

The General Assessment of Black Sea Ecological Problems and Recommendations of Eliminate Them

Robert Diakonidze^{a*}, Irine Baramidze^b, Kakhaber Bilahvili^c, Vazha Trapaidze^d,
Tamriko Supatashvili^e, Bela Diakonidze^f

^a*Tsotne Mirtskhulava Water Management Institute of Georgian Technical University Ave. I. Chavchavadze 60.
0169*

^b*Batumi State Maritime Academy Ave. Rustaveli 53. Batumi. 6010*

^c*Ivane Javakhishvili Tbilisi State University Ave. I. Chavchavadze 1, Tbilisi, Georgia. 0179*

^d*University of Georgia Ave M. Kostava 77a, 0171*

^a*Email: robertdia@mail.ru*

^b*Email: bella_diakonidze@mail.ru*

^c*Email: wocean@telenet.ge*

^d*Email: v.trapaidze@yahoo.com*

^e*Email: tamunasupatashvili@gmail.com*

^f*Email: bella_diakonidze@mail.ru*

Abstract

In the article is presented the result of the 2008-2017 research, particularly, the general assessment of Black Sea ecological problems, quality of sea and inflow water, also depth distribution level of hydrogen sulfide. □ It has been evaluated abrasion processes of the Black Sea coastal zone and the possibility of its stabilization by regulation of solid sediment transported by rivers. □ It is estimated that the number of solid sediment scales that will stop or significantly reduce the seaside capture and wash away. □ It has been made general assessments of the Black Sea ecological problems and recommendations for their elimination.

Keywords: Black Sea; water quality; hydrogen sulfide; abrasion.

* Corresponding author.

1. Introduction

For Change of border the Black Sea within the territory of Georgia particular importance has the last late fourth period, which began 120-140 thousand years ago and includes the complete and subsequent incomplete cycle - Pleistocene [20]. Its beginning coincides with the lower layers of the Black Sea sediments and includes the epoch of the last ice age. In the Patagonian epoch, the Karagana Sea (present Black Sea) level is tens of meters above today and freely connected to the Mediterranean Sea [19]. About 9-10 thousand years ago, the waters of the Mediterranean Sea invaded in the Akhallevskin pools due to arise ocean level, which led to the increase in the level of the Black Sea, which lasted 3-4 thousand years and ended about 6,000 years ago, when it reached the maximum level (3-4 m more than today).

About 6000 years ago the Black Sea borders received the form of today's borders [19].

Some scientific work [15] analysis allows us to conclude, that changes in the Black Sea border of Georgia, especially the Colchis lowland was mainly caused by the changes in the Black Sea Hypsometric Index. Lowering the surface of the relief of the Colchis lowland was going on by tectonic sink –Black Sea regression while raising - as a result of the accumulation of rivers - Black sea transverse.

2. Material and method

It is widely known that the Black Sea's purpose is to link the economic relations between East and West, it is one of the main components of the Georgian Transport Corridor and its ports are an important tool for transportation of cargo.

It is also known about the ecological problems of the Black Sea, which has now acquired international importance.

From the ecological problems of the Black Sea, first of all, water quality should be noted, especially hydrogen sulfide distribution in the sea and activate the sea coastline abrasive processes in the connection with increase water level, on which is importance depend the development of tourism in the country visitor entry and shipping of goods from ports.

Nowadays, there are three ports: Batumi, Poti, and Kulevi are located on the territory of Georgia's jurisdiction on the Black Sea. The construction of Anaklia Drainage Port has been started, which will be carried out gradually (9 stage). The ship's cargo turnover will eventually increase to 100 million (2069). The construction of the port will have a significant positive effect on shipping of goods between East and West, for our country it will have strategic importance in addition to the economy.□

For the protection of the Black Sea ecosystem, there is the Bucharest Convention on Black Sea Pollution Protection (1997), which was ratified in Georgia in 1999. According to this Convention, governments of Bulgaria, Georgia, Romania, the Russian Federation, Turkey and Ukraine reaffirm their commitment to rehabilitation and protection of the Black Sea ecosystem, however, some states do not fulfill these obligations

and therefore the ecological condition of the Black Sea remains anxious.

We have been studying the Black Sea ecological conditions for several years (2008-2017) based on the basis of the Black Sea quality (including hydrogen sulfide prevalence) and general evaluation of abrasive processes [1, 2, 3, 4, 5, 6, 8, 9, 10].

For assessment, sea water quality has been selected territorial waters adjacent to the popular (demanded) Black Sea resorts (Batumi, Kobuleti, Ureki, Grigoleti, Maltakva, Anaklia) of Georgia. The analysis took place near the shore and 150 meters from the shore, 30 cm deep. The quality of rivers (Chorokhi, Kintrishi, Chakvi water, Natanebi, Supsa, Rioni, Khobi, Enguri) was also studied on the territory of Georgia. Overall 30 features were evaluated. Unfortunately, we cannot determine the radiation background of sea water. For water quality assess was used the European, former Soviet Union and the normative directions of our country [7, 11, 12, 16, 17, 18].

It was established that the Black Sea water, Georgian territorial waters are mainly polluted with heavy metals: zinc, copper, nickel, arsenic, bullet, phenols, whose magnitude is 0.1-0.5 times higher than the permissible concentration, while the maximum indicators range 1.5 to 2,5 times higher than the permissible concentration. These pollution indicators, according to the above assessment are not harmful to health. Instead, it is contaminated river inflow in the sea, including microbiological substances: common coefficients, fecal streptococcus and intestinal strokes (analysis is taken during the flood), which is inadmissible. The ecological position of European countries, according to the recommendations of the Mutual Economic Council (CЭB) [18], the absolute majority of water quality indicators are within the I-III class and only a few variables range from II-V classes.

3. Results

As for the spread of hydrogen sulfide in the sea, we have measured twice in almost the same coordinates (for the first time $x = 715\ 709,75$; $y = 4667877$ and second time $x = 715\ 884,34$; $y = 4667920,58$), 3 miles away from Poti, where the depth of the sea is over 500 m, it is observed that the extent of hydrogen sulfide is about 180 m from the water surface, and this value is close to the size of the international experts. See the Figure 1.

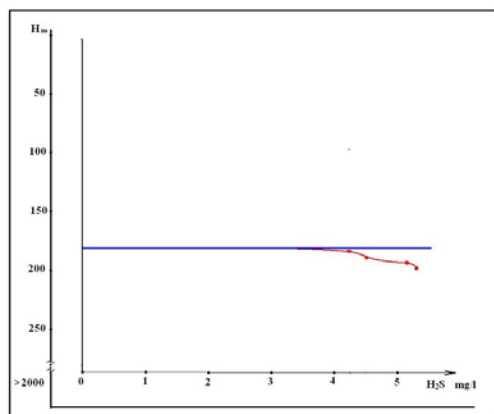


Figure 1: Depth distribution of hydrogen sulfide in the territorial waters of Georgia

It is necessary to note that the reason for the existence of hydrogen sulfide in the sea is not yet fully studied. About the existence of hydrogen sulfide in the sea is basically two versions: Restore the sulfates of sea bacteria in the destruction of dead organic substances and gas emissions from the bottom of the Black Sea. It is true that the authenticity of these versions is not accurate, but we still believe in a second version.

One of the ecological problems of the Black Sea increasing abrasive processes developed by the seashore and sea shore impacts, which contributes to the rise of the ocean (sea) level.

It is recognized that to protect the sea coastline from abrasive processes all kinds of hydraulic activities (construction) are only temporary and the advantage is to solve the problem regulation of the rivers solid sediments, which depends on the balance between the solid sediment accumulation and the volume of washing in the coastline.

The studies have shown that to maintain the stability of the Black Sea beaches within Georgia is required around 6 million m³ is a solid sedimentation capacity [14].

Based on research on the available materials, it is established, that on the territory of Georgia when the rivers were cut off in the Black Sea about 25-30 million m³, the more or less the equilibrium was established between the solid sediment transported by the rivers and the sediments washing of the coastline caused by the sea waves.

It is also worth mentioning, the main volume of solid sediment – 57 % carried out in the Black Sea was from Chorokhi, which nowadays no longer carry solid sediment in the Black Sea.

The solid sediment transported by the Enguri River is also very low. The only river, which continues transportation of solid sediments is Rioni. However, the solid sediment transported by Rioni in the sea is not enough to maintain the stability of the Black Sea coastline of Georgia. Because of this, there is an increase in sea wave impact in the coastline, because is going on seafaring by the sea.

Below you will show a change in solid sediment volumes in time for certain periods, For rivers that play an important role in transporting solid sediment into the sea. Table 1.

Table 1

Name the river	The volume of solid sediment, thousand tones. □		
	Until 1971	1971-1991	present
Enguri	2649,0	866,6	227,1
Rion	7152,4	7720,0	Almost same that 1971-1991
Chorokhi	9839,2	4957,4	1021,8

The rivers in the Black Sea total transported: until 1971 - 22468,6 thousand tone; 1971-1991– 16486,0 thousand tone; nowadays the total amount of solid sediment transported to the sea is only 10727,5 thousand tone makes up for a year [20].

It is estimated that the main reason for the reduction of solid sediment transported by rivers in the Black Sea is the anthropogenic factors (removal of the hydrological regime of rivers, construction of water reservoirs and hydropower plants, removal of solid sediments from the bed and other).

It should be noted here that today is only river Rioni is maintained by solid sediment transport and temporarily, because in the near future, there is planned Construction of several HPPs on Rioni, and after the river settlement, this river will also reduce the solid sediment transported.

Finally we can make such a conclusion: if the Black Sea coastline stabilization was sufficient 25-30 million a year solid sediment and, more or less, the balance of equilibrium was established between the sea washed out and the solid sediment transported by the rivers, then it turns out that today for the sustainability of the Black Sea coastline, it is necessary to fill in a solid sediment 15-16 million tones per year.

4. Conclusions

- Due to importance reduce o solid sediment transported by West Georgia rivers in the Black Sea there is going on to capture Black Sea coastal zone by impact of sea wave, especially adjacent to village Adlia and village Anaklia (Currently construction of the infrastructure and deep water port is under way), which contributes to an increase in ocean level;
- Reduction of solid sediment volumes is mainly caused by anthropogenic factors (Construction of hydroelectric complexes, obtaining solid inert materials from riverbeds and etc.). The human influence at nature especially undergoes river Chorokhi (due to the construction of Muratli and Demiral Dam cascade in Turkey) and river Enguri (due to the construction of the Jvari and Gali reservoir on the territory of Abkhazia, which is not temporarily controlled by the State of Georgia);
- It has been determined the approximate amount of solid sediment deficit (approximately 15-16 million tons per year), which will be enough for the balance between the washing and sealing in the seashore of the Georgian territory (the works continue to verify this value);
- Considering that, The most reliable way to protect the sea coastline from abrasive processes is to regulate the solid sediment volumes in the sea by the rivers, it is necessary to prohibit all kinds of illegal and scientifically unsubstantiated activities in the river basins, which will undoubtedly contribute to the regulation of the hydrological regime of the rivers in the Black Sea, when there will be no loss of solid sediment on the rivers to the sea;
- Because for all countries it is necessary to create energy supplies, no state of Georgia will be an exception. However, in this case, it is necessary to operate hydropower facilities with strict compliance with the recommendations for their exploitation, and to fill solid sediment deficiency to be used practical measures and other bankruptcy complex measures;
- In the Black Sea, water is polluted by some heavy metals, however, due to general ecological status,

seawater quality is satisfactory according to the recommendations of the Council of Economic Relations of the European Union (SVE) and is mainly placed within the I-II class;□

- The depth of hydrogen sulfide in the Black Sea coincides with a well-recognized indicator and its margin in the territorial waters of Georgia is 180 meters deep.

5. Recommendations

- To prohibit the acquisition of solid inert materials from riverbeds, without scientifically grounded recommendations;
- In case of construction of hydro compiles on the rivers, instruct the construction producers or investors, to fill solid sediment deficiency, in advance, specifically commit the cost of solid sediment deficit in projects, to fill it by the artificial way;□
- The protection of coastal banks will be implemented in a complex, including modern coastal protection facilities;
- To maintain high-quality water in the Black Sea, prohibit the discharge of polluting wastewater into the sea;
- Planned monitoring in the sea for testing the quality of water;
- To study the origin of hydrogen sulfide in the Black Sea, drilling works on the seabed, in order to determine if there is a wave of hydrogen sulfide from the bottom of the seabed;□
- Using modern technical means it is possible to conduct deep drilling works on the seabed, which will allow us to establish whether the gas seizure is made from the seafaring seafront and if it turns out, that is so then we can think of industrial recycling of hydrogen sulfide;
- It is known that the Black Sea is linked to the rest of the world ocean with straits with short depths (Bosporus and Dardanelles) which is limited to the exchange of black seawater flows at the Mediterranean, in our opinion; another additional factor is the growth of hydrogen sulfide layer in the Black Sea. In our opinion, if Bosporus Strait was deeper it would have been possible to reduce the area of hydrogen sulfide in the Black Sea, which would have been caused by interconnecting water flows between the Mediterranean and the Black Sea;
- In accordance with all 8 recommendations, we would like to present a more bold and complicated project content, which implies the artificial increase in the depth of Bosporus Strait. This project will be difficult to implement, both technical and political as well because it is necessary to express the free will of the state in which the strait is located.

Reference

- [1]. R. Diakonidze, E. Shengelia, G. Chakhaia, L. Tsulukidze, Z. Varazashvili, T. Supatashvili. "Evaluation of Black Sea Water Quality in Border of Georgia". V International Scientific and Technical Conference "Modern Problem of Water Management, Environmental Protection, Architecture and Construction" Dedicated to the 95 anniversary of Academic Tsotne Mirtskhulava, 16-19 July, Tbilisi, 2015. pp 69-72;□
- [2]. R. Diakonidze, Z. Varazashvili, P. Sichinava, I. Khubulava, G. Omsarashvili "The recommendation of

- ecological safety of the Black Sea coastal zone from marine waves impact". Collected as of Water Management Institute of Georgian Technical University. #67. Tbilisi. 2012. pp. 45-48;□
- [3]. R. Diakonidze, G. Chakhaia, L. Tsulukidze. "Protection of the ecological security of the Black Sea shore from marine abrasive processes through regulation of sedimentary runoff" Scientific-Technical Jurnal "Hydroengineering" of Georgian Technical University. #1, #1-2 (11-12) Tbilisi, 2012, p 12-26.;
 - [4]. G. Gavardashvili, G. Chakhaia, R. Diakonidze and etc. "The investigation of the Black Sea coastal zone". International Scientific and Technical Conference "Modern problems of the environment within the boundaries of Georgia Protection, architecture and construction", Jule 24-31, Qobuleti, Georgia, 2012, pp. 23-24.;□
 - [5]. G. Gavardashvili, G. Chakhaia, R. Diakonidze and etc. "Result and Analysis of Studies Carried out in 2011in the Black Sea Water Area Within the Boundaries of Georgia". Annual BS Scientific Conference and UP-GRADE BS-SCENE Project Joint Conference 1-4 November, Odessa, Ukraine, 2011. pp. 25.;
 - [6]. R. Diakonidze, G. Chakhaia, L. Tsulukidze. , Protection of Black Sea coastal zone ecological safety from abrasion processes by regulation of solid sediment of the rivers" Georgian Technical University. Georgian Engineering Academy. Scientific-technical journal. Tbilisi, 2011, p.12-26;□
 - [7]. Resolution No. 15 dated 27.02.2010 approving the requirements of SanPiN 2.1.5.2582-10 "Sanitary and epidemiological requirements for protection of coastal waters of the seas from pollution in places of water use of the population", the Russian Federation. 2010;
 - [8]. R.V. Diakonidze, G.G. Chakhaya, L.N. Tsulukidze. Empirical dependencies for calculation of sediment (bottom) and total runoff of sediments of catchments of the rivers of Georgia. Ministry of Education and Science of Georgia. Institute of Water Resources. Collection of scientific papers, No. 64, TB, 2009. p. 77-81;
 - [9]. . Diakonidze, G. Chakhaia, L. Tsulukidze; J. Mamasakhlisi. The ecological problems of the Black Sea and Georgian seaside on the background of global warming. Collected paper of the Georgian agrarian university. Vol. I, #2 (43), Tbilisi 2008, p. 80-84.
 - [10]. R.V. Diakonidze, I.V. Khubulava, Kh.L. Kiknadze, F.N. Lortkipanidze et al. Climate change of the planet and hydro-ecological problems of the environment. J. "Ecological Systems and Devices", No. 9, Moscow, 2008. p. 45-47;□
 - [11]. "Hygienic Requirements on Water Composition and Quality of Drinking-Agricultural and Cultural Water Consumptions and Maximum Permissible Concentrations of Substances Substantial Substances (ZDC)". Order # 297 / N of 16 August 2001 of the Minister of Labor, Health and Social Affairs of Georgia "on approval of the norms of the environmental arrangement of the environment". Georgia's authorized print body "Legislative Herald of Georgia" (GPB), # 90, 24.08.2001, p. 51-93 .;
 - [12]. "Protecting Sea Coast Water from Pollution, Sanitary Rules, and Norms in Water Resources". Ministry of Labor, Health and Social Affairs of Georgia, Tbilisi, 2000, from Tsunami to 2.1.5. 000-00 .;□
 - [13]. A.G. Kiknadze, F.G. Meladze, V.V. Sakvarelidze. Protection of the Black Sea coast of Georgia from the sea by sea. Georgian Scientific Research Institute of Technical Information and Technical and Economic Studies of the State Committee for Science and Technology of the Georgian SSR. Series 7. Tb. 1998. 53 seconds;

- [14]. Kiknadze A., Russo G., Khorava S. Sea coast protection problems in Adjara. Engineering Problems of Georgia: Condition and Perspectives Georgian Engineering Academy, Tbilisi, 1998, p. 137-147 .; Colchis lowland, the scientific prerequisites for development. "Science", Moscow, 1990, 248 pp .;
- [15]. Yakovenko PI, Tursunov OA, Yakovenko Yu.P. The first of the wonders of nature. Publishing house "Harvest", Kiev, 1989, 169 pages;□
- [16]. Sanitary rules and norms for protecting surface waters from pollution. Ministry of Health of the USSR. Chief Sanitary and Epidemiological Administration, Official publication, M., 1988, 70 p.;Рекомендации – «Единые критерии качества вод». Совет Экономической Взаимопомощи (СЭВ), Секретариат СЭВ, 1982, 68 с.;
- [17]. Dzhanlidze Ch.P. Paleogeography of Georgia in the Holocene, "Metsniereba", Tbilisi, 1980, 176 p .;
- [18]. Maruashvili L.I. The physical geography of Georgia, Ch. 2, Metsniereba, Tbilisi, 1970, 300 p;