

HYDROGRAPHY OF THE WATERS ALONG THE GUJARAT COAST DURING THE SUMMER PERIOD OF THE YEAR 1963

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ABSTRACT

The hydrographic features of the waters along the Gujarat Coast during the summer period of 1963 are presented and discussed. During this period the waters were mostly isothermal within the continental shelf and a thermocline was perceptible only outside the shelf. Maximum salinity was observed in the region off Porbandar which again was the region of minimum temperature and maximum dissolved oxygen content. A southward increase in temperature was associated with a southward decrease in salinity. The sinking and spreading of high saline waters from the Gulf of Aden and Persian Gulf were perceptible in investigational area.

INTRODUCTION

THE GENERAL hydrographic features along the west coast of India have already been discussed in a number of papers published by the Central Marine Fisheries Research Institute. Detailed observations regarding the oceanographic parameters in the northern regions (Bombay to Porbandar) are only a few. In this connection reference may be made to Patil *et al.* (1964) and Panakala Rao and Jayaraman (1970). In the present text the region from 18° 30'N to about 21° 30'N within the continental shelf has been taken up for detailed studies. The collections were possible during the cruises on board R.V. VARUNA during May 1963. More detailed investigations were made along the Gujarat Coast in comparison to the southern regions.

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DATA AND METHODS

The collection of data and mode of analysis are mostly the same as in earlier works. Altogether five sections were worked out, 3 being

latitudinal and the other two being quasi-latitudinal. The geographical positions of the hydrographic stations are shown in Fig. 1. The vertical and lateral distribution of the hydrographic parameters were charted out and studied.

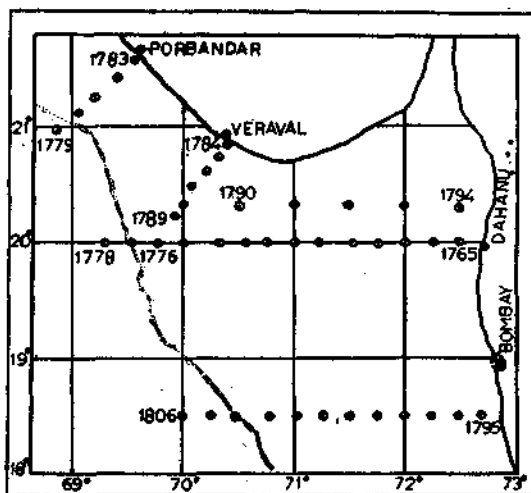


Fig. 1. Geographical position of hydrographic stations.

VERTICAL DISTRIBUTION OF PARAMETERS

Temperature: The distribution of temperature in the section off Porbandar is given in Fig. 2. It can be observed that the surface waters

upto about 40 m depth are mostly isothermal although a weak upslope of the isotherms is existent towards north east. The thermocline

It can be seen that the topography of the bottom, influences the shaping of the isotherms. In the section along the 18° 30'N latitude more or less

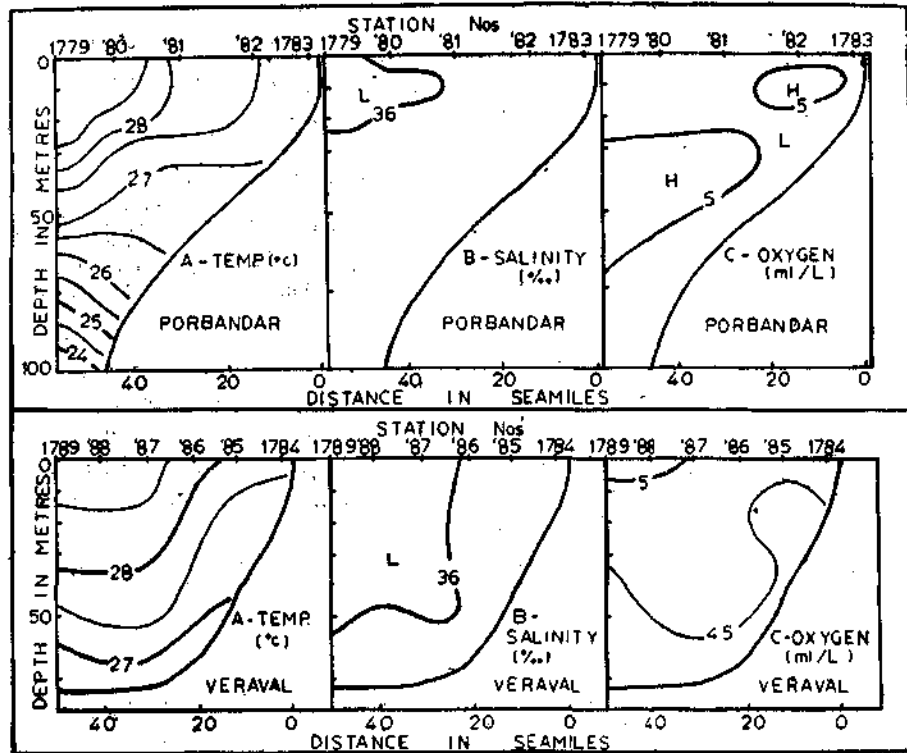


Fig. 2. Vertical distribution of temperature, salinity and dissolved oxygen off Porbandar and Veraval.

starts at about 60 to 75 metres and the vertical temperature gradient is not so strong. Similar features prevail in the section off Veraval (Fig. 2) with a trough like nature of the isotherms in stations 1787 to 1789. This may be due to the influence of the bottom topography in this region. The thermocline is not observed off Veraval. In the section north of Dahanu the isothermal nature of the waters is quite conspicuous (Fig. 3) with the absence of the thermocline within the shelf. Off Dahanu (Fig. 4), comparable features are found within the continental shelf. The thermocline is observed in the offshore region over the continental slope.

similar features as off Dahanu exist (Fig. 5) with slight increase in temperature.

Salinity: In the section off Porbandar (Fig. 2), the salinity values within the shelf were uniformly high, values ranging from 35.8‰ to 36.5‰. The extension of a low saline tongue (Fig. 2) was observed in the surface waters. Off Veraval (Fig. 2), the distribution is again mostly uniform and in the section north of Dahanu (Fig. 3) the near coastal values were lower than the regions, off Porbandar and Veraval. In the off-shore regions, towards the western part of the continental shelf, the values were again high, the

maximum being found in the surface layers around the station 1790 (Fig. 3). The low, near coastal values, still persist off Dahanu (Fig. 4) and similar to the previous section the off-shore values are again high. A salinity maximum is

tical zone, between 50 and 120 m, below which comparatively lower values exist.

Oxygen: In the section off Porbandar (Fig. 2) more or less a uniform distribution of dissolved

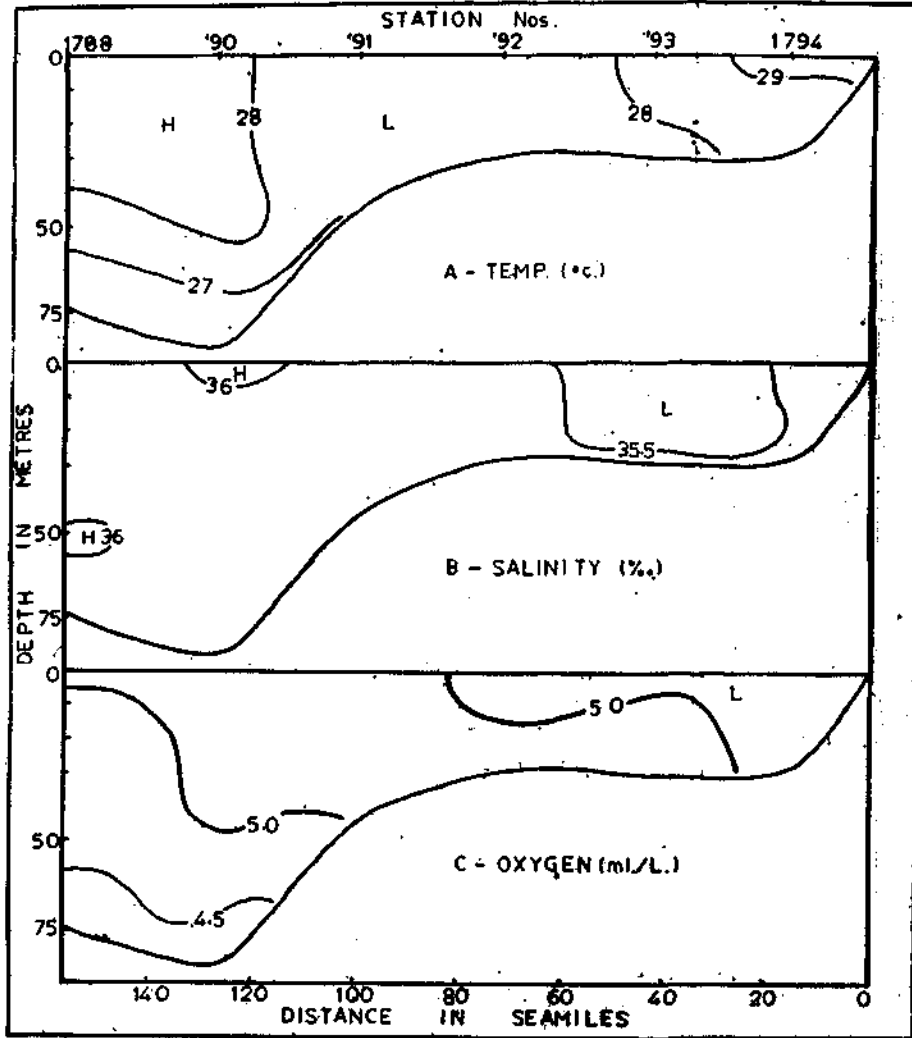


Fig. 3. Vertical distribution of temperature, salinity and dissolved oxygen in the latitudinal section north of Dahanu.

observed around the thermocline which is a feature usually observed in southern waters along the west coast of India (Ramamirtham *et al.*, 1965). In the section along 18°30'N (Fig. 5) the salinity maximum is observed as a large ver-

oxygen is observed. Two high oxygen cells are conspicuous in this section. Off Veraval (Fig. 2) the distribution in the vertical plane is more uniform and the waters are saturated upto about 80-85% with respect to oxygen. Comparable

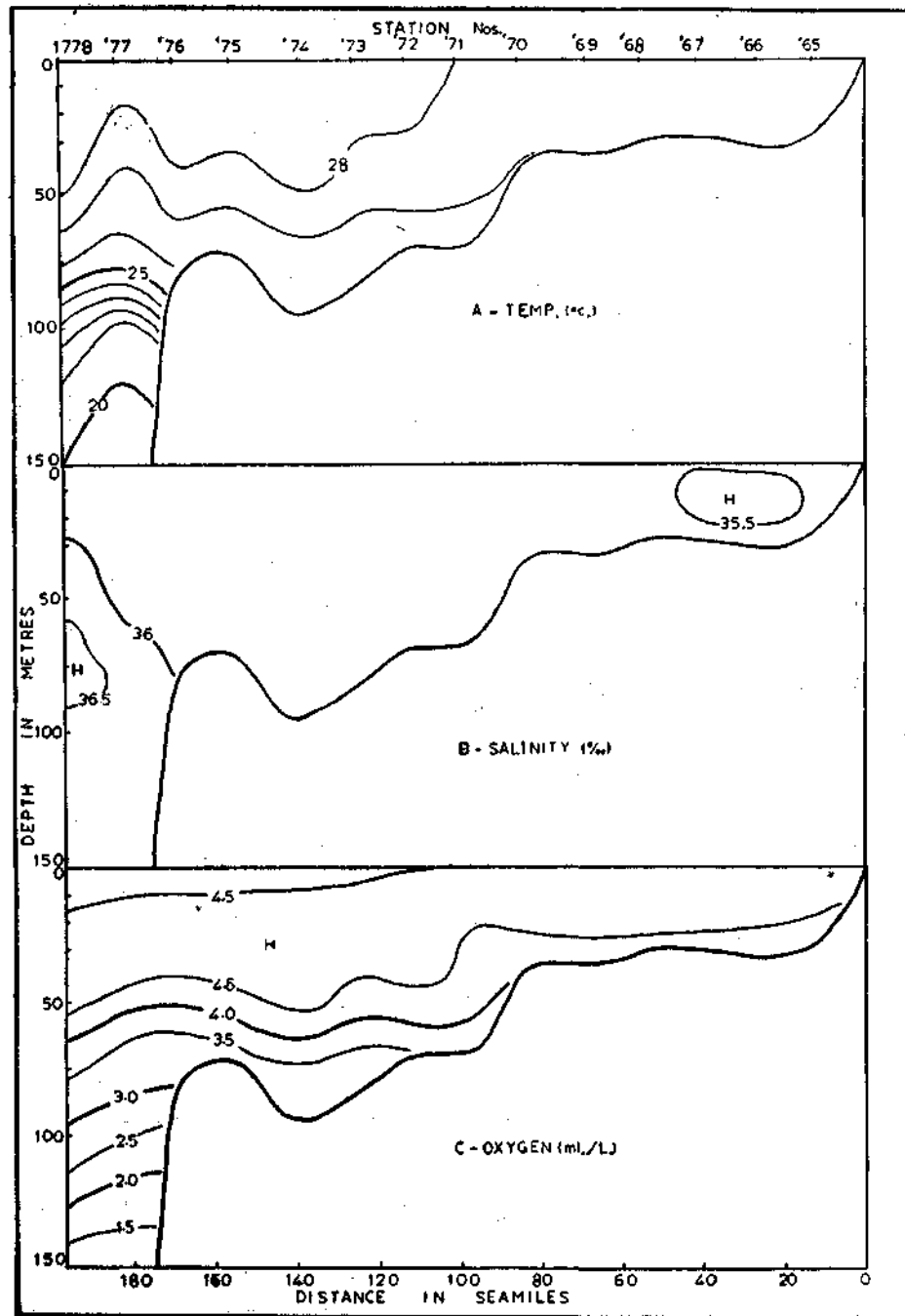


Fig. 4. Vertical distribution of temperature, salinity and dissolved oxygen in the section off Dahanu.

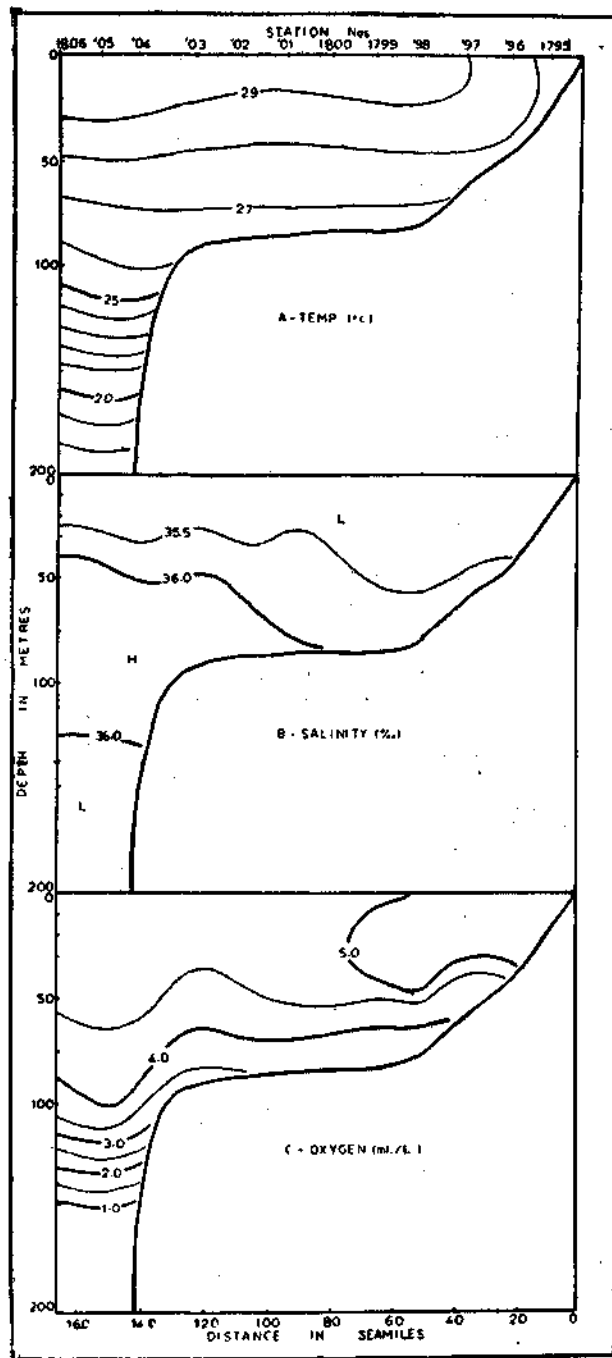


Fig. 5. Vertical distribution of temperature, salinity and dissolved oxygen in the section along 18° 30'N.

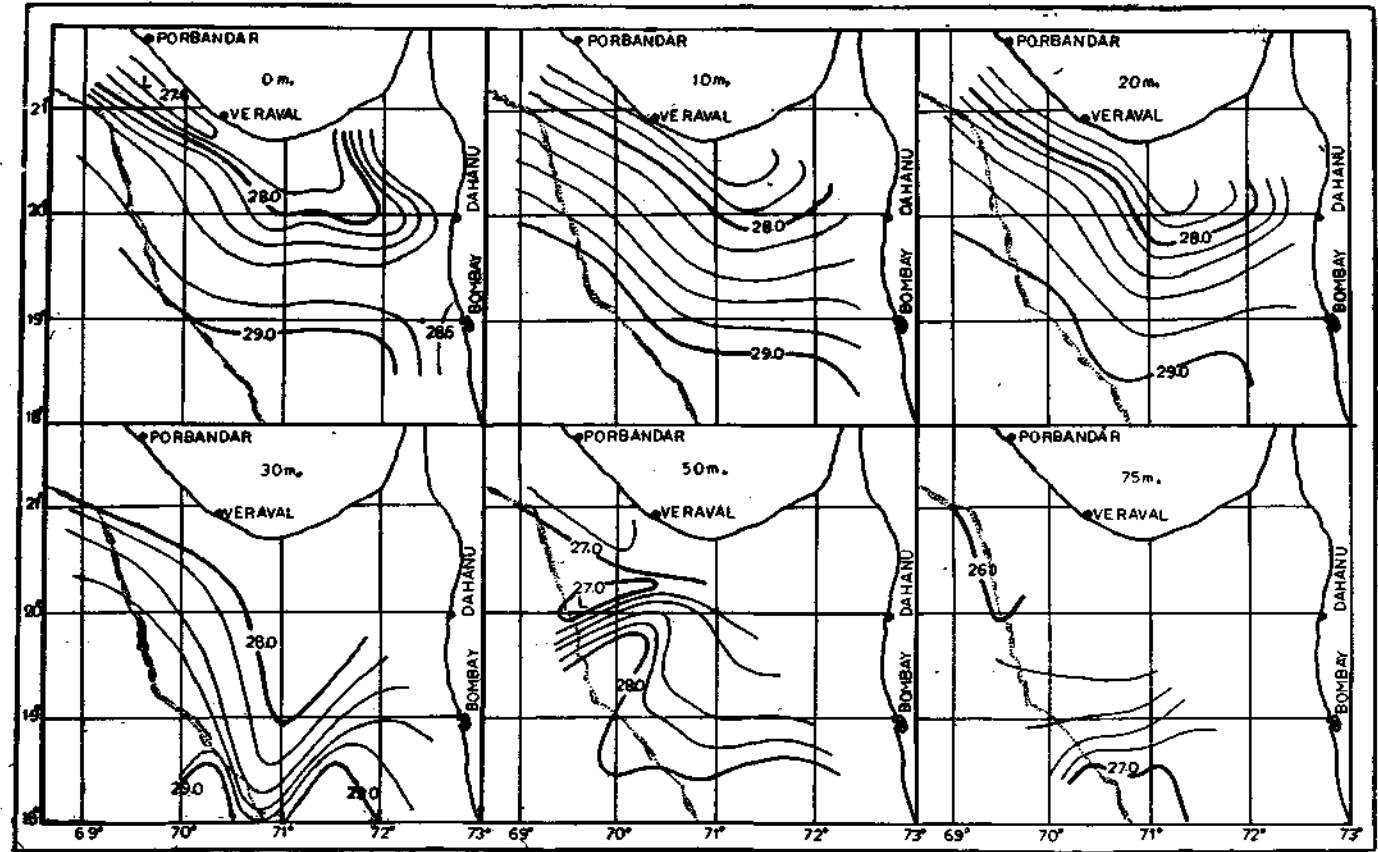


Fig. 6. Horizontal distribution of temperature at 0, 10, 20, 30, 50 and 75 m depths.

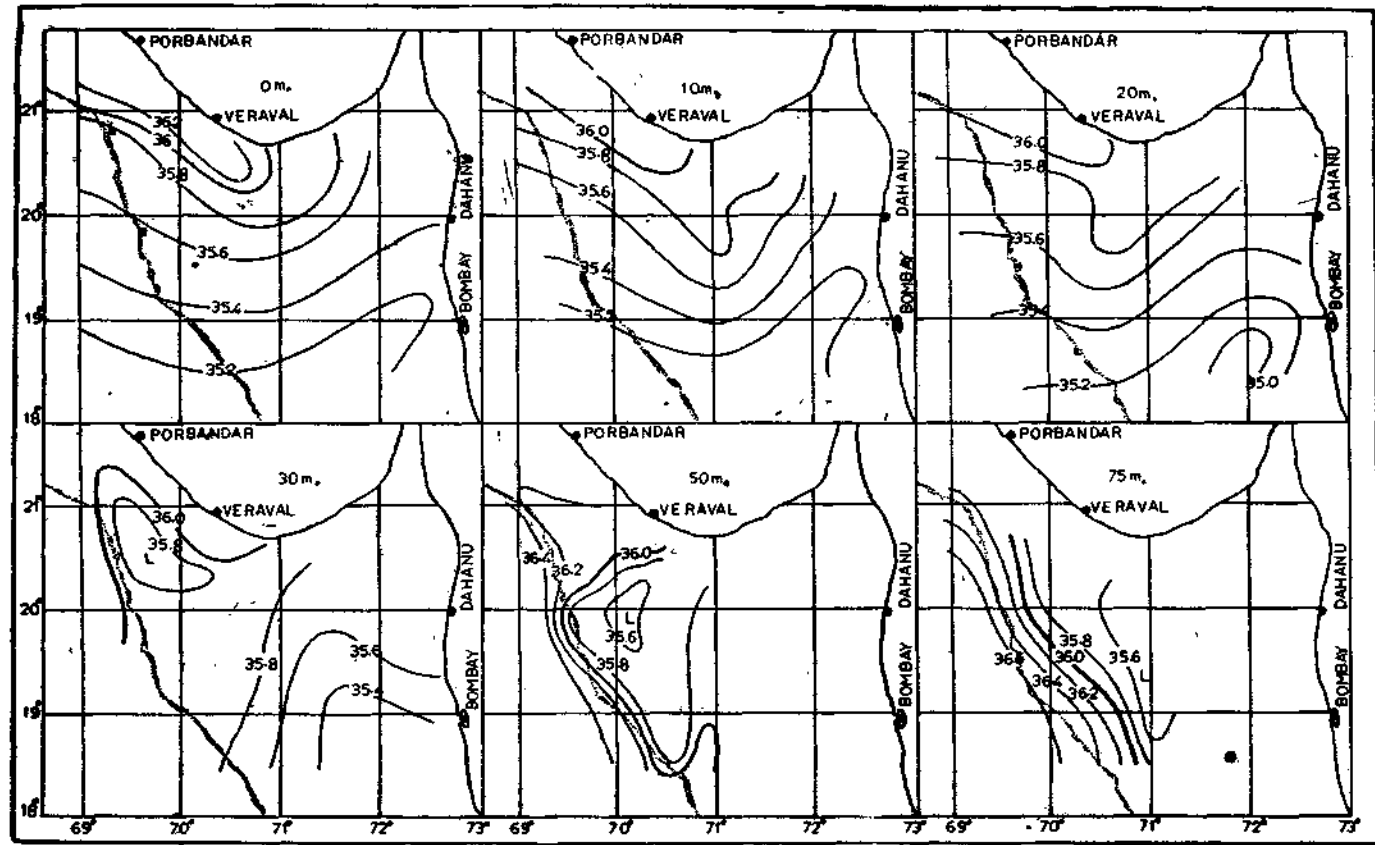


Fig. 7. Horizontal distribution of salinity at 0, 10, 20, 30, 50 and 75 m depths.

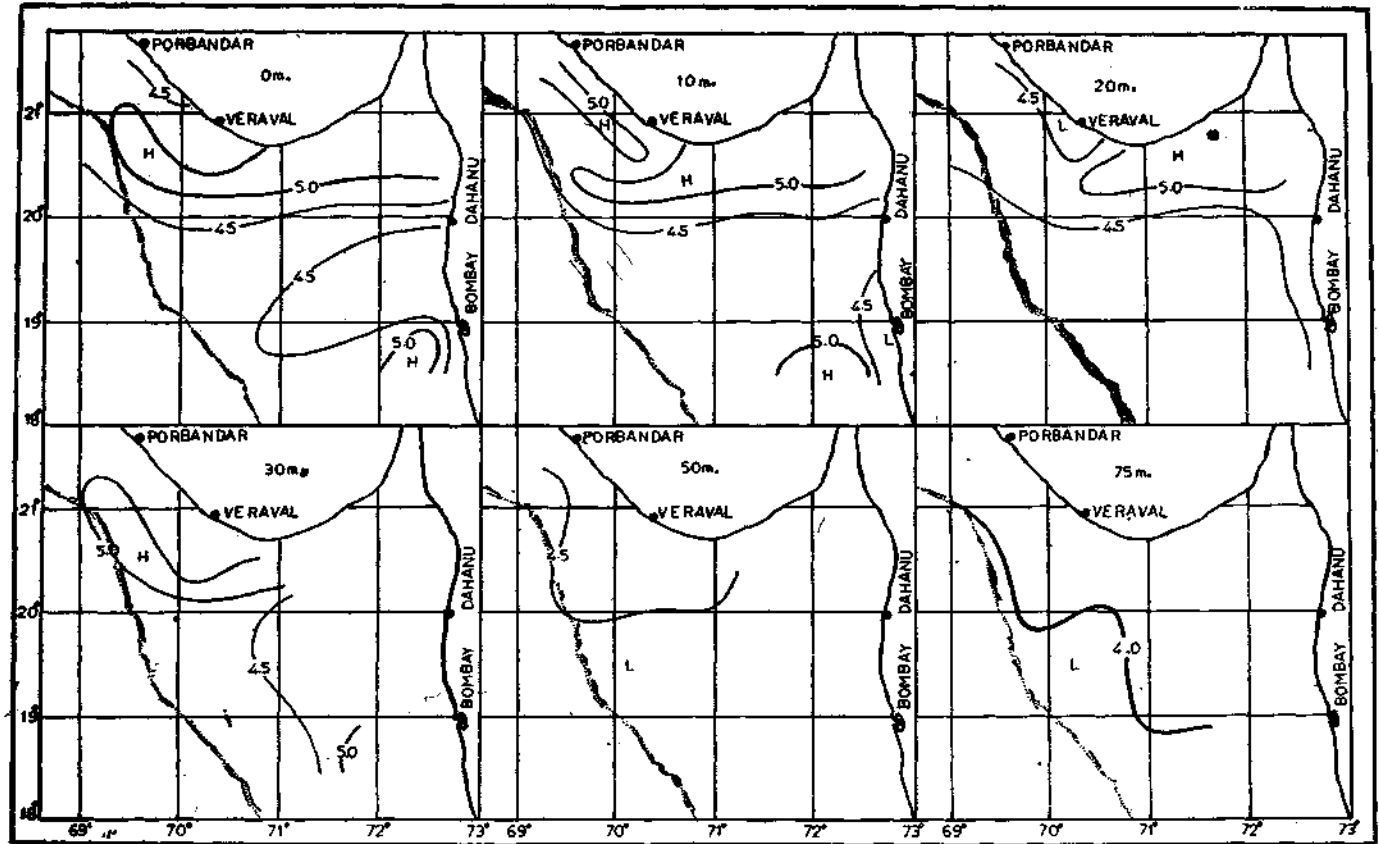


Fig. 8. Horizontal distribution of dissolved oxygen at 10, 20, 30, 50 and 75 m depths.

features are found in the section north of Dahanu (Fig. 3) and the overall oxygen content is higher than in the previous sections. Within the continental shelf off Dahanu, there is found a small depletion in oxygen content (Fig. 4). The isothermal mixed layer again exhibits uniform distribution of oxygen as can be seen from the large vertical column bounded by two identical isopleths of dissolved oxygen content. A sharp gradient in the dissolved oxygen value is observed from the top of the thermocline downwards in the offshore regions outside the continental shelf. In the section along $18^{\circ}30'N$ (Fig. 5) the distribution of dissolved oxygen is similar to the previous section.

HORIZONTAL DISTRIBUTION OF PROPERTIES

Temperature: At surface (Fig. 6), more or less a uniform pattern of distribution of temperature is observed with a slight increase towards offshore. In the section along $18^{\circ}30'N$ higher values exist, than in those along the Gujarat Coast. The distribution at the deeper levels show more uniform trend than the surface waters.

Salinity: At surface (Fig. 7), a high saline zone (core value $> 36.2\text{‰}$), is observed along the Gujarat Coast. The values decrease towards offshore and in the southernmost sections the values are much lower than those along Gujarat Coast. Comparable features prevail up to 30 m depth and at 50 m the salinity cell is observed to have shifted further south to the $20^{\circ}N$ parallel. The core value of the cell is less than 35.6‰ and values are found to increase towards northwest. Both of the high saline zones and the low saline cell have disappeared at the 75 m level. Here a continuous ascendant in salinity is observed towards west.

Oxygen: At surface (Fig. 8), high values of dissolved oxygen (content 5.0 ml/l) are observed along the Gujarat Coast. The distribution is mostly uniform as can be seen from the figure.

Comparable features occur at deeper depths up to 30 metres and at 50 and 75 metre depths the values are lower than the upper levels.

DISCUSSION

While discussing the distribution of hydrographic parameters in the region concerned we have to bear in mind a few important aspects. One is, that the main zonal section is along the $20^{\circ}N$ parallel which is defined as the zone of maximum salinity (Defant, 1961) and the second is that the continental shelf is much wider than the southern regions except for the regions off Porbandar and Veraval.

Patil *et al.* (1964) while discussing the hydrographic features along the Maharashtra Coast, have observed a tongue of high temperature from north to south along the coast. The lowest temperature as observed by them was in the region off Veraval. In the present case also the lowest temperature values have been noted in the quasi-latitudinal sections off Porbandar and Veraval. During the monsoon the clockwise circulation in the Arabian Sea develops, which proceeds as a southeastward current along the Gujarat Coast and this may be the cause for the lowering of the near-shore temperature values. This can further be clarified from the vertical distribution patterns of temperature in the sections off Porbandar and Veraval, where a coastward upslope of isotherms are observed. In contrast to the earlier observations the high temperature tongue is not so conspicuous in the present case.

As has been indicated elsewhere, the maximum salinity in the investigational region is observed between 20° and $21^{\circ}N$ in the region off Veraval. The salinity values decrease southwards and in the section along $18^{\circ}30'N$ the lowest values of salinity are noticed. This is in accordance with the generally accepted hypothesis (Defant, 1961). Rao *et al.* (MS) while quoting Panakala Rao and Jayaraman have stated that the

sub-surface conditions reflect to some extent the characteristics of Red Sea and Persian Gulf waters. The high values of oxygen found in the investigational area upto about 50 metre depth can also be attributed to the sinking and spreading of oxygen rich waters from the Gulf of Aden and Persian Gulf, which enriches the sub-surface layers (Panakala Rao and Jayaraman, 1970).

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