THE LEVANTINE INTERMEDIATE WATER IN THE WESTERNMOST MEDITERRANEAN DURING THE LAST 20 KY CAL BP: GEOCHEMICAL PROFILES OF MANGANESE AND REDOX CONDITIONS.

Francisco Jose Jimenez-Espejo [1]*, Francisca Martinez-Ruiz [2], David Gallego-Torres [3] and Tatsuhiko Sakamoto [1]
[1] Institute of Biogeosciences, JAMSTEC, Yokosuka, Japan. - fjjspejo@ugr.es
[2] Instituto Andaluz de Ciencias de la Tierra (CSIC-UGR), Granada, Spain.
[3] Faculty of Geosciences, University of Utrecht, Netherlands

Abstract

The Mediterranean thermohaline circulation plays a major role in the transference of energy between climate and ecosystems. The Levantine Intermediate Water (LIW) is a distinctive water mass that occupies intermediate layers in the entire Mediterranean Sea. Redox sensitive elements can be used in order to reconstruct the physic-chemical changes and the evolution of the LIW during the last glacial peridod. Different paleoceanographical proxies have been studied in three cores from the Alboran Sea and the Mn/Al ratio has been selected to reconstruct redox oscillations associated with redoxcline variations.

Keywords: Alboran Sea, Intermediate Waters, Paleoceanography, Redox

Introduction

The LIW is formed during winter in the Levantine basin and spreads to the entire Mediterranean until reaching the Alboran basin and the Gibraltar Strait. The LIW is essential to the Mediterranean thermohaline circulation and is the main contributor to the Mediterranean outflow (MOW), which has been associated to the recovery of the Atlantic thermohaline circulation and the subsequent end of the past glacial conditions [1].

Main text

Three cores have been analyzed that were recovered at different water depths in the Alboran slope: core TTR-300G (36º 21,532 N,1º 47,507 W 1860 mbsl), TTR-302G (36º 01,906 N, 1º 57,317 W at 1989 mbsl) and TTR-304G (36 º 19,873 N,1º 31,631 W at 2382 mbsl). The studied time interval spans the last 20 ky cal BP.

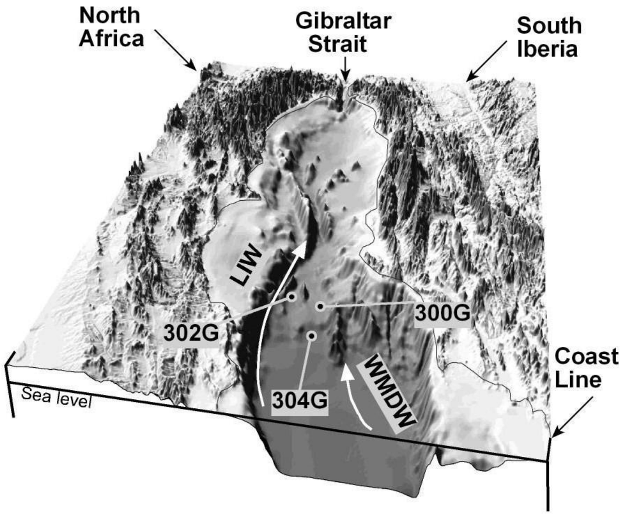

Fig. 1. Bathymetric map of the western Mediterranean showing the location of the studied cores, TTR-300G, TTR-302G and TTR-304G. Arrows represent the main oceanographic currents Levantine Intermediate Water (LIW) and Western Mediterranean Deep Water (WMDW)

The Mn/Al ratio profiles support that that this ratio is highly sensitive to paleoceanographical changes associated to different climate/oceanographic events as the Younger Dryas, the S1 sapropel deposition and the cold event 8.2 (Fig. 2). It is worth mentioning the obtained Mn/Al ratio obtained in the TTR-320G, that clearly records the changes occurred in the easten Mediterranean, as the end of the S1a and S1b sapropel deposition (Fig. 2). This location is therefore of key importance for the reconstruction of the physic-chemical conditions of the LIW when reaching the westernmost Mediterranean. When comparing the analyzed records, the Mn/Al enrichment peaks are not time coincident, especially during certain events such as the Last Glacial Maximum and the Heinrich event 1 (HE1) (Rectangles in Fig.2).

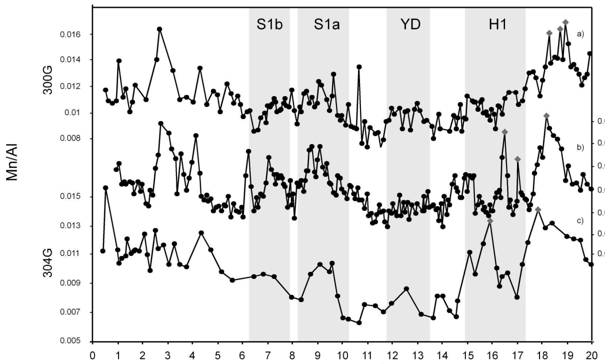

Fig. 2. Mn/Al ratio vs. age plots show profiles from the sallowest to the deepest sites: TTR-300G TTR-302G and TTR-304G. Grey vertical bars indicate Heinrich 1 event (H1), Younger Dryas (YD) and sapropel S1 (S1a and S1b) time intervals. Grey rectangles indicate discussed Mn/Al peaks.

Mn enrichment disparity is especially relevant because it is not observed in others geochemical profiles as as the Ba/Al ratio or the detrital record linked to the Mg/Al ratio [2]. In addition, the Mn/Al peaks are not coincident with the major climatic changes occurred in this region. Instead, the Mn content in these sediments mainly reflects redox conditions in bottom waters, and maximum Mn fluxes have been recognized when changes in bottom waters redox conditions occurred [3]. The most plausible explanation for the described Mn/Al enrichments is the presence of a redoxcline at the studied depths. The redoxcline could have beeen originated in relation to the boundary between the LIW and the WMDW water masses. Our data suggest a redoxcline deepening during the H1, as occurred with the base of the MOW in the Gulf of Cadiz at the same period. During the Last deglaciation and YD the Mn/Al enrichment peaks are no recorded, probably due to major changes in the water column in the WMS that allowed the formation of the Last Organic Rich Layer [3]. During the Middle and Late Holocene newly Mn/Al enrichement peaks are observed, after the ORL deposition, probably linked with WMDW variations associates to Bond cycles.

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References

1 - Voelker A.H.L., Lebreiro S.M., Schönfeld J., Cacho I., Erlenkeuser H., Abrantes F., 2006. Mediterranean outflow strengthening during northern hemisphere coolings: A salt source for the glacial Atlantic? *Earth Planet. Sci. Lett.* 245: 39–55

2 - Jimenez-Espejo F.J., Martinez-Ruiz M., Rogerson M., Gonzalez-Donoso J.M., Romero O.E., Linares D., Sakamoto T., Gallego-Torres D., Rueda Ruiz J.L., Ortega-Huertas M., Perez Claros J.A., 2008. Detrital input, productivity fluctuations, and water mass circulation in the westernmost Mediterranean Sea since the Last Glacial Maximum.*Geochem. Geophys. Geosyst*., 9, Q11U02.

3 - Rogerson M., Cacho I., Jimenez-Espejo F.J., Reguera M. I., Sierro F. J., Martinez-Ruiz F., Frigola J., Canals M., 2008. A dynamic explanation for the origin of the western Mediterranean organic-rich layers. *Geochem. Geophys. Geosyst., 9, Q07U01.*