Water content and eruption mechanism of the 1707AD and 864AD basaltic magmas of Fuji volcano

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Hydrous melting experiments on the 1707 A.D. basalt of Fuji Volcano was conducted to examine the relation between An content of liquidus plagioclase and water content of the melt at 195 MPa, yielding an equation: An=6*X+68, where X represent water content of the melt. Plagioclase in the 1707 A.D. basalt has a composition An=85-92, suggesting that the water content of host magma is 3-4 wt.%. The 864 A.D. basalt of Fuji volcano contains reversely-zoned plagioclase phenocryst, suggesting that initial magma has degassed and crystallized sodic plagioclasewith subsequent mixing of H2O-rich magma.

Present study discusses the degassing history of the basaltic magma of historic eruption products of Fuji volcano in terms of the composition of plagioclase phenocrysts. Presence of water in magma increases the An content of liquidus plagioclase in equilibrium with the melt. We carried out melting experiments at 190-195 MPa on the 1707 basaltic samples with variable amount of water. The An content of liquidus plagioclase is well correlated with the H2O content of the starting material. Using this experimental correlation, we estimated the water content of the 1707 basaltic magma and also interpreted the degassing/magma mixing history of the 864 eruption products.

High pressure experimental study at 190-195 MPa was conduced using the Ar gas-media internally heated pressure vessel installed at the Faculty of Science, Kobe University. The starting material for the experiments was the powdered basaltic scoria in the 1707 ejecta. Capsules used was the Au70Pd30 or Ag50Pd50, and the known amount of water and sample was inserted and welded shut, processed in the pressure apparatus, quenched, mounted, polish thin sectioned, and examined under microscope and electron probe microanalyzer. The temperature was initially overheated by 20-30 C for 1 to 10 hours, then cooled and held at constant temperature for more than 40 hours. Plagioclase in the experimental charges are equant to irregular shape, often with inclusions of magnetite. An content (100*Ca/(Ca+Na)) of the near liquidus plagioclase was, An=69% under H2O=0.2wt.% at 1200 C, An=74% under H2O=1.5% at 1160 C, and An=88% under H2O=3.7% at 1080 C. Five experimental results at near liquidus temperatures showed the good correlation between the An content of plagioclase and the water content in the melt with an equation: An=6*X(H2O)+68.

The basaltic ejecta of the 1707 A.D. eruption of Fuji volcano contains less than 1 volume % phenocryst of plagioclase and olivine. The plagioclase phenocryst show idiomorphic form with homogeneous calcic core (An=85-92%) and sodic rim (An=ca. 75%). When we simply apply the above correlation between the An content of plagioclase and water content of the melt, the water content of the magma which crystallized the core of plagioclase phenocryst was 3-4 wt.%.

On the other hand, the basalte ejecta of the 864 A.D. eruption of Fuji volcano contains abundant phenocrysts (20-30 vol. %) of plagioclase, olivine, orthopyroxene, clinopyroxene. Plagioclase phenocryst in the 864 A.D. eruption product often shows reversed zoning. The core of plagioclase generally have An 70-80, with rare calcic corroded inner core. The reverse zoning at the rim is often associated with dusty zone, and the An content of the rim ranges from 78-85. The associated orthopyroxene phenocryst generally shows corroded out line commonly surrounded by idiomorphic olivine microphenocryst. These petrographic features are reconciled with the following scenario. The 864 eruption occurred at Nagao hill ca. 10 km northwest of the summit of Fuji volcano, and it is conceived that parental magma was fed from the central source vent just under the summit. The supplied magma was injected into a dike toward northwest at depth of 0.5 to 2 km, where convective magma degassing took place. The degassed magma is undercooled and crystallized the core of sodic plagioclase phenocryst. Subsequently, volatile-rich magma was injected into the dike, where magma mixing took place and reverse zoning of plagioclase phenocryst was formed. The increase of the magma pressure in the dike caused the extensiton of the dike and the eruption started where the dike reached the surface of the northwest slope of the volcano.