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Characteristics of volatile material in olivine-hosted melt inclusions from the 2000 eruption of Miyakejima Volcano, Japan

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Among the series of eruptions at Miyakejima volcano in 2000, the largest summit explosion occurred on 18 August (e.g., Nakada et al., 2005). Petrological observation of the essential ejecta (Kaneko et al., 2005; Amma-Miyasaka et al., 2005) and chemical analyses of melt inclusions (Saito et al., 2005) indicated that new basaltic magma ascended from a deeper chamber (~10 km). Saito et al. (2005) also suggested that plagioclase and Mg-poor olivine (Mg#68-72; Type A in Saito et al., 2005) crystallized in the magma during the shallow degassing, while Mg-rich olivine (Mg#77-84; Type B) trapped less evolved melt containing high sulfur concentration. However, it is necessary to accumulate information on volatile concentration of less evolved magma for further discussion on evolution and degassing process of the magma. In this paper, I report volatile analyses of melt inclusions trapped in olivines from a bomb and lapilli from the 18 August 2000 eruption.

Chemical analysis of 14 melt inclusions in Type A olivines and 15 inclusions in Type B olivines were carried out. Most melt inclusions analyzed are distributed in the cores of olivine. They are glassy, round to elliptical in shape and in the size range 0.05-0.1 mm. Several inclusions contain a mineral and/or a bubble in the glass. Analyses of major elements, sulfur and chlorine of melt inclusions in these samples were made by an electron probe micro analyzer (EPMA). Water and CO_2 concentrations of the melt inclusions were measured by secondary ion mass spectrometry (SIMS). In order to construct a SIMS calibration for the water and CO_2, natural basaltic glass samples containing water (0.3-1.4 wt %) and CO_2 (0.01-0.04 wt.%), and synthetic basaltic glass having water (2-4 wt %) and CO_2 (0.01-0.04 wt.%) were used. The synthetic glass samples were made from powder samples of a bomb from the 18 August 2000 eruption and Na2CO3 solution by high-pressure experiment. These glasses have analyzed for H_2O and CO_2 abundances by Fourier Transform Infrared spectrometry (FTIR).

Major element composition of Type A olivine-hosted melt inclusions is similar to that of groundmass in the bomb of the 18 August eruption. Type B olivine-hosted melt inclusions have SiO_2- and K_2O-poor but Al_2O_3-rich composition than Type A olivine-hosted inclusions. Preliminary results of volatile analysis indicate that Type A olivine-hosted inclusions have 2.3-3 wt.% H_2O, 0.003-0.019 wt.% CO_2, 0.063-0.12 wt.% S, and 0.066-0.087 wt.% Cl. These volatile concentrations are roughly similar to those of plagioclase-hosted inclusions (Saito et al., 2005), but the H_2O and CO_2 concentrations are a little higher than those of plagioclase-hosted inclusions. On the other hand, Type B olivine-hosted inclusions have 3.6-4 wt.% H_2O, 0.017-0.027wt.% CO_2, 0.14-0.22 wt.% S, and 0.041-0.069 wt.% Cl. They have higher H_2O, CO_2 and S concentrations and lower Cl concentration than those of Type A olivine-hosted inclusions. In addition, the water concentration is higher than that of melt inclusions in Mg-rich olivines (Fo80-84) from eruptions of Oyama stage of Miyakejima volcano (1.8-2.2 wt.%; Niihori, 2007). Gas saturation pressure of the magma is calculated to be 170-220 MPa on the basis of H_2O and CO_2 concentrations of the Type B olivine-hosted inclusions, which is corresponds to 7-9 km depth. These results suggest that less evolved melt in deeper part contains higher H_2O concentration than estimate by Saito et al. (2005). Further discussion requires detailed petrological studies on origin of the Type B olivine-hosted inclusions and careful consideration on analytical errors of SIMS measurements.