Geophysical Research Abstracts, Vol. 8, 06395, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06395

Deep Water Variability at the mid-depth Portuguese Margin during Marine Isotope Stages 10 to 16

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Calypso core MD03-2699, whose record covers the last 780 kyr, was retrieved from the Estremadura promontory north of Lisbon from a water depth of 1895 m. Nowadays, this site is bathed by North Atlantic Deep Water (NADW), whose physical properties are modified by diffusive mixing with the overlying Mediterranean Outflow water (MOW). During the last glacial, the boundary between these two water masses deepened from the modern 1500 m to 2200 m at the southwestern Portuguese margin (Schoenfeld & Zahn, 2000). To document the deep water history on the mid-depth Portuguese margin during the middle Pleistocene we are producing centennial-scale benthic isotope and mean grain size records for the interval of Marine Isotope Stage (MIS) 10 and older in core MD03-2699. The isotopic results from core MD03-2699 are placed into the framework of existing records of (lower) NADW (ODP sites 980 and 658) and upper NADW/ GNAIW (ODP site 982) variability.

For most of the studied interval, the benthic oxygen isotope curve of core MD03-2699 reflects the NADW record of ODP site 980, but δ^{18}O oscillation are larger at mid-depth. Deep water ventilation is often better at the mid-depth level. The Portugese margin δ^{13}C values are, however, more in the range of the NADW source signal at site 980 and greatly diverge from the eastern NADW signal at ODP site 658. From 420 to 390 kyr (MIS 11.3), δ^{18}O values in core MD03-2699 are the same as at ODP sites 980 and 658, and at site MD01-2443 from the deeper Portuguese margin (de Abreu et al., 2005) indicating that lower NADW was present at the margin at least from 1890 to 3000 m water depth and that, different from today, vertical mixing with MOW did not occur down to 1895 m water depth. A similar scenario, but with some MOW advection down to site MD03-2699 occurred during MIS 13.3. The transition

from MIS 11.3 to MIS 10 at site MD03-2699 is marked by high-frequency oscillations of 0.5-1 permil δ^{18}O that coincide with increased current speeds. Similar oscillations are also associated with the interglacial to glacial transitions from MIS 13.3 to12 and from MIS 15.1 to14. The higher current speed and the lighter δ^{18}O values indicate an increased influence of warm MOW at 1895 m and therefore a deepening of the MOW/NADW boundary. A deeper flowing, warm MOW is probably also the cause for the light δ^{18}O values (about 3.3 permil) during Termination V, when the water mass on the mid-depth Portuguese margin was better ventilated than the site 980 NADW record and for most parts also than the GNAIW at site 982. A similar, but less distinct δ^{18}O peak is also observed during Termination VII.

As MOW influence at the mid-depth Portuguese margin increased when climate conditions in the northern hemisphere deteriorated, the see-saw affect bet-ween western Mediterranean (WMDW) and North Atlantic deep water formation during the Dansgaard-Oeschger cycles of MIS 3 with increased WMDW formation (Sierro et al., 2005) and stonger and deeper MOW (Voelker et al., submitted) during times of decreased NADW formation (= stadials) seems to also have been in affect during the mid-Pleistocene.