

Evolution of a hydrothermal system of Kusatsu-Shirane volcano inferred from aerial infrared surveys in the nighttime

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Kusatsu-Shirane volcano is one of the most active volcano in terms of release of a large amount of heat as volcanic gas and hot springs. In addition to steaming grounds and fumaroles, the Shirane pyroclastic cone contains a hot crater lake, locally referred to as Yugama, which shows interesting variations of water temperature and chemical concentrations.

Intense earthquake swarms have occurred at shallow depth of the Shirane pyroclastic cone since March 2014, accompanied by a ground deformation, changes in geomagnetic field and chemical concentration of volcanic gas. A location of the pressure source is determined by network of our tilt meters at 550 m depth from Yugama crater lake. These unusual activities may be caused by an accumulation of hydrothermal hot water at shallow depth of Yugama crater lake, so we expect changes in thermal activities around the Shirane pyroclastic cone.

To detect changes in thermal activities on Kusatsu-Shirane volcano, an aerial infrared survey was carried out on 25 October 2014. The observation was done in the nighttime because even slight anomalies in ground surface temperature can be detected. Images of detailed ground temperature enable us to estimate precisely heat- and water-discharge rates from steaming ground as well as Yugama crater lake.

Steaming grounds around Yugama crater lake show no significant changes compared with the record obtained in 2012, although changes in chemical compositions of volcanic gas emitted here were observed. On the other hand, we detect an increase in water surface temperature of Yugama crater lake. Water evaporation rate in 2014 is estimated approximately to be 5 kg/s, which is 2.5 times higher than that of the value in 2012. Such an increase in water temperature occurred in May 2014 suggested by monitoring of Yugama crater. Records of tilt meters indicate that an accumulation rate of the hydrothermal water decreased after May 2014. We consider that the reservoir of hydrothermal water fractured gently in May 2014. Consequently, an additional input of hydrothermal water started at the bottom of Yugama crater lake.

Keywords: Kusatsu-Shirane Volcano, airborne IR surveys, hot crater lake, steaming ground, hydrothermal system, heat-discharge rate