Connectivity and density variation of pumice clasts from the Simoyamazato pyroclastic flow deposits

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Degassing mechanism is one of the most important issues for understanding eruption styles. The foam collapse model leading to the effusive eruption, in which compaction of the foamed magma proceeds by permeable degassing, has been proposed (e.g. Eichelberger et al., 1984).However,little is known about magma compaction in the actual volcanic eruptions.

In order to understand the foam collapse process in the volcanic conduit, we have investigated textural variations of essential materials of the Simoyamazato pyroclastic rocks erupted 0.20-0.08Ma from Onikobe volcano, northeast Japan. The Simoyamazato pyroclastic rocks consist of fallout deposits and pyroclastic flow deposits. The pumice clasts of the flow can be classified into three types according to their color; white pumice, gray pumice (including dark gray pumice) and essential glassy fragments, of which bulk chemical compositions are the same. The color variation in the pumice clasts is mainly due to the microlite contents in groundmass (white pumice, ca.5%; gray pumice, ca.15% and dark gray pumice, ca.40%). Because volatile loss is responsible for the groundmass crystallization rather than cooling of magma (e.g. Hammer et al., 1999), the difference in microlite crystalinity shows the difference in the degree of degassing before quenching. The density of the pumice clasts shows bimodal frequency distribution; white and gray pumices have densities of 0.4-0.8g/cm3 and dark gray pumices 0.8-1.0g/cm3, whereas essential glassy fragments have 1.6-2.0g/cm3. The essential glassy fragments partly show pumiceous texture, and elongated bubbles exist in some cracks. Almost all of the fallout pumices have white color and microlite can be scarcely observed.

The connectivity of the bubbles (C= [the largest bubble cluster sizes / total cluster sizes of bubbles]) in the pumice clasts, which represents the degree of bubble coalescence, increases abruptly at the porosity of 50-77% for the pyroclastic flow deposits. The threshold porosities are different among the pumice types (white pumice, 72-77%; gray pumice, 62-73% and dark gray pumice, 50-63%). By contrast, fallout pumice does not show systematic increase of connectivity with porosity, although it has similar porosity range to that of the pumice clasts from pyroclastic flow deposit.

On the basis of the microlite and connectivity analysis, we propose that the textural variation of the pumice clasts represents the process of foam collapse, namely, the foam of the white pumices would have less collapsed than that of the gray pumice, in which devolatilization-induced crystallization of magma was promoted. The formation of the interconnected bubble network would result in permeable degassing and succeeding foam compaction, which would increase the foam density maintaining the connectivity.