Circum-Iberia paleoceanography and paleoclimate

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Due to its hydrographic and climatological diversity during modern and past times the Iberian Margin is a unique place to study ice–ocean and land–ocean interactions as well as changes in the Atlantic's meridional overturning circulation. Many of the recent break-through results came from deep-sea cores around Iberia, particularly those retrieved during IMAGES campaigns I and V. To synthesize the existing knowledge on circum-Iberian climate and hydrographic dynamics on various time scales and to elaborate on open questions a group of 56 scientists representing a broad spectrum of disciplines, met in January 2007 in Peniche. Speakers gave overviews on the current knowledge and/or existing data with regard to: 1) Modern atmospheric and oceanic circulation; 2) Nutrients and biological productivity; 3) The recent sediment coverage and the Holocene record; 4) Variability during the last two climatic cycles – and beyond; 5) History of the subsurface and deep water masses.

The talks on modern conditions highlighted the complexity of hydrographic and nutrient conditions on the western Iberian Margin and their effect on plankton communities. The complexity results from the seasonal change in dominant currents and upwelling features. Also the data from the recent past (indicates that seasonality needs to be taken into account for paleo-data interpretation. On the western Iberian Margin, diatom, and to some extent also planktonic foraminifera faunas, reflect upwelling conditions, while coccolithophores dominate during winter/spring and prefer the subtropical surface waters along the southern margin; the season and water mass thus mainly reflected by alkenone temperature records (Fig. 1). In the western Mediterranean Sea, sediment trap records reveal that planktonic foraminifera abundance peaks in spring but some species are mainly present in winter-spring or regionally restricted to the Gulf of Lions. Consideration of the dominant seasonal signal reflected by a planktonic foraminifera species and potential shifts from glacial to interglacial times is essential to interpret multi-species isotope and Mg/Ca-temperature records, e.g. from the Alboran Sea. Seasonal and water mass effects, however, cannot be the only explanations for the differing SST records across the Younger Dryas with major cooling only exhibited in the alkenone records off Sines (MD95-2042, SU81-18), off Lisbon (D13882) and in the offshore position MD95-2039 (Fig. 1), but not at the other sites. This conundrum is still an open question and reinforces the need for detailed studies into influences of hydrographic fronts and river water plumes.

Major progress has been made in the refining of transfer functions for SST and productivity along the western Iberian margin. The available planktonic foraminifera fauna based data (Fig. 1) allows the mapping of gradients between time series for both latitudinal and longitudinal transects and specific time slices. Time slice productivity reconstructions for intervals between the last glacial and the Holocene show a generally higher productivity during the glacial maximum in particular north of the Lisbon latitude. Abrupt climate change events like Heinrich events (during the last ±60,000 years) left a distinct mark in SST and productivity records of the area stretching from the Azores Islands to the western Iberian Margin and the Mediterranean Sea. Besides, the mapping of frontal positions, conditions in subsurface waters and temperature gradients in the upper water column are now important questions for these time intervals. Coccolith data, for example, indicate the presence of warm subsurface waters in the Gulf of Cadiz during Heinrich events. Other aspects of abrupt climate change research are the emplacement of turbidites or contourites in deep-sea records linked to sea level changes and variations in the Western Mediterranean Deep Water (WMDW) and Mediterranean Outflow (MOW), respectively. Consequently, tracing millennial-scale WMDW variability from its source in the Gulf of Lions downstream into the MOW in the Gulf of Cadiz and along the western Margin is one of the themes that the group has decided to concentrate on.

Pollen records from deep-sea records around the Iberian Peninsula reveal also a

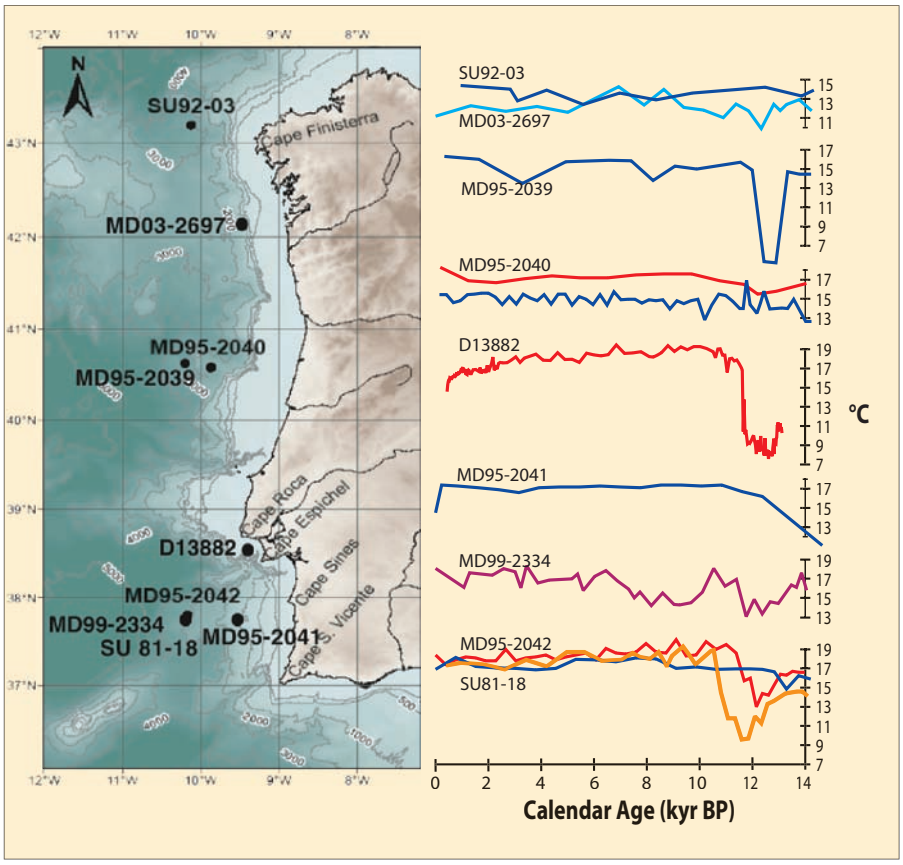

Figure 1: Sea surface temperature (SST) records for the last 14,000 years from the western Iberian Margin arranged in latitudinal order from North to South. Alkenone records are shown in red or orange (SU81-18) and winter SST series based on planktonic foraminifera census counts in blue (light blue for MD03-2697). Foraminifera and biomarker based SST should more or less reflect the same seasonal signal. For core MD99-2334, the Mg/Ca temperature record for G. bulloides is shown (Skinner et al., 2005). Off Portugal this species is related to upwelling and thus should reflect summer surface water conditions. Alkenone record of MD95-cores: Paillar and Bard, 2002; SU81-18: Bard et al., 2000; D13882: Rodrigues et al., submitted; foraminifera records for SU92-28, MD95-2040, -2042: Salgueiro et al., submitted; for MD95-2039 and -2041 unpublished data of de Abreu recalculated with Salgueiro et al. (submitted) modern analog data base; MD03-2697: Sánchez-Goñi et al., in prep.

distinct imprint during Heinrich events, exhibiting rapid changes during glacials and interglacials alike. The existing pollen data cover the last 5 interglacial periods and there are clear linkages between sea surface water conditions off Iberia and forest expansion/retraction on the Peninsula. Open issues that need to be addressed in the future are apparent phase differences between forest expansion/retraction at the NW and SW Iberian Margin and potential marine moisture source(s) for vegetation dynamics. Reconstruction of hydrological conditions on land is making good progress, even though some time series are affected by stratigraphic hiati due to mountain glacier advances. For the Holocene, aridity events on land can clearly be correlated with WMDW variability off Menorca. Additional information on terrestrial environments and prevailing wind patterns may come from charcoal records in deep-sea cores like the study presented for site MD95-2042.

Papers resulting from the workshop will be published in a Geochemistry, Geophysics, Geosystems (G^3) special theme.

Acknowledgements

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Salinity, climate change and salinization

LIMPACS 2nd Workshop, 11-14 April 2007, Nanjing, China

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Forty-five participants attended a workshop focused on climate change and human impact on lake systems and water resources in arid and semi-arid regions sponsored by PAGES, the Chinese Academy of Science (CAS), and the Chinese Natural Science Foundation. Scientific papers were presented primarily on research from China, Mongolia, and India but also included presentations on sites in Africa, Australia, and North and South America. Workshop discussion focused on integrating monitoring, modeling, and paleoenvironmental approaches to evaluate change and to coordinating research under this theme within the Asian region.

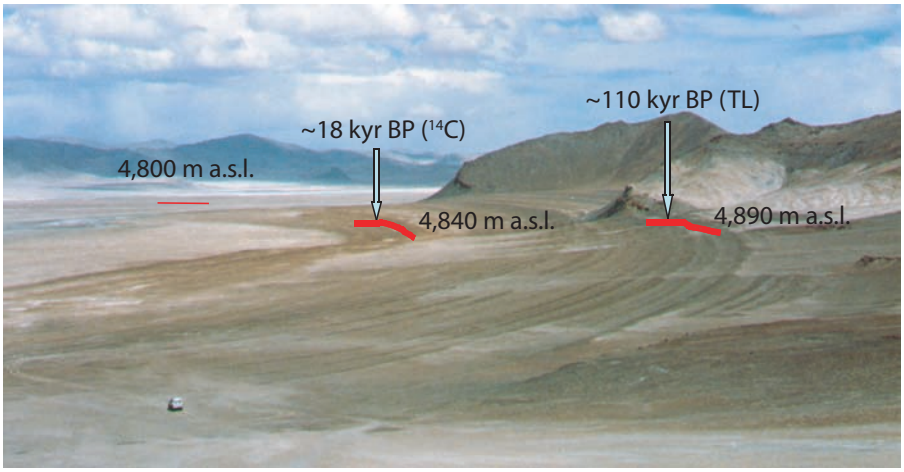

Figure 1: Lake shoreline in the Tianshuihai Basin, south slope of west Kunlun Mountains, NW Tibetan Plateau (Photo by Shijie Li).

Talks on the first day dealt with observations and modeling of contemporary limnological variability and recent and projected climate change. Several lakes in Tibet have measurements of key limnological and climatic variables that span more than 30 years, and presentations highlighted efforts to understand the linkages between recent lake-level change and changes in atmospheric circulation in both glaciated and non-glaciated catchments. The second day focused on paleoclimatic records that spanned from a few hundred years to hundreds of thousands of years and have been used to reconstruct the history of the Asian monsoon systems. Many of the sites have paleoshorelines (Fig. 1) that can be used to link core and geomorphic records and generate quantitative models of volumetric changes in hydrology. A field trip on the final day included a visit to Taihu, one of the largest Chinese freshwater lakes, which serves as a source of drinking water for Shanghai. Ongoing research on eutrophication and metal pollution in the lake were highlighted in a visit to a field station on the lake run by the Nanjing Institute of Geography and Limnology, CAS, and management issues were raised in a meeting with the vice director of the Environmental Protection Bureau of one of the major cities in the lake's catchment.

Discussion sessions during the meeting covered a range of topics relating to the challenges of integrating contemporary and paleoclimatic studies and of reconstructing climate history from lakes. It was suggested that monitoring efforts should center on measuring simple variables that can be scaled to climatically relevant data, such as lake level measurements, to generate integrated basin precipitation. Others emphasized the advantages of integrating cores from both littoral and deep-water areas, which may reflect different types of climatically driven catchment and lake change. Much of the discussion considered issues related to what is known about the history of the Asian monsoon systems and the relevance of these data for the future. It was agreed that additional high-resolution records are needed to complement the iconic speleothem records from Dongge and Hulu Caves, and that the potential for high temporal resolution in many Chinese and Mongolian lake systems has not been fully exploited. Participants also discussed the application of paleo data to policy decisions and to sustainable environmental management.

A key output of discussions was the generation of an informal research network across Asia to examine the influence of the eastern and southern (Indian) monsoon and westerlies on climate variability in the region. Three research foci centering on Mongolian, Tibetan and Indian lakes were proposed to advance research directed at distinguishing the influence of climate change and people on lake status and water resources in the present and future. It was proposed that the preliminary outcomes of the network be shared at the 3rd workshop proposed for Delhi, India in February-March 2009.