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From thrusting to back-arc extension: seismic structure and field evidence of the Apennine Tyrrhenian margin (Central Italy)

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The Apennine Tyrrhenian margin records the evolutionary steps of the back-arc basin developed at the rear of a E-ward migrating fold-and-thrust belt. As well-documented in literature, the counterclockwise rotation of the Apennines is related to the southward increase of the roll back-related subduction of the Adria slab. This led first to the progressive incorporation of thrust sheets within the Apennine prism in the upper plate and later to its subsequent back-arc extension that is contemporaneous with the continuate inarching of the Apennine front towards the Adriatic and Ionian seas. Uncertainties arise on the structural style and timing in the internal Apennines between the orogenic and post-orogenic stages, that are respectively represented by thrust-sheet implacement, and crustal thinning.

We hereby propose a combined 2D seismic and field data review that allows identifying the geodynamic processes preceding the crustal stretching of the Apennine Tyrrhenian margin with new insights from on- and off-shore seismic lines. In particular, the construction of a new geotraverse across the margin, which is stretched over 100 km between the internal Central Apennines belts and the Pontian escarpment, allows to roughly estimate: i) the Late Miocene - Earliest Pliocene shortening with its change of the basal decollement depth through time; in particular, subsurface data highlighted stacked thrust sheets that were involved in an initial in-sequence propagation with top-to-the-ENE, synchronous to late Tortonian foredeep to wedge-top sedimentation. We also distinguish late backthrusts related to the formation of triangle zones that are more deeply rooted moving to the western chain interior. ii) The amount of crustal stretching and subsidence; Back arc-related orogenic collapse is preceded by initial orogen uplift and erosion in the internal sectors. iii) The onset of at least two magmatic cycles; in this frame, the lateral slab tearing and retreat is tracked by E-rejuvenated volcanic activity in the upper plate along the Volsci Volcanic Field and the Palmarola-Vesuvius lineaments. Those volcano-tectonic trends are favoured by a series of transtensive structures that progressively reflect the arc expansion in the rear. In this frame, the NE-dipping crustal detachment(s) may have played into crustal thinning during the Pliocene, driving and occasionally hampering magma emplacement, while high-angle faults have locally driven monogenetic eruptions. Finally, we report on field and seismic evidence of neo-tectonics, supporting ongoing extension occurring on the margin.