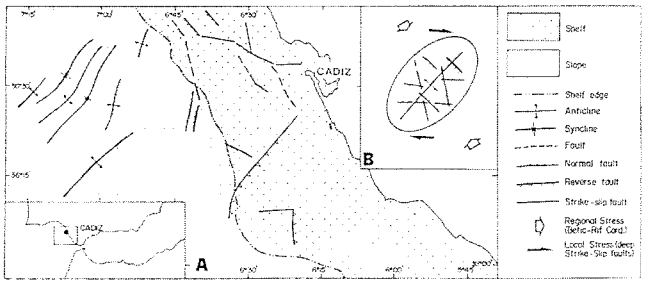
TECTONICS OF THE GULF OF CADIZ AND THE WESTERN END OF THE MEDITERRANEAN ALPINE BELTS

PALLARES L.[1], ALDAY, F.[1] and MALDONADO A.[1,2]

[1] Depart. de Geodinámica, Univ. de Granada. [2] Inst. Andaluz de Geología Mediterranea (C.S.I.C./Univ.de Granada). C/Fuentenueva s/n. 18002 Granada, Spain.

The Gulf of Cadiz includes the westernmost sector of the External Zones of the Betic-Rif chains, where the Gibraltar arc bends to develop an arcuated orogenic belt plunging westward. The continental margin of the gulf consists of three main tectonic provinces which concentrically surround the internal zones of the arc. These include the flysch units of the Campo de Gibraltar Complex in the proximity of the strait of Gibraltar, the Betic-Rif external zones, and the Neogene basins of the Guadalquivir Valley which extends southwestward and occupies most of the central sector of the Gulf of Cadiz. The area could be defined as a type of Mediterranean fore-arc basin. Two areas, NW and SE, are identified in the continental shelf, characterized by the absence or presence of shallow acoustic basement formations. The basement in the NW sector is restricted to a narrow zone close to the coastline, while the overlying Cenozoic deposits show significant seaward thickening. The basement, in contrast, crops out over large areas in the SE sector of the shelf, and it is locally drapped by a thin veneer of recent deposits. The Cenozoic formations are only observed in this sector in the most external parts of the shelf. The basement is composed of fault-bounded blocks of flysch and subbetic units, individualized by major tectonic surfaces, which may be correlated with the Gibraltar Thrust. The morphological characteristics of shelf are influenced by the tectonics lineaments, since the main boundaries coincide with faults affecting the basement in the SE sector and the development of fault bounded basins in the other sectors of the margin (figure).



Northwestern shelf. The inner and central sector of the NW shelf is characterized by three fault sets striking NNW-SSE, NW-SE and E-W, which affect the basement. The first and third group indicate a predominant strike-slip development, while the second group is a complex of normal faults, some of which correspond to growth faults, that may also have strike-slip component. All these faults have been active during the Quaternary, with a significant proportion showing Late Quaternary and even present displacement. Some faults, however, are interpreted reactivated Pliocene and Miocene fractures. The outer shelf contains faults with NNW-SSE and N-S directions, which intersect the edge of the shelf. These are generally normal faults, some of which appear to have a strike-slip component and locally showing reverse drag. The most recent displacements are from the Middle or Early Quaternary, therefore older than in the faults of the middle and inner shelf. Some of these faults are associated with diapirs which show more recent displacements.

Southeastern shelf. The SE sector of the Gulf of Cadiz shelf is very different from the NW sector. The shallowness of the acoustic basement and the absence of a significant depositional cover difficult the identification of faults and only the most significant frac-tures have been represented (figure). This sector is bounded to the N and W by an inverse fault, which cuts oblique across the shelf in a NE-SW direction, bending southward in the southern sector. Another, probably reverse fault running N-S lies to the SE of the above fault, in the middle-outer shelf sector (figure). The northern fault facilitates the westward extension of the shelf, where it reaches it maximum width. The southern fault bounds the basement formations and delineates the limit of the Cenozoic depositional units onlapping the basement. The northern fault was active in the northern sector from the Pliocene to the Late Quaternary, in the central zone during the Late Pliocene, and in the southern end from Late Pliocene to Early and Middle Quaternary. The southern fault was active during the same last period. The orientation, age and kinematic of these faults suggest the last compressive stages of the Betic-Rif orogene and its westward thrust.

The Slope. The most prominent tectonic elements of the slope are open folds with a NE-SW axis, slightly curved and subparallel. They could represent the near-surface expression of deep wrench faults with an approximate orientation of E-W to ESE-WNW (figure). These structures are coherent with the fault system described in the NW shelf. The existence of deep faults in this region, however, have not been clearly demonstrated at present. Recent works based on the solution of focal mechanisms indicate a diffuse area of seismicity eastward of Gorringe Bank, which probably follows the boundary between major crustal elements. One branch of this presently active area extends into the Gulf of Cadiz and may be represented by the suggested E-W to ESE-WNW strike-slip faults.

The distribution and characteristics of the acoustic basement and the structures of the continental margin of the Gulf of Cadiz differentiate two sectors in the shelf. The northwestern sector is characterized by distensive features subparallel to the coast, which are associated with subsidiary faults of predominant strike-slip component. These faults facilitate the seaward subsidence of the shelf and the development of thick Cenozoic depositional units. The structure of the southeastern shelf, in contrast, is controlled by a compressive regime, which develops fault bounded blocks of the acoustic basement and constrains the development of large depositional basins. The curved-axis, NE-SW trending folds of the slope are congruent with the existence of deep wrench faults E-W to ESE-WNW oriented, and with the faults in the NW of the shelf. It may be postulated that the structures in the Gulf of Cádiz are compatible with wrench zones with a dextral sense involving both dip-slip and strike-slip components, caused by deep faults associated with a broad deformation zone. This zone may corresponds to a branch of the boundary defined by the continuing collision of the African and Eurasian plates. The observed structures and inferred tectonics in the Gulf of Cadiz are compatible with those observed in the Betic cordilleras characterized by a NNW-SSE compression.

THE MCS PRISMED CRUISE, PART 2 : THE INNER MEDITERRANEAN RIDGE, THE HELLENIC TRENCH AND MARGIN

Henrik Hove PEDERSEN[1], Eric CHAUMILLON[2] and Jean MASCLE[2]

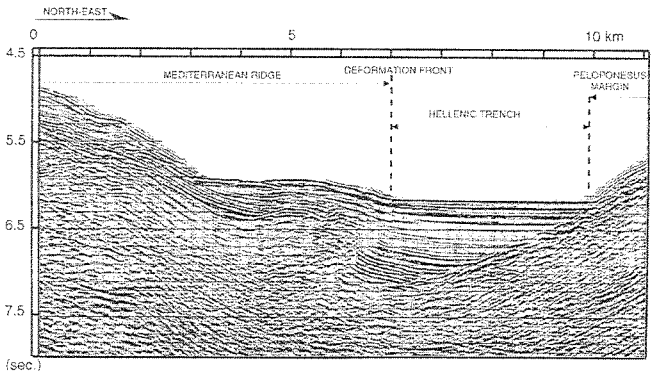
[1] Geosciences, Aarhus Universität, 8000 Aarhus, Denmark
[2] GEMCO - Laboratoire de Géodynamique Sous-Marine, B.P. 48, 06230 Villefranche sur mer, France

The multichannel seismic reflection survey Prismed (March 1993) has yelded new data on the geological structures of the northern Mediterranean Ridge (M.R.) and of its contacts with the Hellenic trench and bordering Aegean margin. These areas are of major interest to study the transition betwen extensional and compressional regimes.

1 - Off Peloponesus, the M.R. contains a thick, likely Messinian, basin affected by gentle folding and reverse faulting ; only few deformations are detected within the Plioquaternary cover. In opposition the contact between the M.R. and the bordering Matapan trench is characterized by reverse faulting and compressional deformations involving recent sedimentation. We interpret these features as evidences of transpressional activity related to dextral strike slip motion at the boundary between the trench and the M.R. In the area the continental margin is cut by extensional faulting that has likely reactivated previous thrust zones.

2 - South of Crete, the margin is cut into a series of imbricated and tilted blocks resulting in fan-shaped basins only covered by thin, unconformable plioquaternary sediments. There, the M.R. appears bounded by northward directed thrust zones ; however the 3000 meters deep trench represents the northern limit of major gravitational sliding over parts of the lower continental margin.

3 - Finally, south-east of Crete the Hellenic trench system divides into two branches ; the northern Pliny trench may correspond to en echelon strike slip reactived former major thrusts across continental margin blocks ; the southern Strabo trench represents the northern limit of M.R. related sedimentary sliding.



The M. R inner deformation front facing the Peloponesus margins