Geophysical Research Abstracts
Vol. 12, EGU2010-8271, 2010
EGU General Assembly 2010
© Author(s) 2010

Frictional properties of simulated fault gouges of natural dolomite and anhydrite

Marco Maria Scuderi (1), André Niemeijer (2), Cristiano Collettini (1), Chris Marone (3), and Dereck Elsworth (3)

(1) Dipartimento di Scienze della Terra Università degli Studi di Perugia, Italy, (2) Istituto Nazionale di Geofisica e Vulcanologia, Roma, Italy, (3) Department of Geosciences and Energy Institute Center for Geomechanics, Geofluids, and Geohazards, Penn State University, University Park, PA 16802, USA

The integration of seismic reflection profiles with well-located earthquakes shows that the mainshocks of the 1997-1998 Umbria-Marche seismic sequence (M_{max} = 6.0) nucleated at a depth of ~6 km on normal faults within the Triassic Evaporites (anhydrites and dolomites). This result appears enigmatic since evaporitic rocks are commonly considered to deform ductily and thus aseismically. In order to investigate the frictional properties of the Triassic Evaporites, we performed frictional sliding experiments on simulated fault gouges of natural dolomites and anhydrites and 50/50 mixtures of the two. Dry and wet experiments were done in a double-direct shear configuration inside a biaxial loading apparatus using granular fault gouges at a range of normal stresses (10 - 150 MPa), sliding velocities (1-300 μm/s) and at room temperature and 75 ºC. Under dry and cool conditions all the lithologies exhibit: i) a brittle behaviour with the coefficient of friction ranging from 0.6 to 0.7; ii) a velocity strengthening (i.e. stable, aseismic) behaviour. For the experiments at 75 ˚C, we observe a decrease in the coefficient of friction from 0.65 to 0.44 with increasing normal stress and strain. All the lithologies exhibit a velocity strengthening behaviour except for the mixtures of anhydrites and dolomites that show an evolution from velocity strengthening to velocity weakening with increasing sliding velocity. The microstructures developed during all experiments show a general grain size reduction from 150 μm to 30-40 μm, with localised deformation and strong comminution (grain-size 5-10 μm) along B_1 and R_1 planes. With increasing shear strain and temperature the R_1 planes are more pronounced in particular for the mixtures of anhydrite and dolomite. Thus at a seismogenic depth of ~6 km, with increasing temperature and the presence of fluid, the localization of deformation along planes composed of anhydrites and dolomites, as observed along exhumed evaporite-bearing faults from the Apennines, may be a mechanical explanation for the occurrence of frictional instabilities (i.e. earthquakes within the Triassic Evaporites).