Melting experiments on high-Mg andesite of Oto-Zan, Shodo-Shima

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The Oto-Zan lava flow on Shodo-Shima island forms a composite lava flow: the basal part of this lava flow is composed of high-Mg andesite (HMA), and it grades into more differentiated lava with increasing height. In order to investigate the origin of this composite lava flow, we performed high pressure melting experiments on HMA, by using internally heated gas presure vessel.

High pressure experiments were carried out by using 500 MPa type internally heated gas pressure vessel, installed at the Tokyo Institute of Technology. Pure Ar gas was used as the pressure transmitting medium. The samples were sealed in Au-Pd alloy capsle, and held for 6 - 75 hours at 300 MPa and 900 - 1200 C. Three glasses with different water contents were used for the present experiments, and they were prepared as follows. Powdered HMA sample was sealed in Pt capsule with a small amount of water. These samples were then heated to 1300 - 1350 C at 200 MPa for 20 - 30 min, and then quenched isobarically. The amounts of water in the recovered glass were found to be 0.7, 1.5 and 2.1 wt%, from FT-IR micro-spectrometer measurements.

The liquidus temperature of the HMA in the presence of 2.1 wt% water is around 1200 C, whereas the HMA with 0.7 wt% and 1.5 wt% water crystallize OPx at that temperature. OPx and a small amount of olivine were found at 1150 C on the specimen with 2.1 wt% water, while the other specimens were composed of melt, OPx and a little amount of Plagioclase at this temperature. Amphibole appeared at temperature conditions lower than 950 C. In the case of the sample with 0.7 wt% water, biotite was also found at 900 C.

SiO2 content of the melt found in the present experiments were increased with decrease in temperature; it was at around 58 wt% at 1200 C, and about 70 wt% at 1000 C. The texture of run products at temperature below 950 C were too small to analyze the composition of melt. The observed chemical trend of Oto-Zan composite lava flow is different from that of the melts observed in the present experiments. However, the observed chemical trend of Oto-Zan lava flow is nearly the same to the tie line of the melts observed at 1200 C and at 1000 C. This observation suggests that the chemical trend of Oto-Zan lava flow may be explained by the mixing of two melts, (1) almost totally molten HMA melt and (2) the primary melt of HMA. In the case of K2O, the trend cannot be explained by such a mixing, because the observed K2O content of melts largely increased with increase in SiO2 content at above 1000 C. However, amphibole and biotite were coexisted with a small amount of melt at 900 C, and the alkali contents of the primary melt of HMA can be different form that of the melt at 1000 C. Therefore, K2O content of primary magma may be considerably smaller than the melt composition observed at 1000 C, and the chemical trend of K2O in Oto-Zan lava flow may also be explained by magma mixing.