

EGU21-5037

<https://doi.org/10.5194/egusphere-egu21-5037>

EGU General Assembly 2021

© Author(s) 2022. This work is distributed under the Creative Commons Attribution 4.0 License.



Cycles of seismic and aseismic slip recorded in faulted sediments under shallow burial conditions

Mattia Pizzati, Fabrizio Balsamo, and Fabrizio Storti

Università di Parma, Dipartimento di Scienze Chimiche, della Vita e della Sostenibilità Ambientale, NEXT Natural and Experimental Tectonics Research Group, Parma, Italy (mattia.pizzati@unipr.it)

Valuable information concerning the seismic cycle are mainly provided by the study of exposed fossil subduction-accretionary complexes and by coring and probing through present-day active major plate boundary interfaces. Subduction zone investigation and monitoring allowed to comprehend the mechanics of thrust-related faulting and to discern seismic events with different slip rate (coseismic events, slow slip events and tremor). While subduction zones received particular attention especially following the M_w 9 Tohoku-Oki earthquake in Japan, relatively small-scale extensional faults affecting the uppermost portion of seismogenic zone of the Earth's crust are still less studied.

Here, we present a field and laboratory study of meso-scale structures recorded within the fault core of an extensional fault zone (Rocca di Neto fault, offset < 100 m) affecting Pleistocene siliciclastic sediments in the Crotona Basin, Calabria, Southern Italy. Due to shallow burial conditions experienced by deformed sediments (< 400-500 m), the fault zone structure is characterised by deformation features typical of high-porosity granular rocks, with extensive occurrence of deformation bands, subsidiary faults and gouges. The 1 m-thick fault core displays a complex network of mutually cross-cutting black gouges and deformation bands developed in foliated sand. Some black gouges have straight pattern parallel to the master fault surface, while others are displaced and dragged along the deformation bands (mm-offset). Black gouges, previously interpreted as coseismic events due to moderate to high-temperature mineral assemblage, are characterised by cm-offset and extreme grain comminution via severe cataclasis (mean grain size of 20-30 μm and fractal dimension from 3.0 to 3.3); clast preferred orientation is almost parallel to the gouge outer boundaries, thus resulting in a well-developed foliation. Deformation bands are organised in two conjugate sets and display moderate to intense cataclasis depending on the accommodated displacement (mean grain size of 80-170 μm and fractal dimension from 2.4 to 2.8), with preferred orientation of clasts describing an angle of 30-45° from the band surface. Within deformation bands the foliation is less defined compared to black gouges. At the intersections between gouges and deformation bands, the resulting tectonic fabric is given by the superposition of different deformation events overprinting the original one.

The difference in grain size distribution, fractal dimension, clast shape preferred orientation (i.e., foliation) and mineral composition between black gouges and deformation bands supports the

hypothesis of different slip rates causing their development. In particular, black gouges are interpreted to develop during coseismic slip ($\sim 0.1-1$ m/s), while deformation bands formed during interseismic intervals (slip rate from nm/s to $\mu\text{m/s}$). The cross-cutting relationship between gouges and deformation bands, combined with the overprinting of different tectonic fabrics along the intersections, suggests they formed as a result of repeating coseismic (fast slip) and aseismic (slow slip) events occurring at shallow burial-near surface conditions. This feature could be a key point to evaluate the deformation style (fast vs slow slip) and to estimate the potential seismic hazard of superficial faults affecting high-porosity sediments.