Glomeroporphyritic plagioclase in lava flows of early stage Younger Fuji volcano

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We describe and experimentally examined the plagioclase glomeroporphyritic crystal aggregates abundantly found in both Mishima and Saruhashi lava flows erupted in the early stage of the Younger Fuji volcano. Both lava flows are basaltic, and Mishima lava flow is less differentiated (FeO∗/MgO=2.0-2.2) compared with the evolved Saruhashi lava flow (FeO∗/MgO=2.7-2.9). Mishima lava flow includes olivine phenocryst of about 5% and plagioclase phenocryst of about 25-30%, and Saruhashi lava contains only plagioclase phenocryst of about 15-20%. Plagioclase phenocrysts of these lava flows characteristically show glomeroporphyritic texture. We define glomeroporphyritic as including more than 4 plagioclase crystals in thin sections. About 25% of plagioclase in Mishima lava flow is glomeroporphyritic, whereas about 75% of plagioclase in Saruhashi lava flow shows glomeroporphyritic texture. Ikeda et al (2001 CMP) proposed that crystal clustering is enhanced by high interfacial energy ratio (solid-melt interfacial energy/solid-solid grain boundary energy). They experimentally demonstrated that crystal aggregation tends to develop when cooling rate is smaller, at lower temperature, and when melt composition depart from the composition of crystal. In this study, we intended to duplicate the glomeroporphyritic crystals by two kinds of melting experiments. First, we performed high pressure cooling (0.5 and 0.05 C/min) experiments at 100 MPa. Considering the natural conditions of phenocryst crystallization, the starting materials were prepared from the powders of Mishima and Saruhashi lavas with additional water (1% and 3%) in AuPd capsules. Temperatures were decreased from 1160 to 1050C (1%) and 1100 to 1000 (3%) at rates of 0.5C/min and 0.05C/min. Although plagioclase crystallized in some of the runs up to ca. 30 vol.%, glomeroporphyritic crystals are less than 6% in the run products. In the second experiment, we performed cooling experiments at 1-atmosphere under NNO buffered condition. Starting material is the powder of Saruhashi lava filled in Al2O3 crucible. Glomeroporphyritic crystal aggregates composed only of plagiocalse are generated, and 20-25% of plagioclase composed the aggregate in the run product. Considering the possible effect of shear stress in the formation of crystal aggregate, we also ran a cooling experiment with shear by a rotating rod. The run product, however, contained glomeroporphyritic plagioclase of about 20-25%. These experimental results suggest that plagioclase glomeroporphyritic crystals are little generated in high pressure hydrous condition, whereas 20-25% of plagioclase conformed glomeroporphyritic crystal aggregate at 1-atm conditions. It is suggested that plagioclase-plagioclase interfacial energy is smaller than plagioclase-melt interfacial energy at 1 atmosphere in the Saruhashi lava. Higher proportion of the glomeroporphyritic plagioclase in the Saruhashi lava flow was not duplicated, and it is possible that crystal accumulation may have caused the additional contact of plagioclase phenocryst and formed high proportion of glomeroporphyritic plagioclase in the Saruhashi lava.