Geophysical Research Abstracts
Vol. 14, EGU2012-6336, 2012
EGU General Assembly 2012

Seismic properties of volcanic rocks from Montagne Pelée (Martinique, Lesser Antilles) and their relations to transport properties

M.-L. Bernard (1) and M. Zamora (2)

(1) Laboratoire de Recherche en Géosciences et Energies (LaRGE), Université Antilles-Guyane, 97159 Pointe-à-Pitre, France (mlbernar@univ-ag.fr), (2) Dynamique des fluides géologiques, Institut de Physique du Globe de Paris, 4 Place Jussieu, 75252 Paris Cedex 05, France

Numerous laboratory and theoretical studies on the physical properties of rocks and their relationships - lead mainly in the framework of petroleum exploration - show that rock physics is necessary for an accurate quantitative interpretation of geophysical observations. Moreover joint inversion of different geophysical datasets is emerging as an important tool to enhance resolution and decrease inversion artifacts in imaging of structurally complex areas such as volcanoes. In many cases, the coupling between the inverted parameters is based on empirical or theoretical relationships derived from laboratory data. Consequently rock physics can be used to: interpret simultaneously several geophysical datasets on volcanoes when they are available, improve the imaging of volcano structures, and better understand the coupled processes that can occur during volcanic unrest.

It's in this context that we lead a laboratory study on the transport properties (permeability, thermal and electrical conductivities) and seismic properties (velocity and attenuation of P and S waves) of volcanic rocks representative of Montagne Pelée (Martinique) deposits. In this presentation we will focus on (1) the seismic properties and (2) the relations between seismic and transport properties.

The 43 samples collected are representative of the main lithological units of this volcano: vesicular lava blocks and indurated ashed from indurated block-and-ash flows also called breccias, vesicular lava blocks from "Pelean nuee ardente" flows, scoriae from scoria flows, pumices from ash-and-pumices flows, and dense lava blocks from lava flows and lava domes. Their total porosity varies over a wide range from 4 to 73%. Since the samples present similar chemical and mineralogical compositions (andesites), the main difference between the samples comes from their pore structure and reflects differences in the mechanisms of magma degassing and vesiculation during their formation (Bernard et al., 2007). This allows us to investigate the effect of the pore space characteristics on the studied properties and on their relationships.

Results show that ultrasonic velocities in water saturated samples vary with increasing porosity from 5,4 to 2 km/s for P-waves and from 3 to 0,9 km/s for S-waves. Seismic quality factors are relatively low and range between 27 and 3 for P-waves and between 40 and 5 for S-waves. Seismic velocities and attenuation coefficients correlate with porosity. But the links between seismic and transport properties are generally stronger, and particularly between P-wave attenuation and electrical formation factor. This indicates large similarities in the characteristics of the pore space that control the seismic and transport properties in volcanic rocks. Thereafter seismic measurements can help to monitor fluid flows in volcanic and geothermal areas.