# Magmatic hydrothermal system inferred from the resistivity structure of Kusatsu-Shirane Volcano

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Kusatsu-Shirane volcano consists of two main pyroclastic cones. One is Mt. Shirane located in the northern part of summit area, which has three active crater lakes. Various geochemical and geophysical researches have been conducted and several models of the subsurface structure and the hydrothermal system have been proposed. The other is Mt. Motoshirane located about 2 km south of Mt. Shirane. In this area, no volcanic activity is observed today, and therefore studies targeted for this cone have not been conducted other than several geological studies. Two major hot springs of the volcano, Kusatsu and Bandaiko hot springs which are characterized by high-temperature and high-discharge-rate, occur in the east flank of Mt. Motoshirane. The recent geological study revealed that the last magmatic eruption had occurred from Mt. Motoshirane about 1500 years ago.
We conducted a magnetotelluric (MT) study on the subsurface structure of Mt. Motoshirane in this study. The MT method is a kind of electromagnetic method to infer the subsurface structure and sensitive to conductive materials such as melt and hydrothermal fluids. The objective of this study is to clarify the whole image of magma-hydrothermal system of Kusatsu-Shirane volcano. The final three-dimensional (3-D) resistivity model revealed the presence of a conductor (henceforth we call it C2) beneath the summit area extending from Mt. Shirane to Mt. Motoshirane. Since the horizontal extent of this conductor covered two clusters of hypocenter distribution which are located within each pyroclastic cone, the conductor was interpreted as a hydrothermal fluid reservoir providing fluids to the shallow terrain and causing volcanic earthquakes. From the result of the 3-D resistivity structure indicating no conductor which is considered to preserve such volcanic fluids in the region between the hot springs of the east flank and C2, we consider that the conductor C2 is a source of the heat and fluid of Bandaiko and Kusatsu hot springs, and propose the following model of a hydrothermal system of the volcano.
The region beneath the C2, a heat source is located and provides the heat and fluids to C2. The heated fluids in C2 ascend to the summit area, causing volcanic earthquakes. A part of the heated fluids ascends to the east flank of Mt. Motoshirane, through fractures of the Kusatsu fault, and forms a hydrothermally altered zone and fumarolic zones such as the Sessho fumarolic area. Mixture of ground water and the fluids from C2 flows down to the east flank of the volcano and is discharged as Bandaiko and Kusatsu hot springs.
In a deep part of the volcano, no conspicuous feature indicating the existence of magma was found in the final resistivity model. However, it does not necessarily mean that there is no magma chamber beneath the region. Additional observations and/or simulations are required in order to constrain the location of magma, which should be carried out in the future.

Keywords: Kusatsu-Shirane volcano, Mt. Motoshirane, resistivity structure, hydrothermal system, magma reservoir

 