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Variability of Antarctic Intermediate Water composition in the South Atlantic over the last 600,000 years.

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Antarctic Intermediate Water (AAIW) forms an integral part of the global thermohaline circulation as it redistributes heat, salt, CO_2 and nutrients from the Southern Ocean to the nutrient deprived tropics. Although there is clear evidence that the transport and composition of AAIW played a key role in the climate change of the last deglaciation, there are only a few longer records of AAIW variability. Here we reconstruct variations in AAIW water mass sourcing and nutrient content in the South Atlantic using Neodymium (Nd) isotopes and benthic Cd/Ca records complemented by benthic stable carbon isotope ($\delta^{13}C$) data. This study is based on a sediment core from DSDP Site 516 at 1300m water depth from within the modern-day core of the AAIW. The Nd isotope signatures exhibit a glacial-interglacial variability of up to 1.2 εNd units over the last 600 kyr with interglacials characterized by unradiogenic Nd signatures close to modern AAIW while more radiogenic signatures of up to -6.4 prevailed during glacials. This suggests a reduced contribution of unradiogenic northern sourced waters to the Southern Ocean during glacial periods. The $\delta^{13}C$ record displays a similar amplitude with another intermediate depth record from the Southwest Pacific [1] showing glacial $\delta^{13}C$ values as low as 0.55‰. This can be attributed to a reduced ventilation at that depth during glacials. The intermediate depth Cd/Ca record indicates a higher nutrient content during interglacials consistent with other Cd/Ca reconstructions from the Atlantic for the last 55kyr. In addition, we observe a pronounced and steady nutrient decrease of AAIW starting ~270 ka and continuing until the Holocene. This trend is similar to that of the iron content records of DSDP Site 516 and that of Southern Ocean ODP Site 1090 [2] which show an overall increase in glacial iron supply over the last ~270 kyr. This has likely increased productivity and has impacted the nutrient inventory of AAIW as reflected by Cd/Ca.

[1] Ronge, Tiedemann, Prange, Merkel & Nürnberg (2015), Paleoceanography 30, 23–38.

[2] Martínez-Garcia, Rosell-Melé, Jaccard, Geibert, Sigman & Haug (2011), Nature, 476(7360), 312–315.