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3D architecture and structural characterization of the Lima Valley low-angle fault system (Northern Apennines, Italy).

L. Clemenzi (1), G. Molli (2), F. Botti (2), A. Ungari (2), and F. Storti (1)

(1) Dipartimento di Scienze della Terra, Università degli Studi di Parma, Italy, (2) Dipartimento di Scienze della Terra, Università di Pisa, Italy

The nappe pile of the northern Apennines is characterized, from bottom to top, by metamorphic units (Apuane and Massa), overlain by the anchimetamorphic cover unit (Tuscan Nappe), in turn overlain by remnants of former intraoceanic accretionary wedge (Subligurian and Ligurian units) and by the Epiligurian wedge-top sediments. The upper part of the structural edifice, in several areas, is dismembered and thinned by low-angle extensional fault systems, such as those described in southern Tuscany (Carmignani et al., 1994) and in southernmost Liguria (e.g. Tellaro detachment, Storti, 1995).

Here we present another example of such low-angle fault systems, exposed in the Lima valley (northern Tuscany). It consists of a well developed bedding-parallel fault system which appears to be, in turn, affected by superimposed folds and late-stage normal faults (Botti et al., 2010). The original geometry of the low-angle fault system has been reconstructed and superimposed deformations have been restored. The fault system is composed by two first order segments, both of them showing bedding-parallel attitude and top-to-NE kinematics. The uppermost segment causes the tectonic repetition of the pelagic sediments of Scaglia fm. (Upper Cretaceous - Oligocene) and the sandstone of Macigno fm. (Oligocene - Miocene); the lowermost one causes the direct contact of the Macigno fm. on the pelagic carbonate of the Maiolica fm. (Upper Jurassic – Lower Cretaceous), via the elision of the Scaglia fm.. In the central part of the study area, other formations are elided by the lowermost fault segment, giving the direct contact of the Macigno fm. with the Calcare selcifero di Limano fm. (Lower Jurassic).

The damage zone of the two main tectonic contacts has been studied in detail to investigate the role of the different lithologies involved. In the Macigno sandstone, a foliated cataclasite developed in the proximity of the fault core, intercalated with smaller lithons of less deformed rock associated with crushed breccias. At increasing distances from the fault core, the thickness of the deformed domains decrease up to millimetric scale while the thickness of the undeformed rock domain increase up to decimetric scale. In the Scaglia fm., a very intense fault parallel foliation developed in the shale layers while the more competent limestone layers are affected by low-angle subsidiary faults. In the Maiolica limestone, the presence of abundant calcite filled veins is the evidence of intense fluid circulation. Fault sealing and fluid confinement processes are testified by the strong increasing of the vein volume in the proximity of the fault and the almost complete absence of veins in the hanginwall.

Fluids overpressure in the Maiolica fm. had a strong impact on active deformation mechanisms and shear localization. In the portions of rock characterized by lower fluid volume, the veins are not deformed. With increasing fluid volume, vein get more deformed and tension gashes develop. In the proximity of the fault core, where the fluids constitute more than 90% of the whole rock volume, vein array is involved in an S-C type shear fabric.

References

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