大分県姫島に分布する城山黒曜石溶岩の定置過程
Emplacement process of the Shiroyama obsidian lava in Himeshima Island, SW Japan

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The Shiroyama lava is distributed in northwestern part of the Himeshima Island in Oita prefecture, and the K-Ar age is 0.32± 0.05 Ma (Kaneoka and Suzuki, 1970). The dark-gray colored dense obsidian is partly developed in the Shiroyama lava (Itoh et al., 1997). Although distribution of the obsidian is restricted in the narrow area of Kannonzaki cape where is northern margin of the lava, the good exposure provides an opportunity to understanding the formation process. The obsidian gradually changes to light-gray colored, highly vesicular rhyolite lava (Itoh et al., 1997) that comprises a large part of the lava. The welded-pyroclastic rocks (Kannonzaki pyroclastic rock; Itoh et al., 1997), which are contacted with the dense obsidian, are also occurred in Kannonzaki cape. In this study, we show the geological characteristics of the Shiroyama lava and discuss about its emplacement process.

The flow direction of the Shiroyama lava, inferred from the topography and flow banding morphology, is from north (Kannonzaki cape) to south. This means that the obsidian is distributed around the source region and was emplaced at the final stage of the extrusion. The internal structure of the obsidian is characterized by pervasive brecciation. The brecciated clasts are commonly elongated in length from a few cm to several tens of cm and frequently show ductile deformation. This means that the brecciation was occurred during ductile-brittle transition temperature. The elongated clasts are aligned nearly vertically, and the foliation is nearly parallel to the plane of contact with the Kannonzaki pyroclastic rocks. In the boundary between the brecciated obsidian and the pyroclastic rocks, the cataclastic zone with <1m in width is developed. The cataclastic materials are composed of both the obsidian and pyroclastic rocks. The foliation and lineation of the cataclasite defined by the alignment of the fragments are consistent with those of the brecciated obsidian. These mean that the obsidian breccia and the cataclasite were formed by shear stress under the same sense.

The vertical-orientated brecciated clasts indicate that the obsidian suffered vertical shear stress. This observation shows that the obsidian corresponds to the ascending magma within the shallow conduit rather than the advancing lava on the land surface. It has been considered that the magma fracturing and brecciation are caused by intense shear at the conduit walls (e.g. Gonnermann and Manga, 2003; Tuffen et al., 2008). The cataclastic zone between the obsidian and the Kannonzaki pyroclastic rocks would be caused by accumulation of the shear stress at the conduit wall. The development of the cataclastic zone in the conduit margin is consistent with observation of the silicic lava extrusions at Unzen and St. Helens volcanoes (Nakada et al., 1999; Pallister et al., 2013). Since the transient fractures within the magma is expected to act as degassing pathways (Tuffen et al., 2003, Okumura et al., 2015), the pervasive brecciation of the obsidian shows that the magma experienced extensive degassing within the conduit. Cabrera et al. (2015) proposed that the formation of the dense obsidian is promoted by magma degassing using the fractures. In the Shiroyama lava, the restricted distribution of the dense obsidian in the conduit may be explained by the extensive degassing due to the magma fracturing and brecciation that predominantly occurred

at the final stage of the extrusion.

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