Cataclasitic texture in gabbroic xenoliths of the Fuji 1707 eruption, Japan

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Gabbroic xenoliths are often found in the volcanic products of the 1707 eruption at Fuji volcano, Japan. These xenoliths offer an opportunity to investigate processes occurred in an active magma reservoir. We observed ~300 samples of the gabbroic xenoliths and found several samples which show cataclasitic textures. Cataclasite is typically formed by brittle fracturing associated with a fault. Therefore, the gabbroic xenolths with cataclastic textures may imply interaction between fault and magma plumbing system. In this study, we performed textural observations and chemical analyses of minerals and glasses for the gabbro cataclaseite xenolths to clarify the formation process of the cataclasitic textures.

The gabbro cataclaseite xenolth samples mainly consists of clast and fine-grained matrix, that we also observed a foliated cataclasite at several samples. Mineral assemblage is plagioclase + olivine + pyroxenes + FeTi oxides and interstitial glass is often observed; this is similar to the xenoliths without cataclaseite-like textures. Fine-grained fragmented plagioclase grains sometimes show undulatory extinction whereas less-fragmented coarse plagioclase grains do not show it. Cracks in less-fragmented parts are filled by rhyolitic melt of ~75 wt.% SiO_2. The melt is chemically different from the melt erupted during the 1707 eruption, indicating that the melt is not derived from host magma. In addition, pyroxene reaction rims are found between the melt and olivine, suggesting that the melt was not the product of deformation-induced melting. Plagioclase-hosted melt inclusions in the gabbroic rocks have similar composition with the crack-filling melt. Therefore, the melt was derived from interstitial melt in crystal mush and infiltrated into cracks during formation of cataclastic textures. Compositional relation of FeTi oxide-plagioclase-melt constrains the temperature-water content condition of the crack-filling melt to be ~800 degree C and ~8 wt.%, which is similar to those of melts in the xenoliths without cataclastic textures. Saturation pressure of the water content is calculated to be ~290 MPa, which corresponds to the depth of ~11 km, indicating that the cataclastic textures were formed at the depth.
One of possible causes of the cataclastic textures is the fault at the depth of 5-15 km beneath the SW flank of Fuji volcano. The fault is recognized by Shizuoka-Tobu earthquake occurred at March 15, 2011; the NE edge of the fault is located beneath the vent of the 1707 eruption, implying interaction between the fault and the magma plumbing system of the 1707 eruption. However, the estimated temperature for the gabbro is higher than that at which a tectonic earthquake occurs. Alternatively, deformation of magma reservoir, associated with magma supply and/or compaction of crystal mush, may induce strain localization and local fault movement, resulting in the formation of the cataclastic textures in gabbros.

Keywords: Gabbro, Cataclasitic texture, xenliths, Fuji volcano

