Himalayas uplift and Indonesian Island Arcs activity recorded in the Equatorial Indian Ocean water: Pb and Nd isotope stratigraphy

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During the last 40 Myr, the Indian Ocean has undergone larges changes in response to the reorganization of tectonic plates. The Australian block moved northward opening the Tasman Strait in the south, closing the Indonesian Passage, and creating multiples actives volcanic arcs in the Equatorial region. The Thethys disappeared closing the connection between the Indian Ocean and the Atlantic at low latitude. The collision of the Indian and Asian blocks yielded the rise of the Himalayan Chain and the Tibetan Plateau.

The Indian Ocean circulation and its chemistry were largely affected by the modification of the connection with the other oceans. The chemistry also responded to changes in the sources of chemical elements as well as the changes of the erosion rate of these sources.

Nd isotope stratigraphy performed on carbonated sediments from the ODP Sites 707, 757 and 758 in the Equatorial Indian Ocean has shown the initiation at ≈14 Ma of a strong westerly oceanic current that durably linked the eastern and the western Indian Ocean. This current was refered as the MIOJet (Miocene Indian Ocean Equatorial Jet) [1].

We also determined the Pb isotopic composition and concentration of the past seawater over the last 40 Myr by analyzing the sediment at these three ODP Sites. The Pb isotope records show more complex patterns linked to the fact that Pb has a much shorter residence time than Nd and thus is more sensitive to local or regional inputs. By contrast with the Nd records, the influence of the Himalayan surrection is clearly observed in the Pb records over the past 30 Myr. In conjunction with the emergence of the MIOJet, which is also observed from the Pb isotope records, the Pb concentration largely increased in response to the weathering of the rocks from the newly developed volcanic arcs in the Indonesian region.

[1] Gourlan *et al*., 2008 *Earth Planet. Sci. Lett*, **267**, 353-364

Degassing of sulfur from MORB: Evidence from popping rocks

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Virtually all mid-ocean ridge basalts (MORB) erupt saturated with sulfide melt, as shown by the immiscible sulfide blebs they contain and their linear trend on a plot of FeO *versus* S [1]. We show that glasses from popping rocks have dissolved Sulfur (present as S^{2-}) contents that are low for their FeO content compared to N- and E-MORB. So-called popping rocks are highly vesicular E-MORB that ascended to the seafloor rapidly from great depth, without two-phase separation and loss of volatiles [2]. Vesicles contain predominantly CO_2 [2] as expected from degassing models [3]. This study includes two popping rocks: one is from 14°N on the MAR [2] and the other is from Explorer Deep, in the NE Pacific [4]. EMORB are expected to have high initial CO_2. In contrast to popping rocks, typical EMORB erupt with low vesicle contents, because they have lost large amounts of CO_2 bubbles during slower ascent in the mantle and crust [2]. The CO_2 content of vesicles in popping rocks estimated from the vesicle abundance and eruption depths are: 17% vesicles for 2∏D43 at 2300 meters suggests 1.4% CO_2 [2]. 48% vesicles for 79-6-32-1 at 2500 meters suggests 3% CO_2. Dissolved CO_2 left in the glass is only 0.012%. The remarkable vesicularity and low Sulfur in popping rocks must be related. We suggest that the low Sulfur in popping rocks is related to a negative pressure dependence of the partitioning behavior of S into a CO_2 rich vapor, as shown by experiments [5] for andesites at higher P. Typical EMORB lose a CO_2-rich, S-poor vapor at higher P, so they arrive at the seafloor with little CO_2 to carry away S. Popping rocks retain CO_2 to low pressure at which point S partitions into bubbles and is lost from the liquid. The S/CO_2 ratio in the gas, calculated from the S deficiency relative to the FeO *vs* S line for MORB, is 0.014 for popping rocks. Measured S in vesicles is low [2] because SO_2 gas reacts with Fe to form sulfides that decorate vesicle walls [6]. CO_2/S ratios for Reykjanes MORB, estimated from vesicle size and sulfide abundance on vesicle walls [6] are similar to our estimates.

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