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HYDROGRAPHIC STUDIES OF SOUTH WESTERN COAST OF THE ARABIAN GULF AND WESTERN COAST OF THE GULF OF OMAN.

BY

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ABSTRACT

During September 1986 the hydrographic conditions of an important areas of the Arabian Gulf i.e. the area near the Strait of Hormuz, were discussed. The salinity picture, which is considered one of the reasons of the small residence time of the Arabian Gulf was obtained.

Four different water masses were detected. A surface one, from 0 to 100 meters reflecting the Arabian Gulf surface water. The second one, its core at about 200 m. depth which reflects the deeper Arabian Gulf mixed waters. The third water mass, at depth from 0 to 20 m. which is the surface water, mixed with the Gulf of Oman waters. The fourth water mass was recorded at depth 20 to 300 m. which reflects the deep waters of the Gulf of Oman.

INTRODUCTION

The Arabian Gulf, is a semi closed basin, extending from 24° - 30` °N and 48° - 56` °E, along 600 miles long from the Strait of Hormuz, in the south east to Iraq and Kuwait in the north west Figure (1). The Gulf covers an area of about 226,000 km2 and its water volume is of about 6000 km3 , (Persian Gulf Pilot, 1967). It is a shallow basin on the continental shelf. It has asymmetrical longitudinal axis of depth. The bottom slops gentle (35 cm /km) to the western more stable Arabian side, but it slops more (175 cm / km) towards the tectonically unstable Iranian coast. Depths at the east reach more than 90 meters, while that at the western parts were of about 25 meters. Depths decrease to the north west, and more to the west (Purser, 1973).

Aim of the work :

This area of exchange between the Arabian Gulf and the Gulf of Oman was not well investigated before. The present work represents some hydrographic studies in the coastal area. The study clarifies some of the hydrographic features in the exchange between these two important Gulfs, The study also is of interest as a basic knowledge for other oceanographic studies.

Previous work :

The main works done on the physical conditions in the area under investigation were reviewed (Hughes and Hunter 1979), (Hunter 1984, 1986) in addition to reports issued (either by UNESCO or other organization). Since 1986 little works were done to study the coastal area of the Arabian Gulf of Oman (Grassoff 1975, Hassan et al 1987, Hassan et al 1989, and El Samra 1991). Recently some oceanographic studies were done on data collected during the cruises of R / V Mt. Michell in ROPME Sea Area January 1991 (Lardener, Saad and El - Gindy 1993)

MATERIAL AND DATA COLLECTION

The present paper depends on the data collected during the activities of the R/V "Mokhtabar El Behar " of the University of Qatar during September 1986. The area of study extends from 24° O` - 26° 25` N and 51 0` - 59 0` E represents the coastal areas of the State of Qatar, Arab Emirates and Oman. The area was covered by small 15 hydrographic sections during September 1986, samples for water temperature, salinity and other chemical parameters were collected from 43 hydrographic stations, using Nansen bottles in addition to Guildline CTD. figure (1).

Gulf water characteristics :

As a result of the geographic position of the Gulf in a subtropical zone, the air temperature is relatively high compared with other marine areas. A minimum temperature, as low as 3°C was observed in January, and a maximum of 50°C during July. Temperature in the Arabian Gulf area does not reflect well four seasons, but only two (long summer and short winter). Its water characterize by high temperature and abnormal high salinities affected by high evaporation (Meshal et. al. 1986). Due

to atmospheric pressure distribution in the area, winds play an important role in its climate. Dry north western wind blow from land during December to February. Some air masses blow from the Mediterranean or from the Arabian Sea area, this is the rainy period (February - April).

The surface waters temperature in the Arabian Gulf is low (19°C) during March to the north, near Kuwait, and higher (22 °C) in the south, near Qatar, (Hughes, 1979). During July it reaches 31°C near Kuwait and 33 C near Qatar. Vertically there is no clear stratification in the waters due to the small depths and the wind effect. An obvious effect of the west southern monsoon is clear during May especially on the Gulf of Oman, (FAO Report 1974) where surface water temperature reaches 30°C on the Arabian side, and 26°C on the Iranian one.

Water salinity changes from 38.0 near Hormuz Strait to 41.5 inside the Gulf without any annual changes in its distribution, except to the north where the effect of rivers discharge during spring, there salinity may locally decreases to reach 38.0 in March near Shatt - El Arab, compared with 40.0 near Saudi Arabia coast. Salinity decreases also close to some parts of the Iranian side as a result of some Iranian rivers discharge. While salinity in the Gulf of Oman reaches in general 35.5, and closer to the Strait or near the bottom it is about 38.0.

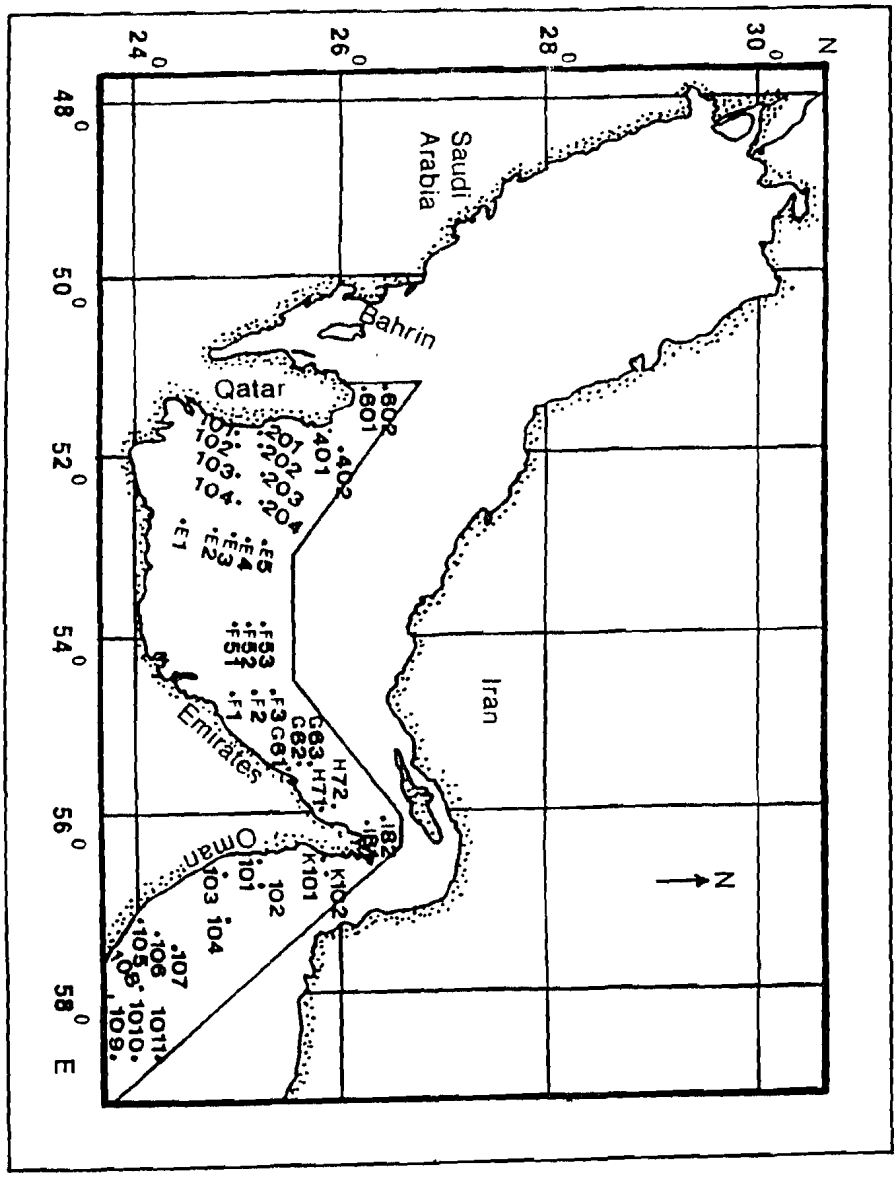

Figure 1 : Stations position and area of investigation.

RESULTS

Horizontal distribution of temperature and salinity :

During September 1986, the surface water temperature, figure (2), changes from 34.0°C near Qatar to 27.0 C in the Gulf of Oman. The pass of the isotherms, as intrusion to the south east suggested the south eastward currents flowing on the coastal area.

Surface salinity distribution at 0 and 10 meters depths figures (3 and 4) shows that salinity changes from 40.0 near Qatar peninsula to more than 44.0 in the south east coast of Qatar, then it decreases to 37.0 inside the Gulf of Oman. The isohalines meandering refers also to the south eastward current.

The near bottom salinity, figure (5), shows no significant difference from the upper salinity especially inside the Arabian Gulf, but inside the Gulf of Oman features of upwelling is clear in salinity distribution close to the coast of Oman, where salinity decreases to the coast to less than 36.5.

Figure (6) shows the mean of some wind vectors, constancy (which is given in % of mean wind vectors to the mean wind stresses) and the direction during September in the Arabian Gulf which was N W to N, with wind direction E to NE. Mean wind vectors can give an indication of the net pass of an element of water over a month's time. The area is also affected by the Indian monsoon in September (El Gindy and Sabra, 1992).

Vertical distribution of temperature, salinity and density :

In the longitudinal section parallel to the Gulf axis figure (7), no clear temperature difference, on the surface where the surface temperature ranges from more than 33.5°C inside the Arabian Gulf to less than 32.50°C outside it. Some stratification in the water temperature occurs across the Strait of Hormuz, where water temperature decreases, from 31.0°C at the surface to 22.0°C near 50 meters giving an evidence on the outflow of the Arabian Gulf warmer waters. The water temperature decrease downwards to reach 17.0C° at 300 meter in the Gulf of Oman.

Salinity (Fig. 7b), changes from 40.0 on the surface near Qatar to less than 37.0 at 300 meters in the Gulf of Oman. The isohalines (salinity less than 37) give also some evidences on the inflow of Gulf of Oman surface waters to the Arabian Gulf.

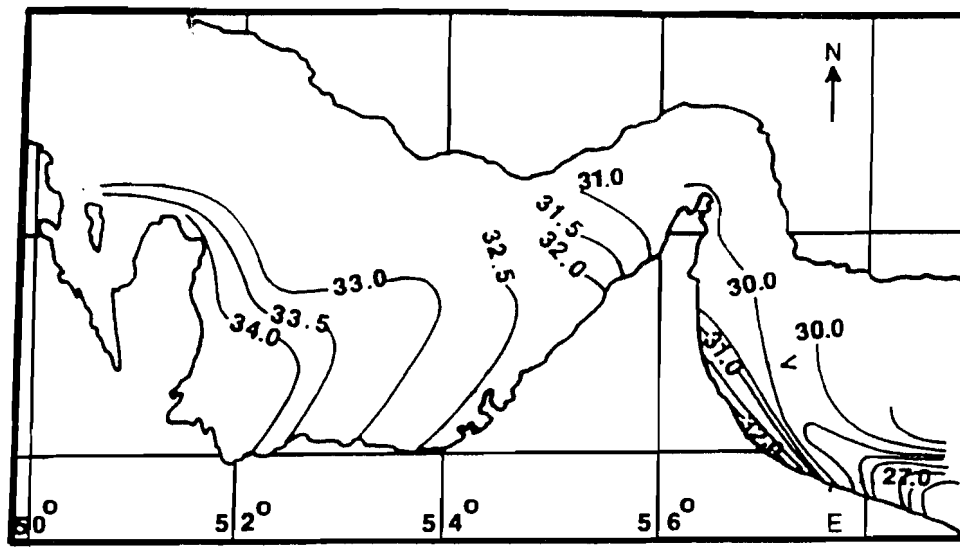

Figure 2 : Horizontal distribution of surface water temperature.

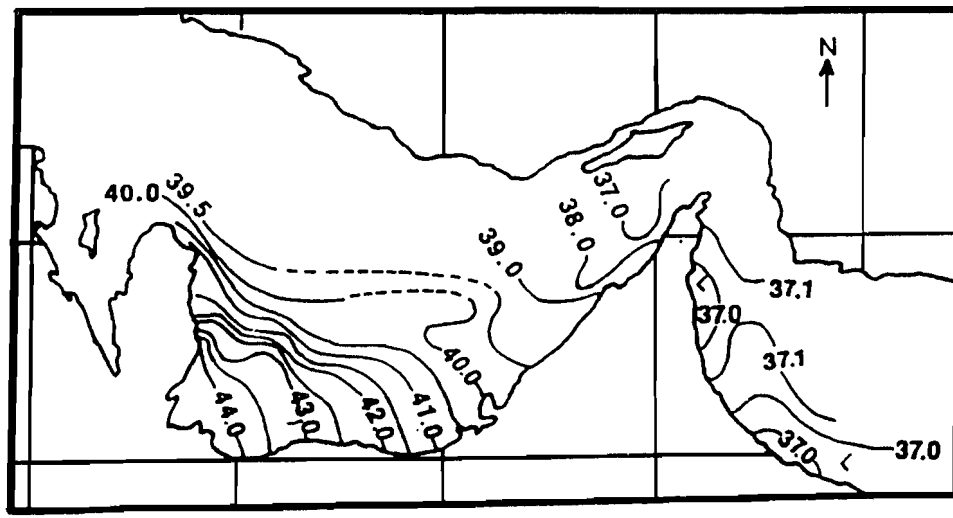

Figure 3 : Horizontal distribution of surface salinity.

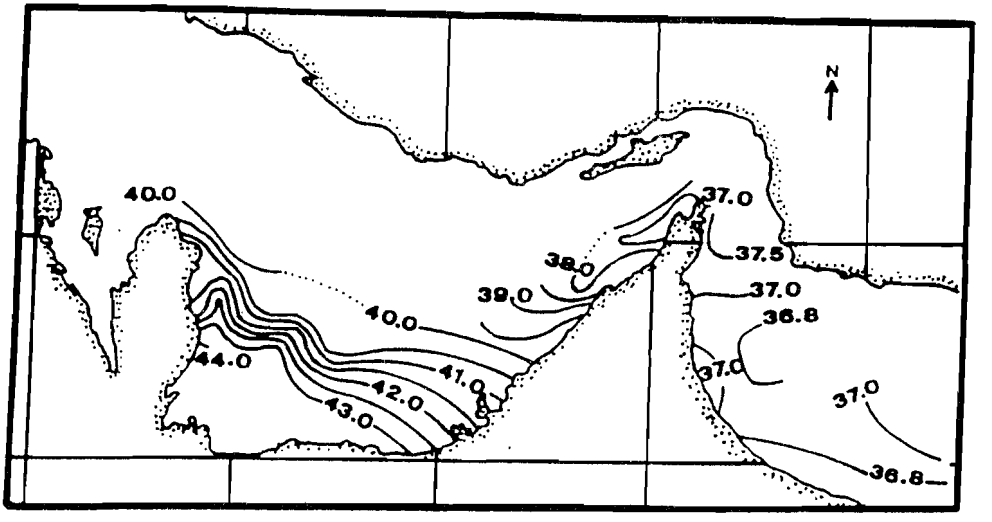

Figure 4 : Horizontal distribution of salinity at 10 meters.

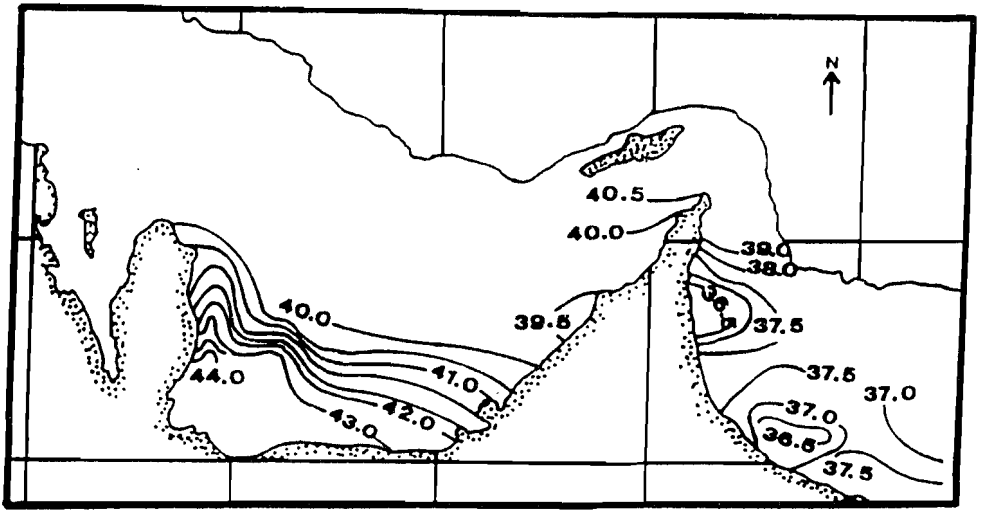

Figure 5 : Near bottom salinity.

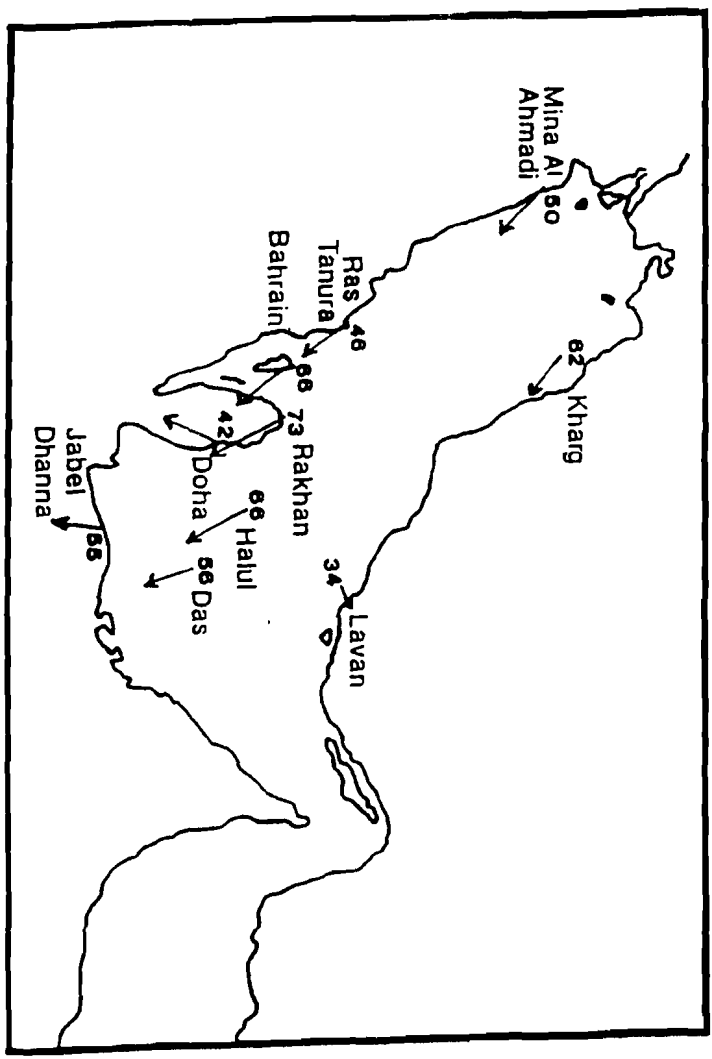

Figure 6 : Mean wind vectors on the Arabian Gulf in September.

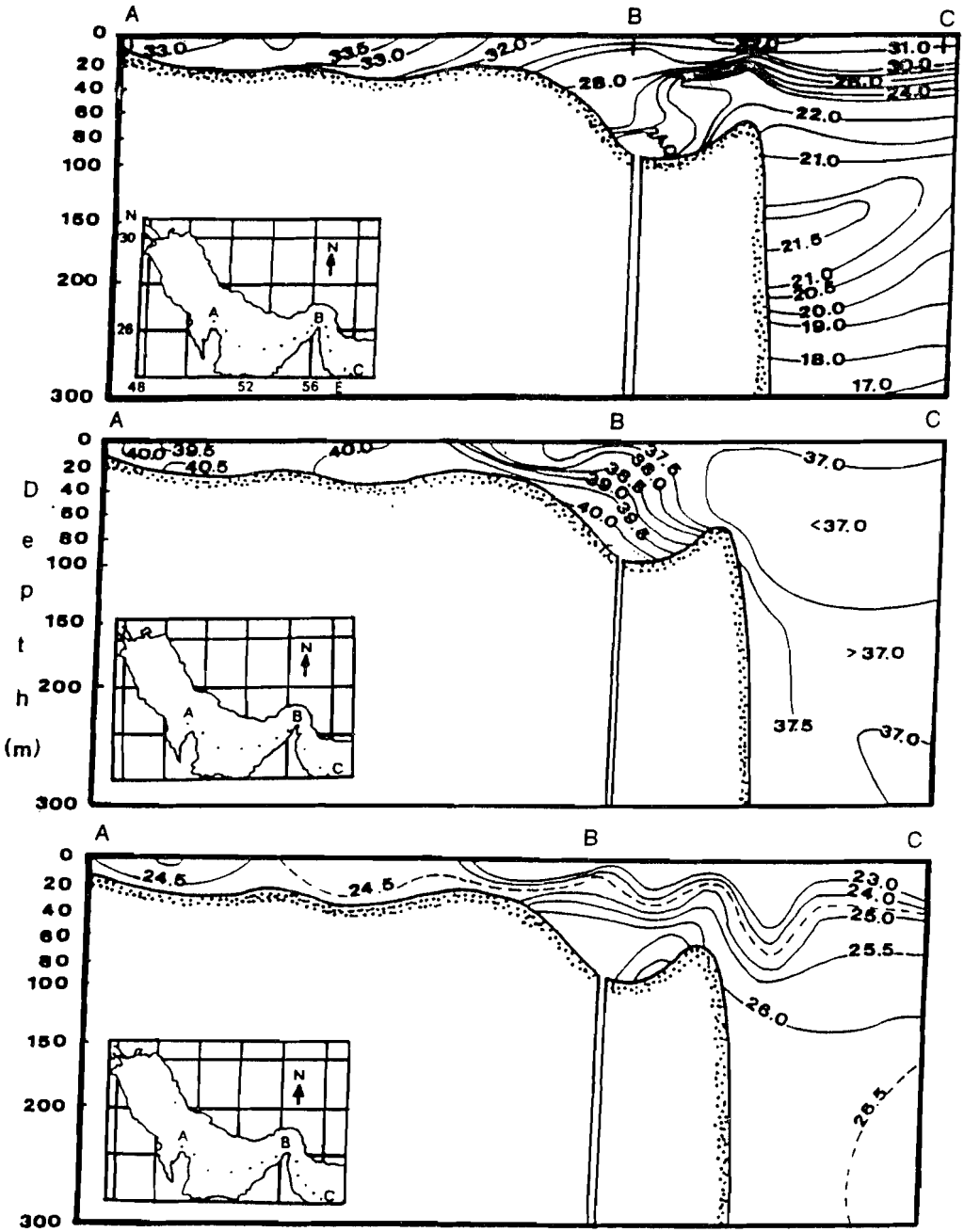

Figure 7 : Temperature, salinity, and sigma - t in longitudinal section parallel to the Arabian Gulf axis.

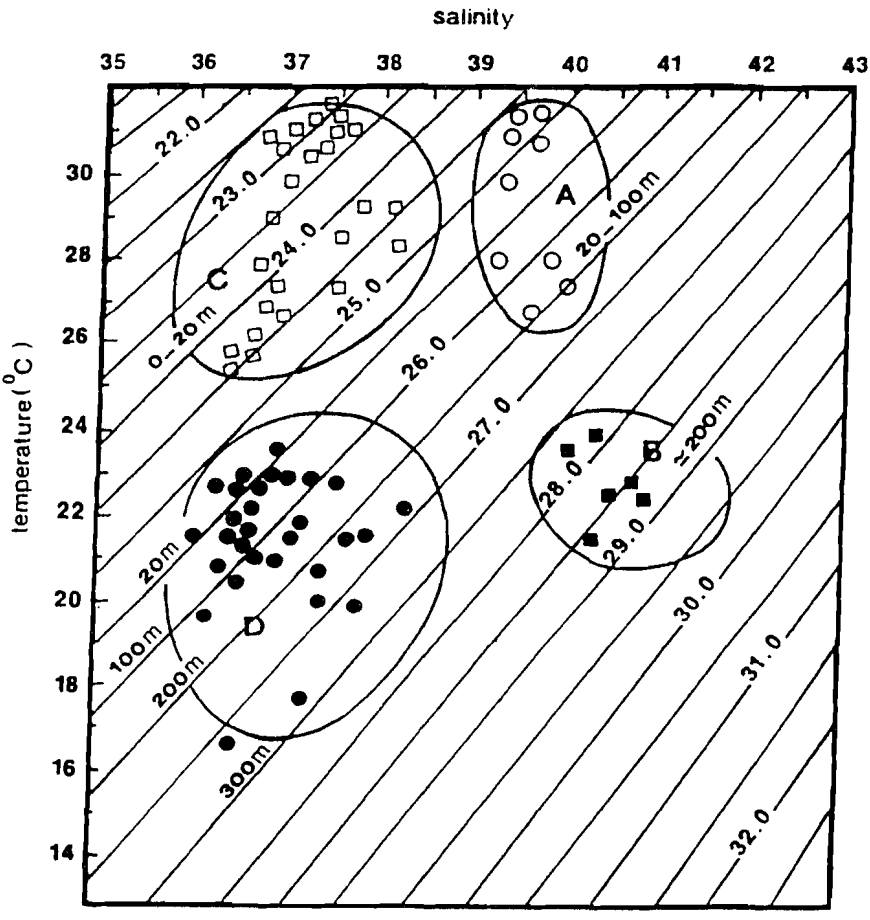

Figure 8 : Water masses in the area during September 1986.

Water masses :

During September 1986 the area of investigation was characterized by four different interchanged water masses figure (8). A water mass (A) of high temperature 26 - 31°C ,high salinity 39 - 40.5 and its sigma - t ranges from 24.5 - 26.5. This water mass reflects the Arabian Gulf surface water, extends at depths from 0 to 100 meters. The second water mass (B) is of lower temperature 20 - 23.0°C and high salinity 39.5 - 41.5 and its sigma - t is from 27.5 to 29.0, Its core at about 200 m depth, reflecting the deeper Gulf mixed waters. The third water mass (C) is of high temperature 25.0 - 31.0°C and low salinity 36 - 38, its sigma - t is from 22.5 - 25.0 at depths from 0 to 20 m. This is the surface Arabian Gulf water, mixed with the Gulf of Oman surface waters. The fourth water mass (D) extends from 20 to 300 m, it is characterized by low temperature 16-24°C and low salinity 36-38. It has sigma-t from 25 to 27.5, and found at depths from 20 to 300 m. This water mass reflects the Gulf of Oman deep waters.

CONCLUSION

Since the area across the Strait of Hormuz is the area of exchange between the Gulf of Oman and the Arabian Gulf, so its study is of special oceanographic interest. Beside the tidal effect, the salinity differences and hence density is of the major factors affecting the water movements in this area (E. M. Hassan et al 1989). Any change in salinity, e.g. due to evaporation, will be accompanied by a considerable change in the water exchange. Salinity picture in this area is very important since it is one the main reason causing the small residence time of the Arabian Gulf (Meshal et. al. 1986). Four different water masses reflecting the Arabian Gulf surface water, the deeper Arabian Gulf mixed waters, the surface water mixed with the Omani Gulf waters and that reflects the Gulf of Oman deep waters, were detected.

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