Petrochemical variation and petrogenesis of adakitic rocks - examples from the igneous rocks in the Kitakami Mountains, Japan

Nobutaka Tsuchiya[1]

[1] Dept. Geology, Iwate Univ.

The formation of stable granitic continental crust is a unique characteristic of the planet earth. Archean TTGs and modern adakites are considered to be the best example of the juvenile component of the silicic continental crust. This indicates that investigation of adakites is of particular importance to understanding crust-forming processes in the planet Earth. The purpose of this paper is to describe the petrochemical variation of adakitic rocks in the Kitakami Mountains and to discuss the petrogenesis of these rocks.

Martin et al. (2005) divided adakitic rocks into two groups; high-SiO2 adakite and low-SiO2 adakite. The former is considered to represent subducted-basaltic slab melts that have reacted with peridotite during ascent through mantle wedge, while the latter is interpreted to have formed by melting of a peridotite mantle wedge modified by reaction with slab melts. Adakitic rocks in the Kitakami Mountains consist of Lower Cretaceous adakitic zoned pluton, Lower Cretaceous dike rocks, and Paleogene Jodogahama rhyolitic rocks. Among them, the central facies rocks of the Lower Cretaceous adakitic zoned pluton and the Paleogene Jodogahama rhyolitic rocks belong to the high-SiO2 adakaite after Martin et al. (2005). The Lower Cretaceous high-Sr andesite (Tsuchiya et al., 1999), the Lower Cretaceous high-Mg andesite (Tsuchiya et al., 2005), and Paleogene high-Mg andesite (Tsuchiya et al., 2005) are resemble to the low-SiO2 adakite after Martin. In addition, the marginal facies rocks of the Lower Cretaceous adakitic zoned pluton are considered to be important variation of the adakitic rocks.

The central facies granites of the Lower Cretaceous adakitic zoned pluton are characterized by low Y and high Sr concentrations and fractionated LREE/HREE patterns, these characteristics are common to Archean TTGs and modern adakite. These petrohemical characteristics of the central facies granites can be explained by the slab melting model. The Lower Cretaceous high-Sr andesite, Lower Cretaceous high-Mg andesite, and Eocene high-Mg andesite show similar petrochemical characteristics to those of Cenozoic adakite (high LREE/HREE ratios and Sr contents, low Y and HREE contents) except higher Cr, Ni, and Mg contents. The petrochemical features of these rocks in Kitakami can be explained by reaction of slab derived adakitic melt with overlying mantle peridotite. The differece between the high-Sr andesite and high-Mg andesite is explained by the degree of reaction with mantle pridotite; origin of the high-Mg andesite magmas can be explained by extent reaction of slab melt with mantle peridotite to equilibrate with mantle olivine. The marginal facies granites of the Lower Cretaceous adakitic zoned pluton are characterized by slightly lower Sr/Y ratios, less fractionated REE patterns, and weak negative Eu anomalies. The marginal facies magma is considered to be derived by the reaction of slab melt with lower crustal amphibolite.

Compared with the description of Martin et al. (2005), origin of the low-SiO2 adakite in Kitakami can be explained by various degree of reaction of slab melts with mantle peridotites. The lower Cretaceous shoshonite dikes (Tsuchiya et al., 1999) are considered to be products of the magma which is generated by melting of mantle peridotite reacted with slab melt. The petrochmistry of the shoshonites, however, is characterized by lower concentrations of high-field strength elements compared with those of low-SiO2 adakites by Martin et al. (2005). These difference between the shoshonites in Kitakami and low-SiO2 adakites by Martin et al. (2005) can be explained by the degree of depletion of mantle wedge periditite.