Bottom boundary layer measurements off the Po River, Italy

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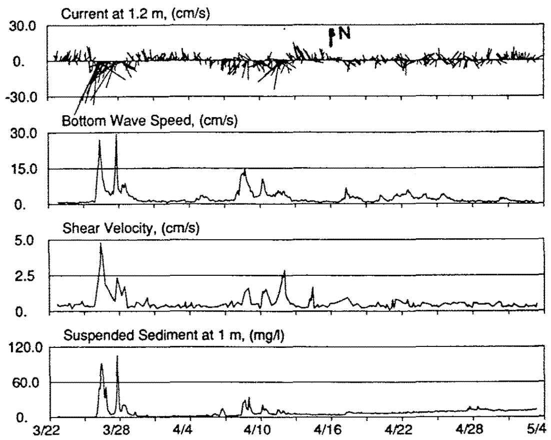
During the 41 day period from 22 March 1990, to 2 May 1990, an instrumented bottom triopod (GEOPROBE) was deployed about 8.5 km SE of the southern flanks of the Po River in about 22.5 m mean water depth. This experiment was part of a cooperative project between the Istituto di Geologia Marina (Italy) and the U.S. Geological Survey (USA) to investigate bottom and near-bottom sediment and pollutant transport on the inner continental shelf along this region. Primary GEOPROBE data included time-series measurements of horizontal current velocity at three levels above the bed, near-bottom pressure and temperature, light transmission at three levels and optical backscattering at four levels. Bottom photographs were taken with a 35 mm underwater camera-strobe assembly every four hours. The GEOPROBE was lowered from a ship within a three point array of closely spaced surface buoys and positioned with the aid of divers. The divers provided in-situ measurements of the tripod orientation, which was selected to provide minimal interference on the current sensors based on the expected average flow direction. The divers also confirmed that the tripod sinkage into the surficial sediment was less than 1 cm at each footpad, and that the tilt was nil. Other instrumentation located near the GEOPROBE included two sediment traps and a profiling C-T-D.

During the GEOPROBE deployment the weather conditions were generally fair, with light and variable coastal winds. However, two storms from the NE and E of moderate intensity transitted the northern Adriatic region on 23-25 March and on 11-12 April, respectively. As will be described, these storms caused significant increases in near-bottom flows and sediment resuspension. Otherwise, the general near-bed conditions were rather quiescent, with weak currents and wave energy, and low amounts of near-bottom suspended sediment. GEOPROBE pressure records indicate that the tide at this location is of the mixed type, with a maximum range of about 1.0 m.

Fig. 1 shows a detailed plot of selected parameters to illustrate these results. The upper panel (current) depicts the current vectors for the sensor at 120 cm above the bottom. The current data were measured once per second in bursts 360 seconds long every two hours. Each vector in the current plot (Fig. 1) represents a burst-average. Over most of the period the currents were rather low (5 to 15 cm/s) with no clear preferred direction, although in the early part of the record apart form the storm passage of 22-23 March the currents were mostly to the north. During both storm periods the current speeds increased substantially, reaching maxima of 40 cm/s and 26 cm/s on 26 March and 11 April, respectively, and were directed toward the SSW. Significant increases in wave velocities occurred during the storms, with peak near bottom wave speeds of 25 to 30 cm/s during the earlier event and 10 to 15 cm/s during the latter one (Fig. 1). Otherwise, near bottom wave speeds were low (<10 cm/s).

The increased current and wave speeds during the storms were associated with rather large shear velocities (u^*) near the bed (Fig. 1) and elevated suspended sediment concentrations at 1 m above the bottom as determined from the transmissometer data (Fig. 1). The u^* values in Fig. 1 were derived from the GEOPROBE velocity data using a least squares fit of the "law of the wall" for rough, turbulent boundary layers. Values of u^* are shown only for regression coefficients of the fitted line ≥ 0.995. The u^* values apply to the portion of the bottom boundary layer dominated by the current, but are enhanced by the wave motion (GRANT and MADSEN, 1979).

Calculations using the GEOPROBE data applied to the Glenn and Grant (1987) model of combined current and wave flows show that the model and data-derived estimates of u^* and roughness length compare extremely well. Bed shear velocities computed from this model have large values during the storms (u^* = 3 to 3.5 cm/s), well in excess of that needed for sediment resuspension at this site. The moderate storms therefore produced significant sediment resuspension and sediment transport toward the SSW during the GEOPROBE measurement period.



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A high-resolution MCS study of the Western Alboran Sea evolution (SW Mediterranean Sea)

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More than 800 k of high-resolution multichannel seismic profiles were gathered in the western Alboran Sea onboard B/O *HESPERIDES* during the first 1991'testing cruise. The profiles were oriented to cut the major structures observed during previous seismic cruises (MALDONADO *et al.*, 1992). Two different morphostructural domains identified in the deep sectors, bounded by the continental margins of Spain and Morocco, include basins and structural highs (CAMPILLO *et al.*, 1992). The three deep basins characterized are limited by structural blocks of the acoustic basement. The western Alboran Basin is the largest showing the thickest depositional sequences, while Malaga Basin and south Alboran Basin are less developed and they have thinned depositional sequences. The faults limiting the basins trend roughly NW-SE and NE-SW and they show a normal to strike-slip component, with the exception of the faults that bound the Alboran Ridge and south Alboran basin which show an inverse to strike-slip component from Pliocene to recent times (BOURGOIS *et al.* 1992; CAMPOS *et al.*, 1992). The structural highs are largely attributed to metamorphic rocks of the Alboran Domain, although local intrusions of volcanic rocks may be important, such in the Alboran Ridge and Djibouti Bank.

The western Alboran Basin was initiated in the early Miocene by normal faults which have subsided the basin until present time. The seismic profiles show one of the most impressive sequence of Neogene deposits reported in the western Mediterranean Sea, with more than 4 seconds (twtt) of terrigenous sediments. These deposits are disrupted in the axis of the basins by deep-seated diapirs of undercompacted muds. Seven sequences from Tortonian to Quaternary deposits bounded by unconformities are identified in the basins, which can be correlated with major tectonic and paleoceanographic events. Two unconformities correspond to large erosive events, which developed major channels (fini-Messinian and intra-Pliocene channels), trending westward from the Strait of Gibraltar and deeply entrenched in the underlying deposits (CAMPILLO and others, 1992).

Malaga Basin starts the opening to the SW and it was affected by important subsidence during the Tortonian within a transtensional regime, probably in favour of strike-slip faults. During the Pliocene time the most important tectonic activity in the basins has ceased. South Alboran Basin was, in contrast, developed as a synclinal related to the positive flower structure of the Alboran Ridge (BOURGOIS and others, 1992).

The stress regime in the western Alboran Sea seems to be at present transpressional, with the deformation accumulating along the structural highs, the continental margins and Alboran Ridge, while the basins are undergoing active subsidence.

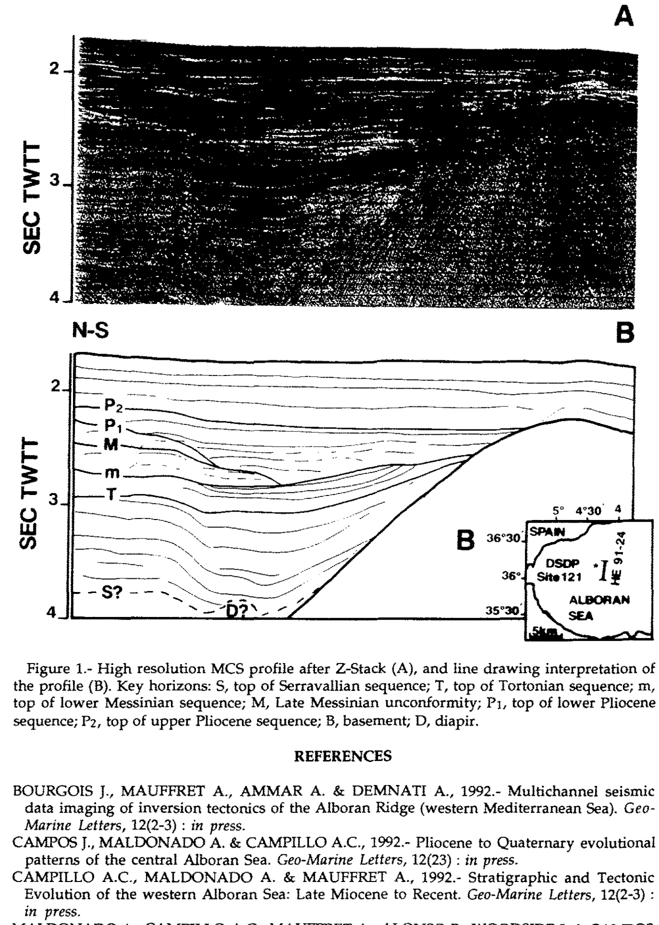

Figure 1.- High resolution MCS profile after Z-Stack (A), and line drawing interpretation of the profile (B). Key horizons: S, top of Serravallian sequence; T, top of Tortonian sequence; m, top of lower Messinian sequence; M, Late Messinian unconformity; P_1, top of lower Pliocene sequence; P_2, top of upper Pliocene sequence; B, basement; D, diapir.

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