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Constraints on the neodymium (Nd) oceanic cycle in the Mediterranean Sea using a high resolution coupled model

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Neodymium isotopic composition (Nd IC) is a tracer of oceanic circulation and lithogenic inputs to the ocean.

An extensive compilation of published Nd isotopic values was realized in order to establish a database and a map of Nd and Nd concentrations characterizing all the Mediterranean margins. This was built based on different kinds of samples: riverine solid discharge deposited on the shelf, sedimentary material collected along the margins and geological material above or close to an oceanic margin (following Jeandel et al., 2007). The margin Nd isotopic signatures vary from non-radiogenic values around the Gulf of Lions (Nd IC values between -11.5 and -10), to radiogenic values around the Aegean and the Levantine sub-basins (Nd IC up to +6). Such West-East variation was also observed in the seawater data, which are becoming more radiogenic along the eastward circulation in the Mediterranean Sea (Tachikawa et al., 2004). The Nd budget proposed by these authors raised the hypothesis that the exchange of Nd along the margins could play a significant role in driving the oceanic distribution of this tracer.

On a more global scale, it was further demonstrated and modelled that dissolved/particulate exchanges between continental margin sediments and open ocean (termed boundary exchange, BE), could be the dominant source-sink terms that determine the distribution of neodymium isotopes in the global ocean (Lacan and Jeandel, 2005a, Arsouze et al 2009). But this global scale study with it low-resolution configuration ORCA2 (2° of horizontal resolution) could not resolve many local and regional-scale features

Our purpose is to test this hypothesis for the first time in the Mediterranean Sea by using a high resolution regional coupled model (1/12° of horizontal resolution). In a first approach we considered that boundary exchange is the only term governing Nd distribution in the Mediterranean Sea (other sources have been neglected). This aimed to validate the "Boundary Exchange" hypothesis as the main source/sink term of Nd to the oceanic reservoir. Coupling the circulation with a detailed biogeochemical model is currently ongoing.

The Boundary Exchange is parameterized using a first order relaxation equation towards the Nd Isotopic composition of the margins. We also investigated the impact of the inter annual variability of the circulation of the Mediterranean Sea on the distribution of the Nd oceanic isotopic composition, focusing on observed events such the Eastern Mediterranean Transient (EMT) or the Western Mediterranean transition (WMT).