

Evolution of the magma plumbing system in the Nijima volcano, Izu islands

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The Nijima volcano locates at the northern tip of Izu-Mariana arc. More than twelve rhyolitic and one basaltic monogenetic volcanoes compose the main volcanic edifice (Isshiki, 1987). The latest eruption occurred in A.D. 886 and formed Mukaiyama lava dome. In and around the Nijima island, seismic activity has occasionally become high level. Partly due to the lack of syneruptive geophysical observation, we know little of its subvolcanic structures. In this study we have carried out a petrographic study on the rhyolitic eruptive materials in order to understand the magma feeding system of the Nijima volcano.

Rock samples were collected from eight rhyolitic volcanoes formed in the last 50,000 years (in order of formation, Setoyama(Se), Ooiso(Oo), Jina-kayama(Ji), Akasakimine(Ak), Nijimayama(Ni), Miyatukayama(Mi), Atiyama(At), and Mukaiyama(Mu)). We confirmed that phenocryst assemblage varies systematically with time as reported by previous studies (e.g., Isshiki 1987); plagioclase(Pl) + quartz(Qtz) + cummingtonite(Cum) + Fe-Ti oxide(Opq) (~Akasakimine; 10ka), Pl + Qtz + biotite(Bt) + Cum + Opq (~Miyatukayama; 5ka) and Pl + Qtz + Bt + Opq (~Mukaiyama). Because the major element chemical compositions of the rock types are almost the same, this phenocryst assemblage variation shows that physicochemical conditions of the magma chambers such as temperature, pressure and water pressure had changed in 50,000 years. In addition to the phase assemblage, we found that the solid solution composition of plagioclase and mafic hydrous minerals show systematic change, except for At which has clear magma-mixing signature. The An contents of plagioclase phenocryst core are 50-30 for Se-Ji, and decreased to 35-20 in Ak. The core An contents have relatively wide range in Ni and Mi (45-20), and the lowest in Mu at 30-20. The Mg# ($MgO/(MgO+FeO)$ in mol%) of cummingtonite phenocrysts are 63-60 in Se-Ji and decreased to 60-59 in Ak and 60-58 in Ni and Mi. The MgO contents of biotite phenocryst core are 12-11 wt% in Ni and Mi, whereas 11-10 in Mu. These assemblage and solid solution composition of phenocrysts cannot be explained by an isobaric fractionation process. We consider following two possibilities for genetic relationship among the monogenetic volcanoes: (1) The Se-Mi are sequentially differentiated magmas with hydrous minerals from Cum to Cum + Bt, whereas the magma of Mu has different origin. (2) There are two series of magmas, Se-Ak magma with cummingtonite and a magma with biotite such as Mu. The Ni and Mi magmas may be formed by the mixing between the two. We have been carried out temperature and oxygen fugacity estimation using Fe-Ti oxides, and hydrothermal experiments to determine the phase equilibration condition of the magma chambers.