements and therefore appear to be recording Ba levels in the surrounding seawater. The timing of peaks within the Ba/Ca records also seem to record an external signal. Both the baseline value and the timing of peaks may be a result of variations in ocean circulation and water mass composition. In contrast, the amplitude of peaks in the Ba/Ca time series is likely modulated by physiological effects which reveals the need for colony-specific calibrations.

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