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шает их содержания в донных осадках границы Печорская губа – Печорское море. Повышенные содержания нефтяных углеводородов приурочены к алевритово-глинистым осадкам, как и в случае с распределением тяжелых металлов [7].

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ESTUARINE RESPONSE OF THE PECHORA RIVER TO THE EXTERNAL ECOLOGICAL IMPACTS FROM OIL AND MINING ACTIVITIES

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The Pechora Sea and Pechora river are parts of the Barents Sea located in the Russian Arctic. The unique environment of the Pechora Sea ecosystems should be maintained and protected for nature conservation. However, the negative impacts caused by the excessed anthropogenic activities cause serious environmental consequences. Current paper reported geographic characteristics of this geographic area, detailed some of the current environmental challenges and contributed to the monitoring of the vulnerable Russia Arctic region. Among all Arctic seas, the Barents Sea is singled out for its unique environment and its high biodiversity. At the same time, parts of the Gulf Stream current transfers its waters directly into this area bringing along different contaminants from Northern Sea. Actually in Timan-Pechora carbon basin situated in the Barents Sea area 76 gas- and oil-fields are discovered, which is a quarter of all Russian deposits. Ca. 30 of these deposits are prepared for drilling, some of them are under construction. Until 2020, the exploitation of oil and gas deposits is planned to reach 30 mil tons of oil and 130 billions of m3 of gas annually. In this case, the ecological burden on the marine environment and aquasystem of the Barents Sea will be extremely high. Due to different contaminants, the actual status of the biota and unique marine environment can be in danger if the human impact will be continued. Amid all the contaminants, the UNEP (United Nations Environmental Project) Commission has marked out 12 types as having especially negative and dangerous influence on the nature: polychlorinated biphenyls (PCB's), pesticides (DDT), Hexachlorbenzol (HCB's), insecticides (Heptachlor), Chlordan, etc. From all those, using existing data, the following contaminants as especially representative were chosen: pesticides und chlororganic materials – PCB's, HCH-group, some heavy metals (copper, zinc, lead, cadmium, chromium, nickel, vanadium, arsenic, cobalt), oil and gas and radioactive (137Cs) contamination for thematic mapping of the Barents Sea. The problems of nature's protection to resist towards human activities and negative effects on the marine environment under the conditions of arctic climate were outlined in this paper. Geoecological mapping was realized in several steps including the analysis of its natural geographic parameters and characteristics, secondly, the level of contamination with different water pollutants, incl. their nature and character, the quantity, the ways of transport and the sources. Finally, based on both the negative anthropogenic impacts on the Barents Sea environment and the natural capabilities of marine ecosystems to resist the ecological pressure (determined by their unique geographical characteristics), the geoecological situation of this unique hydrodynamic system was analyzed.

The Pechora river plays exceptionally important role in the functionality and sustainability of the environment of the Pechora Sea. Being the only one great river, inflowing into this relatively small-sized sea, it sweetens its waters waters, maintains the ecosystem structure of this sea, playing important role in this complex interconnected ecosystem 'river-sea'. The Pechora river is the only one located in the European part of Russia beyond the Ural mountains which can be compared in its dimensions with big European rivers, e.g. Rhine of Germany. Pechora river is notable for its unique environment. Almost all European salmon fish (12 various species) and other rare species of the marine fauna still occur in this river. The Pechora river is important breeding area and a stopover site for the migratory birds, wintering in Europe and Africa: 50% of the flyway population of swans, great populations of wild geese and ducks breed in delta of Pechora river. At the same time, the environment of the Pechora river is damaged by the negative impacts of the oil mining and industrial contaminants. Annually, it carries out to the sea (exactly, to its estuary) ca. 5400 tons of hydrocarbons, 2720 tons of detergents, 70 tons of phenols and other chemical detergents. Besides the transit of the contaminants and water-sweetening effect, drain of Pechora river cause the system of the drain currents in the Pechora inlet. These submarine currents determine distribution of the contaminants and water pollutants within the Pechora Sea basin. On the contrary, the inverse influence of the Pechora Sea back to the Pechora river is less significant. It consists of the inflow into the river ebb and inflow of the shelf and bottom waters [1].

The sea border of the estuary of the Pechora Sea is a virtual line passing through the peninsula Russkiy Zavorot, the chain of the islands Gulyaevskie Koshki, and the island Pesyakov. The square of the estuary seashore with the coastal waters occupies vast shallow bay – the Pechora Gulf. The region of the estuary of the Pechora river is being gradually developed as object of the intensive economical activity, caused by discovering and developing of hydrocarbon deposits. These ones are located directly in the estuary of the Pechora river and in the some adjacent areas of the Bolshezemelskaya and the Malozemelskaya tundra.

Being a part of the Barents Sea, the Pechora Sea has nevertheless some unique physic-geographic features which should be mentioned. Thus, glacial conditions make the environment of this small sea distinct from the neighboring seas – Barents and Kara. Respectively, its ecology is also much more vulnerable and has lower resilience level towards negative anthropogenic impacts. Thus, while the Barents Sea is ice-covered most of the time, which is formed in the clear waters of high-Arctic, ice of the Pechora Sea has generally local origin, formed by the local waters, which can already be polluted by the oil spills and other chemical particles. Only sometimes thick first-year ice is imported from the Kara Sea. It is the ice exceeding the maximum local ice thickness of the Pechora Sea by 0.3–0.4 m [2]. The icebergs, formed in the high Arctic are not detected in the Pechora Sea, whereas they are occasionally observed in the Kara Sea and can regularly be found in the Barents Sea where they drift either from the Franz Josef Land archipelago or from the glaciers on the east coast of Svalbard [3]. The ice conditions within the Pechora Sea vary significantly from its eastern part to the west. Whilst at western part of the sea the ice period continues from mid-November until May, in its east-southern part it lasts much more longer: from October to June, and in some years until July [4], [5]. For example, the average ice-free period in the Prirazlomnoye oil-field situated in the East is ca. 110 days/year, whereas 9 months in a year it is ice-covered [6].

Generally, the period of the ice-free navigation time lasts 90 days in the Pechora Sea, which is more than in the Kara Sea with its very severe climatic conditions (Table 1). This explains the fact that low-temperature climatic conditions predominate in this region, as compared with the Barents Sea. Frozen processes and grounds have direct impact on the self-purifying processes which are slower in the eastern ecosystem of the Pechora Sea. Consequently, the contaminations may remain here for a longer period, thus making the marine environment of the eastern Pechora more vulnerable and respectively, its resilience towards anthropogenic impacts lower.

Table 1

Comparison of freeze-up and ice clearing in several Arctic seas, [5]

Sea	Beginning of freeze-up		Clearing		Ice-free, days
	Severe	Mild	Severe	Mild	
Pechora	End Oct.	End Nov.	Mid July	Mid May	115–190
Kara	Early Oct.	Mid Nov.	Early Aug.	Mid June	0–130
Northern Barents	End Oct.	Mid Dec	End Aug.	Mid June	60–180
Central Barents	Mid Nov.	End Jan.	End June	End April	135–255

Exploitation of the oil under the conditions of the north nature can bring extra danger for the local ecology. It is explained by the phenomena that the processes of biological, biochemical and microbiological oxidation are very slow due to the low temperatures of air and water under the conditions of polar climate. Necessarily, it leads to more significant contamination of the water, as the resilience is much lower than at those by lower latitudes. Thus, having similar ecological pressure, the ecosystems of tropical and equatorial latitudes can resist negative industrial impacts more strongly as well as clean and refine waters [7]. As a result, the scenario of oil and phenol contamination of the Pechora Sea waters in the areas of drilling platforms can be similar to the Kolguev Island situation. The increase of the oil split square is detected there at decennial observations. Gradually, the oil split covered most of the south-eastern part of Barents Sea [8].

The distribution of oil and gas deposits in bottom sediments of Pechora Sea and the contents of the chlorophyll in the shallow waters were studied in order to analyze current environmental situation in the study area. The ArcView software was used for the visualization and analyses. After digitizing the relief of the Pechora basin by means of Autotrace software, the shp-file was added to the map as a ground basis for the thematic layers. After that, using maps, created by other authors and additional thematic information from the cited literature containing geological and geomorphological characteristics, features of the coastal relief, morphological structure of the Pechora submarine sea floor relief etc., the thematic maps were designed within the framework of this research. The number of concentrations of contaminants as well as spatial characteristics of the objects were added to the project as thematic layers and attribute data containing various characteristics of objects.

To study oil and gas deposits within the Pechora basin its geographical natural specifics were analyzed. It includes their geological, geomorphological conditions and tectonics, impacting the environmental situation as such and distribution of its carbon deposits within the marine basin. For understanding the sustainability of the aquatic systems to resist the anthropogenic impacts its climatic and meteorological conditions (directions of currents) were studied as well. Using information and data from the existing thematic maps and tables both ecological and geographical data of Pechora Sea were compared together. First, its geographic aspects were studied: geological, geomorphological and climatic factors as the most important ones. Secondly, the distribution of the main oil and gas fields within the Pechora basin that make considerable negative impact to the marine environment of unique Pechora ecosystem were analyzed. The thematic information layers were stored in the different topological layers and mapping operations were performed for mapping: data editing, overlapping of thematic layers, making synthesis of different kinds of information, creating legends, layouts visualization. The maps illustrate distribution of the main oil and gas deposits in the Pechora Sea and the content of the contaminants in the shallow waters of the Pechora Sea. The maps show factors in the Pechora Sea basin that have negative impact and effects of oil and gas drilling activities under the conditions of Arctic ecosystems.

The ecological variability of the marine ecosystem in the Barents Sea is influenced in time and space by physical geographic factors (its natural characteristic features, oceanographic data, marine geology, coasts and climatic conditions), biological interactions and technological contaminants of anthropogenic origin. Thus, for the analysis of the modern status of the Barents Sea environment, its oceanographic conditions and external contaminants (their origin, quantity and ways of transportation) have been examined. The common geographic conditions of this region as a whole, the distribution and particularities of the ecosystem's components and substance transport between the different elements of the environment were investigated. Also their importance for the conditions of marine ecosystems were emphasized: the impacts upon the geoecological situation of the environment. At the same time, not only the details of the contamination and its distribution within the Pechora basin were investigated, but also the 'whys' and 'wherefores' of the entrance of contaminants into the Pechora Sea. First of all, sources and origin, potential ways of transportation within the basin (by Pechora river), types (heavy metals, pesticides, hydrocarbons, radioactive nuclides, etc.) and finally, accumulation according to the absorbing capability of the different types of the bottom sediments. Based upon the analysis of all these facts and processes caused the environmental damage, the final geoecological situation of the Barents region was designed. Studying environmental conditions of the Pechora Sea for ecological monitoring was realized in GIS.

Current paper was focused on the environmental studies of the Pechora Sea and river. It contributed to the ecological research of the Arctic region which is strongly impacted by the oil and gas drilling activities as well as other anthropogenic factors.

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ЭКОЛОГИЧЕСКИЕ КРИТЕРИИ ОЦЕНКИ КАЧЕСТВА АТМОСФЕРНОГО ВОЗДУХА КРИОЛИТОЗОНЫ ЗАПАДНОЙ СИБИРИ

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Криолитозона Западной Сибири является основным нефтегазодобывающим районом России и мира в целом. Только на территории Ямало-Ненецкого автономного округа (ЯНАО) открыто более двухсот месторождений углеводородов, которые содержат 72,5% текущих разведанных запасов газа России, а в объеме мировых текущих разведанных запасов газа – 22,2%. По разведанным запасам жидких углеводородов округ занимает второе место после Ханты-Мансийского автономного округа, и их доля составляет 2,5% в объеме мировых запасов и 19,2% российских. Четверть доказанных мировых запасов газа сосредоточены в недрах автономного округа, где ежегодно производится 23,7% мировой и 90% общероссийской добычи голубого топлива [1].

Ямал, с населением в 502 тысячи человек и территорией в 750 тысяч квадратных километров, а это 4,5% территории России, сегодня обеспечивает более 54% общего объема производства первичных энергетических ресурсов страны. В то же время объекты нефтегазодобычи оказывают