UNRAVELING DEEP-OCEAN CONNECTIONS TO CLIMATE WITH DEEP-SEA CORAL RECORDS OF RADIOCARBON AND CD/CA

Thesis by

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ABSTRACT

We generated records of radiocarbon and trace metals in deep-sea corals to investigate the role of the deep ocean during episodes of rapid environmental change. Our record of radiocarbon ages measured in a modern deep-sea coral from the northeastern Atlantic shows the transfer of bomb radiocarbon from the atmosphere to the deep ocean. We detect bomb radiocarbon at the coral growth site starting in 1975–1979. Our record documents a $\Delta^{14}C$ increase from –80 ± 1‰ (average 1930–1979) to a plateau at –39 ± 2‰ (average 1994–2001). From a suite of fossil deep-sea corals, variability in North Atlantic intermediate water $\Delta^{14}C$ during the Younger Dryas (13.0–11.5 ka) supports a link between abrupt climate change and intermediate ocean circulation. We observe rapid shifts in deep-sea $\Delta^{14}C$ that require the repositioning of large $\Delta^{14}C$ gradients within the North Atlantic. The shifts are consistent with changes in the rate of North Atlantic Deep Water formation. We also observe a decadal scale event at 12.0 ka that is marked by the transient return of radiocarbon to the eastern and western basins of the North Atlantic.

To develop a nutrient proxy for use in deep-sea corals, we measured Cd/Ca in 14 modern corals. Several of these corals had anomalously high Cd/Ca that we explain with a systematic bias in Cd/Ca obscuring the signal of seawater Cd/Ca. When these high Cd/Ca corals are removed from the calibration, the best-fit coral-water partition coefficient is 1.3 ± 0.1. Examining Cd/Ca in fossil deep-sea corals, we find that our coral from the Younger Dryas (12.0 ka) resembles the high Cd/Ca corals of the modern calibration and probably does not reflect seawater Cd/Ca. The Cd/Ca record from a 15.4 ka coral resembles our low Cd/Ca calibration samples and probably reflects average seawater Cd/Ca.

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