**E221-035** **Room: 303** **Time: May 18 16:15-16:30**

# Different eruptive conditions among the last three eruptions at Unzen volcano, Japan, identified by magnetic petrological analyses

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Recently, studying magnetic behavior and petrology of iron-titanium oxide minerals have achieved steady results and such a method of study have been known as magnetic petrology or magneto-petrology (e.g. Frost, 1991). Magnetic petrology is an effective method for studying the genesis or evolution of volcanic materials because they contain abundant iron-titanium oxides which show wide variation according to the difference of eruptive and cooling processes (e.g. Gromme et al., 1969; Audunsson et al., 1992; Kontny et al., 2003; Saito et al., 2004). I have been working on understanding the mode of eruption in various volcanoes by using magnetic petrological methods (e.g. Saito et al., 2003, 2004, JVGR). In this presentation, I will report about characteristic magnetic properties and petrology of iron-titanium oxides in lavas from Unzen volcano, Japan, indicating the difference of eruptive conditions.

Unzen volcano is one of the most active volcanoes in Japan. Historical eruptions occurred in 1663, 1792 and 1990-1995. Andesite lava (57.5 wt.% SiO2) flowed out in 1663 and dacite lava flow (66.5 wt.% SiO2) was effused in 1792 (Ohta, 1984). The most recent activity is the 1990-1995 eruption, which is characterized by the effusions of dacite lava domes (64.5-66.0 wt.% SiO2) and the generations of abundant block-and-ash flows of dome collapse origin (Nakada et al., 1999). Although the 1792 lava showed the highest SiO2 bulk rock composition in these three lavas and it would be expected that the 1792 lava showed the lowest fluidity, the 1990-1995 lava formed lava domes and showed the lowest fluidity. Nakatani and Sato (2002) tried to explain this discrepancy by petrological analyses, but they did not get consistent results.

In order to clarify the eruptive condition of the last three eruptions at Unzen volcano and to explain the above-mentioned discrepancy, I carried out magnetic petrological analyses on the 1663, 1792 and 1990-1995 lava samples. High-temperature susceptibility and the orthogonal IRM experiments revealed that three kinds of lava samples show distinct magnetic behavior and iron-titanium oxide mineral assemblages. All samples contain two kinds of titanomagnetite with different Ti content. Ti-poor titanomagnetite whose Tc is about 450 degrees C is commonly found in three lava samples. However, each lava shows another Ti-rich titanomagnetite with distinct Ti content. Ti-rich titanomagnetite in the 1990-1995 lava shows the highest Tc of about 350-400 degrees C. The 1792 lava shows lower Tc of about 300 degrees C and the 1663 lava shows the lowest Tc of about 200 degrees C. Generally speaking, Ti-rich titanomagnetite shows high equilibrium temperature (Ghiorso and Sack, 1991). This indicates that Unzen samples are derived from two magmas with different temperature and temperature of the high-T magma in the 1990-1995 lava is lower than that of the 1663 and 1792 lava. In addition, IRM experiments indicate that the remanence carried by Ti-rich titanomagnetite shows greater contribution to the total remanence than Ti-poor titanomagnetite. This character is more apparent in the 1663 and 1792 samples than in the 1990-1995 lava. This indicates that supplied high-T magma during 1663 and 1792 eruption is greater in amount than in the 1990-1995 eruption. This is consistent with the microscopic observations, which indicate that the 1990-1995 lava shows higher groundmass crystallinity and richer in phenocrysts than the 1663 and 1792 lava. These results suggest that temperature of the 1990-1995 magma is lower than the 1663 and 1792 magma. This difference of magma temperature probably causes the different mode of eruption and the different fluidity of three lavas.