WESTERN MEDITERRANEAN RESPONSE TO RAPID CLIMATE VARIABILITY: THE EOLIAN INPUT RECORD DURING THE LAST 20.000 YEARS.

M. Rodrigo-Gámiz [1]*, F. Martínez-Ruiz [1], F. Jiménez-Espejo [2], D. Gallego-Torres [3], V. Nieto-Moreno [1], D. Ariztegui [4] and O. Romero [1]

[1] Instituto Andaluz de Ciencias de la Tierra, CSIC-Universidad de Granada, Granada, Spain. *Correspondence to: - martarodrigo@ugr.es

[2] Institute for Frontier Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Japan.

[3] Marine Geochemistry & Chemical Oceanography. Utrecht University. Budapestlaan. The Netherlands.

[4] Section of Earth & Environmental Sciences, Geneva University, Geneva, Switzerland.

Abstract

Climate variability for the last 20.000 years in the western Mediterranean Sea has been reconstructed using geochemical and mineralogical proxies. An excellent high-resolution record from the East Alboran Sea basin has been analyzed. Geochemical data have provided detailed information on paleoclimate conditions and have allowed to establish fluvial and eolian input oscillations during abrupt climate changes, as well as the paleoxigenation conditions at time of sediment deposition.

Keywords: Western Mediterranean, Alboran Sea, Deep Sea Sediments, Atmospheric Input, Geochemistry

Introduction

Eolian input from the Sahara and other arid regions surrounding the Mediterranean has provided a considerable amount of dust particles contributing to the terrigenous sedimentation [e.g., 1]. This contribution was especially significant during glacial times when the eolian dust into the atmosphere increased through intensified surface winds, lower surface humidity and enhanced desertification [2]. The high sedimentation rates from the westernmost Mediterranean provide excellent conditions for reconstruction of the eolian input record at very high resolution and in turn atmospheric response to climate variability.

Material and methods

A gravity core 293G (402 cm length), recovered in the East Alboran Sea basin during the cruise Training Trough Research 12 Leg 3 (Lat. 36´10.414N, Long. 2´26.071W, water depth 1840m) was chosen for this study. It contains hemipelagic sediments composed of homogeneous green-brownish mud with some shell fragments, foraminifera and bioturbated layers. A continuous sampling every 1.5 cm was carried out for the interval spanning the last 20 kyr. Radiocarbon ages and stable oxygen isotope record from planktonic foraminifera (*Globigerina bulloides*) have provided a detailed age model. Sediment samples were analyzed using X-Ray Diffraction, X-Ray Fluorescence and Inductively Coupled Plasma Mass Spectrometry.

Results and discussion

Preliminary results indicate that the Heinrich event (H1) has been a generalized cold and dry period as shown by high $\delta^{18}O$ values and increasing ratio of eolian input proxies such as Zr/Al, Ti/Al and Si/Al (Fig. 1). In addition, an increase in deep water ventilation points to the injection of large volumes of freshwater from melting iceberg that reached the westernmost Mediterranean, causing a weakened in the Mediterranean thermohaline circulation [3]. During the Bölling-Alleröd period (B-A), a stable trend in thermohaline circulation is evidenced by lower oxygen bottom conditions and the oxygen isotope record. Therefore, this warm and humid period has been characterized by a decrease in values of eolian detrital proxies, indicanting a weaker atmospheric circulation as also supported by pollen records from this region [4]. Geochemical proxies also evidence a particular atmospheric configuration during the Younger Dryas chronozone (YD). Variations in detrital proxies suggest an increasing fluvial activity at the onset of this period, which points to a coupling between the hydrological cycle and the cold atmospheric configuration due to enhanced sporadic rainfalls. More stable climate conditions characterized the Holocene that is also punctuated by significant climate fluctuations such as the 8.200 yr cold event.

Acknowledgements: This work has been funded by Projects CGL2009-07603, CTM2009-07715, CSD2006-00041 (MICINN); 200800050084447 (MARM), Project RNM 05212, Research Group 0179 (Junta de Andalucía) and Training-Through-Research Programme UNESCO-IOC/ MSU.

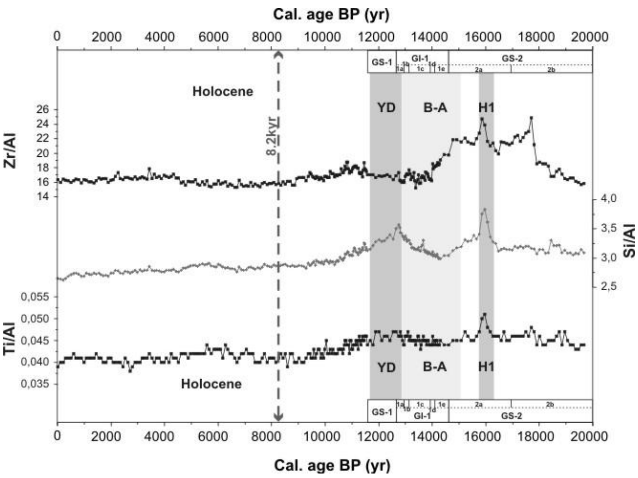

Fig. 1. Geochemical proxies profiles versus calibrated ^{14}C ages (Element/Al ratio for major elements and Element/Al ratio $*10^{-4}$ ppm for trace elements). Light grey vertical bar indicates the warm period Bölling-Alleröd (B-A) time interval. Dark grey bars indicate main cold periods, Younger Dryas (YD) and the Heinrich event (H1) time intervals. Very short dashed grey arrow indicates the “8.200 yr” cold event. Greenland Stadials (GS-1, GS-2) and Interstadials (GI-1) are indicated by white horizontal boxes.

References

1 - Loÿe-Pilot M.D., Martin J.M., 1996. Saharan dust input to the western Mediterranean: an eleven years record in Corsica. *In:* Chester R. (ed.), The impact of desert dust across the Mediterranean. Kluwer Academic Publ., Dordrecht, pp 191-199.

2 - Reader M.C., Fung I., McFarlane N., 1999. The mineral dust aerosol cycle during the last glacial maximum. *Journal of Geophysical Research-Atmospheres*, 104: 9381–9398.

3 - Sierro F.J., Hodell D.A., Curtis J.H., Flores J.A., Reguera I., Colmenero-Hidalgo E., Bárcena M.A., Cacho I., Frigola J., Canals M., 2005. Impact of Iceberg melting on Mediterranean thermohaline circulation. *Paleoceanography*, 20: PA2019. doi: 10.1029/2004PA001051.

4 - Combourieu Nebout N., Peyron O., Dormoy I., 2009. Rapid climatic variability in the west Mediterranean during the last 25.000 years from high resolution pollen data. *Climate of the Past Discussions*, 5: 671-707.