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Sr-Nd-Pb isotope systematics of the Early Cretaceous adakitic granites in the Kitakami Mountains, Japan

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Early Cretaceous igneous rocks in the Kitakami Mountains, northeast Japan, attract special interest because of the occurrence of adakitic rocks. Adakitic plutons, which show remarkable petrochemical variation, occupies the largest area of the Early Cretaceous igneous rocks in the Kitakami Mountains. The adakitic pluton consists of the adakitic granites in central part of zoned plutonic bodies (central facies) surrounding by adakitic to non-adakitic granites in marginal part (marginal facies; Tsuchiya and Kanisawa, 1994). The central facies granites are characterized by low Y and high Sr concentrations and fractionated LREE/HREE patterns, characteristics common to Archean TTG and modern adakite. Chemical compositions of the central facies granites can be explained by the “slab melting” model. On the other hand, the marginal facies granites 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 from the reaction of slab melts with mantle peridotite and lower crustal amphibolite.

Initial $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios of the adakitic granites, normalized to an assumed age of 120 Ma, show a relatively wide range; from 0.70350 to 0.70454 and 0.51272 to 0.51254, respectively. In addition, initial Pb isotope ratios (corrected for in situ decay of U and Th based on measured concentrations of U, Th, and Pb and assuming an age of 120 Ma) show a relatively narrower range of compositions ($^{206}Pb/^{204}Pb$: 18.668–19.340; $^{207}Pb/^{204}Pb$: 15.593–15.675; $^{208}Pb/^{204}Pb$: 38.516–39.191). The adakitic granites in Kitakami are characterized by more radiogenic Sr and Pb, and less radiogenic Nd isotopes compared with most of Quaternary adakites (Kay, 1978; Halliday et al., 1983; Futa and Stern, 1988; Defant et al., 1992; Kay et al., 1993; Yogodzinski et al., 1995; Bernard et al., 1996; Stern and Killian, 1996; Conrey et al., 2001). From the trace-element and Sr-Nd isotopic characteristics, the contribution from sediments to slab melting is estimated to be 7 to 20 %. Pb isotope ratios of the adakitic granites can be explained by bulk mixing of average Pacific MORB (Rollinson, 1993) with 2 to 10 % of GLOSS (global subducting sediment: Plank and Langmuir, 1998), and is consistent with the consideration of trace-elements and Sr-Nd istopic characterisitics. Concludingly, considerable amounts of contribution from subducted sediments are found on the generation of adakitic magmas. Pelagic sediments are probably scarce on the young oceanic plate, however older sediments from the overriding plate may be subducted together with oceanic plate and may contribute to slab melting.