

Ecological study of gas fields in the northern Adriatic

8. Concentration of oxygen and nutrient salts

Lambe STOJANOSKI and Ilija VUKADIN

Institute of Oceanography and Fisheries, Split, Croatia

This paper gives a presentation of the concentration of oxygen and nutrient salts according to published data. The northern Adriatic and the area of the oil fields as well, is well aerated. Mainly because of the influence of the Po River, and other land factors, the northern Adriatic is slightly richer in nutrient salts than the central and southern Adriatic.

8.1. INTRODUCTION

Dissolved oxygen (O_2) is of great importance for the living marine life, and it is exceptionally important for the oxidation of organic matter.

Generally, in areas with low oxygen concentrations there is an excess of nutrient salts and vice versa.

The waters of the Adriatic Sea are in general, rich in O_2 and poor in nutrient salts. A well-known fact is that the Adriatic enriches the Mediterranean with oxygen. In the deep parts of the Adriatic, waters of the same temperature as the eastern Mediterranean were found, yet rich in oxygen, about 5 ml/l (BULJAN, 1974). The origin of such waters is probably in the northern Adriatic, from where the cooled and saltier water of the bottom layer spreads to the bottom layer of the central and southern Adriatic.

On the basis of the distribution of nutrient salts, BULJAN (1964) divided the Adriatic into 4 productive zones. According to this division the northern Adriatic belongs to the second zone with the mean production of $40-90 \text{ g Cm}^{-2} \text{ year}^{-1}$.

With respect to the fact that nutrient contents in the Adriatic are rather low, this high organic production in the waters of the northern and central Adriatic are very likely a result

of the very rapid transport of nutrient salts from deep layers to the surface, that is their rapid regeneration. This conclusion was confirmed by other authors in later research (KVEDER, 1971).

ŠTIRN (1969) recorded considerably higher values of phosphates ($PO_4\text{-P}$) in the waters of the northern Adriatic and considers this area the primary source of these salts for the entire Adriatic, even for the Ionian Sea. He believes that the high values of phosphates are not solely due to freshwater inflows, since considerable quantities of these salts are results of the regeneration from holoplanktonic organisms. DEGOBBIS (1974) also believes that biological processes mainly determine seasonal variations in the concentrations of inorganic nitrogen in the waters of the northern Adriatic. He proves the considerable eutrophic impact of nutrient salts inflow via the Po River and other freshwater inflows. All this results in the considerable acceleration of all processes in the nitrogen cycle, especially in areas directly affected by the Po River. This affects the concentration gradient of these salts, that greatly changes from the eastern toward the western coast. The southeastern part of the northern Adriatic, where the IVANA and IKA fields are located, is characterized by very moderate variations in nutrient salts, as well as very low concentrations.

8.2. MATERIAL

Data collected during the expedition of m/s VILA VELEBITA (GILMARTIN et al; 1972, 1973) during 1972 and 1973 (station 15 and 19) were used in this paper. Data (station 34 and 35) from the expedition of m/s ANDRIJA MOHOROVIČIĆ (State Hydrographic Institute, 1982) were used as well. (Fig. 8.1.)

Nutrient salts were determined by standard oceanographic methods that were quoted in the works above.

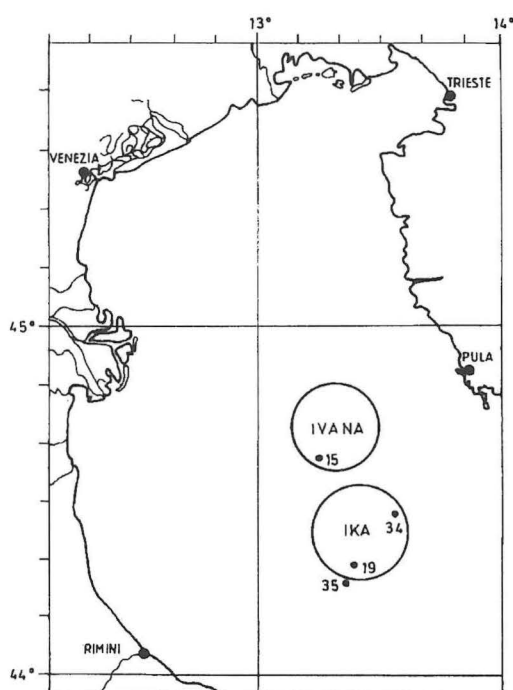


Fig. 8.1. Stations of the VILA VELEBITA and ANDRIJA MOHOROVIČIĆ expeditions from which data were applied

8.3. OXYGEN

The Adriatic Sea is rich in oxygen (5-6 ml O₂/l), therefore it enriches the waters of the Mediterranean. The northern Adriatic is also rich in oxygen, meaning that it is a well aerated basin.

In the areas of the IVANA and IKA fields the following minimum and maximum oxygen content values and saturation are recorded:

Table 8.1. Oxygen content (ml/l) and saturation (%)

Station	Max. O ₂ (ml/l)	Min O ₂ (ml/l)	Max. O ₂ (%)	Min O ₂ (%)
15	6.50	4.49	115	89
19	6.31	4.77	112	84
34	6.09	4.68	107	93
35	6.08	4.57	110	96

The maximum saturation values were recorded in the sea water layers between 10-30 m, that is the layer where the assimilation processes take place.

Minimum values were mainly recorded in the bottom layers in winter when the sea water temperature is usually low, that is when photoactivity was reduced.

Recent research (BENOVIĆ et al. 1987; JUSTIĆ, 1987; DEGOBBIS, 1987) have shown that in autumn (October, November) the oxygen content in the bottom layers is reduced considerably. This is probably the result of plankton mortality, following the second summer blooming, and their sinking to the bottom, where considerable quantities of oxygen are needed for their decomposition.

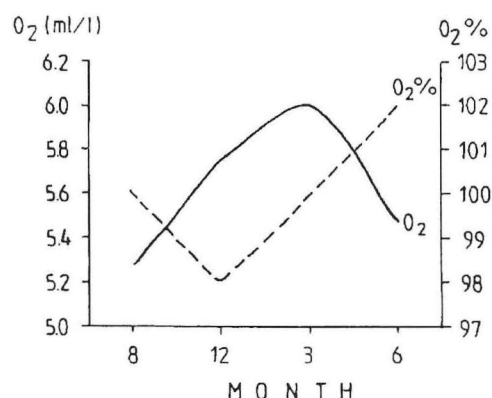


Fig. 8.2. Seasonal change of oxygen and saturation by oxygen at station 19

Fig. 8.2. presents the seasonal variations of mean values of oxygen content and saturation at station 19. The figure shows that this area is rich in oxygen in all seasons particularly during the colder period.

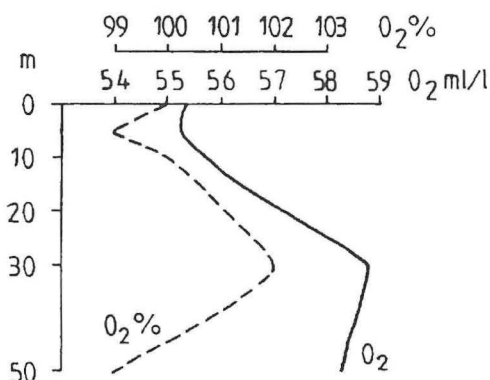


Fig. 8.3. Change of oxygen composition and saturation by oxygen according to depth at station 19

Fig. 8.3. shows the variations in mean oxygen values and saturation with depth at station 19. Maximum saturation values were recorded between 10-30 m, that is in the sea water layer where main biological processes take place. As the remaining stations are located nearby, similar oxygen values were recorded there.

8.4. NUTRIENT SALTS

A well-known fact is that the Adriatic Sea belongs to seas poor in nutrient salts. The northern Adriatic is slightly richer since it is under a very strong impact of land factors, primarily the Po River. The southeastern part of the northern Adriatic, where the IVANA and IKA fields are located, is characterized by very low concentrations of nutrient salts (DEGOBBIS, 1974).

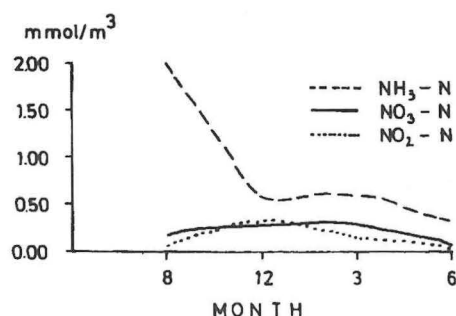


Fig. 8.4. Seasonal distribution of nitrogen salts at station 19

8.4.1. Nitrogen salts

The cycle of nitrogen salts (nitrates, nitrites, ammonia) in the northern Adriatic was studied by DEGOBBIS (1974) who concluded that the main processes that influence the content and distribution of these salts are:

- input of the Po River
- transfer of water masses
- assimilation - regenerative processes

The table below shows the maximum and minimum values of nutrient salts in the studied area:

Table 8.2. Contents of nutrient salts (m mol/m³)

Station	NO ₃ -N		NO ₂ -N		NH ₃ -N	
	Max.	Min.	Max.	Min.	Max.	Min.
15	1.05	0.00	0.39	0.00	1.90	0.00
19	1.62	0.02	1.30	0.00	3.70	0.00
35	0.55	0.08	0.35	0.01	0.63	0.08

Seasonal variations of average nitrogen salt values at station 19 are presented in Fig. 8.4., whereas Fig. 8.5. shows the variations of nitrogen salts with depth. It is clear from these diagrams that ammonia is a dominant form of nutrient salts in this area.

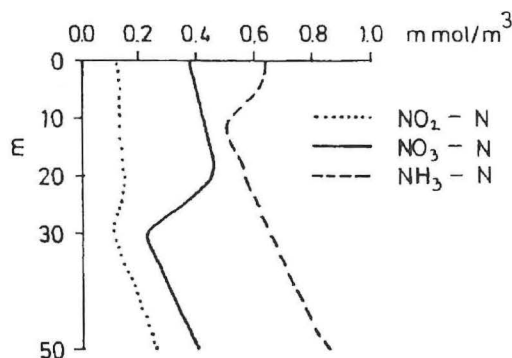


Fig. 8.5. Change of nitrogen salt composition according to depth at station 19

8.4.2. Phosphates

Ortho-phosphate concentrations were expected to follow nitrate concentrations. However, there are some unexplained results. It must be kept in mind that the phosphates measured in these areas are very close to the detection limit of the method.

The western part along the Italian coast is slightly richer due to the influence of the Po River.

8.4.3. Silicates

The silicium cycle in the sea is very similar to cycles of other nutrient salt. The major part of the dissolved silicium enters the sea via river inflows and the greatest quantity is lost by settling on the sea bottom. The following table shows maximum and minimum values in the investigated are:

Table 8.3. Content of silicates (m mol/m^3)

$\text{SiO}_3\text{-Si}$		
Stations	Max.	Min.
15	7.00	0.0
19	6.6	0.0
35	4.18	0.12

At the IVANA and IKA fields no exceptionally high maximum values were recorded as in the western parts of the northern Adriatic.

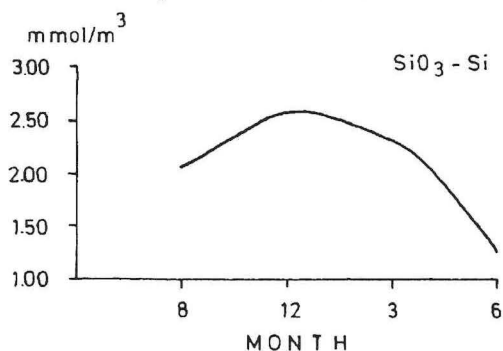


Fig. 8.6. Seasonal distribution of silicates at station 19

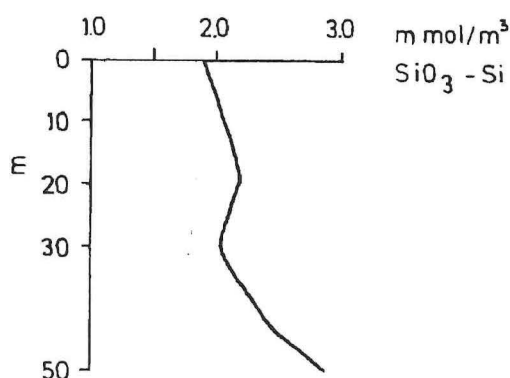


Fig. 8.7. Change of silicate composition according to the depth at station 19

Fig. 8.6. shows the mean seasonal distribution of silicates at station 19 that is mainly affected by freshwater inflows in this area.

Fig. 8.7. shows the variations of silicate average values with depth at station 19. This distribution is expected, that is, deeper layers are richer in silicates.

8.5. REFERENCES

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Ekološka studija plinskih polja u sjevernom Jadranu

Sadržaj kisika i hranjivih soli

Lambe STOJANOSKI i Ilija VUKADIN

Institut za oceanografiju i ribarstvo, Split, Hrvatska

KRATKI SADRŽAJ

U radu su prikazane sezonske i prostorne raspodjele hranjivih soli (nitrata- NO_3 , nitrita- NO_2 , amonijaka- NH_4 , fosfata- PO_4 i silikata- SiO_2) te sadržaja otopljenog kisika O_2 u vodama sjevernog Jadrana, odnosno u području plinskih nalazišta IVANA i IKA. Korišteni su do sada objavljeni rezultati istraživanja za ovo područje sjevernog Jadrana, te uspoređivani s vrijednostima za ostale dijelove Jadranskog mora.

Uočeno je da je istraživano područje pod dosta snažnim utjecajima kopnenih čimbenika, posebno rijeke Po, što se očituje u povišenim vrijednostima hranjivih soli u odnosu na one u srednjem i južnom Jadranu.

