Seawater alteration of Central Indian Ocean Ridge basalts: Geochemical and Isotopic evidences.

DILEEP REDDY[1]*, SRIDHAR.D.IYER[2], S.BALAKRISHNAN[1], RAJNEESH BHUTANI[1]

[1]Dept. of Earth Sciences, Pondicherry University, 605014, Puducherry,India (*email: dilu.abc9@gmail.com)
[2]formerly at CSIR-NIO, Dona Paula, Goa, 403004, India

Alteration of the Central Indian Ocean Ridge (CIR) rocks is a major geological process affecting both the seawater and the rock, precipitation of Fe-Mn crust and nodule and eventually recycling elements to mantle through subduction zones. We report mobility of elements between seawater and CIR basalts during alteration through changes in elemental abundances and isotopic composition.

Based on textural, compositional and geochemical parameters, the CIR Basalts are categorized as fresh, partially altered and altered rocks [1]. Rapidly cooled pillow basalts show concentric zoning with least altered inner zone. Least altered basalts are composed of labradorite, augite and minor amounts of forsteritic olivine whereas, altered basalts have abundant clinochlore and quartz. Mn, Co and Ni are mobilized by seawater during alteration. Fresh basalts have flat MORB-normalized REE patterns but partially altered and altered basalts are LREE enriched relative to HREE as evidenced by increasing La/Yb ratios of 1.33, 2.07 and 2.83 with extent of weathering. La/Yb in outer altered zone and inner least altered zone is 3.30 and 1.67 respectively, in the zoned basalts. Alteration of pyroxene leads to the HREE depletion. Outer zones have higher concentration of LREE than inner zones due to precipitation of secondary minerals and exchange with seawater. Altered basalts show positive Ce and negative Gd anomalies.

Change in $^{87}Sr/^{86}Sr_i$ is a significant evidence for basalt alteration by seawater as it is independent of element partition in secondary phases [2]. $^{87}Sr/^{86}Sr_i$ of fresh basalts ranges between 0.703010 and 0.703471, as in typical MORB [3]. Altered basalts have $^{87}Sr/^{86}Sr_i$ as high as 0.708488 which is close to the present day seawater (0.709211) [4]. $^{87}Sr/^{86}Sr_i$ of 0.706201 of outer altered zone is skewed towards seawater and correlated postively with Ce anomaly. These results would help to quantify mass-exchange between slow-spreading ridge and the seawater.

[1] Kelley et al. (2003) G^3 **4,** 6.
[2] Staudigel et al. (1981) EPSL **52,** 311-327.
[3] Sano et al. (2004) Proc. ODP **191,** 1-11.
[4] Elderfield (1986) PPP **57,** 71-90.