Melt-rock reaction in gabbroic rocks from the Central Indian Ridge and the influence on MORB

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The composition of mid-ocean ridge basalts (MORB) is controlled by various processes within the crust before they erupt to seafloor. Melt-rock reaction in the lower crust is considered to be widespread in mid-ocean ridges, but the influence on the composition of MORB is poorly known.

We performed petrographic and geochemical investigations on gabbroic rocks and erupted lavas dredged from a segment of the Central Indian Ridge (7°50'-8°25'S). Gabbroic rocks contain various reaction textures in a wide range of scales. The evidence includes olivine and plagioclase dissolution textures, brown amphibole blebs in a large clinopyroxene grain and clinopyroxene oikocrysts patches in gabbros and troctolites. Melt-rock reaction causes changes in mineral modes, hence in lithology. Olivine and plagioclase are replaced by clinopyroxene and secondary plagioclase.

Geochemically, fractionation indices for clinopyroxene show poor inter-correlations. Incompatible trace elements of clinopyroxene are not only over-enriched but also more fractionated than those predicted by fractional crystallization. These incompatible element over-enrichment and fractionation trends are related to zoning and textures of clinopyroxenes and their locations in the vicinity of the contact between the two different lithologies. It should be noted that the melt-rock reaction appears to be accompanied by fractionation of plagioclase because enrichement and fractionation of trace elements increase with increasing Sr- and Eu-negative anomalies. These results suggest that melt-rock reaction occurs within the lower crust at a segment in the Central Indian Ridge.

Trace element ratios of MORB from the study area have a strong correlation with Sr-anomaly, which cannot be reproduced by fractional crystallization only. AFC modeling in various conditions can explain the observed trace element ratios in MORB. Thus, we suggest that the MORB composition is affected by melt-rock reaction in the lower oceanic crust.