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Hydrographic response to the 8.2kyr event in surface and intermediate waters along the eastern boundary of the northern subtropical gyre (NW Africa)

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Exceptionally high sedimentation rates along the northwestern African continental margin provide a unique opportunity to study abrupt paleoceanographic changes of the Atlantic Meridional Overturning Circulation (AMOC) during the Holocene. In this study we focus on the 8.2kyr event caused by abrupt meltwater outbursts to investigate the sensitivity and response of the climate system to a weakening of the AMOC. For this purpose we chose to investigate sediment core GeoB6007-2 collected during the Meteor cruise M45/5 in 1999 at 30°51'N, 10°16'E at 900m depth for high resolution analyses. Preliminary analysis of this core document high sedimentation rates allowing a temporal resolution of 10 to 20 years, high overall quality of the core (absence of turbidities and abundance of foraminifera species) and the presence of the 8.2kyr event (XRF and alkenones). Our major scientific goals for this study include (1) exploring the role of the AMOC for abrupt climatic events during the Holocene such as the 8.2kyr event, (2) quantifying the sensitivity of the upper 1000m of the water column of the sub-tropical Atlantic to changes in the AMOC using planktic and benthic foraminifera and to combine these results with (3) simulating the oceanic response of sub-tropical surface, central, and intermediate waters to a single or two-step meltwater episode using the UVic Earth System-Climate Model (ESCM).

Here we present first results for the regional calibration of Mg/Ca ratios in the benthic foraminifera Hyalinea balthica as well as the down-core record of bottom water temperatures (BWT) for the 8.2kyr event. Foraminifera abundances are high in this section of the core, allowing a sample resolution of 1cm. This corresponds to a temporal resolution of approximately 15.3 yr for the duration of the event. The regional calibration of Mg/Ca to temperature on H. balthica provides an excellent correlation (r2= 0.93) and agrees with calibrations from Indonesia, the Mediterranean and the North Atlantic (r2=0.90). When applied to the down-core record, these results suggest a total drop of 1°C in BWT for the 8.2kyr event at intermediate water depth. In addition to a general cooling trend starting after 9kyr BP we also observe the distinct two-step cooling that characterizes the event in the Mg/Ca record. In order to constrain possible forcing scenarios the proxy data will be compared directly to model simulations from the UVic ESCM. A framework of forcing has been investigated which focuses on the magnitude and duration of freshwater release into the Labrador Sea as a result of the rapid drainage of the Laurentide lakes. Realistic forcing scenarios produce a slowdown in the modeled AMOC and the collection of simulations provides information with which the expected fingerprint of the 8.2kyr event within the proxy record can be quantified.

We plan to complete the GeoB6007-2 record by providing high resolution SST data using Mg/Ca on Globigerina bulloides as well as an improved age control on this section of the core measuring radiocarbon dates on planktic and benthic foraminifera species. We expect therefore to obtain a detailed record of the hydrographic response of surface and intermediate waters of the eastern boundary of the subtropical gyre for the 8.2kyr event at decadal timescales.