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Abstract 2-03p

Large hydrothermal reservoir beneath Taal Volcano (Philippines) revealed by MT survey

Part I: 2-D resistivity modeling

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Taal volcano, located in the Taal caldera lake, the southern part of the Luzon Island, is one of the most active volcanoes in Philippines. We conducted a magnetotelluric resistivity survey to clarify the distribution of hydrothermal and magma reservoir beneath the volcano. AMT and wideband MT data were measured along two lines, which were crossing the main crater lake (MCL) at the center of the volcano island, and the southwestern flank. The impedance tensor and induction vector were calculated from the measured time series data.

Prior to a 2-D analysis, the phase tensor analysis estimated the electromagnetic strike direction in the study area as N35ºE, which is approximately perpendicular to our survey lines. Here, during the 2-D analysis, it is required to consider the sea effect to the MT data because the study area is surrounded by the ocean, being about 15 km distant from there. The measured induction vectors pointing toward the ocean are obviously affected by the seawater. The 3-D forward model assuming a simplified bathymetry with 0.3 Ωm seawater evaluated this effect. The calculated induction vectors explained well the observed ones at a frequency band below 0.3 Hz, reflecting the sea effect. However, this effect to the impedance above 0.01 Hz was not so large as to give critical artifacts to a resistivity structure suspected by a 2-D analysis. Therefore, the apparent resistivity and impedance phase above 0.01 Hz were inverted to resistivity sections, by using the 2-D resistivity inversion scheme developed by Ogawa and Uchida [1].

The inverted resistivity section across the MCL indicates a relatively resistive body (30-100 Ωm) at 1-3 km (b.s.l.) surrounded by conductive structure. Since this feature is common to the other resistivity section, the conductor can shape a kind of the shell spherically covering the resistive body (Fig. 1). These resistive and conductive bodies can be interpreted as a hydrothermal reservoir and surrounding impermeable clay cap, respectively. The episodic inflation and deflation activities were observed around the volcano in 1998-2000, and their deformation source was estimated at the depth of 4-6 km beneath the MCL [2]. If the inflation reflected a magma intrusion into the source depth, the following deflation could suggest a dissolution or diffusion of magmatic fluid into the overlying hydrothermal reservoir. It is likely that these reservoir and cap structures control the current activities of the Taal volcano, and will be destroyed during the expected magmatic explosion in the future.

References

[1.] Ogawa and Uchida, A two-dimensional magnetotelluric inversion assuming Gaussian static shift, Geophys. J. lnt., 126,69-76, 1996.

[2.] Bartel, B. A., M. W., Hamburger, C. M. Meertens, A. R. Lowry, Dynamics of active magmatic and hydrothermal systems at Taal Volcano, Philippines, from continuous GPS measurements and Ernesto Corpuz, J. Geophys. Res., 108 B10, 2475, doi:10.1029/2002JB002194, 2003

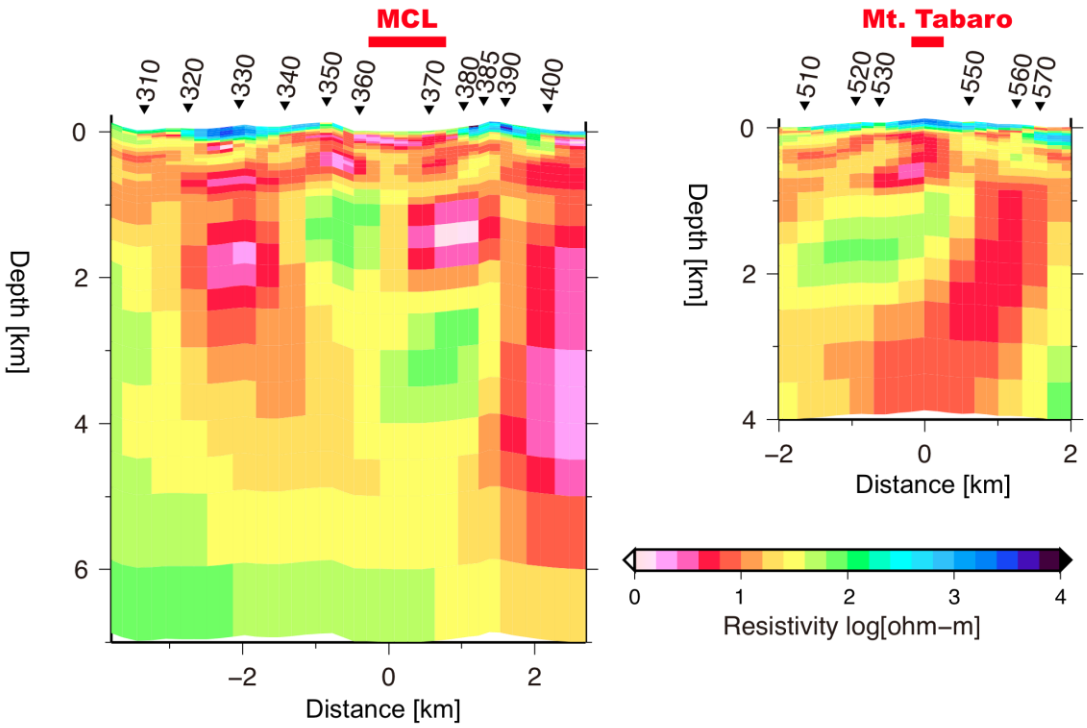

Fig. 1: Resistivity sections along Line 300 (across MCL) and 500 (across SW flank).