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Millennial-scale Deep/ Intermediate Water Changes at the Mid-depth Portuguese Margin During Marine Isotope Stage (MIS) 11

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Calypso piston core MD03-2699 was retrieved from the Estremadura promontory north of Lisbon from a water depth of 1895 m. Nowadays, this site is bathed by lower North Atlantic Deep Water (NADW), whose physical properties are slightly modified by diffusive mixing with the overlying Mediterranean Outflow water (MOW; 700–1400 m). Labrador Sea Water, the upper NADW, is generally only observed up to the northern edge of the promontory. During the last glacial maximum the MOW became denser and its lower core settled as deep down as 2100 m on the southwestern Portuguese margin (Schoenfeld and Zahn, 2000; P3). This MOW core also gained in flow strength during MIS 3 Greenland stadial phases (Voelker et al., 2006; EPSL). Between 420 and 395 ky BP, i.e. during parts of termination V and the interglacial period of MIS 11, site MD03-2699 was bathed by lower NADW like today. After 395 ky BP, however, site MD03-2699 is showing millennial-scale oscillations of lighter oxygen and heavier carbon isotope values than recorded for the lower NADW at ODP site 980 (McManus et al., 1999; Science). Especially, during periods with colder sea surface temperatures (SST) in the eastern North Atlantic (390 ky BP, 382 ky BP, 374 ky BP, 371 ky BP) these oscillations are associated with maxima in the mean grain size indicating a strenghtening in the bottom current. The most likely source for the stronger and well ventilated bottom water current is a deeper flowing MOW similar to the pattern observed during MIS 3 Greenland stadials. However, some of the benthic isotope values recorded at site MD03-2699 after 395 ky BP are also in the range of the upper NADW values from ODP site 982 (Venz et al., 1999; Paleoceanography). So to better distinguish between periods of MOW and those of upper NADW influence after 395 ky BP and thus to reveal potential rapid changes in the MOW/ NADW interface on the mid-depth Portuguese margin we will generate benthic foraminifera Mg/Ca and Ba/ Ca data.

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Winter mixed layer conditions in the mid-latitude North Atlantic during MIS 11

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The stable isotope data of Globorotalia inflata, which generally reflects conditions in the winter mixed layer, together with ice-rafted debris records from four deep-sea sites are used to reconstruct changes in the surface water conditions off the Portuguese margin and within the latitudinal band between 41 and 38°N. Off Portugal sites MD03-2699 at 39°N and MD01-2443 at 38°N monitor nearshore conditions that during winter are strongly affected by the Iberian poleward current, which transports subtropical surface and subsurface waters originating from the Azores current northwards. Further offshore, the equatorward flowing Portugal current, which also transports hydrographic changes occuring in the subpolar gyre towards the western Iberian margin, becomes important and paleo-conditions in it are recorded at site MD01-2446 (39°N, 12.6°W). The Portugal and Azores currents are both branches of the Gulf Stream/ North Atlantic Drift and past variability in that major current is monitored at IODP site U1313 in the western North Atlantic (41°N, 33°W). The records of all four cores are placed on a common stratigraphy by tuning their respective benthic oxygen isotope record to the one of ODP site 980 on the LR04 timescale. On the nearshore Portuguese margin the planktonic carbon isotope data indicates a lower nutrient content in the winter mixed layer between 410 and 400 ky BP indicating that this part of the margin was – like today – dominantly influenced by the nutrient poorer, but warmer subtropical North Atlantic Central Water (NACW). After 400 ky BP the more northern site MD03-2699 reveals heavier isotope values and thus an increased influenced of the nutrient richer and colder subpolar NACW that forms the subsurface component of the Portugal current. After 390 ky BP, i.e. during the glacial inception, the winter mixed layer experienced stronger variability and 5 major cooling events at approximately 390 ky BP, 382 ky BP, 374 ky BP, 371 ky BP, and 365 ky BP were recorded off Portugal. The most prominent of those episodes with the advance of polar waters at least as far south as 38°N occurred around 390 ky BP. Comparing the Portuguese margin records with those of U1313 will allow to trace the intensity of these Heinrich-type cold events across the mid-latitude North Atlantic and may be even to distinguish differences in timing.

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Contrasting dust supply patterns across the north-western Chinese Loess Plateau during the Last Glacial-Interglacial cycle

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Loess grain-size distributions of four loess-paleosol sequences, located on a west to east transect from the north-eastern Tibetan Plateau (TP) to the north-western Chinese Loess Plateau (CLP), are unmixed with the end-member modelling algorithm EMMA. The unmixing results indicate that the loess is a mixture of three components representing very fine sandy, coarse silty and medium silty loess. The proportional contributions of the loess components in conjunction with loess mass accumulation rate estimates reveal that during the last glacial-interglacial cycle two contrasting dust supply patterns were active over the north-eastern TP and the north-western CLP: a constant supply of medium silty loess and an episodic supply of coarse silty loess and fine sandy loess. The variable input of the two coarse dust components is the main cause for the variation in grain size patterns and mass accumulation rates between the studied sites. Alluvial fans and fluvial systems in the intra-mountainous basins of the Tibetan Plateau and the deserts of Inner Mongolia are the main dust source areas for loess deposits of the north-eastern TP and the CLP, respectively. Sensitivity of these dust source areas to climate variations determines the timing of dust transport and deposition. In general, high dust fluxes are recorded during the last glacial period (MIS 2 to 4) and low dust fluxes during the last interglacial (MIS-5). However, the loess sections in the two regions (TP, CLP) show contrasting dust flux patterns during MIS-3. The records from the CLP show a relatively low dust input in this period, most likely related to increased humidity in the northern dust sources (deserts) where an increased vegetation cover 'prevented' dust deflation. In contrast to this, the Tibetan Plateau records appear to