Geophysical Research Abstracts
Vol. 19, EGU2017-411-2, 2017
EGU General Assembly 2017

Shear localization in the shallow part of megathrusts: understanding active megathrusts trough the study of fossil analogues.

Anna Cerchiari (1), Silvia MIttempergher (2), Francesca Remitti (1), and Andrea Festa (2)

(1) Dipartimento di Scienze Chimiche e Geologiche, Università di Modena e Reggio Emilia, Modena, Italy, (2) Dipartimento di Scienze della Terra, Università di Torino, Torino, Italy

The shallowest part of active megathrusts has an intriguing behaviour, characterized by the coexistence of coseismic slips and aseismic creep, slow slip events, low and very low frequency earthquakes. Origins and interplays of these phenomena are actually little known. In this respect, the study of exhumed shallow parts of fossil megathrusts is an advantageous approach in terms of accessibility, costs and resolution.
The Sestola-Vidiciatico tectonic Unit in the Northern Apennines has been interpreted as a possible analogue of a shallow, hectometer scale megathrust shear zone, which accommodated subduction of the Adria plate under the Ligurian prism during early-middle Miocene by involving sediments from the seafloor to burial depth corresponding to 150° C maximum temperature.
Performing detailed microstructural analysis on samples through optical, cathodoluminescence and scanning electron microscopy, we studied a 5 m thick fault zone marking the base of the SVU. Here, more or less competent marls make up a heterogeneous fault zone assemblage, with a strongly deformed tectonic fabric characterized by mesoscopic cleavage, boudinage, faults and low-angle thrusts coated by calcite veins. At the top of the shear zone, a sharp and continuous shear vein, 20 cm thick cuts all other structures.
At the microscale, we identified a primary sedimentary layering, consisting of alternating fine and coarse marly or shaly laminae that are crosscut by "soft-sediment"-type deformation bands derived from the reorientation of mineral grains without fracturing. Parallel to the sedimentary laminae, oriented phyllosilicates define a pervasive foliation in clay-rich domains. More competent calcareous portions are strongly boudinaged and cut by calcite shear veins displaying crack-and-seal texture and locally implosion breccias. Multiple mutually crosscutting generations of extensional veins are recognizable, with dispersed orientations and complex relations with shear veins. Calcite veins appear also to be partially dissolved by pressure-solution processes.
Our microstructural findings suggest that deformation started acting on not completely lithified sediments, with a progressive and differential embrittlement of the shear zone, depending on lithology (i. e. competence contrast) and fluid pressure cycles. Features described point out also for thrusting under low differential stress, with decoupling from the footwall and progressive migration and thinning of the shear zone.