On the cause of Mt. Motoshirane eruption in 2018

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Mt. Kusatsu-Shirane is an active volcano located in the northern part of Gunma prefecture, composed of three peaks extending in the north-south direction. On the northern tip of volcano, there is Yugama crater with strongly acidic lake water. At the north foot of Yugama crater there is a geothermal zone developed. We have Ainomine peak on the 1 km south of Yugama crater. A ropeway station had been operated at the foot of Ainomine peak. There is a crater group of Mt. Motoshirane at 1 km southward of Ainomine peak, one of which caused a small steam eruption on January 23, 2018. In this paper, we consider magma hydrothermal system developing in Kusatsu Shirane volcano and propose eruption mechanism.

Considering the resistivity structure given by previous studies and the hypocentral distribution, there are two hydrothermal reservoirs in Mt. Kusatsu Shirane, one is located under Yugama crater and another is located just under 500 meters east of Ainomine peak. We call those reservoirs, H1 and H2, respectively. A part of the fluid released from H1 is supplied to Yugama crater, and a part flows down the basement at the east foothills. The gas phase separated from the fluid is released from the geothermal area north of Yugama crater. The fluid released from H2 flows down underground at the foot of the east of Ainomine peak, and it is discharged as a thermal spring water at Bandaikou and Kusatsu town. The gas phase separated from this fluid is released as fumarolic gas at Sesshou geothermal area. Since the position of H2 is deeper than H1, the gas phase separated from the fluid of H2 must rise a distance of about 1000 m to reach the ground in the summit area. For that reason, it is thought that low temperature fumaroles are formed by being cooled during the movement.

From 2014 onwards, the supply rate of magmatic gas to H1 is thought to have decreased based on the fumarolic composition change at the geothermal area north of Yugama crater. The decline in seismic depth at H1, which became prominent in 2017, is likewise explained by a decrease in the supply rate of magma gas. Such a drop in the supply rate of magma gas to the hydrothermal reservoir may be caused by so-called magma sealing. As a result of the progress of magma sealing between H1 and a degassing magma, magmatic gas lost its place and was supplied much to H2, the fluid pressure in H2 rose and the depth of seismicity at H2 became shallow. Furthermore, since a part of H2 fluid moved to the crater group at Mt. Motoshirane, it is considered that steam eruption occurred.

Keywords: Mt. Motoshirane, Steam eruption, Magma sealing