Microcracking and fault pathways in Rock: Implications for transport properties in volcanic edifices.

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Pore fabric anisotropy is a common feature of many crustal rock types, whether high porosity sedimentary rock or lower porosity rock such as granite or basalt. Crack fabrics in particular have a disproportionate influence on many key rock physical properties, and range in scale from microscopic fracture networks to larger scale meso-scale and macro-scale fault systems. Velocity anisotropy and fluid flow (permeability) anisotropy are heavily influenced by such features, both in terms of magnitude and anisotropy, which is commonly induced through the alignment of crack and joint sets. Takidani granite is an example of a rock with such a microscopic joint set, exhibiting up to 10% P-wave anisotropy. In contrast, Etnean basalt exhibits no discernable velocity anisotropy. Mechanical strength can also be anisotropic, and dependent upon the same kind of internal damage. This research reports simultaneous laboratory measurements of ultrasonic velocity and fluid permeability upon these two rock types. Measurements were made under hydrostatic pressures ranging from 5 to 80MPa in order to simulate conditions found up to ~4km depth within the crust. Image analysis of the rocks clearly shows crack and fracture networks, which is further confirmed by thermally stressing some samples in order to induce further isotropic crack damage. The research aims to explore the fundamental mechanisms associated with the prediction and understanding of active volcano mechanics from field scale data, by determining how volcanic and related mechanisms can influence the physical properties of rock. Accurate knowledge of such parameters is vital in modeling and field-scale monitoring work. Finally, a new proposal is introduced (submitted to EU-FP6), which utilises the recent discovery of Long-Period (LP) harmonic seismic events, which are re-created in the laboratory. Using state-of-the-art acoustic emission systems, the microseismic events due to internal fluid and gas movement will be recorded, in a manner analogous to the seismic events at field scale on a volcanic edifice. This well constrained laboratory data will be used to investigate the rock physical parameters and conditions necessary for the creation of these events, and how they influence the recorded LP and VT events.