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LABORATORY ASSESSEMENT OF PHYSICAL PROPERTIES OF ROCKS

In order to be able to predict the onset of failure in the Earth’s crust, manifested in volcanic eruptions and earthquake ruptures, and thus be in a position to reduce the hazard to people and property, we need to develop a much better understanding of the relationship between the build-up of geological stresses, deformation and/or fracturing. It is well established that the best way to achieve progress is to conduct carefully controlled laboratory scale experiments in which all of the important physical and mechanical parameters can be controlled and monitored.

The mission of our new Laboratory of Rock Physics is to understand the evolution and dynamics of the Earth’s crust through experimental and modelling studies of the mechanical and physical properties of rocks. This scientific methodology is based on experimental rock physics, a discipline that integrates rock mechanical, transport and physical property measurements, underpinned by the theoretical framework of fracture mechanics. A jacketed rock sample is placed inside the pressure vessel, and the vessel is then pressurised (using silicone oil) to simulate the lithostatic stress at depth. A separate pressurisation system is then used to provide pore fluid pressure in the internal pore space of the rock sample. The sample assembly may then be heated via an internal furnace to simulate the temperature at depth, and finally an axial stress is applied via a loading ram to simulate the tectonic stress (Fig. 1).

The servo-controlled system allows to perform constant strain-rate experiments as well as creep experiments. A typical stress-strain curve is shown in Fig. 2.

Piezoelectric transducers allow to measure elastic wave velocities (both compressional and shear) and microseismic (acoustic) emission output during deformation.

Finally, a number of optical techniques are used to characterise the ‘post-mortem’ microstructure, aiming either to identify crystallographic preferred orientations (e.g. SEM, TEM) or to assess the chemical composition (e.g. Microprobe, X-ray fluorescence).
Fig. 1 - Schematic sketch of the 20kN triaxial deformation cell in the Laboratory of Rock Physics of OV-INGV.
Fig. 2 - Typical stress-strain curve.