Ocean and Climate Change Institute
Final Report Summary

Using Coral Radiocarbon as a Tracer of Atlantic Circulation During the Last 400 Years

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What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

We were exploring the utility of radiocarbon in corals to inform us on variations in tropical Atlantic circulation over the last 400 years. We focused on a coral from the Bahamas, but also made some preliminary measurements on corals from the US Virgin Islands and the Yucatan.

What have you discovered or learned that you didn't know before you started this work?

We found that the radiocarbon of a coral from the Bahamas closely follows that predicted by simple modeling of the ocean mixed-layer to atmospheric radiocarbon variability. The relatively young ages, compared to the mean surface ocean that we found, as well as the lack of significant departures from the atmosphere, at the low resolution of our record, reflects its position on the western boundary of the subtropical gyre, a region that is less influenced by upwelling or advection of older subsurface water than other areas previously studied.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

The greatest significance of our work is that it provides the first confirmation of the models (and their assumptions) used to predict the response of the surface ocean to atmospheric radiocarbon variability. This is excellent news for researchers studying the radiocarbon of past oceans, and those using radiocarbon as a dating tool.

What were the most unusual or unexpected results and opportunities in this investigation?

The most unexpected result is described below in “challenges” – namely that in this one coral, there were short periods where the bands appear to occur more frequently than annually. Once we understand why these extra bands formed, we may have new insights into oceanographic conditions during these two short (~15-yr) periods.

The other surprising observation was that at the Bahamas, departures from the trend suggested by models were so small.

What were the greatest challenges and difficulties?

The greatest challenge was resolving the small radiocarbon variations in the surface subtropical ocean, and establishing an age model for the coral. Initially, we used years provided by coral bands assumed to be annual. However, radiocarbon results were difficult to explain and U-series ages pinpointed time intervals when bands were not annual, and led us to date other corals – in the other corals, U-series ages and band counts were identical, suggesting we had chanced upon a coral with intervals on additional bands.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

This was all new research conducted at WHOI.

What were the key tools or instruments you used to conduct this research?
NOSAMS 500 kV AMS system and the Neptune multi-collector ICP-MS.

Is this research part of a larger project or program?

Yes, this is part of a larger program with Dr. Anne Cohen to reconstruct tropical climate change of the last several centuries. It also involves other WHOI collaborators, including Dr. William Thompson, who generated the U-series ages.

What are your next steps?

Collecting additional radiocarbon dates, and then submitting a proposal to the NSF to continue this work.

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

No. We plan to collect a few additional radiocarbon ages, to fill out our record, and then plan a multi-author peer-reviewed contribution.

Please provide photographs, illustrations, tables/charts, and web links that can help illustrate your research.