CLIMATE CONTROL OVER THE TERRIGENOUS INPUT TO THE ALGERO-BALEARIC BASIN DURING THE LAST 50 KA

J. Frigola [1] *, A. Moreno [2], M. Canals [1], I. Cacho [1], E. Colmenero [3], F. Sierro [3], J-A. Flores [3], D. A. Hodell [4], J.H. Curtis [4]

[1] GRC Geociències Marines, Departament d'Estratigrafia, P. i Geociències Marines, Facultat de Geologia, Universitat de Barcelona, Barcelona, Spain - miquel@geo.ub.es

[2] Instituto Pirenaico de Ecología, CSIC, Zaragoza, Spain

[3] Departamento de Geología, Universidad de Salamanca, Spain

[4] Department of Geological Sciencies, University of Florida, Gainesville, USA

Abstract

We present the first geochemical results of a very high-resolution study carried out in the MD99-2343 IMAGES core recovered in the Algero-Balearic Basin to characterize the temporal evolution of the terrigenous input to this area. The high-resolution profiles obtained from this core and its close similarity with a core from the Alboran Sea previously studied bring new inputs to the understanding of the rapid climatic variability during the last glacial cycle in the Western Mediterranean Basin. Our multi-proxy approach helps improving the knowledge of the consequences of abrupt climatic changes on the terrestrial and marine environments of the Mediterranean region.

Keywords: Western Mediterranean Sea, aridity-humidity conditions, terrigenous inputs, geochemical records, teleconections.

Recent studies from the Alboran Sea (core MD 95-2043) have revealed high-frequency climatic oscillations in the Sea Surface Temperature (SST) record [1], in the aridity/humidity conditions in adjacent continental landmasses [2] and in the terrigenous (fluvial and eolian) inputs to the basin [3] that have been correlated with Heinrich Events (HE) and Dansgaard-Oeschger (D-O) cycles recorded in the North Atlantic region [4]. However, a high-resolution study to unravel how this climatic variability is represented in other Western Mediterranean sub-basins without a direct influence of Atlantic waters is still lacking.

Core MD 99-2343 was recovered north of Menorca Island (40°29,84'N 04°01,69'E; 2,391 m water depth; 32.44 m long) within the frame of the IMAGES international program. This core was collected to investigate the sources that supply terrigenous material to the Algero-Balearic Basin and to discriminate the climatic mechanisms that may affect the sedimentation processes in the area. Our study has been focussed in the top 18 m of the core, which has been sampled every 5 cm. The high sedimentation rate, a mean of 34 cm/ka during the last 50 ka, allows the study of past rapid climatic variability at centennial to millennial scales. MD 99-2343 core was selected because of its location along the path of present-day dust plumes originating from North Africa. The core location is far offshore from continental landmasses in order to minimize the effects of fluvial inputs on the sediment record. The core is thus intended to monitor changes in dust supply to the Western Mediterranean. In addition, since the core was recovered from a contourite drift [5], it was expected it would also contain a record of the variability of deep-water currents associated to the Gulf of Lions deep-water formation.

High-resolution analyses were carried out by means of X-ray fluorescence (XRF) to get the contents of major elements (Si, Ti, K, Al, Ca, Mg, Mn, Fe, P, Na) in the core sediments. The elementary profiles show high frequency oscillations through the last 50 ka. This is in particular the case of elements associated to terrigenous inputs like Si, Ti, K and Al. These profiles follow a clear D-O periodicity during Marine Isotopic Stage (MIS) 3. Although the Holocene sequence is characterised by lower contents of terrigenous elements and an overall smoother pattern, the variations recorded could be easily related to noticeable climatic oscillations, such as the African Humid Period. During Termination 1 a significant decrease in the supply of terrigenous elements is recorded synchronously to an increase of the Ca percentage, which probably denotes the accumulation of shelf carbonate during the postglacial sea level rise. The preliminary age model for MD 99-2343 was performed after tuning its *G. bulloides* oxygen isotopic record with that from the Alboran MD 95-2043 core [1]. This exercise allows a direct comparison between the elemental ratios normalized to Al in both cores. The strong parallelism between the Si/Al, Si/(Si+K) and Ti/Al records suggests a similar origin and, consequently, the action of similar transport and deposition processes in the Alboran Sea and in the Algero-Balearic Basin. Therefore, the results obtained point to an increase of Saharan dust transport during D-O stadials and cold events, thus supporting the hypothesis of stronger African winds during these episodes [3]. This suggestion correlates with arid conditions [2] and colder sea surface temperatures (SST) [1] that have been described previously during the D-O stadials in the Alboran Sea MD 95-2043 core. In addition, increased contents of the colder-water indicator *E. huxleyi* (>4μm) [6] in our core MD 99-2343 from the Algero-Balearic Basin during HE and D-O stadials confirm the important drop of SST during these periods, as formerly proposed from the Alboran Sea record.

The high parallelism between both Mediterranean cores and the GISP2 ice core oxygen isotopic record [7] shown after our study, strengthens the rapid response of the Mediterranean oceanographic-atmospheric system to climate oscillations thus pointing to an efficient climate teleconnection between the Mediterranean Sea and the North Atlantic region. Finally, although the intensification of atmospheric circulation has been suggested as the main force driving the variability of terrigenous inputs to the open Western Mediterranean Basin during cold events for at least the last 50 ka, complementary grain-size and isotopic analyses are in progress to distinguish the effects of deep-water currents intensity shifts on the sedimentation pattern.

References

[1] - Cacho, I., J.O. Grimalt, C. Pelejero, M. Canals, F.J. Sierro, J.A. Flores, and N.J. Shackleton, 1999. Dansgaard-Oeschger and Heinrich event imprints in Alboran Sea temperatures. *Paleoceanography*, 14 (6): 698-705.

[2] - Sánchez-Goñi, M.F., I. Cacho, J.-L. Turon, J. Guiot, F.J. Sierro, J.-P. Peypouquet, J.O. Grimalt, and N.J. Shackleton, 2002. Synchroneity between marine and terrestrial responses to millennial scale climatic variability during the last glacial period in the Mediterranean region. *Climate Dynamics*, 19: 95-105.

[3] - Moreno, A., I. Cacho, M. Canals, M.A. Prins, M.F. Sánchez-Goñi, J.O. Grimalt, and G.J. Weltje, 2002. Saharan Dust Transport and High-Latitude Glacial Climatic Variability: The Alboran Sea Record. *Quaternary Research*, 58 (3): 318-328.

[4] - Dansgaard, W., S.J. Johnsen, H.B. Clausen, D. Dahl-Jensen, N.S. Gundestrup, C.U. Hammer, C.S. Hvidberg, J.P. Steffensen, A.E. Sveinbjörnsdóttir, J. Jouzel, and G. Bond, 1993. Evidence for general instability of past climate from a 250-kyr ice-core record. *Nature*, 364: 218-220.

[5] - Velasco, J.P.B., J. Baraza and M. Canals, 1996. La depresión periférica y el lomo contourítico de Menorca: evidencias de la actividad de corrientes de fondo al N del Talud Balear. *Geogaceta*, 20 (2): 359-362.

[6] - Colmenero-Hidalgo, E., J.A. Flores, and F.J. Sierro, 2002. Biometry of *Emiliania huxleyi* and its biostratigraphic significance in the Eastern North Atlantic Ocean and Western Mediterranean Sea in the last 20000 years. *Marine Micropaleontology*, 46 (3-4): 247-263.

[7] - Grootes, P., M. Stuiver, J.W.C. White, S.J. Johnsen, and J. Jouzel, 1993. Comparison of oxygen isotope records from the GISP2 and GRIP Greenland ice cores. *Nature*, 366: 552-554.