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Fault Sealing Behaviour of Soft-sediment Extensional Faults in High-porosity Sediments from the Crotone Basin, Italy

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SUMMARY

The hydraulic behaviour of deformation band-dominated fault zones is strongly controlled by the petrophysical properties of the protolith sediments, deformation intensity and environmental conditions of deformation. To provide further constrains on the relationships between fault structure, displacement and hydrology, we acquired structural, granulometric and permeability data from a total of 25 extensional fault zones developed in high-porosity sandy sediments of the Crotone basin, having mean permeability values in the 10E3 to 10E5 mD range. Fault core rocks developed by progressive grain size reduction and consist of foliated granular material and gouge lenses along striated slip surfaces. Mean fault core rock permeability ranges between 10E1 and 10E4 mD, although we recorded permeability values lower than 10 mD. Fault damage zones consist of closely spaced cataclastic deformation bands with different degree of complexity and mean permeability between 10E2 and 10E4 mD. By combining structural and hydraulic information, we obtained empirical quantitative relationships between bulk permeability variations, fault zone thickness variations, and fault displacement. Most of permeability reductions in both fault cores and damage zones occur at sub-seismic scale, whereas such a rapid permeability decay significantly decreases for displacement greater than 25-30 m.

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