

Geology of a volcanic edifice selected as a reference experimental site for structure imaging using muography and standard geophysical methods: the Puy de Dome volcano, Chaîne des Puys, France

Didier Miallier¹, Pierre Boivin², Philippe Labazuy²

¹Clermont Université, Université Blaise Pascal, LPC, CNRS-IN2P3, France, ²Clermont Université, Université Blaise Pascal, OPGC, LMV, CNRS, UMR 6524, LMV ; IRD, R 163, France

E-mail: miallier@clermont.in2p3.fr

The muon imaging technique 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 quaternary monogenetic volcanoes in the France mainland (Chaîne des Puys). Thanks to the extensive geological, geophysical and muon imaging observations and measurements already acquired or planned for the near future, this volcano is appropriate for becoming a reference site for testing structure imaging techniques. With a height of 400 m, a base-diameter of 2 km and a simple shape, Puy de Dome volcano has also an adequate topography for being a representative enough testbed. Puy de Dome was built about 11 ka ago by accumulation of viscous trachytic lava over a vent opened between pre-existing strombolian basaltic cones. Its construction is interpreted as the one of a classic lava-dome, accompanied by weakly energetic pyroclastic flows which embedded its basis. However, as most large volcanic domes, it appears to be composite. From a morphology analysis, at least two structural units can be distinguished. The western half is characterized by an uneven surface formed by ridges and pinnacles as for bristle lava-domes. The eastern part has a more gentle surface morphology, suggesting thick pyroclastic and talus deposits at the surface. Also it seems to be emplaced in a scar formed in the initial dome after a flank collapse.

With new observations, in particular those provided by outcrops created by excavations during installation of new touristic facilities, a new high resolution Lidar survey and the preliminary geophysical results from the Tomuvol project, the geology of the dome is being significantly refined. Among the new elements to take into account are: the importance of the remains of cinder basaltic cones beneath the flanks of the Puy de Dome and the extensive hydrothermal alteration observed in the summit area. Also, the even morphology of the east and south-east parts of the volcano could be partly due to the existence of 6 - 10 m thick lava lobes or flows emitted from a summit vent.

A planned drill hole for geothermal heat pump is expected to provide soon a glimpse of the interior of the dome. Therefore, in addition to being interesting to the general understanding of lava-domes construction, the detailed study of the geology of this volcano is important to provide strong constraints on the nature of the rocks and on the structure of the dome to help in the interpretation of muon and geophysical data. An accurate model of the dome should become available by combining data from all these methods.