Bituminous sandstones of the Chechen Republic

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ABSTRACT: The article gives a general description of tar sandstone deposits in the Chechen Republic. In total, nine areas of outcrops of sand and sandstones of the Karagansky and Chokrasky stages of the Neogene system, which are confined to two structural zones, are the zone of the Advanced Ranges and the zone of the Montenegrin monocline. Four zones were identified in each area.

All deposits of the Advanced Ridge zone are small, due to their local distribution of bituminosity and a steep occurrence of the host reservoirs. In addition to the volume of reserves, the deposits of the Montenegrin monocline are unpromising due to their remoteness from the main transport and energy highways.

When studying the bituminous strata of the promising sections, the following problems were solved: the geological structure of the section was studied; layers with industrial significance are highlighted in the context of the tar layers; bitumen content and the nature of its change are determined; the physicochemical characteristics of bituminous rocks and interposition with the host rocks are specified; qualitatively evaluated and determined technological parameters of bitumen; estimated mineral reserves are estimated.

The general characteristics of bituminous rocks include - the uneven distribution of bituminous in both individual intersections and in areas as a whole; are classified as - from low

bitumen to medium bitumen. By particle size distribution and particle size modulus, finely and medium-grained, by mineralogical composition, quartz sand.

All described areas of bituminous rocks can be attributed to promising development at the local regional level.

1 INTRODUCTION

Currently, the task has arisen of searching for additional resources of organic binders and developing methods for their rational use in the construction of roads. The source of reducing the deficit in oil bitumen is natural bituminous rocks, the deposits of which are widespread, including in the Chechen Republic. The conditions for the formation of natural bitumen in the host sedimentary formations are migration processes of fluids consisting of water and hydrocarbons with the obligatory access of air and specific microorganisms. In the process of this, this fluid mixture is differentiated on the fractured-pore surfaces of the rocks according to the fractional basis, i.e. heavy hydrocarbons, asphaltenes and resins.

An analysis of the available material obtained during geological exploration from the 30s of the XX century, which includes specialized geological studies for oil and gas in the Grozny and Nozhay-Yurt districts, to the present (expedition of Chechennftekhimprom OJSC) indicates that manifestations of bituminous rocks occur almost everywhere in the strip of outcrops on the surface of Karagan-Chokrak deposits. (Mitchin, 1992)

Deposits of the Jurassic, Cretaceous, Paleogene, Neogene, and Quaternary systems take part in the geological structure of the territory of the Chechen Republic. (Orel, Raspopov, Skripkin, 2001) Because bituminous sandstones have a clear stratigraphic and lithological confinement; in practice, we will only dwell on the characterization of these deposits only to the sandstones of the Chokrak and Karagans. (Khasanov, Shaipov, Zaurbekov, 2010)

The deposition of the Chokrak and Karagan strata together with the overlying layer of the Miocene and Pliocene belong to the Neogene system (N)

According to the scheme of N.A. Kozlova distinguishes 11 strata of sandstones of the Chokrak deposits (E1 - E11) of various thicknesses and lithology, including strike. The layers are separated by clays and marls of various thicknesses and lithology. (Orel, Raspopov, Skripkin, 2001) The lower boundary is drawn along the roof of the marls in accordance with the presented fauna. The thickness of the entire Chokrak tier reaches 1068 m.

The rocks of the Karaganskian layer, according to the overlap of the deposits of the Chokrak layer and are represented by interbedded horizons of sandstones and packs of clay. The section of Karagan deposits is similar to the section of the Chokrak and differs from the latter only in fauna.

In total, 13 layers of sandstones, some of which are largely bituminized, were noted in the Karagan section. (Khasanov, Shaipov, Zaurbekov, 2010) These deposits are confined to the Grozny manifestation of tar stoves and some others (Bulgat-Irzu). The total thickness of the Karagansk deposits varies between 150-200 m.

Miocene sediments are undivided, according to overlap the formation of the Karaganskian stage and are represented mainly by clays, with the appearance of sandstones, marls, shells and conglomerates in the upper part of the section.

Pliocene sediments are characterized by a wide range of lithological differences in rocks: sands, clays, sandstones, limestone, marls, and limestone.

The deposits of the Quaternary system (Q) are represented by clays, loams, sands, and pebbles.

In tectonic terms, the described region belongs to the zone of the Advanced Ranges and the Montenegrin monocline of the Northern slope of the Greater Caucasus.

In the zone of the Advanced Ranges, Tersky, Sunzhensky, Grozny, Bragunsky and Gudermes anticlinoria, as well as the Sunzhensky and Alkhanchurt synclinoria are distinguished. (Khasanov, Shaipov, Zaurbekov, 2010)

The anticlinoria are composed of a series of antichinal brachisculides elongated in the sub-latitudinal direction and complicated by a series of longitudinal reverse faults. As a rule, in the

nuclei of these structures the rocks have a steep occurrence, noticeably flattening towards the northern and southern wings. In the zone of the Montenegrin monocline, the rocks have a stable northern fall at angles of 20-40. The eastern part of the Montenegrin anticline is complicated by the Benoit anticlinal ledge of sub-latitudinal strike with steep northern and flatter southern wings. The central part of the Benoit ledge is complicated by a series of transverse discontinuities. A significant gap was noted along the line of the village of Gilyana - Mount Eli Baving, called the Gilyansky reverse fault. There is an opinion that according to the throw-up in the area with. The Gilans are brought into contact with the Maykop and Karagan-Chokrak deposits, and oil flows from the former to the latter.

Within the described area there are a number of oil and gas fields. (Kerimov, Daukaev, 2003) In hydrological terms, the area can be divided into three zones: the zone of the Advanced Ranges, the lowland zone and the Black Mountains zone. In the zone of the Advanced Ranges, formation-fractured waters confined to the cover are developed. In the lowland zone, aquifers of the Pliocene, Pleistocene, and also underground waters of the terrace complex are noted. The Black Mountains zone is hydrologically poorly understood. Potentially aquifers are sandstones of Karaganchokrak deposits.

When studying promising areas of bituminous strata in the Chechen Republic, only 9 sites were covered: Grozny, Sernovodsky, Simsirsky, hkendatenn-Kort, Bulchat-Irzu, Kuren-Benoy, Gudermes, Bragunsky. (Mitchin, 1992) (Figure 1).

Figure 1. Schematic map of the manifestations of tar sandstones.

The numbers on the map indicate

№	Name	Location
1	Grozny site	Starogroznsky ridge, Mamakayevskaya beam
2	Sernovodsky site	On the southern slope of the Sunzhensky ridge, between the villages of Sernovodsk and Sleptsovskaya
3	Simsirsky district	District of the village of Simsir, the confluence of the Yaryk-Su and small Yaryk-Su
4	Section Mahkendatten	Court 2.5 km east of the village. Bulgat Irzu
5	Plot Bulgat-Irzu	Western outskirts with. Bulgat Irzu
6	6 Section Kuren-Benoy	Northern outskirts of the village
7	Gudermes	section 4-5 km Southeast of Gudermes on the northern slope of the Gudermes ridge
8	Bragunsky site	4-5 km. west of s. Braguns, on the northern slope of the Bragun range

In these studies, the following tasks were solved:

- study of the geological structure of the site;
- the allocation in the context of tar packs, layers of “industrial” intervals;
- determination of the contour of productive intervals and assessment of their mining and geological conditions;
- determination of bitumen content and the nature of its change;
- clarification of the physico-chemical characteristics of bitumen-containing rocks and their interposition with the host rocks;
- a qualitative assessment of the mineral;
- determination of technological parameters and their compliance with the requirements for road construction.

The remaining sites were studied in less detail.

Grozny site. It is located on the northwestern outskirts of Grozny in the Mamakayevskaya beam (the Starogroznsky ridge is a spur of the Sunzhensky ridge). The size of the surveyed area is 1.1 x 0.7 km². Only part of the selected promising area measuring 100x300 m² was subjected to detailed examination.

The orographically studied site occupies the valley of the Mamakayevskaya beam, which has sides 30-40 m high, composed of sandstone layers. By age, sandstones belong to the Sarmatian and Karagansk layers. Overlap loams of Quaternary age, low power.

The mineral is confined to the Karagansky bituminous sandstones, which form an anticlinal fold, the core of which is opened by the Mamakayevsky beam incision.

Sandstones are heterogeneous, with a predominance of fine-grained and silty differences of massive texture, gray to black, depending on the intensity of bitumen saturation. In the absence of bitumen, sandstones are light gray to white in color with a slight yellowish tint. Visually, the bituminous intensity is heterogeneous, and it was not possible to establish any regularities in its distribution.

Productive sandstones are overlain by weak interbedded clays and marls of the Sarmatian stage, which reach up to 30 m in thickness to the north and south from the outcrops of the studied layers at a distance of 50-60 m. The Grozny site was studied by routes and five clearing, of which 65 laboratory and 1 laboratory and technological samples were selected. (Table 1.)

The table shows an extremely uneven distribution of bituminousness in the Grozny manifestation - from a practical absence to a high content. In general, according to the manifestation of bituminosity, sandstones and sands are characterized as having a low bitumen content.

According to the mineralogical composition, sands are essentially quartz; the silica content in them varies from 96.14% to 98.01%.

Based on the ratio between water saturation and strength of water-saturated samples at 2000 ° C, the optimum values of the amount of bitumen in the asphalt-concrete mixture were

Table 1. Characterization of bituminous sandstones of the Grozny site.

№	№ workings	Number of samples	Bitumen content, %		
			from	to	from to weighted average
1	Clearing 1	9	3,17	39,4	9,46
2	Clearing 2	17	0,19	3,66	1,61
3	Clearing 3	13	0,08	2,43	0,74
4	Clearing 4	11	0,89	3,08	2,15
5	Clearing 5	15	1,79	8,59	0,39
6	Manifestation	65	0,08	39,4	2,95
7	Regulations	Not less 2 %			

determined, which are 54% for the sample. The knowledge of the manifestations allows us to classify reserves by C2.

The expected reserves of the Grozny manifestation with a deposit width of 100 m, a length of 300 m and an optimal thickness of 6 m are: $100 \times 300 \times 6 = 180$ thousand m³.

Simsirsky site. Located 0.5 km north of the village of Sim-Sir Nozhai-Yurt district at the confluence of the rivers Yaryk-Su and Malaya Yaryk-Su. Erosion processes here formed an isolated isometric area, armored with a layer of tar sandstones. The size of the site is 500x100 m². In geomorphological terms, it is an inclined plane in the northwest direction cut off from the north, west and east by a river cut.

Exceeding the maximum values of the site above the confluence of the rivers reaches 120 m. The sides of the river valleys are gorges formed by cuts into sandstone packs.

The geological structure of the site is simple. It is composed of a rather powerful (up to 15 m) pack of sandstones of the Chokrak stage, covered by an alluvial-deluvial cover of loam with detrital material and underlain by shaley argillite-like clays. The fall of bedrock (sandstones and shale clay) is measured in the north-western rumbas, the angle of incidence is 200.

The mineral is represented by tar sandstone. Its thickness varies within 8-15 m. The section of the sandstone layer from the roof to the bottom is presented in the following form:

- loose sandstone light gray to white - up to 4 m,
- weakly bituminous banded sandstone - up to 4 m,
- medium-bituminous banded sandstone - up to 6 m,
- strongly bituminous banded sandstone - up to 2 m.

Visually, the bituminous content of the rocks is uneven.

The upper part of the sandstones, especially in exposed areas, washed and sandstones become white with no signs of bitumen. Down the section of the sandstone formation, the degree of bituminousness increases, reaching its maximum at the bottom. (Table 2). Bitumen and crusts of bitumen are formed in this part, especially with the development of fracturing.

Table 2. Characterization of bituminous sandstones of Simsirsky site.

№	Clearings	Number of samples	Bitum contains, %		
			from	to	average
1	Clearing 20	10	0,91	6,57	4,39
2	Clearing 21	8	0,58	3,81	1,37
3	Clearing 23	12	3,72	6,61	4,82
4	Clearing 24	14	1,98	3,05	2,42
5	Clearing 25	13	2,28	6,05	4,60
6	Clearing 26	10	3,43	7,11	6,22
7	On site	67	0,58	6,61	3,86
8	Regulations	Not least 2 %			

Table 3. Characteristics of bituminous sandstones of the Mahkendatten Cort.

№	Clearings	Number of samples	Bitum contains, %		
			from	to	average
1	Clearings 27	4	2,67	3,72	3,38
2	Clearings 28	5	0,01	4,30	2,41
3	Clearings 29	5	1,08	1,54	1,34
4	Clearings 30	5	0,72	2,01	1,59
5	Clearings 31	5	0,09	1,14	0,52
6	Clearings 32	5	0,83	1,43	1,18
7	Clearings 33	5	1,34	1,68	1,56
8	ON the site	34	0,01	4,3	1,62
9	Regulations	Not least 2 %			

In hot weather, drops and streams of bitumen form on the surface of the rocks and a characteristic “asphalt” smell is felt at a considerable distance

It follows from the table that, as for individual intersections, and for the site as a whole, the distribution of bitumen saturation is heterogeneous and is classified from low contents (p. 21, 24) to medium (p. 20,23,25,26), average bitumen content in the site characterized as low, close to average.

According to the grain size and size modulus, the sands are fine-grained, with a clear predominance of the 0.14 fraction.

By mineralogical composition - quartz sands, with silica content of 96, 34-98, 37%.

The studied area has forecast reserves of categories C2 in accordance with the sizes 500x100x10 m3 -500 thousand m3, i.e. the deposit is small.

Section Mahkendatten - Court. It is located 2.5 km east of the village of Bulgut - Irzu in Nozhai - Yurt district and is confined to a gentle hill with a mark of 1008.7 m. On the northern and southern slopes, erosion processes in the form of a 10-15 meter ledge reveal tar sands of the Chokrak stage, which object of search work.

Judging by the elements of occurrence, two layers are recorded here, separated by a 10-15 meter pack of clay rocks. The bedding of the strata is north-western at angles of 200. An optimized section of sandstones, compiled from clearing, is presented as follows:

- uneven-grained sandstone - 1-4 m,
- fine-grained sandstone, silty - 4-7 m,
- uneven-grained sandstone - 7-11 m.

The observed bitumen saturation of the host rocks varies. More saturated rocks, exposed on the southern slope (clearing 28). In hot weather, a hydrocarbon consistency flows out of the formations, which is quite liquid and oily with the smell of oil.

The site is contoured along the perimeter by seven clearing sites (p. 27-33), of which 34 samples were taken. Bituminous rocks are characterized as follows (Table 3).

The table shows that this site is characterized by a fairly uniform, albeit low bitumen content.

The mineralogical composition of the sands is quartz, with a silica content of 97.28%.

The Makhkendatten-Kort section has reserves of up to 325 thousand m3, in accordance with the dimensions 250x130x10 m, which is characterized as a small field, in the presence of the likelihood of continuation of productive formations of the considered section along strike. Although the geomorphology of the region does not fully confirm these assumptions.

2 CONCLUSION

Thus, the available geological materials on the outputs of the bituminous sites allow us to say the following: all deposits promising for bituminousness are confined to two structural

zones — the zone of the Advanced Ranges and the zone of the Montenegrin monocline. (Ganieva, Polovnyak, 2012)

The zone of advanced ranges (Tersky, Sunzhensky, Gudermes and Bragunsky) is represented by anticlinoria, folded brachiskladas of various orders and complicated by numerous fractures of the thrust nature. (Mitchin, 1992) The bedding here is mostly steep, productive horizons of bituminous rocks quickly “dive” under the deposits overlapping them. In this zone, the Grozny, Sernovodsky, Gudermes and Bragunsky sites were studied. In general, the zone of the Advanced Ranges should be classified as unpromising for the identification of deposits of bituminous rocks. (Zaurbekov, Mintsae, Cherkasov, Labazanov M.M., Shaipov, Damzaev, 2015)

The zone of the Montenegrin monocline is composed of monoclinically falling to the north at angles of 20-40° rock strata, including bituminous. Theoretically, in this zone it is possible to identify deposits of bituminous rocks.

Within the Montenegrin monocline, the sections Simsirsky, Mahkendatten-Kort, Bugat-Irzu, Kuren-Benoi were studied. Only the Simsirskiy and Mahkendatten-Kort sections have certain prospects.

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