SEASONAL VARIATION OF TEMPERATURE AND SALINITY STRUCTURE OF THE MEDITERRANEAN WATERS IN THE LEVANTINE BASIN.

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- ABSTRACT -

From the oceanographic observations (temperature and salinity) taken in the Levantine basin during the last thirty years, the hydrographic structure was investigated seasonally in the horizontal and in the vertical direction. The water masses of the basin during the four seasons were identified in terms of the T-S diagrams.

- INTRODUCTION -

The oceanographic data from the International Research vessels were obtained for the Levantine basin (Fig.1) during the last thirty years. The hydrographic stations and sections taken during the four seasons were chosen to study the horizontal and vertical structure of temperature and salinity during each season.

WATER MASSES:-

(1) Winter season:-

During the winter season the characteristics of the water masses are shown in the T-S diagram (Fig.2). Under the influence of the winter convection, two cold homohaline water masses developed in the upper 300 m layer. The surface layer (from 0 to 50 m) has an average salinity of 39‰ and temperature between 16.2°C to 18°C (Sigma-t around 28.5). The salinity showed a slight decrease in the subsurface layer (50-100 m), followed by a slight increase at the intermediate layer (100-300 m). The deep water showed again a slight decrease in salinity. However, the difference in salinity was much less than in summer, and indicates a great homogenity due to winter convection. The sigma-t values reflect such a small stability.

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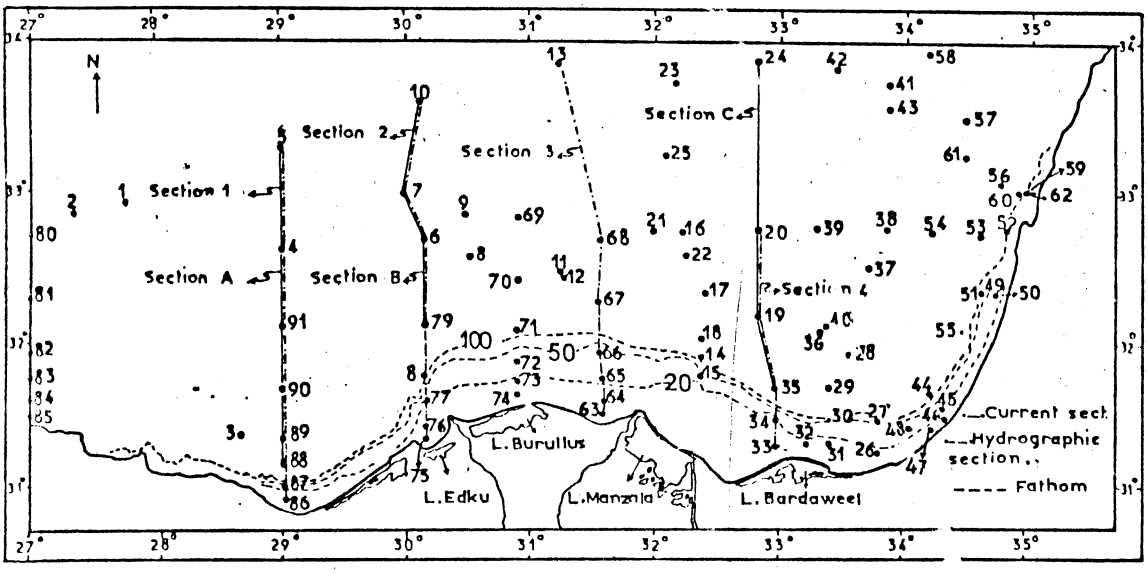

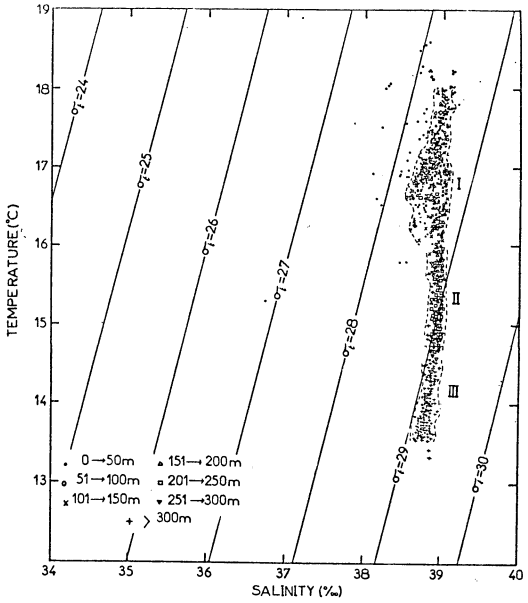

Fig. 4.1 : T-S diagram for all observations taken in winter.

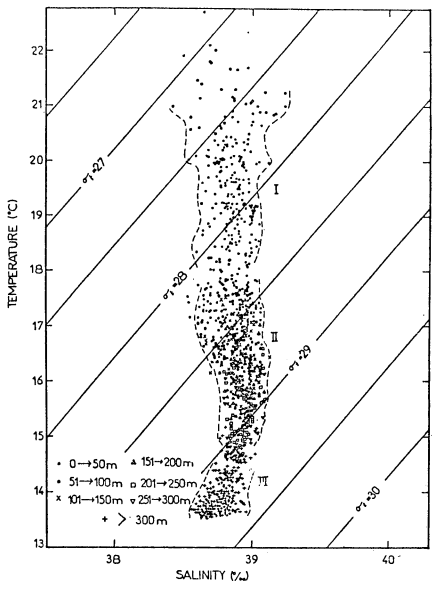

Fig. 4.2 - T-S diagram for all observation taken during the spring season.

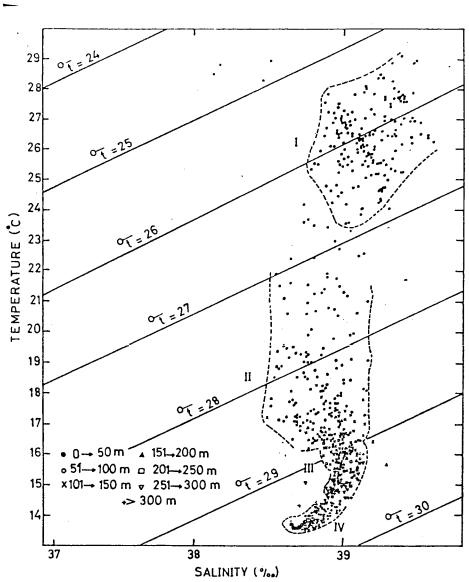

Fig. 4.3 T-S diagram for all observations taken during the summer season.

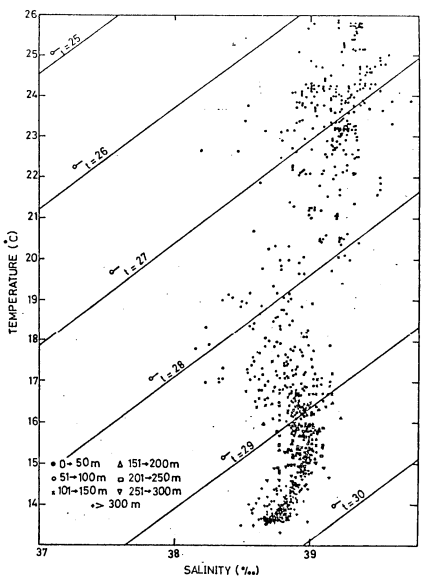

Fig. 4.4 - T-S diagram for all observations taken during the autumn season after the High Dam.

Below the 300 m depth the deep water mass III existed and was characterized by a low salinity (38.6-38.9‰) and a low temperature (13.45-14.6°C) and with a density of 29.1.

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(2) Spring season:-

In that season, the surface layer started to get warm. A relatively warm surface water mass (18-22°C) developed in the upper 50 m layer, having an average salinity of 38.8‰ (σ_t about 27.8), as shown in Figure (3). A continuation of the homohaline water mass I observed in winter appeared also in that season, but after sinking it occupied the subsurface 50-300 m layer and is indicated in the T-S diagram by the symbol II. The water mass II had an average salinity of 38.9‰ with temperature from 15° to 18°C. The deep water body III (below 300 m) was characterised by a low salinity (38.6-38.9‰) and a low temperature (13.6 to 14.4°C) almost similar to that observed during the winter season.

(3) Summer season:-

The water masses can be divided into four types. As a consequence of the great evaporation caused by the great increase of solar heating, the surface water mass was characterised by a maximum salinity (39.2‰) and a high temperature from 24°C to 29°C. This water mass existed in the upper 50 meters. This is indicated on the T-S diagram as water mass I (Fig. 4).

A water mass II apppeared in the T-S diagram in the subsurface 50-150 m layer. It was believed that this water is of an Atlantic water origin since the Atlantic water of the relatively low salinity entered the Mediterranean Sea at the surface and spread to the Eastern Mediterranean at about 75 m depth (Wust, 1961). This water body was characterised by a minimum salinity of 38.8‰ and temperature between 16.5°C and 20°C (σ_t = 28.3).

Below the subsurface minimum-salinity water mass, the intermediate maximum salinity water mass III appeared in the 150-300 m layer. It was assumed that this water type is of a north Levantine surface water origin (Wust, 1961). The salinity of this water body was relatively high (39-39.1‰) with temperature from 14.5°C to 16°C, and having a density of about 29.

The deep water mass IV (σ_t around 29.15) existed below 300 m. The characteristic of the water body is almost the same as existed in other seasons.

(4) Autumn season:-

A surface water mass appeared (Fig.5) in the upper 50 m layer having high salinity (about 39‰) and a temperature between 21°C and 26°C. A layer of subsurface minimum salinity (about 38.7‰) and relatively low temperature (16°C-18°C) was observed between 50 and 200 m depth (σ_t = 28.5). The deep water mass below 300 m depth has a low temperature of about 13.6°C and relatively low salinity (38.8‰) with σ_t around 29.7.

SUMMARY AND CONCLUSIONS

In winter, the surface water temperature is generally increased in the seaward direction, whereas in the intermediate and deep water it decreased towards the sea. During spring, the temperature became somewhat higher than in winter and the temperature decreased seawards in the upper 10 m layer. In the intermediate water, the temperature range was greatly similar to that in winter, which could be interpreted as that the winter convection effect remained at the intermediate depth and the spring heating was not enough to overcome the mixing effect at lower depths. In the spring, the deep water was almost isothermal (about 13.6°C) which agreed with Pollak (1956) and Wust (1961). During the summer season, the surface temperature reached its maximum value all over the year (about 28°C). The isotherm is well developed in the surface layer. As for the deep waters the temperature had the same trend as in the other seasons. In autumn, the surface water pattern showed a slight decrease in temperature since the air temperature became less than that in summer. The bottom water has similar temperature to that which existed in the other seasons.

In the winter season, the salinity increased in the seaward direction. Low salinities in the coastal area, particularly in front of the Egyptian coast, could be interpreted as a result of land drainage from the lakes and the Rosetta branch (Hassan, 1969). Consequently, the salinity gradient in the inshore area was greater at all levels. In spring, no appreciable change occured in salinity. Higher salinities than in winter and spring have been observed in the summer season in the upper 10 m layer which could be attributed to the great evaporation in summer. However as in winter and spring, the high salinity values were restricted to the offshore waters. A characteristic feature in the salinity pattern of autumn season is the existence of a high-saline water (39.5‰) which could be attributed to the outflow of high salinity from

Lake Bardaweel. The mean salinity decreased slightly in that season with respect to that in summer. In the open sea, the bottom water has a unfform salinity of about 38.7% all over the year.

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