Radio Carbon Dating and Growth Rate Estimates for California Deep Sea Bamboo Corals
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This summer I worked in collaboration with Megan Freiberger to develop age chronologies of Deep-Sea Bamboo Corals collected from the California Margin in the Pacific Ocean. These corals grow in alternating branches of calcitic and organic nodes at depths of about 1000ft. Their branches accumulate elements from the surrounding water column as they grow out radially allowing them to record changes in seawater chemistry within their skeletons. Although water column data is now collected from buoys and cruises around the world, deep-sea corals, which can live for several hundreds of years, provide a much older and larger spatial archive for past variations in ocean circulation and chemistry. In the face of global warming and the resulting rapid changes in both atmospheric and oceanic conditions, it is important to understand past climactic variability to predict how future changes will impact the ocean. To accurately compare elemental variability to past climactic changes, however, it is first necessary to determine an age and growth rate estimate. This was the focus of our summer research.

We worked on six samples from the California Margin that were harvested from a depth transect in the Eastern Pacific oxygen minimum zone. We used a radiocarbon reconnaissance method that identifies a C¹⁴ increase and spike within the coral’s organic node associated with the years 1957 and 1980 during nuclear bomb testing. Using these tie points, we were able to construct an age and growth rate estimate. We identified this spike by combusting samples from individual peels (Figure 1), converting the samples into graphite, and then running them through an AMS (accelerator mass spectrometer). We completed these parts of the analysis at the Woods Hole Oceanographic Institute in Massachusetts.

Our results provide clear evidence of an initial bomb spike and peak (Figure 2). Growth rates ranged between 72-200microns per year and decreased further from the core. These growth rates gave age estimates between 40-110 years. The decrease in growth rate with age suggests that these corals do not have linear growth rates and a better growth model must be developed before accurate ages can be estimated.

This summer, I also analyzed primary productivity data from the past 50 years from the online database, CalCOFI. I averaged chlorophyll concentrations from the upper 20m in the Pacific Ocean for each season. I found that chlorophyll concentrations have been increasing over the past 50 years and show centennial to decadal variability associated with El Nino and Pacific Decadal Oscillation (Figure 3). This data can also be used in the future to align with coral chronologies to better understand past changes in nutrient cycling and remineralization.

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References: Burke et al, 2010; Hill et al., 2014; Roark et al., 2005