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Permo-Triassic high-grade metamorphism recorded in metamorphosed bauxites from the Red River shear zone, Vietnam

Nobuhiko Nakano^{1*}, Yasuhito Osanai¹

¹Kyushu Univ.

The Red River shear zone is left-lateral shear zone caused by collision of the Indian subcontinent to the Eurasian continent at the Tertiary. Although most metamorphic rocks were reset by the deformation, recent chronological works have revealed presence of the former Permo-Triassic thermal event. However, the details of such thermal event are obscure. Here, we report metamorphic evolution and the age of aluminous granulite from the shear zone.

The whole rock chemistry of the granulites is extremely rich in Al_2O_3 (36.7-50.9 wt%), TiO_2 (5.5-13.0 wt%), and $\text{Fe}_2\text{O}_3^{\text{total}}$ (24.9-35.3 wt%) and poor in SiO_2 (7.9-24.1 wt%), MgO (0.5-1.0 wt%), Na (75-258 ppm analyzed by ICP-MS), and K (mostly lower than 100 ppm analyzed by ICP-MS). HFSEs and REEs also show high concentrations (e.g., Ga, 37-74 ppm; Y, 41-102 ppm; Zr, 367-724 ppm; Nb, 44-99 ppm; La, 43-187 ppm; Ce, 90-357 ppm; Pr, 10-38 ppm; Nd, 45-172 ppm; Sm, 10-37 ppm) whereas LILEs are depleted (Rb, 0.3-4.6 ppm; Sr, mostly <30 ppm; Ba, mostly <15 ppm). These features strongly suggest that the protolith of the aluminous granulites is lateritic bauxite.

The granulites commonly contain garnet, corundum, sillimanite, hercynite, and ilmenite with minor monazite, apatite, and zircon. Garnet includes kyanite, staurolite, ilmenite, siderite, and rutile. Kyanite, staurolite, siderite, and rutile are not observed in the matrix and they appear only as inclusion phases. Ilmenite occurring in the matrix contains sillimanite inclusions. Based on the petrographical observations and isochemical phase diagram using whole rock chemistry suggests former eclogite-facies (>1.8 GPa at 790 C) metamorphism and subsequent decompression under granulite-facies condition (>1000 C at 1.5 GPa).

In-situ U-Pb zircon dating was carried out using LA-ICP-MS system, Kyushu University. Based on the CL image, zircon is commonly zoned and sometimes contains dark core portion. Preliminary result is that there are several $^{206}\text{Pb}/^{238}\text{U}$ ages (including discordant ages) from the Permian to Tertiary but the Tertiary ages were obtained only from zircon occurring in the matrix. Permian-Triassic ages (265-230 Ma) were mostly detected from the dark core and some are from zircons included in garnet. Only the dark core includes large number of high-density (Ave. 1.15 g/cm^3) CO_2 fluid inclusions. Garnet, corundum and staurolite also contain CO_2 fluid inclusions and their densities are also high (Ave. 1.00 g/cm^3 , 1.07 g/cm^3 and 1.09 g/cm^3 , respectively). These features strongly suggest that the dark cores had been in equilibrium with the garnet, corundum and staurolite that had formed under high-grade (eclogite- to granulite-facies) metamorphic conditions mentioned above.

Although further chronological works are now in progress, present study will suggest that the Permo-Triassic thermal event in the Red River shear zone is high-grade metamorphic event and it should be related with collision between the South China and Indochina cratons.

Keywords: metamorphosed bauxite, metamorphic evolution, Permo-Triassic, Red River shear zone, Vietnam