HYDROGEN SULFIDE CONCENTRATION IN THE BLACK SEA

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INTRODUCTION

The Black Sea is the largest anoxic basin in the world. It has an area of approximately 415 000 km². The average depth of the Black Sea is 1 275 meters, and its maximum depth is 2 235 meters. In the Black Sea, precipitation and run-off exceed evaporation, and it has a surface layer of low salinity, which is about 18 ‰. The exchange of water between the Black Sea and the Sea of Marmara takes place through the Bosphorus. In the Bosphorus, the water of low salinity from the Black Sea flows to the Mediterranean as a surface layer, and below this layer, water from the Mediterranean (about 38 ‰ in salinity) flows in the opposite direction. At the northern end of the Bosphorus, a sill depth of 90 meters limits the exchange. The amount of inflow and outflow through the Bosphorus is affected by the meteorological condititions. With strong and continuous southerly winds, the flow at all depths is towards the Black Sea.

Anoxic conditions.

The vertical circulation in the Black Sea is essentialy limited to an upper layer of about 200 meters in thickness. Because of this, the organic constituents accumulate in high concentration at depths, and do not return to the upper layers as in other seas.

The concentrations of hydrogen sulfide, oxygen, phosphate and distribution of temperature and salinity obtained during recent cruises, are given in figure 1.

The oxygen necessary to oxidize the organic matter is supplied by the reduction of nitrates (denitrification process) and sulfates (BRANDHORST, 1959 and REDFIELD *et al.*, 1963). The nitrate and nitrite are reduced to ammonia and free nitrogen, and the sulfates are reduced to sulfides.

Hydrogen sulfide in the black sea.

The Turkish Navy Hydrographic Office has undertaken detailed oceanographic studies in the Black Sea. Three cruises in April, July and October of 1963, and two cruises in the April and July of 1964 have been made. On each cruise, a total of about 50 stations, approximately 45 miles apart, have been occupied.

The results of the recent surveys show that hydrogen sulfide is generally found at depths below 150 to 250 meters. Near the Turkish coast, hydrogen sulfide is first detected at a depth

of 200-250 meters. In the central parts of the eastern and western Black Sea, the depth of « no-oxygen » is at 150 meters. (Figure 1 shows the concentration of hydrogen sulfide of a typical station in the Black Sea.) The concentration of sulfides increases with depth, and is about 7 ml/liter at a depth of 2 000 meters.

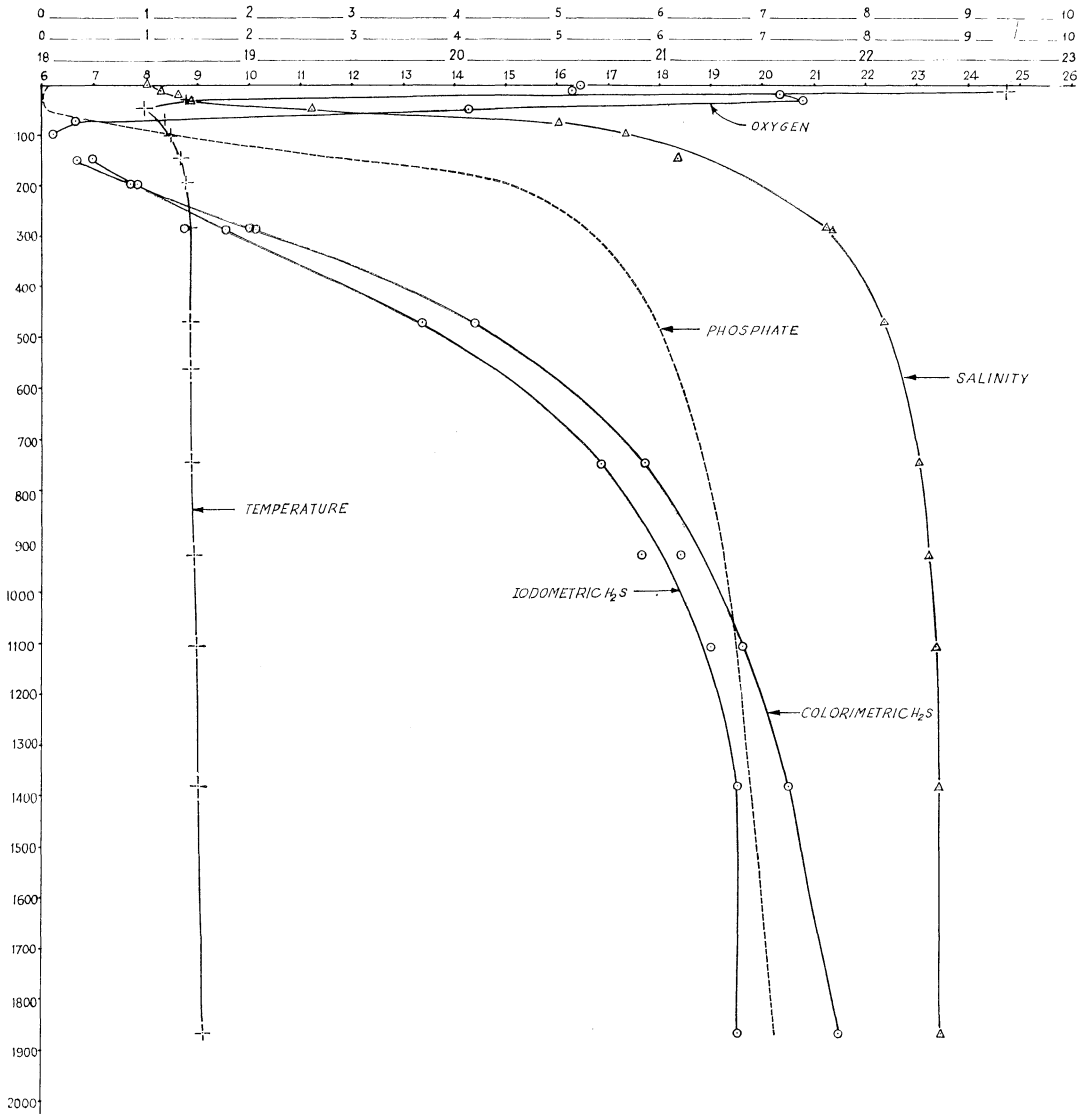

FIG. 1. — *A typical station in the Black Sea.* Distribution of temperature (°C, cross), salinity (‰), triangle), oxygen, hydrogen sulfide (ml/l, circle) and phosphate (μ g-at, stippling).

During surveys made in 1963, the hydrogen sulfide concentration in the Black Sea was determined both by the iodometric and colorimetric methods.

The iodometric method is based on the reaction of iodine with sulfide in the presence of acid. The excess iodine is titrated with thiosulfate.

The colorimetric method is based on the reaction which takes place under suitable conditions between para-amino-dimethylaniline, ferric chloride and sulfide ions, resulting in the formation of methylene blue. The development of color is complete in 30 minutes, and is stable for a long time. The absorbancy is read at 670 millimicrons (BUDD and BEWICK, 1952).

The colorimetric method gave consistently higher results than the iodometric method. Figure 1 shows the hydrogen sulfide values determined by both methods.

Turkish Navy Hydrographic Office.

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