Geophysical Research Abstracts, Vol. 9, 06964, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06964

Crack damage evolution approaching failure in Etna basalt

S. Vinciguerra (1), S. Stanchits (2), C. Trovato (3), G. Dresen (2)

HP-HT Laboratory, Department of Seismology and Tectonophysics, Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, 00143, Rome, Italy (Tel ++39 06 51860478; Fax. ++39 06 51860507; e-mail: vinciguerra@ingv.it); 2) GeoForschungsZentrum Potsdam, Department 3.2, Telegrafenberg D423, 14473 Potsdam, Germany; 3) Dipartimento di Fisica e Astronomia, Università di Catania, 95129, Catania, Italy;

Triaxial compression tests were performed on the Etna basalt at confining pressures up to 20 MPa and at room temperature. Deformation was monitored integrating induced acoustic emissions activity, P and S- wave velocity changes and volumetric strain. Physical parameters indicate the existence of dominantly compliant low-aspect ratio pores in Etna basalt, which also contains high-aspect ratio voids. With increasing differential stress significant contribution of tensile events occurs. Close to the failure, horizontal wave velocities decrease significantly and a concomitant increase of double-couple (shear) type of AE events takes place. We suggest that shear cracks link previously formed tensile cracks. In order to generate progressive deformation and increasing crack damage we also unloaded samples beyond onset of dilatancy and before failure. Crack density (CRD) was measured on SEM images. For undeformed and deformed samples the total crack length per unit area was about 3.7 - 3.8 mm/mm^2, and we found no preferred orientation of microcracks. Maximum values of anisotropy is $\sim$ 15-20%. Severe crushing of grains in deformed specimens occurred preferentially near large and irregularly shaped pores. CRD for the failed samples reaches values up to 11.6 mm/mm^2, with anisotropy values ranging from 25 to 50%. CRD decreases of about 70-80% at distances about 1.5 mm from the fault plane, indicating increased damage in the fracture process zone. We can suggest that in Etna basalt deformation is initially driven from crushing of grains in the vicinity of pores, without significant reactivation of pre-existing cracks, and abrupt failure occurs, when initial microcracks (of microns sizes), propagate and coalesce, forming major macroscopic cracks (with sizes of mm or cm scale).