

Reconstructing past ocean circulation with $^{231}\text{Pa}/^{230}\text{Th}$ and Nd isotopes

J. LIPPOLD¹, M. GUTJAHR², P. BLASER³, B. ANTZ³,
E. BÖHM^{3,4}, M. L. DE CARVALHO FERREIRA³,
F. WOMBACHER⁵, M. CHRISTL⁶, S. MULITZA⁷ AND
S. JACCARD¹

¹Oeschger Centre for Climate Change Research, University of Bern, Switzerland. (joerg.lippold@geo.unibe.ch).

²GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany.

³Institute of Environmental Physics, University of Heidelberg, Germany.

⁴LSCE, Gif-Sur-Yvette, France.

⁵Institute of Geosciences, University of Cologne, Germany.

⁶ETH Zurich, Laboratory of Ion Beam Physics, Zurich, Switzerland.

⁷MARUM, University of Bremen, Germany.

For more than a decade $^{231}\text{Pa}/^{230}\text{Th}$ and Nd isotopes from deep sea sediments have been essential parts of the toolbox in paleoceanography [1-3]. While the $^{231}\text{Pa}/^{230}\text{Th}$ proxy is a recorder of past overturning strength, $^{143}\text{Nd}/^{144}\text{Nd}$ can be used as a water mass tracer, providing information towards the source of deep water at a sampling site. Clearly both proxies maximize their potential when combined, yet only very recently have studies reported results from such combined approaches [4-7]. Unfortunately, the spatial coverage is very patchy and far from being comparable to the observations available from stable isotopes or paleonutrient proxies. New combined data from several locations spanning the Atlantic Ocean suggest that $^{231}\text{Pa}/^{230}\text{Th}$ before and during the last glacial termination cannot be interpreted in a straightforward way, mostly because the deep Atlantic was bathed in Southern Source Water [7] [8]. Since water mass age, upwelling and downwelling and in particular water depth are essential parameters controlling $^{231}\text{Pa}/^{230}\text{Th}$, we will present examples as to why it is advisable to compile available data sets [9] [10] rather than interpreting $^{231}\text{Pa}/^{230}\text{Th}$ down core profiles from a single location.

[1] Yu, E. et al. (1996) *Nature* [2] McManus, J. et al. (2004) *Nature* [3] Piotrowski, A. et al. (2004) *Earth and Planetary Science Letters* [4] Roberts, N. et al. (2010) *Science* [5] Gutjahr, M. et al. (2011) *Paleoceanography* [6] Böhm, E. et al. (2014) *Nature* [7] Jonkers, L. et al. (2015) *Earth and Planetary Science Letters* [8] Curry et al. (2005) *Paleoceanography* [9] Bradtmiller, L. et al. (2014) *Nature Comm.* [10] Lippold, J. et al. (2012) *Nature Geoscience*