SPATIAL ISOPYCNAL ANALYSIS OF SOME PROCESSES RESPONSIBLE FOR THE HYDROCHEMICAL STRUCTURE OF THE BLACK SEA WATERS

EREMEEV V. N., KONOVALOV S. K.

Marine Hydrophysical Institute, Academy of Sciences of Ukraine, Kapitanskaya 2, Sevastopol, Crimea, 335000, Ukraine

Scientific discussion on shoaling of the upper boundary of hydrogen sulfide zone and catastrophic degradation of the Black Sea environment is the reason of intensive investigation of the surface and undersurface Black Sea waters during the last ten years. Obviously, that scientists need some new methods to collect and to analyze samples of water, but more over they have to use new methods to analyze obtained chemical data.

Before the nearest time investigators usually analyzed the data on the hydrochemical structure of the Black Sea waters versus depth. In this way they could only conclude that intensity of the main cyclonic and anticyclonic gyres determine the main features of the chemical vertical structure. But it is very difficult to eliminate the influence of different gyres on a shape of the isopycnal surfaces, so this is extremely difficult to analyze the influence of chemical and biochemical processes, to analyze the real (cross-isopycnal) vertical fluxes of any chemical substances in this way.

Hydrochemists started to use intensively one-dimensional isopycnal analysis for investigation of the Black Sea chemical structure after American-Turkish cruise on R/V "KNORR" in 1988. The sigma-t scale rather then depth is used in this method. This one-dimensional method is very useful, but one needs to suggest that the intensity of different biochemical processes and crossisopycnal fluxes are equal for entire basin.

When some large data sets for entire Black Sea (obtained, for example, during "CoMSBlack" experiments) were analyzed, scattering of some hydrochemical parameters for equal values of density has been observed. This scattering was much higher then any possible analytical errors.

Spatial isopycnal analysis is very useful method for investigation of variations of hydrochemical structure. The most advantages will be received, if to use this method for investigation of highly stratified marine basins. In this way the influence of different hydrophysical and chemical or biochemical processes on the hydrochemical structure can be divided effectively.

We have used 2D-isopycnal analysis to understand and to investigate the main features of the spatial distribution of oxygen and hydrogen sulfide in different layers of water (on different isopycnal surfaces) and the main processes responsible for it. The significance of the winter ventilation processes over the main cyclonic gyres in the central part of the Black Sea for transfer of oxygen downward to the upper boundary of hydrogen sulfide has been indicated.

It has been confirmed, that sub-oxygen zone ("SO"), where concentrations of oxygen and hydrogen sulfide are less then 3 - 5mcM/l, with the thickness of 14 - 51 meters or 0.2 - 0.6 units of sigma-t is the permanent feature of the Black Sea hydrochemical structure. Analysis of spatial variations of the structure of "SO" zone has been carried out and some mechanisms responsible for it have been suggested. Spatial enter and interannual variations of hydrogen sulfide distribution versus sigma-t have been investigated on the basis of "CoMSBlack-91", "CoMSBlack-92", "CoMSBlack-93" data sets.

It has been shown that convectional ventilation over the main cyclonic gyres in winter time is responsible for destruction of the layer of nitrates' maximum (sigma-t ~15.4) and the upper phosphates' maximum (sigma-t ~15.6). This process can transfer a lot of nutrients into euphotic zone. It has been estimated for nitrates by value as much as ~200 000 tuns, what is equal to annual riverine inflow.

These winter ventilation processes can be the reason of intensification of oxygen - hydrogen sulfide interaction and, as a result, decreasing of phosphates in the layer of their minimum (sigma-t ~15.95) and increasing of phosphates in the layer of their down maximum (sigma-t ~16.20-16.30). The area of the sea, where all three extremes of phosphates can be observed in winter-spring period of the year is bounded by the Main Black Sea Flow.

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