Magma history of Unzen Volcano, investigated using drilling slime from conduit drilling (USDP-4)

Masaru Kurokawa[1]; Setsuya Nakada[1]; Mitsuhiro Yoshimoto[1]; Taketo Shimano[1]; Takeshi Sugimoto[2]; Kazukiyo Oguri[3]; Hideo Hoshizumi[4]

[1] ERI, Univ. Tokyo; [2] BGRL, Kyoto Univ.; [3] Earth Science, Nihon Univ; [4] GSJ, AIST

Scientific Drilling Project (USDP) started at Unzen Volcano in 1999 in order to clarify the geologic/tectonic growth history and magma evolution and to understand the eruption mechanisms. Following three holes (USDP-1, -2 and -3) penetrated on the volcano flank, the conduit drilling (USDP-4) aiming at penetration into a hot magmatic path was carried out during February 2003-July 2004. Drilling slims were taken from down to the depth of 1994 m with 2m depth intervals during the conduit drilling in the purpose to get the information of geology and petrology along the hole and to minimize the drilling time and cost. In this study, the drilling slimes were described quantitatively in order to understand geologic and magmatic history of the volcano.

Drilling slime samples were washed, sieved into four grain size groups (~2, 2-1, 1-0.25 and 0.25~ mm), and dried. Based on the shape and color of cuttings particles, the original rock was recognized as either lava flow, or pyroclastic- or debris-flow deposits. The cuttings is porphyritic dacite to andesite, and contains phenocrysts of plagioclase, hornblende, biotite, orthopyroxene, clinopyroxene, quartz, and opaque minerals. Plagioclase phenocrysts consist of dusty and clear types.

Color of the cuttings was expressed in the CIE L*a*b* color space. L* value is considered to reflect the degree of porosity in particles, and both a* and b* values reflect the degree of sample oxidization. Magnetic susceptibility or the cuttings reflects both the abundance of Fe-Ti oxides and state of oxidation. The intensity has a good correlation with total iron content of the cuttings.

It is expected that the bulk chemistry of the cuttings represent approximately that of the original rocks. It plotted against the drilling depth was very close to the temporal chemical variation in bulk chemistry that was reported previously, except for minor depletion in Sr and slight enrichment in SiO2.

In binary chemical variation diagrams all the cuttings show straight trend, and dusty and clear types coexist as plagioclase phenocrysts in all the thin sections. The fact strongly implies the common occurrence of magma mixing in the Unzen volcanic rocks throughout its growth history. Chemical compositions, especially SiO2 content and K/Rb ratio, are nearly constant in cuttings samples deeper than the 500 m of drilling depth and rather variable in the shallower samples. This suggests that mixing of magmas with different K/Rb ratios occurred for the shallower samples, and that for the deeper depths, the internal mixing with the almost fixed proportions may have occurred.