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The mechanism that causes shift of explosive intensity; petrological case-study for Mt. Shinmoe 2011 eruption

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In general, explosive eruptions have some variation in duration time, intensity, erupted volume and textural and compositional characteristics of erupted materials. These variations shift in few days at a same volcano. There might be any endogenous mechanisms for shifting eruptive styles, except geological or tectonic settings as exogenous mechanisms. However, endogenous mechanisms are still not understood well. Moreover, these parameters shift even in a simple explosive eruption with time. There has been only a few petrological studies which analyze erupted materials with high time resolution. Together with geophysical and geochemical observations, the petrological study may provide clues for these shifting mechanisms. We focuse on the pumice deposits of the 2011 eruptions of the Mt. Shinmoe volcano, Kyushu, Japan, which were well observed several geophysical methods (e.g. tilt, GPS seisomograms and echo height by weather radar).

The Shinmoe 2011 eruption generated three sub-Plinian eruptions on January 26-27 and shifted to lava dome growth with vulcanian eruptions. Because the eruption cloud by the 3rd sub-Plinian eruption on 27 afternoon, Jan traveled different direction from those of the 1st and 2nd eruptions (Furukawa et al., 2011, JpGU), deposits by the 3rd eruption at specific localities are distinctive from deposits by the 1st and 2nd eruptions. In this study, we petrologically analyze pumice samples during the whole sequence of eruption. We collected pumice samples at approximately 3 km south from the vent along the major axis of this eruption, Takachiho gawara, where the thickness of deposit was 7 cm. We divided the whole deposits into three layers; below, middle and above layer with two sub-layers for each. Deposits commonly contain white pumice, gray pumice and black particles, which occupy >3.2 wt.%, 58.3 ? 82.9 wt.% and 15.6 ? 36.2 wt.% in this section, respectively. The black particles have the characteristics of juvenile pyroclastic lava as pointed out by Kichise et al. (2010, JpGU). White pumice is most abundant in the bottom layer, the gray pumice was most abundant in middle to upper layer and the black particles are most abundant in uppermost layer.

We measured the bulk density of particles as a proxy of eruption intensity, which changes with time. We calculated the bulk density from a volume of sample by using David Laser Scanner 2.6.3, and the weight by an electronic balance. The density of gray and black particles are (0.7-2.2 g/cm^3) and (1.4-2.7 g/cm^3), respectively. For the same particles, we analyze chemical compositions of microlites, groundmass and matrix glasses. The black particles have higher bulk densities than gray pumices while the black particles have similar local bulk compositions to those of the gray particles. Particles with higher bulk density have higher groundmass crystallinity and higher in SiO_2 content of matrix glasses. It is interesting that the similar correlation between vesicularity and microlite crystallinity is also observed in the sub-Plinian eruption of the 1986B Izu-Oshima eruption and the Plinian eruption of the Fuji Hoei eruption, suggesting a common conduit process which may work widely in most of basaltic andesitic to andesitic sub-Plinian eruptions.

Keywords: Shinmoe volcano 2011 eruption, explosive eruption, bulk density, duration time