低水蒸気圧下における安山岩質軽石の石基結晶化実験
Groundmass crystallization experiments of an andesitic pumice under low vapor pressure.

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Recently, nanoscale crystals (ultrananolite and nanolite) have been found in groundmass glasses of volcanic rocks. These crystals are thought to crystallize at very shallow part of conduit or inside lava dome. It is suggested that nanoscale crystals recorded information about eruption style transition in shallow conduit. In addition, the eruption style is assumed to be change with viscosity increase due to crystallization of nanoscale crystals. Therefore, it is imoprtant to clarify the nucleation and growth condition of nanoscale crystals for understanding volcanic eruption dynamics . Kinetics of nanoscale crystallization is, however, poorly understood compared to that of microlites. In this study, we performed the series of crystallization experiments that simulate dehydration-induced crystallization in shallow conduit and near surface conditions and investigated the crystallization condition of ultrananolite and nanolite.

As a starting material for the experiments, we used almost microlite-free andesitic pumice clasts from the 1914 (Taisho) Plinian eruption of Sakurajima volcano. The water content in the groundmass glass is approximately 0.5 wt.%. The samples were sealed in a silica glass tube and heated instantaneously to temperatures of 800, 900, 930, and 1000°C for 3 and 30 minutes, and 2, 8 and 32 hours. When the silica glass tube was evaluated and welded shut, vapor pressure produced via degassing of the starting material is calculated to be of 0.07 (Low Vapor Pressure runs: LVPs). The higher vapor pressures were conducted at 2, 4, and 6 MPa by dehydration of brucite powder.

The mineral assemblage of the crystallized nanolite includes magnetite and pyroxene. The crystallization mode of the groundmass crystals is mostly classified into 5 types; 1) homogeneous nucleation of pyroxene in whole the sample and following growth to the size up to nanolite and occasionally microlite, 2) homogeneous nucleation of ultrananolite in whole the sample, 3) homogeneous nucleation of pyroxene and magnetite crystallization in the vicinity of plagioclase, 4) heterogeneous nucleation of pyroxene on the surface of plagioclase phenocrysts and microlites, and 5) heterogeneous crystallization of pyroxene and magnetite on the bubble surface. Appearance of these types was dependent on the experimental conditions. Magnetite nanolite crystallized under relatively high supercooling, i.e. at low H_2O vapor pressure. Pyroxene nanolite crystallized under wide temperature and pressure conditions. Ultrananolite crystallized in all the runs at 800°C and at LVP. This indicates that ultrananolite appears under high supercooling. These results on nanoscale crystallization can be used to constrain the pressure-temperature-time paths of volcanic pyroclasts in a shallow conduit.

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