Examining proxy evidence from the deep Northwest Atlantic for the state of the AMOC over the past 90 ka

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It is hypothesized that there was a shallower Atlantic Meridional Overturning Circulation (AMOC) in the glacial North Atlantic, likely caused by the presence of the Laurentide ice sheet (LIS) and its impact on atmospheric circulation and freshwater budgets. Proxy studies have provided evidence to support this hypothesis [1], although the interpretation of some of these proxies has recently been scrutinised [2]. High resolution $^{231}Pa/^{230}Th$ and ε_{Nd} analysis of an ocean sediment core from the deep Northwest Atlantic has been used to infer that a strong and deep AMOC prevailed during Marine Isotope Stage (MIS) 3 and 4 (~27 ka to ~70 ka) [3]. This result is perhaps less surprising for the intermediate climate state of MIS 3, yet MIS 4 has been viewed as a 'typical' glacial period, when the AMOC might be expected to be in its shallow glacial/cold state. Possibly the smaller size of the LIS, with respect to the last glacial maximum (~MIS 2), did not cause the AMOC to shift to its full glacial state of operation? We investigate this issue further by reporting on benthic foraminifera $\delta^{18}O$ and $\delta^{13}C$, and sortable silt mean grain size analyses obtained from a depth transect of sediment cores in the Northwest Atlantic, spanning the past 90,000 years (MIS 1-5a). In contrast to the published ε_{Nd} and $^{231}Pa/^{230}Th$ data [3], our datasets suggest that during MIS 4 the AMOC was operating in a similar mode to MIS 2 (albeit not identical). Reconciling all these datasets requires a re-evaluation of the possible controls on these proxies.

[1] Lynch-Stieglitz *et al*. (2007), *Science* **316**, 66-69. [2] Gebbie (2014), *Paleoceanography* **29**, 190-209. Böhm *et al*. (2015) *Nature* **513**, 73-76.