Modes of foreland deformation ahead of the Apennine thrust front

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The Apennine orogen of peninsular Italy represents a suitable area for analysing modes of deformation in front of a developing thrust belt, and the role played by early-formed foreland structures in controlling the general architecture of the orogen. Structures which developed ahead of the thrust front occur in the present-day Adriatic foreland, and are also increasingly reported from the thrust belt (in which they were later incorporated). These structures include both extensional and contractional features. In the Umbria–Marche–Romagna Apennines, Neogene foreland extension produced normal faults organised in two main sets, roughly parallel and perpendicular to the strike of the orogen.

Orogen-perpendicular features consist mainly of mesoscopic structures, showing displacements of a few meters at most. On the other hand, orogen-parallel normal faults show large offsets (locally in excess of 1 km), and appear to have controlled foreland basin depocenters in late Tortonian to early Messinian times. Later shortening led to fault reactivation and basin inversion ahead of the thrust front, whereas buttressing and fault truncation occurred as the extensional structures were incorporated into the thrust belt, as can be observed in key-areas such as the Montagna dei Fiori and Monte San Vicino. In the southern Apennines, an allochthonous peritidal carbonate platform-pelagic basin assemblage tectonically overlies shallow-water carbonates (Apulian Platform) which are involved into deeper rooted (?thick-skinned?) fold and thrust structures that constitute the main target for oil exploration in this well known hydrocarbon province. At the contact between the two superposed portions of the thrust belt, a several hundreds meters thick, overpressured melange zone, also including disrupted Miocene synorogenic sequences, has been penetrated by numerous oil wells. Within the allochthon, fold structures involving the Mesozoic pelagic succession of the Lagonegro basin are truncated by an overlying large-displacement thrust sheet made of platform carbonates. Structural geometries indicate that early shortening of the Lagonegro basin succession preceded thrusting of the tectonically overlying Apenninic Platform unit. Such early deformation, taking place in the foreland at some distance from the active thrust front, was most probably mechanically controlled by the occurrence of a thinner and fault-segmented crust comprised between the Apenninic and Apulian carbonate platforms. Age relationships in the shallow-water carbonates resting in the hanging wall to the major thrust within the allochthton suggest that the pre-orogenic margin architecture most probably controlled also the subsequent (thrust--related) structural evolution of the Apenninic Platform unit.

Our observations suggest that high stress levels in the Apennine foreland controlled different stages of basin formation, subsidence and related sedimentation, as well as early contraction and fault reactivation (inversion) ahead of the thrust front.