

THE CRUSTAL STRUCTURE OF SOUTHERN TYRRHENIAN SEA SUBDUCTION ZONE

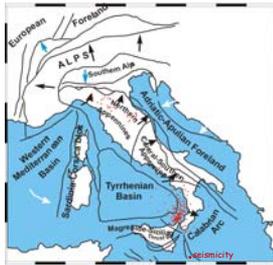
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The Southern Tyrrhenian sea is a complex area, where major global plate tectonic processes are observed: oceanic subduction with seismicity down to 500 km, but included within a slab with well-defined edges; slab rollback and detachment; arc and intraplate volcanism; sea-floor spreading; continental rifting. All plate tectonic processes are operating within a few hundred kilometres.



Schematic Geodynamic setting of Italy

Geodynamic evolution of the study area is still a matter of debate. The occurrence of deep seismicity (down to 500 km) led some authors to consider the subduction of the Ionian Plate beneath the Calabrian Arc a still on-going process. However, subduction coexists with both active extensional tectonics on the Calabrian Arc - Apennine chain, and a general upwelling (0.5-0.7 Myr - present) of northern Sicily and Calabria continental crust. This has been suggested to be the result of slab detachment beneath the Calabrian Arc

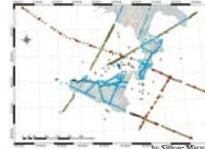
Seismic data

In order to evaluate competing geodynamic models of the area, we need to know more about the regional crust and upper mantle structure.

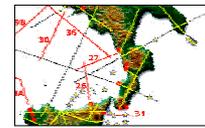
ReWARD (refraction and reflection wide-angle data base)

This project aimed to assemble and store with a common format all the Deep Seismic Refraction data collected before 1994 over Italy, and high-resolution Wide-Angle-Reflection (R/WAR) digital waveforms generated by air-gun shooting and acquired on-shore Italy. At present the Calabrian Arc subset of the Database is available.

The image of southern Italy crustal structure results from seismic modeling of **Deep Seismic Refraction (DSS)** and **Wide-Angle-Reflection (WAR)** data included in ReWARD.



REWARD DSS Calabria dataset

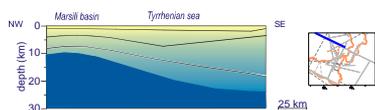


CROP R/WAR profiles

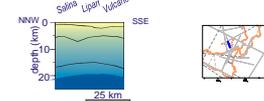
SEISMIC DATA MODELING

Refraction profiles and high resolution on-offshore Wide-Angle-Reflection profiles provide a picture of crust-mantle interface with rough topography in the southern Tyrrhenian and western Ionian basins.

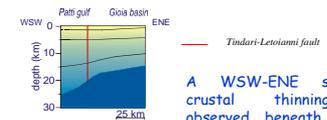
The seismic data modeling highlights **short wave-length undulations** all over the Tyrrhenian basin and **sharp lateral discontinuities**



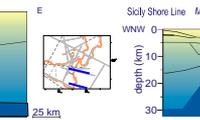
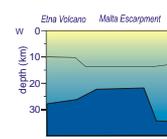
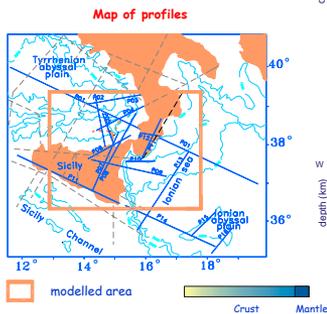
The major upheaval occurs beneath the **Marsili basin**, in the center of the Tyrrhenian basin, where the Moho rises up to 10 km of depth.



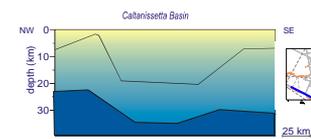
A short wave-length undulation characterizes the Moho (18 km) beneath the **Southern Aeolian** active volcanic area, where the whole crust exhibits a general uprise of all velocity boundaries



A WSW-ENE sharp crustal thinning is observed beneath the **gulf of Patti-Gioia basin** at the south-eastern edge of the Tyrrhenian basin.



A main deflection of the Moho is observed at western margin of Ionian basin, **offshore east Sicily**



The maximum crustal thickness (38km) is observed beneath **Caltanissetta basin** in central Sicily

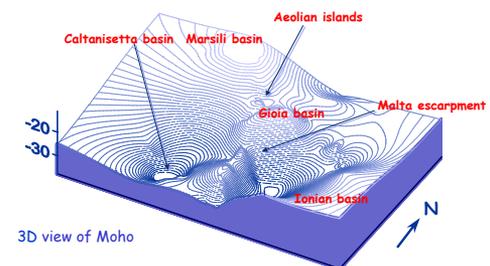
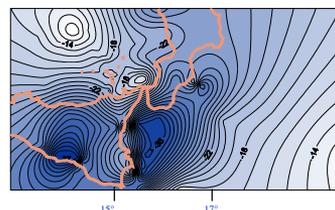
CONCLUSIONS

Present-day tectonics of the area is characterized by **NE-SW normal faults** forming the major peri-Tyrrhenian basins and **NNW-SSE oblique-slip faults with dextral components** of motion (i.e. the Tindari-Letojanni fault system). The Tindari-Letojanni fault system extends from the Marsili Basin to the Etna volcano and Malta Escarpment. **Compressive tectonics** only occurs to the west of the Aeolian Islands. This structural environment has been interpreted as the result of the **slab detachment** or delamination processes beneath the Calabrian Arc

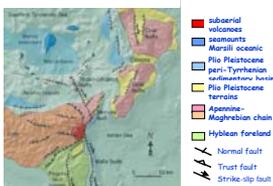
Moho contour map

Seismic modeling suggests a **NNW-SSE lithospheric structure**, the Tindari Letojanni fault system, oriented at high angle to the trench. This structure connects the Marsili basin oceanic crust to the Etna volcano (Northern Sicily) throughout the Aeolian Islands, and could be the northward prosecution of regional Moho uplift related to the Malta escarpment. Across the Tindari Letojanni fault system the southern Tyrrhenian crustal seismicity changes from mostly shallow to the west, to deep intra- slab to the east.

2D Map of Moho



Geology of southern Italy



Earthquakes distribution and focal mechanisms

