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Submerged Depositional terraces offshore Favignana (Northwestern Sicily)

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INTRODUCTION

Within the geological surveying in the area of the Sheet n.604 (Isole Egadi) at 1:50.000 scale, some researches has been carried on in the continental shelf offshore of the Favignana isle by means of acoustic surveys and seismic reflection prospecting completed with investigations by R.O.V. (Remote Operated Vehicle) and bottom sampling by grab (DEL BONO *et alii* 1991).

The collected data have been acquired from September 1989 to June 1993 during some surveys with the Ammiraglio Magnaghi vessel of the Italian Hydrographic Institute (I.I.M.) and the Minerva and Urania vessels of the National Research Council (C.N.R.).

For the high resolution seismic prospecting it has been utilized a 300 Joule UNIBOOM source; a total 300 km of profiles were acquired in the area of the Sheet to characterized the sea floor and near surface sediments of the continental shelf and to classify the main characters of the acoustic facies.

Fig. 1- *Location map of the studies area.*

GEOLOGICAL FRAMEWORK

Fig. 2- *Geological sketch of the sea floor in front of Favignana Isle.*

The examined area (Fig.1), located westward of Trapani on the Western Sicilian offshore, is formed by a continental shelf built up on a rocky tectonized substrate, strongly eroded by marine erosion. Recent sedimentary deposits are almost exclusively made of organic fragments.

The structural configuration is characterized by a series of tectonic units overthrusted eastward and southeastward on the Iblean foreland during Miocene age. New compressive movements (reserve faults, tectonic inversion) occur during Pliocene (CATALANO & D'ARGENIO, 1982; CATALANO *et alii*, 1985; CATALANO *et alii*, 1988).

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An extensional phase, from Upper Pliocene to early Pleistocene, determined the formation of some basins and structurals heights with main orientation NNW-SSE and E-W, till now in evolution (AGATE *et alii* 1992; ARGNANI 1993; CATALANO & MILIA, 1990); their outlines are pointed out by submarine morphology.

Seismostratigraphic analysis clear up a Mesozoic substratum formed by sedimentary deposits evolving from neritic to pelagic facies (CATALANO, 1988; CATALANO *et alii*, 1989). This substrate outcrops underwater along a continous belt around the island and in isolated banks to the South, West and North of Favignana at depth ranging from -40 to- 70 m. On this substrate often the coralligenous biocenosis sets off.

The recent sedimentary cover is very thin and is made of organogenous medium to coarse sands.

The source of biogenic material are calcareous algae, mollusks, Bryozoa, Serpulides, Foraminifera etc. (D'ANGELO *et alii*, 1994) that cover the shelf to depth of -100 m. Beyond this depth the fine portion increases and we find the pelitic sands and the sandy pelites as far as the pelites in the deepest areas (Fig.2).

All the sediments, also the finest one, have a prevailing biogenic content, while the terrigenous part is very scarse.

This trend is extended backward in time to early Pleistocene, as it is conformed by the presence of bio-calcarenites outcropping on the island and on the Sicilian coast (ABATE *et alii*, 1996).

Fig. 3 - *Geomorphological sketch of the area (from* ORRÙ & ULZEGA, *1993, modified). Bathymetric lines are provided from the Hydrographic Institute of Navy* (I.I.M.) *that, during the last years, has carried out new surveys offshore Western Sicily. They offer a good detail for the description of the main morphological lineaments.*

MORPHOLOGY

On the basis of the data from bathymetric map and from Uniboom and Sub-Bottom records, we can recognize an abrasion continental shelf that joins with a slight slope the island of Favignana and Levanzo to the mainland. It extend for about ten Km to depths of -80,-90 m.

Another inner abrasion shelf is shown at depths of -30, -40 m, between Favignana and Levanzo and southward of Favignana; it joins with the lower one with a regular slope.

Scattered morphological highs are present between the two island and south of Favignana and they correspond to the outcrops of the Mesozoic carbonatic substrate.

They are shaped at the top by abrasion surfaces and at the base (-25, -30 m) by tidal grooves (AGNESI *et alii* 1993) (Fig.3).

The depth of the shelf break is steep and stright, denoting a tectonic origin.

Westward and Northwestward of Favignana it is backward eroded while to the South, Southwest of the island it is prograding in some places.

The depositional wedge, interpreted such as a submerged depositional terrace, is located in an area subject to strong erosion and itself is interested to successive erosions; it lays at the edge of the lower shelf at depths ranging from -80, -90 m. It lenghtens in NNW-SSE direction for about 10 km and it extends to a maximum of 2.5 km in width, with thicknesses variable up to 40 m depending on the steepness of the scarp.

It's mainly set up by pelitic sands and sandy pelites (grab sampling).

Northward the terrace thins and ends where the slope is steeper for the backing of the canyon headscarp which separates the Favignana shelf from that of Marettimo; southward it is cut off by slumpings.

Fig. 4 - *Development of the submerged depositional terrace.*

Several depositional phases setting up the terrace can be recognized.

These episodes probably are related to the strong sedimentary stages during the lowstand of the last glacio-eustatic event characterized by numerous fluctuations.

Their respective geometric relations are different, depending from the different evolution of some

of the shelf edge: from the bottom currents, from balancing, from different subsidence rate and from the morphology of the shelf lying behind.

During the period the morphology of the area depends from the formation of the isthmus between Levanzo and Favignana and between Favignana and the Sicily, from the long littoral bars and from the incision of the morphological height of the "Secca del Toro" to the South of Favignana (Fig. 3) (AGNESI *et alii*, 1993).

This coastal environment so changeable and subjected to strong bottom currents (testified by several sedimentary structures identified with Side Scan Sonar records nearer to the coast) supplied the sediments setting up the terrace.

Furthermore, the trend of general uplifting of the area somewhere has produced conditions of strong erosion that make the keeping hard for these depositional structures and which have reshaped the depositional terrace with erosion at the top, piles at the base dislocation of the blocks.

Fig. 5 - *Uniboom profile crossing the N-S canyon westward of Favignana. It's the northern examined profile (Fig. 4). The opening of the depositional terrace is at a depth of 80 m, in correspondence of the shelf-edge.*

The steepnees of the slope (amplified by the the vertical exaggeration of the seismic profile, 17x) produces a small development of the sediment thicknesses and of the extension perpendicularly to the wedge.

The end seems to be identified at - 160 m, while the edge, just signed for the terrace surface, is located at about -94 m.

The coarse grain size of the sediments and the high gradient of the reflectors, prevent the penetration of the seismic signal and the identification of the internal structures of the depositional terrace.

The withdrawing of the head of the canyon causes a marked lateral instability of the sediments that collect at the base of the terrace, forming a convex wedge which partly obstructs the buttom of the canyon. On the opposite side of the canyon, placed against the Marettimo shelf break, it's visible another submerged depositional terrace, even less developed, and placed at different depths.

Fig. 6 - *On the eastern side of the canyon on the Favignana shelf (Fig. 2), three phases of growth of the margin are recognized, identified by breaks of the slope of the sea-bottom..*

The internal structure is scarcely recognizable for the low penetration of the acoustic signaland the strong gradient of the reflectors.

At the base of the frontal scarp of the terrace, a morphological height of sedimentary origin is observed, probably eroded by the currents that occur at the bottom of the canyon. The layers of the weak internal reflectors does'nt seem to be related to the deposits of the eastern slopes. At the opening (at -94 m) a depositional oblique-tangent structure eroded at the top is visible; offshore the deposition continues with a slight angular discordance and with prograding oblique-sigmoidal reflectors, in which it has been recognizable a standstill and a following restarting of the progradational event.

The edge is placed at -106 m and the end, not very clear, seems to be at -178 m.

Fig. 7 - *The shelf is composed by a substrate cut by a rough erosional surface on which prograding deposits lay with a clear morphological break.*

Also in this profile, like in the previous one, three depositional phase can be recognized, marked by light flexures on the sea-floor. The terrace is characterized by transparent acoustic units. It's evident the erosive action of the currents at the base of the slope which were active also during the first prograding phase and have created a low morphology (transfered westward during the time). These currents probably interested the frontal scarp of the depositional terrace, which (unlike the cases shown in the former figures) seem to have greater gradients than the inner reflectors.

The opening is at -106 m, the edge is at -108 m and the close at -144 m.

Fig. 8 - *The prograding structure lays laterally on a terraced slope. The acoustic units are very transparent and it's difficult to recognize the internal structure. Like in 5 b) at the opening (-104 m) the surface is eroded while towards the edge the progradation is a little more clear. Unfortunately a temporary stopping of the acoustic signal acquisition has prevented to point out the base of the depositional terrace; in this record the edge is the only recognizable element, placed at -114 m, while the end of the depositional body (at about -160 m) is partially buried by a light morphological height similar to that noticed in Fig. 5 b).*

In the bottom of the channel the same low erosive morphology is observed.

Fig. 9 - *The shelf break is marked and very steep; a relict depositional structure lays at the base of the scarp. In this case the erosion seems to have interested deeply the body of the depositional terrace till to leve only the basal parts. Only a thin portion (50 m of thick-*

ness) of the terrace has been preserved; it's the remnant of erosion at the centre of the profile, in which the same three depositional phase can be recognized. Regard *on this structure only the close is recognizable at about -135 m.*

The strong erosion also moves the deposits which cover the bottom of the morphological depression.