

Environmental protection Contemporary ecological problems of oceans and seas

Methodology of the study of the reasons for the presence of hydrogen sulfide in the Black Sea

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I. Introduction

Climate change is one of the most significant world environmental problems today, which is associated with the increase in the melting rate of glaciers and ice, changes in the amount of precipitation, changes in the hydrological regime of rivers, an increase in the level of the world ocean and changes in their boundaries, an increase in the frequency of floods, expansion of the area of erosion-mudflow and landslide events, shifting of the borders of swamps and plains, changes in the quality and quantity of water resources, reduction of the sustainability of ecosystems, increase in the abrasive processes of the sea coast, and others [3, 6, 8].

1. Main ecological problems of oceans and seas

The main ecological problems of the oceans and seas can be divided into two parts: the water level increase in the oceans and seas and their pollution issue. Research conducted at Rutgers University indicates that the global sea level may rise by an average of 1.5 meters by 2100. The authors of the work suggest that if appropriate measures to slow down the pace of global warming are not taken in time, by the year 2300, the sea level will rise to 15.5 meters. Given, that 11 percent of the world's 7.8 billion people live along coastlines, this sea-level rise will pose critical risks to human life, national economies, food production, infrastructure, and planet ecosystems. According to the work authors, it is true that much is still unknown about sea level past and future changes, but uncertainty should not be a reason to ignore this challenge. According to scientists, carefully describing what we know and what we don't understand is critical to managing the risks posed by rising sea levels to coastlines around the world, scientists say. [Annual Review of environment and Resources].

The authors of the work note that the publication of their work coincided with the UN report, based on an analysis of more than 6,000 scientific works. The United Nations urges the United Nations organization to take urgent measures to limit the consumption of coal and petroleum products and the release of greenhouse gases into the environment. The authors of this article also support the necessity of these measures. According to a work we have found, the level of the Black Sea has risen by 12 cm in the last 100 years [blekSea-education.ru/2-2. Shtml]. In connection with the rise in the levels of the Black Sea, we have developed recommendations on how to protect the ecological safety of the coast by regulating the hydrological regime of wastewaters. [4, 5]. We would like to point out that it is probably appropriate to carefully consider the issue of global warming in climate change, which is regarded as a factor in the oceans and seas levels increase because in our opinion, it is not yet determined how much the average temperature on the planet has increased (was this increase the same everywhere on Earth?!) and most importantly no analysis is done on whether and how much average maximum temperatures have ever increased. We are allowed to put this question by the fact that we have familiarized with the materials presented by the Greenwich Observatory, which are based on historical sources and which present graphs of the change in the average annual temperature over time (900-1950 гг.). It found that the highest average annual temperature in central Great Britain was recorded near London in the early 13th century when the world was not highly industrialized [6, 8]. Therefore, the opinion that the maximum

annual temperature values are currently too high requires verification. The reason is that, according to the presented source, the average annual temperature in the mentioned period was much higher than today in the world.

As for the climate, of course, it undergoes certain changes in time in the form of periodic cycles, in result, the temperature in some regions of the planet increases while in others decreases.

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The pollution issue is no less an ecological problem than the water levels rise in the oceans and seas. However, if society can reduce environmental pollution as much as possible, this problem can be manageable. To assess the water quality of the Black Sea, we have studied the water quality in the territorial space of Georgia for many years. [1, 10].

It should be noted that the above-mentioned ecological problems are characteristic of the Black Sea as well. Moreover, the impressive layer of hydrogen sulfide in the Black Sea has a catastrophic effect on the ichthyofauna and flora in the sea, especially on living organisms. The presence of living organisms is limited in the hydrogen sulfide diffusion area, and only some types of bacteria exist there. The studies we conducted in the territorial space of the Black Sea of Georgia in 2009-2010 showed that the level of hydrogen sulfide (measured twice) is close to 180 m from the sea surface. [2].

Today, the enormous amount of hydrogen sulfide in the Black Sea is recognized as an international environmental problem. As is known, on October 31, 1996, in Istanbul (Turkey), the countries of the Black Sea coastline gathered: Bulgaria, Romania, Russia, Georgia, Ukraine, and Turkey. October 31 was declared the International Day of the Black Sea, and the meeting participants unanimously noted that it is necessary to study the ecological problems of the Black Sea, especially the presence of hydrogen sulfide. Unfortunately, as we know, the implementation of research in this direction is delayed.

According to the materials we found, the presence of hydrogen sulfide in the Black Sea was described by an oceanographic expedition in 1990. According to them, the content of hydrogen sulfide was 90% of the total mass of the sea and was fixed at a depth of 50 meters from the sea surface in the central part of the sea, and at a depth of more than 200 meters near the coasts. [cyclowiki.org/wiki:blacksea-education.ru]. As we mentioned above, as a result of our measurements, 3 miles away from the shore (city of Poti), the depth of hydrogen sulfide distribution reached 180 m [2].

When researching the distribution of hydrogen sulfide in the Black Sea, it must be taken into account that the Black Sea is an open sea. However, since the Bosphorus and Dardanelles straits connecting Black Sea with the Mediterranean Sea have small dimensions (small depth and width), the circulation (exchange) of water between them is limited, which leads to more problematic water quality in the Black Sea. Although the surface layers of the Black Sea are moving into the Mediterranean Sea, the lower water layers remain static. As for the upper layers of water, they already contain a small amount of hydrogen sulfide. All this is compounded by anthropogenic factors, which further worsen the already poor background of seawater quality. For example, we cannot fail to point out the impact of the Chernobyl nuclear power plant accident on the pollution of the Black Sea. It is also worth noting that the waters of heavily polluted large river basins, such as the rivers Danube and Dnieper, flow into the Black Sea [7, 9].

As mentioned above, many scientific works are researching the problems of the oceans and seas, including the Black Sea's ecological condition. [https://www.youtube.com/watch?v=3PscEvAd1k]. However, we could not find a work where is done an unmistakable conclusion about the origin of hydrogen sulfide in the Black Sea. There are some opinions that hydrogen sulfide in the sea may be the result of decaying living organisms, or it may even come from the earth's crust. However, if infallible, strengthened by relevant experimental research, the conclusion of the origin of hydrogen sulfide in the sea is not established, it will be impossible to take measures against it. However, the development of today's scientific technologies, in our opinion, allows us to start decisive experimental studies to explore the spread of hydrogen sulfide to make it possible to take measures against the spread of hydrogen sulfide in the Black Sea.

2. Recommendations for studies on the presence of hydrogen sulfide in the Black Sea

The analysis of existing studies showed that the level of hydrogen sulfide in the Black Sea is gradually rising to the surface, and in time we may no longer see living organisms in the Black Sea at all. It may become the Dead Sea. The presence of hydrogen sulfide in the Black Sea is also dangerous from the point of view of safety.

It is necessary to study the causes of the origin of hydrogen sulfide in the sea to develop preventive measures for its spread in the Black Sea. As we mentioned above, the issue is only at the level of theoretical considerations. There is no conclusive evidence for the origin of hydrogen sulfide in the sea.

We, scientists interested in the ecological problems of the Black Sea, have some experience concerning the mentioned issues, which, in addition to several scientific works, are presented in scientific grant projects.

„Evaluation of ecological problems of the Black Sea against the background of global warming and forecasting of erosive and mudflow processes as well as solid sediments of river basins for protecting Georgian coastal strip from abrasive processes“ grants # GNSF/ST08/5-433 (2009/01/01-2011/01/01); „Providing environmental safety of Poti industrial zone through uninterrupted functioning of a watershed unit existing at river Rioni“. grants GNSF/ST08/7-477 (2009/01/01-2010/01/01); „The evaluation of ecological conditions of Black Sea and treatment of complex measurements of coastal zone protect from abrasion processes in border of Georgia“, grants #FR/115/9-180/13 (2014/01/01-2017/01/01); „Black sea research network UP-GRADE BS-SCENE“, grants #226592(2009/01/01-2011/01/01). Thus, we have a bold plan and research recommendations on how to conduct the study of the issue to establish finally, and without doubt causes of hydrogen sulfide in the Black Sea.

Within the scope of the research, the following should be carried out:

- Evaluation of the modern state of seawater quality based on the available materials. In the absence of some necessary characteristics, additional studies will be carried out;
- The current state of the Black Sea water quality will be determined;
- The level of hydrogen sulfide spread in the eastern, western and central parts of the Black Sea will be measured. At the same time, hydrogen sulfide earlier measurements results will be sought;
- The level of hydrogen sulfide spread in the sea will be determined and, based on the materials of the previous measurements, its change over time will be estimated;
- Sea water sampling will be carried out several times (at least three times) in the Bosphorus Strait, and it will be evaluated whether the water flowing from the Black to the Mediterranean Sea contains hydrogen sulfide or not;
- Sampling for laboratory studies of the sulfurous waters from the operating wells of the Kolkheti plain in western Georgia will be carried out to explore the presence of hydrogen sulfide;
- It will be determined whether the sulfurous water rising from the wells contains hydrogen sulfide;
- The total amount (volume) of fresh water flowing into the Black Sea through rivers will be searched and specified;
- Taking into account that for today there is no conclusive scientific evidence about the origin of hydrogen sulfide in the Black Sea (there are probable opinions that the cause of hydrogen sulfide spread in the sea may be the decay of living organisms or its rise from the bowels of the earth (crust)) and these opinions are not confirmed by experimental studies, we believe that this issue should be decided based on empirical studies. Otherwise, in our opinion, any attempt to take preventive measures against the spread of hydrogen sulfide in the sea is futile. Based on the above, we consider it necessary to conduct research based on experiments;
- A well will be arranged in the continental part of the Black Sea (in our opinion, one well will be enough) in the territorial part of Georgia, in particular, on the Kolkheti plain, where the relief mark is equal to the sea level (it is easier to arrange a well on land than in the sea). It will be continuously monitored and determined if hydrogen sulfide rises from the earth's crust. It will be estimated at what depth the rocks containing hydrogen sulfide will be found (if any) in the Earth's crust;
- The idea of carrying out such research was strengthened by familiarization with many ancient scientific opinions about the existence of a large amount of hydrogen sulfide reserves in the shallow layers of the Kolkheti plain;
- Even if both scientific opinions of the origin of hydrogen sulfide in the sea (decay of living organisms, rising from the earth's crust) is actual, the research results will still be significant since will be determined each factor contribution to the formation of hydrogen sulfide. Otherwise, as we mentioned above, any attempt to take preventive measures against the spread of hydrogen sulfide will be in vain;
- Determining the causes of the spread of hydrogen sulfide in the Black Sea will make it possible to take care of developing preventive measures against the spread of hydrogen sulfide in the sea;
- To carry out experimental studies, according to preliminary estimates, certain financial funds will be required for the following activities:
 - a) Arrangement of a well which depth will be determined according to the deepness at which hydrogen sulphide will be found. In our opinion and based on various geological studies, the maximum depth is to be around 500-600m. According to today's data, such a large volume of work will require a certain amount of funds.
 - б) Other expenses (water sampling and laboratory examination; determination of hydrogen sulfide in at least 3 locations in the sea; renting a floating vehicle and, in the absence of appropriate equipment, providing it with proper facilities; salary and transportation, including travel, etc.).

II. Conclusion

Determining the reasons for the spread (existence) of hydrogen sulfide in the Black Sea will allow us to design various appropriate measures against the spread of hydrogen sulfide.

Annotation

The article describes the modern global problems of oceans and seas. Based on the opinions of a number of scientific institutions and famous scientists, it is estimated that the modern ecological problems of the oceans and seas can be divided into two main groups: the increase of water levels in the oceans and seas and their pollution.

The work presents consistent recommendations for studies to determine the causes of hydrogen sulfide spread (presence) in the Black Sea.

Scientific research recommendations are the property of the authors.

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