Morphology and sedimentary pattern of the Southern Ionian Calabrian margin (South Italy)

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The neotectonic evolution of the Ionian Calabrian margin, external side of the southern Apennines mountain range (Calabro-Peloritanian Arc), is marked by important fault systems transverse or parallel to the chain. They were active, with extensional mechanism, during the Late Quaternary and delimit a regional horst-graben style, respectively characterized by high uplift and subsidence rates (ERGENZINGER, 1978; GHISETTI, 1979). Marine geological and geophysical surveys (high resolution seismic reflection profiles and cores) in the area between *Le Castella* and *Cape Spartivento*, pointed out that the morphology of the shelf-slope system of the margin and its Late Pleistocene-Holocene depositional evolution are mainly controlled by active tectonics, extension of the onland one, along with a remarkable fluvial input and glacioeustatic sea level fluctuations.

Morphological features

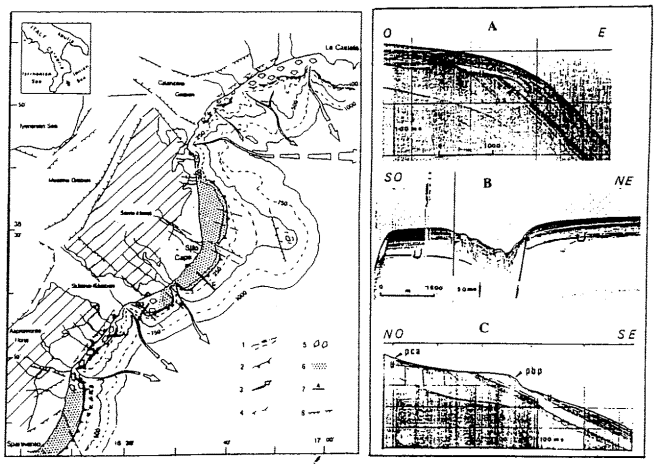
On the whole, the area shows a narrow shelf and a steep slope, deeply cut by several active canyons, which are aligned with the fluvial mouths. The shelf is only 0.4 km wide, irregular and discontinuous due to the canyon erosion in correspondence of the *Catanzaro* and *Siderno* grabens. Around *Le Castella, Cape Stilo* and *Cape Spartivento* it is almost continuous with average width around 6.5 km. The shelf break is, on average, at 115-120 m over the whole area. The slope deepens continuously and without significant breaks (average dip around 4°-6°) in the whole southern sector of the margin. In front of *Cape Stilo* its continuity is broken by wide structural high, which constitutes the seaward side of a small intraslope basin. In the whole northern sector *(Gulf of Squillace)* it is instead composed by ridges, narrow valleys and canyons, tributaries of the main longitudinal Squillace canyon, which mainly trends NNW-SSE.

Gravity deformations of different kind and size (creep, debris, slump) are diffused along the entire slope and the most pervasive of these events are probably triggered by the high seismicity of the area.

Depositional setting

The shallow seismic records (3.5 kHz S.B.P., Uniboom and Sparkarray 1000-3000 J) across the shelf- slope system within the study area show a superposition of seaward progradational units. The youngest of these overlays a prominent shelf-wide erosional unconformity, formed during the last glacio-eustatic sea level fluctuations (about 18 ka B.P.; BORSETTI *et al.* 1989) and truncating former middle late Pleistocene progradational units, still under investigation (GABBIANELLI, *in prep.*). In the zone of graben areas with a narrow shelf, this unit is represented by a upbuilt and outbuilt of accretionary shelf-slope sequence, which reaches thicknesses around 30 ms. A buried sedimentary prism, probably connected to the low stand sea-level phase, is some times detectable within the sequence in correspondence of the shelf break. In these areas the erosive unconformity reaches maximum depths around 170-180 ms and, in particular, it is sharply cut and lowered in correspondence of the fault system *(Roccella Ionica-Marina di Nicotera)* controlling the northern side of the Siderno graben. On the other way around, in areas with wider shelf the youngest depositional sequence is marked by a modern sediment wedge that thins near the shelf edge and reaches landward a maximum thickness of about 25-30 ms. A small sedimentary prism is continuously developed along the whole shelf edge in front of *Cape Stilo* and *Cape Spartivento* while the shelf wide erosive unconformity is at an average depth of about 140 150 ms.

Legend - Morpho-structural sketch map of the Ionian Calabrian margin (data on land from GHISETTI, 1979, modified) and seimic sections across the shelf-upper slope system. 1. isobath in meters ; 2. shelf break ; 3. main canyons ; 4. main breaks ; 5. draped sediments and buried wedge areas ; 6. shelf areas with coastal aggradational wedge and sedimentary shelf break wedge ; 7. location of profiles : U = erosional unconformity, ps = buried sedimentary wedge, pca = modern sedimentary wedge, pbp = small sedimentary prism at the shelf break ; 8. faults.



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Meteo and hydrodynamic conditions governing the recent evolution of the Ebro delta

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Since the end of the forties -when the construction of large dams in the lower Ebro valley began-, the Ebro delta front has behaved as a stretch of poorly-nourished sandy coast under the action of both the local meteorology and marine hydrodynamics (S.-ARCILLA *et al.*, 1990).

The main role of meteo agents is driving or influencing the water motions off the Ebro delta. Apart from that, the wind stress acting on the local sediments produces noticeable eolian transport in some areas such as the Fangar dune field and the Trabucador bar (fig. 1). Strong prevailing "mestral" winds from the NW may produce alongshore drifts of sediments compensating for a small part of the littoral transport at the Fangar area, whereas the (unfavourable) effect of the mestral winds on the Trabucador bar is migration of sand from the backshore to the beachface.

Wind waves (i.e. high-frequency water motions) and associated surf-zone currents appear to be the primary driving mechanism for the sediment transport in the Ebro delta coast. Available directional wave data show that "llevants" -seas and swells from the NE or E directions- are the most energetic sea states and account for most of the wave energy flux reaching the Ebro delta (GARCIA *et al.*, to be published. See fig. 2). This is coherent with the directions of the alongshore littoral transport derived from sediment budget calculations (JIMENEZ *et al.*, 1990).

Tidal motions do not seem to have any remarkable influence on the large-scale evolution of the Ebro delta coast. Data retrieved from local tide gauges yield a tidal range of ca. 20 cm (LOPEZ, to be published). Surges associated to storm events are a much more important factor that astronomical tides. Meteo- induced elevations of the mean sea level (MSL) of 50 cm are not exceptional, as they may happen more than once per year. The effect of these surges is clearly understood when storm events like that of 8th to 11th October, 1990 are considered. As described in JIMENEZ *et al.* (1991), the elevation of the MSL favoured then a break-through of the Trabucador bar under high-but-not-too-high wave height conditions.

Low-frequency motions, ranging from inertial oscillations to quasi-steady currents, are only capable of transporting sediments either near the Ebro mouth -where the amount of suspended sediments is relatively important- or at deeper locations, provided that waves produce resuspension of bottom sediments. Field results from CACCHIONE *et al.* (1990) show that such a process hardly occurs beyond the delta "mud belt", which extends as deep as 20 m. On the other hand, advection of material may not follow the prevailing current direction to the SW but be instead affected by mesoscale phenomena such as spatial variations of the wind stress field and transient water exchanges across the shelf edge (GARCIA, 1990; TINTORE *et al.*, 1990), which can give rise to local gyres of different character.

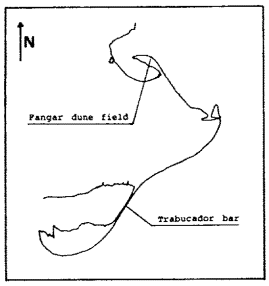

Fig. 1 Location of the Fangar dune field and the Trabucador bar within the Ebro delta.

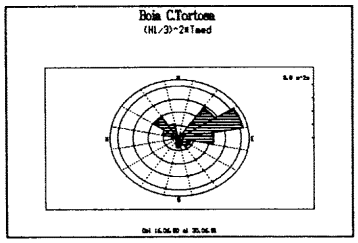

Fig. 2 Distribution of the local mean wave energy flux at deep water.

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