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GEOLOGICAL PROBLEMS IN THE TYRRHENIAN AREA AND PLANNED FUTURE RESEARCH

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Abstract. The still open geological problems of the Tyrrhenian area are briefly reviewed, with emphasis on the significance of new geophysical and geological data that should be achieved in the near future.

The Tyrrhenian Sea is a Neogene ocean-type basin individuated within a strongly deformed area which was occupied, during Paleogene and early Miocene times, by a continent-continent collisional system. This system consisted of the Africa-verging Apennines deformed during the Burdigalian tectonic phase, as well as of the southward continuation of the Europe-verging Paleogene Alps. Greenschist-facies metamorphism in the Apenninic nappes from Tuscany to Calabria and calc-alkaline volcanism, widespread in Western Sardinia, are important events related to Oligocene--Miocene plate convergence and subduction processes.

After Burdigalian times, rifting processes affected the Tyrrhenian area, producing crustal thinning in the north and new oceanic crust in the south. The individuation of the Tyrrhenian basin was accompanied by counterclockwise rotation, fragmentation and horizontal displacement of the tectonic elements pertaining to former belts.

Intermediate and deep-focus earthquakes in the southern Tyrrhenian area reveal the existence of a deep-seated lithospheric body, which probably represents a relic of the Oligocene-Lower Miocene subduction.

First-order problems in the Tyrrhenian basin are:
- when the rifting phase begun and how the basinal evolution occurred;
- what kind of processes governed the kinematic system.

Time constraints for the rifting phase are:
1. the vanishing of the calc-alkaline volcanism in Sardinia (about 13-14 MY ago);
2. the beginning of the Tuscan anatectic magmatism (15-10 MY ago);
3. the occurrence of thick marine sequences, showing syn-rift attitudes, widespread in the western part of the basin and underlying Lower Pliocene deposits;
4. the age of the abyssal tholeiites drilled at DSDP Site 373A (7 MY), which suggests that during latemost Miocene oceanic crust was already produced in the central part of the southern Tyrrhenian area.

Constraints for the late evolution are:

a) calc-alkaline and high-K orogenic volcanic products (mainly Quaternary), widespread along the inner part of the Apennines and Sicily;

b) tholeiitic intraplate volcanics (about 3 MY old) which constitute isolated edifices rising up from the bathyal plain; similar products have been also drilled at DSDP Site 373A;

c) alkaline volcanic products (Pliocene-Quaternary) in Sardinia, Strait of Sicily and along the southern and western margins of the Tyrrhenian Sea. The activity developed following a NW-SE trend that is roughly parallel to the bulk extension of the oceanic basin, and effected areas occupied by different structural domains;

d) E-W and N-S directions of the magnetic anomalies in the central Tyrrhenian area. The N-S trend roughly conforms to the elongation of the main tholeiitic seamounts. It is not ascertained whether the age of these seamounts and the age of the surrounding ba-
- thyal plain is different moving from the central basin to the southeastern one.

Another matter of question is how the basinal evolution developed. We wish to underline that any genetical model adequate for the Tyrrhenian evolution must take into account thet severe compressional tectonics affected the outer border of the Apennines, of the Calabrian Arc and of the Sicilian Maghrebides during the opening of the basin. The most important compressional phases occurred during Tortonian, early Pliocene, middle Pliocene and late Pliocene-Quaternary times.

If the Tyrrhenian domain played, at least in part, the role of source-area for the contemporary tectonic accumulation, then the time-space migration of the thrust belt-foredeep-foreland system and the consequent crustal shortening can not be related to a classical plate-convergence mechanism.

Rejecting over-simplified and/or inadequate models such a back-arc spreading and microplate dispersal, we must admit that first-order analytical data are still to be obtained prior to explain how and why the Tyrrhenian basin opened and evolved.

We think that more attention should be addressed to the possible role played by gravitational sinking of the relic lithospheric slab presently underlying the southern Tyrrhenian area. Passive subduction, as presently observed in the external Calabrian Arc, could be responsible for contemporaneous compressional and extensional phenomena, for orogenic volcanism, uprise of the asthenosphere and consequent generation of an ocean-type basin. In this hypothesis, close correlations between post-Burdigalian compressional phases in the thrust-belt and extensional tectonism in the Tyrrhenian area should be expected. Such kinematic analyses have not been attempted so far. Important information could derive by dating regional disconformities within the Neogene-Quaternary sequences of the Tyrrhenian area. Such disconformities are clearly evident on most seismic profiles performed in the basin.

Geophysical and geological researches planned for this and next year will greatly help in assessing some of these first-order tectonic and stratigraphic events in the Tyrrhenian area.

A French multichannel reflection seismic survey preparatory for future drilling operations, is scheduled for March 1985 with shipboard and processing facilities provided by IFP and IFREMER. Presently available seismic profiles, although forming a dense regional network, are for over 90% single-channel lines, with obvious limitations in penetration. On the other hand, the few multichannel lines were mostly performed by OGS many years ago and their processing is not updated. The new survey should thus provide unequivocal evidence for listric faults and oceanic crust in the central Tyrrhenian area, greatly improving the seismic knowledge of the region.

ODP drilling during Leg 107, scheduled for early 1986 along a W-E transect, will hopefully provide the followong basic information:

- age and facies of the pre-, syn- and post-rift deposits and age of the seismic disconformities in areas with tilted fault-blocks generated by listric faults in the western and central basins;
- evidence and age of oceanic crust in the portion of the basin characterized by organized magnetic anomalies, avoiding thus the ambiguities of DSDP Site 373A;
- presence of oceanic crust with different age, in different portions of the basin.

The new inputs will allow to solve the problems of when and how the Tyrrhenian basin opened, with unequivocal and high-resolution constraints.