Geophysical Research Abstracts
Vol. 12, EGU2010-12934, 2010
EGU General Assembly 2010

Multi-scale properties of strike-slip faults crosscutting the Pleistocene carbonate grainstones of Favignana Island (NW Sicily, Italy).

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After detailed field (stratigraphic and structural) and laboratory analyses of intact and deformed rocky outcrops, we studied the multi-scale properties of strike-slip faults nucleated and developed in Pleistocene carbonate grainstones of Favignana Island (Sicily, Italy). This skeletal carbonate rocks ranging in thickness between 5 and 20 meters make up the whole eastern side of the Island, where they unconformably lie on silicoclastic deposits of the Upper Pliocene.

The studied structures are very similar to those one affecting carbonate grainstones of San vito Lo Capo Peninsula (Sicily, Italy) and already documented in a recent paper. There strain localization into narrow bands encompass first compaction, shear, pressure solution formation, their subsequent shearing, and finally cataclasis. The transitions from one deformation process to another, which were likely controlled by changes in the material properties, are recorded by different ratios and dissimilar distributions of the fault dimensional attributes.

In Favignana Island, the results of our study allow us to: (i) indentify two conjugate sets of faults trending NW and NNE, characterized by right-lateral and left-lateral kinematics, respectively; (ii) document the progression of the deformation from single compactive shear bands, with an offset ranging between mm's to cm's, to zones of compactive shear bands, characterized by a larger amount of offset with discontinuous cataclasis and slip surfaces, and finally to well developed faults, with an inner cataclastic core surrounded by wider damage zones made up of compactive shear bands, joints, and possible dilational bands; (iii) decipher that linkage processes, responsible for fault development, took place by mechanical interaction of adjacent individual structures at any deformation stage (single bands, zone of shear bands or well developed faults) with formation of characteristic ramp and eye structures.

Based on their internal architecture and petrophysical properties, the studied strike-slip faults behave as combined barrier-conduit hydraulic structures to fluid flow. The single compactive shear bands, the shear band zones, and the cataclastic cores of the faults have a lower porosity relative to the surrounding carbonate host rocks, and therefore form seals for cross-fault fluid flow. On the contrary, the discrete and undulated slip surfaces present either within or at the edges of the fault cores enhance the along-fault fluid flow.

Finally, the detailed analyses of macro- and mesostructural features exposed in Favignana Island show that the overall deformation pattern in the area may be interpreted in terms of strike-slip tectonics driven by a current stress field geometry characterized by a NW oriented maximum compression. The stress field acting in the area appears to be directly controlled by the convergence between the African and European plates. The present-day Africa motion along NNW–SSE- to NW–SE-directed vectors is substantiated by geological, seismological, VLBI (very long baseline interferometry) and global positioning system data.