

Volatile components of apatite grains from pyroclastic flow deposits of Aso volcano

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Water in the Earth is important for life and mantle dynamics. The amount of water in the interior of the early Earth and chondrites is one of the most essential constraints for revealing the origin of the Earth's water. An important clue to the water budget in the early Earth is apatite grains in chondrites and in -4.4 Ga zircon from Jack Hills in Australia. Since apatite has volatile components, it is expected to determine the amount of water in chondrites and the interior of the early Earth from OH composition of the apatite. However, partitioning and exchanging of volatile components, especially water, between apatite and melt has been unclear. Mathez and Webster (2002) and Webster et al. (2009) tried to reveal partitioning of F and Cl between apatite, melt, and fluid with high-temperature and high-pressure experiments, but they did not discuss the exchange relationship in volatile components' site (X site) in apatite. Pan and Fleet (2002) suggests that volatile components in apatite should be affected by other cation components. Accordingly, the goal of this study is to reveal the relationship of volatile components between apatite and melt, including revealing the exchange relationship in volatile components' site in apatite and other components which affect on it.

We analyzed volatile compositions of apatite grains and melt inclusions in plagioclase phenocrysts from pyroclastic flow deposits of Aso volcano with EPMA and nano-SIMS. We analyzed 4 samples, rhyolitic and andesitic of Aso-3 and Aso-4. EPMA and nano-SIMS analysis revealed that F concentrations in apatite in each sample show large variations while Cl concentrations are constant, suggesting that F and OH substitute for each other in the X site. OH concentration in apatite of mafic sample was larger than that of silicic one.

We find that F and Cl in apatite and these in melt inclusion have no correlation, while OH in apatite and water in host magma, which is estimated from temperature, pressure, the composition of plagioclase, and so on (Kaneko et al., 2007), have a positive correlation. We also find that the amount of OH and that of CaO, P₂O₅ and MgO in apatite have positive correlations, therefore Ca, P, and Mg could affect on the behavior of F and/or OH. Additionally, Number of cations in M site (assuming oxygen number = 13) was 4.66-4.88, which is smaller than expected from stoichiometry, suggesting that other components, such as rare earth elements, would be present in M site.

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