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Time-space evolution of the Calabrian accretionary wedge : insights fom seismic reflection profiles

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We present the results of a study based on the interpretation of the available multichannel seismic reflection profiles acquired in the Ionian offshore with the aim of describe the time-space evolution of the Calabrian accretionary wedge during the last 30 Ma.
We map out the main structures in the basin with their time of activity. The analysis of backarc extension process, punctuated by episodes of fast trench retreat and period of quiescience, coupled with the result of interpretation of seismic data shows a complex and discontinuous evolution of the Calabrian subduction zone.

1. Geological setting

The Calabrian subduction zone is a narrow but seismologically well defined slab plunging toward northwest in the Central Mediterranean.

The subduction of the Ionian basin under Eurasia, is mainly dominated by trench rollback producing the opening of the two large backarc basin (Liguro-Provencal and Tyrrhenian) and the formation of the Calabrian accretionary wedge.

The Calabrian accretionary wedge is a partially submerged south-verging accretionary prism that extends from south Calabria to the Ionian abyssal plain and laterally from the Malta Escarpment to the West and Apulia Escarpment and Mediterranean Ridge to the East.

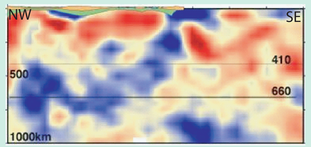


Fig. 1 High velocity anomaly of the Ionian slab (Piromallo e Morelli, 2003)

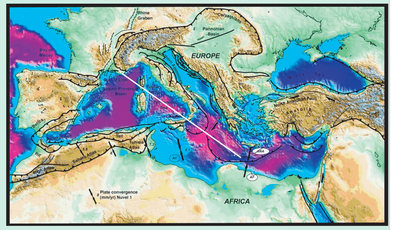


Fig. 2 Structural map of the Mediterranean area (after Faccenna et al., 2001, modified and redrawn)

Despite the Ionian basin has been investigated in the last forty years by several geological and geophysical survey, the results are often controversy, and the structure of the wedge is still poorly defined (Finetti e Morelli, 1973; Rossi e Sartori, 1981; Cernobori et al., 1986).

2. Methodology and data

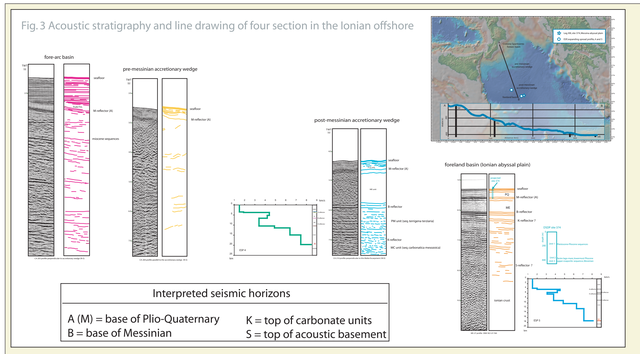


Fig. 3 Acoustic stratigraphy and line drawing of four section in the Ionian offshore

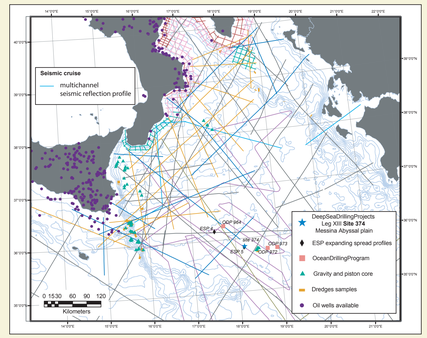


Fig. 4 Location map of the seismic reflection profile across the Calabrian accretionary prism in the Ionian offshore

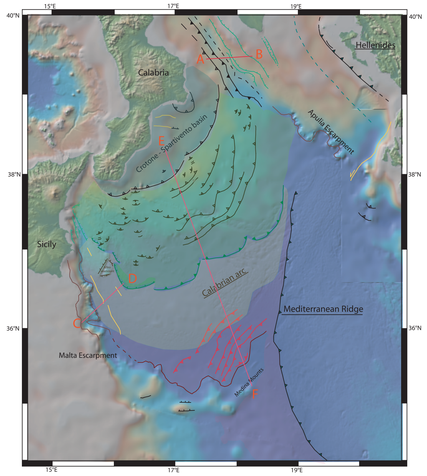
We have collected all the available multichannel seismic reflection profiles, acquired up to 60's, in the Ionian offshore by industrial exploration and academic cruises.
The resolution and the data quality of the seismic profiles vary remarkably because the different acquisition parameters and energy system used for the different survey.
The interpretation of these data was facilitated by integration of other geophysical and geological data (ESP, de Voogd et al., 1992; ODP, site 374) and well stratigraphy dataset near the southern coasts of Calabria, in order to better constrain a more complete history of the subduction process.
In the central sector of Ionian sea where no direct ties were available for the interpretation, the overall sequences can be identified on the basis of previous works and of their seismic character.

3. Preliminary results

The high density grid of the seismic lines allow us to map out the main structural feature and the recognition along several seismic profiles of the main reflection horizons and their geological attributes allow us to date the activity of the main thrust system and to reconstruct a detailed, time-space, evolution of the accretionary prism.

The stratigraphy feature, style of deformations and internal seismic character suggest the division of the Calabrian accretionary wedge, along a general NS transect, from the foreland basin to the backstop of the wedge, into four major structural zones:

- forearc basin and crystalline backstop
- post-Messinian accretionary wedge
- pre-Messinian accretionary wedge
- foreland basin



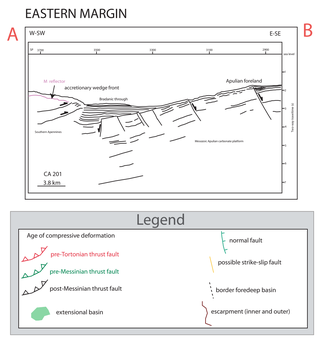
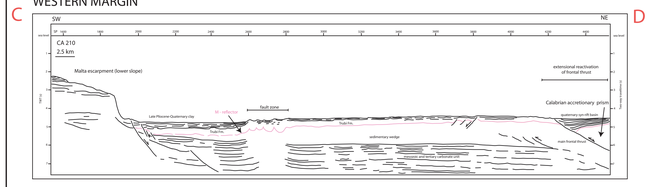


Fig. 5 Structural synthetic map of Ionian offshore reconstruct by interpretation of seismic reflection profile. The thrust system have been further distinguished using different colour referring to age of activity



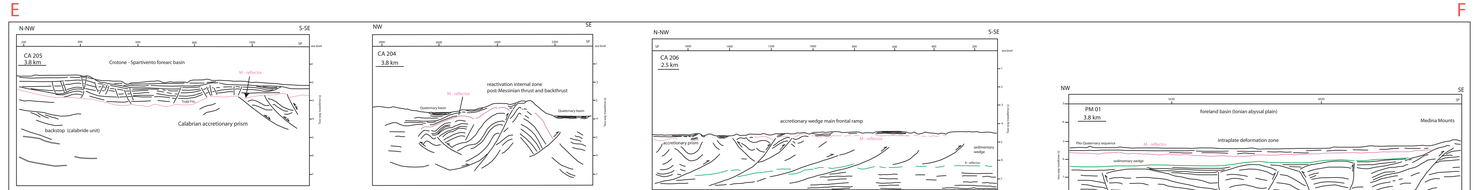


Fig. 6 The interpretative line-drawings (time vs depth) show the structural feature of three different sector: western and eastern margin of the wedge and a profile along the dip of the wedge, from the backstop to the foreland basin.

4. Concluding remarks

The main results of this works concern: 1) the timing of compressive events 2) the structure of the wedge and 3) its relationship with other tectonic elements of the ionian offshore.

The interpretative line-drawings highligth the completely different tectonic-style of the three margins of the prism.

In particular the structural map shows that the accretionary history of the Calabrian prism is punctuated by discrete episodes of deformations evolving in both time and space.

Along a hypothetical profile running NW-SE, we distinguished:

1. A pre-Messinian phase of frontal accretion concomitant with the growth of the wedge. The growth itself is interrupted by stopping phase as attested by intraplate deformation in the foreland basin. The Tortonian (?) age of this phase of deformation is probably linked with a phase of stopping in backarc extension.

2. A post-Messinian backstepping of the defomation in the inner portion of the wedge, with thrust and backthrust that probably rework previous structure.

5. References

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