

Nitrite Maxima in the Northern Arabian Sea

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There are 2 nitrite maxima in the northern Arabian Sea, one at the thermocline depth and the other at depths between 300 and 500 m. The 2nd maximum is more prominent in the northeastern part of the Arabian Sea. The 1st maximum is associated with varying amount of dissolved oxygen whereas the 2nd is associated with very low amount of dissolved oxygen ($< 1 \text{ ml.l}^{-1}$). Below the 2nd maximum the nitrite is absent.

Distribution of nitrite in the waters of coastal and offshore regions of the world oceans has been studied, including the Arabian Sea¹⁻⁵. In the present study, an attempt has been made to correlate the nitrite maxima with the temperature, salinity and dissolved oxygen conditions existing in the northern Arabian Sea.

Data were collected from various stations covering the northern Arabian Sea during the cruises of *INS Darshak* from Dec. 1973 to May 1974. Water samples were collected from standard depths using transparent TPN water samplers (Type Hydro Bios, Kiel, West Germany). The analyses of the samples for dissolved oxygen and nitrite were carried out immediately after the collection of samples following standard methods^{6,7}.

Nitrite in surface waters in the northern Arabian Sea during Dec. to Feb. varies between 0 and $0.5 \mu\text{g-at.l}^{-1}$ with slightly higher values in the area west of 64°E long. which has been surveyed during winter. In the area between 64°E and 68°E long. (covered during the spring season—March-May), nitrite is either very low or totally absent. In the area between lat. 20° and 23°N and long. 68°E and the west coast of India, which has been covered partly during spring (April-May), the values in general vary between 0.1 and $0.5 \mu\text{g-at.l}^{-1}$.

Vertical profiles of nitrite in waters at a few selected stations from different parts of the area of observation show an increase of nitrite with depth, with a maximum around 50 to 100 m depth. Below this level nitrite is present in small amounts or is undetectable. At certain locations south of 22°N lat. along the west coast of India, a prominent 2nd nitrite maximum is present at all stations around 300 m depth. Nitrite concentration at this maximum is often found to exceed $3 \mu\text{g-at.l}^{-1}$ whereas in the north-western Arabian Sea west of 62°E long. this maximum has not been observed. In some parts of the northern Arabian Sea the 2nd maximum occurs between 300 and 500 m

depth with values generally $1 \mu\text{g-at.l}^{-1}$. Below the 2nd nitrite maximum, nitrite either exists in very low concentration or is totally absent.

Nitrite concentrations from the 1st maximum for all stations having the maximum are plotted (Fig. 1A). The depths of occurrence of the 1st maximum varies between 50 and 100 m depth and is at the top of the thermocline. This maximum which is associated with a wide range of oxygen levels (2 to 5 ml.l^{-1}) is due to nitrification activity³. In the Arabian Sea a high amount of organic production^{8,9}, leads to a great amount of organic material left unused and this results in its accumulation in the region of the thermocline. The regional variation in the concentration of nitrite in this layer of primary maximum appears to be due to

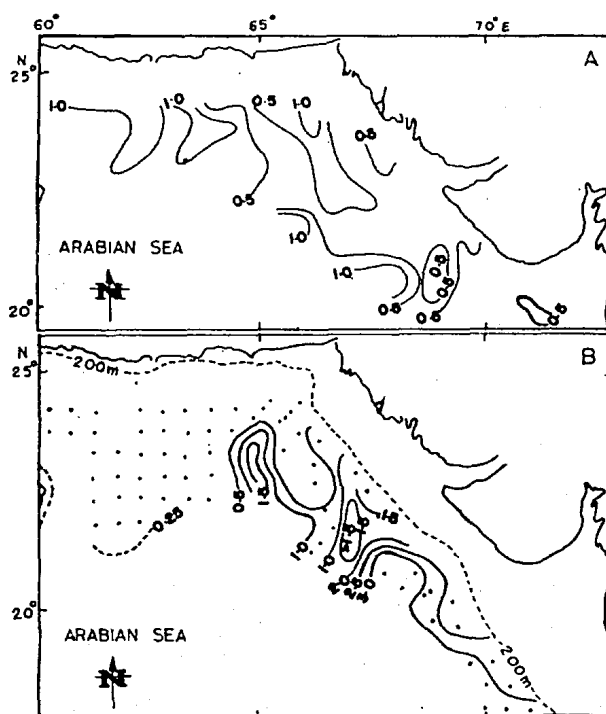


Fig. 1—Distribution of nitrite ($\mu\text{g-at.l}^{-1}$) at 1st (A) and 2nd (B) maxima

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varying amounts of organic matter present and the different stages of their oxidation.

The presence of the 2nd maximum in the Arabian Sea at several stations was first observed by Gilson¹⁰. He observed nitrite concentration as high as $7.4 \mu\text{g-at.l}^{-1}$ in this maximum layer. Nitrite content for stations having the 2nd maximum is shown in Fig. 1B. The maximum concentration observed is $3 \mu\text{g-at.l}^{-1}$. This is mostly confined to the west coast of India and is more pronounced in the region south of 20°N lat. The depths of occurrence of this maximum are between 300 and 500 m in the northern Arabian Sea. In the intermediate layers the dissolved oxygen is present in very low concentrations ($< 0.5 \text{ ml.l}^{-1}$) at depths between 200 and 1500 m in the area. At some stations the oxygen content is as low as 0.05 ml.l^{-1} . Oxygen versus nitrite at the 2 maxima is shown in Fig. 2. The first maximum as stated already, is associated with oxygen content over a wide range (2 to 5 ml.l^{-1}), whereas the 2nd maximum is associated with low oxygen content ($< 1 \text{ ml.l}^{-1}$).

Accumulation of nitrite and its 2nd maximum in the Arabian Sea appear to be due to denitrification process³. According to Brandhorst¹¹ there is an enrichment of nitrite at the expense of nitrate when the dissolved oxygen level decreases to $< 0.16 \text{ ml.l}^{-1}$. Thomas¹² has reported a significant decrease in the nitrate content in the region of 2nd nitrite maximum of the tropical eastern Pacific and further suggested that gaseous nitrogen can be formed because the decrease in nitrate appeared to be greater than the increase in the nitrite.

It is believed that in the northern Arabian Sea denitrification may lead to the formation of gaseous nitrogen compounds^{3,4}. In the north-eastern Arabian Sea the 2nd nitrite maximum is associated with low nitrate, low ammonia and low oxygen values. It is possible that conditions for the formation of N_2 or N_2O as the end product are very favourable in this region. Sen Gupta *et al.*⁴ have reported denitrification in the Arabian Sea at depths of low oxygen concentration, which is often associated with a nitrite occurrence with an average value of $0.1 \mu\text{g-at.l}^{-1}$. They have also reported based on data from *Meteor* and *Ismex* cruises that in the Arabian Sea about 41% of available nitrate is lost during the denitrification. Deuser *et al.*¹³ have reported denitrification taking place in the area.

In the northern Arabian Sea 2nd nitrite maximum, occurs in the layer between 300 and 500 m while in the

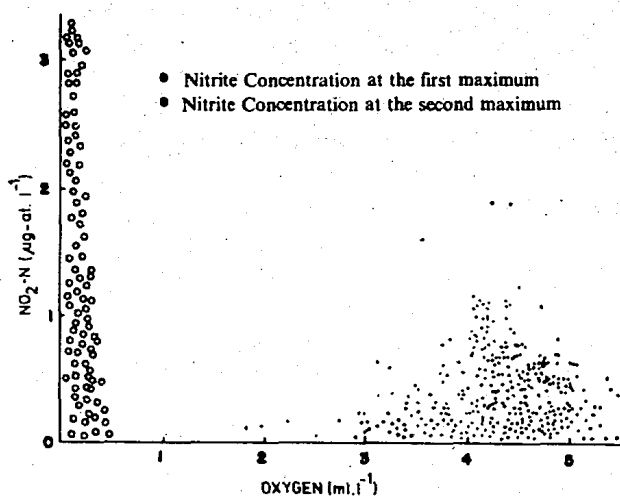


Fig. 2—Nitrite concentration against dissolved oxygen at nitrite maxima

Persian Gulf water it occurs around 300 m. The high primary productivity of the Persian Gulf water¹⁴ at its source and that of the northern Arabian Sea⁹, may be responsible for the suboxic conditions observed in the subsurface layers of the Arabian Sea leading to an intense denitrification by microbial agencies.

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