History of subsidence and deformation of the Northern Apennine foredeep (Neogene to Recent)

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In the frame of a joint research on the tectonics and sedimentation of the Adriatic foredeeps (TAF), involving ENI-AGIP, Amsterdam and Bologna Earth Sciences Institutes, we analyzed the evolution of the Northern Apennines foredeep by constructing four cross sections, spanning from the external foreland till the relief. The cross sections are located both in the Padan (western and central Emilia) and the Adriatic (northern and southern Marche) foredeeps. They have been constructed by depth conversion of seismic lines, calibrated by means of several exploration wells. Field work on the relief belt provided essential constraints. The results allow an accurate estimate on the subsidence history, the geometry and kinematics of the thrust arrays affecting the foredeep, and the modes and timing of exhumation and relief formation.

The structural style of the belt strongly depends on the pre-thrust subsidence history. The different flexural behaviour of the foredeep produced thickness variations along-strike of the clastic foredeep infill. Because of the absence of an Apennine relief during Miocene and lower Pliocene, the provenance of the turbidites was essentially from the Alps, located to the North. The sedimentation, however, could not keep the pace with the subsidence, therefore deep palaeobathymetries were creating. The palaeobathymetry controlled the emplacement of the Ligurian nappe, an up to 6 km thick remnant of the Cretaceous–Paleogene accretionary wedge. The strict control over advancement and thickness of the Ligurian nappe operated by palaeobathymetry-subsidence patterns points out the relevant role of gravity in the Neogene motion of this thick submarine slide.

After lower Pliocene, the Ligurian nappe stopped and an embryonic relief was emerging, driven by the activity of newly created normal faults. The growth of the relief was accompanied by ending of thrust activity, increasing sedimentation rates and changing subsidence patterns, producing the final infilling of the foredeep. Along the external Apennine belt, these processes acted in a diachronous way, ranging from the Pliocene to the NW to the Middle Pleistocene in the central and southeastern sectors. Also the shape and spacing of the thrusts is strongly related to the thickness of the foredeep deposits: the thicker the clastic interval, the wider the spacing between thrust ramps. Moreover, it has been observed that erosion of the thrust top occurred on ramp anticlines located on thicker clastic foredeep successions, in contrast to thinner intervals showing top-thrust deposition.

The Plio–Pleistocene shortening increases along strike from about 5 km in the northern cross section (North verging) up to 30 km in the southern part of the belt (Northeast verging). This shortening difference can represent the amount of the Plio–Pleistocene bending of the Northern Apennines belt. The remnant arc shape of the Northern Apennines should have been acquired during Miocene, possibly due to the same differential shortening.

Late Jurassic to Early Miocene tectonic evolution of the Polish Outer Carpathians – possible influence on development of the peri-Tethyan Polish Basin

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The Outer Carpathians in Poland are divided into Magura, Dukla, Silesian, Subsilesian and Skole thrust units, derived from separate basins/subbasins. Their Tithonian to Lower Miocene basin-fill was detached from a basement, folded and thrusted over the European Platform. During Jurassic and Cretaceous further to the north, i.e., in the peri-Tethyan realm, sedimentary bas-