

Magnetic and SP measurements in Taal Volcano, Philippines

Makoto Harada[1]; Yoichi Sasai[2]; Jacques Zlotnicki[3]; Julio P. Sabit[4]; Jane T. Punongbayan[4]; Juan M. Cordon Jr.[4]; Edgardo U. Villacorte[4]; Paul Karson B. Alanis[4]; Ishmael C. Narag[4]; Raymond Patrick R. Maximo[4]; Teodorico A. Sandoval[4]; Ernesto G. Corpuz[4]; Bartolome C. Bautista[4]; Renato U. Solidum Jr.[4]; Toshiyasu Nagao[1]; Seiya Uyeda[1]

[1] Earthquake Prediction Res. Center, Tokai Univ.; [2] Disaster Prevention Division, Tokyo MG; [3] OPGC-Clermont; [4] PHIVOLCS-DOST

The monitoring network of the volcanic activity in Philippines has been maintained by the Philippine Institute of Volcanology and Seismology (PHIVOLCS) which is affiliated with the government of the Republic of Philippines. The network consists of the seismometer, GPS receiver, water level data logger, tide gauges, EDM and precise leveling, which are mainly concerned with the detection of crustal movement.

The electromagnetic (EM) study in the volcanology has made rapid progress in the last two decades. The continuous measurement and repeat survey of self-potential (SP) and total magnetic field (TMF) intensity are considered as the promising approach to connect the phenomena on the surface activities such as the steam explosion and PH variations in the lake, and the deep magmatic activity. By adding the EM measurements to the observation system, the alert level of a volcano could be more properly specified, which will lead to protect the life and property of the residents around the volcano.

In order to advance the cooperative research of the geotectonics, seismicity and volcanism of the southern Luzon Region in Philippines, the working group on Electromagnetic Study of Earthquakes and Volcanoes (EMSEV) under the International Union for Geophysics and Geodesy (IUGG) and PHIVOLCS have agreed to the MOU by the end of December, 2004. Taal Volcano was chosen as the practical field of study.

Taal Volcano (120.99E, 14.00N) is located 60 km south of Manila. The Taal Caldera is approximately 25 km by 30 km wide. Inside the caldera is Taal Lake, at the center of which is the Taal Volcano Island, one of the world's lowest and deadliest volcanoes. The thirty-three recorded eruptions of Taal from 1572 - 1977 include phreatic to phreatomagmatic eruptions. In the most famous 1965 eruption, base surges that originated from the southwest flank of the Island (Mt. Tabaro) killed 190 people when the surges traveled across the lake onto the southwest Taal Lakeshore. Although the volcano has been relatively quiescent since 1977, swarms of seismic events excite the monitoring network from time to time. Intense swarm earthquakes occurred in 1994, accompanied by ground fissuring, uplift and increased steaming activity. Recently, significant volcanic earthquakes were recorded on September 23, 2004. Since then, the number of high-frequency type earthquakes is increasing up to present. Although the most recent volcano's status is at Alert Level 1, which means there is still no clear indication of an impending eruption, the Main Crater is off-limits to the public because sudden steam explosion may occur or high concentrations of toxic gases may accumulate (PHIVOLCS, Feb.18, 2005).

The electric and magnetic measurement in Taal Volcano was carried out on January 9-14, 2005. We measured the total magnetic field (TMF) intensity, electrical self-potential (SP), and CO₂ concentrations on the same lines in the Main Crater, on the crater rim, and on the hillsides of the Volcano Island. We used one proton precession magnetometer (OMNI-IV, SCINTREX Ltd.) and two Overhauser magnetometers (GSM-19, GEM Systems Inc.) to acquire the TMF. One of the Overhauser magnetometers was used as the remote reference, which was installed near the volcano observatory at Buco. The pair of Pb-PbCl₂ electrodes and high-impedance multi-meter was used to measure the SP field. Mobile survey of TMF and SP fields was practiced at every 25 meters. In order to monitor the anomalous magnetic field variations due to the change of geothermal distributions, we constructed 21 benchmarks for the repeat precise TMF survey inside and outside the geothermal area.

We observed 2.5 nT of systematic TMF increment at the repeat survey points in the Main Crater even at 5 days' interval during the campaign, which implies the decrease of magnetization due to the geothermal increase. We will show the details of the observation and the preliminary results in the presentation.