Formation process of flow structure of rhyolite in Himeshima-island, Oita, Japan

Takayuki Nakano[1]; Atsushi Toramaru[1]

[1] Earth and Planet. Sci, Kyushu Univ.

There are a lot of rhyolite lava units in Himeshima-island, Oita, Japan, which exhibit the alternating light and dark layering structure, which is interpreted as a flow structure. For a lava unit at Mt. Daruma (the west-coast of Himeshima-island), we carry out textural, and chemical analysis for each light and dark part, and multifractal analysis for the flow structure. Textural observation reveals that the light layer is richer in vesicle content than the dark layer. These vesicles include particles of magnetits and glasses, are not transparent for the transmitted light. So we call these opaque materials as opaque aggregates. Chemical analysis by XRF shows the difference in the bulk chemical compositions between dark and light layers, indicating that iron, titanium and calcium contents in dark layers are higher than those in light layers. In contrast, silicon, aluminum and potassium contents in dark layers are lower than those in light layers. Particularly, iron contents show a remarkable difference between light and dark layers. In summary, the dark layer is iron-rich and vesicle-poor. Multifractal analysis shows that the spatial distribution of flow bands has a multifractal property, suggesting that quantities (ion and vesicle content, etc) characterizing individual band have the continuous variation in their intensities. Furthermore, some flow structures show the same multifractal signature. On the basis of these results, we propose that key processes of flow structure formation are the separation of vesicles and consequence iron transportation in magma, and the subsequent magma deformation, as follows. First, in a rhyolitic magma chamber vesicles form as a vapor phase with magma decompression. Second, vesicles move toward the top of the magma chamber and the chemical transportation of alkali elements occurs with rising vesicles (Sakuyama and Kushiro, 1979). At the same time, the iron component moves toward the bottom of the chamber. As a result, the contents of iron and alkali elements and vesicles take the heterogeneous but simple spatial distribution which gradually varies from the bottom to the top in magma chamber. Third, such a heterogeneous but simple structure of magma receives the sequential deformation during the magma ascent in the volcanic conduit. Such a stretching and folding process makes the flow structure with the multifractal characteristics.