## Shallow and deep active structures of the Val d'Agri area (southern Apennines)

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A large debate exists on the deep structure of the southern Apennines and on the geometry and kinematics of fault systems controlling active deformation and seismicity. The Apennine accretionary wedge forms an allochthon overlying foreland strata continuous with those exposed in the Apulian promontory. The tectonically buried portion of the Apulian Platform was involved in the final shortening phases, giving rise to reverse-fault-related, open, long-wavelength folds that form the hydrocarbon traps for the oil discoveries in southern Italy. Recent geophysical studies have provided evidence that deep-seated reverse faulting involves the basement, while interpretation of high-quality seismic profiles and cross-section balancing favour an inversion tectonics model involving reactivation of pre-existing (Permo-Triassic) basement normal faults, the related deformation being characterized by limited horizontal displacements. Our work suggests an important role of the mélange zone interposed between the buried Apulian Platform carbonates and the surface allochthnous units in producing effective decoupling between deep and shallow structural levels. While the former are dominated by deeply rooted major faults, surface units are dissected by numerous brittle structures that formed at various stages during Apennines evolution. These structures comprise rather different features such as Mesozoic fracture sets and extensional fault systems, Neogene normal faults associated with bending of the foreland plate during the foredeep/forebulge stages, lateral/oblique thrust ramps and tear faults, and strike-slip fault systems. As a result of late Quaternary extensional reactivation of the deep-seated major faults, the inherited fault network characterizing the shallow rigid lid (decoupled by the ductile mélange zone at its base) is reactivated in a complex fashion. This results in a highly segmented and articulated fault pattern, including en-echelon sets of moderate-size (<10 km lengths) faults showing extensional offsets of few hundreds of meters at most. On the other hand, major brittle structures in the buried Apulian Platform carbonates and underlying basement represent mature fault zone that cumulated displacements of up to a few kilometres over geologic time. As such, they are capable of nucleating large earthquakes as a result of late Quaternary extensional reactivation. Such a tectonic setting has been tested by applying the finite element modelling method to the analysis of the reconstructed crustal structure, integrated with available seismological datasets. In particular, the role of the most important discontinuities and thickness variations of different crustal layers has been investigated by finite element modelling with the aim of unravelling likely stress perturbations and strain field around main active structures.

## Geodynamics and active tectonics of the Calabrian Arc: the contribution of regional and local deformation sources

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The Calabrian arc represents a forearc terrane emplaced to the southeast during Neogene north-westerly subduction of the Ionian slab and minor collision between Europe and Nubia. Today, the remaining intact part of the slab, one of the narrowest and steeper in the world, is imaged by seismic tomography and by earthquakes beneath the south-eastern Tyrrhenian Sea. The ~30 km thick Calabrian crust is thought to rest directly on an asthenosphere wedge emplaced above the Ionian lithospheric slab, and delamination of the lower crust together with corner sub-slab mantle flow at the slab edges is suggested by residual topography and gravity. During slab roll-back, extension within the hinterland stretched continental crust and locally formed oceanic crust beneath the Tyrrhenian Sea. Today, an array of active normal faults is traced along the axis of the arc, and extension is viewed as a result of uplift-driven collapse or attributed to plate boundary reorganization. The extension direction determined by fault slip analysis, focal mechanisms of crustal earthquakes and GPS geodetic velocities is ~NW-SE. Regional GPS velocity fields also point to a reduction in the rate of Ionian slab retreat and Tyrrhenian back-arc extension with respect to the geologic rates. However, ongoing shortening is documented by seismic reflection profiles offshore and involves the frontal, possibly aseismic part of the accreting wedge. Similarly, recent shortening and transpression is recorded offshore at the lateral borders of the uplifting regions in northern Calabria and in northern Sicily. The recent uplift of the Calabrian arc is spectacularly documented by displaced Middle Pleistocene and younger flights of marine terraces. Uplift is viewed as an isostatic response to removal of a high-density deep root, either through slab break-off, or through decoupling of the upper crust from the underlying slab and convective flow in the mantle wedge. Alternatively, uplift may have been induced by stalling in the roll-back process and trapping of Calabria between the buoyant continental landmasses of Adria and northern Africa, or as due to viscoelastic response to enhanced erosional flux from land to sea following the onset of glacial-interglacial cycles. Maximum cumulative uplift rates averaged since the Middle Pleistocene are estimated at >1.5 mm/yr. Several studies have shown that uplift is partitioned into ~1 mm/yr due to regional processes and the residual to distributed displacement on major faults, both transpressional and transtensional at the borders, and extensional along the chain axis. A large co-seismic uplift component is also embedded in displacement of Late Holocene shorelines in the Calabrian Arc, possibly associated to slip on offshore faults and/or to fold growth.