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A VOLUMETRIC TEMPERATURE/SALINITY RELATIONSHIP FOR THE EGYPTIAN MEDITERRANEAN WATER.

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ABSTRACT

The winter volumetric temperature / salinity water using the hydrographic data collected by the R/V "Academic Leverantive" in December, 1988 has been studied. The investigated area is about 25,000 km^2 in which three different water masses have been identified. The first water mass (the surface one) has a mode at 18.78° C, 39.08‰ and 28.21 σ_t covers the continental shelf of the area and the surface layer in the open sea. The intermediate water mass of maximum salinity is at a mode of 15.33 C, 38.92‰ and 28.94 σ_t .The third one (deep water mass) has a mode at 13.61° C, 38.66‰ and 29.11σ_t.

The possibility of formation of the intermediate water in the southeastern Levantine basin, infront of the Egyptian coast has been discussed.

INTRODUCTION

The advent of the temperature-salinity diagram has led the way for the construction of all the characteristics diagrams that are considered now as indispensable tools in oceanographical and meteorological investigations. Among these diagrams, the volumetric temperature / salinity census one is useful in providing information about the major water masses found in an area, their boundaries and relative abundances, and seasonal variations as well. This type of diagrams (Wright and Parker, 1976) would also help in the evaluation of the effects of processes such as advection, evaporation and precipitation and continental runoff on the physical characteristics of a given water body.

So, it was decided to undertake the present study with the main objective of making a quantitative estimation of the relative volumes as well as the characteristics limits and means of the different water masses occurring in the southern sector of the Levantine Basin using the temperature-salinity correlation.

The area under investigation extends from the Mediterranean coast of Egypt to about 33° 00` N and is limited between the meridian of 30° 00` and 32° 30` E (Fig. 1). It extends to a depth of 1,500 m and , thus, occupies the zones of the continental shelf and continental slops as well. It is about 25,000 km^2 in area.

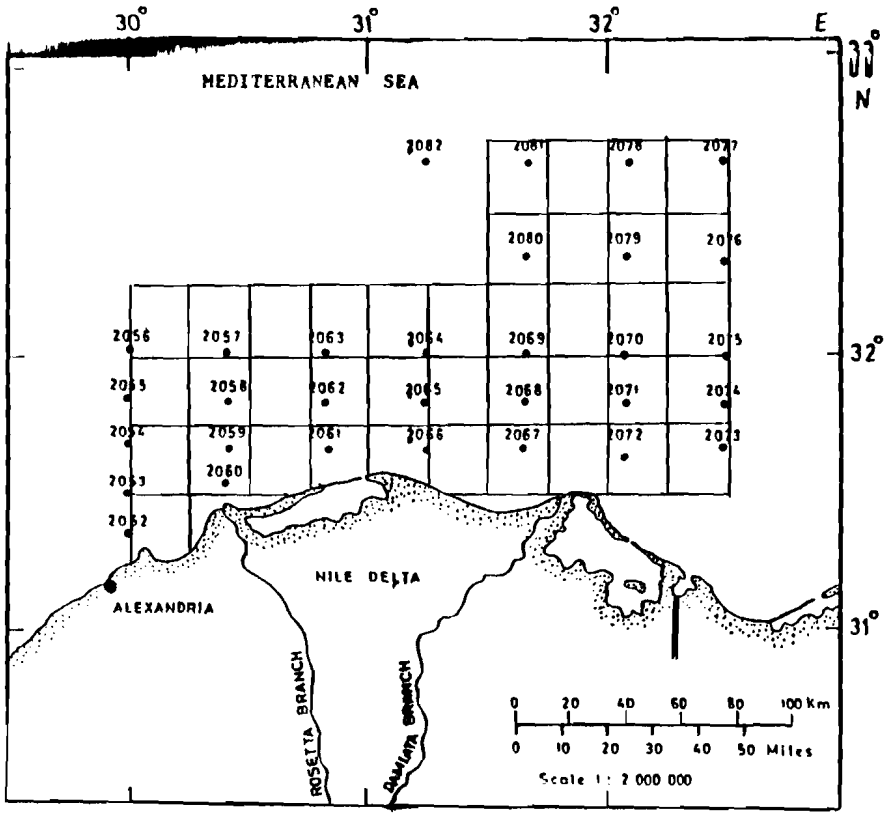

Fig. 1

Area under study and location map.

DATA AND METHOD OF ANALYSIS

In December 1988, the Russian R/V "Academic Levrantive" conducted an oceanographic survey in the area under investigation and it is the hydrographic data collected during this survey that are used in the present syudy. The location of the hydrographic stations occupied during this survey are shown in Fig. 1.

For the present study, the area under investigation was divided into a number of equal-area squares each of which is 15` lat. by 15` long.; i.e., each square has an area of

about 191 square nautical miles or 655 km^2. For the empty squares, the nearest hydrographic station was taken to be representative.

Each sample was vertically weighted in proportion to the thickness of the layer represented. The layer was demarcated by the midpoints between samples or by the sea surface or bottom. For each sample, the volume was the product of multiplying its unit area by the thickness of the layer represented.

The fundamental temperature-salinity covered the range of 1.0° C by 0.1‰ and in each bivariate class, the volume of water was obtained through summation. Finally, the totals for all such intervals were added and the temperature / salinity classes containing the greatest volumes were summed to obtain the 50% (dashed) and 75% (heavy) boundaries represented on the diagram, (Fig. 2).

RESULTS AND DISCUSSION

The volumetric temperature /salinity census of the southern sector of the Levantine Basin during the winter of 1988 is represented in Fig. 2. Apparently, the 75% boundary line demarcates three distinct major water masses which can be defined as follows:

1- The surface layer:

This mass has a mode at 18.78° C, 39.08‰ and 28.21 σ_t while its volume amounts to about 1,775 km^3. This volume is about one-fifth the bulk volume of water contained in the area under investigation. This mass occupies the continental shelf zone as well as the surface part of the water column in the open-sea area. It is formed through the mixing of the Mediterranean surface water, which is mainly affected by the process of the air-sea interaction, and the Atlantic subsurface water that flows eastward along the African coast. This Atlantic subsurface of minimum salinity distinctively exists during summer and autumn. At the beginning of the cooling period and under the action of vertical mixin,. this layer starts to mix with the upper surface layer till it vanishes by the end of winter. This pattern is also evident from the results of this study as the subsurface layer of minimum salinity (38.69 - 39.15‰) was only identified in the offshore area where it was underlying the surface layer with an average thickness of 50 m. However, it is suggested here that the two surface and subsurface layers are dealt with as the surface mass since they are of the same origin; i.e. the Atlantic water.

2- The intermediate layer:

This water mass has a characteristic mode at 15.33° C, 38.29‰ and 28.94 σ_t and accounts for 8.2% (754 km^3) of the bulk water volume of the area. Apparently, this water mass

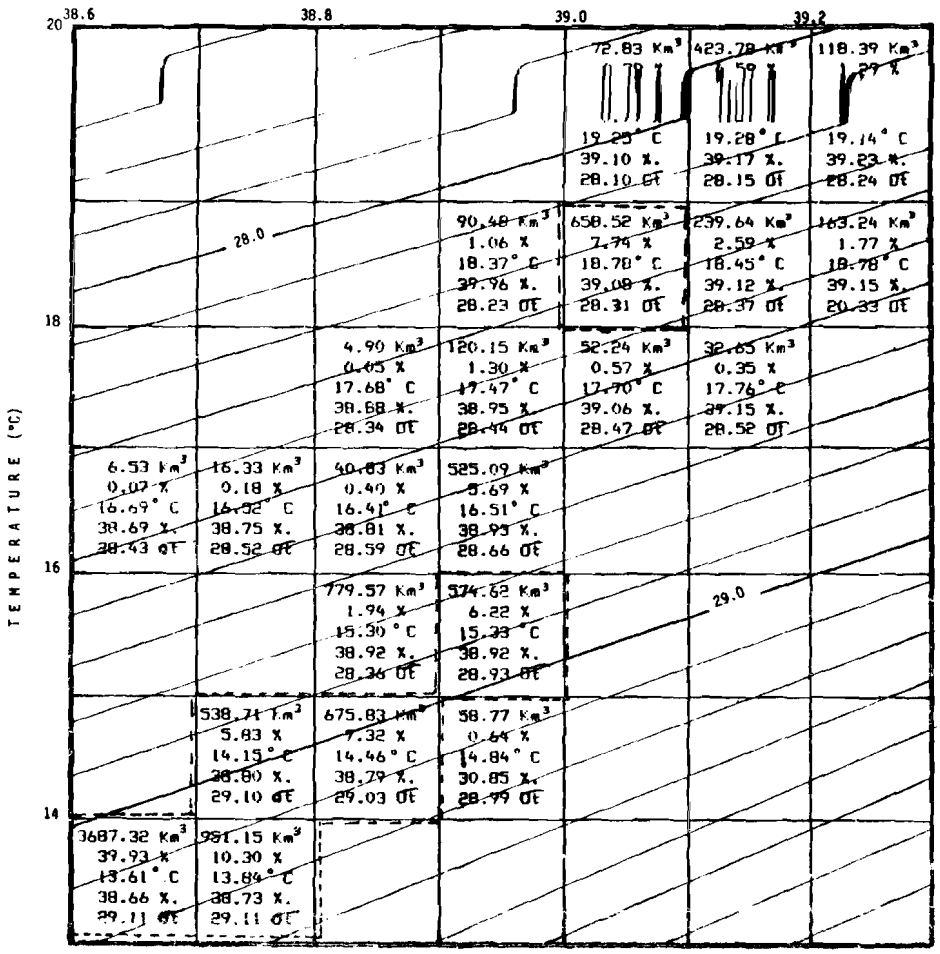

Fig. 2

Volumetric temperature/salinity diagram for the Egyptian Mediterranean water.

SALINITY ($‰_o$)

is thicker and deeper in west than in the east of the investigated area. Thus it is 100-150 m thick and is found below 250-400 m from the surface in front of Alexandria while its thickness is in the range of 70-100 m and occurs below a depth of 100-200 m in the eastern part of the area; i,e., between 31° 30` and 32° 00 E. It might be worth while here to notice that although the intermediate water mass is thicker than the surface one, it is of comparatively much more reduced volume. This is simply due to the fact that the surface layer has a vast extension in comparison with the intermediate one.

The Levantine Basine is one of the places where the formation of the Mediterranean intermediate water is likely to be taking place (Morcos, 1967 and 1972). During November, the intermediate layer (Morcos and Hassan, 1973 and 1976) is typically manifested as a tongue of high salinity occurring at depth that range between 150 and 300 m with a slight tendency to go deeper to the west. This tongue was extinct in February with the whole water column down to 300 m having an identical salinity. Karam (1977) has also reported the occurrence of the intermediste layer of maximum salinity at the depth interval of 100-300 m and has assigned its site of formation to the northern part of the Levantine Basin. Furthermore, El-Gindy (1982) has found that the core layer of this water mass occurs at a depth of 200-300 m with a density that ranges between 28.8 and 28.9 σ_t. Nevertheless, Said (1985) has entirely rejected the suggestions made by Morcos (1972) about the formation of the intermediate layer in the southern sector of the Levantine Basin. On the other hand, it is evident that the results and conclusions given by Abdel Moati and Said (1987) are vague and even self-contradictory, and hence, can not be relied upon.

On the basis of the bulk pattern obtained here for the intermediate layer of maximum salinity, it is tentatively suggested her that the southeastern sector of the Levantine Basin is a likely place where this layer can be formed.

3- The deep water layer:

This water mass has a mode at 13.61° C, 38.66‰ and 29.11 σ_t. It amounts to about 5,880 km^3 in volume (63.4% of the bulk volume of water) and is similar to the preceding layer in that it goes deeper from east to west across the area under investigation. So, it is found below a 200 m depth off Damietta while it occurs below a 400 m depth in front of Alexandria. In the southeastern sector of the Levantine Basin, the deep water mass (Karam, 1977) extends below the depth of 3,99 m with a characteristic low salinity of 38.6-38.9‰, as well as temperature (13.45-14.60° C) that correspond to a density as high as 29.1 σ_t.

CONCLUSIONS

From the finding of the present study, the following conclusion, can be drawn:-

1- The volumetric temperature/salinity analysis is a useful technique in investigating the hydrography of a given area.

2- During early winter, three distinctive major water masses occur in the southern sector of the Levantine Basin.

3- The characteristic features as well as the mode of occurrence of the intermediate layer of maximum salinity obtained here suggest that the southern sector of the Levantine Basin is a likely place where this layer can be formed. However, such an influence has to be verified

through other studies that are much more elaborated in their spatial and temporal aspects.

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