Magma ascent and outgassing processes of obsidian lava
-Insights from structures, textures and water concentration profiles -

*Kyohei Sano[1], Eiichi Sato[2], Yoshihiko Goto[3], Keiji Wada[4]

1.Shirataki-Geopark, 2.Kobe Univ., 3.Muroran Institute of Technology, 4.Hokkaido University of education at Asahikawa

Structures of obsidian lava are mainly divided into two regions; obsidian and rhyolite. These are defined based on the differences in appearance of hand specimens and rock texture. Rhyolite has perlitic cracks in the glass and contains some amounts of crystalline materials, namely, spherulite and lithophysae, whereas obsidian includes no such material at all.
Recent observation on Cordon Caulle (Chile, 2011-12) reported that explosive-effusive hybrid activity (Schipper et al., 2013), and we can consider that these differences are reflecting heterogeneous processes such as vesiculation and outgassing in volcanic conduit, and forms obsidian and rhyolite. In order to reveal such heterogeneous vesiculation and outgassing processes of viscous magmas, we performed water concentration analyses with comparing rock texture of samples from Sanukayama (SN) obsidian lava at Ko-zu island and Akaishiyama (AK) obsidian lava at Shirataki, Hokkaido.
A cross-section of the SN lava shows the following sequence from the bottom up: a lower rhyolite region (SN-LRhy), a lower boundary banded region (SN-LBB: 40 [m]) of obsidian and rhyolite, obsidian region (SN-Ob), upper boundary banded region (SN-UBB) and a clinker region (SN-CL) that is composed of vesiculated rhyolite and fine matrix. The SN obsidian is aphyric and contains microlites of plagioclase, biotite and oxides. Phenocrysts are plagioclase and biotite.
AK lava is characterized by well-growth spherulite. A cross-section of the AK lava is the following sequence from the bottom: lower obsidian region (AK-LOb), lower boundary banded region (AK-LBB), rhyolite region (AK-Rhy), upper boundary banded region (AK-UBB) and Upper obsidian region (AK-UOb). The AK obsidian contains oxide microlite, and no phenocrysts are contained. At AK lava, we can observe flow bands which are composed of the cm-scale spherulites in BB and Rhy regions. Sometimes spherulites include the obsidian particle. We can also observe the tuffisite structure.
The water concentration was determined using Karl Fischer Titration at the Hokkaido University of Education at Asahikawa. First, we powdered rock samples making sure that there were no crystal fragments. Next, we handpicked powders with an accuracy of $\pm 10^{-3}$ g for titration. The samples were heated to 120 [°C] for about 1 h to eliminate all adsorbed H_2O. Finally, we heated the samples to a temperature of 1000 °C to calculate the amount of dissolved water (Westrich, 1987). The titrations were finished when Time-Water amount slope become flat. The duration of analyses was up to 1[h].
Water concentrations in SN samples are following; 0.07 -0.27 [wt.%] in L-Rhy, 0.22 -0.99 [wt.%] in L-BB, 0.01 -0.29 in Ob, 0.01 -0.21 [wt.%] in Ob, 0.08 -3.06 [wt.%] in rhyolite region, respectively. The degree of hydration is higher in clinker region than lower rhyolite. Shields et al. (2016) suggested that the amounts of hydration of rhyolite lava samples have positive correlation with the connected vesicularity. According to their study, connected vesicules were highly developed in upper regions.
Water concentrations in AK obsidian were in the range of 0.01 -0.03 [wt.%], and no systematic change relating to lava structure can be observed. Spherulite shows 1.1 [wt. %] water concentration. We can consider that this value reflects that flow band structure, which is composed of spherulites, has connected vesicularity.
We compared the water concentration profile with lava structure and rock texture at SN and AK lava. Water concentration profiles give us the useful information to reveal the vesiculation and

outgassing processes in obsidian lava.

Keywords: obsidian, outgassing, water concentration