Geophysical Research Abstracts
Vol. 19, EGU2017-10385-2, 2017
EGU General Assembly 2017

Geotechnical and geomechanical characterization of the “fault gouge” of the “Alhama de Murcia” active fault, SE Spain.

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Here we present the results of the mechanical and mineralogical study of the fault rock of the Alhama de Murcia fault. This fault is one of the most active faults in the Iberian Peninsula. It shows segments partially formed by exhumed fine grained fault rocks (fault gouge FG) with a thickness of more than 50 m developed mainly in a brittle regime. Several strength and strain tests have been carried out, both in-situ and in laboratory, considering different stress orientations in relation to the tectonic fabric. Undisturbed samples encountered from two fault observatory boreholes drilled near Lorca, (FAM-1 and FAMSIS-IGN, of 174 and 40 m depth, respectively) has been used for the laboratory tests. The FG shows a hard soil and soft rock like mechanical behavior with uniaxial compressive strength < 2 MPa and elastic moduli (E) < 12 GPa. The tenso-deformational behaviour at low confining stresses is mainly plastic, acquiring a strain-hardening behaviour at high shear strain. The FAM-FG shows a very notable tectonic fabric controlled by a frictionally weak preferential orientation of the plate like minerals arranged in an anastomosing texture that controls the mechanical strength. The results of the strength tests show the variability of the friction coefficient (μ) depending on the stress orientation in relation to this tectonic fabric. The FG exhibit mineral assemblage similar to the shicsts , suggesting that it has been developed mainly as a result of comminution mechanisms of the hanging wall protolite . The mineralogical composition of the FG contains mica minerals (muscovite and paragonite), quartz (mainly powdered) and traces of feldspar and carbonates. The predominant clay minerals are illite, paragonite, and, occasionally and some kaolinite. In some samples, it has been observed the presence of very sparse graphite and smectite. The plate like minerals are arranged in a preferred orientation (turbostatic microfabric), that surround the quartz porphyroclasts. The friction coefficient (μ) varies between very low values (0.29-0.49) for planes oriented favourably to the tectonic fabric (following the fault failure kinematic), to very high values (>1.19) for planes unfavourably oriented.