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Structural and permeability evolution of soft-sediment extensional faults in high-porosity sands from the Crotone basin, south Italy

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We present structural, granulometric and permeability data from 25 extensional fault zones developed in high-porosity sandy sediments of the Crotone basin, southern Italy. Displacement values span from few cm to about 100 m. The fault zones generally consist of well defined narrow fault cores bounded by damage zones on both hanging wall and footwall sides. Fault core rocks developed by progressive comminution and consist of foliated granular material and gouge lenses along indurated and striated slip surfaces. Fault damage zones typically consist of closely spaced single to anastomosing cataclastic deformation bands with different degree of complexity. Undeformed sediments have mean permeability values in the 10E3 to 10E5 mD range. Mean fault core rock permeability broadly ranges between 10E1 and 10E4 mD, although we recorded permeability values lower than 10 mD in gouge lenses. Fault damage zones have a mean permeability between 10E2 and 10E4 mD, i.e. lower than host sands. We obtained empirical relationships between bulk permeability, fault zone thickness, and fault displacement. In particular, both fault cores and damage zones tend to widen with increasing fault displacement, especially in the first ten meters. Most bulk permeability reductions in both fault cores and damage zones occur at sub-seismic scale, and decrease for displacement greater than 25-30 m.