



The Geochemistry of volatile species in melt inclusions and sulfide minerals at Izu-Oshima volcano, Japan

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Knowledge of the pre-eruptive volatile content as well as major chemical composition of magma is of fundamental importance for the understanding of various magmatic processes, eruption dynamics and the recycling of volatiles in the subduction zone. Since volatiles in magma are largely degassed during subaerial eruption, it makes difficult to estimate the pre-eruptive concentrations. Melt inclusions trapped in phenocrysts may retain dissolved volatiles in magmas, because the host crystal surrounding the inclusion acts like a tiny pressure vessel. Therefore, melt inclusions have provided valuable information on primary volatile concentrations of magma.

Izu-Oshima volcano is an active stratovolcano, which is located about 110km SSW of Tokyo, belonging to the Izu-Mariana arc system. It is about 15km long, elongated in the NW-SE direction, and mainly of tholeiitic basalt. We have systematically analyzed major, trace and volatile (H_2O , CO_2 , S, Cl) concentrations in olivine-hosted melt inclusions and matrix glasses in scoria from O95 and N4 pyroclastic layers erupted at different times using EPMA, Fourier transform infrared and Ramam spectrometers.

The melt inclusions from both layers have basalt to basaltic andesite compositions, and display similar geochemical variation. The SiO_2 contents of melt inclusions vary from 49 to 55 wt.% and increase linearly with increasing K_2O contents and decreasing MgO , Al_2O_3 and CaO contents. They also show positive correlation with Cl content, and negative correlation with H_2O and S contents. These compositional variations are well interpreted in terms of magma mixing between highly evolved magmas and the least evolved magma. The highly evolved magmas were possibly formed by fractional crystallization together with low pressure degassing of H_2O and S. The least evolved magma of O95 is characterized by higher MgO (7.3 wt.%), SO_3 (0.4 wt.%) and H_2O

(3.4 wt.%) and lower SiO₂ (49 wt.%) and K₂O (0.2 wt.%) with respect to that of N4, and these variations should reflect primary features of the primitive magmas. The measured S⁶⁺/S_{total} ratios range from 0.64 to 0.73 in melt inclusions from O95, which suggests a relatively high oxidation state of magma (up to NNO+0.87 at 1150°C).

Rare pyrrhotites are present only in the cores of titanomagnetite microlites. These observations suggest that sulfide saturation occur early in the microlite growth stage of this magma just prior to eruption. The sulfur fugacity (log fS₂) estimated from the composition of pyrrhotite is around +0.5 for $T = 1060^{\circ}\text{C}$.

The behavior of volatile species during eruption can be inferred from their content of the matrix glasses and initial content of the melt inclusions. The matrix glasses are more evolved than the melt inclusion, and contain similar or high amounts of Cl but significantly less H₂O(0.2 wt.%) and SO₃ (less than 0.01 wt.%), suggesting that the Cl did not behave as volatiles, but almost all the S and H₂O in magma were released to atmosphere by degassing during the eruption.