Generation and evolution processes of rhyolitic magma in Niijima volcano, Izu-volcanic arc, Japan: petrological and geochemical constaints

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We examined the petrography, petrology and geochemistry of the high-silica rhyolite in Niijima volcano at the northern part of the Izu-Bonin volcanic arc, Japan, for clarifying their origin and evolution process. The Niijima volcano, located in the rear arc, consists predominantly of rhyolitic lavas and pyroclastics accompanied by minor basaltic and andesitic pyroclastics. The rhyolites with 12 distinct eruption units are classified into four types based on the mafic phenocryst assemblage: orthopyroxene-cummingtonite type, cummingtonite-type, cummingtonite-biotite type and biotite type (e.g., Isshiki, 1987). Hornblende phenocrysts are sometimes included. Anorthite content (An mol %) of plagioclases and Mg value (Mg#) of mafic mineral phenocrysts decrease with eruption period. The whole rock chemical compositions of the rhyolites are characterized by high SiO_2 (wt.%) (73-78%) and K_2O (wt.%) (1.5-3.5%), and the major and trace element contents show slight differences among the four types and eruption units.
Mineral assemblages particularly with cummingtonite and without clinopyroxene, and high SiO_2 and K_2O contents of rhyolites suggest that the magmas were produced under low temperature (< 800ºC) and pressure (< 3kb), and hydrous conditions. The major and trace element characteristics indicates prominent fractionation of amphiboles and plagioclase from the parental magmas, and this is supported by tonalitic cumulate xenoliths found in the rhyolitic lavas and pyroclastics (Arakawa et al., 2017). The primitive magma is assumed to have been generated by partial melting of middle crust rather than the mafic lower crust. In comparison with the other rhyolites in volcanic front and rear arc regions in northern Izu-Bonin arc, the Niijima rhyolites show distinct features from the others, possibly representing the differences in magma source, and generation and differentiation processes of silicic magmas.

Keywords: Niijima volcano, High silica rhyolite, Izu volcanic arc, Cummingtonite

