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Changes of the Atlantic meridional overturning circulation of the past 30 ka recorded in a depth transect at the Blake Outer Ridge

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Oceans and climate are a tightly coupled system interacting with each other in various ways such as storage of carbon dioxide in the deep ocean. Within the global conveyor belt the Atlantic Meridional Overturning Circulation (AMOC) holds a key function, transporting warm salty surface waters from the tropical to the northern Atlantic where deep water formation takes place. Following the continental rise of North America this newly formed deep water propagates southward as Western Boundary Undercurrent (WBUC) ventilating the deep Atlantic. In the past (e.g. the last glacial cycle) strength and geometry of the AMOC have changed significantly [1]. This study aims to provide a better understanding of the temporal and spatial (also depth depended) evolution of the AMOC in the western Atlantic sector since the last glacial (∼30 ka). We have investigated four sediment cores of the Blake Outer Ridge (30°N, 74°W; ODP 1059 to 1062) in a depth transect from 3000 to 4700 m water depth in the main flow path of the WBUC. We measured four down-core profiles of neodymium (εNd) and 231Pa/230Th isotopes for the reconstruction of water mass provenance and circulation strength of the last ∼30 ka. In contrast to published Nd isotope [2] and 231Pa/230Th [3] records from the Blake Ridge area our records are of unprecedented resolution, resolving climate key features of the North Atlantic region: Heinrich Stadials (HS) 1 and 2, the Last Glacial Maximum (LGM), the Bølling-Allerød and Younger Dryas (YD). Radiogenic Nd isotope signatures during the LGM reveal AABW to be the prevalent water mass in the deep western North Atlantic. The trend to more unradiogenic signatures during the deglaciation point to an increased formation of NADW which was again replaced by AABW during YD. The Holocene shows the most unradiogenic signatures and therefore established NADW. The circulation strength-proxy 231Pa/230Th indicates reduced LGM deep circulation, a pronounced slowdown during HS1 and a strong and deep circulation during the Holocene. Compared to isotopic records from the Bermuda Rise (ODP 1063; [4]) we found depth depended geometry changes of the WBUC which have occurred through the last glacial. Here, we focus on how deep northern sourced water has reached during phases of reduced circulation (indicated by increased 231Pa/230Th ratios) and the timing of this southward progradation of lower NADW.

References:

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