

# The main geologic features of the Ionian Sea

by

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The morphology of the Ionian Sea distinguishes the following units : *a.* continental shelf; *b.* upper continental slope; *c.* peri-ionian terraces; *d.* calabrian ridge; *e.* valley of Taranto; *f.* apulian plateau; *g.* Kerkira basin; *h.* Kefallinia canyons; *i.* Hellenic trench; *l.* Mediterranean ridge; *m.* ionian bathyal plain.

The facts emerging from the morphological data permit for instance to state that the so called "Messina cone" or "fan" do not exist. Actually this area is dissected by a network of deep canyons confluent into the central Messina canyon. Furthermore, the Mediterranean ridge is not connected with any land structure in Italy. The Apulian ridge (plateau) practically reaches the Ionian islands Kefallinia and Zakintos.

In order to obtain a concrete geologic knowledge and definition of these units a continuous seismic reflection survey with a 30 kJoule Sparker has been carried out over 4100 miles. The preliminary results are : two main peri-ionian sedimentary basins (Sibari and Crotona-Spartivento) extend parallel to the calabrian coast from the Gulf of Taranto to South of the Cape Spartivento. Their margins are also traceable (by outcrops) on land. The substratum of the Crotona-Spartivento basin and of the SW half of the Sibari basin is represented by metamorphic terrains of calabrian nappes, followed by a thick post-orogenic sequence.

The latter consists of *a.* a flysch formation of Mid-Helvetian to top of Tortonian age. At sea its thickness varies from 0.3 to 2.0 secs (2-way reflection time); on land it is only found in wells drilled south of Crotona; *b.* thick Messinian units (lower and upper evaporites and the intermediate halite formations, with numerous large salt diapirs particularly in the Crotona-Spartivento basin; *c.* the Upper Messinian — Recent terrains (up to 1.5 secs thick along the axis of the two basins) interbedded with very large submarine slumpings.

Between the axis of the Sibari basin and the axis of Taranto valley the Messinian-Pliocene-Quaternary formations are overlying the chaotic allochthonous terrains of north-calabrian appenninic nappes. The lowermost Messinian formation is broken up into slabs covered by Rossano nappe (crotonides) which slid from the Northeast to the present coast.

The appenninic allochthonous terrains, i.e. the *south appenninic chain*, continues under the sea in the southeasterly direction terminating about 39°30' N parallel. The front of the chain lies along the axis of the valley of Taranto on the Lower Pliocene terrains and is covered by Pleistocene neo-autochthonous sediments with the same tectonic and stratigraphic relations which are found on land in the Appennine foretrough.

Southeast of the Crotona-Spartivento basin there is the *Calabrian-ridge*. This morphological and geological unit is characteristic by numerous, very large diffraction hyperbolae in the substratum, very likely caused by metamorphic rocks distorted in vast overthrusts to SE. Here, the thickness of Plio-Quaternary sediments is usually less than 0.25 secs. The Calabrian ridge is probably an independent chain parallel to the Calabrian arch thus meriting the name of *External Calabrian Arch*.

In the *bathyal plain* the Plio-Quaternary sediments are almost always less than 0.25 secs thick and their tectonic orientation always runs NE-SW.

Along the Taranto valley as far as the mouth of Kefallinia Canyon stretch numerous narrow sedimentary basins following a NE-SW alignment (*Metaponto - Kefallinia furrow*) and bounding the *Apulian ridge*. This feature corresponds to a large and gentle anticline (with longitudinal small faults) also oriented NW-SE with a thin Plio-Quaternary cover ( $< 0.25$  sec) upon a very thick calcareous formation of Cretaceous age. Having passed a NE-SW fault (corresponding to the Kefallinia Canyon) the anticline continues through the Kefallinia and Zakynthos islands, where it is covered by the Hellenic nappes carried from the NW. Finally, the wide *Kerkira basin* oriented NW-SE, presents a very thick (up to 1.5 sec) and a very quiet Plio-Quaternary sequence.

### Conclusions

The Ionian Sea can be clearly subdivided into two areas with quite different and very evident tectonic trends. The NE area with NW-SE orientations comprises the Sibari basin, the termination of the appenninic chain, the appenninic foretrough, the Metaponto-Kefallinia furrow, the Apulian ridge, the Kerkira basin and the Hellenic chain. The SW area with NE-SW tectonic orientations comprises the metamorphic Calabrian arch, the Crotona-Spartivento basin, the external Calabrian arch and the bathyal plain.

The appenninic and sicilian structures (i.e. chain, foretrough and foreland) are not connected. In fact, the appenninic chain is independent from the Calabrian arch, but continues with a NW-SE orientation through the Ionian Sea; the appenninic foretrough continues into the Hellenic trends and the Apulian foreland reaches the Ionian islands. Moreover, it would be possible to visualize an enormous trench extending from Piedmont (N. Italy) as far as Cyprus. The trench was formed by subsidence starting at the beginning of Miocene (Piedmont) and lasting until Pleistocene (Ionian Sea and the Hellenic Trench). Probably the External Calabrian Arch corresponds to the front of the Sardinian-Corsican-Tyrrhenian microplate and the Metaponto-Kefallinia furrow to the boundary of Adriatic microplate.

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### Discussion

A une question portant sur les paramètres utilisés pour affirmer que des diapirs existent au large de Crotona l'auteur précise que pour lui il s'agit de sel bien caractérisé car les corrélations avec les évaporites affleurant à terre sont faciles à faire.

En ce qui concerne la nature métamorphique de la « calabrian ridge » l'auteur précise qu'il s'agit d'une pure hypothèse basée sur l'importance de la diffraction aboutissant à une absorption complète de l'énergie. On ne possède cependant aucune autre preuve et en particulier aucun échantillon.

**Woodside :** Why the deep reflection hyperbolas shown on one seismic section is real reflections and not side echoes from what appeared on the slide as irregular bottom.

**Selli :** The bottom is very flat on the area of the profile and similar hyperbolas were not seen elsewhere.

**Caire :** Dans les orientations que reflètent les variations d'épaisseur du Plio-quaternaire, on reconnaît, entre Apulie et Sicile, les directions conjuguées du réseau rhe magmatique africain. Dans les Atlas et en Sicile, ces directions sont celles de failles, de flexures ou de décrochements. A-t-on une idée de leur signification tectonique en Mer Ionienne?

**Réponse :** Dans les Apennins et les Hellénides ces accidents ont la même direction. Lorsque les Apennins s'incurvent vers le Sud-Est ils s'arrêtent et ne continuent pas dans la ride Est Méditerranéenne. La Calabre est indépendante des Apennins et de la Sicile. Elle constitue le front d'une petite plaque englobant une partie de la Tyrrhénienne, la Sardaigne et la Corse. Le front de cette plaque constitue la « Calabrian ridge ».

**Biju-Duval :** La question du Professeur CAIRE sur l'existence d'accidents décrochants pose aussi celle de l'ouverture des systèmes arqués méditerranéens; mais je pense que si la géologie de terrain permet de parler de décrochements, la sismique ne permet pas de mettre en évidence des déplacements horizontaux : c'est alors une question d'interprétation.