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Ocean ventilation rates during the last deglaciation: paired radiocarbon and Nd isotope compositions in deep-water corals from the NW Atlantic

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Atmospheric CO_2 has varied systematically during mid-Pleistocene glacial/interglacial cycles. Despite intense investigation, the exact causal mechanisms remain unknown. Sequestration of carbon in the deep ocean during glacials and its subsequent release during deglaciation undoubtedly play a role, given the much larger size of the ocean carbon reservoir compared to that of the atmosphere, thus allowing small changes in ocean circulation to have a large impact on atmospheric CO_2. However, concrete evidence of the ocean's role has yet to be established. One route of investigation is to determine ocean ventilation rates. To do so requires combining dynamic tracer data, such as radiocarbon, with a conservative tracer to identify the water masses involved and their mixing ratios.

We describe the novel use of deep sea coral species *D. dianthus* as an archive material providing both radiocarbon and conservative water mass tracer data in the form of Nd isotope compositions. The majority of corals in this study are deglacial in age and span a water depth of 1000 to 2600 m in the NW Atlantic, where changes in the water column structure were pronounced across the last glacial/interglacial cycle (1). Additional coral samples are located in the NE Atlantic and the northernmost parts of the North Atlantic to provide a broader picture of change. Corals with existing radiocarbon data and U/Th ages (1-4) were subsampled before undergoing extensive physical and chemical cleaning (5). Purification of coral Nd was achieved using an initial Fe co-precipitation step followed by separation of coral REE from matrix, and finally Nd separation by α-HIBA column chromatography. The low concentrations of coral Nd (3 to 29 ppb; 5) required analysis of the isotope composition by TIMS as NdO^+, which ionises Nd more efficiently compared to Nd^+ analysis (6).

This study builds on existing work using *D. dianthus*, which has identified radiocarbon age reversals within single specimens (4) and rapid changes in radiocarbon content of the NW Atlantic water column (1). By pairing the Nd isotope data to the radiocarbon data, we are able to identify the water masses present in the NW Atlantic during the deglaciation, the extent of mixing between these, and ultimately to translate the radiocarbon data into ocean ventilation rates.

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