Geophysical Research Abstracts
Vol. 14, EGU2012-10979, 2012
EGU General Assembly 2012
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Mesoscopic S-C fabrics in shallow fault zones: a case history from the Umbria-Marche Apennines (Central Italy)

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Several examples of fault zones, characterised by a penetrative S-C fabric at a mesoscopic scale, developed at shallow depth (D< 3 km) in sedimentary rocks (pelagic limestones and marls) have been described in the Umbria-Marche region, associated to any type of fault kinematics (i.e. normal faults, thrust faults and strike-slip faults).
In this paper, we study the structural pattern of the Scheggia Thrust Zone (STZ), a spectacularly exposed shear zone, more than 100 m thick, localized along the Scheggia-Foligno Line , a major tectonic feature of the Umbria-Marche Apennines. The formation of the STZ is related to a SW-dipping thrust dipping 25° to 35°, cutting through the backlimb of the Mt. Nerone-Mt.Cucco anticline with a down-section trajectory, and producing the tectonic superposition of younger (Miocene marls and sandstones) on older (Paleogene limestones) rocks.. The clayey rocks of the hangingwall block are almost undeformed.
We performed a detailed mesostructural analysis along several outcrops of the STZ, aimed to: i) a detailed qualitative and quantitative description of a significant example of S-C fabric, developed in sedimentary rocks at shallow crustal levels; ii) the reconstruction of the structural meso and macro-architecture of the shear-related damage zone; iii) the study of the factors, controlling the genesis and development of the analyzed tectonic pattern.
The STZ consists of an intensely cleaved fault core (S-C fabric, where C-surfaces are spaced 5-10 cm, whilst S-surfaces are spaced 2-20 mm), up to 50 m thick, affecting the Eocene-Oligocene marly succession. Within the fault core, a set of steeper reverse shear planes (C2, dip>45°) affects and displaces the pre-existing S-C fabric. Just below the fault core, a band of asymmetric chevron folds is observed. Going down into the footwall block, the mudstones of the Scaglia Rossa Fm. are characterized by a progressively less intense and more brittle deformation, superimposed on a previous set of tectonic features (spaced pressure solution cleavages and associated calcite veins, i.e. “background deformation”). As expected, within the STZ, the magnitude of deformation decreases with the distance from the main tectonic contact; however, far from the fault core, the magnitude of deformation is lithologically controlled: almost undeformed calcareous beds are alternated to intensely sheared intervals, localised along weak, marly horizons.
The interpretation of a seismic profile, suggest that the STZ is the surface expression of two different thrusts, splaying-out from two décollements, located at different depth within the pelagic multilayer. The second thrust event is related to the deeper décollement.
Our conclusion is that that STZ underwent two co-axial compressional events, probably occurred soon after, or during, the Mt. Nerone-Mt. Cucco anticline growth, as suggested by the down-section trajectory. The first event was linked to a semi-brittle deformation (S-C fabric) followed by a more brittle deformation (C2).
This study also helped us to understand the role of the Scheggia-Foligno Line in the deformation history of the Umbria-Marche Apennines.