

Plagioclase phenocrysts and Opx-magnetite symplectite of the Sessho Lava of the Kusatsu-Shirane Volcano

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Chemical composition and crystal size distribution of plagioclase phenocrysts may represent the cooling rate and chemical heterogeneity of the magma chamber. Therefore, chemical and physical conditions in the magma storage before eruption can be constrained by analyzing the morphology and chemical composition of phenocrysts in lava.

For the purpose, we focused on the Sessho lava, a single lava flow erupted from Kusatsu-Shirane volcano. Kusatsu-Shirane volcano is a quaternary active volcano located in the Central Japan arc. According to Uto *et al.* (1983), the Sessho lava is estimated to have erupted from the Moto Shirane cone during an eruption about 3000 years ago. The Sessho lava shows andesitic composition (Takahashi *et al.*, 2010; Ueki and Terada, 2012). In this study, detailed descriptions in morphologies of phenocryst minerals have been carried out. We determined the modal composition of phenocrysts, and measured the aspect ratio and the crystal size distribution of plagioclase phenocryst. We also carried out the detailed description of opx-magnetite symplectite, which have been observed in several samples.

The phenocrysts assemblage of the Sessho lava is plagioclase, clinopyroxene, orthopyroxene, magnetite, and rare olivine. Groundmass shows glassy structure. Modal composition of phenocrysts shows homogeneous value in a single lava flow; 54.0 to 59.0 vol. % for groundmass, 33.4 to 38.1 vol. % for plagioclase, 2.1 to for 4.2 vol. % for magnetite, 3.0 to 6.4 vol. % for pyroxene. On the other hand, the aspect ratios of plagioclase phenocrysts show wide range of variation in a single lava flow. Fine grained plagioclase shows needle-like morphology whereas coarse grained plagioclase shows tabular morphology. Although the modal composition shows the homogeneous value, sizes of plagioclase phenocrysts show wide range of variation; samples rich in fine-grained phenocrysts and samples rich in coarse-grained phenocrysts are both present in the single lava flow.

Observations and quantitative analysis using EPMA and SEM show that the structure of plagioclase phenocrysts can be classified into following five groups; normal zoning, reverse zoning, oscillatory zoning, patchy zoning, dusty zoning. Plagioclase phenocrysts show a wide range of composition in the single lava flow. An# ranges 55-84 %. Olivine phenocryst is observed in some samples, its Mg# is -83, which is a non-equilibrium composition with its host rock.

Opx-magnetite symplectite have been observed in several samples. The symplectite show oval form. Its diameter ranges 2-4 mm. Magnetite shows lamella structure, and is concentrated at the central part of the symplectite. Orthopyroxene is 75-975 μm in diameter and distributes around the magnetite lamella. Orthopyroxene in the symplectite is characterized by its low birefringence than the typical orthopyroxene phenocrysts of the Sessho lava. This structure is estimated to be formed by the rapid oxidation of olivine, indicating that during the formation of andesite magma of Sessho lava, oxygen fugacity in the magma storage may have rapidly increased.

In conclusion, it is estimated that final temperature was homogeneous in the magma strage of the Sessho lava, because modal contents of phenocrysts in the single lava flow show homogeneous value. On the other hand, several types of the chemical composition and size of plagioclase have been observed in the lava flow, indicating rate of crystallization and cooling had variation in the magma storage of the Sessho lava. Existences of orthopyroxene-magnetite symplectite and non-equilibrium olivine indicate magma mixing and oxidization event had occurred during the formation of andesitic magma of the Kusatsu-Shirane volcano.

References

- Uto *et al.*, Kusatsu-Shirane volcano geological map, Geological Survey (1983)
- Takahashi *et al.*, Nihon University College of Humanities and Sciences, Research bulletins, 45, 205-254 (2010)
- Ueki & Terada, Volcano 57, 4, 235-251 (2012)

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