ARCHIVE IN THE DEEP: A 2000 YEAR HISTORY OF OCEANOGRAPHY AND CLIMATE CHANGE RECORDED IN WESTERN NORTH ATLANTIC DEEP-SEA BLACK CORALS

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Introduction

Analysis of Antipatharian corals retrieved from Stetson and Savannah Banks in the western Atlantic Ocean off the southeastern United States. We used ^{210}Pb to date outer bands and ^{14}C to date inner bands. The specimen from Stetson Bank, collected live from 500 meters depth, began growing 900 years BP. The specimen from Savannah Bank was collected dead, but ^{14}C dates indicate that it grew from 650 BP to approximately 2850 BP. We verified ^{210}Pb age models with ^{14}C dates from the outer bands, which yield modern ages with a Δ^{14}C equal to atmospheric ^{14}C. The ^{210}Pb growth curve indicates a constant coral growth rate of 15um/yr. Using that chronology, ^{14}C dated bands from the center (oldest) and outer (youngest) part of the skeleton lie on the growth-rate line, but intermediate ^{14}C samples were abnormally old. This dichotomy suggests the water mass in place during growth of the middle bands contained 'old' carbon. This coral grew on the Stetson bank, near the edge of the Blake Plateau, and we suggest that the source of this old carbon was up-welled water from the Atlantic Basin. The apparently old dates occurred during the Little Ice Age and may indicate changes in the strength of the thermohaline circulation of the region, likely a slowing or change in the Gulf Stream.

Results and Discussion

Trace element analyses were performed by Laser and solution ICP-MS techniques on an ELEMENT-1 ICP-MS at the Geochemistry Division, NHMFL. The chemical analyses of antipatharians showed that they are extremely enriched in metals. Measurements of the trace metal content of individual black coral bands demonstrate that micronutrient metals vary with time and may be correlated with the dust record from the GISP II ice core. The decrease in cadmium concentrations during the Little Ice Age may indicate decreased nutrient flux related to changes in oceanic circulation or productivity. The record of yttrium and cadmium has remarkable correlation with volcanic activity from 1000 BP to about 1850. From 1850 to the present, however, cadmium flux increased and the correlation disintegrates. This suggests that the increased is due to anthropogenic influences which are being recorded in the deep corals (Figure 1).

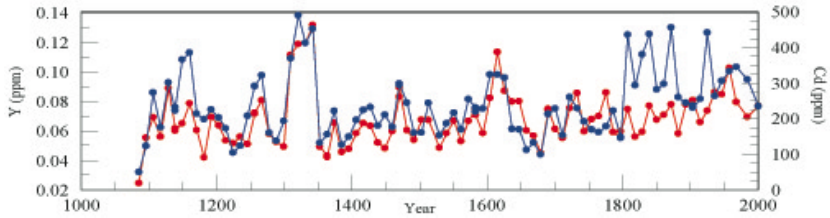

Figure 1: Distribution of yttrium and cadmium in black coral. Note the correlation between the two elements from 1000 to 1800 BP. From 1800 to present the cadmium concentration increases relative to yttrium. (Yttrium = blue; Cadmium = red).

Conclusions

The major conclusion for this effort is that these long lived corals contain an incomparable chemical and climatic historical record of the Western North Atlantic Ocean. With annual concentric bands, these corals have been growing for hundreds to thousand years, recording oceanographic, climatic and atmospheric changes within their skeleton.