

Distribution of dissolved neodymium and ϵ_{Nd} in the Bay of Bengal

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The concentrations and isotope composition of dissolved Nd have been measured in the water column along 87°E transect in the Bay of Bengal to investigate the impact of water mass mixing and desorption of Nd from particulates in determining their distribution in the Bay. The concentration of Nd in surface waters of the BoB shows a North-South decreasing trend (~ 46 to ~ 22 pmol/kg) with increasing salinity, whereas its depth profiles typically show a high value in surface waters, a minimum (~ 15 to ~ 23 pmol/kg) in shallow subsurface (~ 50-200 m) followed by a gradual increase with depth. The Nd concentration of the BoB waters is generally higher than that at corresponding depth in nearby oceanic basins. The ϵ_{Nd} of the northern BoB waters ~ -15 ± 1 overlaps with that of dissolved and particulate phases of the Ganga-Brahmaputra (G-B) Rivers, but less radiogenic than those reported for other regions of global oceans, except the Baffin Bay and the North Atlantic Subpolar Gyre. The abundance and distribution of dissolved Nd and its unradiogenic isotope composition suggests that the dominant source of Nd in the BoB is the dissolved and/or particulate phase of the G-B river system.

The ϵ_{Nd} values in the BoB show greater variation in the upper water column with more radiogenic values ~ -8 in surface waters of the southernmost profile (~ 6°N), which decreases to -15 in the northernmost profile (~ 20°N). This latitudinal trend is most likely a result of the variation in mixing proportion between the Indonesian Throughflow surface waters (IW) and the G-B river water. Inverse model calculations suggest that excess Nd of the order of ~1 to 65 % of measured Nd concentration is required from other source(s) in addition to various water masses. The calculations also show that ϵ_{Nd} of the additional source(s) has to be in the range of ~ -16 ± 2, typical of G-B river sediments. These observations coupled with the North-South distribution of dissolved Nd and ϵ_{Nd} indicate that this additional source is release from particulate phases supplied by the G-B river system and the continental margin sediments. This study underscores the significant role of dissolved/particulate Nd from the Ganga-Brahmaputra river system in contributing to the dissolved Nd budget of the global ocean.

LA-MC-ICPMS iron isotopic measurements of zoned olivine

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Previous studies have revealed that iron and magnesium isotopes may be used to identify diffusion-driven zoning in olivine crystals [1-3]. In magmatic systems, Mg-rich olivine is an early crystallizing phase. As the melt evolves, it becomes more Fe-rich, so that in reaching equilibrium, Fe diffuses into and Mg diffuses out of the initial olivine crystal. Because light isotopes diffuse faster than heavy isotopes [4-5], such diffusion-driven mechanism is accompanied with 1) a negative correlation of Fe and Mg isotopes, and 2) a negative correlation of Fe isotopes and a positive correlation of Mg isotopes with Fo#. Teng et al. [1] showed these correlations in olivine fragments from Kilauea Iki lava lake. Sio et al. [3] used microdrilling techniques to spatially resolve the same correlations in a single olivine crystal.

Many zoned olivine crystals are smaller than or comparable to the size of a drill bit (300 µm used in [3]). Hence, it is imperative to develop *in-situ* techniques that provide better spatial resolution. Using a UP193HE laser, we conducted LA-MC-ICPMS iron isotopic measurements on the same sample analyzed in [3]. The spot sizes used in the sessions were 40-55 µm, an improvement of lateral and depth spatial resolution by approximately an order of magnitude relative to microdrilling. Smaller spot sizes may be used if ⁵⁷Fe is not analyzed.

Numerous tests were conducted to evaluate sample mount orientation and matrix effects. These tests suggest that the orientation effect must be carefully evaluated in order to obtain accurate data and true errors, which can be three times greater than the error taken only from measured isotopic variations on a single crystal. The typical precision is 0.2 ‰ (1 SD) based on repeat analyses of the same profile. The final iron isotopic profile agrees with the microdrilling results, with the rim at $\delta^{56}\text{Fe}$ -0.2 ‰ and the core at -1.2 ‰. A plot of $\delta^{56}\text{Fe}$ versus Fo# is also in perfect agreement with microdrilling data.

LA-MC-ICPMS provides the means to measure iron isotopic compositions with high spatial resolution in olivines. Such techniques can be employed on zoned crystals to better understand their crystallization and cooling histories. Our work establishes LA-ICPMS Fe isotopic analyses as a powerful tool of petrology in the study of igneous zoned minerals.

[1] Teng *et al.* (2011) *EPSL* **308**, 317-324. [2] Dauphas *et al.* (2010) *Geochim. Cosmochim. Acta* **74**, 3274-3291. [3] Sio *et al.* (2011) Goldschmidt Abstract 1884. [4] Richter *et al.* (2009) *Geochim. Cosmochim. Acta* **73**, 4250-4263. [5] Roskosz *et al.* (2010) Goldschmidt Abstract A882.