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Simulation of the Oceanic Nd Isotopic Composition with the ORCA Model

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Since the end of the eighties, it is recognized that the Nd isotopic composition (expressed as ε_{Nd}) varies from ca -13 in the North Atlantic to ca -4 in the Pacific. It has been clearly established that far from any source of lithogenic material, ε_{Nd} is a conservative tracer of water mass mixing (Piegras and Wasserburg, GCA, 1987; von Blankenburg, Paleoceanogr. 2001, Lacan and Jeandel, GRL, 2004). Since deep water ε_{Nd} values are imprinted in metalliferous sediments, they are used by paleoceanographers to reconstruct past variations of the thermohaline circulation. However, several studies conducted in the present day ocean highlight that the Nd budgets involving only dust and riverine inputs were unable to reconcile the Nd concentration and isotopic composition variations between the 3 oceanic basins (the "Nd paradox"). The "missing source", often suspected to be the oceanic margins, was quantified only recently (Lacan and Jeandel, EPSL, 2001; 2005; Tachikawa et al, JGR, 2003): In situ measurements, within water masses flowing along continental margins constrain the occurrence of exchange fluxes between the water masses and the sediments. In order to assess the importance of this exchange at the margins in the oceanic Nd cycle, we propose here results of modelling of the Nd oceanic distribution (concentration and isotopic composition). For doing that, we first compiled about 250 ε_{Nd} signatures of the world continental margins and then interpolated them using a numerical world geological map, allowing to characterize the input fluxes of Nd to the ocean (exchange term). The large scale circulation model ORCA (LODyC) is used to simulate the transport (advection-diffusion) of the tracer within the ocean. Simulated distributions of the tracer Nd are compared to the present-day data base, on global and regional scales. Futher developments will be to couple the biogeochemistry model (PISCES, Aumont et al., GBC, 2003) to ORCA, to better constrain the Nd oceanic scavenging.