

STRUCTURE OF THE SARDINIAN CHANNEL : CRUSTAL THINNING AND TARDI-OROGENIC EXTENSION IN THE APENNINIC-MAGHREBIAN OROGEN ; RESULTS OF THE CYANA SUBMERSIBLE SURVEY (SARCYA AND SARTUCYA) IN THE WESTERN MEDITERRANEAN.

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Abstract

A diving survey on the Sardinian Channel led to the characterisation of the structure of both the Sardinian and the Tunisian margins. The observations and in situ collected samples allow to precise the nature and the thermal evolution of the basement (Sardinian or Calabrian-Peloritanian-Kabylian), and to characterise the volcanic evolution, providing new constraints to the kinematic evolution of the region.

Key words : Crustal structure, Volcanology, Algerian basin, Tyrrhenian basin

The Sardinia Channel is located on a segment of the Apenninic-Maghrebides collision chain. Although this segment is nowadays completely submerged, it has not been broken apart by the opening of the Algerian-Provence and Tyrrhenian oceanic basins. Previous seismic data have shown that the structure of the Sardinia Channel is due to the superposition of two successive regimes of deformation: a compressional event with crustal thickening followed by extension and thinning out. The morphology and structural patterns of the Sardinia Channel are still well preserved because the post-orogenic extension was moderate and submergence prevailed important erosion. Thus, the Sardinia Channel represents a key area for the study of the tectonic evolution of a collisional chain. Moreover, the use of the easy handling CYANA submersible allows a detailed structural and morphological survey, and the collection of well located and sometimes oriented samples.

The primary object of the campaign was to carry out in situ observations on the main morphostructures of the Deep Sardinian Channel, the escarpments of the south Sardinian Margin, where the Sardinian basement is exposed, the north Tunisian escarpments, corresponding to inverted crustal-scale thrusts of Calabrian-Peloritan-Kabylian (CPK) affinity, and the "Central Ridge", developed between the Sardinian and CPK zones. A second object of the diving campaign concerned the search of the syn- and post-orogenic magmatism, known from the dredged samples and on-land outcrops of Galite Archipelago and NW Tunisian Mountains. The samples collected on-site increased the compositional range of the magmatic rocks collection and allowed an examination of the emplacement mechanism.

The dives on the Sardinian Margin led to the discovery of a submarine volcano, dated at 12.6 Ma and composed of shoshonitic andesites with lamprophyre inclusions, and to the characterization of the nature and structure of the underlying basement, consisting of tilted blocks of Hercynian metamorphic and granitic rocks and their sedimentary cover. The sea floor morphology reflects the structure.

The Southern Margin and Central Ridge, belong to the CPK group. They are composed of a metamorphic and granitic Hercynian basement deformed during the Alpine orogeny, which is stratigraphically overlain by an Oligo-Miocene detrital cover of Peloritian or Kabylian type, and tectonically overlain by the so-called "flysch nappe". Throughout the CPK domain these formations were subjected during the Oligo-Miocene, at ca. 23 Ma ago, to a first denudation event, and during the Tortonian, ca. 10–8 Ma ago, to a second denudation, which has been connected to the opening of the Tyrrhenian basin. Structures, microstructures and thermochronological data indicate relatively low P-T conditions for the extensional deformations: this suggests that these units remained at shallow depths in the Apennine-Maghrebian Orogen, and were relatively sheltered from the Messinian erosion. The age (12.5 Ma) and nature of the volcanic sequence in the Sorelle is closely comparable with the calc-alkaline suite of the Galite Archipelago, Tunisia.

The data gathered during these dives in the Sardinian Channel give new constraints to the reconstruction of the kinematic evolution of western Mediterranean. The kinematic history of the Sardinian Channel can be divided into five stages:

1 - The first stage, between 35 and 22 Ma, is dominated by a regime of tectonic shortening and crustal thickening, which affected the former European Margin of the Tethys. Tectonic inversion of ancient extensional structures resulted in thrust basement units.

2 - The second stage, between 22 and 12 Ma, is characterized by the thinning and gravitational collapse of the previously over-thickened crust. During this period, the Algero-Provençal-Ligurian Basin opened, the Corsican-Sardinian-Calabrian-Peloritanian-Kabylian block (CSCP) rotated (20–16 Ma), and the thinning of the Sardinian Margin began, resulting in the splitting of the CSCP block into a Corsican-Sardinian (CS) and a Calabrian-Peloritanian-Kabylian (CPK) one.

3 - The third stage, between 12 and 6 Ma, is characterized by a general thinning in the whole Tyrrhenian area. The Sardinian Channel corresponded to an extensional transform zone separating a thinned area in the south-west, from an area undergoing thinning in the north-east. The splitting of the CSCP block was enhanced, with total detachment between the Calabrian-Peloritanian (CP) and the Kabylian (K) fragments. A morphological evolution of the area resulted from the Messinian Salinity Crisis, responsible for the regional leveling, the excavation of canyons, and the exhumation of the fault scarps.

4 - The fourth stage, between 6 and 2 Ma, began with the flooding of the Mediterranean Basin, after the Messinian Crisis. At this time, oceanization takes place in the Western Tyrrhenian (Vavilov Basin). The Sardinian Channel was situated at one extremity of an extensional transform zone which splitted Calabria from the Peloritani Mts.

5 - The fifth stage, between 2 Ma and the Present, corresponds to oceanization in the Eastern Tyrrhenian (Marsili Basin), far from the Sardinian Channel. The splitting of the CPK area is concluded with the separation of numerous small blocks such as Sila, Serre and Aspromonte. The Sardinian Channel is undergoing the first stages of the shortening, which is affecting the entire Western Mediterranean, well documented on the Algerian and Ligurian margins.

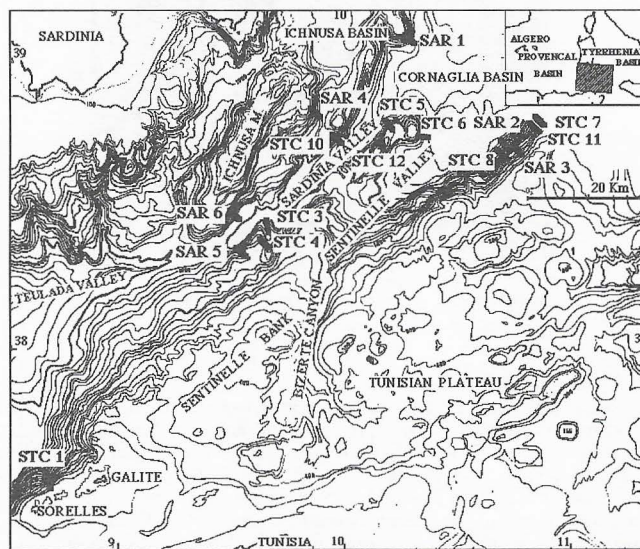


Fig. 1. Bathymetry of the Sardinian Channel and position of the Dives carried out on the escarpments (bathymetry after Gennesseaux and Stanley, 1983).