Geophysical Research Abstracts,
Vol. 10, EGU2008-A-03700, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-03700
EGU General Assembly 2008

The interplay between deformation, fluid flow and dolomitization on the evolution of the Tellaro detachment fault, Northern Apennines, Italy

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The origin of low angle normal faults has been a matter of a long lasting and still ongoing debate. The fundamental question is whether the very shallow fault dip is an original feature or it was acquired by subsequent passive folding of an original Andersonian brittle shear zone. The Tellaro detachment provides an example of a low angle normal fault on the Tyrrhenian side of the Northern Apennines. Andersonian extensional faults in the hangingwall flatten down into the main exposed shear zone, which has a near horizontal attitude, thus ruling out the possibility of a high-angle initial geometry of the Tellaro detachment. Good exposures provide the possibility to investigate the three-dimensional structural architecture of this shear zone, which cuts across the layered carbonates of the Tuscan basinal succession. Deformation is characterized by intense pressure solution and S-C fabrics, veins, large grooves and transversal passive folds. The main exposed shear zone lies at the bottom of a thick cataclastic dolomite layer that unconformably cuts across the carbonate layering in the hangingwall. Deformation bands and injection structures developed in the cataclastic dolomitic material, indicating fluid assisted deformation events that postdated cataclasis and predated cementation and brittle faulting. Extensive brecciation and veining in the footwall of the main exposed shear zone support high fluid pressure and hydrofracturing during faulting. Fluid inclusion analysis on different vein generations provided constraints on the temperature range of fault activity. All the acquired data support a model of shear zone evolution that progressed from early diffuse damaging and preferential fluid flow that induced dolomitization along the prospect shear zone.

Overpressuring in the footwall favoured cataclasis of the dolomitized layer and development of fluid-assisted deformation structured within the granular material prior to cementation. Further deformation progressed by shear localization at the base of the cemented cataclastic layer due to its strong mechanical contrast with the underlying layered marly limestones.