Observations on the chemical properties of polluted waters in Alexandria region (A.R.E.)

by

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Sea water samples were collected from various regions in the vicinity of Alexandria in order to study the relationship of chlorinity to salinity in these samples, to compare them with oceanic non polluted waters and to investigate the effect of coastal dilution and/or pollution on the chemical composition of these waters.

The present study was carried out on 35 samples collected from five different water types. Each sample was sedimented, filtered in glass filter paper and placed in well stoppered glass bottles. The following determinations were made on each sample :

a — Chlorinity according to Knudsen's method, titrations were carried out in duplicates on weighed aliquots of samples and standard sea water.

b — Gravimetric salinity determined directly according to the method of Morris & Riley [1964]. The determinations were made in quadruplicates and gave a coefficient of variability of 0.04 %.

From the data of chlorinity and gravimetric salinity determined and using the method of the least squares, empirical relationships between chlorinity and gravimetric salinity were calculated for each set of samples. It was found that differences in the ionic composition of the different water types studied were reflected on the relationship between salinity and chlorinity and the five water types gave more or less different empirical formulae.

1 — The empirical formula computed from the data of gravimetric salinity and chlorinity of the offshore non-polluted water (4 samples) was identical with that of Knudsen i.e. :

$$S\text{‰} = 1.805 \ Cl\text{‰} + 0.03 \quad (1)$$

The difference between the values of gravimetric salinity determined for these samples and the corresponding values computed from this equation was on the average — 0.008 S ‰ varying between — 0.004 S ‰ and — 0.014 S ‰. Applying the new relation : S ‰ = 1.80655 Cl ‰ [Wooster *et al.*, 1969], the average difference between gravimetric salinity and the corresponding values computed from this equation was 0.005 S ‰ varying between 0.003 S ‰ and 0.010 S ‰.

2 — The second set include 7 samples representing sea water diluted by Nile water and were collected from off Rosetta Nile Branch during the flood period. These samples covered a salinity range of Ca 8-30 ‰. The empirical equation calculated from these samples was :

$$S\text{‰} = 1.805 \ Cl\text{‰} + 0.04 \quad (2)$$

Evidently this equation gives salinity values higher than that computed from Knudsen equation by 0.01 S ‰.

[31]

Morris & Riley [1964] determined the gravimetric salinity of 16 samples and found a maximum difference of 0.052 S ‰ for a Baltic water sample. This difference is due to the difference in ionic composition of diluted sea water caused by the admixture of river water with its relatively high sulphate content. The sulphate/chlorinity ratio of the Nile water is more than 12 times that of sea water [Morcos, 1967].

Morcos & Riley [1966] determined the gravimetric salinity of sea water diluted by Nile water and gave the following empirical formula

$$S‰ = 1.805 \; Cl‰ + 0.056$$

3 — The third category include 5 samples collected from the south western part of Abu Kir Bay, an area which is polluted by the industrial wastes of several paper factories, salinity range 20 to 38 ‰. These samples gave the empirical formula

$$S‰ = 1.790 \; Cl‰ + 0.292 \quad (3)$$

Salinity values computed from this equation are higher than the corresponding values calculated from Knudsen equation by an average of 0.03 S ‰ varying between — 0.104 S ‰ to + 0.058 S ‰.

4 — The fourth set of samples (7 samples) were collected from the Eastern Harbour off Alexandria. The waters of this harbour are polluted by the refuge of fishing boats and ships, besides, it is affected by the sewage effluents of Alexandria. The salinity of the water in this harbour varied between Ca 36 to 38.5 ‰. The empirical equation computed for the waters of this harbour was

$$S‰ = 1.802 \; Cl‰ + 0.111 \quad (4)$$

This equation gave salinity values higher than Knudsen's equation for the same range of salinity by an average of 0.018 S ‰ varying between — 0.021 and — 0.017 S ‰.

5 — The last set of samples (12 samples) were taken from the western harbour which is the main harbour of traffic. The samples were collected from waters polluted by oil and oily compounds in addition to the refuge of ships and tankers. The empirical equation calculated from the study of these samples was

$$S \; ‰ = 1.760 \; Cl‰ + 1.175 \quad (5)$$

As would be seen from this equation, the waters of the Western Harbour showed the greatest deviation. The gravimetric salinity and salinity computed from this equation were both consistently higher than the salinity obtained from Knudsen's equation (equation 1) by an average of 0.2 S ‰ varying between 0.267 and 0.183 S ‰. It was also found that this deviation decreases more or less gradually by increasing salinity, being higher in samples of low salinity and lowest in samples of high salinity. The waters of these samples were thoroughly investigated for their chemical composition. The pH, titration alkalinity, carbonate and bicarbonate concentrations, dissolved oxygen, sulphates and bromides were determined [Morcos & Dowidar, unpublished data]. These analyses showed that the specific alkalinity, SO_4/Cl ‰ ratio and the bromide chlorinity ratio are all within the normal range for oceanic non-polluted water. Pollution in the Western Harbour is mainly due to oil from ships and refiners and it is most probable that the high deviation from the salinity values expected for oceanic waters is due to oil products or compounds which remain in the water and resist the high ignition temperature of about 600 °C.

References

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Discussion

Macchi Giuseppe, Vice-Président

I would like to know the values of anomalies for sulphate.

Dowidar. The sulphate content of fresh or brackish water is much lower compared to that of sea water. In the water samples studied the sulphate content ranged from 0.3667 g/Kg for the diluted sea water of Abu Kir Bay to 3.024 g/Kg for the polluted water of the Eastern Harbour. However the sulphate/chlorinity ratio is generally a more indicative parameter in differiating water types. The sulphate/chlorinity ratio of river water is much higher than that of sea water. The SO_4/Cl ratio of sea water is on the average 0.1400. The Nile water has a SO_4/Cl ratio of 1.6878 i.e. more than 12 times that of sea water. In the samples studied, the SO_4/Cl ratio ranged from 0.2963 in the water samples of Abu Kir Bay to 0.1390 for the polluted water of the Eastern Harbour.

Duursma. Has the diminution of the Nile outflow influenced the pollution in the coastal areas favourably or unfavourably?

Dowidar. Prior to the damming of the Nile River, the large amounts of nutrient salts carried by the Nile had brought fertility to the Mediterranean waters off the Nile Delta. Further, the discharge of huge amounts of Nile water into the sea, minimized the effect of industrial pollution in the coastal waters through dilution and adsorption of pollutants on the sediments carried by the Nile water and probably also through complex formation and chelation. As an example the discharge of industrial wastes in Abu Kir Bay in the vicinity of Rosetta branch of the Nile caused no harmful effects prior to the damming of the Nile, nowadays the water of the Bay is becoming seriously polluted.

Fukai, R. In order to prove that crude oil is the cause of the deviation of salinity, it is necessary to measure the weight of residue of unit volume of crude oil. Trace metals such as vanadium, cooper, zinc, etc., should also be very much enriched in sea water, if the mineral residue of crude oil have effects on salinity.

Dowidar. This is certainly true, we assume that the mineral residue of crude oil would affect salinity values as determined gravimetrically. Further research on this point is now being done. Thank you.