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Styles of positive inversion tectonics in the Central Apennines and in the Adriatic foreland: Implications for the evolution of the Apennine chain (Italy)

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A B S T R A C T

Integration of new field structural and geophysical data with existing information from the Apennines chain in Italy and its adjacent Adriatic foreland indicates that the styles of positive inversion tectonics and the modes of interaction between the extensional and the subsequent compressive structures vary. Starting from the Cretaceous, the contractional deformation induced by the mainly north-directed convergence of Africa/Adria with respect to the European plate promoted the closure of various arms of the Atlantic and the Neo-Tethys oceans, which opened in different times and with distinct orientations. The mosaic of continental blocks, carbonate platforms, rift basins and oceanic domains with several geometries and orientations with respect to the axis of the subsequent compression, and the resulting heterogeneities within the shallow sedimentary cover and the overall lithosphere, strongly influenced both the structural evolution of the Apennine orogenic belt and the intra-continental deformation within the Adriatic foreland.

Field observations reveal that the steeply E- and W-dipping Mesozoic–Cenozoic normal faults are systematically decapitated by sub-horizontal or gently west-dipping thrusts propagating with short-cut trajectories. Pre-thrusting normal faults were commonly deformed by later thrusts, but little evidence seems to support their entire reactivation as high-angle reverse faults. This suggests that these shallow- and steeply-dipping discontinuities were not suitable to be reutilized by the superficial thin-skinned thrust faults propagating within the sedimentary cover. In contrast, presumably late Paleozoic and Mesozoic W-dipping normal faults appear moderately reactivated in the Adriatic foreland, and strong positive inversion tectonics affect the deeper and buried structural levels of the Apennine chain. Within the latter, the syn-rift sediments in the hangingwall blocks of the fault-bounded basins were totally extruded and generated the strong uplift of the thinned Adria continental crust.

Finally, the contrasting styles of interactions of the pre-existing normal faults with later thrusts (i.e., passive truncation or positive reactivation) strictly result from the different evolution of the Apennine chain and the combined thin- and thick-skinned modes of deformation of the stretched lithosphere of the Adria plate.

1. Introduction

In the last decades, special attention has been given to reconstructing the role played by the inherited tectonic grain of foreland plates in the subsequent evolution of fold-and-thrust belts. Several foreland domains have been affected by rift-related extensional tectonics prior to being incorporated into the mountain belts and/or have suffered normal faulting induced by the flexure of the foreland plate (e.g., Dewey et al., 1989) contemporaneously to the advance of the fold-and-thrust belt (Hancock and Bevan, 1987; Harding and Tuminas, 1989; Bradley and Kidd, 1991). Moreover, in other cases, the stresses acting along the plate margins have been transmitted far into the foreland, promoting intra-continental deformation also resulting in the reactivation of pre-existing normal faults (Coward, 1994; Ziegler et al., 1995). The coupling or decoupling of the upper and lower plates has been envisaged as a main factor that controls, respectively, the compressional or extensional deformation affecting the foreland domain, and these dynamic processes can promote normal or reverse faulting at distinct times (Ziegler et al., 1998, 2002). Moreover, foreland

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