Goldschmidt 2000
September 3rd–8th, 2000
Oxford, UK.

Journal of Conference Abstracts
Volume 5(2), 1056

The Distribution of Lead Isotopes in the Indian Ocean

I. Vlastélic (ivan@mpch-mainz.mpg.de), **W. Abouchami** (wafa@mpch-mainz.mpg.de), **S. J. G. Galer** (sjg@bongo.mpch-mainz.mpg.de), **C. Claude-Ivanaj** (ivanaj@mpch-mainz.mpg.de) & **A. W. Hofmann** (hofmann@mpch-mainz.mpg.de)

Max-Planck-Institut für Chemie, Postfach 3060, D-55020 Mainz, Germany

We report high precision Pb isotope data (2σ=100 ppm) on Fe-Mn deposits from the Indian Ocean basin. The analyses were performed on surface scrapings (N 1 mm) of forty-two Fe-Mn nodules and crusts using a Pb triple spike technique to correct for instrumental mass fractionation. Nd isotope data from these samples were previously reported by Albarède et al. (1997). The aims of this study are: first, to provide a detailed map of Pb isotope distribution in the Indian Ocean; second, to evaluate the relationships between Pb isotopic variations in the Fe-Mn deposits and the pattern of deep water circulation; and third, to characterize the sources of Pb - particularly, given the contradictory conclusions reached in previous radiogenic isotope studies concerning the role of Himalayan erosion products in the elemental budget of the Indian Ocean. The Pb isotope data exhibit large variations with a total range of 18.10 to 19.00, 15.55 to 15.73 and 38.17 to 39.25 for the $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios, respectively. Two groups of samples can be distinguished: (1) A small subset of samples located in the vicinity of the Indian ridges shows a marked hydrothermal influence. (2) The remaining, majority of samples show a Pb isotopic distribution that is clearly geographically controlled, and most likely reflect that of the local deep water masses involved. For example, the highest $^{207}Pb/^{204}Pb$ and $^{208}Pb/^{204}Pb$ ratios are found in the north of the Central Indian basin; there is also a progressive North-South decrease in $^{208}Pb/^{206}Pb$ ratios which vary from 2.077 in the Somali basin (at ~5 ºN) to 2.061 at about 60 ºS in the Australian-Antarctic basin. This Pb isotopic provinciality translates into three distinct, tightly constrained linear arrays in Pb isotope space (with the exception of a few samples from shallow depths). Each of these arrays corresponds to a different geographic province, delimited by latitude: (1) north of 20 ºS, (2) between 20º and 50 ºS, and (3) and south of 50 ºS. The arrays south of 50 ºS and between 20 ºS and 50 ºS are consistent with the "A-Indian" and "Indian" Pb isotopic arrays identified by Abouchami and Goldstein (1995). We interpret these linear Pb isotopic arrays as binary mixing lines, with each line requiring two distinct end-members. The presence of three mixing lines implies that several sources -whether these be Himalayan inputs (Frank et al., 1998) or the Antarctic Circum-Polar current (Albarède et al., 1997)- contribute Pb to the Indian ocean. The large Pb isotopic variations observed in these Fe-Mn deposits contrast with their nearly homogeneous ε_{Nd} values of -8, which have been attributed to the incursion of the Antarctic Circum-Polar current (Albarède et al., 1997). The difference in Pb and Nd isotopic distribution may be, in part, related to the longer ocean residence time of Nd (10^3yrs) relative to that of Pb (80-100 yrs). South of 20 ºS, North Atlantic Deep Water (NADW) plays an important role in the Pb budget, with some influence from local continental sources in the vicinity of southern Africa. North of 20 ºS, there exists a distinct highly radiogenic source of Pb which may be derived from the lesser Himalayan formations south of the Indus-Sangpo suture zone and the Indian shield, as supported by Pb isotopic compositions of suspended loads from the Ganges and Brahmaputra rivers (Galy et al., 2000). The Pb isotopic signature found in the Central Indian basin is more radiogenic than that in the Somali basin. This difference may result from interaction with sediments: Bengal fan sediments propagate southward into the Central Indian basin, while Indus sediments are topographically confined within the Arabian basin and do not reach the Somali basin. The distribution of Pb isotopes in the Indian ocean appears to be consistent with the distribution of deep water masses. The geographic boundary at 20 ºS seen in Pb isotopes coincides with the northernmost influence of NADW in the Indian ocean, based on silica and oxygen contents. North of this 20 ºS boundary, North Indian Deep Water is characterized by more radiogenic Pb isotope compositions. The Pb isotopic boundary at 50 ºS corresponds to the incursion of Antarctic Bottom Water into the Indian Ocean.

Abouchami, W & Goldstein SL, *Geochim. Cosmochim. Acta*, **59**, 1809-1820, (1995).

Albarède F, Goldstein SL & Dautel D, *Geochim. Cosmochim. Acta*, **61**, 1277-1291, (1997).

Frank M & O´Nions RK, *Earth Planet. Sci. Lett*, **158**, 121-130, (1998).

Galy A, Frank M, O'Nions RK & France-Lanord C, *in prep*, (2000).