History of the study of oil resources of the Mesozoic sediments in North Ossetia-Alania and adjacent territories

Zh G Kusova

North Caucasus Mining and Metallurgical Institute (State Technological University), 44 Nikolaev st., Vladikavkaz, 362021, North Ossetia-Alania, Russia

E-mail: quartz7@mail.ru

Abstract. The article analyzes the studies on petroleum resources of the Mesozoic sediments carried out in the XIX-XX and the beginning of the XXI centuries in the Republic of North Ossetia-Alania and the neighboring republics of the North Caucasus. The purpose is to study the history of research carried out to collect available information for qualitative and quantitative assessment of oil and gas resources of the Mesozoic sediments. Only separate materials on this issue were found. Most of the materials were lost and destroyed during the Chechen wars. Combined historical studies of the oil and gas potential and materials from the North Caucasian and central state archives are required. Using the available data, the article provides information on the history of the study of promising areas and deposits of the region, starting from the beginning of the XIX century and up to the beginning of the XXI century. The analysis indicates a high potential of further scientific research on hydrocarbons of the Mesozoic sediments by improving the scientific and methodological base and research methods.

1. Introduction

The history of development of the oil and gas industry includes a wide range of areas (geological prerequisites, prospecting and exploration, assessing hydrocarbon reserves, effective development of promising areas) [1].

Accumulated information can be used to assess the gradual development of the oil and gas industry in the region and the country, outline new areas for prospecting and exploration, and increase hydrocarbon production. The North Caucasus which is of scientific and practical interest for the further development of hydrocarbon resources.

The territory of the North Caucasus is divided into three areas according to the geological structure and oil and gas bearing conditions: Western Ciscaucasia (Krasnodar Territory), Central Ciscaucasia (Stavropol Territory) and Eastern Ciscaucasia (Republic of North Ossettia-Alania, Republic of Ingushetia, Chechen Republic, Republic of Dagestan and South Ossettia, and South Africa and South Africa areas) [2].

In the Eastern Ciscaucasia, oil and gas potential prospects are associated with the Mesozoic sediments including the Jurassic and Cretaceous sediments. The Cretaceous sediments are composed of thick fissured limestone with marl and clay interlayers. Their reservoir properties with a capacity varying from 200 to 1500 m are caused by the development of fractured rocks and leaching. The Cretaceous deposits are promising.
2. Purpose of the study
This paper is devoted to the history of the studies conducted in the RNO-Alania and adjacent territories in order to collect information for assessing prospects of oil and gas resources of the Mesozoic sediments.

3. Materials and methods
The materials used for this research are results of scientific and industrial-production studies of the oil and gas potential of the North Caucasus, in particular, Eastern Ciscaucasia (monographs, articles, literary sources and stock materials).

4. Results
The geological and geophysical materials accumulated over many years of research conducted in the RNO-Alania remains are stored in various funds, organizations, institutions outside the republic. It is necessary to conduct oil and gas potential historical studies in the RNO-Alania.

In Russia, the oil industry began to develop on the Absheron Peninsula and in the North Caucasus. For the first time in the Caucasus, near the Mozdok fortress, in 1823, the Dubinin (fortress peasants) built a small oil distillation facility to produce transparent liquid called photogen. As a result, they obtained thick dirty and black liquid named “mauzut” which was further transformed into the word “mazut”.

The beginning of the development of hydrocarbon resources in the North Caucasus is the end of the XVIII century and the beginning of the XIX century; the beginning of the systematic geological research is the time of the first and subsequent geological surveys conducted by Abih German Wilhelmovich (1862, 1866, 1973, 1876). In 1873, G.V. Abih presented his first systematic ideas about the geological structure of the area and established the Mesozoic (tertiary) age of oil deposits of the North Caucasus with lithological characteristics of individual parts of the section [3].

For the regional petroleum geology, the surveys conducted by A.M. Konshin in 1892, 1896 were crucial. He argued that oil fields in the Eastern Ciscaucasia are confined to three structural zones of the Terek-Bragunsky, Sunzha-Grozny ridges and the Black Mountains which stretch from Vladikavkaz railway to the coast of the Caspian Sea where the formation of significant oil reserves is possible [4].

In 1901, in the Eastern Ciscaucasia, surveys were conducted by the Geological Committee of the Supreme Economic Council in the Terek-Sunzhensk oil and gas region. Their results revealed its prospects.

Since 1915, drilling works began on the southern wing of Voznesensk fold (Mozdok), and the first industrial oil flows were obtained.

In 1917, A.S. Savchenko established an uplift of the Kabardian fold to the east.

In the 1920s, the survey in the Kharbizhin area began. Geologists obtained reliable information about the geological structure. In 1924, Kudryavtsev identified the existence of an oil-bearing structure. In subsequent years, a whole series of seismic studies were conducted in this area. The Mesozoic sediments were discovered. In addition, the reflecting horizons were traced along the Lower Cretaceous and Upper Jurassic sediments.

In the same years, geological surveys were conducted on the territory of the Argudan area by Shvetsov and Alferov who aimed to assess the oil and gas content of tertiary deposits.

In 1925, Shvetsov discovered a new orographic dome-shaped elevation.

In 1925-1927, within the boundaries of the Malo-Kabardinsky Ridge, Orlovsky and Dolitsky carried out geological surveys to specify its tectonic structure. Malo-Kabardinskaya, Zamankulskaya and Kurpskaya anticlinal folds were identified.

A more detailed study of the geological structure and petroleum resources began in the 1920s and 1930s. This period is characterized by intensified geological studies aimed to identify oil and gas areas and discover oil in the Karagan-Chokrak deposits [5].
In 1933, under the leadership of V.I. Dokunin, a gas survey was conducted on the territory of Akhlov. An elevated methane content which coincides with the Sarmatian deposits and a high content of heavy hydrocarbons associated with the Akchagyl contact and Sarmatian deposits were discovered.

In 1937-1938, the trust "Groznftegeofizika" directed by N.V. Bogdanovich conducted surveys in the western part of the Malo-Kabarinsky Ridge. As a result, they managed to create a geological map.

In 1940, in the central part of the ridge, Harbhik carried out a geological survey and specified the tectonic structure of the Kabardian anticline.

In addition, based on the research results, the following promising areas were identified: Kardin-Zmeiskaya, Zamankulskaya, Korinskaya, Argudanskaya, Verkhne-Kurpskaya, Kharbizhinskaya, Yuzhno-Kharbizhinskaya, Akhlovskaya, Severo-Malgobekskaya.

In 1940, in order to specify the geological structure of Argudan, N.V. Bogdanovich carried out geological surveying covering the area between the Psygan-su and Argudan rivers. The Argudan structure whose tectonic features were studied is an open sloping anticline with wings falling at an angle of 15-17°. The structure is complicated by a series of violations of various amplitudes and orientations. N.V. Bogdanovich suggested a more detailed study of the fold combined with drilling operations.

In 1948, I.M. Krisyuk conducted a geological survey on a scale of 1: 50,000. P.P. Zabarinsky gave a positive assessment of the oil and gas prospects of Maikop, Karagan-Chokarak and Sarmatian-meotic sediments under the lithological or tectonic isolation of layers.

In 1948, the “Malgobekneft” trust drilled over 15 deep wells in Zamankul area to specify the tectonic structure of the Malo-Kabarinsky fold and assess the oil and gas content of the Karagan-Chokarak deposits of the northern and southern slopes of the ridge. Gas formations were discovered, and water with gas was obtained. However, the presence of oil was not observed [6, 7].

In 1948-1957, the “Malgobekneft” trust directed by I.V. Hans, L.F. Kostrich, B.K. Lotiev, V.L. Mkrtichev, and Yu.M. Zwedel performed structural drilling works. The "Groznftegeofizika” trust conducted electrogravimetric and seismic studies. The complex structure of the Zamankul anticline arch was revealed, and a series of longitudinal violations that split the fold into a number of separate blocks were found.

In 1952-1955, in order to assess the prospects of petroleum resources, the Malgobekneft trust carried out structural drilling works along five profiles along the valleys of the Fiagdon, Ardon, Ursdon, Dur-Dur, Urukh rivers in the western part of the Terek-Sunzhenks oil and gas region, in the Korzhin-Zmeiskaya area. As a result, stratigraphic sections of deposits of Maikop, Chokarak and Karagan layers were specified.

In 1952-1953, in the Korin Area, researchers of Grozny Oil Institute directed by of P. P. Zabarinsky and B. K. Lotiev carried out reconnaissance work on the Montenegrin Monocline between the Assa and Psygan-su rivers. The results indicated favorable conditions for accumulation of oil and gas. Due to the strong intersection of the relief covered with deciduous forest, it was impossible to conduct areal seismic surveys; therefore, the main method of geological study was drilling of structural-exploratory wells. A single seismic profile was developed along the Ursdon-Saverdon River.

In 1951-1952 and 1956-1957, in the Verkhne-Kurpskaya area, the studies on the geological structure of the Psedakh structural protrusion and the Kharbizhinsky uplift were carried out. In this area, there were no obvious signs of oil deposits, but during the drilling works, the kern with oil signs was lifted. The main result of the structural drilling was new data on the geological structure of the Kharbizhin anticline and a promising positive structure was mapped in the upper tectonic floor.

In the post-war period, targeted geological studies on Mesozoic deposits began in connection with determining the prospects of oil and gas potential, although these prospects were suggested much earlier [8].

In 1957, prospecting drilling works began in the Zamankul area. As a result, industrial oil inflows from Upper Cretaceous limestones were obtained. In 1958-1981, the Upper Cretaceous sediments were studied in more than 25 wells, most of which gave industrial oil inflows with a flow rate of up to 58 tons / day. As a result, the reserves were calculated for the Upper Cretaceous deposit, and the deposit was put into development.
In 1957-1958, in the Argudan Area, researchers of Grozny Oil Institute conducted geological surveys between the Nalchik and Argudan rivers. In 1959, B.K. Lotiev, Yu.A. Sterlenko and B.G. Vasin described the Argudan structure as a tectonic protrusion complicating the Montenegevri monocline. The authors concluded that the pre-Jenomanian, Pre-Chrachian and Pre-Aphertonian tectonic movements had the most pronounced effects on the development of the Montenegevri Monocline as evidenced by the erosion of the Cenomanian, Upper Maikop, Upper Sarmatian and visible angular disagreement between the layers of the upper conglomerate strata of the Apsheron and Akchagyl longlines and the underlying complex of rocks.

Despite a significant amount of research carried out during these years, the genesis of the fold, its link with the neighboring Serpentine structure, the nature of facial-lithological variability of the sediment that forms the region remained unsolved, which became the main problem in assessing the oil and gas potential of the area. In 1962, structural-exploratory drilling works were conducted by the Grozneftegizvedka Trust and the Sevkaavtsvetmetgizvedka Trust. The works were carried out despite the fact that in the western part of the protrusion, incompatibility of this section in the Cenozoic and Cretaceous sediments was established and in the eastern part, the area of oil and gas resources was not specified.

In 1962, exploration works were carried out in the Ukhlov Area; a number of exploratory wells were developed in different parts of the Akhlov structure. In one of the wells, an oil fountain was obtained. Oil was produced by wells drilled on the eastern pericline and the southern wing of the Akhlov anticline. Exploration works were carried out to delineate the Upper Cretaceous reservoir and discover oil deposits in the Lower Cretaceous and Upper Jurassic reservoirs.

Oil deposits were discovered in the marl of the Kumsky horizon, in the lower Cretaceous sediments of the Aptian and Valanginian longlines.

It was necessary to summarize the research data. A number of geological organizations began to conduct case studies in different directions. In 1964, A.F. Lopatin identified buried structures favorable for oil and gas accumulation based on the comprehensive analysis of morphometric and gravimetric materials to specify the tectonics of the Argudan bulge.

Analyzing structural and prospecting drilling operations carried out in 1964-1968, the lack of industrial accumulation of oil and gas in Neogene-Paleogene and Cretaceous sediments was established. Since the test was conducted in the open trunk, the prospects for petroleum potential should be associated with the Dotiton complex of sediments which are in structural and tectonic isolation. The oil-bearing deposits whose sandstones have high reservoir properties can be the Lower Cretaceous sediments. The Maikop sediments and carbonate rocks of upper and lower Cretaceous sediments in fault zones can be promising. Geologists were suggested to drill central and eastern deep exploratory wells in tectonically isolated blocks. After unsuccessful drilling of these wells in the late 1970s due to emergency situations, in the early 1990s, drilling operations began, but at the end of 1992, they stopped at 3581 m with a design depth of 5300 m.

In 1963-1965, in the Korinskaya area, the Sevkaavtsvetmetgizvedka trust drilled more than 15 wells in order to identify favorable structures containing oil and gas. As a result, the tectonic structure of the Korin Protrusion was studied. In its central part, a terrace-like Mesozoic deposit was discovered.

In 1964, the Groznetgeofizika trust gave a passport of the Kharbizhin structure to the "Groznenft". The presence of a favorable structure and reservoir rocks indicated the need and feasibility of launching drilling operations in the Kharbizhin area in order to identify the oil and gas content of the Cretaceous sediments.

To accomplish the tasks, a project was drawn. According to it, in 1969, exploratory drilling works began in the area of the Lower and Upper Cretaceous deposits. In the well drilled in 1971, there were no oil in the Barrem and Apt deposits, and the Upper Cretaceous rocks (Maastricht) produced a short-term fountain of oil. The well watered out quickly. Other drilled wells yielded inflows of water which made it difficult to draw final conclusions about the spatial location of the reservoir.

Exploration works were aimed at searching for oil and gas deposits in deep-lying Valanginian-Berrias and Upper Jurassic deposits. To this end, in 1972, step-by-step drilling of wells was carried out.
on the indicated horizons. Deposits were discovered in the Lower Cretaceous and Upper Jurassic sediments.

Further works were aimed at searching for the deposits in the intersalt and subsalt Jurassic sediments. In 1988, SevKavNIPIneft developed a project for the exploration of the Upper Jurassic intersalt deposits.

In 1971, the Grozneftegeofizika trust discovered a structure in the Cretaceous sediments that was transferred to the Grozneft company. The proximity of the area to the well-known deposits (Zamankul, Harbizhin) indicated the high oil and gas potential of this area.

In the North-Malgobek area, exploratory drilling began in 1971. In 1973, the SevKavNIPIneft institute drafted an oil deposit project for the Upper Cretaceous sediments. The drilling of the first exploratory wells showed that the arch part of the uplift, outlined along the conditional reflecting Upper Cretaceous horizon, is located slightly to the north, and the depth of productive deposits is significantly lower than that determined by the seismic survey results [9].

In 1978, the first operational estimation of reserves of the Upper Cretaceous reservoir was carried out; the volume of reserves was calculated and approved by the State Reserves Committee in 1985.

In 1995, Sevosetinneftegazprom began to restore the wellbore drilled in 1992 to a depth of 3,581 m in the Argudan area. However, due to drilling difficulties and the lack of funds, they decided to test the Upper Cretaceous and Karagan deposits characterized as oil saturated.

In 1997, materials of previous studies of the Korin Area were summarized. Using these materials, an exploration project and a passport of the oil prospecting structure were created for the Upper Jurassic, Lower Cretaceous, Paleogene, Neogene deposits.

In 2000, Sevkaygeologia developed a project of oil and gas exploration and analysis for the Yuzhno-Kharbizhin area which assessed the C3 oil resources in the Jurassic, Cretaceous and Paleogene sediments. Exploratory wells were designed, but design solutions were not implemented.

5. Conclusion
Despite longstanding research and exploration, the oil potential of the Mesozoic sediments in North Ossetia-Alania and adjacent territories is still very high.

Historical analysis of the exploration of the territory shows that the main ways to improve the efficiency of geological exploration is to improve the scientific and methodological research and exploration base, increase accuracy of seismic mapping methods, study the hydrocarbon resources of North Ossetia Alania and adjacent territories.

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