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Inner structure of the Puy de Dôme: cross-comparison of geophysical models (ERT, Gravimetry, Muonic Imagery)

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Muon imagery of volcanoes and other types of geological structures is presently actively developed by several groups in the world. It has the potential capability to provide the 2D or 3D distribution of density with an accuracy of a few percent. However, at this stage of the development of the method, comparisons with the results from established geophysical methods are necessary to validate its results. An experience is presently carried out at the Puy de Dôme volcano involving the concurrent acquisition of muon imagery, electrical resistivity, 2D tomography (ERT) and gravity survey. Here we present the preliminary results for the last two methods.

The Puy de Dôme is an 11,000 years old, 1465 m high composite dome in the Chaîne des Puys (France). Geological studies suggest an evolution with at least two pulses of lava extrusion, separated by a partial destruction of the first construction. This interpretation is in good agreement with the present morphology, as, for example, it can be observed in the new high precision LIDAR elevation model (50 cm resolution). In addition, Miallier and al., (2010) suggest that a final explosive episode formed a small crater on the summit at 10,700 years. Hydrothermal alteration is widespread on the outcrops in the summit area of the dome.

A first south-north resistivity section has been obtained in June 2011 using a 2200 m long line of electrodes (electrode spacing of 35 m and of 5 m in the summit area). A second west-east similar profile is planned for April 2012. These electric data will provide models of the distribution of the resistivity values down to the base of the dome. Because the resistivity of the rocks varies significantly (several orders of magnitude) according to their water and clay contents, a resistivity section can be interpreted as a geological section. A detailed gravity survey has also been carried out in March 2012. The dome and its surroundings are now covered with more than 250 gravity stations. The computed Bouguer anomaly can be interpreted by models of the density distribution within the dome. This will be directly comparable with the results from the muons imagery. Our ultimate goal is to derive a model of the dome using the joint interpretation of all the sets of data.

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