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Fault rock mineralogical controls on creep versus dynamic rupturing; examples from the W. Cyclades (Greece)

M. Edwards, B. Grasemann, and . ACCEL-Team

Dept. Geodynamics, University of Vienna, Structural Processes Group, Vienna, Austria (michael.edwards@univie.ac.at)

The Western Cyclades belong to the now aseismic portion of the Aegean. Preserved here is massively extended crust exhumed up from the middle- through to the upper-crust. This extension was the accommodation of accelerated subduction retreat of the incoming Africa slab. The present day expression this subduction is now immediately outwith the aseismic Aegean; the focus of Europe's most intense seismicity. The historical expression of this seismicity is however ubiquitous, including in the Western Cycladic Islands. Here, several low angle high strain zones and their high angle offshoot- dependants record a history of ductile and brittle behaviour, and, more importantly, cycling between the two. This cycling is well-constrained by outcrop relative timing relationships. That the cycling is NOT due to steady upward exhumation (i.e. a 1D ductile to brittle migration) is documented in fault rock mineralogy (and deformation conditions thereof). A creep versus dynamic rupturing cyclicity is thereby required.

The faults portions (both in the governing mature, throughgoing, low-angle fault system and in the governing fault's individual high angle dependant strands) where significant genesis of brittle fault rock product is present seem to have a strong protolith control. The mineralogy of the fault rock products provides critical indication of discrete rheological differences in both (1) the original protolith of the fault rock in question as well as (2) the changing nature of the fault rock as it experiences alteration over the course of the fault's active displacement history (e.g. due to fluid throughput). This key mineralogical evidence of rheological difference is beautifully borne out by (micro)fabrics and their attendant deformation conditions.