Major and trace elemental composition of melt inclusions in magmas of Aso-2, Aso-3, and Aso-4 eruptions in Aso volcano

*Ryohei Kikuchi[1], Katsuya Kaneko[1], Olivier Bachmann[2]

1. Department of Planetology, Graduate School of Science, Kobe University, 2. Institute of Geochemistry and Petrology, ETH Zurich

Aso volcano in the SW Japan arc is one of the largest caldera volcanoes in Japan and caused four VEI-7 pyroclastic eruptions in the past, referred to as Aso-1, Aso-2, Aso-3, and Aso-4. Each VEI-7 eruption basically began with a discharge of silicic (dacitic-rhyolitic) magma, followed by mafic (andesitic) magma. Previous studies have proposed generation models of the silicic and mafic magmas and concluded that both magmas were generated from a single magma source by crystallization and melting. To understand more detailed magmatic processes such as crystallization, mixing, and remelting in the models, we analyze melt inclusion (MI) and groundmass glass in the silicic and mafic magmas in Aso-2, Aso-3, and Aso-4. The major elemental composition was measured by SEM-EDS (Kobe University), and the trace elemental composition was measured by LA-ICP-MS (ETH Zurich). In addition, we calculated the water content of MIs by melt-plagioclase hygrometer using MI composition data obtained in this study.

We observe three types of MIs that are compositionally distinct in major elements: silicic High-K series type (HK-S), mafic High-K series type (HK-M), and Medium-K series type (MK). The water content of each MI type is generally in the range of 3.0-6.0 wt.%, independent of SiO2 content. The HK-S and HK-M MIs are included in all the phenocryst minerals, whereas the MK MIs are only in olivine and high-An (An75-87) plagioclase phenocrysts. The whole rock and groundmass glass composition of the silicic and mafic magmas in the large eruptions belong to High-K series. Therefore, HK-S and HK-M MIs are considered to be the melt of silicic and mafic magmas, respectively. On the other hand, the MK MIs have composition that is not observed as whole-rock or groundmass in the Aso magmas.

The trace elemental composition of each MI type has different features. Comparing REE patterns between HK-S and HK-M, the concentrations of LREE and HREE in HK-S tend to be higher than in HK-M, while the concentrations of MREE in HK-S tend to be similar or lower than in HK-M. For MK, the composition is similar to HK-M, but the LILE content is lower, and Sr and Eu are higher than HK-M in relation to Zr content. The difference in the REE patterns of HK-S and HK-M may be due to amphibole crystallization, for which MREE is more compatible than LREE or HREE. On the other hand, the enrichment of Eu and Sr in MK suggests the involvement of plagioclase crystallization, which is compatible with these elements.

Keywords: Caldera volcano, Melt inclusion, LA-ICP-MS, Trace element, Large eruption, Petrology

