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The S-C tectonites in the Northern Apennines (Italy) thrust shear zone: Implication for mode and timing of deformation

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The Apennines are a fold-and-thrust belt originated during the Neogene-Quaternary time as a consequence of the NNW-SSE convergence of the African and European plates in a subduction/collision context. The orogenesis affected the Triassic to Miocene sedimentary successions belonging to pelagic and carbonate platform paleogeographic domains of the Adria promontory of the African plate.
The structural setting of the Central/Northern Apennines is characterized by the presence of two main oblique thrust ramps trending approximately NNE-SSW that sign the separation between different sectors of the chain: the Sangro-Volturno and the Olevano-Antrodoco lines. The NNE-SS-trending Olevano-Antrodoco oblique thrust ramp and the NW-SE-trending Sibillini frontal thrust ramp form the characteristic arcuate shape of the Northern Apennines. During the Neogene positive inversion tectonics, the NNE-SSE oblique thrust ramp of the Olevano-Antrodoco-Sibillini thrust reactivated the Jurassic normal fault developed on the Adria paleomargin between the pelagic and persistent carbonate platform domains. NNW-SSE trending anticlines involve both the footwall and the thrust plane of the NNE-SSE limb of the Olevano-Antrodoco-Sibillini thrust, suggesting an in sequence deformation development.
Milonites and tectonites shear zones, in ductile and ductile-brittle regimes, respectively, are characterized by S/C fabrics related to simple shear asymmetric and rotational deformations contest. In the literature, conjugate extensional shear planes are related to simple shearing if sliding along a foliation takes place. Moreover, the extensional conjugate shear planes are the result of deformation within domains of shear zones characterized by flow that moved away from the progressive simple shear. In this contest, these normal structures allow a down-section trajectory of the thrust plane that give rise to the footwall plucking phenomenon.
We analyzed the ductile-brittle shear zone associated to the Olevano-Antrodoco-Sibillini thrust, which offers spectacular outcrops within the Tertiary marls and shales lithotypes. We discriminate the shear-zone fabrics associated with the two different trending Olevano-Antrodoco-Sibillini thrust. In the NW-SE trending sector, the shear zone is characterized by S/C fabric tectonites compatible with a simple shear deformation with a top to N50-60° direction of tectonic transport. Along the NNE-SSW-trending sector, conjugated extensional planes (extensional crenulation cleavage) crenulate the S/C fabrics.
The structural association reconstructed in the NNE-SSW trending sector of the Olevano-Antrodoco-Sibillini transversal thrust allowed us to interpret the conjugate extensional crenulation cleavage as developed within domains of shear zones characterized by a late stage of deformation roughly coaxial, characterized by flow that moved away from the progressive simple shear. These coaxial extensional domains characterized by conjugate extensional shear planes development are due to the outer arc stretching deformation related to the development of NNW-SSE trending anticlines in the footwall of Olevano-Antrodoco-Sibillini thrust, according to an in sequence deformational context.
We propose the analysis of the extensional crenulation cleavage as a tool to constrain the mode and timing of thrusts and related folds development.