Relationship between oxide gabbros and felsic rocks from IODP Hole U1473A: Implications for the late-stage evolution of the MORB at ultraslow spreading Southwest Indian Ridge

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Constructive plate margins including mid-oceanic ridges are the most important sites of magma generation volumetrically. International Ocean Discovery Program - Hole U1473A was drilled on the summit of Atlantis Bank, Southwest Indian Ridge brought back an excellent opportunity to study the lower oceanic crust at the ultra-slow spreading ridges. Core samples recovered from the hole include mainly gabbroic rock dominated by the olivine gabbro, lesser amounts of oxide (bearing) (olivine) gabbro, and minor troctolitic gabbro and felsic rock.

Oxide gabbros often show disequilibrium texture between Fe-Ti oxides and silicate minerals, containing clinopyroxenes with high Mg# (70-90) but rich in REEs as those of the brown amphibole in the felsic veins. These features could not be explained by simple fractional crystallization. The characteristics of melt trace-REE patterns reconstructed from clinopyroxenes in most gabbroic rock types were compared with perfect fractional crystallization model; results may suggest the lack of a large volume of melts with intermediate compositions. On the other hand, the melt HFSE-REE patterns in equilibrium with the brown amphibole in oxide gabbros show unusual Eu and HSFE (Zr, Hf, Ti) signals compared to those in the felsic rocks. These observations might suggest another differentiation mechanism of the MORB in addition to fractional crystallization is required.

The comparison among possible mechanisms (i.e., hydrous partial melting, Reactive Porous Flow, fractional crystallization, and liquid immiscibility) occurring at the late-stage evolution of the parental MORB points to the immiscible melt hypothesis. The oxide gabbros might be composed of primitive gabbro cumulates with the addition of apatite, Fe-Ti oxides from percolating Fe-Ti oxide rich melts that intimately related to the formation of felsic rocks.

Keywords: IODP-Hole U1473A, Atlantis Bank, oxide gabbro, felsic vein, MORB evolution