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Evolution of the Neodymium isotopic ratio of the Indian Ocean seawater during the Cenozoïc

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Neodymium isotopic composition in old marine sediment is a powerful proxy to investigate past ocean circulation. Because its residence time is short (200-1000 yr), Nd is not isotopically homogenized in the global ocean. Consequently, isotopic composition in the each ocean has varied as a function of changes in paleocirculation, source provenances, intensity of weathering on the continents, as well as orogenic processes. Sedimentary cores have the advantage on Fe-Mn crusts to have a good chronology based on Bio and Sr stratigraphy. When appropriate leaching is performed on sediment, the analysis of Nd isotopes reflects the one of seawater and therefore gives information about the past ocean.

We have applied this technique for reconstructing the Indian Ocean Cenozoïc paleo oceanography. Due to the rise of the Himalayan chain on the border of the Indian Ocean, the Nd isotope in this ocean present a paradox. Previous data from Mn-Fe crusts (SS663 and 109D)[1] show relative uniform εNd value between -8 and –7 in the Indian ocean over the last 20 Ma. This is surprising because on one hand Nd isotopic signal is usually coherent within each large ocean as shown by Fe-Mn crusts and on the other hand the Sr and Os isotopes, which reflects the global ocean evolution due to their long residence time, both show that the largest event for the past 30 Ma is the collision of India and Asia with the formation and the erosion of the Himalayas. In addition, the study of Nd isotopic values of the detritic material coming from the Himalayas, cored in the Bengal Fan [2] shows εNd(0) values which are in a very narrow range around –16.

We have analysed both the seawater and the detrictic Nd isotopic compositions in marine sediments from ODP 121 site 758. This site is located at the northern end of

the Ninetyeast ridge (2925 m water depth), in the North East Indian Ocean, and lies about 1000 m above Bengal fan.

Using plate tectonics reconstruction, one can see that this location has two interesting characteristics. First it has drifted toward the north on the Indian plate for more than 5000 km in 70Ma but the distance to the Indian continent stayed almost the same through time.

We were able to reconstruct the evolution of the deep seawater and the detritic signals. The detritic signal clearly reflects the increasing influence of the Himalayan input with the movement of the site to the North. The seawater signal also shows this indication but with much smaller variations. In addition, the seawater signal seems to be modulated by climatic fluctuations in the recent period [3]. We have also studied a second site 2000 km to the South (ODP Site 757).

Using the results of both sites in conjunction with Fe-Mn crust data, we have tentatively put constrains on the paleocirculation of the Indian Ocean through time. Comparing those results with the curve of Sr isotopes in seawater, we support the idea that the increase of radiogenic Sr in seawater was produced by an increase of the isotopic ratio of the flux rather by an intensification of chemical erosion.

[1] R.K.O'Nions et al., 1998, EPSL, 155, ; [2] C.France-Lanord et al., 1990, Himalayan Tectonics, 74 ; [3] K.W. Burton and D. Vance, 2000, EPSL 176,