perimeter and calculation of the incremental oil rate. In connection with the goal of the research, the following tasks are set in the work:

1) to analyze horizontal well stock with the multi-stage hydraulic fracturing;
2) to study the existing methods of repeated multi-stage fracturing;
3) to carry out analytical calculations for the selection of candidate wells;
4) to review the results of a repeated "blind" hydraulic fracturing.

The subject of the study is horizontal wells with the uncemented liner, where the multi-stage fracturing was previously performed. To solve the problems the following methods are used: study of literature sources, actual data analysis, hydraulic fracturing process modeling. Keywords of study: horizontal wells, multi-stage hydraulic fracturing, uncemented liner.

The calculation of potential production rate of horizontal wells with hydraulic fracturing was conducted by the method of Li [1]. In July 2017, as part of the search for solutions, a «blind» hydraulic fracturing was conducted on one of the horizontal wells. As per planned 3 stages 70 tons of proppant each there was a premature stop pumps during the first stage of the main hydraulic fracturing. The incremental oil rate of 4 tons/day was obtained after bottomhole cleaning, lowering the electric submersible pump and starting the well. This result allows us to conclude that the correct selection of candidate wells and the technological success of the repeated multi-stage hydraulic fracturing will allow obtaining a larger oil increase.

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FORMATION OF THE GROUNDWATER CHEMICAL COMPOSITION UNDER AEROTECHNOGENIC IMPACT (THE KOLA PENINSULA)

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The impact of anthropogenic factors leads to a change of all landscape elements, including deterioration of natural water quality. The enterprises of the Kola Mining and Metallurgical Company have polluted the atmosphere with sulfur compounds, copper, nickel for many years. At the same time, soil, as a landscape element, is a biogeochemical barrier for chemical elements input to ecosystems from the polluted atmosphere. Soil degradation leads to decrease in their sorption capacity and, consequently, to groundwater contamination with heavy metals.

Taking into account the peculiarities of the water chemical composition, geological structure and the degree of anthropogenic impacts, two principally different areas were identified [3]. The first area is the Khibiny massif area (the eastern part of the lake Imandra catchment) and the second one is area exposed to anthropogenic impact of «Severonikel» plant (the western part of the lake Imandra catchment) – Figure 1.

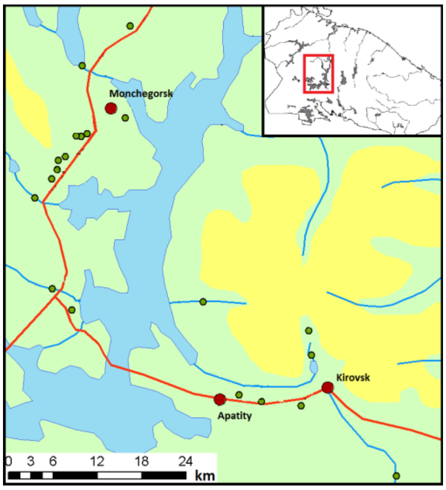

Fig. 1 Map of the studied area and sampling points

In the groundwater in the eastern part of the Imandra lake basin catchment, the concentrations of a number of chemical elements, especially nickel and rare earth elements, are lower than in the western part, which may be due to both metallogenic features of the territory and the lack of man-caused impact of the plant [3]. Formation of the groundwater chemical composition is a very complex process. It is determined by a combination of factors that create a certain geochemical situation. The most important process in the formation of the groundwater chemical composition is the interaction of water with water-bearing rocks.

Based on the obtained data on the groundwater chemical composition [3], the state of thermodynamic equilibrium of groundwater with minerals of rocks [1], a conceptual model for the formation of the groundwater chemical composition was constructed (Fig. 2).

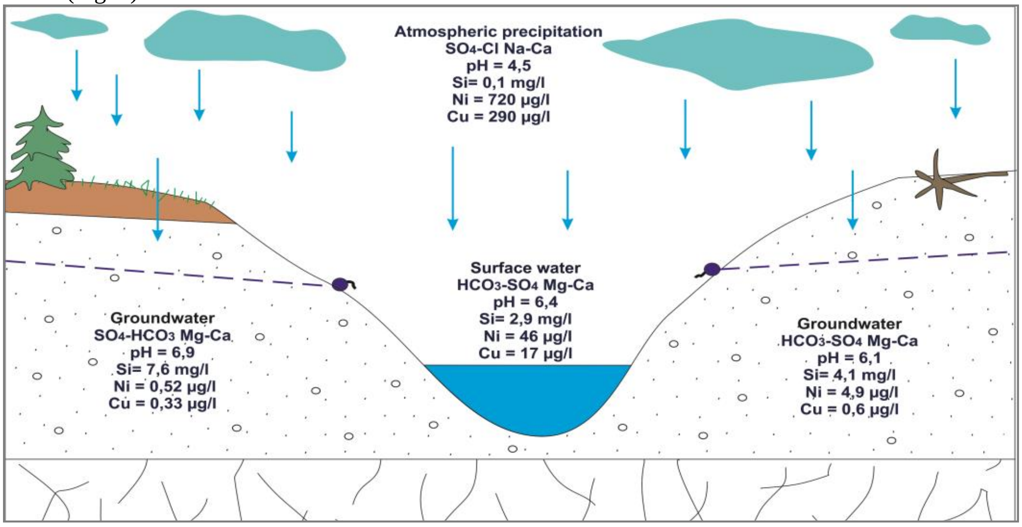

Fig. 2 Model of the formation of groundwater chemical composition

This area is characterized by a high rate of water exchange; the average long-term underground runoff is 3-5 liters per second km2. Precipitation is significant and for most of the territory is 550-600 m, reaching 1000 mm or more in the mountains [2]. The water of the region has a short contact with the rock. Therefore, ultra-fresh groundwater is formed here, which is at the initial stages of interaction in the water-rock system.

Atmospheric precipitation, falling on the study area, is ultra-fresh water. The pH varies from 4.2 to 5.9. The ionic composition is dominated by the sulfate ion, so the water of atmospheric precipitation is a chloride-sulfate sodium chemical type.

It should be noted that the chemical composition of atmospheric precipitation is considered within two different zones: background landscape and in the zone of maximum degradation of vegetation (anthropogenic wasteland) - Table 1.

Table 1

Chemical composition of atmospheric precipitation, mg/l

Elements	Concentration					
	Background landscape (N=12)			A disturbed landscape (anthropogenic wasteland) (N=8)		
	min.	ave.	max.	min.	ave.	max.
pH	4.3	5.0	5.9	4.3	4.5	4.7
SO42-	0.8	2.08	2.7	4.2	5.85	7.7
Cl-	0.52	1.16	1.8	0.7	1.26	2.3
HCO3-	0.01	0.01	0.01	0.01	0.01	0.01
NH4-	0.12	0.69	1.35	0.01	0.52	2.5
NO3-	0.14	0.42	0.82	0.006	0.29	0.78
Ca2+	0.001	0.36	0.88	0.08	0.45	0.88
Mg2+	0.001	0.1	0.34	0.05	0.12	0.22
Na+	0.19	0.59	1.54	0.15	0.32	0.45
K+	0.06	0.29	0.94	0.04	0.12	0.33
TDS	1.7	5.3	9.6	5.0	9.0	14.0
Al	0.001	0.02	0.11	0	0.08	0.31
Si	0.02	0.11	0.22	0.02	0.1	0.23
Corg	1.04	2.83	5.8	0.36	1.06	3.05
Cu	0.0001	0.004	0.007	0.31	0.72	1.604
Ni	0.0001	0.003	0.006	0.132	0.29	0.713
Co	0.0001	0.0003	0.002	0.01	0.03	0.08
Mn	0.0001	0.0146	0.018	0.002	0.02	0.029
Fe	0.012	0.037	0.074	0.018	0.05	0.17
Zn	0.0001	0.019	0.028	0.009	0.05	0.081

In the area of anthropogenic wasteland, the precipitation is characterized by a higher TDS, from 5.0 to 14.0 mg/l. The concentration of sulfate ion increases to 7.7 mg/l and the pH value drops to 4.7.

The rain water of the background landscape is also ultra-fresh, acidic, chloride-sulfate sodium. However, TDS decreases here, its value varies from 1.7 to 9.6 mg/l, and the pH rises from 4.3 to 5.9.

The feature of microcomponent water composition is high content of copper, nickel, cobalt, manganese.

In the area of the anthropogenic wasteland, especially high concentrations of nickel and copper in atmospheric precipitation are observed - 0.29 and 0.72 mg/l.

Atmospheric precipitation penetrates the geological system. Here they interact with the water-bearing rocks. Water dissolves primary aluminosilicates with which they are nonequilibrium, enriched by chemical elements, and become saturated with secondary minerals such as kaolinite, illite, muscovite, Ca-, and Mg-montmorillonite. At the same time, the total mineralization, pH, temperature, water composition change. The source of CO2 in the waters, perhaps, is the processes of mineralization of organic matter.

It should be noted that soil plays an important role in the formation of water composition. It is assumed that the soil is a buffer in the path of penetration of aerotechnogenic copper and nickel into groundwater. The content of Cu and Ni in surface water in the zone of influence of dust-gas emissions of the copper-nickel plant is significantly higher than in the groundwater. This indicates that in area with undisturbed soil cover groundwater is protected from pollution through anthropogenically polluted atmosphere.

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LITHOLOGY AND CONDITIONS FOR FORMATION OF THE LOWER-MEDIUM-JURASSIC DEPOSITS OF THE SOUTH-EASTERN PART OF THE WESTERN-SIBERIAN PLATE IN CONNECTION WITH THEIR OIL AND GAS EFFICIENCY

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Western Siberia is the largest oil and gas basin in the world, and, therefore, the most important territory for the production of hydrocarbons on an industrial scale. The main hydrocarbon reserves are concentrated in the PreJurassic, Lower-Middle Jurassic, Vasyugansky, Bazhenovo-Abalaksky, Neocomian (including Achimovsky), Apt-Alb-Senomsky and Cenonsky oil and gas complexes [1].

In the south-east of Western Siberia (Tomsk Oblast), hard-to-recover reserves of the Lower Middle Jurassic productive deposits are of great interest to date due to the growth in the resource base and increase in oil production.

The relevance of the study in the Lower-Middle Jurassic deposits of the southeastern part of the Western Siberian Plate in the Tomsk Oblast is of no doubt due to the increased oil and gas content and poor knowledge in this sphere. As drilling increases, there is a growing awareness of great complexity of productive reservoir structure. To date, the information on formation conditions of local deposits and data on lithology need to be updated based on the modern concepts.

We have developed a comprehensive method for studying the Lower-Middle Jurassic oil and gas bearing deposits in the south of Western Siberia including the study of core samples to determine the genesis of the described deposits with paleogeographic reconstructions at the time of productive strata accumulation in the Lower and Middle Jurassic periods in the study area as well as modeling sedimentological environments and construction of 3D models.

The issues of the geological structure and conditions for the formation of the Lower Middle Jurassic deposits in the territory of the Western Siberian oil and gas province are considered in the works by many Soviet and Russian geologists: G.F. Stepanenko and L.S. Chernova (1998), M.Yu. Zubakova (1999, 2001), G.F. Ilyina (2002), N.M. Nedolivko (2003), T.G. Ten (2003), E.E. Dannenberg (2006), O.S. Chernova (2010, 2014), etc. At the present, it is possible to address the study in the features of complex reservoirs structure with low permeability of the Lower Middle Jurassic deposits by means of a complex research method.

The Western Siberian oil and gas province is located within the largest Western Siberian lowland in the world, in the West it borders on the Hercynian deposits of the Urals, in the East the province is confined by tectonic structures of the Yenisei Ridge and the Central Siberian ancient Paleozoic platform. Tomsk Oblast is the third largest oil industry center in Western Siberia.

The Lower-Middle Jurassic deposits in the study area are represented by the Gettang-Early-Toarsky oil and gas bearing complex consisting of alternating coastal-marine and lacustrine-alluvial sandy-clayey and shallow-marine sediments, Late-toar-Aalensky and Bayos-Batsky oil and gas promising complexes consisting of stratigraphically shielded sand beds with industrial hydrocarbon reserves.