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北海道白滝．十勝石沢黒曜石溶岩のマグマ上昇と内部構造形成過程
Magma ascending and formation processes of Tokachi-Ishizawa obsidian lava, northern Hokkaido, Japan

佐野 恭平 [1*], 和田 恵治 [1], 佐藤 鋭一 [2]
SANO, Kyohei[1*], WADA, Keiji[1], SATO, Eiichi[2]

[1] 北海道教育大学旭川校, [2] 神戸大学　大学教育
[1]Hokkaido University of Education at Asahikawa, [2]Kobe University Edu.

Volcanic products generally contain several crystals. These crystalline materials can be formed due to cooling, ascending and vesiculation processes of magma. Obsidian is also volcanic product, and obsidian-forming magma must experience these processes. However, obsidian contains rare crystals, and formation processes of obsidian are poorly understood. This includes the poor understanding of obsidian eruption process, like a magma ascending and emplacement. Thus we need the discussion about these processes.

Obsidian lava complex in Shirataki, Hokkaido, erupted at 2.2Ma and formed obsidian monogenetic volcanoes. A cross section of Tokachi-Ishizawa obsidian lava (TI lava) in the complex is about 50 m in height and is stratigraphically observed from its flow bottom; brecciated perlite layer, obsidian layer (Ob layer), banded obsidian layer (BO layer), and rhyolite layer (Rhy layer). The BO is alternate layer of obsidian and rhyolite. We collected lowermost (Rhy-1) and interior (Rhy-2) samples in rhyolite layer. Rhyolite in BO layer (BO_rhy) is the brittlest and the most vesiculated in all rhyolite samples. On the other hand, Rhy-1 has low vesicularity.

In this study, we conducted chemical analysis and precisely described the rock micro-textures of TI lava samples from obsidian layer to the rhyolite interior in order to understand the magma ascending and formation processes of silicic obsidian lava structure.

TI lava obsidian is almost aphyric, composed of glasses (>98% in volume), rare plagioclase phenocryst (0.4-1.0 mm), plagioclase microlite (<0.2 mm), magnetite microphenocryst (= 0.05-0.07 mm), magnetite microlite (<0.05 mm) and rare biotite (<0.01 mm). Rhyolite samples have crystalline texture.

We counted crystal number (N_v) of magnetite microlite by 3D counting method (Castro et al., 2003). The N_v value in all of the TI lava samples is high with $10^{13.4}$-$10^{14.2}$ [number/m^3]. N_v is considered to reflect the super-cooling of crystallizing magma (Toramaru, 1991; Toramaru et al., 2008). TI lava magnetite microlite indicates no systematic change of crystal number toward lava interior. If the magnetite microlite is cooling-induced crystal, N_v of TI lava samples should indicate the decreasing correlation toward lava interior due to the slow cooling of lava interior. Furthermore, Rhy-1 shows the lowest number density and the highest value of mean width of magnetite microlite. This tendency of crystal growth observed in Rhy-1 can not be explained by cooling, because Rhy-1 is the outer sample than Rhy-2, and cooling rate of Rhy-2 should have been lower than Rhy-1. And for so we infer the magnetite microlite in TI lava are decompression-induced (i.e. crystallized by vesiculation) crystals.

We performed X-ray diffraction analysis (XRD) for all TI lava samples. Rhyolite samples indicated the distinguished peak of albite. Based on the result of XRD, crystallinity of all rhyolite samples are following order: Bo_rhy > Rhy-2 > Rhy-1. Furthermore, this order is corresponding to the N_v value and degrees of vesiculation, that is, high N_v sample indicated the highest crystallinity and vesiculality in TI lava rhyolite. This relation may reflect the crystallization process by the vesiculation.

N_v and crystallinity inferred from XRD in TI lava indicate magma ascending and formation processes of obsidian-rhyolite layer during conduit and surface flow. Based on the rock texture and XRD, we can consider that crystallization process in rhyolite layer is affected by vapor phase. We intend to model the formation process that produced the obsidian-rhyolite internal structure of TI lava by viscous silicic magma.

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