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Foraminifera Stable Isotopes, Bulk Sedimentary $^{231}Pa/^{230}Th$, and the Link Between Thermohaline Circulation and Rapid Climate Oscillations

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The combination of nutrient-proxies and dynamic tracers of thermohaline circulation can provide insights into the ocean's role in climate variability. Uranium-series disequilibria in marine sediments (specifically, the initial ratio of excess ^{231}Pa to excess ^{230}Th) provide a quantitative assessment of the flux of deepwater produced and exported (Yu et al., 1996). We have used model calculations (Marchal et al., in press) and preliminary sedimentary data from the Atlantic Ocean to show that this radionuclide approach may be applied to evaluate the rapid changes associated with the last deglaciation. In conjunction with the more widely applied δ13C nutrient-proxy for water mass signature, these results provide constraints on the changes in production associated with thermohaline reorganization. The competing priorities of the two methods, the model-predicted spatial patterns of sensitivity, and the accumulation rates required to resolve millennial oscillations, all limit the number of appropriate cores for such a study. We have identified three locations that optimize the likely results from this multi-proxy approach. ODP Site 984 (61º26'N, 24º05'W, 1.6 km) occupies an intermediate water depth in the subpolar North Atlantic near sites of deepwater production, thus monitoring North Atlantic Glacial Intermediate Water as well as modern North Atlantic Deep Water. Core OC326-GGC5 (32º56'N, 76º17'W, 3.6 km) occupies a deep location in the central gyre of the subtropics and thus monitors deep waters, whether of northern or southern origin. Core 13289 (18º04'N, 18º01'W, 2.5 km) is a relatively marginal site, and thus provides an indication of any changes in boundary scavenging that might accompany changing residence time of waters in the Atlantic Basin. Pairing the stable isotope and radionuclide measurements in the same core, along with planktonic environmental proxies, eliminates the requirement for correlation between records in order to assess the phase relationships and relative durations of the climatic and oceanographic states indicated by the respective proxies. As a first step, we have established oxygen isotope stratigraphies at the three sites, and identified the Holocene and Last Glacial Maximum (LGM), and further identified the chronozone of the Younger Dryas climate reversal. Preliminary radionuclide measurements at the three sites utilize ICP mass spectrometry, rather than the previously applied alpha-counting. The data from Site 984 represent the first paired glacial-interglacial measurements from the subpolar ocean between 45º and 60º, and the low-resolution time series at the other sites represent improvements on the previous time slice evaluation. The Holocene-LGM results are in general agreement with the finding of Yu et al. (1996) that modern circulation preferentially exports excess 231Pa from the North Atlantic, and that glacial circulation was characterized by some export rather than a total cessation. Deglacial δ13C records contains dramatic oscillations consistent with major reorganization of water masses, and the deglacial time series of $^{231}Pa/^{230}Th$ display sufficient structure to suggest changes in the rate of production of the Northern Component Water. Model calculations constrain the duration of thermohaline changes and the time-varying response consistent with total cessation, diminished production, or counterbalancing intermediate vs deep water associated with the observed rapid climate oscillations.

Yu, E.-F., Francois, R., and Bacon, M, *Paleoceanography*, (In press).

Marchal O., Francois R., Stocker T., & Joos F, *Nature*, **379**, 689-694, (1996).