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Conductivity distribution of the surface layer in Aso Caldera

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Kagiyama and Morita(2008) proposed that volcanism has a wide range of diversity represented by two typical end members controlled by the easiness of magma storage beneath volcano; Eruption dominant (ED) volcanism in difficult condition and Geothermal activity dominant (GD) volcanism in easier condition. In GD volcanoes, magma stagnates beneath volcanoes and maintains geothermal activity. This seems GD volcanoes continue to give much benefit to human society. However, GD volcanoes sometimes have large eruptions after repeated stagnations of magma. This fact suggests it is very important to understand where and why magma stops ascending. Kagiyama and Morita (2008) indicated magma degassing is one of the important factors to control magma ascending. On this aspect, the authors have carried out VLF-MT survey around some active volcanoes in Japan, because electrical conductivity of ground strongly depends on the conductivity of pore water.

Aso Caldera has an acid crater lake in Nakadake, which is one of the post caldera cones, and has many hot springs such as Uchinomaki, Akamizu. Conductivity distribution shows two typical features; caldera floor has almost homogeneous and high conductivity (>10mS/m), while the post caldera cones show wide range.

Most cones such as Kishima-dake and Ohjo-dake have lower conductivity (<3mS/m), except around Naka-dake Craters and western flank of post caldera cones such as Yoshioka, Yunotani and Jogoku-Tarutama (>30mS/m). Kusasenri Volcano, located between Naka-dake and Yoshioka has also rather high conductivity (3-10mS/m). These areas locate along the E-W trend of the major post caldera cones. Most part of the northern flank of the post caldera cones shows low conductivity (<3mS/m). However, higher conductivity was found around Sensuikyo, just north of Nakadake Craters. This suggests down flow of hydrothermal water from Naka-dake Craters to the caldera floor. Similar features are detected in the southern flank; from Nakadake to Shirakawa Hot Spring, from Jigoku-Tarutama Hot Springs to Tochinoki Hot Springs.

Caldera floor has almost homogeneous conductivity. This feature is explained by the fact that the caldera floor was under the lake until 9 ka and is covered by lake deposit. However, extremely high conductivity was found at three areas (>50mS/m). Two of them correspond hot spring areas; Uchinomaki in the north and Akamizu in the west. The third area is distributed around old post caldera cones, Mietsuka. The age of these cones was estimated around 46 ka, and no hot spring is distributed. High conductive zones, Uchinomaki, Mietsuka and Naka-dake are located along the NNW-SSE line. Hydrothermal water may be supplied along this line.

These results suggest that hydrothermal water is supplied along the E-W trend crack from Naka-dake to Yoshioka, mainly supplied beneath Naka-dake, and expanded to the northern caldera floor. The NNW-SSE trend from Naka-dake to Uchinomaki may suggest a tectonic fault. Aso has wide high conductivity area and degassing in Aso might be large to be GD volcano.

Reference: Kagiyama and Morita, First steps in understanding caldera forming eruptions, J. Disaster Res., 3, 270-275, 2008.

Keywords: Electrical conductivity, Geothermal activity, Failed eruption, Aso Caldera