Formation of the Kannak Complex and adakite during Late Permian continent-continent collision event in the Kontum Massif, Vietnam

Masaaki Owada[1]; Yasuhito Osanai[2]; Nobuhiko Nakano[2]; Tran N. Nam[3]; Pham Binh[4]; Toshiaki Tsunogae[5]; Tsuyoshi Toyoshima[6]; Hiroo Kagami[7]

[1] Dept. Earth Sci., Yamaguchi Univ.; [2] Earth Sci., Kyushu Univ.; [3] Dept. Geosci., Hue Univ.; [4] Research Inst. Geol. Min., Hanoi; [5] Univ. Tsukuba; [6] Grad. Sch. Sci. & Tech., Niigata Univ.; [7] Grad.Sch.Sci.Tech., Niigata Univ.

Formation of adakite magmas can be explained by partial melting of subducting oceanic crust under the Eclogite facies conditions. In that case, the subducting slabs should have high geothermal gradient. The slab melting, therefore, takes place in the hot and young slabs including the process of ridge subduction.

Ultrahigh-temperature (UHT) metamorphic rocks that metamorphic conditions are estimated at 900 degree Celsius and 1.0 GPa locally occur in collision zones. If the partial melting takes place in a mafic UHT rock in collision zones, it is expected that the melt composition possesses similar to adakite.

The Kontum Massif is exposed on a mountain range of the Central Vietnam as a core complex in the Indo-China block. The massif consists of both high-P and high-T metamorphic rocks with small amounts of igneous rocks. The chronological data revealed that the metamorphic rocks were formed at 650-450 Ma, and were reworked during late Permian. The U-Pb zircon SHRIMP dating of metamorphic rocks (Kannak Complex) situated on Ba river, southern part of Kontumu Massif gives an age of 250Ma. The metamorphic conditions are up to 1.1 GPa and 1050 degree Celsius. The igneous rocks occurring as stocks or lenses in the metamorphic rocks show monazite CHIME ages of 250 Ma. The igneous activity and the granulite facies metamorphism would, therefore, coincide with each other at 250 Ma. The granitic rocks are composed of following rock types, 1) garnet granite (Grt Gr), and 2) orthopyroxene tonalite (Opx To). The mutual relationship between the Grt Gr and the Opx To are less understood.

The Grt Gr locally forms migmatite structure accompanied by a garnet-orthopyroxene gneiss (Grt-Opx gneiss). Anothite contents of plagioclase of the Opx-Grt gneiss are An=70 to 80. Estimated P-T conditions using geothermobarometryies of the Opx-Grt gneiss show 0.6 to 0.7 GPa and 800 to 870 degree Celsius. The P-T conditions cross over the melting curve with dehydration biotite in the pelitic system. The initial Sr and Nd isotope ratios of the Opx-Grt gneiss and the Grt Gr corrected by 250 m.y. range from 0.7321-0.7562 and 0.51163-0.51167, respectively. Taking mineralogy and isotopic compositions into account, the Grt Gr would be produced by partial melting of the pelitic gneiss leaving the Grt-Opx gneiss as a residue.

The Opx To has similar SiO2 contents to the Grt Gr. The aluminum saturation index of the Opx To is of metaluminous. The chondrite normalized rare-earth patterns of the Opx To show LREE enrichment and HREE depression with slightly positive or no sings of Eu anomalies. The chondrite normalized La/Yb and Yb values are plotted within the adakite field. Sr and Nd isotopic compositions of the Opx To are similar to those of the mafic granulite from Kannak Complex on the epsilon diagram. The REE patterns of the Opx To are identical with those of model calculation for 30 to 40% degree of melting of the mafic granulite leaving mainly garnet and clinopyroxene as residual phases. Results of previously reported experimental work reveal that the melting conditions would be at 1.1 GPa and 1050 degree Celsius. These P-T conditions resemble the peak metamorphic conditions of the UHT rocks from the Kannak Complex.

Based on above described petrological constrains, the possible formation process of the Kannak Complex including the Grt Gr and Opx To magmas in the Kontum Massif are as follows, 1) continent - continent collision to produce a thickened crust, 2) foundering of the lower most crust after transition to eclogite coincidently upwelling of mantle plume, 3) UHT metamorphism and the Opx To magma formation, 4) the Opx To magma ascending into the middle crust, 5) anatexis of pelitic rocks and formation of the Grt Gr and the Grt-Opx gneiss.