# O-III8

## Lagrangian and Eulerian observation of inertial oscillations in the shelf break offshore the Ebro River Delta (Catalan Sea, NW Mediterranean)

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The shelf/slope region in the Catalan Sea (Northwestern Mediterranean) is characterized by a density front, mainly due to the salinity gradient between coastal and offshore waters. Along the front there is a permanent current that contours the continental shelf and can be considered the continuation of the Liguro-Provençal current downstream the gulf of Lions (Font *et al.*, 1987). This current is weaker than in the Ligurian Sea (usually less than 20 cm/s) and gives an adequate framework for the study of cross-front dynamics and frontal instabilities.

Near the Ebro river delta (41°N, 1°E) intensive hydrographic and currentmeter surveys have shown that the circulation, although dominated by the alongshore large-scale dynamics, has a complex structure strongly influenced by the topography and the buoyancy input from the river (Font *et al.*, 1988). In this area very energetic and rapidly evolving three-dimensional filaments have been observed in the frontal zone (Wang *et al.*, 1988), during a study on shelf/slope water exchange carried out in 1986 and 1987.

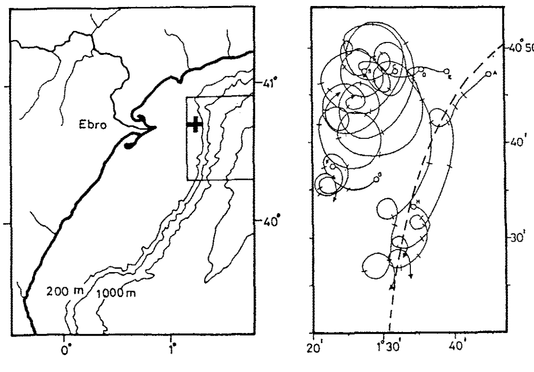


Figure 1. Experimental area (mooring and drifters) in June 1987, and drifter trajectories superposed to the mean surface location of the density front

In June 1987 an experiment took place, in the frame of the same project, on board the Spanish R/V García del Cid, envolving CTD casts, underway surface TS analysis, currentmeters and surface and sub-surface drift buoys tracked by radio (figure 1). Three Aanderaa currentmeters were deployed at 15, 50 and 100 meters depth (bottom at 165 m) in an oil drilling rig near the shelf break off the Ebro delta. Drift buoys were launched in the frontal zone (over a bottom of 1000 m) and in its continental side. The offshore drifters followed the southwards main current, in accordance to geostrophic calculations but with higher surface velocities (30 cm/s), while the others were trapped for the four days (7 to 11 June) in an area of 10 nautical miles around their starting point. One of them was picked up just in the same location where launched.

Spectral analysis of the currentmeter records indicated a dominating contribution of the inertial period (18.4 h in this latitude) in the upper layer. We observed that the successive positions calculated by triangulation for the onshore drifters, usually 6 h apart, showed mostly clockwise gyres. The corresponding straight-line trajectories between fixes had changes in direction coincident with a very small error (less than 5°) with a pure inertial motion. When the drifters were passing near Casablanca station, there was a good agreement between their direction and speed and the velocity recorded at the same time by the surface currentmeter. Consequently we re-calculated all the drifter trajectories, assuming that contiguous fixes were connected through an inertial motion. We obtained an image of the circulation in the surface layer with inertial oscillations superposed to a very slow southwestward motion, inshore of the front, and to a considerable alongfront displacement, in the frontal zone (figure 1). An important horizontal shear has to develop between both regions, just where strong salinity inversions had been observed in 1986, associated to the evolving filament.


Figure 2. NS component of the velocity recorded at 100 m from 7 to 14 June 1987

The study of the currentmeter data indicate that the inertial oscillations are present in the whole water column, with decreasing, but not vanishing, intensity. Even at the level of 100 m the inertial period is clearly an outstanding feature (figure 2), what could indicate that there is no strong vertical shear on the shelf. Strong NW wind blows occurred in the first hours of 8 June (7.5 m/s) and of 9 June (12.5 m/s), with an effect of increasing the speed registered in the currentmeters (up to 41 cm/s at 15 m) and accelerating the drifters in their inertial motion (peaks of 70 cm/s in mean velocities between fixes).

The géographic characteristics of the area, wide continental shelf (45 km) and the narrow Ebro valley, allow the occurrence of NW wind jets acting in adecuate dimensions to originate fully developed inertial oscillations in the shelf down to at least 100 m.

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Font, J., Salat, J. and Julià, A. (1988) Marine circulation along the Ebro continental margin. Submitted to *Mar. Geol.*
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# O-III9

## On the formation of dense water over the shelf areas of the Northern Aegean Sea

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During the period from 27th February to 3rd March 1987, CTD data have been collected from a grid of 32 stations in the Northern Aegean sea (fig. 1), using an SBE-9 profiler on board R/V AEGAIO.

The observed low surface temperatures (10.83-13.85°C) was the main result of the predominant weather conditions, which cannot be characterized as catastrophic. The mean air temperature (2.2-4.1°C), during the sampling period, was much more lower than the 30 years average mean of February and March (Maheras, 1983). The prevailing winds over the eastern part of the study area were NE with speeds up to 17m/sec, while over the western part they had a significant eastern component and their speed reached 10m/sec.

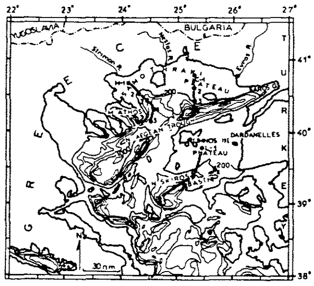


Fig.1. Bathymetric chart of the N. Aegean sea (depths in meters). Location of selected stations.

The dense water detected over the Limnos and Samothraki plateaux have different hydrological characteristics (fig. 2). This is due mainly to the different water masses participating in the formation processes. The relatively colder and less saline waters of the Black Sea, coming out from the Dardanelles and the warmer and more saline waters of Levantine origin form a strong thermohaline front to the east of Limnos island.

Over the eastern side of Limnos plateau the water column is characterized by the most dense water ($\sigma_\theta$= 29.37, from 73 to 80 dbars ), observed over the whole area of the N. Aegean. These density values are even slightly higher than those ($\sigma_\theta$=29.35) of the waters found at the deepest part (1000dbars) of Skiros bassin.

Over the Samothraki plateau the profiles of temperature (fig. 3) and salinity show a rather disturbed water column, due to the complex mesoscale circulation and processes and the flow of dense waters formed over the shallow parts of the shelf. Lacombe et al.(1958) noted that the deep waters of the N. Aegean Trough, north of Limnos island, are probably renewed by the dense waters formed in the Gulf of Saros under the influence of continental dry and cold winds during the winter. The maximum densities ($\sigma_\theta$=29.27) observed just above the bottom (50dbars), over the central Samothraki plateau, are equal to those of the waters found at 530dbars at the deepest station (1600m) of the N. Aegean. The minimum temperature value (10.99°C), near the bottom, is comparable to that (10.13°C) reported by M.Fieux (1974) for the plateau of the Gulf of Lions in the Western Mediterranean.

At the shallowest station of the westernmost part of Samothraki plateau the density reach the value of $\sigma_\theta$=29.20 from 15 down to 100 dbars. The same density has been observed at 260dbars at the southern deep station of the respective basin (M. Athos).

Thus, over the western part of the Samothraki plateau, where the weather conditions were milder than those of the eastern part, the formed dense waters have the lowest density values (fig. 2).

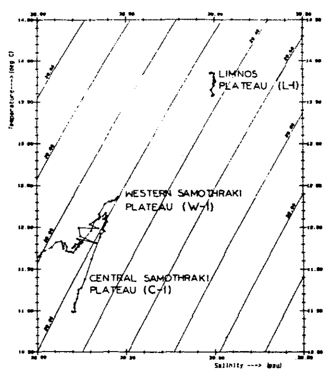


Fig. 2. T/S diagram.

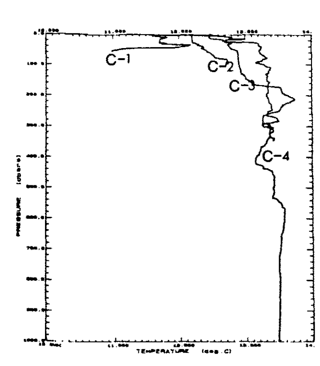


Fig. 3. Temperature profiles along the C transect.

The observed cold and dense waters which occupy the subsurface and/or the lower part of the water columns, have been formed evidently over the shallow regions of the shelf areas of the N. Aegean by vertical convection mixing during the winter. They tend to slide towards the respective basins, following the bottom topography and then along the respective isopycnals, contributing thus to the renewal of intermediate and deep waters.

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