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Multidisciplinary investigation (ERT, CO_2, SP and T) reveals fluid circulation at Somma-Vesuvius

Matthieu Poret (1,2), Tullio Ricci (3), Anthony Finizola (4), Eric Delcher (4), Aline Peltier (5), and the Vesuvius Team ERT 2014 Team

(1) Istituto Nazionale di Geofisica e Vulcanologia, Geophysics, Bologna, Italy (matthieu.poret@ingv.it), (2) Department of Geophysics, University of Bologna, Italy, (3) Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy, (4) Laboratoire GéoSciences Réunion, Université de la Réunion, Institut de Physique du Globe de Paris, CNRS, UMR 7154, Sorbone Paris Cité, La Réunion, France, (5) Institut de Physique du Globe de Paris, CNRS, UMR 7154, Sorbone Paris Cité, La Réunion, France

Somma-Vesuvius volcano, located near the city of Naples, threatens about 800,000 peoples producing one of the highest volcanic risk in the world. In the framework of the EC FP7 project "MEDiterranean SUpersite Volcanoes" a multidisciplinary investigation was performed in March 2014. This survey aimed (1) at locating the present-day hydrothermal system of Somma-Vesuvius and (2) at identifying the preferential paths and fluid flows inside the volcano.

The prospecting methods used were Electrical Resistivity Tomography (ABEM SAS 4000) with 64 electrodes at 40 m spacing (in Wenner alpha configuration), self-potential (SP), temperature (30 cm depth) and CO_2 concentration in the soil at 20 m spacing. All the measurements were performed along a 7 km long profile completed with roll-along (North- West to South-East). The depth of investigation for ERT reached about 500 m. This method revealed an electrical conductive body (20-100 ohm.m) centered beneath the summit of the Vesuvius cone. This conductive body was interpreted as the present-day hydrothermal system of the volcanic complex. Regarding the shape of this structure we noticed a deeply different shape respect to the one observed on both Stromboli and Vulcano volcanoes. Indeed, the Vesuvius hydrothermal system appears to act as a body which is constrained up to 200-250 m below the surface and, moreover, also emphasized by the W-like shape of the SP signal. From ERT and SP results a diameter of around 1.7 km at the maximum depth of investigation is estimated for the hydrothermal system of Somma-Vesuvius.

In addition, four weak thermal anomalies (6-13°C) are identified on the summit area. They can be explained as preferential paths of up-flowing fluids. It follows that the largest structure seen on both temperature signal and ERT tomography is related to the crater rim of the 1906 eruption. Furthermore, on both lower sides of Vesuvius cone a conductive body (300-600 ohm.m) is identified within a resistive environment (2300-2500 ohm.m). In agreement with the literature, these structural boundaries are interpreted as the 1631's caldera rim. These observations are also validated by topographic breaks in slope and higher CO_2 concentration values.