

An evolution of a chamber system beneath Unzen volcano, SW Japan

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Unzen volcano at the Shimabara peninsula in central Kyushu is one of active Quaternary stratovolcanoes in Japan. It is composed mostly of calc-alkaline volcanics, however, its early activity is characterized by eruptions of tholeiitic volcanics. To examine the development of the shallow-level intracrustal magma storage system of Unzen volcano, we collected lava samples from all stratigraphic units including the early activity. The fundamental feature which these lava shows was as follows: (1) Composition break which appears between basalt and andesite + dacite exists near $\text{MgO} = 5 \text{ wt.}\%$; (2) Mixing trend between undifferentiated basalt magma and differentiated andesite + dacite magma is not seen; (3) Groundmass composition from differentiated basalt overlaps with undifferentiated end-member of andesite + dacite; (4) Composition distribution of dark inclusions which is contained in felsic lavas occupy the composition break between the basalt and the andesite + dacite; (5) Phenocryst minerals in andesites and dacites show dissolution or decomposition features by heating; (6) $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of the basalts increase with strontium contents. $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of the andesites and dacites increase in this case with the concomitant decrease of strontium content; (7) Densities of basaltic melts estimated from groundmass compositions show values higher than those of plagioclase phenocrysts in the andesite and dacite. The evolution model of magma chamber suggested from the above results supports the coupled chamber model which Yanagi et al. (1992) advocated in Unzen volcano. Dark inclusions contained in felsic lavas are considered to be quenched fragments of high temperature magma supplied to the shallow magma chamber. This high temperature magma is basaltic andesite which once accumulated in a crust-mantle boundary and differentiated to $\text{MgO} = 5 \text{ wt.}\%$ from primary magma composition. The variation in $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of lavas suggests the contribution of crustal assimilation to the magma evolution. Two contrastive crustal assimilation trends suggest that plagioclase is not crystallizing from the basaltic magmas, while it is crystallizing from the andesite and dacite magmas during assimilation. Comparison between calculated densities of a liquid and associated plagioclase crystals suggests that once plagioclase layer accumulated at the bottom of the chamber, newly injected basaltic magma could not pass through this layer because of the density difference. The formation of this layer in the chamber will represent the very initial phase of the evolution of the coupled chamber.