UDK 553.042:553.94(517) DOI: https://doi.org/10.59911/mgg.2786-7994.2024.1-2(8-9).340957

Narantsetseg Buyanbat, Oyuntugs Magsar, Bolormaa Ayurzana

A COMPARATIVE STUDY OF METHANE GAS COMPOSITION IN SOME COAL DEPOSITS OF MONGOLIA

This study selected 14 samples from the Tavan Tolgoi coal deposit and 19 samples from the Naryin Suhait coal deposit, totaling 33 samples, and the amount of gas composition was determined. In 33 samples taken for research, gas chromatography determined gas composition in the "Green Crown" LLC laboratory. This study aimed to determine the correlation between the methane gas composition of the coal seams of Tavan Tolgoi and Naryn Sukhait deposits, the coal seams' depth and thickness, the coal's chemical and physical properties, and the cracks in the rocks. For the above 2 deposits, the findings revealed that the composition of coalbed methane gas (Methane) contains up to 95% of methane gas, the gas composition varies depending on the physical and chemical properties of the rocks containing the deposit, coal structure, age, pressure of the layer, hydrogeological and geological conditions, and gas sampling. Shortly, it is believed that the standard methodology needs to be improved.
Key words: coal seam methane gas, gas composition, physical and chemical properties

PURPOSE AND OBJECTIVES OF THE STUDY

Purpose of the study

The composition of methane gas in the Tavan Tolgoi and Naryn Suhait coal deposits of Mongolia was studied and the influence of geological and other factors affecting their composition was determined.

Objectives of the study

To achieve the purpose of the research, the following objectives were proposed.

- Analyze the composition of coal samples taken from coal deposits by gas chromatography;
- Process the results of laboratory analysis and observe the pattern of physical and chemical properties and geological parameters;
- Determine the factors affecting the composition of methane gas in coal seams.

Significance of the study

Analyzing the composition of methane gas in coal deposits and determining the correlation between the factors affecting it, it is of practical importance to create sources of information necessary for exploration, research, analysis, and use of deposits for current and future exploration and research.

Novelty of the study

An innovative aspect of the research is the comparative study of the methane composition of coal seams in Mongolian coal deposits. Moreover, in this research, using gas chromatography, the researchers studied the chemical composition of CBM and compared it with the geological conditions of the deposits.

Literature review

Mongolia has estimated reservoirs of 7.5 trillion cubic meters of coalbed methane (CBM) gas [5].

For Mongolia, coal deposits have been explored for more than 300 coal deposits in 22 basins and 3 regions. Among them, Tavantolgoi, Baruun Naran, Naryn Suhait, Ovoot Tolgoi, Ulaan-Ovoo, Tugrug Lake, Tsaidam nuur, Baganuur, Shivee-Ovoo, and Hushuut are considered as the largest mines with abundant resources. Since they signed a production-sharing agreement (PSA), 4 companies have been conducting exploration work continuously in Mongolia, and now they are intensively conducting geophysical and drilling work in 6 fields. In 2022, "GOH" LLC started trial and extraction work in the Nomgon sub-basin located in Nomgon sum which belongs to an area of Umnu govi province; in 2023, "Methane Gas Resource" LLC planned to drill a cross hole at the Tavan tolgoi coal deposit, while "Telmen resource" Ltd. has started testing and mining at the Gurvan tes sum coal deposit in Umnu govi province [12]. The coal deposits in the South Gobi region of our country have rich methane gas resources, and the composition of the gas or hydrocarbon content plays an essential role in the future efficient use of these resources. Regarding the source, coal methane is divided into two categories: coalbed methane and coal mine methane. Methane extracted from unused mines or deposits is called coalbed methane gas, while methane extracted from utilized and abandoned deposits is called coal mine methane gas [3]. In general, coalbed methane gas (CBM) refers to methane absorbed into the solid matrix that can be extracted from coalbeds, the main composition of which is methane, with a few percent of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen (N_2), and oxygen (O_2). Simple gases, such as ethane (C_2H_6), ethylene (C_2H_4), propane (C_3H_8), and short-chain hydrocarbons [9]. Coalbed methane is generally formed due to the thermal maturation of kerogen and organic matter, while in some cases it may also be of stratified origin. Coal bed gases are classified as biogenic, thermogenic, and of mixed origin. Biogenic methane is methane produced and released from living organisms at low temperatures (below 56^{o}C) with the help of methanogenic bacteria

[8]. It is mostly sub-bituminous lignite, a lower class of coal with less age. Thermogenic gases are formed due to the chemical decomposition of organic matter of coal in a hot environment, i.e., in an environment where biochemical reactions do not occur above 100°C, which usually occurs on high-ranked coals such as bituminous and anthracite. However, for the high-ranked coal, it is considered that the biological process takes place at the beginning of its formation [1]. It is believed that the composition of CBM depends on coal structure, age, formation pressure, and hydrogeological and geological conditions [9]. Light molecular hydrocarbons and carbon dioxide in CBM gas are by-products of the carbonization process. On the other hand, there is a theory that straight-chain hydrocarbons occur when long straight-chain alkyl chains separate from aromatic hydrocarbons [1]. Carbon dioxide is produced from the oxidation of organic materials in the early stages of the coal formation process. Scientists hypothesize that at the stages of the coal formation process, the amount of methane increases, while the amount of carbon dioxide decreases. Hydrogen is also formed when coal is formed, in the contrary nitrogen and oxygen are released during the sedimentation process of organic sediments and absorbed into the coal seam from air dissolved in water. From this, oxygen is consumed for carbon dioxide formation, while helium is caused by the decay of radioactive isotopes [10].

Coalbed methane is classified into 3 types of compounds [1]. It includes:

- >90% methane content – high-rank gas. It can be distributed to customers via direct pipelines;
- 50 – 80% methane content – medium-rank gas. It can be utilized in internal combustion engines, gas turbines, or thermal plants;
- <40% methane content – low-rank gas. It is for limited use.

It can be seen that the amount of methane composition in CBM is the main indicator for determining the purpose and feasibility of using natural resources. Figure 1 shows how the origin of coalbed methane depends on coal grades.

GEOLOGICAL FORMATION OF TAVANTOLGOI DEPOSIT

Tavantolgoi coking coal deposit is located administratively in Ulaannuur Valley which belongs to the area of Tsagaan-Ovoo bag, Tsogttsy Sum. It is 540 km south of Ulaanbaatar, 90 km east of Dalanzadgad, the capital of Umnogov Province, 16 km southwest of the center of Tsogtsetsiy Sum, 440 km from Sainshand station, the nearest railway point

540 km south of Ulaanbaatar city, 90 km east of Dalanzadgad, the capital of Umnogov province, 16 km southwest of the center of Tsogtsetsy sum, 440 km from Sainshand railway station, 400 km from Har-Airag station as the nearest railway station, more than 200 km from the Mongolia-China border, and more than 150 km

from Oyutolgoi copper and gold deposits. It exits on planes L-48-7, 8, 9 19, and 20 of the topographic map of Mongolia (Figure 2).

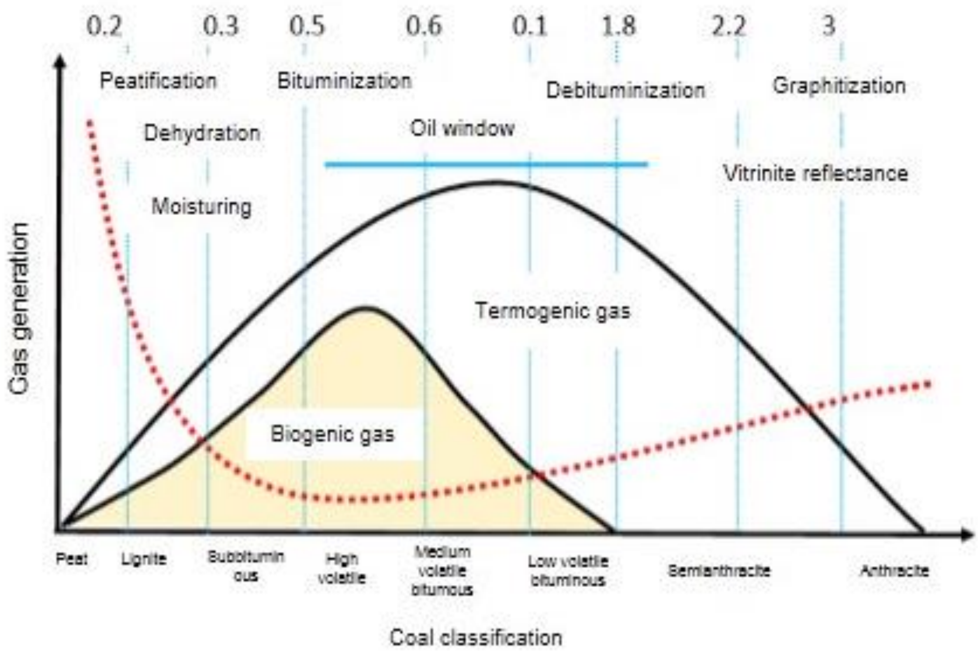

Figure 1. Coal classification and gas content correlation

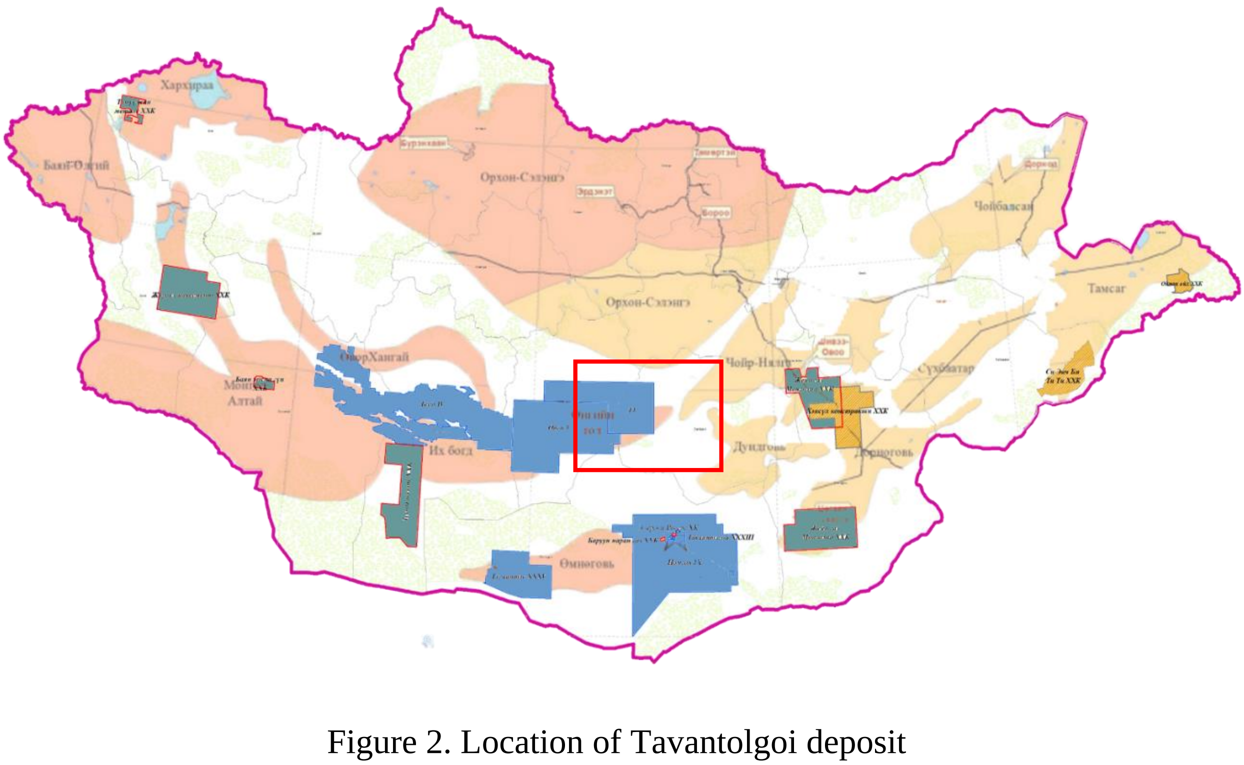

Figure 2. Location of Tavantolgoi deposit

The central part of the Tavantolgoi syncline is filled with Upper Permian coal-bearing sediments, and there are mounds where Middle-Upper Devonian, Lower

Carboniferous, and Late Carboniferous-Early Permian volcanogenic sediments lie on top of the deposits. Cenozoic sediments are developed in a limited area.

Silurian-Lower Devonian Nomgon Uul Formation (S-D1 nm)

Middle-Upper Devonian Tsetsgershand Formation (D2-3 cs)

Lower Carboniferous Ikhshankh Formation (C1 is)

Late Carboniferous-Early Permian Dush-Ovoo Formation (C3-P1 ds)

Lower Permian Tsogtsetsy Formation (P1 cc)

Upper Permian Jirem Formation (P2qr)

The coal-bearing sediments of the Tavantolgoi Formation of the Tavantolgoi deposit contain layers of coal 0-XIII with a thickness of 1-86 meters (86.2 m thick in well 1298 and 74 m in well 1295 with stone age from layer VIII). There are 10 seams of coal from 0 to IX in the area of Tsankh, and the area is limited by exploration line XII in the west, XIII in the east, and XI in the north.

In the Uhaakhudag area, the thickness of the Tavantolgoi formation reaches 674 meters, at the preliminary exploration stage, it is noted that it contains 11 layers of coal with a total thickness of 51.43 meters. Coal layers OB, OV, III, IVA, IVB, V, VIII, and IX are coking. The coal seams have a composite structure, coal thicknesses range from 2.37 to 6.56 m, and contain up to 7 siltstones with a thickness of 0.08 to 1.0 m. The layers have an average spacing of 9-97m and are classified as relatively stable for the thickness and structure. In the Bortolgoi area, the thickness of the Late Permian coal-bearing sediments is 760 meters, and the 0-IV layers, which comprise 9 layers of coal at the prospecting stage, are located 43-75 meters above each other stratigraphically, according to the report. Coal seams range in thickness from 3.15 to 15.87 m and contain up to 9 siltstones. According to the thickness and structure of the layers, it is classified as unstable. It is proven that at the exploration and evaluation stages, 670 m of Permian coal-bearing sediments in the Onchharaat (East) area contain 19 sets of coal seams. The coal seams are stratigraphically 24-97 meters above each other. The coal seams are quite complex in structure, the coal thickness ranges from 6.12 to 16.15 m and contains up to 6 siltstones from 0.07 to 1.06 m thick. The layers are relatively unstable in terms of thickness and structure.

GEOLOGICAL FORMATION OF COAL DEPOSIT OF NARYN SUHAIT

The Naryn Suhait coal mine is located in the southwestern part of Mongolia, in the Gurvantes sum, Umnugovi province, 57 km north of the Mongolian-Chinese border (Figure 3).

Coal in Naryn Sukhait and accompanying sedimentary sediments were deposited in promontory basins. Promontory basins are characteristically formed at continental extremities, on stable foundations. In such cases, the basin formed on the margin of a nascent basin during the Early Mesozoic, and during subsequent stages of widespread deformation, the basin was filled with sediments until it became highly rifted and disrupted. The sedimentary rock basin is filled with coal seams and branched layers of thick and fine-grained clustered rocks. Deformation of the basin-filling sediments occurred at least twice, the first during the Late Jurassic basin rifting and damage. The second deformation occurred in the late Cenozoic period, in connection with the distortion, rifting, and damage of the India-Asian sub-continent. The geological formations containing the mineable coal reserves of the Naryn Sukhait mine went from the Early Jurassic to the Middle Jurassic.

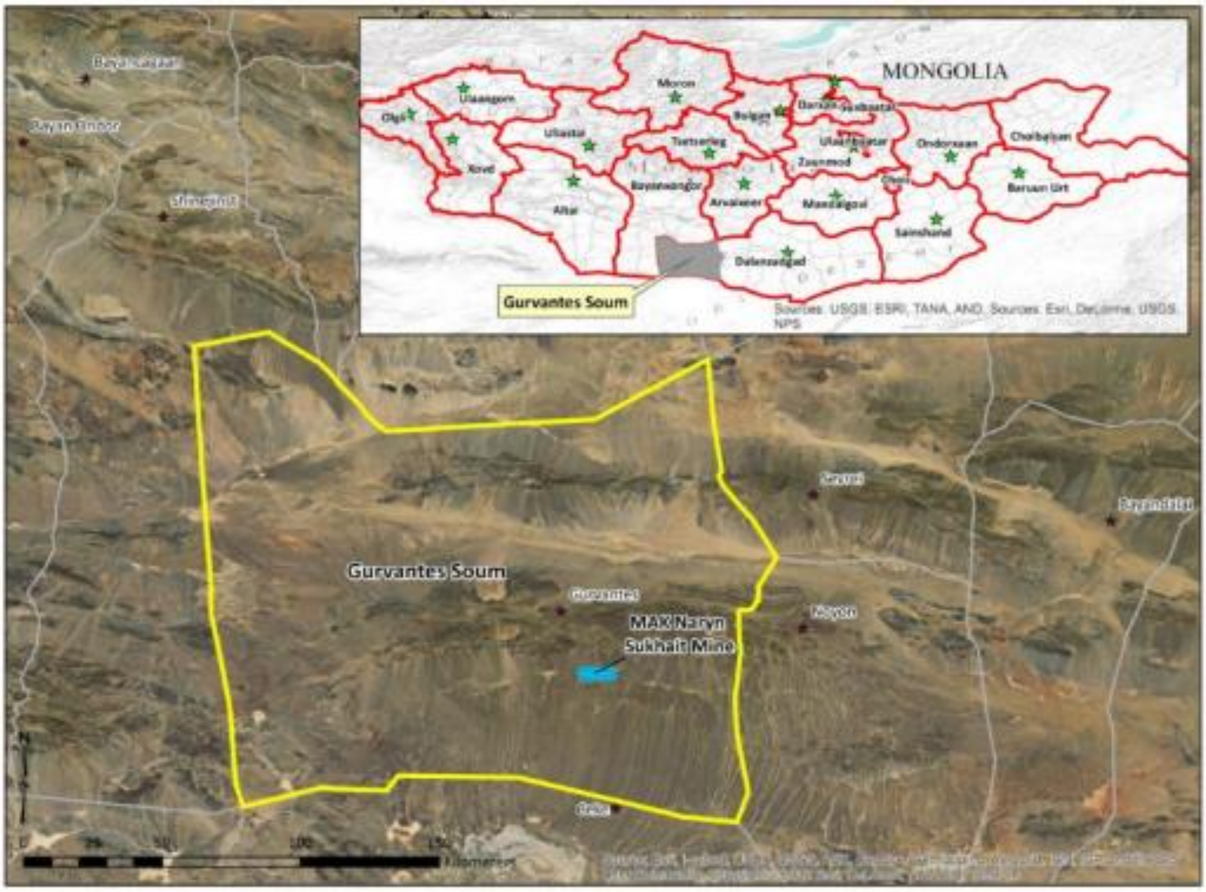

Figure 3. Location of the Naryn Suhait coal deposit

The carbonization stage of the deposit

The geological reservoirs of the Naryn Suhait deposit are estimated at more than 580 million tons. Except for the 5th layer of the Naryn Sukhait coal deposit, the layers have a complex structure, on the contrary, the enrichment characteristics are the same, the degree of enrichment is light, the content of clay minerals bound to the coal is low, and the amount of coal pollution or ash is found to be mostly caused by external pollution. Coal from the deposit belongs to the GF (GF) mark or 1/3 coking coal category. Coals classified due to weak adhesion depend on their ash content, so all coals, except oxidized coals of the surface layer, are classified as 1/3 coking grade coal when they are enriched during extraction and utilization, and the ash content is kept below 10%. Previous researchers have made a complete cross-section of the Middle Jurassic (Upper Ferm) sedimentary rocks containing coal from the Nary Suhait coal deposit and separated 9 layers of coal. From them, layers I, IV, and V are industrially important, and layers I and V were closely studied. Two synclines of the explored area are Bulagtyn and Naryn Sukhait which are distinguished from each other. Carbonation is described for each one as coals in these synclines are slightly different in size and shape. Layer V has a steep vertical position on the left side (J. Dashkhorol classified this object as layer 4) and continues to the field border with a sharp leveling pattern to the west. The average intercepted thickness of layer V is 37.2 m, and the rock lentils are quite rare, while in the right flank, lentils with a thickness of 0.8-3.4 m are found. This layer is 73.6-129.4m from the VI layer above it. Layer VI extends and spreads from west to east. The average thickness of layer VI is 3.95 m. Layer VII extends from west to east but becomes thinner. The average intercepted thickness of layer VII is 3.05 m. Layer VIII extends between the west and east of the exploration area, but sometimes it becomes thinner. The average intercepted thickness of the VIII layer is 2.64m, and in the mountain strata, there are no rock layers and lentils, so it spreads out in a self-folding pattern. In this section, all cross-section lines are cut. The coal appears as successive seams 5.6-18.5m from layer VII and 6.5-38.2m from layer IX. The IX layer creates the b5, b7, b3, and b4 sub-folds when forming the left side of the Bulagt syncline, and it will prolong to the western margin of the area when forming its right side. The average intercepted thickness of the IX layer is 32.47m, and it contains 1-8 pieces of rock lentils with 1.2-19.2m thick. It appears between VIII and IX layers at 7.0-22.0m below, and 5.8-18.0m above. Coal seam thickness becomes slightly thinner from west to east.

RESEARCH RESULTS

19 Naryn Sukhait samples and 14 Tavan Tolgoi samples totaling 33 samples were analyzed for CBM gas composition. The samples were made at the customers' expense and have not been disclosed to the public, so at the customer's request, the details of the customer and the geographic location of the samples taken from the deposits have been kept confidential.

MATERIALS AND RESEARCH METHODS

Empirical data collection, observation, comparison, and experimental research methods have been used in this research work.

Gas chromatographic method for determination of coal bed methane gas composition

The gas chromatographic method for determining the composition of the natural gas mixture is the most widely used in the world, and it has been used since the 1960s for the qualitative and quantitative analysis of the components of natural gas. For Mongolia, the method was introduced lately, but only at the onset of the 2010s, the gas chromatography was used to determine composition analysis. The advantages of determining the composition of the gas are high precision and low error, while the disadvantages are high operating cost, premium purity gas used, large size resulting in difficulties to transport and use, or high sensitivity; the latter requires a clean environment, constant care, and maintenance. However, in the last few years, compact single-detector micro-gas chromatography systems have been increasingly used at geological exploration laboratories. A fully equipped gas chromatographic instrument is used to analyze the methane gas composition of coal seams.

Sampling and Preparation

19 Naryn Suhait samples and 14 Tavan Tolgoi samples totaling 33 samples for CBM gas composition were taken with the same method.

The sample was placed directly from the carcass sample taken out of the well into a 500 ml TEDLAR sampling bag, stored in a foam box, transported, and delivered to the laboratory within 7 days. The Tedlar bag is made of PTFE-polytetrafluoroethylene material and has a 3.5 mm valve tube made of Teflon polymer. Teflon is made with material resistant to mechanical action, friction, and heat.

Data Analysis Methods and Techniques

Gas chromatography equipment determined gas composition with a PERKIN ELMER CLARUS 500 gas sampler. The instrument is equipped with TCD and FID detectors, and a TCD or thermal conductivity detector is used for CBM gas analysis.

Carrier Gas

Helium gas with a purity of 99.999% has been used as a carrier gas. The carrier gas flow rate was 40 mL/min automatically adjusted by the computer program.

Programming in Gas Chromatography

The TOTALCHROM Navigator program controls gas chromatography analysis. The program provides data such as time, temperature data, pressure, sample injection volume, and time for the sample to be analyzed. Programming in Gas Chromatography is a method of programming the temperature data of the instrument to run the sample.

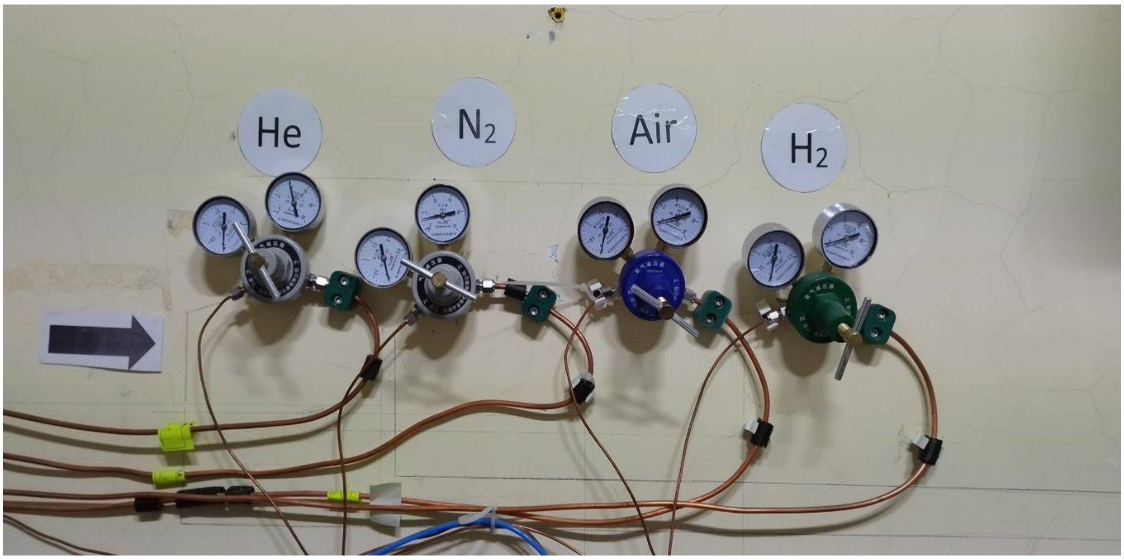

Figure 4. Chromatographic gas supply

Analysis sequence and methodology

To prepare for analysis, turn on the chromatograph, open the gasses, and read the stabilization program, when the carrier gas is circulated and heated at 200-250ºC for 3-4 hours to stabilize the column. Out of a total of about 10 ml of sample, 1 ml of the sample enters the column for analysis. The incoming sample is stepwise heated using a furnace and subjected to a separation process in the column with a carrier gas of 40 ml per minute.

Figure 5. Perkin Elmer Clarus 500 Gas Chromatograph

In the gas composition of the samples taken at a depth of 2-47 meters from the well of the Tavan head coal deposit, the majority of gas composition ranges from 28.7% to 81.68% methane gas, from 13.26% to 57.13% nitrogen, from 3.26% to13.36% oxygen, from 0.06% to 0.16% carbon dioxide, from 0.01% to 0.06% ethane, from 0.69% to 1.07% ethene, according to the analysis (Table 1).

Table 1.

The gas composition of samples taken from the Tavantolgoi coal deposit

#	Sample depth in meters	Gas composition, %					
		Methane	Nitrogen	Oxygen	CO_2	Ethan	Ethene
1	2	28.7	57.13	13.36	0.06	0	0.69
2	4	64.64	27.88	6.52	0.1	0	0.8
3	6	66.63	26.21	6.13	0.16	0	0.81
4	10	75.4	18.98	4.44	0.12	0.03	0.97
5	14	70.79	22.65	5.30	0.1	0.04	1.04
6	16	64.72	27.62	6.46	0.15	0.06	0.92
7	19	73.14	20.90	4.88	0.09	0.04	0.87
8	20	71.1	22.57	5.28	0.1	0.01	0.87
9	20	78.74	16.19	3.78	0.1	0.04	1.07
10	25	66.45	26.45	6.18	0.11	0.02	0.73
11	29	79.7	13.26	5.83	0.1	0	1.04
12	36	76.64	18.01	4.21	0.13	0	0.94
13	42	81.68	13.96	3.26	0.14	0	0.9
14	47	71.37	22.57	5.27	0.11	0.01	0.61

Correlation between methane gas content and the depth of the borehole

When selecting the methane gas samples, the samples were randomly taken in steps of 4-5 meters. Figure 6 depicts that the methane composition of the samples has a linear correlation to the deposit depth. As for nitrogen, a decreasing phenomenon was also observed depending on the depth (Figure 7). This is because the air rate in the gas composition decreases as the coal layer gets deeper. However, there is a very weak correlation between carbon dioxide and deposit depth (Figure 8).

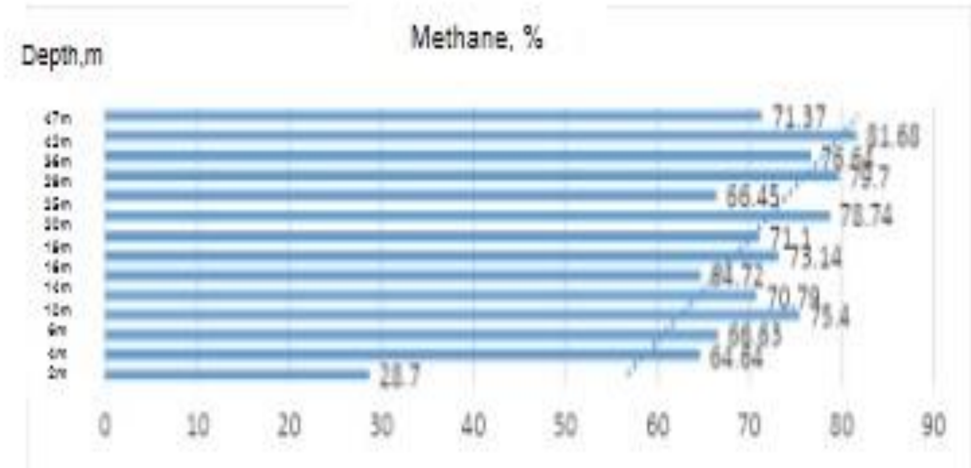

Figure 6. Correlation between methane content and borehole depth

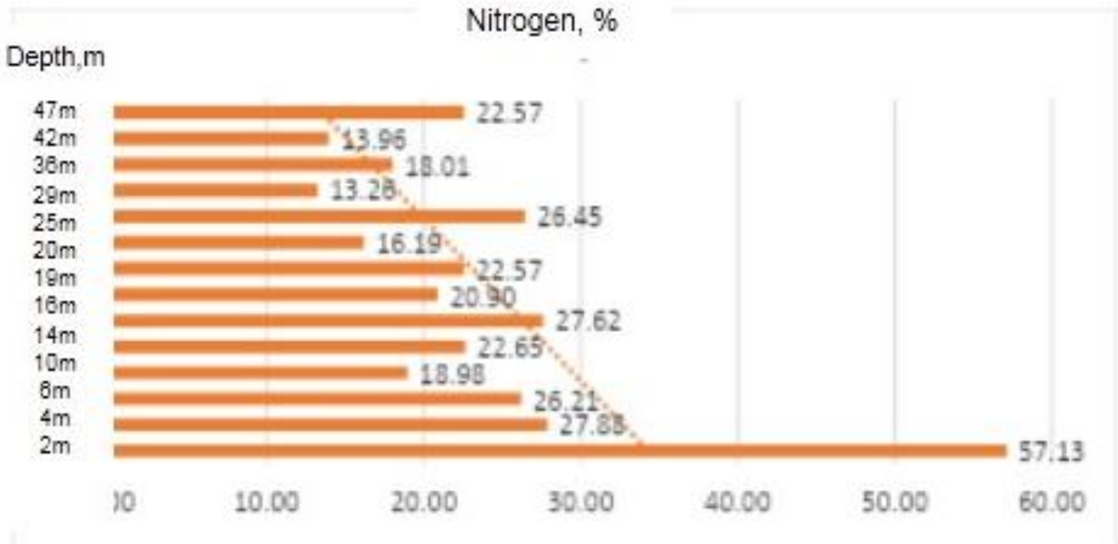

Figure 7. Correlation nitrogen gas content and borehole depth

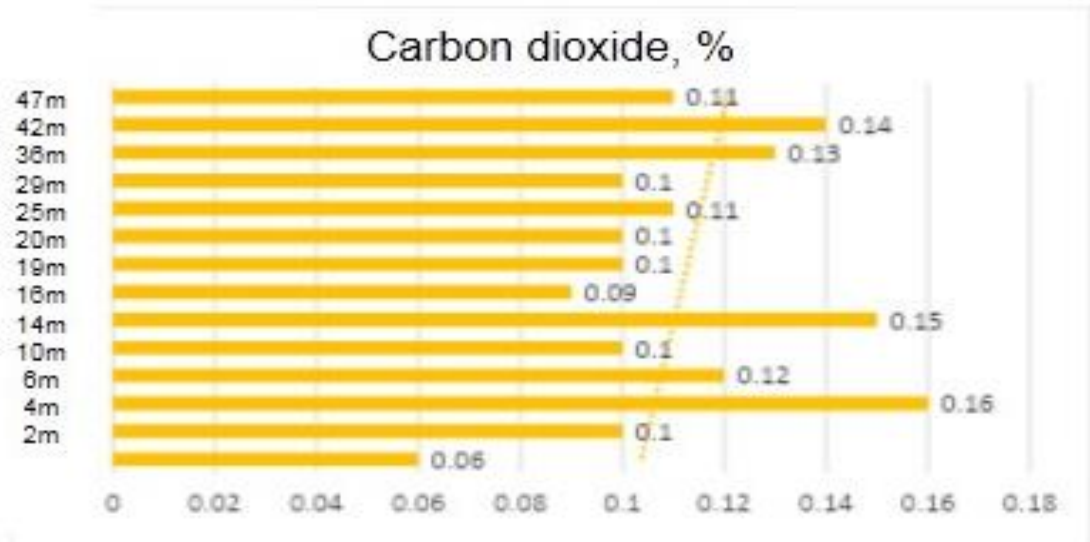

Figure 8. Correlation between carbon dioxide content and borehole depth

The gas composition of the samples taken from a depth of 10-180 meters at the borehole of the Naryn Sukhait coal deposit contains methane gas between 62.2-95.49% which constitutes the majority of gas composition, nitrogen 1.21-27.57%, oxygen 0.78-7.16%, carbon dioxide 0.01-3.31%, carbon monoxide 1.29- 4.54%, propane between 0.02 and 1.13% (Table 2), according to the estimation.

Table 2.

The gas composition of samples taken from Naryn Sukhait coal deposit

#	Sample depth in meters	O_2	N_2	CO	CH_4	CO_2	C_3H_8
1	10	3.93	14.28	2.33	77.20	2.22	0.05
2	16	2.82	9.85	2.22	81.47	3.17	0.46
3	25	1.98	7.65	4.45	85.38	0.10	0.45
4	30	2.42	8.71	2.47	83.76	2.62	0.02
5	47	4.85	18.00	2.38	73.74	0.22	0.82
6	58	2.14	8.33	2.31	85.85	0.27	1.10
7	75	-	8.88	2.29	86.44	2.12	0.27
8	85	7.16	27.57	1.65	62.20	0.83	0.59
9	95	0.78	6.53	2.28	86.80	3.19	0.43
10	105	3.30	12.53	4.54	78.35	0.32	0.96
11	113	-	2.59	2.55	91.37	3.03	0.46
12	120	2.92	10.77	2.41	82.79	0.27	0.84
13	128	-	1.85	1.29	95.49	0.38	0.99
14	136	2.46	8.37	2.18	84.44	2.50	0.04
15	144	-	1.21	2.60	93.41	2.76	0.03
16	150	3.06	11.16	2.37	81.81	0.24	1.36
17	156	3.05	11.31	2.25	81.99	0.27	1.13
18	163	-	9.83	2.44	84.07	3.31	0.34
19	180	-	7.83	2.69	86.57	2.53	0.39

Figures 9, 10, and 11 show how methane gas content, nitrogen gas content, and carbon dioxide content depend on the depth of the fine coal deposit.

When comparing the composition of methane gas at the same depth in the Tavan Tolgoi and Naryn Sukhait coal deposits, the Naryn Sukhait deposit has a relatively high methane gas content of 62.2-95.49%, low nitrogen content of 1.21-27.57%, low oxygen content of 0.78-7.16%, carbon dioxide of 0.01-3.31%, propane of 0.02-1.13% that is called the residue, a relatively heavy gas, due to estimates (Figure 12).

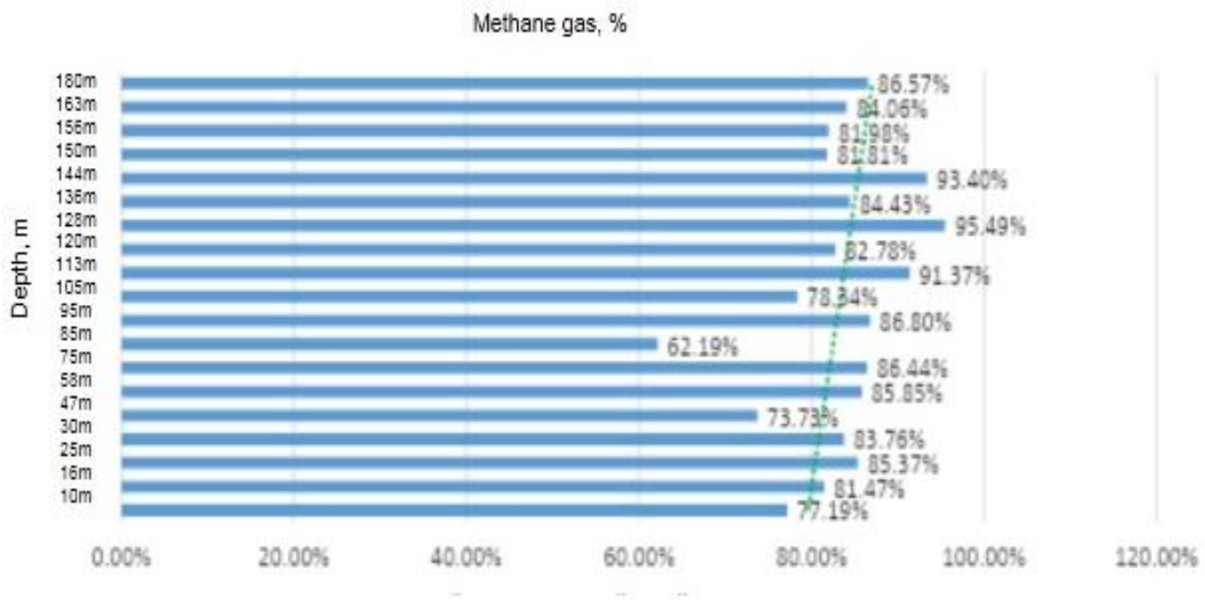

Figure 9. Correlation between methane content and borehole depth

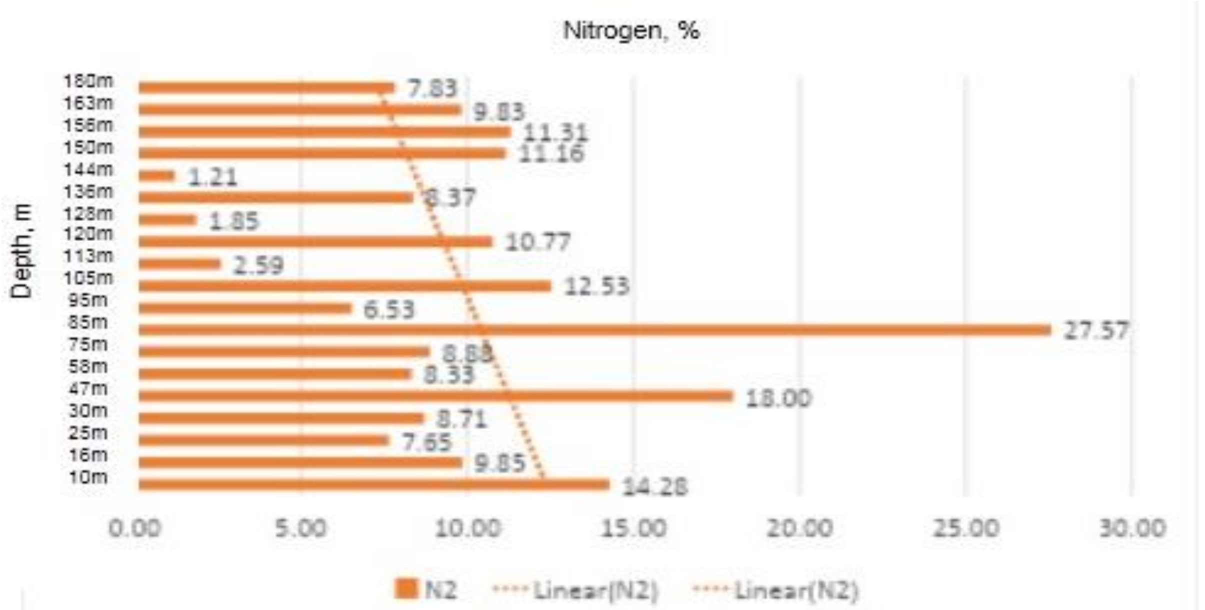

Figure 10. Correlation between nitrogen gas content and borehole depth

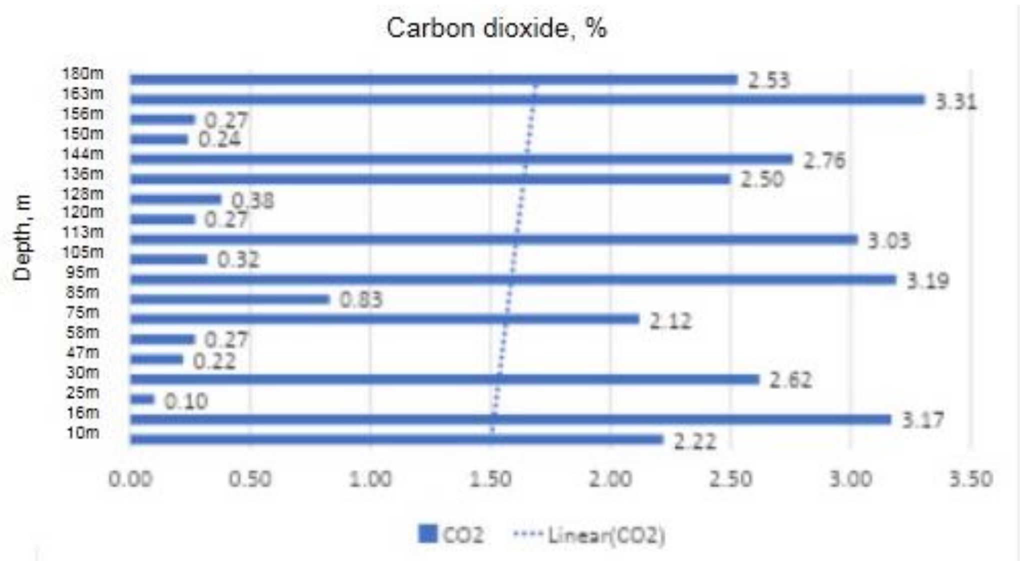

Figure 11. Correlation between carbon dioxide content and borehole depth

A comparative study of gas composition at the Tavan Tolgoi and Narij Sukhait coal deposits

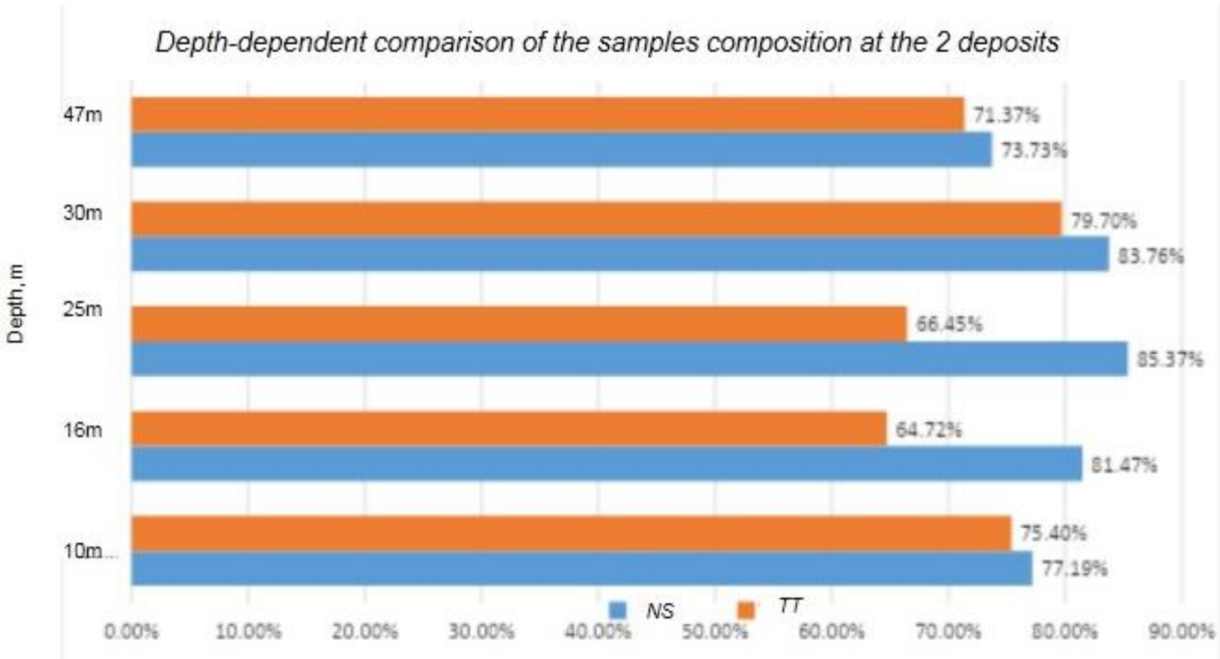

Figure 12. Depth-dependent comparison of the samples composition at the 2 deposits
TT – Tavan Tolgoi coal deposit gas
NS-Naryn Sukhait coal deposit gas

As shown in Table 3, it is obvious that the Naryn Sukhait deposit has a higher amount of ash but a relatively lower amount of moisture and sulfur compared to the Tavan Tolgoi deposit.

Table 3.
Chemical characteristics of coal at the Tavan Tolgoi and Naryn Sukhait coal deposits

#	Indicators	Tavan Tolgoi deposit	Naryn Sukhait deposit
1	Ash content, (%)	14.9%	5-30%
2	Moisture content,%	6.9%	5%
3	Moist and air-dried	0.1-2.5%	1.0-2.8%
4	Volatility Daf,%	32.8	20-40
5	Age	P2	P2
6	Classification	HV(C)-LV	HV(C)-A
7	Sulphur, %	0.8%	0.4%

As moisture and sulfur content at the Naryn Sukhait deposit is relatively low, it is possible to use a relatively simple technology to purify its coal seam gas. Findings reveal that the relatively different content of chemical properties of the 2 deposits’ coal depends on certain factors such as the geological parameters, age, and properties of the coal. Moreover, the gas composition is affected by external factors: gas sampling and transportation methods, etc.

One of the biggest factors that affect sampling is the sampling method since there are many different sampling methods. Standard sampling equipment is considered to be different from one another. In addition, it depends on the abilities of the person processing the sampling. The sampling is primarily measured with the amount of methane gas in the coal drill bit sample – Q, and this method mostly follows the Australian standard AS 3980:2016 to determine gas content in coal and other carbon-bearing minerals. The transfer of drill samples from the depth depends on factors such as preparation and speed of the specialist. Methane gas is separated from the coal sample by pushing with helium and other inert gases. 300-1000 ml of separated gas is stored and sealed in a special plastic sample bag. The borehole identity, sample number, collection date, and time should be recorded on its label. Theoretically, the samples taken from the same depth cannot have a relative error of more than 15%. However, in this case, a relative error has been close to or greater than 15%, according to the analysis of the samples from one borehole. This is likely to have appeared due to the time of preparation or packaging, transportation, and a sealing error of the sample.

CONCLUSIONS

The laboratory analysis of methane gas samples at the Tavan Tolgoi and Naryn Sukhait deposits by gas chromatography revealed that the variation of methane gas content is medium to high, from 60 to 96%, which means that CBM does not require deep purification technology, as well as gas can be served for energy, automobiles, and domestic use. When comparing the methane gas composition at the same depth of both deposits, it was discovered that the Naryn Sukhait deposit has a relatively high methane gas of 62.2-95.49%, lower nitrogen of 1.21-27.57%, lower oxygen of 0.78-7.16%, carbon gas of 0.01-3.31%, and the residue or propane, a relatively heavy gas at a rate of 0.02-1.13%.

The pattern of changes in the composition of methane gas in the coal seam depending on the depth was observed for both deposits, and the content of methane gas increases with the depth of the coal seam, according to previous geological exploration reports.

In coalbed methane sampling, the sample composition of some boreholes is significantly different, indicating the need to improve the sampling methodology and reduce sample loss.

To do this, it is necessary to improve the standard methods, sampling techniques, and the sampling staff's abilities.

REFERENCES

1. Bayarsaikhan B, Avid B. “Coalbed Methane Research” News of the Academy of Sciences. 2010. № 03 (197).
2. Bujidmaa D. "Feasibility Study of Coalbed Methane Gas".
3. Narangerel J. "Fundamentals of Coal Chemical Technology", UB, 2021.
4. Zolzaya D. "The Possibility Study of Recharging Vehicles with Methane Gas from the Tavan Tolgoi Coal Deposit". 2016. 69 pages.
5. Sunjidmaa B. Review on Mineral Resources. UB 2022.
6. Rodney A. Gayer. Coalbed Methane and Coal Geology-Geological Society Pub House. 1996.
7. Lamarre, R.A. Coal bed Methane. A Compendium of Influential Papers. AAPG. 2006.
8. Tumurbaatar Z. Climate Changes and Coalbed Methane Utilization Opportunities. Ulaanbaatar city 2020. 248 pages.
9. Shivanjali Sharma, Amit Saxena, Neha Saxena. Introduction to Coal Bed Methane. 2019.
10. Cooper, Murchison. Organic Geochemistry of Coal. Organic Chemistry 1969.
11. A Summary Report of Resource Assessment of Licensed Areas MV-011953, MV-011954, MV-011955, MV-011956 Belonged to A Group of Tavan Tolgoi Mines in Tsanhi, Borteeg (South), Oortsog (West-South), Onchharaat (East), in the West of Bor tolgoi, Ukhaa khudag Located in Tsogt tsetsiy Sum, South Gobi Province.
12. Pre-feasibility Study for Coal Mine Methane Recovery and Utilization at Naryn Sukhait Mine, Raven Ridge 2013.

13. Pramod Thakur, Steve Schatzel, Kashy Aminian, Morgan Mosser, Gary Rodvelt, Joeseph D'Amico - Coal Bed Methane. Theory and Applications. 2020.
14. "Policy and Planning of the Oil Industry" Report, Ministry of Mines and Heavy Industry.

Наранцецег Батбуян, Оюнтугс Магсар, Болормаа Аюурзана

ВИВЧЕННЯ СКЛАДУ ГАЗУ У ВУГІЛЬНИХ РОДОВИЩАХ МОНГОЛІЇ

У дослідженні проведено порівняння складу газу 33 проб: 14 зразків відібраних на вугільному родовищі Таван Толгой та 19 зразків з вугільного родовища Нарин Сухайт. У зазначених зразках, взятих для дослідження складу газу згідно з Австралійським стандартом АС 3980:2016, проведена газова хроматографія в лабораторії ТОВ «Green Crown». Метою даного дослідження було визначення кореляції між складом метанового газу вугільних пластів родовищ Таван Толгой та Нарин Сухайт, які відрізняються глибиною залягання та потужністю вугільних пластів, хімічними та фізичними властивостями вугілля та тріщинами у породах. Для вищевказаних родовищ результати показали, що у складі метанового газу вугільних пластів (метан) міститься до 95% метанового газу, склад якого варіюється залежно від геологічних та гідрогеологічних умов родовищ, фізичних та хімічних властивостей порід, що містять родовище, структури вугілля, віку, тиску пласта та способу відбору проб газу. Результати, отримані при дослідженні вмісту газу, вказують, що стандартна методологія потребує вдосконалення. Лабораторний аналіз проб метанового газу родовищ Таван Толгой та Нарин Сухайт показав, що діапазон вмісту метанового газу середній та високий, від 60 до 96%, що означає: досліджений газ не потребує додаткової технології глибокого очищення та може використовуватись для автомобілів, енергетичних та побутових потреб.
Ключові слова: геологія вугільних родовищ, метановий газ вугільних пластів, склад газу, фізичні та хімічні властивості газу вугільних родовищ

Mongolian State University of Science and Technology (MUST), School of Geology and Mining, Ulaanbaatar, Mongolia

Narantsetseg Buyanbat
Dr (PhD),

Associate Professor of the Oil and Drilling department
https://orcid.org/0000-0002-1422-3294

School of Geology and Mining at MUST
Oyuntugs Magsar
Head of the Oil and Drilling department,
Dr (PhD), Associate Professor
e – mail : moyuntugs@must.edu.mn
https://orcid.org/0000-0002-8191-3877

Bolormaa Ayurzana
Vice Dean of the School of Foreign Languages at MUST,
Dr (PhD), Associate Professor
https://orcid.org/0009-0001-7232-4245

Стаття надійшла: 10.11.2024