[EE] Evening Poster | S (Solid Earth Sciences) | S-VC Volcanology

[S-VC39]Pre-eruptive magmatic processes: petrologic analyses, experimental simulations and dynamics modeling

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Processes leading to volcanic eruptions are central and yet still enigmatic issues in volcanology. Recent advances in understanding thermo-mechanical and open-system behavior of magma reservoirs and mineral zoning stratigraphy allow us to take a step forward to reveal the complex incubation processes during volcanic dormancy and following magma chamber tapping. This session aims at putting together recent knowledge on magmatic processes including 1) magma chamber evolution through magma reintrusion, crystallization-induced volatile exolution, magma mixing and gas fluxing, 2) externally-driven eruption trigger mechanisms, and 3) conduit processes and controls on eruption styles such as outgassing, dehydration-induced crystallization, fragmentation and rheological transition of ascending magmas. We welcome contributions based on petrological, mineralogical and geochemical analyses of pyroclasts and volcanic gasses, experimental simulations of magma reservoir conditions and conduit flow dynamics, and numerical modeling to integrate the elementary processes.

[SVC39-P04]Pre-eruptive magmatic process of silicic monogenetic volcano inferred from amphibole phenocrysts: A case study of Izu-Kawagodaira volcano

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1. Introduction

Monogenetic volcano is formed by the first eruption of a newly built magma plumbing system. Therefore, a study about pre-eruptive process of a monogenic volcano eruption leads us to understand the formation process of a new magmatic system. In this study, we focus on Kawagodaira volcano erupted at ca. 3100 years ago in Izu Peninsula, Japan (Shimada, 2000). Rhyolitic magma was erupted from the monogenic volcano. The eruption started from Plinian explosion, followed by pyroclastic flow eruption, and then lava flow effused finally. All of pumices and lavas of the volcano have amphibole phenocrysts. Recently, Putirka (2016) proposed empirical equations relating temperature (T) and co-existing melt SiO_2 content (SiO_2^{melt}) with amphibole composition. These equations allow us to estimate the physical and chemical conditions of a silicate melt in equilibrium with amphibole. In this study, we performed textural and chemical analyses of amphibole phenocrysts from Kawagodaira volcano, and then T- SiO_2^{melt} conditions of amphibole crystallization are estimated to constrain the pre-eruptive magmatic process of the volcano.

2. Sample and methods

In this study, we collected pumice and obsidian samples from the Plinian fall and the pyroclastic flow deposits, and lava samples from a lava flow. The samples were polished to thin sections. We performed petrological descriptions and observations of BSE and element mapping images by using SEM. In addition, major element compositions of the amphibole, Fe-Ti oxide, rim of plagioclase, and groundmass glass were measured by using EPMA.

3. Results and discussions

The chemical compositions of magnetite, ilmenite, rim of plagioclase, and groundmass glass are respectively almost homogeneous in the studied samples. Pre-eruptive temperature and melt water content conditions are estimated by combination of Fe-Ti oxide thermometer and plagioclase-melt thermo-hygrometer to be ~ 800 °C and ~6.5 wt.% for all of the studied samples.

Compositional ranges of amphibole are identical in all of the studied samples. Two different types of amphibole phenocrysts are found; F-type amphiboles are chemically homogeneous whereas C-type ones show Si-rich or Si-poor core surrounded by rim with composition similar to F-type ones. F-type amphibole phenocrysts are classified into Magnesiohornblende. Rim of C-type phenocrysts are also Magnesiohornblende whereas core of C-type ones show large compositional variation from Magnesiohornblende to tschermakite. Estimated temperatures for most of F-type amphiboles (F1-type) and rims of C-type ones are ~ 800°C. This temperature is consistent with the pre-eruptive temperatures estimated by Fe-Ti oxide thermometer. On the other hand, cores of C-type amphiboles reveal crystallization temperatures of ~750-900°C. Some of F-type amphiboles were crystallized at ~850°C (F2-type). SiO_2^{melt} estimated from amphibole compositions are ~73 wt.% for all F1-type amphiboles and rims of C-type ones, which is similar to SiO_2 content of the groundmass melt. SiO_2^{melt} estimated from cores of C-type amphibole varies from 58 to74 wt.%.
Our results show that pre-eruptive magmatic conditions were identical regardless of the eruptive style, suggesting that the eruptive style change is attributed to the conduit ascent process. The estimated T-SiO_2^{melt} conditions from cores of C-type amphiboles vary continuously, indicating that these amphiboles were crystallized in a chemically zoned magma reservoir; melt composition varies from andesitic to rhyolitic in the reservoir. The magma reservoir was at the depth >7.5km based on the estimated water content of the pre-eruptive melt. F2-type amphibole phenocryst is thought to be incorporated in the rhyolitic melt right before the eruption. Therefore, we think that F2 type and cores of C-type amphiboles were derived from crystal mush surrounding rhyolitic melt chamber. In addition, presence of F2-type amphibole implies that partial collapse of crystal mush might occur right before the eruption. Continuous variation of SiO_2^{melt} estimated from cores of C–type amphiboles indicates that andesitic melt was initially supplied and then it evolved to rhyolitic melt as cooling in the magma reservoir of Kawagodaira volcano. Considering the eruptive volume of the volcano (~1km^3), it may need a long time for the magma to be cooled and evolved to rhyolitic composition from the initial intrusion. Therefore, we think silicic monogenetic volcanoes do not erupt immediately after the initial magma supply.