Experimental constraints on pre-eruptive P-T conditions of Aso-4 silicic magma

*Masashi Ushioda[1], Isoji MIYAGI[1], Toshihiro Suzuki[2], Eiichi Takahashi[2]

1. Geological Survey of Japan, The National Institute of Advanced Industrial Science and Technology, 2. Department of Earth and Planetary Sciences, School of Science, Tokyo Institute of Techonology

Aso-4 is the largest and recent caldera forming eruption (>600 km^3) in the Aso volcano. In order to forecast future eruptions, understanding the magmatic process of past eruptions was very important. Determining the physical and chemical conditions (P, T, X_{H2O}, fO_2) in the magma chamber enables us to constrain trends of crystal differentiation and compare the data with geophysical observations. Kaneko et al.(2007) carried out petrological analyses for Aso-4 products systematically and discussed the conditions of magma chamber. However, pressure of the pre-eruptive conditions, which is an important parameter for the comparison to various observations, for Aso-4 products was not determined by petrological study. In this study, the purpose was determination of pre-eruptive conditions (P, T, X_{H2O}, fO_2) of Aso-4 silicic magma chamber. Reproduction of phenocryst assemblage and compositions of Aso-4A pumice (KJ5665: Hoshizumi, personal communication), which had the most silicic composition and was considered as the felsic end member, was carried out using high-P and high-T experiments.
KJ5665 pumice had plagioclase, orthopyroxene, magnetite, and ilmenite and trace of hornblende phenocrysts. All frequent distributions of core compositions for these phenocryts were unimodal. Core compositions of plagioclase and orthopyroxene ranged from An30 and Mg#72 to An50 and Mg75#, respectively. Temperature and fO_2 were 870~880 ˚C and FMQ+2, respectively, estimated by thermometer and oxygen barometer using equlibrium between magnetite and ilmenite (Lepage 2003; Andersen and Lindsley 1985). Three hydrous glasses (2.0 to 6.0 wt.% H_2O) were synthesized using the powder of KJ5665 for starting materials of high-P and high-T experiments. Melting experiments were performed in temperatures between 810 and 930 ˚C at 200, 400, and 700 MPa under NNO-buffered condition using IHPVs (SMC8600 and HARM200 installed at Tokyo Institute of Technology and Geological Survey of Japan, AIST, respectively). Plagioclase, orthopyroxene and/or K-feldspar crystallized with small amount of Fe-Ti oxides in the lower H_2O content of run products, while orthopyroxene did not crystallize and biotite crystallized in the higher H_2O content of run products. At 200 MPa and 900 ˚C and under low H_2O content (~2wt.%) of run products, plagioclase and orthopyroxene which compositions falled within the range of that of phenocrysts crystallized. In the experiments, hornblende which existed rarely as phenocrysts in the KJ5665 pumice did not crystallized. Origin of hornblende phenocrysts need to be carefully considered using various petrological features.

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