Geophysical Research Abstracts
Vol. 14, EGU2012-4428, 2012
EGU General Assembly 2012

Understanding pre-eruptive patterns: the rock physics interpretation

S. Vinciguerra (1), P. Benson (2), P.G. Meredith (3), G. Di Toro (4), G. De Natale (5), J.P. Burg (1), P.R. Young (6), and L. Caricchi (7)

(1) Dipartimento di Scienze della Terra, Università di Torino, Italy (sergiocarmelo.vinciguerra@unito.it, +39 347 9129548), (2) Geological Institute, Swiss Federal Institute of Technology, Switzerland, (3) Department of Earth Sciences, University College London, England, (4) Dipartimento di Geoscienze, Università degli Studi di Padova, Italy, (5) Osservatorio Vesuviano - Istituto Nazionale di Geofisica e Vulcanologia, Naples, Italy, (6) Lassonde Institute, University of Toronto, Canada, (7) Dept. of Earth Sciences, University of Bristol, England

Changes of seismic wave velocities, rates of seismicity and different types of seismic signals are routinely observed before eruptions in volcanic areas. Anomalies and rapid changes of geophysical parameters have been interpreted as rapid changes of the mechanical properties of the medium and/or of magmatic pressurization (e.g. coupling of dyke emplacements and fracturing of the medium).
A thorough assessment of the physical properties of volcanic rocks and an improved understanding of the complex coupling between mass/heat transfer mechanisms and rock deformation/failure processes has been revealed to be essential for the interpretation of the geophysical signatures monitored in volcanic areas.
For instance seismic tomography had greatly benefit from simultaneous measurements of P and S wave velocities at simulated 'in situ' stress conditions, while time-to-failure models were supported from a deeper knowledge of the changes of mechanical and physical properties as a function of incremental thermal and mechanical damage.
Luigi had the first great intuition that laboratory simulations could allow us to rebuild the physical mechanisms responsible for a given seismic signal, thus providing invaluable quantitative information for understanding and discriminating the different seismic signals observed before volcanic eruptions. A direct relationship between seismic waveforms + spectrograms and physical phenomena was assessed, by scaling length and frequency between the laboratory and the field.

Departing from the first data set of seismic signals related to magma emplacement generated from the work with Luigi, we obtained crucial advances where simulated volcanic conditions of corresponding geophysical parameters have been directly measured, while reproducing deformation, fluid decompression and hybrid mechanisms acting in volcanic areas. This provided a solid and well-constrained new experimental insight into the developing damage leading to faulting and geophysical signatures related to fluid flow and to the role of supercritical phases.
The close agreement between laboratory and nature allows us to open a new research field where geophysical signatures can be directly linked to physical processes tested in the laboratory where these processes are very well constrained.