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SHELF-OCEAN MATERIAL EXCHANGE INFLUENCING THE ATLANTIC CHEMICAL COMPOSITION OFF NW IBERIAN MARGIN SINCE THE LAST GLACIATION

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Introduction

Rivers are the main conduit of sediment to the shelf. The basin geology, the drainage area and the discharge rate are the major factors that determine their sediment load (Milliman and Syvitski, 1992). Besides suspended particles, dissolved components may also give some information on the eroded crust. Sr isotopes in carbonate shells of biological organisms have been used to study, in the geological record, the influence exerted by the chemical weathering of the continental crust on the seawater composition (Macdougall, 1991). In this work, Sr isotope ratios obtained in tests of foraminifera representing the last 40 ka are presented and discussed in the scope of the palaeogeographical evolution of NW Iberia.

Materials and Methods

This work aims to present and discuss the results of Sr isotope analyses (performed, by TIMS, in the Isotope Geology Laboratory of the University of Aveiro) of tests of two species of foraminifera, from nine samples taken along the OMEX core KC 024-19 (181 cm; 42°08' 98"N, 10°29' 96"W, and 2765m), collected in the Galicia Bank area, off Galicia. Taking into account that Sr contained in the carbonate tests is usually considered as preserving the signature of the contemporaneous seawater, one planktonic species (*Globigerina bulloides*) and one benthic species (*Cibicides wuellerstorfi*) were selected in order to try to detect Sr isotope variations both through time and between two different levels of the water column.

The core age model, which records the last 40 ka, is based on a combination of oxygen isotope stratigraphy, eight AMS ¹⁴C datings and the synchronisation of the last four Heinrich Events in the Iberian Margin sedimentary records.

Results

As a whole, the obtained ⁸⁷Sr/⁸⁶Sr ratios vary between 0.709209 and 0.709108, with a mean 2σ error of 0.000025. These values lie within the range of modern marine Sr isotope ratios (0.70910-0.70922), as previously defined using analyses of both seawater and marine carbonates (see compilation by Faure and Mensing, 2005). Despite their small variation, the ⁸⁷Sr/⁸⁶Sr ratios obtained in *G. bulloides* seem to indicate that Sr dissolved in seawater at the KC 024-19 core site became slightly less radiogenic after the Last Glacial Maximum (LGM). This decrease is concomitant with diminishing amounts of the detrital components in the sediments (Fig. 1). Therefore, both the composition of dissolved Sr, as revealed by results on tests of planktonic foraminifera, and the proportions of suspended terrigenous particulate material arriving at the KC 024-19 site point to a decreasing importance of the contribution of the erosion of the Iberian Variscan crust since the Last Glacial Maximum and in the Holocene.

The ⁸⁷Sr/⁸⁶Sr ratios measured in tests of benthic foraminifera (*C. wuellerstorfi*) are more erratic and no correlation can be established with palaeogeographical/palaeoclimatic constraints. The difference between the behaviour of Sr compositions in *G. bulloides* and *C. wuellerstorfi* may indicate that whilst the planktonic foraminifera should reproduce very closely the seawater composition, the benthic organisms should, in addition to the major role of seawater, also be affected by some sort of interaction with the sediments. As such, planktonic foraminifera are probably more reliable indicators of seawater composition in studies involving very small periods and corresponding very slight variations of the ⁸⁷Sr/⁸⁶Sr ratios.

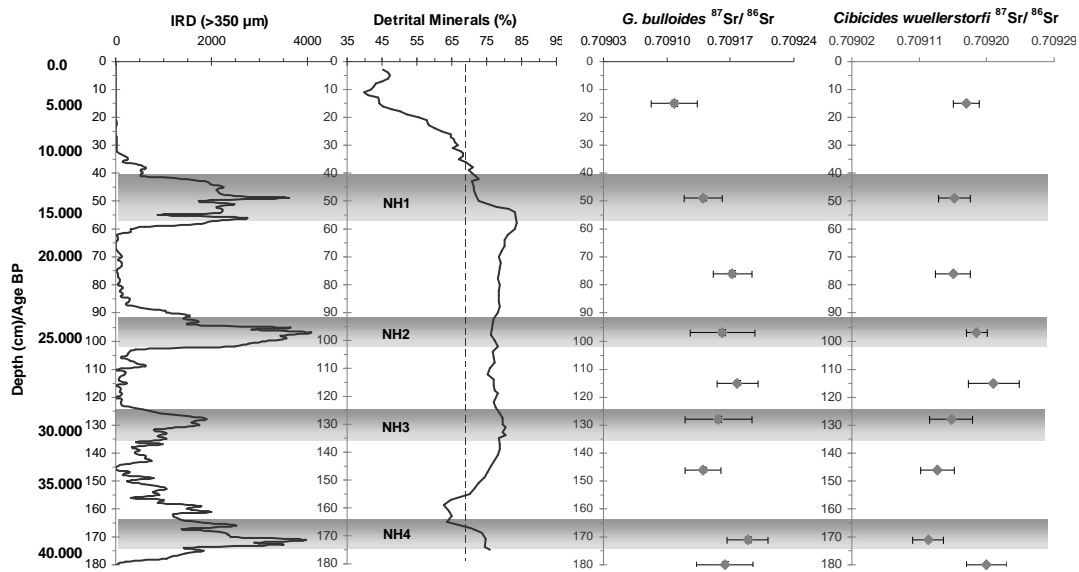


Figure 1 – $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in tests of foraminifera compared with the variation of the amount of detrital component and the occurrence of IRD events.

Discussion and Conclusions

Taking into account that *G. bulloides* is a common planktonic species (living mostly in the first 50m of the water column), whose tests seem to be in equilibrium with sea water composition, variations in its $^{87}\text{Sr}/^{86}\text{Sr}$ ratios can be related with changes in the chemical composition of the water of the Atlantic Ocean off NW Iberian Margin.

The highest $^{87}\text{Sr}/^{86}\text{Sr}$ values are contemporaneous with a period of low sea level (about -140 m; Dias et al., 2000) during the LGM. According to Dias et al. (2000) at 18 ka BP the shoreline was close to the shelf break. The summital parts of the Gerês and Estrela mountains were covered by local glaciers and close to the coast freezing occurred frequently. The river catchments, which extended far to the shelf, received more rainfall due to a longer, compared to present day conditions, wet season, which promoted both physical and chemical weathering. Higher pluviosity combined with the effect of spring ice melting maintained high river discharge and consequently caused very important sediment supply to the coastal zone. The extremely narrow shelf was a very energetic environment due to sea bottom inclination and very limited long wave refraction. Therefore, at that time, a long wet season and very competent rivers should have caused important erosion of the Variscan basement in NW Iberia. Additionally, then, the shoreline was much closer to the KC 024-19 site. The combination of all these factors favoured an important deposition of terrigenous sediments and the local slight enrichment in radiogenic Sr of the seawater.

With sea level rise, after the deglaciation and during the Holocene, the river estuaries became progressively far away from the shelf break. Their competence of transport also became progressively reduced and the offshore transport of detrital sediments became progressively lower. Conversely the biogenic carbonate proportion in the sediments increased, due to lower dilution by the terrigenous particles. Simultaneously, the values of $^{87}\text{Sr}/^{86}\text{Sr}$ in the seawater at the KC 024-19 site became lower, as a consequence of a complete homogenization with the ocean global composition, which was now more effective with the increasing distance towards shoreline.

References

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