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Structure of the Mount Vesuvius volcano from geophysical exploration

M. Vassallo[1,2]; A. Zollo[1]; G. Festa[1]; C. Satriano[2]; L. D'Auria[3]; P. Gasparini[1,2] and P. Strolin[1]

[1] Dip. Scienze Fisiche, Università di Napoli Federico II, Italy
[2] AMRA S.c.a.r.l., Napoli, Italy
[3] Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano, Napoli, Italy

Mt. Vesuvius is a strato volcano near a densely populated area and only a few km southeast of Campi Flegrei, the active calderas on which the city of Napoli has been built. It is composed of a volcanic cone (Gran Cono) that was built within a summit caldera (Mount Somma). The Somma-Vesuvius complex has formed over the last 25,000 years by means of a sequence of eruptions of variable explosiveness, ranging from the quiet lava outpourings that characterized much of the latest activity (for example, from 1881 to 1899 and from 1926 to 1930) to the explosive Plinian eruptions, including the one that destroyed Pompeii and killed thousands of people in 79 A.D. It experienced at least three violent explosive eruptions in historical times (79, 472, and 1631 A.D.). More frequent, less explosive eruptions have occurred from 1631 to 1944. Mt. Vesuvius is presently in a quiescent state, characterized by low-temperature fumaroles (less than 100°C) and moderate seismic activity (about 100 earthquakes per year with magnitudes between 0.5 and 3.6), and it is difficult to predict when it may erupt explosively again.

In the last 50/60 years the municipalities located on the slope of the volcano have had an uncontrolled expansion. Actually about 700,000 people live along the volcano's flank, within a 15 km radius from the central crater. This has transformed Mt. Vesuvius surroundings into one of the areas with the highest volcanic risk in the word. As a consequence the volcano has been the object of accurate geophysical and volcanological

studies aiming at the definition of a structural model of the volcano that can be used to help prediction of the scenario of the next eruption and to improve the forecasting capability of the monitoring system. Several important results have been obtained by seismic tomography and seismic reflection analysis:

- no evidence for the occurrence of a reservoir shallow than 8 km;
- the presence of a high-velocity body located 1-1.5 km underneath the summit caldera of volcano and interpreted as an array of magmatic dykes solidified at small depth;
- evidence of an extended (at least 400 square kilometers) low-velocity layer at about 8 km depth interpreted as an extended sill with magma interspersed in a solid matrix.

As a work performed in Japan has recently demonstrated, useful information on the internal structure of shallow part of volcanoes can be retrieved using innovative radiographic techniques based on cosmic-ray muons. We have initiated a perspective study for a muon radiography of shallow part of Vesuvius with the aim to reconstruct a density model for volcanic cone that is difficult to obtain by conventional geophysical techniques. The cone density model can provide a valid information for geologic interpretations of various near surface phenomena.

We show the most recent and important results of geophysics studies on the Vesuvius aimed at the definition of a volcanic model that can be useful as reference for the perspective study for the reconstruction of volcanic edifice by radiography images using cosmic ray muons.