ELECTROMAGNETIC, GEOCHEMICAL AND THERMAL ANOMALIES RELATED TO THE HYDROTHERMAL ACTIVITY OF TAAL VOLCANO (PHILIPPINES)

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On volcanoes which display hydrothermal/magmatic unrests, Electromagnetic (EM) methods can be combined with geochemical (GC) and thermal methods. The integration of these methods allows to image in detail hydrothermal systems, to find out possible scenarios of volcanic unrest, and to monitor the on-going activity with knowledge on the sources of heat, gas and fluid transfers. In the frame of 'Electromagnetic Studies of Earthquakes and Volcanoes (ESMEV)' working group activities and the joint EMSEV-PHIVOLCS ('Philippines Institute of Volcanology and Seismology') cooperation supported by the International Union of Geodesy and Geophysics ('IUGG'), an international joint program started in 2005 on Taal volcano. This volcano can exhibit phreatic, phreatomagmatic and plinian eruptions. Since the 1990's the volcano shows recurrent periods of seismic activity, ground deformation, hydrothermal activity, and surface activity (geysers).
Combined EM and GC methods noticeably contribute to map in detail the hydrothermal system and to analyse the sources of the activity:
- Total magnetic field mapping evidences demagnetised zones over the two main areas forming the hydrothermal system (in the northern part of Main crater (MC)). These low magnetized areas are ascribed to thermal sources located at some hundreds metres of depth,
- Self-potential surveys, delineate the contours of the fluids-heat transfer, and find out the northern and southern structural discontinuities enclosing the hydrothermal system,
- Ground temperature gradient measurements evidence the distinctive heat transfer modes, from low fluxes related to soil temperature dominated by solar input to extremely high temperature gradients of 1200 °C m^{-1} or to more related to magmatic fluids.
- Ground temperature and surface temperature of central acidic lake calculated by Thermal Aster imaging highlight the location of the most active ground fissures, outcrops and diffuse areas. Higher and larger anomalies are observed in the northern part of MC. A rough estimation of the thermal discharge in the northern part of the volcano gives 17 MW.
- CO_2 concentrations and fluxes from soil supply inform on fluids origin and on local processes operating along active fractures. Much higher carbon dioxide fluxes at MC sites confirm that the source of Taal activity is presently located in the northern part of the crater.
- Heat and fluids release from the hydrothermal system delineate a general NW-SE ellipsoid in the northern part of MC and may be related to a suspected NW-SE fault along which seismicity takes place and dikes are believed to intrude triggering volcanic crises. The northern flank of the volcano is mechanically and hydro thermally reactivated during seismic crises and this sector could be subjected to a flank failure.

volcanoes, hydrothermal activity, electromagnetism, geochemistry, thermal activity