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Generation of TH and CA suite magmas at Chokai volcano in the NE Japan rear-arc

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The Quaternary Chokai volcano is located in the rear-arc side of the NE Japan arc. Chokai volcano is a typical stratovolcano and the eruption activities are classified into Stages 1, 2, and 3 (Hayashi, 1984: Ban *et al.*, 2001). Stage 1 lavas are olivine two-pyroxene basalt to two-pyroxene andesite, and the lavas contain phenocrystic minerals in equilibrium with the host magmas with occasional dusty plagioclase, which exhibits disequilibrium. An-contents (An%) of the plagioclase phenocryst cores show unimodal distribution, and An% decreases with increasing SiO_2 in the host lavas (An_{90-80} for basalts, An_{70-50} for andesites). Stage 2 lavas are mostly amphibole-bearing olivine two-pyroxene andesite with a small amount of olivine two-pyroxene basalt. Stage 3 lavas are olivine two-pyroxene andesite. Most of the plagioclase phenocrysts in the Stage 2 and 3 lavas possess dusty zones or sieve textures. An% in these plagioclase cores exhibits wide range (An_{50-80}). Bulk-rock compositions of the Chokai lavas plot near the boundary between high-K and medium-K. On the FeO*/MgO vs. SiO_2 diagram, the Stage 1 lavas fall on tholeiitic (TH), whereas the Stage 2 & 3 lavas fall on calc-alkaline (CA) fields. The Stage 2 &3 lavas collectively show straight trend on MgO vs. SiO_2 plots and MgO content is higher than those in the Stage 1 lavas. Sr isotope compositions of the Stage 1 lavas gently increase with increasing SiO_2 ($^{87}Sr/^{86}Sr$ =0.70303 - 0.70341) contrasting to the steep increase shown by the Stage 2 & 3 lavas (0.70288 - 0.70342). The Stage 1 geochemical trends can simply be explained by fractional crystallization of a basalt magma with minor crustal assimilation. The Stage 2 & 3 trends can be generated by mixing between basaltic and felsic magmas. The Stage 1 parental basalt magma differs from the Stage 2 & 3 basalt mixing end-member, chemically and isotopically. The petrological and geochemical characteristics of the Chokai TH (Stage 1) and CA (Stage 2 & 3) suite magmas are similar to those in the Zao and Azuma TH and CA suite magmas found at the volcanic front of the NE Japan arc. Tatsumi *et al.* (2008) and Takahashi *et al.* (2012) have argued that the TH basalt with radiogenic Sr was formed by melting of the lower crustal amphibolite, whereas CA basalt with unrediogenic Sr was formed by magma mixing between a mantle derived-basalt and a felsic magma generated from the TH basalt by fractional crystallization. The same mechanism would explain the TH and CA suite magmas at Chokai. The Sr isotopic composition of the Stage 1 TH lavas overlaps with that of amphibolite xenoliths from lower crustal depth beneath Ichinomegata volcano (0.7032 to 0.7051; Yamamoto and Takeda, 2008). The geochemical features of the xenoliths and the TH basalt suggest that the Stage 1 TH basalt can be formed by melting of the amphibolite.

Keywords: rear-arc, tholeiitic series, calc-alkaline series, Sr isotope ratio