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Evolution of elastic properties and acoustic emission, during uniaxial loading of rocks, from the Fogo Volcano in the island of Sao Miguel, Azores; Preliminary results.

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A Computerized Uniaxial Press working up to 250 kN was installed in the middle 2011 in the Laboratory of Microseismic Monitoring of ISEL. The system is able to record continuous time, pressure and axial strain (1 μm resolution) at 1s sampling rate. The loading platens were designed to integrate acoustic emission (AE) transducers. Signals are acquired and processed through an 8-channel ESG Hyperion Ultrasonic Monitoring System (10 MSPS, 14/16-bit ADC).
The first experiments, presented here, were applied to a set of rock samples from the Fogo, an active central volcano in the island of Sao Miguel. Two different volcanic rock types were studied: a fine grained alkali basaltic rock with a porphyritic texture, a porosity of 4.5% and bulk density of 2700 kg m-3 (sample #3); and a benmoreitic rock with a trachytic texture, a porosity of 8.1 %, and bulk density of 2400 kg m-3 (sample #4).
Cores from sample #3 were subjected to continuous increasing pressure, until failure. They show a uniaxial compressive strength (UCS) spanning from 60 to 85 MPa and a stress-strain curve with two phases: a first one with relative low Young's Module (YM) followed by a second phase were the YM increases roughly 3 times. The stress transition value occurs broadly in a stress level 50% of the UCS. The AE produced in the process is almost negligible until the YM transition stress level and increases after that. Important pulses of high AE rate occur, (> 100 s-1), associated with the occurrence and propagation of fractures, which are always parallel to the principal stress, showing an evident pattern of tensile fractures. About 20s before the failure, very important deformation rate is observed, the YM strongly decrease, and continuous AE events, with low rate, usually <50 s-1. The failure is accompanied with a sudden rise of AE events with rate > 200 s-1. Cycling stress experiences were also performed showing reversible stress-strain relation for axial pressure below the YM transition level, and important hysteresis for axial pressure above that level. The associated AE events show a characteristic Kaiser effect pattern.
Cores from sample #4 undergo the same continuous increasing stress process, but failure is attained at a considerable lower pressure of 20-25 MPa. The stress-strain curves show an almost linear relation, but approaching the stress level of failure, the YM decreases. The AE events are constant but with a reduced rate until the decrease of the YM, when a significant rise in the AE occurs, achieving emission rates greater that 200 s-1. The fracture shows a characteristic shear pattern.
Differences in stress-strain behavior, fracture mode and AE rates are associated with the very different structure of the rocks, once the basaltic sample is very fine grained with some very scattered and almost spherical vesicles or voids, while the benmoreitic core shows high values of porosity in a structure with vesicles and voids with very irregular shapes.

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