A quantitative Analysis of Southeastern Mediterranean water masses

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The Southeastern Mediterranean was one of the least investigated areas until the last two decades. To date, no one has been determined the volumes of water represented by the various θ-S types on the Egyptian coast. The present study deals with an attempt to identify the important water masses and their limits in the Southeastern Mediterranean off the Egyptian coast using the volumetric analysis technique during winter and summer seasons.

The oceanographic data used were selected from several expeditions carried out by Egypt and different countries during the last 27 years (1959-1986). Water temperature and salinity data have been taken from 162 stations in winter and from 152 stations in summer. The average values of temperature and salinity of these collected data were computed for stations distributed in a grid for winter and summer seasons. The volume and the mean depth of the waters in each bivariate class with potential temperature range 0.2 or 0.5 °C and salinity range of 0.1 ‰ have been estimated during winter and summer. The resulting statistics were presented on a pair of characteristic diagrams, each having potential temperature as ordinate and salinity as abscissa.

On a bivariate distribution, a boundary has been drawn to enclose all classes of a certain frequency (volume) and greater frequencies. Each standard boundary encloses the smallest area that contains at least the standard proportion of occurrences. The 50-per-cent and 75-per cent boundaries were established by the cumulative addition of frequencies in descending order of magnitude (Fig.1).

In winter, the three largest classes at potential temperature range 13.3o-13.8o °C and salinity range 38.70-38.80 ‰ contain nearly 50% of the total geometric volume and comprise the core of the deep water of the Eastern Mediterranean off the Egyptian coast. In summer, as in winter, a primary and big mode appears at a potential temperature 13.40 °C and salinity 38.75 ‰. It occupies the deeper classes below 1000m depth and is called the deep water mass. The 50-per-cent boundary, encloses three classes from the total of 93. This boundary lies between the potential temperature range 13.30-14.00 °C and salinity range 38.70-38.90 ‰. The 75-per-cent boundary encloses six classes in one group. Outside the 75-per-cent boundary, a secondary mode with high salinity (38.95 ‰) and potential temperature (15.25 °C) is observed. This water mass is called the intermediate water mass which is characterized by a secondary maximum of salinity (38.80-39.10 ‰). Its volume is about 18059. 54 km3 and represents about 8. 03% of the total volume of the Egyptian Mediterranean waters. A third mode in bivariate distribution appears at temperature 18.75 °C and salinity 38.75 ‰. This mode forms the subsurface layer of minimum salinity which is of the Atlantic origin.

For the univariate distribution, it was remarkable that the mean potential temperatures and salinities were 14.141 °C and 38.818 ‰ in winter and 14.407 °C and 38.807 ‰ in summer. Temperature and salinity of half of the water volume were below the mean values. The characteristics of temperature and salinity at 5, 25, 50 and 75 % were identical during the two seasons.

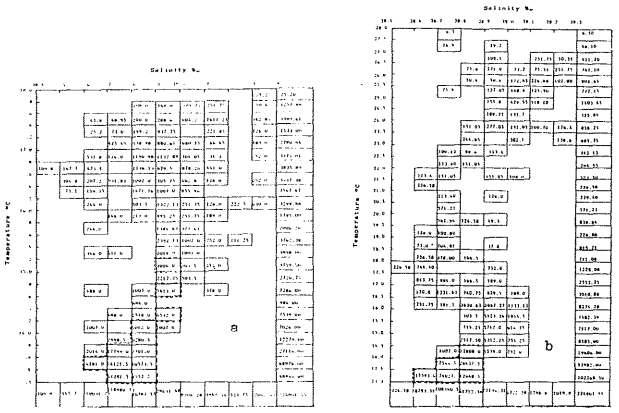

Fig. 1.- Potential temperature-salinity diagram of the Southeastern Mediterranean waters during a- winter and b- summer. Heavy boundary encloses 50 percent of the total and the dotted boundary encloses 75 percent. Volume in km3.

The interaction between the Catalan and Balearic Currents in the Southern Catalan Sea, FE91 Cruise (May 1991)

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The circulation in the Catalan sea is dominated by the Catalan current, a continuation of the Liguro-Provençal current along the continental slope, in geostrophic equilibrium with a typical shelf/slope front (WANG *et al.*, 1988). On the Balearic islands side there is another front which delimites the incursion of southern mediterranean waters with lower salinity of Atlantic origin (SALAT & CRUZADO, 1981). These two main dynamic features interact in the southern half of the Catalan sea (CASTELLON *et al.*, 1991).

The FE91 Cruise was a part of the "Flotadors Errants" series of cruises to contribute to the knowledge of the mesoscale features associated to the circulation in the Western Mediterranean. During May 1991, the southern half of Catalan Sea was covered with a net of CTD casts (Fig. 1), ADCP measurements and TS surface continuous analysis along the ship track, and a synoptic coverage of AXBTs. Samples for organic micropollutants and radioactive tracers were also obtained at several points. In this paper, the main preliminary results concerning circulation are presented, while some of the information is still under elaboration.

Summary of Results

The shelf/slope current suffers two important deflections (Fig. 2): the first at a change of the slope orientaton at 40°30'N 1°40'E, and the other at 39°30'N 1°E. At this point, it the main flow is definitely detached from the slope and a residual flow continues attached towards the Gulf of València to reach the Eivissa channel.

The circulation over the wide shelf between these two points is anticyclonic, dominated by inertial oscillations (SALAT *et al.*, 1992). It plays a role of a trap for the Ebro river discharges (Fig. 2). At the open sea side, in the northern point appears a clear signature of a cyclonic eddy that may deviate, towards open sea, part of the shelf/slope waters and also help the propagation of filaments of shelf water described by WANG *et al.* (1988).

The southern waters of Atlantic origin appear in the upper 100 m at the eastern side of Eivissa channel (Fig. 2) forming a well defined anticyclonic eddy. A remarkable surface front is detected in the northern side of this eddy, when it contacts the deflected Catalan current at 39°30'N. As the southern waters are lighter, the water coming from the north sinks and passes underneath.

The organic micropollutans have two main sources: one in the northern coast (Cap Salou) and the other in the southern coast (out of the map). The maximum concentrations of those compounds are found in two zones: one in the wide northern shelf, accumulated by the anicyclonic circulation there, and the other associated with the entrance of southern waters.

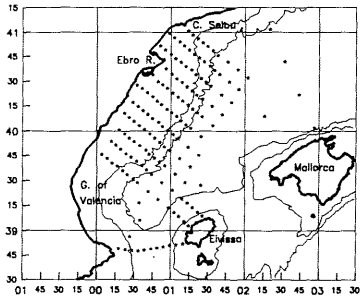

Fig. 1. Map of the studied region showing the CTD stations and bottom topography (200 and 1000 m)

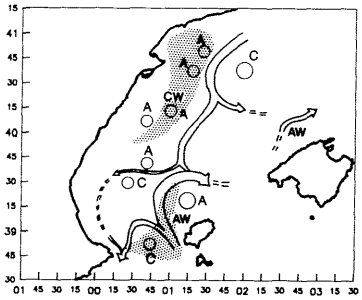

Fig. 2. Summary of results:

Schematics of circulation and position of eddies (circles)
A: Anticyclonic,
C: Cyclonic.

Water mass distribution:
CW: Continental influence
AW: Atlantic influence

Shaded area:
Maximum of organic micropollutants

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