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D.Zh. Kalimanova, A.D. Kalimukasheva, J.A. Kubasheva, A.A. Nazhetova

Atyrau State University named after H. Dosmukhamedov, Atyrau, Kazakhstan
dana80_04@mail.ru, aral1959@mail.ru, Ja2560596@gmail.com, aiko_79_21@mail.ru

FEATURES OF HYDROCHEMICAL AND GEOCHEMICAL INDICATORS OF THE NORTH-EASTERN PART OF THE CASPIAN SEA (ZONES, OIL AND GAS FIELDS OF THE KAZAKHSTAN SECTOR)

Abstract. Changes in hydrometeorological conditions that play a major role in the life of the Caspian Sea are combined with the impact on its ecosystem of economic activity, one of the types of which is pollution of the marine environment. Much attention is paid to environmental safety in the search and exploration of hydrocarbon deposits in the North Caspian, because without it, neither its high biological productivity, nor the fishery value can be maintained. The Caspian Sea, and especially its northern shallow part, is a highly productive body of water. Such extremely high productivity of the Caspian is combined with the relative poverty of the biological diversity of this reservoir. A significant part of the Caspian hydrobionts is relict. This part of the sea is the richest in biological productivity. And it is not by chance that the rich nutrients and the organic substrate of the waters of the Northern Caspian have a great influence on the diversity of the flora and fauna of the entire Caspian. However, at present, the Caspian Sea and especially the Northern Sea, like the other seas of the world, are experiencing increasing anthropogenic impact, which is manifested in pollution with oil products and heavy metals, as well as in active shipping and hydro-construction.

Keywords: heavy metals, concentration, salinity of water, dissolved oxygen, pH, hydro chemical and geochemical indicators.

INTRODUCTION

The Eastern section of the North Caspian Sea adjacent to the Kazakhstan coast was selected as the study area. The study area is characterized by a gentle slope of the bottom and a slow increase in the depths. The soils here are predominantly silty and silty - sandy.

Seasonal fluctuations in the level of the Caspian Sea do not exceed a few dm. For the northeastern coast of the Caspian Sea, high surge levels are characteristic.

MAIN PART

The study site is unique in its geochemical and hydrological and hydrochemical conditions, as well as its hydrobiological characteristics. Comprehensive studies of the main geochemical, hydrological and hydrochemical characteristics were carried out at stations located near the surface and bottom of the sea.

Heavy metals in bottom sediments. The main statistical parameters are shown in table 1.

Associations of chemical elements that form anomalies in areas of oil and gas fields are determined by the primary presence of mobile elements in soils that can move and concentrate on the corresponding barriers. Most often they include Pb, Zn, Mn, Cu, Ba, Co, Ni, Cr.

Table 1 - The main statistical characteristics of the content of heavy metals (mg / kg) in bottom sediments.

parameter	maximum	average	minimum
Cu	9,00	6,80	5,00
Zn	22,00	16,68	10,00
Cd	4,70	2,28	0,80
Fe	8300,00	3468,00	600,00
Mn	421,00	168,48	63,00
Co	19,00	12,84	6,00

Such associations of chemical elements arise from the fact that gaseous products from hydrocarbon deposits periodically enter the soil. These primarily include the hydrocarbons themselves, hydrogen, carbon dioxide, and inert gases. Their bacterial decomposition, accompanied by various chemical reactions, leads to the formation of numerous and diverse geochemical barriers (hydrogen sulfide, acid, alkaline, sorption, and biogenic) in soils above the deposits. Redox reactions occurring on such sites (with the participation of bacteria that decompose hydrocarbons) can increase the mobility of the regenerating elements of variable valence, often leading them to "distillation" from the central parts of the sites. As a result of all these processes, redistribution anomalies are formed in the soils, accompanying areas of oil and gas fields.

The observation of the bottom sediments of the eastern part of the Northern Caspian was carried out in the autumn and spring, and it was found that the concentration of heavy metals in the bottom sediments in the autumn decreases as compared with the summer period.

From monitoring observations, it follows that the average concentration of zinc and cadmium in bottom sediments on the Kashagan structure in 2003-2006 turned out to be lower than in 2000-2002. (Table 2). These changes occurred both on the main test site and on the structure as a whole, but did not affect manganese, the average concentration of which in the surface layer of bottom sediments increased, unlike other heavy metals, and more so on the main test site. It is unlikely that the reason for this is to carry out drilling operations, since when discharging drilling waste the pollution of the marine environment is complex. Most likely, the difference in the rate of manganese accumulation between the landfill and the background area as a whole was due to the specific behavior of this microelement in the bottom sediments, its close connection with redox conditions and the acidity of these sediments, in which by myself.

Table 2 - The average concentration of heavy metals in the bottom sediments on the Kashagan structure in 2000-2006

Indicator	Area observations	years	
		2000-2002	2003-2006
Manganese, mg / kg	polygon	122,5	405,0
	background	113,6	175,4
Zinc, mg / kg	polygon	20,74	12,87
	background	19,28	16,94
Cadmium, mg / kg	polygon	2,07	< 1
	background	2,87	< 1

The main sources of iron and copper in the Caspian Sea are surface and underground runoff. In river water, these elements are usually concentrated in unstable minerals or migrate in the form of solutions. As a result, after entering the sea, iron and copper are actively involved in biogenic migration and the formation of various forms of fine mineral and organic matter, which is deposited mainly in deep-sea halistatic areas.

The concentration of iron in the bottom sediments on the main site was on average slightly higher than on the Kashagan structure as a whole. However, both of these areas turned out to be very similar in the dynamics of iron content in bottom sediments, since here and there in 2003-2006. it decreased relative to 2000-2002. (Table 2). The difference in the level and dynamics of iron content between the studied water area as a whole and the main landfill may be due to different depths. It is known that the iron

content in the bottom sediments of the Caspian Sea increases with depth. At the same time, unlike deep-water areas, where iron is concentrated in the thin-melt fraction, iron is often found in shallow water and, especially, near river mouths in aleuritic and larger fractions of the surface layer of bottom sediments.

According to environmental monitoring in 2000-2002. Copper concentration in bottom sediments at the main test site was on average somewhat higher than on the structure as a whole. However, both of these areas turned out to be very similar in terms of copper content in bottom sediments, since here and there it decreased from 2000–2002. (Table 3.). The difference in the level and dynamics of copper content between the studied water area as a whole and the main range is explained by the greater depth of the latter, because the copper content (as well as iron) in the bottom sediments of the Caspian Sea increases with depth. At the same time, unlike deep-water areas, where copper is concentrated in the fine-grained fraction of bottom sediments, coarse-grained fractions of bottom sediments are not rarely found in the estuaries of river basins, as confirmed by environmental monitoring data.

Table 3 - Comparative characteristics of the concentration of iron and copper in the bottom sediments of the Kashagan structure and the background area

Indicator	Area Of observations	years	
		2000-2002	2003-2006
Iron, mg / kg	Main polygon	3600	3120
	background	3340	2490
Copper, mg / kg	Main polygon	13,61	12,20
	background	14,20	9,36

Salinity of water.

The determination of the salinity of water in the water area of the structure revealed its gradual increase from the north of the water area to the south throughout the entire water mass. The smallest salinity (0.37-2.53) in spring was observed in the western and central parts of the water area, the eastern part of the license area was occupied by salinity up to 5-9.

In the fall in the north of the central part of the structure water area, the minimum salinity of water was 0.54 in the surface layer, 2.96 - in the bottom layer. The maximum value of salinity (11.89 ‰ in the surface layer and 12.00 in the bottom layer) was recorded in the south of the central part of the structure.

Dissolved oxygen. In a large part of the sea area, the surface water layer is saturated with oxygen or is in a state close to saturation. The exceptions are the western part of the Northern Caspian and local areas in the central and south-eastern part of the water area, where water saturation in the surface layer from 76 to 95% (in the western part) and from 90 to 98% (in local areas). In the bottom layer, the degree of saturation of water with oxygen in its value and nature of distribution differed from those in the surface layer. In the western, central and southern regions of the water area, local areas are registered, in which oxygen deficiency is noted in the bottom layer. Practically in most of the Northern Caspian water area, the degree of oxygen saturation in the bottom layer did not exceed 100%, with the exception of local zones in the southern and northern regions.

Hydrogen indicator (pH).

The values of the pH in the license area in the spring and autumn periods are presented in Table. four.

Table 4 - Hydrogen indicator (pH) of surface and bottom waters of the northeastern part of the Caspian Sea

Horizon	Spring	Autumn
Surface	8,17-9,44 8,48	8,06-8,86 8,50
Bottom floor	8,20-9,44 8,47	8,20-8,84 8,49

Over the entire water area of the structure, the pH values on the surface and at the bottom are close in magnitude. The distribution of pH values is homogeneous - a smooth decrease in pH values from northwest, north to south, southeast is observed throughout the water mass. This distribution of pH is typical for the water area under consideration in the spring, characterized by the onset of spring flood

waters of the Volga and Ural rivers, and in the summer-autumn period, characterized by a decrease in the influence of river runoff and an increase in salinity as one moves south.

In the hydrological and hydrochemical terms, the area is distinguished by extremely unstable salt and temperature regimes over the seasons.

During the summer period of studies, the water temperature was marked by elevated values and ranged from 20.95 - 29.03 ° C at the bottom and 26.10 - 29.20 ° C on the surface. In the autumn - winter period, the range of water temperature fluctuations was 6.32 - 12.13 ° C at the bottom and 6.10 - 12.00 ° C at the surface. The temperature values at the surface and at the bottom indicate a uniform heating of water along the vertical (homothermy), which is associated with the shallowness of the studied water area.

The research zone was distinguished by low and constantly fluctuating salinity (in the summer period it was 3.84-10.5% o at the bottom and 3.81-10.3% oat the surface with average values of 7.5 and 6.98% o, respectively; in the winter period - 2.4 - 12.5% o and 2.39 - 12.5% 0, respectively, with average values of 9.85 and 7.49).

One of the most important hydrochemical characteristics is the oxygen content in water. The oxygen regime in the studied water area, due to hydrological, hydrochemical, and geomorphological features of individual regions of the structure, was characterized by significant contrast in time and space.

The summer O2 content was 6.86-8.56 mg O2 / l at the bottom and 6.80 - 8.86 mg at the surface with average values of 7.75 and 8.04 mg O 2 / l, respectively; autumn-winter period. - 9.89 - 12.0 mg 0 2 / l and 10.17 - 12.38 mg O2 / l, respectively, with average values of 10.8 at the bottom and 11.4 mg O2 / l at the surface. The oxygen regime was formed under conditions of increased hydrodynamic activity and low temperature - salinity stratification of water masses. In a large part of the water area, the surface water layer was saturated with oxygen. The exception was local areas where the oxygen saturation of water in the surface layer ranged from 89 to 97%. In the bottom layer, the degree of saturation of water with oxygen in its value and nature of distribution was slightly different from those in the surface layer.

CONCLUSION

Localized areas with relatively low oxygen content, identified by surveying materials, were confined to lower, deep-water parts of the bottom topography. Apparently, they were carried out by the influx of oxygen-depleted sea waters from the Middle Caspian, as evidenced by the materials of a synchronous survey of currents, which revealed in these areas of the water area the total transfer of sea waters to the north.

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Д.Ж.Калиманова, А.Д.Калимукашева, Ж.А.Кубашева, А.А.Нажетова

Х. Досмұхамедов атындағы Атырау мемлекеттік университеті, Атырау қ., Қазақстан

КАСПИЙ ТЕҢІЗІНІҢ СОЛТҮСТІК-ШЫҒЫС БӨЛІГІНІҢ ГИДРОХИМИЯЛЫҚ ЖӘНЕ ГЕОХИМИЯЛЫҚ КӨРСЕТКІШТЕРІНІҢ ЕРЕКШЕЛІКТЕРІ (ҚАЗАҚСТАН СЕКТОРЫНЫҢ ЗОНУ, МҰНАЙ ЖӘНЕ ГАЗ ӨНДІРІСІ)

Аннотация. Каспий теңізінің өмірінде маңызды рөл атқаратын гидрометеорологиялық жағдайлардағы өзгерістер оның экожүйесіне әсер етуімен біріктіріледі, олардың бірі теңіз ортасын ластау болып табылады. Солтүстік Каспийде көмірсутегі шикізатын іздестіру мен барлауда экологиялық қауіпсіздікті сақтауға көп көңіл бөлінеді онсыз биологиялық өнімділігі де, балық аулау құндылығы да сақталмайды. Каспий теңізі, әсіресе оның солтүстік қалың бөлігі - судың жоғары өнімділігі. Каспийдің мұндай жоғары өнімділігі осы резервуардың биологиялық әртүрлілігінің салыстырмалы кедейлігімен біріктірілген. Каспий гидробионттарының маңызды бөлігі реликті болып табылады. Теңіздің бұл бөлігі биологиялық өнімділіктегі ең бай. Және Каспий теңізінің флорасы мен фаунасының алуан түрлілігіне Солтүстік Каспийдің суының бай коректік заттар мен органикалық субстраты әсер етпейді. Алайда қазіргі уақытта Каспий теңізі, әсіресе Солтүстік теңіз, әлемнің басқа да теңіздері сияқты, мұнай өнімдері мен ауыр металдардың ластануымен, сондай-ақ белсенді жүк тасымалдау және гидроқұрылыста көрініс тапқан антропогендік әсерді бастан өткеруде.

Түйін сөздер: ауыр металдар, шоғырлану, судың тұздылығы, еріген оттегі, pH, гидрохимиялық және геохимиялық көрсеткіштер.

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Д.Ж. Калиманова, А.Д. Калимукашева, Ж.А. Кубашева, А.А. Нажетова

Атырауский государственный университет им.Х.Досмухамедова, Атырау, Казахстан

ОСОБЕННОСТИ ГИДРОХИМИЧЕСКИХ И ГЕОХИМИЧЕСКИХ ПОКАЗАТЕЛЕЙ СЕВЕРО-ВОСТОЧНОЙ ЧАСТИ КАСПИЙСКОГО МОРЯ (ЗОНЫ, НЕФТЕГАЗОВЫХ МЕСТОРОЖДЕНИЙ КАЗАХСТАНСКОГО СЕКТОРА)

Аннотация. Изменения гидрометеорологических условий, играющие главную роль в жизни Каспийского моря, сочетаются с воздействием на его экосистему хозяйственной деятельности, одним из видов которого является загрязнение морской среды. Большое внимание уделяется экологической безопасности при поиске и разведке месторождений углеводородного сырья на Северном Каспий, т.к. без этого не удается сохранить ни его высокую биологическую продуктивность, ни рыбохозяйственную ценность. Каспийское море, и особенно его Северная мелководная часть, является высокопродуктивным водоемом. Такая исключительно высокая продуктивность Каспия сочетается с относительной бедностью биологического разнообразия этого водоема. Значительная часть гидробионтов Каспия является реликтовой. Именно эта часть моря является самой богатой по биологической продуктивности. И не случайно, что богатые биогенными элементами и органическим субстратом воды Северного Каспия оказывают большое влияние на разнообразие флоры и фауны всего Каспия. Однако в настоящее время Каспий и особенно Северный, как и другие моря земного шара, испытывает усиливающееся антропогенное воздействие, которое проявляется в загрязнении нефтепродуктами и тяжелыми металлами, а также в активном судоходстве и гидростроительстве.

Ключевые слова: тяжелые металлы, концентрация, соленость воды, растворенный кислород, водородный показатель, гидрохимические и геохимические показатели.

Сведенья об авторах:

Калиманова Данагул Жаскайратовна - к.б.н., ст. преподаватель кафедры «Химия и химическая технология», Атырауский государственный университет им.Х.Досмухамедова, ORCID – 0000-0001-6904-3218;

Калимукашева Арал Демеуовна - доцент кафедры «Химия и химическая технология», Атырауский государственный университет им.Х.Досмухамедова, ORCID – 0000-0002-5172-2383;

Кубашева Жадыра Асылбековна - магистрант кафедры «Химия и химическая технология», Атырауский государственный университет им.Х.Досмухамедова, ORCID – 0000-0003-1589-3684;

Нажетова Айкумис Аскаровна - магистр, преподаватель кафедры «Химия и химическая технология», Атырауский государственный университет им.Х.Досмухамедова, ORCID – 0000-0003-1569-6437

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