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Magma ascent process during the late stage of Fuji 1707 eruption; constraints from plagioclase microlite

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The Hoei eruption occurred at 1707 is the latest eruption of Fuji volcano. Plinian to sub-plinian eruption continued ca. 15 days with several times of pause during the eruptuin. Plinian and sub-plinian eruption of chemically homogeneous basaltic magma continued after the third days although dacitic-andesitic magma erupted in the early two days. At the end of the eruption, scoria cone was formed in the first crater, indicating transition of eruption style from plinian or sub-plinian to strombolian. However, the cause of this transition is not understood. In this study, textural and chemical analyses are done for plagioclase microlites in scoria samples collected from plinean fall deposit and the last scoria cone of Hoei eruption to clarify conduit ascent process in the late stage and the cause of the transition occurred at the end of the eruption.

Scoria samples of plinian and strombolian eruptions were collected from fall deposit located ca. 8km east from the source and from the scoria cone in the first crater. Among them, 30 scoria grains of the late stage continuous eruption called as Ho-IV stage, 5 grains for each of 6 units, and 4 strombolian scoria samples were investigated in terms of chemical composition, crystal size and crystal number density of plagioclase microlites. Chemical compositions of plagioclase microlites were analysed using EPMA (JEOL-8800R) at Earthquake Research Institute, University of Tokyo. Microlite size and number density were measured by image analyses of BSE images acquired by using SEM at Michibayashi Lab., Shizuoka University.

Both of plinian and strombolian scorias are aphyric with very trace amount of plagioclase and olivine phenocrysts rarely accompanied with pyroxenes. Maximum An number [=100Ca/(Ca+Na)], maximum size and crystal number density of plagioclase microlites are ca. 74.4, ca. 191μm, and ca. 1240 /mm^2 in the plinean scoria and ca. 78.3, ca. 293μm, and ca. 881/mm^2 in the strombolian scoria, respectively; maximum An number and maximum size are larger and crystal number density is lower for plagioclase micrlites in the strombolian scoria than those in plinean scoria.

Based on phase relation, eruption temperature was estimated to be ca. 1135 ℃. The pressure at which crystallization of plagioclase microlite started were estimated by using plagioclase-melt geohygrometer of Putirka (2008) to be ca. 21 MPa for plinian and ca. 24 MPa for strombolian eruptions, corresponding to depths of ca. 840-870m and ca. 940m, respectively. Conduit ascent velocities at the depths of microlite crystallization were estimated from number density of plagioclase microlites by using the MND water exsolution rate meter of Toramaru et al. (2008) to be ca. 54 km/h and 36 km/h for plinean and strombolian eruptions, respectively. The ascent velocity of plinian eruption was 1.5 times faster than that of strombolian eruption. Present results suggest that conduit ascent velocity decreased at the end of Hoei eruption, resulting in plinian-strombolian transition. The ascent velocity decrease was caused by phenomena occurred at depth >940m, such as decrease in conduit width and/or overpressure in magma reservoir.

Keywords: Fuji volcano, plagioclase, microlite, conduit ascent velocity, scoria, eruption style