WARRS study of Alboran Sea and Strait of Gibraltar

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During a period from 30th. of October, to 5th. of December 1991 the Research Cruise R/V-*Valdivia*(V117) of the Institut für Geophysik Universität Hamburg conducted a seismic (wide-angle reflection and on refraction seismic (WARRS) and high resolution reflection seismic) investigation of Alboran Sea and the Strait of Gibraltar. This Project was a joint venture between : Institut für Geophysik, Universität Hamburg, Instituto Geografico Nacional, SNED, SECEG-SA, and Centre National de la Recherche.

The aim of the project was to :

- solve problems posed by the regional tectonics and geological situation, and
- develop a crustal and upper mantle model for on/offshore Marocco-Mediterranean-Spain. For this purpose 15 OBS (Ocean Bottom Seimographs) and 40 LOBS (mobile seimic land stations were deployed several times on both research areas. We obtained 390 km WARRS lines in the Alboran Sea and 225 km in the Strait of Gibraltar. An airguns array with a total volumen of 371 produce the seismic energy. Shooting was extended beyond the ends of the lines in order to obtain an overlap. Additionnal 20 shots on approximatly the same position (stack shots) were fired at the ends and the centre of each profile (figure 1). A detailed high resolution reflection seismic study in the Strait of Gibraltar completed the survey and covered more than 560 km seismic lines (figure 2). We will present our 1th. results and discuss the tectonic implications.

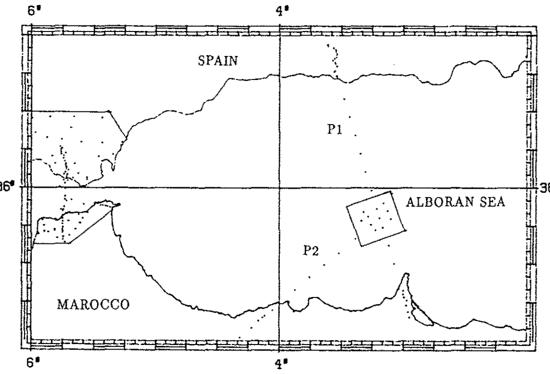

Fig 1: Location map of the on/offshore microseismic areas and the OBS/LOBS positions.

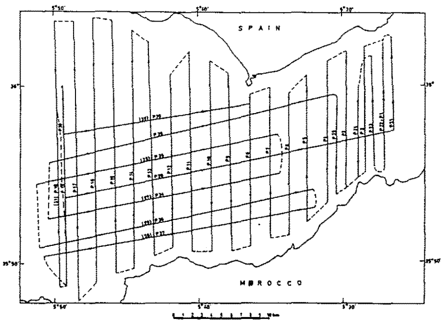

Fig.2: Location of single-channel reflection seismic lines in the Strait.

The morpho - and hydrodynamics of the coastal zone of the Gulf of Kyparissia

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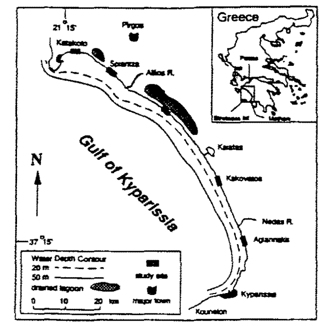
The gulf of Kyparissia is located on the western coast of Peloponnesos (SW Greece), has NE-SW orientation, shoreline length of about 63 km, crescentic shape and is bound by headlands. The aims of the present study are: 1) to determine the sediment transport pattern and estimate the sediment flux in the gulf, 2) to document the relationship between the nearshore wave and current velocity fields and the morphological changes that result in the evolution of rhythmic geomorphological features on the beach face and in the nearshore zone, 3) to test the prevailing hypothesis of edge wave-beach face interaction as the forcing mechanism for the initiation and growth of beach cusps and 4) to document and explain the short and long-term changes of the coastline.

The major geomorphological features that appear at fixed locations along the coast of the gulf are (from N to S) : longitudinal bars, welded bars and crescentic bars and beach cusps. The spacings of the rhythmic forms vary between 16 m and 170 m for longitudinal bars, 110 m and 330 m for welded bars, 110 m and 520 m for crescentic bars and between 3 m and 50 m for beach cusps. The dominant winds in the gulf approach from NW, SW and W and produce waves with maximum theoretical periods of 7.2 s, 11.4 s and 10.7 s respectively. Detailed wave refraction diagrams indicate the existence of a highly variable nearshore current system that gives rise to a complex sediment transport pattern with a divergence at the mouth of Alfios river and a convergence near the Raiafa lagoon.



For the field experiments, five selected locations along the coast were occupied intermittently over a period of three years. A microtopographic grid was established on the beach face at Kakovatos and was used to monitor the small scale morphological and beach slope changes associated with the evolution of beach cusps, to estimate the sediment flux and to produce accurate topographic and erosion maps of the beach face. Topographic cross sections at five locations along the coastline were measured regularly to monitor large scale changes. A computer-based data acquisition system, an anemometer, continuous-resistance wave staffs and specially designed drifters were used for the simultaneous measurement of wind speed and direction, wave height and period and nearshore current velocity and direction. Additional data on the nearshore water circulation were collected with the use of fluorescent dye. Time-lapse photography at 0.5 s intervals permitted the monitoring of run-up and the detection of subharmonic motions on the beach face, indicative of the presence of edge waves in the nearshore zone. All hydrodynamic measurements were analyzed with the use of time series analysis techniques. Grain size samples were collected systematically during measurement periods to determine the textural characteristics of the coastal sediments. The samples were drysieved and the results were analyzed by the method of moments.

The analysis of grid and cross section data showed that the beach was in dynamic equilibrium during the measurement periods with the formation of rhythmic shoreline features being due to a redistribution of sediment on the beach face without any net erosion or accretion.

The computed wave spectra showed that the maximum measured significant wave periods for SW winds were about 20% smaller than the theoretical ones. For W and NW winds there were no significant differences between measured and theoretically expected maximum wave periods.

The longshore current measurements as well as the longshore variation of the textural characteristics of the coastal sediments verify the sediment transport pattern indicated by the refraction diagrams.

A very significant element in certain wave spectra is the presence of infragravity waves with periods between 32 s and 54 s. The existence of these waves and edge wave activity in the nearshore zone have the potential to explain the formation of the observed crescentic and welded bars.

The initiation of beach cusps is associated to a reduction of sediment flux after a period of increased wave activity and to the presence of standing edge waves. In most of the cases, edge wave activity did not persist and cusps grew through the interaction between the incident waves and the initial perturbations on the beach face.

Cliff recession at Katakolo is due mainly to aeolian erosion and not to wave undercutting. Erosion rates up to 1.83 cm/h were measured during periods of strong SW winds.