

Origin of heterogeneity of basalt compositions along SWIR

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Regional variations of basalt compositions along the eastern part of the Southwest Indian Ridge (SWIR) were discussed by Natland (1991), Robinson et al. (1996), Meyzen et al. (2003). In this study, we reexamined the regional variations of basaltic compositions and discuss on the genesis of the heterogeneity from longitude 55 degree (east of Atlantis II F.Z.) to 70 degrees east (Rodriguez Triple Junction). According to distinct geochemical signatures, we classified study area into 4 areas; Area I: 68E to RTJ (70E), Area II: 60E to 68E, Area III: 57E to Melville F.Z. (60E) and Area: IV 55E to Atlantis II F.Z. (57E). We analyzed major and minor element compositions of basalts obtained from 2 areas of the study area using by XRF and ICP-MS. These results and PETDB data are used to examine the regional variation.

Major element variations show that the basaltic rocks from Area I, II and III show different trends, respectively. Especially, basalts of Area II show different characteristics from other areas, as shown by higher Na₂O and Al₂O₃ contents, and lower TiO₂ contents than the other areas. Basalt compositions of area IV are similar to Area III. The basalts of Area I, near RTJ, were formed by the past volcanic activity at SEIR (Southeast Indian Ridge) and CIR (Central Indian Ridge), and not by the current activity at SWIR (Honsho et al.,1996). To eliminate the effect by fractional crystallization, we calculated Na₈ and Fe₈. There is a positive correlation between Na₈ and Fe₈ for the basalts from Area II to IV. Calculated degrees of partial melting (wt%) are 8-10% for Area II, 10-15% for Area III and 11-17% for Area IV. Assuming the same uniform mantle source for the study area, this result indicates that the basalts of Area II are derived by the lowest degree of partial melting at shallowest depth in study areas.

Were Area II basalts formed at low degree of partial melting from the same source? If this is correct, TiO₂ contents of the Area II basalts should be higher than others. However, the TiO₂ contents are apparently lower than others.

Considering minor element compositions, the basalts of Area II exhibit most depleted REE pattern, Area III shows high REE concentrations, and Area IV is intermediate. Generally, REE contents decrease with increasing degree of melting. The most depleted REE signatures of the Area II basalts are clearly inconsistent with a low degree of partial melting inferred from high Na₈ value. Therefore, the geochemical signatures of Area II are not simply explained by different degree of partial melting. It is likely that the source mantle producing the basalt of Area II are significantly different from other areas, characterized by highly depleted signature but by abnormal high Na₂O contents.