Geophysical study of a volcanic edifice for comparison with muon imaging

Jean-Francois Lenat[1], Angelie Portal[1], Philippe Labazuy[1], Collaboration Tomuvol[1], Collaboration Tomuvol[2], Collaboration Tomuvol[3]

[1]Clermont Universite, Universite Blaise Pascal, OPGC, CNRS, LMV, France, [2]Clermont Universite, Universite Blaise PascCNRS/IN2P3, Laboratoire de Physique Corpusculaire, France, [3]Universite de Lyon, Universite Lyon 1, CNRS/IN2P3, IPNL, France

E-mail: J.F.Lenat@opgc.univ-bpclermont.fr

The muon imaging is rapidly developing in geosciences through collaborations between particle physicists and geoscientists. The Tomuvol project contributes to this effort and has started to carry out experiences on a lava dome (the Puy de Dome) located in a field of monogenic volcanoes in the France mainland (Chaine des Puys). Because muon imaging is still in a development stage, it is useful to compare its results with those obtained through conventional geology and geophysics. Moreover, it can be expected that a joint interpretation of muon imaging and conventional geophysical data will lead to more accurate models and help to define the optimal procedure to study the static and dynamic structures of active volcanoes.

Here we present the first results from the geophysical study of the dome. The other aspects (geology, muon imaging are presented in companion abstracts). The trachytic dome is less than 2km wide at its base and about 400 m high. It is about 11,000 years old. As most large volcanic domes, it appears to be a composite construction. From a surface morphology analysis, at least two constructional units can be distinguished. The western half is characterized by an uneven morphology corresponding mostly to massive rocks. The eastern part seems to be emplaced in a scar in the western part and has a more gentle surface morphology, suggesting pyroclastic and talus deposits at the surface although lava lobes less than 10 m thick are also observed.

Gravity, resistivity and magnetic investigations have been carried out on the dome and its surrounding. The gravity data have been acquired with a high spatial resolution and the residual Bouguer anomaly have been modelled in order to provide an information that can be directly compared to the muon imaging. Resistivity surveys have been performed using multi-electrode arrays with both long (35 m) and shorter (5 m) electrode spacing. The arrays with the larger electrode spacing allow to virtually image the resistivity structure of the dome down to its base whereas the arrays with the shorter electrode spacing have been used to refine the shallow structure of the summit area. The magnetic data are not available at the time of writing (Jan. 2013) but will be discussed at the meeting. In addition, the physical properties of rock samples representative of the different facies of the dome are being measured in order to constrain the models.

The initial results show a good correlation between the gravity and preliminary muon results. The resistivity parameter carries a different information and therefore the resistivity models provide a complementary image of the dome structure. Because it is also intended to promote the site as a reference experimental site for geophysical and muon methods, we aim at refining the knowledge of the structure of the dome using all geological, geophysical and muon data.