

From the Geosphere to the Cosmos: ASPERA Workshop

Abstract

Muon radiography applied to volcanology

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The interest of muon tomography for Earth Sciences purposes soon arose after the discovery of cosmic rays when it was realised that muons of cosmic origin are able to cross hundredths of meters, and even kilometres, of rock with an attenuation mainly related to the amount of matter encountered along their trajectory. Up to now, muon imaging has been performed according to a radiography concept where the opacity of geological structures is deduced by comparing the flux of muons crossing the geological target to the incident flux measured at the surface of the Earth in open sky condition. The opacity is converted into density integrated along the trajectories. Further improvements of the method are necessary to actually perform 3D tomography imaging and imply to combine a set of radiographies as done in medical 3D X-ray computed tomography.

A review of the methodology will be presented focusing on the DIAPHANE project in the Lesser Antilles (Soufrière of Guadeloupe and Soufrière Hills of Montserrat). Lesser Antilles is a subduction volcanic arc within which a dozen of either potentially or presently active volcanoes are located in populated areas and therefore require careful monitoring. The aim of muon tomography is to provide a complementary tool to evaluate the present state of the volcano within its eruption cycle, estimate its evolution in the near future, and quantify the associated risk for surrounding inhabitants. Collaborations with INGV on the Etna and with Swisstopo on the Mont-Terri project will be detailed as well. The first results and density profiles obtained with the method are presented and commented.

Bibliography:

- "*Muon tomography : plans for observations in the Lessers Antilles*", D.Gibert et al, E.P.S. 62 (2010) 153-165.
- "*The MU-RAY project: Summary*", F. Beauducel et al, Earth Planets and Space 62 (2010) 141-151.
- "*Geophysical muon imaging: feasibility and limits*", N. Lesparre et al, Geophysical Journal International (2010) 181, 1-14.
- "*Design and Operation of a Field Telescope for Cosmic Ray Geophysical Tomography*" N. Lesparre et al, submitted to NIM A.
