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Role of mantle wedge on the petrochemical variation of slab melt: petrogenesis of the Early Cretaceous adakitic granites from the Kitakami Mountains, Japan

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Although most arc magmas are generated by melting of a mantle wedge, partial melting of a subducting oceanic crust (slab melting) plays a major role on the petrogenesis of the Archean and some modern arcs. In Archean times, since a subducted oceanic crust was relatively younger and warmer than modern subduction system, it reached the conditions of partial melting and produced trondhjemite-tonalite-granodiorite (TTGs; Martin, 1986; Defant and Drummond, 1990). Modern equivalents of TTGs, 'adakites', however, have systematically higher Mg/Fe ratio and Ni and Cr contents, which are interpreted as reflecting interactions between the ascending adakitic magma and the overlying mantle wedge (Martin, 1999; Smithies, 2000). From this, some authors suggest that the Archean TTGs may not be produced by slab melting but by partial melting of lower crusts in arc systems or in the root zones of oceanic plateaus (Smithies, 2000; Condie, 2005).

Early Cretaceous igneous rocks in the Kitakami belt, north Japan, attract special interest because of the occurrence of adakitic rocks which show remarkable petrochemical variation. Namely, adakitic granites possibly derived by simple slab melting origin (Tsuchiya and Kanisawa, 1994) coexist with high-Mg andesites probably resulted from extensive reaction of slab melt with overlying mantle peridotite (Tsuchiya *et al*. 2005). The adakitic granites occur in central part of zoned plutonic bodies surrounding by calc-alkaline granites in marginal part. The exposed area of the adakitic granites is divided into two zones: eastern part of the north Kitakami belt to the eastern margin of the south Kitakami belt (E zone: Hashikami, Tanohata, Miyako, and Kinkasan plutons), and inner part of the South Kitakami belt (W zone: Tono, Senmaya, and Hi-

tokabe plutons). The north Kitakami belt consists of Jurassic accretionary complex, while the south Kitakami belt is composed of collided microcontinental block mainly consisting of post-Ordovician sedimentary rocks (Ichikawa *et al*., 1990; Otsuki, 1992).

The adakitic granites in Kitakami show similar petrochemical characteristics to those of the Archean TTGs (Martin, 1995), and are plotted in higher SiO_2 and lower MgO part of the Cenozoic adakites (Drummond and Defant, 1990; Peacock *et al*., 1994). From the detailed investigation of bulk rock chemistry, however, adakitic granites in the W zone are characterized by slightly higher MgO, Cr, and Ni contents and $Mg/(Mg+Fe^*)$ ratios than those in the E zone, which resemble those from the experimental slab melt (Rapp *et al*., 1991; Winther and Newton, 1991; Sen and Dunn, 1994; Rapp and Watson, 1995). In addition, there is no remarkable differences in incompatible element compositions except Sr between the adakitic granites in the E and W zones. The adakitic granites in the E zone is characterized by slightly higher Sr contents than those in the W zone. From these features, it is concluded that the adakitic granites in the W zone may be slightly interacted with peridotite of mantle wedge during their ascent, while those in the E zone indicate little or no mantle contamination. Such difference in the degrees of mantle contamination in the adakitic granites is analogous to the case of the difference in the secular changes from the early to late Archean TTGs. Namely, late Archean TTGs suggest interaction with mantle peridotite, whereas most of early Archean TTGs show no evidence of such mantle contamination (Martin and Moyen, 2002; Smithies *et al*., 2003). However, since the adakitic granites with little or no mantle contamination (E zone) are characterized by higher Sr contents, the degree of mantle contamination can not be explained by the depth of slab melting as suggested in the Archean TTGs (Martin and Moyen, 2002). The difference in the degrees of mantle contamination in the adakitic granites is possibly resulted from the structure below the accretionary complex and the microcontinental block.