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Deep water mass geometry in the south east Atlantic across the Mid-Pleistocene Transition: bathimetric vs oceanographic controls

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The Mid-Pleistocene Transition (MPT, ~1.3-0.7 Ma) is one of the most drastic climatic transition in the recent climatic history of our planet. During this transition, glacial-interglacial variability shifted from 41- to 100-ka cycles, without notable changes in the orbital forcing. Internal forcing mechanisms in Earth's climate likely shifted the system towards particularly more extreme glacial periods. A decrease in the atmospheric CO_2 contemporary to a severe weakening of the Atlantic deep-ocean circulation around 900 ky suggests that weakened deep-ocean circulation facilitated the capture of CO_2 into the deep ocean and thus contributed to the switch towards more intense and longer glacial periods.

ODP Site 668B, in the deep eastern equatorial Atlantic, has been previously used to reconstruct the atmospheric CO_2 evolution across the MPT using boron isotopes in surface dwelling foraminifera. Here we present new high resolution proxies from the same site covering the last 2 Ma. In particular, benthic foraminifera stable isotopes and trace elements (B/Ca, Mg/Ca, Cd/Ca), as well as Nd isotope data (εNd) from Fe-Mn encrusted foraminifera shells. Using the newly improved chronology based on benthic foraminifera stable isotopes we show that our new εNd data covaries substantially with the atmospheric pCO_2 data and shows a glacial-interglacial variability through the entire record, with εNd values matching typical glacial-interglacial range values in the North-Atlantic basin (~-11 to ~-14). Between ~1 to 2 Ma, when the 41-ka-cycles were dominant, εNd data also covaries with carbonate ion saturation index (ΔCO_3^{2-}) as derived from the new B/Ca data, Bottom Water Temperatures (BWT, Mg/Ca) and, with deep ocean nutrient content (phosphate derived from Cd/Ca). Results indicate a higher fraction of warmer, less corrosive and nutrient-poor northern-sourced waters (higher BWT, higher ΔCO_3^{2-}, lower Cd/Ca, lower εNd) reaching the deep-equatorial Atlantic during interglacial periods compared to glacial periods. Interestingly, this covariation does not stand after ~0.9Ma. Even though εNd and BWT data suggest an increased contribution of southern-sourced waters to the site during glacial periods after 0.9Ma, as shown by a gradual decrease in glacial BWT (>1°C) and increasing glacial εNd values (~1ε units), both B/Ca and Cd/Ca show a distinctive low frequency variability superimposed to the glacial-interglacial variability. These oscillations can be interpreted as infiltrations and/or overflows of southern-sourced waters across the mid-ocean ridge into the SE Atlantic basin that do not completely follow glacial-interglacial periodicity. We propose that

bathymetrical constrains exert a control on the chemistry of the deep waters in the deep eastern equatorial Atlantic with potential impacts on global climate. Partially isolated sub-basins such as the SE Atlantic could have effectively acted as carbon reservoirs over longer time scales than glacial-interglacial changes.