Rotational deformation of a rhyolite lava flow below the Curie temperature of magnetite: Sanukayama rhyolite lava in Kozushima Island, Japan

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Rhyolite lava flow often has a total thickness more than one hundred meters, which is made up mainly of grassy part (e.g. Manley and Fink, 1987; Furukawa and Kamata, 2005). A crystal-poor rhyolitic lava shows its flow front advance that lasts long time after the cessation of lava supply (Tuffen et al., 2013). Consolidated upper grassy part can passively be deformed due to the advance of the inner part, i.e. crystalline part, of rhyolite lava below the Curie temperatures of magnetic minerals. This study aims to investigate the characteristics of deformation, in particular the upper part, of rhyolite lava flow during the emplacement of the lava by means of paleomagnetism. The 50-70 ka, 150 m thick Sanukayama rhyolite lava in Kozushima Island, Japan is chosen as the site of our investigation. The lava shows its vertical section due to erosion, which enabled vertical paleomagnetic sampling up to about 80 m thickness. Paleomagnetic samples were taken from pumice, welded and non-welded breccia, and obsidian in the upper grassy part. In addition, crystalline rhyolite and tuffisite (lenticular body, Isshiki, 1982) in obsidian were sampled.

Remanent magnetization of the rhyolite samples is carried by magnetite, and therefore deformation during emplacement below 580 degrees C may be detected and shows that no rotational deformation occurred after complete consolidation of the lava.

Analysis of remanent magnetization of the lava shows deflection in remanence directions by 30 degrees two times above about 400 degrees C, which is as low as the grass transition temperatures of rhyolite. Therefore, the deflection in remanence directions is interpreted as deformation of the lava after the consolidation of the upper grassy part. Assuming the deformations as being rotation about a pole, the deformations of all the grassy part can be ascribed to rotation about a single axis between temperatures of 580 and 400 degrees C. In contrast to the case for the grassy art, the inner crystalline part and tuffisite have a single thermoremanent magnetization component, suggesting that these parts are considered to have retained high temperature enough to be unaffected, i.e. above the blocking temperatures of magnetite, at the time of deformation of the grassy part.

It is concluded that using paleomagnetic data, the grassy part of the Sanukayama rhyolite lava in Kozushima Island, which was cooled below the Curie temperature of magnetite, has been rotated by the advance of the inner part of the lava during its emplacement process. In contrast, tuffisite in the grassy part of the lava is considered to have retained high temperature locally at the time of rotation of the grassy part.

Keywords: rhyolite lava, deformation, paleomagnetism, Kozushima Island

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