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Rock magnetic parameters and Sr-Nd isotopes as tracers of continental erosion in Red Sea and in Gulf of Aden during the last 20,000 years

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Over the past 20,000 years earth climate has undergone important changes that include the transition from the last glaciation to the Holocene with the retreat of glaciers, the modification of atmospheric circulation systems and hydrologic regimes. The production and transport of matter into the ocean was influenced by these variations in climatic conditions. In this study we considered the Red Sea and the Gulf of Aden as basins that offer a particular geographic and geological setting and that could be of interest in understanding climate variations and their effects in local erosion. The study of two cores in each side of the Bab-el-Mandeb strait (MD 92-1002 in the Gulf of Aden and MD 92-1008 in the Red Sea) allows the comparison between the open ocean and a more isolated basin. Additionally, this is an intertropical region influenced by African and Asian monsoons whose intensities can vary depending on climate and wind patterns.

Erosion and matter transfer from the continents to these basins in response to climate changes can be studied using different approaches including rock magnetism, sedimentology and radiogenic isotopes. Neodymium isotope ratios (expressed here in εNd) are a useful tracer of oceanic sediments sources and type of transport and can be used as a signature of specific water masses. The main sources of Nd in oceans are fluvial and eolian inputs originated from the erosion of the continental crust.

We measured εNd values in both cores of the silicate and carbonate phases, which correspond respectively to detrital and dissolved Nd. We observe differences between the isotopic records of the two basins. In the Gulf of Aden detrital and dissolved εNd values show large changes linked to the Glacial-Interglacial transition, in agreement with other studies in the equatorial Indian Ocean. Both signals decreased by 1.5 εNd units between the LGM and the Holocene. By comparing these results with those from the Red Sea, we observe a less clear decrease in εNd values (0.5 εNd units for the detrital fraction), reflecting the greater communication of the Gulf of Aden basin with the open ocean.

Variations in the detrital εNd values suggest a change of the eolian particles source from the Sahara region during glacial periods, to the Arabian-Nubian shield during interglacial periods. An increase of the dissolved εNd values in both basins between 15 and 10 kyr indicates an intensification of precipitation in this region and, as a consequence, a preferential alteration of the basaltic terrain.

The εNd data are compared with magnetic susceptibility and magnetic mineralogy data in order to discriminate between influences of continental erosion and weathering, and redox conditions in the basins during the considered period of time. We found an overall covariation of magnetic parameters with the detrital εNd and sea water εNd of both cores except for the H1 event in the Gulf of Aden.

Strontium isotope measurements of the detrital fractions are in progress to constrain the origin of the sources.