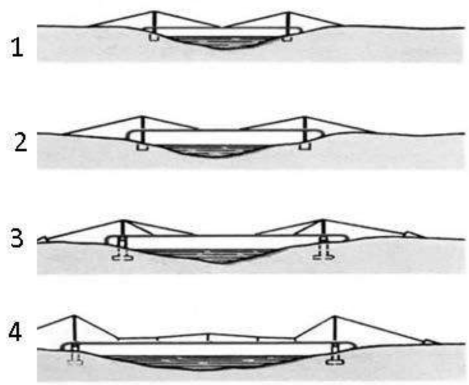

Fig. 3. Scheme of the cable-stayed suspended pipeline: 1, 2, 3 - with inclined cables; 4 - with cable girder.

2. Underwater crossing

Underwater line design is based on long-term geological, geographical, geological and topographical surveys, taking into account the production conditions in the previously built crossing areas; hydro-technical utilities, affecting the water course at the intersections and advanced dredging as well as requirements for fish resource protection. Pipelines across rivers and canals should be installed downstream from the bridges, industrial facilities, piers, river stations, as well as spawning sites and areas of mass fish habitat. The minimum distance from the underwater lines axis to above-mentioned facilities and from the underwater gas pipeline axis, is the same as for underground pipeline [3].

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GROUNDWATER CHEMICAL COMPOSITION OF APTIAN-CENOMANIAN AQUIFER SYSTEM DUE TO SCALE DEPOSITS IN KAYMISOVSKY AREA (WESTERN SIBERIA)

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Scaling emerging on oil facilities during field development and production– is a multifaceted and complex process, especially in cases of well watering. Salification leads to decreasing well productivity, downhole pumping equipment, damage resulting in non-scheduled workovers, which, in its turn, furthers low technical and economic indicators in oil production enterprises. The study of the chemical composition dynamics of produced waters is needed to predict scaling in oilfield equipment. Improving production efficiency is directly interrelated with identifying inorganic salt deposits in production wells. Due to the fact that today numerous oil fields in Russia are under intensive flooding, the study of scaling is important [2]. In view of such a practical importance, scaling in Western Siberia has been studied by many researchers. Most works on this subject were published in the first decades of 2000. Tyumen Oil and Gas University research team headed Semenova T. V. made an attempt to trace the change of ion-salt composition of formation waters at the stage of oil field development. Another group of scientists Galeev R. G., Diyashev R.N., Sattarova M. F., Potapov S. S. from different research institutes conducted a study of the mineral composition to identify the causes of scale on equipment. The staff of the Institute of Oil and Gas Problems RAS: Abukova L. A., Ivanova A. E., Isaeva G. W. studied this problem in perspective development of oil fields. They developed automated selection method of investigate mineral scaling in reservoir and downhole conditions. Forecasting intrastratal deposits of sulfate salts during oil extraction was conducted by Arkhangelsk State Technical University staff under the supervision of A. I. Babikova. Also close to the scaling problem faced A team of researchers of Russian State University of Oil and Gas n.a. I. M. Gubkin: Ivanovo V. N., Sabirov A. A., Gerasimov, I. N., Klimenko K. I. and others also tackled the problem of scaling by developing hardware-software complexes to protect downhole equipment.

Waterflooding of the productive zones- is the main method in oil field development. Geochemical rock formation interaction with injected water leads to emerging produced water saturated with inorganic salts [1]. The most common components of scale deposits is calcium carbonate, calcium sulfate and barium sulfate, usually a mixture of several components with minor terrigenous particles or corrosion products. The scale formation involves several stages beginning with saturated solution as unstable clusters. The atomic clusters convert into fine crystal nuclei, forming initial crystallization zone. These crystals gradually grow as a result of the adsorption of ions within damaged areas. Increasing in size, they merge into more massive units. In time significantly large crystal aggregates form being unsuspended in the solution, which, in its turn, furthers sediment setting[3,5].

Research object is oilfield water in Kamyshovskoe arch, Western Siberia (Fig.), including Aptian-Albian-Cenomanian aquifer system. To predict scaling in the above-mentioned objects, it is necessary to identify the hydrogeochemical characteristics of this complex. Previous reports of Cenomanian waters were published in the works of I M Kuchina and M S Gurevich. In 1960 the monograph "Water and Gases of the Paleozoic and Mesozoic Deposits in Western Siberia" (N V Dubrova, N M Kruglyakov, M. A Pomernacki and V B Torgovanov of Russian Petroleun Research GeoExploration Institute) was published embracing detailed material on groundwater and gas deposits in West-Siberian artesian basin. A more detailed description of the Aptian-Cenomanian complex in West Siberian artesian basin, its hydrodynamic environment and chemical water composition could be found in the thesis of A D Nazarov and research investigations of RRIofHGEG and SNIIGGiMS employees (A A Childless, V G Ivanov, etc.). In 1979-1980 the Department of Hydrogeology and Engineering Geology, Tomsk Polytechnic Institute conducted research on the geochemical composition of groundwater in West Siberian basin, which, in its turn, is associated with such problems as chemical composition origin, oil & gas producibility, economic usage, environmental protection, hydrogeology of oil fields and estimated reserves of groundwaters of Aptian-Cenomanian sediments due to the flooding of productive strata. In 1981-1984 a more detailed investigation of probable reserves of technical waters in Aptian-Cenomanian complex structures of 1, 2 and 3 orders. Based on the research data the characteristics of areal variability of reservoir properties and hydrogeological conditions of the Aptian-Cenomanian sediments were analyzed. It was found that the chemical composition of commercial-industrial water within oil-producing regions is not sustainable. Differences in mineralization, tcontent of calcium, sulfates, water-dissolved gases were determined [4].

In general, Aptian-Albian-Cenomanian aquifer is characterized by horizontal hydrogeochemical zonality typical for this region, i.e. salinity, increase, content of macro – and microcomponents north-westward. Salinity varies from 10.25 (Vakhskoe field) to 21 g/l (Olenoe field), but in most areas of the study area it is 16-20 g/l (table). Concentration percentage for ocean water ranges from 0.32 (Vakhskaya deposits) to 0.58 (Igolskoe-Talovoe deposits). Predominant water type is sodium chloride, as well as chloride sodium-calcium (Vakhskoe, Strezhevskoe, Malorechenskoe, Ozernoe). Chlorine-ion content varies from 92 to 99 %-equiv., sodium-ion – from 77 to 90%-equiv., calcium ion from 4 to 15 %-equiv. Sodium-chlorine ratio varies from 0.68 (Luginetskoe deposit) to 0.97 (Central-Vakhskoe) with an average value of 0.88. Chlorine-bromine ratio varies 170-849 with an average of 253. Water complex is mainly characterized by weak acid reaction (pH ranges from 6.3 to 6.6), very low content or absence of sulphate-ion. Vakhsky deposits are characterized by abnormal content (up to 153 mg/l). According to the literature data, redox potential of Aptian-Albian-Cenomanian sediments within oil fields (Vakhsky, Sovietsky, Strezhevskoy) is +50 +120 mV. Content of total organic acids is 1.93 mg/l. Iron distribution is variegated- minimum (0.3-0.5 mg/l) and maximum (206,3 mg/l). There is also a wide range of microcomponents. in the waters of the Aptian-Cenomanian complex. Bromine is changed from 16.6 (Olenye field) to 84-108 mg/l (Malorechensky and Poludeny fields), with an average value of 46.4 mg/l. Iodine content varies from 1.3 (Central Vakhsky m-e) to 12.6 mg/l (day m-f) with an average content of 10.9 mg/l. Good iodine bond is observed with salinity, chlorine, bromine and ammonium.

Strontium content in waters of the complex ranges from 18 (Central-Vakhsky field) to 130 mg/l (Pervomaysksya and Northern deposits), with an average of 70 mg/l. There is a positive bond of strontium with salinity, chloride ion and calcium. According to its geochemical properties strontium is close to calcium. In addition, boron was detected in the waters, the content of which varies from 1.0 (Vakhsky field) to 18.5 mg/l (day field). Content of silicon in waters varies slightly up to 15.7 mg/l (Vakhsky field) with an average value of 6.0 mg/l. Overall, the content of microelements changes in the waters of the Aptian-Albian-Cenomanian complex corresponds to their mineralization changes. Gas saturation of water is insignificant, gas factor value is not more than 0.5m³/m³ Meton is typical of water-dissolved gas. Based on the hydrogeochemical characteristics of this complex it could be supposed that carbonate calcium would be the most significant component in deposit sediments.

Table

Chemical composition of subsurface Aptian-Cenomanian aquifer system

Oil and gas area	Field	Ph	M, mg/l	HCO_3^-	SO_4^{2-}	Cl^-	Ca^{2+}	Mg^{2+}	Na^+
Kaymisovsky	Krapivinsky	6,3	11708	189,1	5,76	7021	689,38	48,64	3743,6
	Ozerny	6,3	15200	146	16,87	9255	1302,6	119,1	4344
	Pervomaysky	6,6	16812	115,9	8,5	10246	1282,6	82,6	5058,2
	Dvurechensky	6,4	21951	183	13,6	13338	2117,8	7,8	6281,1
	Olenya	6,6	12510	128,1	22,63	7623,9	841,7	165,4	3724,3
	Katylgsky	6,6	22388	164,7	21,8	13559,6	1613,3	85,1	6856,3
	Igolsko-Talovoe	6,6	18949	207,46	11,4	11416	1074,1	92,36	6073,6

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STUDY OF GEOLOGICAL AND GEOTECHNOLOGICAL CONDITIONS OF URANIUM DEPOSITS IN UZBEKISTAN DURING EXPLORATION WORK

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The research states the principle of classification of natural factors and deposit zoning by operation conditions as it applies to the underground leaching method. Peculiar features of polyelement sheet-infiltration deposits of Uzbekistan, which effect their mining by underground leaching are also described.

The Basic proven, estimated and expected reserves of the uranium are concentrated at Kyzyl-Kum Province of the Republic of Uzbekistan. From 1940s there were intensified research works on the natural recourses at the territory of the Uzbekistan: have been carried out complex geologic surveying at Kyzyl-Kum and special exploration works on uranium, as well as aeroradiometric and surface geological-radiometric searches.

As a result of such exploration works there has been found out more than 70 uranium ore occurrences, this discovery was the beginning of the development of Kyzyl-Kum region from the Uchkuduk deposits at 1952 years. Just from the base of this deposit at 1958 there has been started the construction of the Navoi Mining and Metallurgical Combinate (NMMC) and then in 1962 for the first time in mining industry by specialists of the NMMC was discovered the innovative technology of the uranium extraction by the underground leaching method.

Geotechnologic conditions are understood to be the complex of natural factors which substantially effect the possibility to use underground leaching, its process and results. Geotechnologic conditions are studied in order to obtain quantitative prediction of the main operation indices for the deposit on the whole and its individual parts. The indices are:

1. Average concentration of metals in the solution;
2. Efficiency of metal extraction;
3. Amount of leaching solution, and
4. Process duration.

The indices are evaluated on the basis of the study of natural factors and empiric data which characterize experimental work on useful component leaching and its results. These empiric characteristics are called geotechnological parameters and allow to obtain functional dependence between natural factors and operation indices and to make prediction for deposit operation using underground leaching(UL).

Methodology of the study of geotechnological conditions of polyelement deposits has a number of peculiar features:

- all ore components should be known already at early stages of exploration works (exploration-evaluation);
- the study of the entire section of ore-bearing horizon (lithological-facial and mineralogical-geochemical mapping of sediments with determination of lithological types, geochemical and hydrogeologic setting, peculiarities of geochemical limits, determination of mineral forms of useful components);
- the use of thermodynamic data in order to determine geotechnological setting suitable for UL;
- grouping of natural factors and determination of ore grade (by lithology, permeability, degree of carbonatization, sulphide content and other parameters which help to select the UL method) and geotechnologic types of ore-bearing section;
- deposit zoning according to operation conditions.

Complex geotechnological assessment of deposits is carried out with the help of drilling, the study of core sample, testing of rocks, underground water and technological solutions, mineralogical-geochemical and geochemical research, filtration and geophysical tests, special geotechnological studies which allow to understand conditions of leaching of all useful components and provide environment protection measures.

The deposits suitable for UL are concentrated within the large Central- Kyzyl-Kum province in Uzbekistan. They are: Kendik-Tube, Meylisay, Shimoliy, Janubiy Bukinoy, Aulbek, Kuhnur, Istiklol, Severni Kanimekh, Beshkok, Loyliken, Ketmonchi, Yogdu, Sabirsoy, Jarkuduck, Aktau, Terekuduk partially Sugrali and Uchkuduk.

Natural conditions of deposits of the Central- Kyzyl-Kum province affecting the UL method according to the numerous data obtained by the specialists of NMMC who have been explored uranium deposits in Uzbekistan for more than 50 years are as follows: