EMSEV 2012
Gotemba Kogen Resort, Gotemba, Japan
October 1–4, 2012
Abstract 2-02

Large hydrothermal reservoir beneath Taal Volcano (Philippines) revealed by MT survey, Part II: a 3-D Model and its implications to the volcanic activity

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1. Introduction

Taal Volcano is one of the most active volcanoes in the Philippines. The first recorded eruption was in 1573. Since then it has erupted 33 times resulting in thousands of casualties and large damages to property. In 1995, it was declared as one of the 15 Decade Volcanoes. Beginning in 1992 it has experienced several phases of abnormal activity, including seismic swarms, episodes of ground deformation, ground fissuring and hydrothermal activities, which continues up to the present. However, it has been noted that past historical eruptions of Taal Volcano may be divided into 2 distinct cycles, depending on the location of the eruption center, either at Main Crater or at the flanks. Between 1572-1645, eruptions occurred at the Main Crater, while in 1707 to 1731, they occurred at the flanks. In 1749, eruptions moved back to the Main Crater until 1911. During the 1965 and until the end of the 1977 eruptions, eruptive activity once again shifted to the flanks.

We believe that a hydrothermal reservoir exists beneath Taal Volcano, and that a catastrophic collapse of this reservoir is the cause of the violent 1911 eruption. In this study we aim to show the size and location of this hydrothermal reservoir.

2. Method and results

As part of the PHIVOLCS-JICA-SATREPS Project magnetotelluric and audio-magnetotelluric

surveys were conducted on Volcano Island in March 2011 and March 2012. To this data we apply two-dimensional (2-D) inversion modeling by Uchida and Ogawa (1993) which reveals a prominent and large zone of relatively high resistivity between 1 to 4 kilometers beneath the volcano almost directly beneath the Main Crater, surrounded by zones of relatively low resistivity. This anomalous zone of high resistivity surrounded by relatively low resistivity zones is hypothesized to be a large hydrothermal reservoir filled with volcanic fluids. Furthermore according to a 3-D forward modeling using he method by Fomenko and Mogi (2002), the size of the reservoir is as large as 3 km in diameter and its location between 1 to 4 km in depth.

3. Conclusions

The presence of this large hydrothermal reservoir could be related to past activities of Taal Volcano. During the cycle of Main Crater eruptions, this hydrothermal reservoir is depleted, sometimes violently, while during a cycle of flank eruptions this reservoir is replenished with hydrothermal fluids. In particular, the 1911 January 30 eruption showed an anomalous feature similar to a gas explosion. This could be the result of the hydrothermal reservoir collapsing.

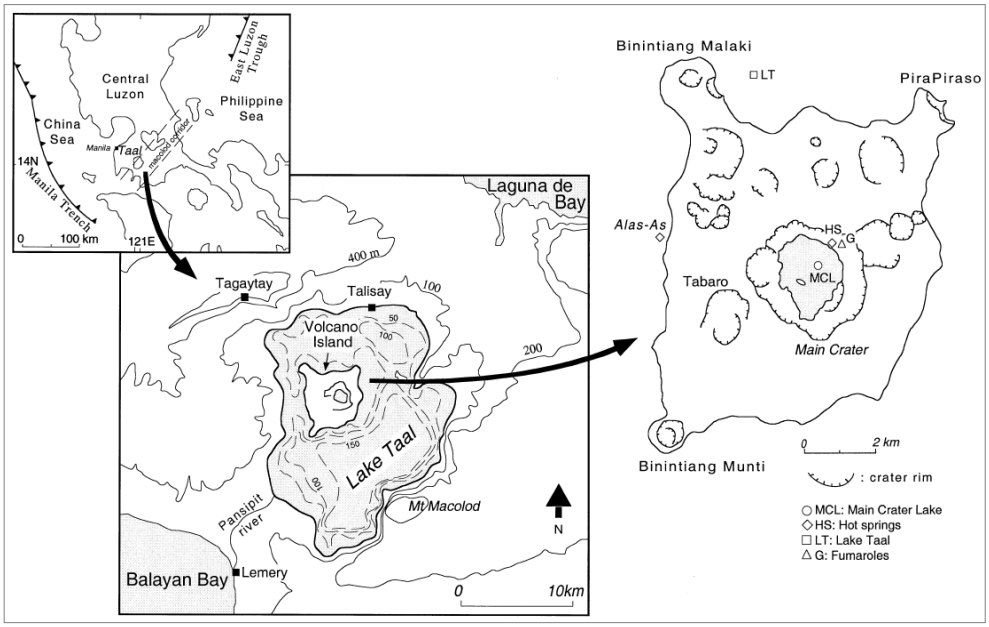

Figure 1. Map of study area (from Delmelle et.al., 1998)

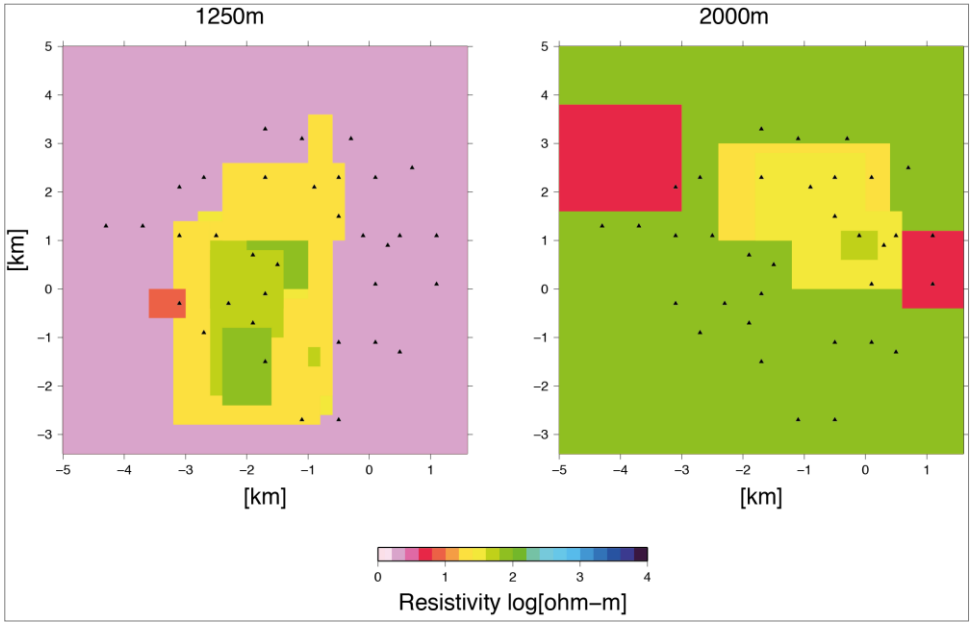

Figure 2. Horizontal resistivity sections at 1250m depth (left) and 2000m depth (right). Black triangles are MT sites.