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火山灰に含まれるナノライトから探る桜島のガス溜まりプロセス
Nanolites in volcanic ash: a clue to understand gas pocket processes in the on-going Sakurajima eruption

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Our understanding of magma ascent processes has been greatly improved by focusing on the dehydration-induced crystallization of microlites in volcanic rocks. In the magmas underwent extensive undercooling at low pressure, the microlite crystallization is followed by appearance of sub-micron scale acicular crystals. The presence of those minute crystals in the groundmass of relatively slowly-cooled magmas has long been known through optical microscopic observation as cryptocrystalline texture. Sharp et al (1996) explicitly defined the pyroxene and plagioclase crystals with width < 0.6 micrometer in the Ben Lomondo rhyolite lava dome as "nanolites". In this study, we report occurrence of nanolites in the juvenile micropumices erupted from Vulcanian explosions of Sakurajima volcano, Kyushu Japan, and propose that they may be a clue to clarify the processes in the "gas pockets" in shallow conduit, which is central to the mechanisms of Vulcanian explosion.

We investigated the volcanic ashes erupted from the Showa crater on February 16, 2010. Besides the highly oxidized and hydrothermally altered lithic fragments, three types of grains were identified in the ashes: (A) vesicular, light-colored micropumices, (B) less-vesicular dark-colored pumices and (C) dense lava fragments. Because their groundmass compositions are almost the same, all the three types are concluded to be juvenile. The groundmass crystallinity increases in the order from A to C. (FE-)SEM observations revealed that acicular pyroxene crystals with length of a few to 10 micrometers and widths from hundreds nanometers to ~1 micrometer are in particular responsible for the increase in the crystallinity and decrease in the sample brightness. Such pyroxene "nanolites" are rich in the Tschermack component, suggesting that they rapidly crystallized under large supercooling, Considering that effusions of such grains had occurred continuously for the period, a few times a day, we assume that their crystallization was driven by undercooling caused not by cooling but by dehydration of the hydrous melt in the shallow conduit (A and B- types) and lava caps (C-type) in the Showa crater. The observed eruption interval may constrain the timescale of nanolites cyrstallization from the supercooled melt and limit the temperature range. Existence of vesicular materials at low pressure and high-temperature environment indicates that the gas pocket was formed in the shallow conduit, as has been required in terms of the explosion dynamics.

In order to understand the crystallization conditions of the nanolites quantitatively, we have started annealing experiments of the vesicular pumice samples. As a starting material, we have used the pumice clasts erupted in the Plinian eruption in 1914. Its bulk-chemical and ground compositions approximate those of the on-going eruption. The water content in the groundmass glass is ca. 0.5 wt. %. The experiments are carried out in the air and in evacuated silica glass tubes with NNO buffer at a temperature ranging from 1000 to 400 degree C for 0.5 to 8 hours. In the run products of preliminary experiments at 1000 degree C, systematic increase in the amount of Al-rich pyroxene nanolites was observed. We are conducting further experiments to find temperature and time conditions that reproduce the chemical composition, shape and number density of the natural nanolites in the ashes from the Showa crater.

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