Imprints of Greenland stadial/ interstadial cycles in marine records off southern Iberia: Hemispheric and Regional Signals

Antje H. L. Voelker [1,2]

1: Unidade de Geologia Marinha; LNEG; Estrada da Portela, B. Zambujal; 2610-143 Amadora; Portugal; antje.voelker@lneg.pt
2: CIMAR Associated Laboratory, Rua dos Bragas, 289; 4050-123 Porto, Portugal

The western Iberian margin has been one of the key locations to study abrupt glacial climate change and associated interhemispheric linkages. Combining various high-resolution records allows mapping how the Greenland stadial (GS)/ interstadial (GI) cycles and the Heinrich stadials (HS) affected the water column along the southwestern Iberian margin and which latitudinal and vertical boundaries existed. Most surface, intermediate or deep water records from this region reveal GS/ GI-type millennial-scale variability with the $\delta^{18}O$ record of the planktic foraminifer *G. bulloides* often being the better record for correlations between marine and Greenland ice core records. However, regional signal modification is also evident and will be the main focus of this presentation.

Based on the existing sea surface temperature (SST) and % *N. pachyderma* (s) records, the polar front reached the northern Iberian margin (ca. 41°N), while the subpolar front (and atmospheric Polar Front) was located in the vicinity of 39°N during the HS of the last glacial cycle. Along with these fronts SSTs increased southward by about 1°C per one degree of latitude leading to steep temperature gradients in the eastern North Atlantic and pointing to a close vicinity between subpolar and subtropical waters. The front at 39°N marks roughly the southern boundary of the North Atlantic's Heinrich ice-rafting belt (Hemming, 2004 Rev. Geoph.) allowing the southern Iberia margin to be influenced mostly by subtropical water masses and leading to some modifications in the climate records (e.g., Voelker et al., 2009 GC; Salgueiro et al., 2010 QSR). For Marine Isotope Stage 3, some of the best examples are the records from site MD99-2339 (35.9°N 7.5°W), located in the central Gulf of Cadiz and in the vicinity of the subtropical front during the HS. All surface to subsurface water records from this core reveal millennial-scale variability but the GS/ GI and GI/ GS transitions were often more gradual than in the Greenland $\delta^{18}O$ records and response in the subsurface waters differed between some of the GI. The most pronounced difference to the Greenland $\delta^{18}O$ records is, however, seen in the SSTs (based on planktic foraminifer assemblage data) that did not drop at the GI/ GS transitions but remained warm throughout nearly half of the GS. GS 10 even experienced no cooling at all (also not in the subsurface waters). Thus in this region hydrographic conditions varied between the GS/ GI cycles.

Not only the influence of subtropical waters can modify surface water signals but also upwelling, the dominant hydrographic feature along the western margin. This is clearly evidenced by the difference between the *G. bulloides* $\delta^{18}O$ records of cores MD95-2042 (37.8°N 10.2°W), showing a clear Greenland ice core-type pattern (Shackleton et al., 2000 Paleoc.), and MD95-2041 (37.8°N 9.5°W). Core MD95-2041, located closer to the coast and thus the upwelling filaments, recorded much more variability in its *G. bulloides* record that can only be explained by a strong upwelling influence and that made correlation to the GS/ GI cycles difficult; a problem that could only be solved by including the % *N. pachyderma* (s) data.

A third regional hydrographic phenomenon affecting the (vertical) water column in the eastern North Atlantic is the Mediterranean Outflow Water (MOW). During glacial times and especially the HS and GS, the MOW settled deeper in the water column (e.g., Rogerson et al., 2005 Paleoc.; Voelker et al., 2006 EPSL) allowing it to be admixed into the Glacial North Atlantic Intermediate Water (GNAIW). Thus Iberian margin records from 2465 m water depth indicate imprints of MOW by warming events during HS 4 and 5 (Skinner et al., 2007 AGU Monogr.) and by a better ventilation of these water depths relative to the western basin. Due to the MOW admixing the boundary between the GNAIW and Antarctic Bottom Water during HS was located between 2465 and 3100 m on the Iberian margin (*vs*. 2000-2200 m in western basin). Greenland-type climate oscillations can be therefore be traced down to this level, while the deeper sites follow the Antarctic patterns of climate change (e.g., Shackleton et al., 2000 Paleoc.).

Despite the regional signal modifications sufficient paleo-data evidence exists now for this area to validate regional climate models for abrupt climate change events such as GS/ GI.