



The Tyrrhenian stage geodynamic evolution of Apenninic-Maghrebian orogen (Southern Apennines and Sicily)

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In the Central Mediterranean region the foreland domains are represented by two continental blocks, the Apulian Block to the north and the Pelagian Block to the south, respectively belonging to the Adria and to the Africa plates. They are separated since Permo-Triassic times by the oceanic crust of the Ionian Sea. The Apenninic-Maghrebian orogen is located between two oceanic crusts: the old Ionian crust, at present time subducting beneath the Calabrian Arc, and the new crust of the opening Tyrrhenian Sea.

The orogenic belt is represented by a multilayer allochthonous edifice, composed of the Calabride Chain (CC) tectonically overlying the Apenninic-Maghrebian Chain (AMC), which in turn overthrust onto the Upper Miocene and Pliocene top-levels of a deep seated thrust system, originating by the deformation of the innermost carbonates of the Pelagian/Apulian blocks (External Thrust System: ETS).

The AMC tectonic units derive from the orogenic transport during Oligo-Miocene times of sedimentary sequences deposited in palaeogeographical domains located between the Europe and the Afro-Adriatic plates. These units are composed of Meso-Cenozoic shallow-water carbonate successions detached from a continental type crust sector, the Panormide/Apenninic Block, recognizable by means of seismic lines shot in the Tyrrhenian offshore of Southern Apennines and Northern Sicily. The Meso-Cenozoic basinal units, that compose the AMC, can be distinguished into two main groups of sequences, originally located on oceanic crusts separated by the Panormide/Apenninic Block: the external ones (Ionides) related to an original basin belonging to branches of the Ionian Palaeobasin involved in the orogenesis, and the internal ones ascribed to the Alpine Tethys (Sicilide Units). The terrigenous deposits of the basinal sequences belonging to the Ionides are represented by Tertiary foreland/foredeep deposits, whose relationships with the substratum are occasionally preserved, although large detachments occurred with further forward transport, which generated repeated slices with an apparent increase to the original thickness.

. The Alpine Tethydes are composed of sedimentary sequences, which were deposited in the Alpine Tethys, and originally were located between the European and the Panormide/Apenninic Block. They are represented by allochthonous far travelled tectonic units, resting on both the Panormide/Apenninic Platforms and the Ionides.

The Calabride Chain originated by the delamination of the European margin. This roof thrust system includes nappes of Hercynian basement with remains of the original Meso-Cenozoic covers deformed during the Paleogene and sutured by the Late Oligocene-Early Burdigalian Capo d'Orlando Flysch.

The geological, geophysical data and the volcanological characters permit to restore the palaeogeography and the geodynamic evolution, and allow to recognize three orogenic stages: the Eo-Alpine, originated during Cretaceous-Eocene times, evident in the western Calabria, in the Tyrrhenian basin and the Alpine Corsica; the Balearic stage (Late Oligocene-Early Miocene), in which the Corsica-Sardinia block rotated and collided with the Adria-Africa margins with thrusting of the Alpine Tethydes over Panormide/Apenninic platforms; and the Tyrrhenian stage (Middle Miocene to Present), when the onset of the Tyrrhenian back-arc basin occurred and after the closure of the interposed Palaeoionian branches the Ionides were tectonically transported onto the foreland blocks.

The CROP crustal sections allow to distinguish thickness and distribution of the crusts in this area of the Mediterranean Sea, and their clear influence on geodynamic evolution of the Tyrrhenian stage. They confirm that both the foreland blocks extend below the orogenic belt, reaching the Tyrrhenian margins, with a gradual thinning and a transition to a Palaeo-Ionian slab, probably not active at present time, from which the Ionides detached and overrode the ETS. The seismogeological data indicate the presence of the Panormide/Apenninic blocks, that

took part in the closure of the branches of the Palaeo-Ionian Sea interposed between the Panormide/Apenninic crust and the Pelagian/Apulian Blocks. At the present time the Panormide/Apenninic blocks are colliding with the foreland blocks.

Such a collisional stage along the Tyrrhenian coast of north-western Sicily and the contemporaneous active subduction processes below the Calabrian Arc produce the NW-SE oriented South Tyrrhenian System. This system drives the transfer of the orogenic front towards areas characterized by still subducting oceanic crust of the Ionian sector. In particular it consists of predominantly NW-SE oriented right lateral faults system with antithetical NE-SW and coeval associated N-S normal faults and south-verging thrusts. All these structures are compatible with an unique cinematic framework dominated by transcurrent tectonics. Geological mapping carried out in the on-shore areas of Sicily, integrated with stratigraphical and structural analysis, permit to recognize some main structures in connection with the geodynamic evolution of the Tyrrhenian stage and allow to propose an updated structural model of this area.