Geophysical Research Abstracts,
Vol. 11, EGU2009-11306, 2009
EGU General Assembly 2009

Monitoring multi-decadal to multi-centennial variability of AMOC strength in the subtropical Northeast Atlantic over Holocene and Eemian

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The EUROMARC-AMOCINT project explores decadal to multi-centennial variability of North Atlantic Meridional Overturning Circulation (AMOC) over the Holocene and previous interglacials as modulated by differential orbital settings. Various key sites in the North Atlantic have been selected tracing the upper AMOC limb along the North Atlantic Drift as well as the deep return flow downstream along the lower limb of AMOC.

In the frame of the AMOCINT 168 Marion Dufresne cruise in 2008 (Kleiven et al., this volume) we cored a partially laminated site at the Mid Atlantic Ridge (MAR) west of the Azores Islands (37.999˚N; 31.1282˚W, w.d. 3050m) monitoring AMOC near the lower boundary of North East Atlantic Deepwater (NEADW). Today NEADW at the MAR is well ventilated by Labrador Sea Water and a small branch of Nordic Seas overflow propagating along the eastern flank of the MAR. At the same time temperature and salinity changes in the Azores Current are monitored, an eastward zonal branch of the Gulf Stream forming the northern rim of the North Atlantic subtropical gyre. The site is thus considered a sensitive AMOC monitor at the interface of North Atlantic and southern hemisphere climate forcing.

According to high-resolution stable isotope records of planktonic foraminifera of core MD08-3180/81 and of a previous short core (GEOFAR KF16) temperature transport in the Azores current was remarkably stable over the last 8000 years, preceded by unstable phase in the early Holocene. Changes in mixed-layer depth as traced by paired δ^{18}O values of shallow and deep-dwelling planktonic foraminifera however reveal multi-centennial and longer fluctuations in the Azores Current strength and position. NEADW temperature according to benthic Mg/Ca values changed only little, slightly decreasing by 1˚C on the long term. In contrast, the benthic δ^{13}C record reveals a succession of pronounced ventilation minima around 0.4, 1.8, 4.2, 6.7, 8.3 documenting the increased influence of AABW suggesting a weakening in AMOC. Among these sucession 8.3 events appears to have been the most prominent one with δ^{13}C values below 0‰Ċoeval changes in Azores current strength and position matching both, NEADW ventilation and changes in the subpolar North Atlantic hydrography, support a close positive linkage to NADW production rates. First results for the oldest part of our records suggest highly unstable AMOC conditions at the end of Eemian and glacial inception.