CASE STUDY ON THE APPLICATION OF UNFC TO ENERGY AND MINERAL RESOURCES IN KYRGYZSTAN

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EXECUTIVE SUMMARY

As part of the UNECE project “Improving national capacities of Central Asian countries to harmonize and implement internationally applicable system of classification and sustainable management of energy and mineral resources”, a “Case Study on the application of the United Nations Framework Classification (UNFC) to Energy and Mineral Resources in Kyrgyzstan” was carried out.

The objective of this assignment was to conduct and prepare Case study on application of UNFC to energy and mineral resources classification and management, aimed to explore opportunities and challenges in using UNFC in Kyrgyzstan.

During the work, two comparison schemes (in tabular form) were made between the UNFC and the “Classification of deposits reserves and prognostic resources of solid minerals of the Kyrgyz Republic”, “Classification of deposits reserves, oil and combustible gases perspective and prognostic resources”.

Two objects were selected for the case study:

1. a complex gold, silver and copper deposit (deposit No.1), and;
2. a multi-pool deposit of oil and gas with a wide stratigraphic range of oil and gas productivity.

In order to maintain confidentiality, the names of objects were not disclosed.

According to the results of the works, the complex deposit No.1 was classified according to UNFC as: E1.1 F1.3 G3, that is, the mining and marketing of minerals are profitable under current market conditions and realistic predictions of future market conditions. Mineral reserves are classified as reserves with a low reliability rating. At the moment, detailed studies have been completed in deposit No.1, which were targeted to demonstrate the expediency of mining by implementing a specific development project or mining operations.

The main reserves of oil and gas deposit No.2 have been assigned a code E2. F2.1.G3 on UNFC; in addition, there are additional quantities of oil and gas in the stratum that have been assigned the code E3.3. F4. G3.

The adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of the Sustainable development Goals (SDG) 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDG 1, 2 and 8. The environmental aspect is unlikely to change as a result of the implementation of the UNFC; however, attracting investment in renewable energy can facilitate achievement of SDG 11 and 13.

Based on the results of the study, certain conclusions were drawn on the existing classifications used in the Kyrgyz Republic, as well as on the advantages and problems of using the UNFC in the Kyrgyz Republic, which are discussed in more detail in the conclusion of the study.

The implementation of the UNFC system should be consistent. The complete abandonment of the existing system of the National Classification of Energy and Mineral Reserves and Resources and the transition to UNFC will take time. Because, this requires reanalysis of all geological and technical-economic materials left over from the times of the Former Soviet Union.

An assessment by the UNFC system of the country's major energy and mineral objects will help attract larger bona fide investments in the development of the country's economy. It is worth noting that when applying the UNFC in Kyrgyzstan, certain classes should be distinguished according to the assessment of environmental and social impacts, because when implementing projects in Kyrgyzstan, there is an acute problem with solving these problems.

A renewable energy object has not been studied in the Case study due to the lack of a national classification of reserves and prognostic resources for renewable energy in the Kyrgyz Republic, but the study provides a brief summary of perspectivity for its use, as well as the possibility of introducing UNFC in this field. It is considered that it is necessary to carry out an assessment, namely, of the competitive objects, as well as renewable energy objects of the Kyrgyz Republic according to the UNFC system. Competitive objects will give a clearer and more realistic picture of the deposit and save time for future investors and the government of the Kyrgyz Republic. It will allow to assess the risks and economic efficiency of investing. Moreover, renewable energy objects on the territory of the Kyrgyz Republic require urgent investment.

In addition, sector of renewable energy sources in Kyrgyzstan is poorly studied, and in this regard the start of the UNFC implementation in Kyrgyzstan should begin from this sector, as currently there are no classifications in this field. The implementation will be simpler, and by using this example, experience on working with the UNFC would be gained, which will be useful in the future. This issue is discussed in Appendix 10.

Based on the results of this case study, it was concluded that the application of the UNFC system in the Kyrgyz Republic would give positive dynamics in the development of the country's mining sector. Nevertheless, as stated above, it takes time for a full transition to the UNFC system. The issue of adaptation and successful implementation of the UNFC in Kyrgyzstan requires optimally close interaction between the state and the subsoil user and the corresponding geopolitical, economic and technological platform.

INTRODUCTION

On the territory of the Kyrgyz Republic there are unified principles for calculating, assessing and state accounting of energy and mineral reserves and prognostic resources based on the "Classification of deposits reserves and prognostic resources of solid minerals of the Kyrgyz Republic" [1], "Classification of deposits reserves, oil and combustible gases perspective and prognostic resources"[2].

Currently, there are no Bridging Documents between the United Nations Framework Classification of Energy and Mineral Reserves and Resources and the National Classifications of Energy and Mineral Reserves and Resources, therefore, the comparison schemes developed in the study are used in this work.

Due to the lack of a unified classification for energy and mineral resources, for the more detailed comparison of the various classifications listed above that are applied in the Kyrgyz Republic with the UNFC, two areas were selected for the Case Study: the first one is a solid mineral deposit and another one is oil and gas deposit. In order to maintain confidentiality, the names of the studied areas are not disclosed.

As an object of study with solid minerals, a deposit of gold, silver and copper was taken (hereinafter deposit No.1). The terrain is rocky-talus, sharply partitioned with an absolute elevation of 3,700-4,000 m. The deposit belongs to the 3rd group of complexity: a complex geological structure, represented by vein zones with ore bodies up to 1-2 m or more in thickness, with a very uneven distribution of mineralization, often discontinuous. At the moment, quite detailed studies have been completed in the part of the deposit, balance reserves of the first stage in categories C_1 and C_2, which correspond to category E1.1.G3 in the UNFC, have been put on the State Balance. In addition, a mining project has been drawn up which demonstrates the expediency of mining, which corresponds to category F1.3.

Deposit No.2 (the second object of study) is a multi-pool type with a wide stratigraphic range of oil and gas productivity. All pools of the deposit are stratified, crested. In 2012, a recalculation of oil and gas reserves was compiled for stratum IV and VIII. Reserves on category C_1 of the deposit No.2 for stratum IV and VIII amounted to: oil – 4623.616 thousand tons, free gas - 162.375 million m^3, dissolved gas – 297.212 million m^3. Of these, 1019.9 thousand tons of on-balance oil reserves and 65.241 million m^3 of dissolved gas on category C1, which correspond to the category E2.G3 in the UNFC. Currently, on these reserves at deposit No.2 works is in progress to draw up a project for mining the deposit, attracting investors and searching for additional geological information. Thus, the status and validity of the project corresponds to category F2.1. The remaining reserves of oil, free and dissolved gas are non-recoverable, i.e. in the UNFC they correspond to the category E3.3. F4.G3.

Such sector of industry as renewable energy sources (RES) in Kyrgyzstan is underdeveloped; the relevant regulatory framework is not sufficiently developed in this sector. On the territory of the Kyrgyz Republic, presently, there is no classification of reserves and prognostic resources for renewable energy sources. Given the above, a comparison of the classification on the example of an object with a renewable energy source was not carried out, but the study provides brief information about the prospects of using renewable energy sources in Kyrgyzstan, as well as the possibility of introducing UNFC in this industry. I express my gratitude to the Association of Small Hydroelectric Power Plants and particularly its head Ms. Elvira Borombaeva for the material provided in the field of renewable energy sources.

NATIONAL CLASSIFICATION SYSTEM FOR ENERGY AND MINERAL RESOURCES AND BRIDGING OR MAPPING TO UNFC

Description and details of the national classification and management system

The classification system of the Kyrgyz Republic is based on the classification of the USSR. This classification of reserves shows mainly qualitative requirements on the completeness of exploration maturity of a deposit, providing baseline information for a feasibility study of conditions and reserves calculation.

According to the degree of geological knowledge, four categories of reserves (A, B, C_1, C_2) and three categories of prognostic resources (P1, P2, P3) are distinguished (Tab.1).

Tab.1 – Reserves categories and characteristics

Reserves category	Reserves characteristic
A	Category A includes detailed explored mineral reserves with precisely defined boundaries of the mineral bodies, their forms and structure. Reserves stand out in the detailing areas of exploration and mined deposits of the 1st group of complexity of the geological structure.
B	Category B includes previously explored mineral reserves with approximately defined contours of mineral bodies, without accurately reflecting the spatial position of minerals natural type. Category B reserves are stand out in the detailing areas of exploration and mined deposits of the 1st and 2nd groups of complexity of the geological structure.
C_1	Category C_1 includes reserves of explored deposits of complex geological structure, as well as poorly explored mineral reserves in new areas, taking into account extrapolation. Reserves of category C_1 comprise the bulk of reserves of explored and mined deposits of the 1st, 2nd and 3rd complexity groups of the geological structure, and can stand out in the detailing areas of deposits of the 4th complexity group.
C_2	Category C_2 includes perspective reserves. Reserves of category C_2 stand out during the exploration of deposits of all complexity groups, and in deposits of the 4th group of complexity of the geological structure make up the bulk of the reserves involved in mining.
P_1	Category P_1 prognostic resources take into account the possibility of expanding the boundaries of mineral distribution beyond the C2 reserves or identifying new ore bodies of minerals in ore occurrences, explored and exploring deposits.
P_2	Category P_2 prognostic resources take into account the possibility of discovering new mineral deposits in the basin, ore region, cluster, field, which estimated presence is based on a positive assessment of the mineral occurrences discovered during large-scale (in some cases, medium-scale) geological surveys and prospecting works, as well as geophysical and geochemical anomalies, which nature and possible prospectivity are established by single workings.
P_3	Category P_3 prognostic resources take into account only the potential possibility of discovery of deposits of one or another type of mineral based on favorable geological and paleogeographic prerequisites identified in the evaluated region during medium-small-scale geological and geophysical surveys, geological surveys, interpretation of satellite images, and also during analysis the results of geophysical and geochemical studies.

According to the economic value, the reserves of solid minerals and the mineral components contained in them, subject to state accounting, are divided into two main groups:

- On-balance (economic);
- Off-balance (potentially economic), which are subject to separate calculation and accounting.

On-balance (economic) reserves include reserves, the mining of which at the time of assessment according to technical and economic calculations is economically effective under competitive market conditions using equipment, mining technology and minerals processing, ensuring compliance with the requirements for the rational use of subsoil and environmental protection.

Off-balance (potentially economic) include:

1. Reserves, which mining at the time of the assessment according to technical and economic calculations is not economically efficient (unprofitable) in a competitive market conditions due to low technical and economic indicators, but which development becomes economically possible when mineral prices change, optimal sale markets or new technology occurs;
2. Reserves meeting the requirements for on-balance reserves, but the use at the time of assessment is impossible due to the location within the water protection zones, settlements, facilities, agricultural facilities, natural reserves, natural monuments, history and culture.

Off-balance reserves are calculated and taken into account if the feasibility studies have established the possibility of their subsequent extraction or the expediency of associated extraction, storage and preservation for future use. Off-balance reserves are calculated separately depending on the basis for attribution to this group.

Thus, the system for classifying reserves of deposits and prognostic resources of solid minerals of the Kyrgyz Republic is difficult to compare with the UNFC. They have a number of significant differences:

1. While the UNFC is based on three fundamental criteria's: economic and social viability of the project (E), the status and validity of the deposit development project (F), and geological knowledge (G), the classification of the Kyrgyz Republic is based on two criteria: (1) state of readiness for industrial development and profitability of mining (on-balance and off-balance reserves); (2) geological knowledge. The first classification criterion of the Kyrgyz Republic combines the first two categories of the UNFC (axis E and F).
2. In UNFC reserves classification for known (discovered) deposits, three degrees of reliability for geological knowledge are indicated: "high", "medium" and "low", they are represented by categories G_1, G_2 and G_3, in the classification of the Kyrgyz Republic, these degrees are represented by categories A (high), B (medium), C_1 and C_2 (low). For deposits known only by indirect data, the G4 category is used, while the P_1-P_3 categories are used in the classification of the Kyrgyz Republic. A significant difference between the classification of the Kyrgyz Republic and the UNFC is the fact that resources of categories P_1-P_3 in the UNFC are not classified and fully classified as "probable".
3. The main difference between the two classifications is the fact that the UNFC uses a numerical code system, while the Kyrgyz Republic classification uses a textual description of all conditions.

Comparison of classes and subclasses of UNFC with the Classification of deposit reserves and prognostic resources of solid minerals of the Kyrgyz Republic is presented in Tab.2.

Tab.2 – Comparison of classes and subclasses of UNFC with the Classification of deposit reserves and prognostic resources of solid minerals of the Kyrgyz Republic

Class	Subclass	UNFC			Classification of the Kyrgyz Republic	
		E	F	G	State of readiness and profitability of development (E и F)	Reserves category (G)
Commercial projects	In mining	1	1.1	1, 2, 3	Ready for mining on-balance reserves	A, B, C_1, C_2
	Approved for development	1	1.2	1, 2, 3		A, B, C_1, C_2
	Justified for development	1	1.3	1, 2, 3		A, B, C_1, C_2
Potentially Commercial Projects	Development pending	2	2.1	1, 2, 3	Perspective for industrial development on-balance reserves	A, B, C_1, C_2
	Development on hold	2	2.2	1, 2, 3		A, B, C_1, C_2
Non-commercial projects	Development unclarified	3.2	2.2	1, 2, 3	Estimated reserves requiring additional exploration	P_1, P_2, P_3
	Development not viable	3.3	2.3	1, 2, 3		P_1, P_2, P_3
Additional quantities		3.3	4	1, 2, 3	Unprofitable for industrial development or non-recoverable	A, B, C_1, C_2
Exploration Projects	Subclasses not defined	3.2	3	4	For this class is not defined	P_1, P_2, P_3
Additional quantities		3.3	4	4		P_1, P_2, P_3

Classification of reserves, perspective and prognostic oil and combustible gas resources, and bridging or mapping to UNFC

Presently, in the Kyrgyz Republic, there is no State-approved classification of deposit reserves, perspective and prognostic resources of oil and combustible gases. During state accounting and calculating the reserves of deposits, perspective and prognostic oil and gas resources of the Kyrgyz Republic are based on the classification approved by the Decree of the Council of Ministers of the USSR dated April 8, 1983 [2].

This Classification establishes unified principles for calculating and state accounting of deposit reserves and perspective resources of oil and combustible gases (combustible gases mean natural hydrocarbon gases – free gas, gas cap gas and gas which was dissolved in oil) in the subsoil according to their degree of knowledge and economic value, conditions that determine the preparedness of explored deposits for industrial development, as well as the basic principles of assessing the prognostic oil and gas resources.

The reserves of oil, gas, condensate and the components of industrial importance contained in them are classified according to the degree of knowledge into explored categories A, B and C_1 and preliminary estimated category C_2. Oil and gas resources according to their degree of validity are divided into perspective – category C_3 and prognostic – categories D_1 and D_2 (Tab.3).

Tab.3 – Reserves categories and characteristics

Reserves category	Reserves characteristic
A	Pool reserves (or of a portion thereof), studied in detail, providing a complete determination of the type, shape and size of the pool, effective oil and gas saturated thickness, type of reservoir, nature of changes of reservoir properties, oil and gas saturation of productive stratums, composition and properties of oil, gas and condensate, as well as the main features of the pool, on which the conditions for its development depend. Category A reserves are calculated for the pool (part of it) drilled in accordance with the approved project for the development of an oil or gas deposit.
B	Reserves of the pool (or of a portion thereof), which oil and gas bearing is established based on the obtained industrial inflows of oil or gas in wells at various hypsometric elevations. The type, shape and size of the pool, the effective oil and gas saturated thickness, the type of reservoir, the nature of changes of reservoir properties, the oil and gas saturation of productive stratums, the composition and properties of oil, gas and condensate in stratum and standard conditions and other parameters, as well as main features of pool that determine the conditions for development have been studied to a sufficient degree to draw up a project for the development of deposits. Category B reserves are calculated according to the pool (part of it) drilled in accordance with the approved technological scheme for the development of an oil deposit or a pilot development project for a gas deposit.
C_1	Category C1 represents the reserves of a deposit (or of a portion thereof) whose oil or natural gas content has been determined on the basis of commercial flows of oil or natural gas obtained in wells (with some of the wells having been probed by a formation tester) and positive results of geological and geophysical exploration of non-probed wells. The type, shape and size of the deposit and the formation structure of the oil- and gas-bearing reservoirs have been determined from the results of drilling exploration and production wells and by those geological and geophysical exploration techniques that have been field-tested for the applicable area. The lithological content, reservoir type and characteristics, oil and natural gas saturation, oil displacement ratio and effective oil and natural gas saturation depth of the productive strata have been studied based on drill cores and geophysical well exploration materials. The composition and characteristics of crude oil, natural gas and gas condensate under in-situ and standard conditions have been studied based on well testing data. In the case of an oil and natural gas deposit, the commercial potential of its oil-bearing fringe has been determined. Well productivity, hydro- and piezo-conductivity of the stratum, stratum pressures and crude oil, natural gas and gas condensate temperatures and yields have been studied on the basis of well testing and well exploration results. The hydrogeological and geocryological conditions have been determined based on well drilling results and comparisons with neighboring explored fields. Category C1 reserves are computed on the basis of results of geological exploration work and production drilling and must have been studied in sufficient detail to yield data from which to draw up either a trial industrial development project in the case of a natural gas field or a technological development scheme in the case of an oil field.

C_2	Category C2 reserves are preliminary estimated reserves of a deposit calculated on the basis of geological and geophysical research of unexplored sections of deposits adjoining sections of a field containing reserves of higher categories and of untested deposits of explored fields. The shape, size, structure, level, reservoir types, content and characteristics of the hydrocarbon deposit are determined in general terms based on the results of the geological and geophysical exploration and information on the more fully explored portions of a deposit. Category C2 reserves are used to determine the development potential of a field and to plan geological, exploration and production activities.
C_3	Category C3 resources are prospective reserves prepared for the drilling of (i) traps within the oil-and-gas bearing area, delineated by geological and geophysical exploration methods tested for such area and (ii) the formation of explored fields which have not yet been exposed by drilling. The form, size and stratification conditions of the assumed deposit are estimated from the results of geological and geophysical research. The thickness, reservoir characteristics of the formations, the composition and the characteristics of hydrocarbons are assumed to be analogous to those for explored fields. Category C3 resources are used in the planning of prospecting and exploration work in areas known to contain other reserve bearing deposits.
D_1	Resources are calculated based on the results the region's geological, geophysical and geochemical research and by analogy with explored deposits within the region being evaluated. Category D1 resources are reserves in lithological and stratigraphic series that are evaluated within the boundaries of large regional structures confirmed to contain commercial reserves of oil and natural gas.
D_2	Resources are calculated using assumed parameters on the basis of general geological concepts and by analogy with other, better studied regions with explored oil and natural gas deposits. Category D2 resources are reserves in lithological and stratigraphic series that are evaluated within the boundaries of large regional structures not yet confirmed to contain commercial reserves of oil and natural gas. The prospects for these series to prove to be oil-and gas-bearing are evaluated based on geological, geophysical and geochemical research.

Reserves of oil, gas, condensate and components of industrial importance contained in them are divided into two groups according to national economic value, which are subject to separate calculation and accounting: on-balance - reserves of deposits (pools), involvement of which for development currently is economically feasible; off-balance - reserves of deposits (pools), involvement of which currently is not economically feasible or technically and technologically impossible, but which in the future can be converted into on-balance reserves.

The preparedness of explored oil and gas deposits (pools) for industrial development is determined by the degree of their knowledge, regardless of the size and complexity of the geological structure.

Explored deposits (pools) or parts of deposits (pools) of oil and gas are considered prepared for industrial development in compliance with the following conditions:

- on-balance and recoverable reserves of oil, gas, condensate and components of industrial importance contained therein are approved by the State Committee for Mineral Reserves of the Kyrgyz Republic and an assessment of the perspective resources of oil, gas and condensate of the deposit is given;
- approved recoverable reserves of oil and condensate, on-balance reserves of gas, as well as the reserves of components of industrial importance contained therein, used in the design of enterprises for the mining of oil and gas, must be at least 80 percent of category C1 and up to 20 percent of category C2. The possibility of industrial

development of explored deposits (pools) or parts of deposits (pools) of oil and gas in the presence of reserves of category C2 more than 20 percent is established in exceptional cases of the State Committee for Mineral Reserves of the Kyrgyz Republic when approving reserves on the basis of expertise of calculation materials;

- composition and properties of oil, gas and condensate, content of components of industrial importance in them, the features of deposit (pools) development, the flow rates of oil, gas and condensate, hydrogeological, geocryological and other environmental conditions have been studied in the degree ensuring receipt of baseline data for compiling a technological scheme for the development of an oil deposit or a Pilot Development Planning Project of a gas deposit;
- in the area of explored deposit, the raw material base of construction materials and possible sources of drinking water and technical water supply should be evaluated to ensure that the needs of future enterprises for oil and gas production are satisfied;
- there is information about the presence of absorbing horizons in exploratory wells that can be used during design and survey works to study the possibilities of discharging industrial and other wastewater;
- recommendations on the development of activities to ensure the prevention of environmental pollution have been composed.

Obviously, the "Classification of deposit reserves, perspective and prognostic resources of oil and combustible gases" and the "Classification of deposit reserves and prognostic resources of solid minerals" are partially similar, therefore, part of the discrepancies in the classification of solid minerals with the UNFC will be duplicated in comparing the classification of oil and combustible gases.

In view of the above, between the classification of deposit reserves, perspective and prognostic resources of oil and combustible gas used in the Kyrgyz Republic and the UNFC, the differences can be established:

1. In UNFC reserves classification for known (discovered) deposits, three degrees of reliability for geological knowledge are indicated (axis G): "high", "medium" and "low", they are represented by categories G_1, G_2 and G_3. For deposits known only by indirect data, the UNFC uses category G4. Whereas in the classification used in the Kyrgyz Republic, reserves according to the degree of knowledge are divided into explored - categories A, B and C_1 and preliminary estimated - category C_2, and resources - into perspective - category C_3 and prognostic - categories D_1 and D_2;
2. Similar to the classification of solid minerals of the Kyrgyz Republic, in the classification of oil and combustible gases, the concept of on-balance and off-balance reserves is used, as well as the degree of readiness of explored oil and gas deposits (reservoirs) for industrial development, they combine the first two categories of UNFC (axis E and F)
3. Similar to the previous comparison, the main difference between the two classifications is the fact that the UNFC uses a numerical code system, while the classification used in the Kyrgyz Republic uses a textual description of all conditions.

Comparison of UNFC classes and subclasses with the Classification of deposits reserves, perspective and prognostic resources of oil and combustible gases (USSR, 1983) is presented in Tab.4.

Tab.4 – Comparison of UNFC classes and subclasses with the Classification of deposits reserves, perspective and prognostic resources of oil and combustible gases (USSR, 1983)

Class	Subclass	UNFC			USSR Classification, 1983	
		E	F	G	Degree of readiness и рентабельность освоения (E и F)	Reserves Category (G)
Commercial projects	In mining	1	1.1	1, 2, 3	Ready for mining on-balance reserves	A, B
	Approved for development	1	1.2	1, 2, 3		A, B
	Justified for development	1	1.3	1, 2, 3		A, B
Potentially Commercial Projects	Development pending	2	2.1	1, 2, 3	Perspective for industrial development on-balance reserves	C_1, C_2
	Development on hold	2	2.2	1, 2, 3		C_1, C_2
Non commercial projects	Development unclarified	3.2	2.2	1, 2, 3	Estimated reserves requiring additional exploration	C_1, C_2
	Development not viable	3.3	2.3	1, 2, 3		C_1, C_2
Additional quantities		3.3	4	1, 2, 3	Unprofitable for industrial development or non-recoverable	A, B, C_1, C_2
Exploration Projects	Ready for discovery perspective object	3.2	3	4	For this class is not defined	C_3
	Probable prospecting object	3.2	3	4		D_1
	Possible prospecting object	3.2	3	4		D_2
Additional quantities		3.3	4	4		C_3, D_1, D_2

BACKGROUND INFORMATION ON PROJECTS SELECTED FOR THE CASE STUDY

Deposit No.1

The systematic prospecting for minerals on a scale of 1:100000 began in 1949. In the future, the area of deposit No.1 was systematically studied from 1957 to the present, starting from preparing works in order to prepare for the study of a geological map on a scale of 1: 200000 (1957) and prospecting works on a scale of 1: 50000 (1958) , which was accompanied by heavy concentrate and lithochemical prospecting on leakage fluxes.

In 1966-1967 the deposit was covered by prospecting and revising works on tin and polymetals at a scale of 1:25000. In the process of works, accompanied by trench sampling of mine workings, heavy concentrate and lithochemical sampling of loose sediments, tin-silver-polymetallic ore occurence was discovered. At ore occurrences, abundant small (up to 40 × 6.5 m) lenticular and nest-shaped polysulfide bodies were sampled, with pyrite-arsenopyrite-chalcopyrite-sphalerite-galena composition with contents of tin 0.03-1.18%, silver – 34-883 g/t, lead – up to 28%, zinc – up to 14%, copper – up to 8.8%, cadmium – more than 1%. Subsequently, the prognostic resources of category P_2 were estimated, lead – 80 thousand tons, zinc – 55 thousand tons, silver – 100 tons, tin – 4 thousand tons, copper – 8 thousand tons. The presence of gold in ores has not been evaluated. And it was recommended for further detailed study.

In 1981-1984 the area became a part of the territory of detailed prospecting on a scale of 1:10000. The work of the group was aimed at assessing the perspectivity of the region regarding gold-antimony, tin-silver-antimony mineralization. As a result of the works, along with antimony and tin-polymetallic mineralization in the mineralized zones and mineralization points, elevated gold contents were established.

In 1983-1987 the area was covered by the State Geological Survey on a scale of 1: 50000. At the same time, conditional maps were compiled: geological, minerals, patterns of distribution and prognosis of minerals. New data on Paleozoic stratigraphy, magmatism, tectonics and minerals were obtained. For the first time, when considering the history of the geological development of the area of work, an attempt was made to decipher the structure based on the principles of geodynamics. At the same time, an important indicator role of magmatites is shown, without which any paleoreconstructions cannot pretend to completeness and objectivity.

In 1999, the gold mineralization of the area was estimated using available geological materials. According to this assessment, gold-polymetallic deposit No.1 was allocated. The prognostic resources of which were: category P_1 for skarn and sulfide bodies to a depth of 20 m –126 kg of gold, content is 8.8 g/t, category P_2 for the mineralized zone to a depth of 50 m – 145 kg of gold, content is 4.9 g/t. Associated components are copper, silver, bismuth, zinc, tin.

In 2010-2012, prospecting routes of 1:10000 scale were completed. The closeness of routes averaged 2-2.5 l.km per 1 km^2. In areas of development of small intrusions, the closeness of prospecting routes was higher, 110 l. km were completed. In the same period, lithochemical sampling on secondary halos, trenching and their sampling were carried out, as well as geophysical studies on a scale of 1:5000 were performed. According to the results of sampling, halos of gold, silver, copper, lead, zinc and bismuth were revealed.

Targeted works on gold were not carried out until 2017. Area estimation was carried out only according to the surface works. Mineralization to the depth was not studied either by boreholes or mine workings. Significant abilities of deposit No.1 are concealed under the overburdens, which occupy a significant part of the area.

In 2017-2019, with the aim of identifying and calculating the reserves of gold and associated useful components, exploration works were carried out on ore bodies No.1 and No.2 of the deposit No.1. Based on the results of the works, first-stage reserves were calculated for ore body No.1 for

categories C_1 and C_2 and the following reserves were approbated: gold – 1652.7 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average content in ore of 5.79 g/t, 0.84%, 27.22 g/t, respectively.

At the moment, detailed studies on ore body No.1 have been completed, and mining project has been drawn up that demonstrates the expediency of mining. The mining of the ore body is planned to be carried out by underground method using a system with sub-level caving of ore.

Exploration works which were carried out in 2017-2019 allowed to calculate only a part of ore body No.1 reserves, that is, reserves of the first stage were calculated, in the future it is planned to observe ore body No.1 to the north-east and south-west, because its continuance is fixed by geophysical research, both by IP (induced polarization) method and magnetometry method.

For ore body No.2, the works carried out earlier is not sufficient for setting reserves and it is planned to explore it with wells.

In addition, during the exploration of ore body No.2, one of the wells crossed ore body No. 3 located in the mineralized zone No. 3, which is located on the hanging side of the fault, along which the D_2žv dolomites came into contact with C_1v limestones. Subsequently, its further exploration is recommended.

Deposit No.2

The first fragmentary information on the geological structure of the licensed area was found in archival documents dated 1871. This year indicates the presence in the area of Cretaceous sediments, which are discordant with older rocks.

V.N. Weber, who worked in the region in 1902-1928, made a great contribution to the study of the deposit area geology. In 1909-13 on the instructions of the Geological Committee, he carried out a ten-verst geological survey. When describing routes, the researcher noted anticlinal folds. In the valley of the dry channel, V. N. Weber described a complete section of the Cenozoic sediments.

In 1911, as a result of studying the sections of the region's oil deposits, Paleogene and Cretaceous sediments were divided into a number of suites, reference marking horizons were highlighted inside them, interstratal movements in folds, accompanying them layers corrugation, their thrust against each other, as well as inconsistency of structural drawings for Neogene, Paleogene and Cretaceous formations were identified and described.

In 1935-1947 a study of the stratigraphy of Cretaceous and Paleogene sediments of the deposit No.2 area was made. In 1935-1936, a new stratigraphic scheme of Cretaceous and Tertiary sediments was developed, which was widely recognized and disseminated. In final form, this scheme is published by the author somewhat later, in 1944-1953. The scheme for Paleogene sediments, with minor modifications and changes, is used to date.

Since the beginning of the 30s, geological surveys of different scales were carried out in the area of work on promising structures identified by reconnaissance studies.

In 1934, both gas and geological surveys were carried out at a scale of 1: 5000. Geological maps, despite some schematics, are very detailed and well-founded.

In 1946, a detailed instrumental survey was carried out on a scale of 1:10000.

The first geophysical works in the area of the field are dated 1952-57. According to electrical exploration data, a map of equal depths of the Paleozoic foundation and a map of the thickness of cover conglomerates were compiled.

In 1954-56 a schematic structural map was compiled on a scale of 1: 200000 along the roof of the Vth Paleogene strata of the Adyr part of the region with a brief description of individual folds. Later (1960), a similar map was compiled on the roof of the Vth strata of the Turkestan layers using seismic data's along the reference reflecting horizon of the Eocene at a scale of 1: 100.

As a result of a gravimetric survey of a scale of 1:500000 – 1:1000000 and an aeromagnetic survey of a scale of 1:200000, covering the entire region, which were carried out in 1966, a complete picture of the structure of the earth's crust and the most important geostructural elements that found expression in geophysical fields were taken. The notion of the relief of the Paleozoic foundation of the Meso-Cenozoic depressions is substantially concretized.

In 1970, a study of presence of oil and gas of the Cretaceous and Jurassic sediments was carried out in the area. A diagram of the tectonic zoning of the Meso-Cenozoic structures was compiled; an analysis of presence of oil and gas in strata-reservoirs was made which was identified in the Jurassic and Cretaceous sedimentary complexes. In total, seven strata confined to the middle section were identified in the Jurassic section. In sediments of the Cretaceous system, the author identified ten productive strata's. In 1971, a final report was compiled, in which, according to the received data, a map of presence of oil and gas in a scale of 1:100000 was presented.

In 1973-75 SRM study of the structural features of the Mesozoic Cenozoic was made in order to search and prepare for deep drilling of oil and gas perspective structures within the zone of the licensed area.

On the results of the works, structural maps were constructed for the reflecting horizons of the Paleogene and Cretaceous, and drilling on the structure of 4 deep wells was recommended.

In 1975-78, the geological structure of the area was studied for the first time by a complex of geophysical and geochemical methods (CDP (common depth point), gas and gas-mercury surveys, VSP (vertical seismic profiling)).

In the beginning of 80s, the entire described territory was covered by gravimetric surveying at a scale of 1:200000, magnetic survey and aerogammaspectrometry at a scale of 1:50000 (1983). As a result of the work, a gravimetric map, maps of magnetic and gamma fields, maps of concentrations of uranium, potassium and thorium, reflecting the specifics of the geological and tectonic structure of the area, were created. A number of perspective areas were highlighted.

According to the results of gravimetric and magnetic surveys, a complex-block structure of the pre-Paleozoic foundation of the region was established. Sediments having different dense, magnetic and radio-geochemical characteristics are delimited.

From 1961 to 2010, oil and gas was mined at deposit No.2. In 2011, the field was not developed. The volume of mined products as at January 1, 2012 amounted to: IV layer – 585 thousand tons of oil and dissolved gas, 16,189139 million m^3 of free gas; VIII strata – 3407 thousand tons of oil.

In 2012, on strata IV and VIII recalculation of oil and gas reserves of deposit No.2 was made. Total reserves on the category C_1 of deposit No.2 amounted to: oil – 4623.616 thousand tons, free gas – 162.375 million m^3, dissolved gas – 297.212 million m^3.

The recalculation of reserves in 2012 was based on a limited number of materials. If more information is obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recalculated to the side of greater reliability.

At the moment, work is underway to draw up a project for developing the deposit, attracting investors and searching for additional geological information.

SOCIO-ECONOMIC AND SOCIO-ENVIRONMENTAL ASPECTS OF THE SELECTED PROJECTS

Deposit No.1

The commercial products of the concentration plant are copper-gold and silver concentrate. Gold, silver and copper are widely used in the jewelry industry, metallurgy, electronics, mechanics,

military, chemical industry, engineering, communications, light industry and medicine, which guarantees the constant attractiveness of raw materials in the financial world.

Mining and marketing of copper-gold with silver concentrate is profitable in the current market conditions and under realistic scenarios of future market conditions. Currently, the price of gold in the domestic market of the country is about 1,500 US dollars/ounce, the market price of silver in the country is 590 US dollars/ kg, and the price of copper is set at about 5,825 US dollars/t. All necessary contracts are already executed.

In the immediate proximity of the considered deposit No.1, the same company developed a gold ore deposit, during the development of which a concentration plant was built. When developing depodit No.1, it is planned to use the same plant, which will lead to the reduction of capital investments.

The economic efficiency of the construction and development of the deposit is relatively good. The profitability, which is a measure of the economic efficiency of the use of fixed production assets and working assets according to calculations, will be 17.2%, and the payback period of investments is 1.8 years (the term of provision with reserves is 5.8 years), which fully indicates the very good prospects for this project.

As a result, about 835 million soms will come from the implementation of the project to the budget of the Kyrgyz Republic.

Thus, the development of the deposit No.1 by underground method is profitable. In addition, additional exploration will be carried out and in the future it is planned to develop the deep parts of considered zones, flanks and other areas for underground mining, for which part of the capital costs for the underground works area can be allocated to the explored areas, which will generally improve the economic indicators on the developed underground works area.

During the development of the deposit No.1, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be deducted to the local budget. These deductions will contribute to improving the infrastructure of the region. In addition, 80% of workers are planned to be hired from the local population, which will create conditions for improving the welfare of the population.

An open-pit method of development of this deposit would strengthen the negative attitude of local population, which in the end could stop the development, therefore, despite the cost of the chosen method compared to open-pit development, it is planned to develop the deposit No.1 by underground method, in order to avoid unnecessary conflicts with the local population.

There are no settlements directly on the area, the nearest settlements are located 5-8 km south of the deposit. The vegetation in the region is very scarce and represented mainly by motley grass. The grass cover is developed to a height of 3600 m, above which lifeless talus and rock ridges are mainly found. The fauna of the area is poor. Groundwater during tunneling and drilling was not found.

During the development of deposit No.1, the main negative impact of the works is predicted on atmospheric air, but with the remoteness of the deposit from settlements, this impact can be considered as low significance. To reduce the impact of the mine on atmospheric air, if necessary, irrigation with industrial water of the mining face and ore carrier road will be carried out in warm weather. Construction and mining equipment that has certificates of compliance with exhaust gas composition parameters, noise level, vibration and other environmental impacts will be allowed to work at the deposit.

On land and water resources, the impact of development is projected as an impact of low significance.

Ore processing will be carried out at a concentration plant located 18 km from deposit No.1. Due to the fact that the processing complex is located at a significant distance from residential settlements (more than 1 km), the environmental impact is not expected to be significant. To reduce the impact of emissions of pollutants into the atmosphere during the crushing, dust suppression by humidification with water will be carried out. It is planned a closed cycle for the use of aqueous solutions and the discharge of solutions into the surrounding water basins is excluded. The base of the tailing site is equipped with an impervious membrane, which will provide reliable protection of groundwater from the penetration of cyanide solutions into them. In addition, cyanides under the influence of oxygen after 2 months are completely decomposes.

Thus, a severely negative impact on the environment is not expected, from the side of the company, all measures will be taken to reduce the impact on the environment, as well as to prevent possible emergency situations.

Deposit No.2

The economic efficiency of the deposit construction and development has not been studied in more details and it will be studied during the preparation of the development project, but it is necessary to note that mining works at deposit No.2 has already been done from 1961 to 2010, and the calculated residual oil reserves indicate the prospect of restoration of oil mining from IV and VIII stratums at the deposit No.2. Reserves of dissolved gas do not provide for commercial value.

The early involvement of deposit No.2 in operation is a mutually beneficial and promising business for both the investor and the Kyrgyz Republic (KR), which currently imports more than 80% of oil and oil products.

To date, extensive factual material has been accumulated that allows us to consider this deposit as very promising for hydrocarbon raw materials.

Deposit exploitation will allow maintaining the existing structure of the oil and gas industry of the Kyrgyz Republic and will contribute to its further development.

In the distance from the cliffs of the river, the surface of deposit No.2 has absolute elevations of 800-820 m above sea level, and is accessible for any type of transport. The entire area of the deposit, in most cases, is covered with pebble rocks, which creates very favorable conditions for the laying of dirt roads.

The entire licensed area is accessible for road transport all the year around; highways are suitable for heavy transportation.

There are dirt roads along the entire area of the deposit along the main latitudinal depressions and meridionally oriented valleys of temporary watercourses and streams. Roads are passable for 12 months a year and suitable for transporting heavy loads and special equipment.

In the area of operations, there is a railway station 85 km east of the license area. Directly north of the deposit area, in 30 km the railway junction (station) is located.

Thus, a well-developed road system in the region and on the deposit itself indicates the absence of problems associated with the transportation of raw materials, which could lead to higher costs and lower profitability of the enterprise.

Two small settlements adjoin the area of the deposit.

During the implementation of the deposit No.2 development, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be allocated to the local budget. In addition, 60-80% of workers are planned to be hired from local residents, which will create conditions for improving the welfare of the population.

Due to the desert nature of the relief, the territory of the deposit is not suitable for cultivation of agricultural crops and it is used only for pasture purposes in the spring. With the onset of summer, sparse vegetation dries, and flocks of sheep go higher to mountains.

At the moment, the environmental impact of deposit development has not been studied yet, and there are no recommendations on the development of measures to ensure the prevention of environmental pollution. These issues will be considered during drawing up a development project.

FIELD PROJECTS STATUS AND FEASIBILITY

Deposit No.1

The rocks composing the ore body and adjacent to it are not aquiferous. During the drilling of the wells, as well as during the tunneling, there were no losses of flushing fluid and water inflows. Due to the location of the ore body on a steep slope, rainwater and snowmelt water freely flow down the slope. There are no water sources near the ore body. Thus, the hydrogeological conditions of underground mining have been identified as very favorable; they will not create difficulties in the development of the mine and can be assessed as simple.

The deposit has good transport conditions; there are dirt roads from the administrative center to the mine, as well as from the mine to the concentration plant. A normal truck can pass along these roads.

On the area of works and in its immediate vicinity, there are no settlements, power lines, gas pipelines, bridges and other security facilities. The supply of raw materials, fuel, constrction materials can fully satisfy the local market.

In addition, the karst-forming process in the deposit area is not developed. According to seismicity, the area belongs to the 9-point zone. Based on the above, we can conclude that the technical conditions for mining at the deposit are simple.

Detailed exploration works at deposit No.1 began in 2017. The purpose of the detailed exploration was to obtain explored reserves in categories C_1 and C_2 through the exploration of the ore bodies of deposit No.1.

Exploration of ore body No.1 was carried out by bulldozer cuttings (955 m^3) in combination with ditches (385 m^3), tunneling at an altitude of 3860 m (247.5 l. m.), as well as drilling deviated wells (345 m) (Annex 1).

Exploration of ore body No.2 was carried out by digging ditches (270 m^3), tunneling on the horizon of 3740 m (187.1 l. m.), as well as drilling deviated wells (560 l. m).

In addition, a topographic survey of the area of works on a scale of 1:2000 was carried out, as well as the fixing of all the mine workings.

All potentially ore-bearing intervals opened by ditches, adits and cuts were subjected to trench sampling, and opened by drilling wells to core sampling. In total, 94 core samples and 215 trench samples were taken, of which 5 core samples and 10 trench samples were taken for internal control of sample analysis. The average discrepancy in the main component (gold) between the control and the main samples was 2.4% (5% is acceptable). The obtained results allow us to conclude that the errors that occur do not go beyond the norms characterizing the correct processing and analysis of samples. Thus, the reliability of the analytical results of sampling on the deposit allows them to be used in reserves calculating.

Besides trench and core samples, one technological sample was selected from the adit, according to this technological sample the material composition and technological properties of ores were studied. The purpose of these studies was to provide a technically feasible and economically reasonable treatment process for the development and use of mineral resources, through a detailed

study of this type of gold. According to the results of the study, two types of ore were identified: pyrite in calcareous breccia and skarn and chalcopyrite in skarn. The bulk is pyrite. In addition, a flotation scheme with two cleanings was proposed.

In order to obtain additional information on the composition and properties of ores and enclosing rocks mineralogical, petrographic and other studies were carried out within the site. Crushed samples, samples for making of thin sections, polished thin sections and determination of unit weight were sampled on workings.

According to the results of mineralogical studies of the ore process, the main metal minerals in the ore are chalcopyrite, pyrite, limonite, etc. Enclosing rocks mainly include hornblende, pyroxene, quartz, graphite and others.

The above methods, as well as the results of work carried out in 2010-2012, clarified the position of ore bodies No.1 and No.2, their sizes, shapes and contents. Consequently, of complex works on the surface (ditches, cuts) and adits horizons, as well as drilling from the surface, data's on ore bodies were obtained. Good results were obtained that met the requirements of detailed exploration.

Geological exploration works allowed to calculate the reserves of the first stage in the contours of the mine workings for ore body No.1 of deposit No.1 in categories C_1 and C_2, for ore body No.2, the works carried out are not sufficient for placing the reserves on the State balance and it is planned to continue exploration by wells.

In the north-east and south-west directions, the explored body No.1 sharply goes under overburden, in further exploration it is planned to trace it to the north-east and south-west, because its continuation is recorded by geophysical studies, both by the IP (Induced Polarization) method and the magnetometry method. Its further exploration is planned by tunneling and drilling wells.

In addition, during the exploration of ore body No.2, one of the wells crossed ore body No. 3 located in the mineralized zone No. 3, which is located on the hanging side of the fault, along which the D_2žv dolomites came into contact with C_1v limestones. Subsequently, its detailed exploration by ditching and drilling of deviated wells is recommended.

Based on the obtained results, a Project for the exploitation of this deposit was developed, and it is also planned to develop a project for subsequent additional exploration.

As indicated above, the development of the ore body will be carried out by underground method, using a mining system with ore shrinkage and ore sublevel caving, by ore haulage from mine workings. This development method is selected based on the relief, bedding of the ore body, and also to avoid conflicts with the local population.

Deposit No.2

There are no small water sources on the surface of deposit No.2. Only one river flows in the deposit, dividing the structure into two parts.

During the drilling of exploratory wells, water inflows were not observed at the deposit, even when drilling on a light clay mud with a unit weight of 1.20-1.25 g/cm^3. They can prove themselves during prolonged downtime, when suspended clay particles fall out of mortar.

When testing wells, water overflow was observed, but not in all wells, only in some of the drilled Paleogene sediments.

The flow rates of overflowing water in all wells are insignificant.

Based on the foregoing, we can conclude that in the Paleogene sediments there are no high-pressure waters. All stratal water of the Paleogene of deposit No.2 belongs to the calcium-chlorine type with a high concentration of salts.

As mentioned above, the entire licensed area is accessible for road transport year-round, highways are suitable for heavy transportation, which indicates a well-developed road network in the region and at the deposit No.2.

On the territory of the deposit, there are no underground, underwater and ground communications and protected natural areas. There are no drinking water intakes in the zone of influence of the deposit.

Thus, the mining conditions of the deposit are favorable for the development of reserves.

In 1950, deposit No.2 was put into detailed exploration. Due to the displacement of the crest of the Paleogene fold to the south for 2.8 km (as established by seismic surveys), the first three wells laid near the axis of the fold based on geological survey data did not give results. Further drilling, taking into account the displacement of the crest, lead to the discovery of gas deposits: in 1955 – in horizons V and VII, in 1956 – in horizon III and oil deposits in horizons IV and VIII. Subsequently, the gas content of the Cretaceous and Jurassic sediments was established.

Exploration began in 1950 by drilling well 1, which was located on the surface axis of the fold. At design depth of 1500 m, the well did not emerge from the Neogene sediments. Well 2 was drilled 550 m south of the first one in 1954, and at the depth of 2330 m it opened the VII horizon of the Paleogene. As a result of testing of the VII, V and IV stratums, inflows of stratal water were obtained.

Well 3 was drilled in 1955, 500 m south of the second. When testing the VII stratum, water with a small amount of gas, from the V stratum of the Paleogene – water with oil films, from the IV – water with oil were obtained.

Simultaneously with drilling in 1955, seismic surveys were carried out, which revealed an anticlinal bend of the reflecting horizon 1800 m south of well 3.

Well 4, located in the crest (according to geophysical data) of the upheaval, in 1955 industrial gas content of the VII and V horizons and the industrial oil content of the IV horizon of the Paleogene revealed.

In 1956, an oil gusher was obtained from stratum IV. In the same 1956, oil gushers from stratum VIII were received in wells No. 6 and No. 8, and gas content of the stratum III was established. Later, industrial oil and gas reservoirs were discovered in the Cretaceous and Jurassic sediments.

Initial explored reserves of oil – 4.5 million tons, gas – 7.9 billion m^3.

In 2012, reserves were recalculated using available information for two horizons.

LEVEL OF KNOWLEDGE / CONFIDENCE IN ESTIMATES

Deposit No.1

The deposit area is composed of carbonate sediments of the Middle Devonian (D_2žv), Lower Carboniferous (C_1v) and carbonate-terrigenous sediments of the Lower-Middle Carboniferous (C_{1-2}). At deposit No.1, three main mineralized zones are distinguished.

As a result of complex works on the surface (ditches, cuts) and adits horizons, as well as drilling from the surface, data were obtained on ore body No.1 and No.2. As mentioned above, the exploration works allowed the calculation of reserves of the first stage in the contours of the mine workings for ore body No.1 of deposit No.1 in category C_1, and for ore body No.2, the works carried out is not sufficient to placing reserves on the State balance and further exploration is planned.

The size of the explored ore body No.1 at deposit No.1 is small. The explored length of the bed is only 61 m. The thickness of the ore body is 10.4-17.8 m. The ore body is traced to the dip to 70-85 m. The dip angle of the ore body is 55-75°.

Ore body No.1 is represented by a vein-like body of uneven on thickness (a pronounced bulge is noted) with an uneven content of useful components. The content of the ore body is uneven (appendices 1-3).

Based on the above in terms of the complexity of the geological structure, the deposit belongs to 3 group: a complex geological structure, represented by vein zones with ore bodies thickness up to 1-2 m or more with a very uneven distribution of mineralization, often discontinuous.

The exploration network of wells for category C_1 is approved for strike and dip – 40×40 m. Drifts were carried out along the strike of the zone from the adit, and cross headings through 20-30 m were carried out from the drifts, which also corresponds to the closeness of the exploration network for category C_1 reserves. For category C_2, geologically justified extrapolation to half of the distance between the workings that opened the useful strata.

For the explored ore body No.1 of deposit No.1, the entire range of geological exploration was carried out: prospecting routes, lithochemical sampling along secondary aureoles, excavation of ditches and cuts, excavation of underground mines, core drilling, sampling, chemical-analytical and topographic and geodetic studies, study of ore material composition and their technological properties. Thus, ore body No.1 along the strike and dip was studied in details.

The necessary and sufficient degree of exploration of solid minerals reserves is determined depending on the geological structures complexity of the deposits. The considered gold-polymetallic deposit No.1, as indicated above in terms of the complexity of the geological structure, refers to deposits of 3 group: a complex geological structure, represented by vein zones with ore bodies up to 1-2 m or more in thickness, with very uneven mineralization distribution, often discontinuous. Reserves of deposits of this group are prospected mainly in categories C1 and C2, which corresponds to the categories of reserves calculated according to the results of detailed exploration carried out in 2017-2019.

To calculate the balance reserves of the first stage of ore body No.1 of deposit No.1, the cut-off grade was taken 1 g/t, the maximum thickness of substandard ores was 1.0 m, the minimum thickness of ore bodies was 1.0 m, and the limiting grade of ore was 2.47 g/t. The listed parameters of conditions for the assessment of reserves were obtained by the results of a feasibility study.

Considering the simple structure of ore body No.1, its sustained thickness, inclination angle, and also relatively uniform mineralization distribution, reserves were calculated using the method of geological blocks with the projection of the ore body onto a vertical plane. To verify the results, a calculation was also performed according to the method of geological blocks with the projection of the ore body on a horizontal plane, the difference between the two methods of calculation is less than 5%, which indicates the correct choice of methods for calculating reserves.

In each calculating block, the average true thickness of ore bodies was determined. By this thickness and the vertical projection area, the volume was determined. The product of this volume to the density of ore (the value of which is 3.0 t/m^3) gives ore reserves for the block. The reserves of gold, silver and copper were calculated by multiplying the ore reserves to the weighted average content of useful components in it, which was determined by considiring the replacement of top-cut grades.

The average gold content of individual workings (calculation sections) was determined as the weighted average of private samples for their length, taking into account conditional limits, and the average gold content of the calculation block was determined as the weighted average of all calculation sections through the total thickness included in the calculation block.

In order to identify and suppress top-cut grades, it was customary to prevent overstating a separate breakdown of the average weighted grade by more than 20%. With this approach, the possibility of a sharp overstatement of the contents due to top-cut grades and, at the same time, a reduction of average contents, and, consequently, the reserves of the deposit, is excluded.

According to the calculation results, the on-balance reserves of the first stage of ore body No.1 in categories C_1 and C_2 amounted to: gold – 1652.684 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average ore grade of 5.48 g/t , 0.82%, 26.26 g/t, respectively.

Deposit No.2

Deposit No.2 is a multi-pool type with a wide stratigraphic range of oil and gas productivity (appendices 4-6).

At deposit No.2, horizons III, V, VII of the Paleogene contain gas pools with very small accumulations of oil in separate areas. In crest position part of horizon IV, a gas cap is developed with an oil slug, the width of which reaches 750 m within the hollow southern wing. Horizon VIII is oil-bearing.

The largest area of oil and gas content is horizon IV. The length of the pool is 8 km, width 1.8 km, height 320 m; the sizes of the gas cap are respectively: 5.5 km, 0.6 km and 240 m. The gas content area of horizons III, V, VII is approximately the same and is 7 × 1.1 km, the heights are respectively 240, 180, 140 m. An even smaller area (5.8 × 0.8 km) is occupied by the oil pool of horizon VIII. The height of the pool is 160 m.

Gas pools in the Cretaceous sediments (horizons XIV, XV-a, XVIII and XXII) occupy the highest part of the structure and have small sizes. A gas pool has been discovered in Jurassic sediments.

All pools are stratified, crested.

Horizon III is gas-bearing, with signs of oil content. Horizon III lies in the roof of the Sumsar layers at a depth of 1070-1350 m. It is represented by gray fine-grained quartz sandstones with intercalations of raspberry colored clays. The total thickness of the horizon is 24.5 m, the total thickness of the productive layers is 14 m. Porosity ranges from 9 to 38% and averages 20%; permeability averages 86 mD. The initial reservoir pressure is 129 atm, the initial gas flow rate is 580-900 thousand m^3. The gas content contour of a reservoir of III stratum is determined at elevation – 400 m.

The stratum IV of the Rishtan stage contains oil and gas. The oil pool of the IV stratum in plan lies outside the oil pool of the VIII stratum. Horizon IV in the upper part is represented by dense gray limestones, and in the lower part by gray fine-grained sandstones with interlayers of green clays and marls. The total thickness of the horizon is 10.4, effective – 2.6 m. The average porosity is 17%, the depth of the horizon is 1300-1420 m. The initial strata pressure in the gas cap is 149, in the oil pool 156 atm.

The stratum V in the sediments of Turkestan stage is gas-bearing, and during the sampling condensate was discharged along with gas in well No.23. Horizon V is composed of gray and greenish-gray limestones with interbeds of green clays and marls. The total thickness of horizon is 11 m, effective thickness is 5 m. The average porosity is 10%, the permeability in the studied samples does not exceed 136 mD. The occurrence depth of the productive part of the horizon is 1370-1450 m, strata pressure is 148 atm. The initial gas flow rate for wells ranges from 80-420 thousand m^3/day.

Horizon VII within the deposit is gas-bearing. And it is represented by gray dolomitic limestones with a 3rd layer of green clay, dividing the horizon into two parts. Limestones contain interlayers of dark green marls and bluish-gray anhydrides. Since the reservoir properties of both parts of the horizon are identical, they are considered together. The total thickness of the horizon VII is 34 m, the effective thickness is 15.3 m, the occurrence depth within the pool is 1380-1520 m. The initial strata pressure is 150 atm, the initial flow rate is 190-420 thousand m^3/day.

Horizon VIII is oil-bearing. There is no gas cap within the stratum. Occurrence of the horizon VIII is in depth of 1470-1590 m. It is composed of gray and white sandy limestones with interlayers of green and brown clays, bluish-gray anhydrides and gray sandstones. The total thickness of the

horizon is 33 m, the total thickness of productive interlayers does not exceed 16 m. Porosity 15-21%, average porosity 18%, permeability 160-180 mD. The lower sandy part of the horizon stands out as horizon IX, but due to the absence of an impenetrable seal, both horizons in field practice are combined into one object. The initial strata pressure in the oil pool is 144 atm, the initial flow rate with a 6-mm nozzle is 35-40 tons/day, with a 10-mm nozzle 70-90 tons/day.

There are four gas-bearing horizons in the Cretaceous complex, the reservoir properties of which are poorly studied.

Occurrence of the horizon XIV is in the middle of the variegated stage of the Upper Cretaceous. The reservoir are sandstones containing a gas pool. When testing well 12, a gas gusher was obtained with an absolutely free flow rate of 1130 thousand m^3/day.

Horizon XV-a is related to the middle part of the Yalavach Formation, represented by sandstones. It contains gas pool. In well 18 in 1958, a gas gusher was obtained with an absolutely free flow rate of 1280 thousand m^3/day.

The horizon XVIII of Lakan Formation is composed of limestones with interlayers of clay. Effective power 17 m, effective porosity 12%. Absolutely free flow rate reaches 500 thousand m^3/day.

Horizon XXII is related to sediments of the Muyan Formation of the Lower Cretaceous, composed of limestones. It contains gas pool. The gas flow rate in well 18 in 1959 reached 252 thousand m^3/day.

The Jurassic sediments horizon contains a gas reservoir. The reservoir is limestone, of which in 1959 in the interval 2030-2040 m in well 67 gas was obtained with an absolutely free flow rate of 40 thousand m^3/day.

Among the gases of the deposit, horizon VII gas, which contains a greater amount of hydrogen sulfide, occupies a special place.

The characteristic of gases of Cretaceous sediments is as follows: density 0.645-0.687 g/cm^3, hydrogen sulfide content is insignificant, methane 93-96%, nitrogen + rare 3-5%.

Available information allows possibility to recalculate reserves for horizons IV and VIII.

At deposit No.2, the oil pool in the IV stratum is held in conjunction with slug located between the gas cap and the stratal waters supporting the oil pool. The length of the deposit is about 8 km. Horizon IV in the upper part is represented by dense gray limestones, and in the lower part by gray fine-grained sandstones with interlayers of green clays and marls. The contouring of the reservoir is based on the results of well testing.

The boundary between the oil pool and atmospheric waters in the eastern part of the structure is taken on well 16 that supplied oil and well 15 that supplied water. The southern border is taken at wells 31, 29, 26 that supplied oil and well 15 that supplied water. Thus, the southern and western borders pass at elevation 660 m. In the northern part of the structure, oil was received from west to east in wells 32, 25, 30 and 16, and is delimited at elevation 700 m. The western part of the structure, as can be seen from the graphic appendices, it is flattened and accepted by us at elevation of 660 m.

The contouring of the boundary between the oil pool and gas cap is also based on well testing results. Based on the testing data of wells 4, 12, 23, 21 that supplied oil and wells 13, 5, 10, 20 that supplied gas, we note that the southern boundary passes at elevation of 580 m, and the northern boundary is 560 m.

The maximum length of an oil deposit from east to west is 8.5 km, and from north to south 2 km. The oil area (S_1) is 7.909 km^2.

The true oil-bearing area, adjusted for a dip angle of 20°, will be:

$$S\ (C_1) = S_1/Cos\alpha = 7.909/0.93969 = 8.4166\ km^2$$

Horizon VIII is oil-bearing. There is no gas cap within the stratum. Occurrence of the horizon VIII is in a depth of 1470-1590 m. It is composed of gray and white sandy limestones with interlayers of green and brown clays, bluish-gray anhydrites and gray sandstones.

The contouring of the pool is based on the results of well testing. So, according to the test results, oil was obtained from wells 4, 6, 22, water with oil from wells 20, 10, water from wells 19, 5, 16, 15. Thus, the oil-water contact ideally passes at elevation 710 m.

The maximum length of oil pools from east to west is 6.5 km, and from north to south 0.8 km. The oil-bearing area (S_1) is 3.856 km^2.

The true oil-bearing area, adjusted for a dip angle of 25°, will be:

$$S\ (C_1) = S_1/Cos\alpha = 3.856/0.9063 = 4{,}2547\ km^2$$

In 2012, a recalculation of reserves was compiled based on a limited amount of materials. If more information is obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recounted to the side of greater reliability. Reserves of category C_1 of the deposit No.2 for stratums IV and VIII amounted to: oil – 4623.616 thousand tons, free gas – 162.375 million m^3, dissolved gases – 297.212 million m^3, of these on-balance reserves on category C_1:1019.9 thousand tons of oil and 65.241 million m^3 of dissolved gases.

CLASSIFICATION OF THE SELECTED PROJECTS USING UNFC

Based on the above information, each of the studied objects can be classified using UNFC.

Deposit No.1

The first of the criteria for evaluating a deposit according to the United Nations Framework Classification is the criterion for the economic and social viability of the project (E axis).

As indicated above, a commercial product of a concentration plant is copper-gold with silver concentrate. Mining and marketing of copper-gold with silver concentrate is profitable in the current market conditions and under realistic scenarios of future market conditions. Currently, the price of gold in the domestic market of the country is about 1,500 US dollars/ounce, the market price of silver in the country is 590 US dollars/kg, and the price of copper is approximately 5,825 US dollars/ton. All necessary contracts are already executed.

The economic efficiency of construction and development of the deposit is relatively good. The profitability, which is a measure of the economic efficiency of the use of fixed production assets and working assets according to calculations, will be 17.2%, and the payback period of investments is 1.8 years (the term of provision with reserves is 5.8 years), which fully indicates the very good prospects for this project.

As a result, about – 835 million soms will come from the implementation of the project to the budget of the Kyrgyz Republic.

During the development of the deposit No.1, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be deducted to the local budget. These deductions will contribute to improving the infrastructure of the region. In addition, 80% of workers are planned to be hired from the local population, which will create conditions for improving the welfare of the population.

An open-pit method of development of this deposit would strengthen the negative attitude of local population, which in the end could stop the development, therefore, despite the cost of the chosen

method compared to open-pit development, it is planned to develop the deposit No.1 by underground method, in order to avoid unnecessary conflicts with the local population.

During the development of deposit No.1, the main negative impact of the works is predicted on atmospheric air, but with the remoteness of the deposit from settlements, this impact can be considered as low significance. On land and water resources, the impact of development is projected as an impact of low significance.

Ore processing will be carried out at a concentration plant located 18 km from deposit No.1.

Thus, sharply negative impact on the environment during the development of field No.1 is not expected. Company will take all measures to reduce environmental impact, as well as to prevent possible emergencies. Mining of deposit No.1 by underground method is profitable, which corresponds to category E1.1 in the UNFC. In addition, additional exploration will be carried out and in the future it is planned to develop the deep parts of the considered zones, flanks and other areas for underground mining, in connection with which part of the capital costs for the underground works area can be allocated to the exploration areas, which will generally improve the economic indicators of the working area of underground works.

The next, but no less important criterion for evaluating a deposit according to the United Nations Framework Classification is the criterion for the status and validity of the project (axis F).

As mentioned above, presently, on ore body No.1 of deposit No.1 detailed studies have been completed, and development project has been drawn up that demonstrates the expediency of mining. The development of the ore body is planned to be carried out by underground method using a system with sub-level caving of ore. Thus, the deposit corresponds to category F1.3.

The third criterion underlying the classification is the assessment of the reliability of the data used.

Based on the results of detailed exploration, which was carried out in 2017-2019, reserves were calculated. On-balance reserves of the first stage of ore body No.1 in categories C_1 and C_2 were: gold – 1652.684 kg, copper – 2468.7 tons, silver – 7920.5 kg with an average ore grade of 5.48 g/t, 0,82%, 26.26 g/t.

As is known in the UNFC, three degrees of geological knowledge reliability are indicated for known (discovered) deposits: “high”, “medium” and “low”, they are represented by categories G1, G2 and G3. In the classification of the Kyrgyz Republic these degrees are represented by categories A (high), B (medium), C_1 and C_2 (low). Thus, the reserves calculated according to the results of the works of 2017-19 are related to reserves with low reliability of knowledge. But it should be noted that for deposits of the 3rd group of geological complexity, the low reliability of the reserves studied is sufficient for further development.

Finally, deposit No.1 is classified as: E1.1 F1.3 G3, that is, mining of the deposit No.1 and the marketing of minerals are profitable under current market conditions and realistic predictions of future market conditions. Mineral reserves are classified as reserves with a low reliability rating. At the moment, detailed studies have been completed in deposit No.1 which were targeted to demonstrate the expediency of mining by implementing a specific development project or mining operations.

Deposit No.2

Consider the first criterion for evaluating a deposit according to the United Nations Framework Classification, namely, the criterion of economic and social viability of the project (E axis).

The economic efficiency of the deposit construction and development has not been studied in more details and it will be studied during the preparation of the development project, but it is necessary to note that mining works at deposit No.2 has already been done from 1961 to 2010, and the calculated residual oil reserves indicate the prospect of restoration of oil mining from IV and VIII stratums at the deposit No.2. Reserves of dissolved gas do not provide for commercial value.

The early involvement of deposit No.2 in operation is a mutually beneficial and promising business for both the investor and the Kyrgyz Republic, which currently imports more than 80% of oil and oil products.

A well-developed road network in the region and on the deposit indicates the absence of problems associated with the transportation of raw materials, which could lead to higher costs and lower profitability of the enterprise.

Two small settlements adjoin the area of the deposit.

During the implementation of the deposit No.2 development, in accordance with the requirements of the legislation of the Kyrgyz Republic, funds will be allocated to the local budget. In addition, 60-80% of workers are planned to be hired from residents, which will create conditions for improving the welfare of the population.

Due to the desert nature of the relief, the territory of the deposit is not suitable for cultivation of agricultural crops and it is used only for pasture purposes in the spring. With the onset of summer, sparse vegetation dries, and flocks of sheep go higher to mountains.

As of now, the environmental impact of deposit development has not been studied yet, and there are no recommendations on the development of measures to ensure the prevention of environmental pollution. These issues will be considered during drawing up a development project.

Thus, the profitability of mining and marketing has not been confirmed yet, but based on realistic predictions of future market conditions, there are reasonable prospects for profitable mining and marketing in the foreseeable future (E2).

The mining conditions of the deposit No.2 development were studied in more detail above, it should be noted that they are favorable for mining the reserves.

At the moment, work is underway to draw up a project for developing the deposit, attracting investors and searching for additional geological information.

Based on this, it can be concluded that preliminary studies of deposit No.2 show the presence of pool, the validity of mining that can be assessed by specific development project. Thus, the project continues to be implemented on the deposit in order to justify development in the foreseeable future and can be classified as F2.1.

It is necessary to note that all of the above characteristics related to the on-balance reserves determined at the deposit. Off-balance reserves are characterized as unprofitable by the UNFC and can be attributed to E3.3. F4.

Presently, based on available data, it has become possible to calculate or estimate oil and gas reserves for stratums IV and VIII.

Oil and gas reserves were calculated for category C_1. It should be noted that the calculation of reserves for category B is doubtful, because reserves for this category are calculated on the basis of approved technological scheme for deposit development, which is absent in the Kyrgyz Republic and will be developed. According to the methodology, reserves of category C_1 are calculated according to the results of exploration and exploitation drilling and should be studied to the extent that provide initial data for drawing up a technological scheme for oil deposit development or a deposit pilot development project. Thus, category C_1 is the most optimal.

As indicated above, the reserves of category C_1 in the UNFC refers to reserves with a low degree of reliability, that is, corresponds to category G_3. If more information was obtained from the predecessors, or data obtained during future works at the deposit, reserves can be transferred and recalculated to the side of greater reliability.

Thus, deposit No. 2 can be assigned by code E2. F2.1. G3 in UNFC, but do not forget that there are additional quantities of oil and gas in the stratum that correspond to code E3.3. F4. G3.

ALIGNMENT TO SUSTAINABLE DEVELOPMENT GOALS IMPLEMENTATION

National Development Strategy of the Kyrgyz Republic for 2018-2040 was created in November 2018. In this strategy, the main stages of mining industry development were identified, which are described below.

Kyrgyzstan has a competitive industry in the country's priority sectors, which promotes full and productive employment and decent work. The industry structure is diversified and export-oriented, it relies on its own resources and production base, and it is integrated into regional and global value chains, taking into account participation in integration associations such as the EAEU, as well as interfacing of the EAEU and One Belt – One way projects. The modernization and expansion of the capacities of existing sectors were carried out.

Citizens will have access to productive and highly profitable jobs that stimulate technical education and creativity.

The industry will develop comprehensively, effectively use its own resource and production base, while the importance will be given to the proportional distribution of enterprises throughout the country.

Complementary industries will be integrated as part of clustering solutions to increase competitiveness for types of products.

It is necessary to achieve an increase in the efficiency of mining, the introduction of modern mining technologies with minimal environmental impact. The development of minerals should ensure the formation of financial resources for development. Incomes from subsoil should be directed not only to solve current problems of developing the environment, but also to strategic targets. Renewable capital funds should be created, which will be aimed at developing the future, developing technologies, innovations, innovations in business, economy, culture, etc.

This activity will continue until the missions of economic and social development of Kyrgyzstan will be sustainable and fully provided with funding from other sources. Subsoil use should be carried out in compliance with the whole range of environmental protection requirements, including the rehabilitation of natural landscapes and disturbed lands, and under public control. Important is the support of scientific research and training of specialists in the field of subsoil use.

The development of competitive production of high-quality oil products and construction materials will ensure saturation of domestic market and development of export potential. The high dependence of Kyrgyzstan on the import of fuels and lubricants, the lack of sufficient own reserves of hydrocarbon materials necessitate a policy to encourage the increase of extraction and production of fuel of high environmental quality standards.

The priority will be the transition to the use of high-quality fuels in combination with the expansion of the use of alternative energy sources. At the same time, it is necessary to diversify energy sources for the needs of the country's economy.

The development of significant reserves of non-metallic minerals in conformity with environmental protection requirements and the interests of local communities, the production of high-quality modern construction materials will create conditions for the accelerated development of the construction industry.

This will contribute to increasing of the housing construction, social and industrial facilities, the transition to new architectural and construction systems, types of buildings and modern technologies.

Conditions will be created for developing the potential of the jewelry industry with the key objective of entering international markets.

It is necessary to create sub-sectors of the manufacturing industry, particularly assembly plants, components, and the restoration of idle enterprises. The development of industries should ensure the growth of productive employment and decent work for citizens of the country; cooperate to the development of industrial technologies and exact sciences in Kyrgyzstan. Domestic manufacturing industry should be focused on the formation of export potential and import substitution of certain goods. The basis of industrial policy will be the localization of foreign industrial enterprises, entry into intercountry value chains, and creation of favorable conditions for access to production infrastructure. The development of industrial zones in various regions will be encouraged.

In addition, on 25 September 2015, UN member States adopted the Agenda for Sustainable Development until 2030. It contains a series of goals aimed at poverty eradication, conserving planetary resources and ensuring well-being for all. Each of the 17 Goals contains a series of indicators that must be achieved within 15 years.

The adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of SDG 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDG 1, 2 and 8.

The environmental aspect, in our opinion, will not change as a result of the implementation of UNFC, but attracting investment in renewable energy can support achievement of SDG 11 and 13.

CONCLUSIONS ON UNFC CLASSIFICATIONS OF ENERGY AND MINERAL RESOURCE PROJECTS IN KYRGYZSTAN

The UNFC serves as a tool for global information exchange that can be applied at all mining activities, covering solid mineral and energy resources, including oil, natural gas, coal and uranium.

The application of the UNFC will ensure the harmonization of terminology and definitions by using an effective digital coding system that applies to all types of fossil energy and mineral reserves and resources, which will allow access to the international stock market and, therefore, will increase the overall investment climate in the Republic.

The main advantage of the UNFC is that it provides a common framework for the solid mineral and oil and gas sectors, for which classification systems have been developed independently of each other.

As it mentioned above, in the Kyrgyz Republic, as in many CIS countries, there is no single classification for energy and mineral resources, so the adoption of the UNFC will provide an opportunity to combine the two largest industries of the Kyrgyz Republic, which will form a single picture of all mineral and hydrocarbon reserves.

In addition, the adoption of the UNFC will provide the opportunity to obtain accurate information on the availability of all non-renewable resources, and thereby assist in the development of appropriate long-term energy strategies.

The basis of reserves classification of the Kyrgyz Republic is the classification inherited from the time of the USSR. At that time, social, environmental and several similar features were not considered important. The main objective was to provide the necessary raw materials for processing plants and industrial complexes.

The UNFC in comparison with the system for applying the classification of reserves in the Kyrgyz Republic has several disadvantages. The main one is the fact that in the UNFC, the main emphasis

is focused on the economic indicators of deposits, while the geological feature of each object is unique and special in its own way. So, in the system for applying the classification of reserves in the Kyrgyz Republic, grouping is applied based on the complexity of the geological structure, which determines the direction of further development of the deposit regardless of the degree of exploration.

Practice shows that the further development of deposits entails a number of other important problems. In Kyrgyzstan, protests by local residents against the development of deposits are not rare. This aspect, recently, has become regular, which complicates further investment. In our opinion, nowadays, it is one of the important points in classification or grouping of deposits. Especially for the Kyrgyz Republic, this aspect should be considered as one of the subclauses of deposits classification.

As stated above, this world requires special attention to the social, environmental consequences, as well as the introduction of safer and more technologically advanced production systems.

The adoption of the UNFC in Kyrgyzstan will lead to improvement of the investment climate, which would make it possible to advance towards the achievement of SDGs 7 and 9. In addition, an increase in investment flows will directly affect the social status of the people, which will advance the achievement of SDGs 1, 2 and 8.

The environmental aspect, in our opinion, will not change as a result of the implementation of the UNFC, but attracting investment in renewable energy can lead to faster achievement of SDGs 11 and 13.

Therefore, the implementation of the UNFC system should be coherent. A complete abandonment of the current system of the National Classification of Energy and Mineral Reserves and Resources and the transition to the United Nations Framework Classification System for Energy and Mineral Reserves and Resources takes a time. Because it is require a reanalysis of all geological and technical-economic materials left over from the USSR.

Currently, the Kyrgyz Republic uses the separation of deposits according to the prospectivity and quantitative reserves of deposits in national significance.

- Competitive objects are objects that have reliably estimated reserves (for example, at least 10 tons of gold) and ready for industrial development;
- Auction objects are objects that have prospectivity for the further industrial development or geological exploration, which have previously estimated or reliable reserves;
- Objects that issued on request of subsoil users. These objects should be free and should not enter the territory of competitive, auction objects and the territories of other subsoil users.

I consider that it is necessary to carry out an assessment, namely, of the competitive objects, as well as renewable energy objects of the Kyrgyz Republic according to the UNFC system. Competitive objects will give a clearer and more realistic picture of the deposit and save time for future investors and the government of the Kyrgyz Republic. It will allow you to assess the risks and economic efficiency of investing. Moreover, renewable energy objects on the territory of the Kyrgyz Republic require urgent investment.

Summarizing the report, I would like to note that the application of the UNFC system in the Kyrgyz Republic would give positive dynamics in the development of the country's mining sector. As mentioned above, a complete transition to the UNFC system takes a time. The issue of adaptation and successful implementation of the UNFC in Kyrgyzstan requires optimally close interaction between the state and the subsoil user and the corresponding geopolitical, economic and technological platform.

An assessment by the UNFC system of large energy and mineral objects of the country will make it possible to attract large bona fide investments in the development of the country's economy. In my opinion, it is worth noting that when applying the UNFC in Kyrgyzstan, certain classes should be distinguished according to the assessment of environmental and social impacts, because when implementing projects in Kyrgyzstan, there is an acute problem with solving these problems.

In addition, as mentioned above, sector of renewable energy sources (RES) in Kyrgyzstan is poorly studied. I consider that the start of the UNFC implementation in Kyrgyzstan should begin from this sector of industry, as currently there are no classifications in this field. The implementation will be simpler, and by using this example, the state will gain some experience on working with the UNFC, which will be useful in the future.

I think firstly for the implementation of the UNFC in Kyrgyzstan the harmonization procedures of the National Classifications of the Republic with the UNFC should be launched. In harmonizing of the classification, particular attention should be paid to the specifics of the mining and energy industries in Kyrgyzstan. It is necessary to consider the social and environmental problems of Kyrgyzstan. In addition, in parallel with the harmonization of classification, the state should bring into conformity some subordinate legislations of the Republic.

The next, but no less important step for the implementation of the UNFC that I recommend is the preparation of a Bridging Document, which explains the relationship between the UNFC and the classification system obtained by harmonization and approved by the UNECE experts group.

When implementing the UNFC in Kyrgyzstan, I also consider that it is important to take into account the experience of countries that have already implemented this classification system or working in this direction. Especially, it is necessary to pay attention to the experience of implementing of CIS countries (Russian Federation, Kazakhstan, etc.).

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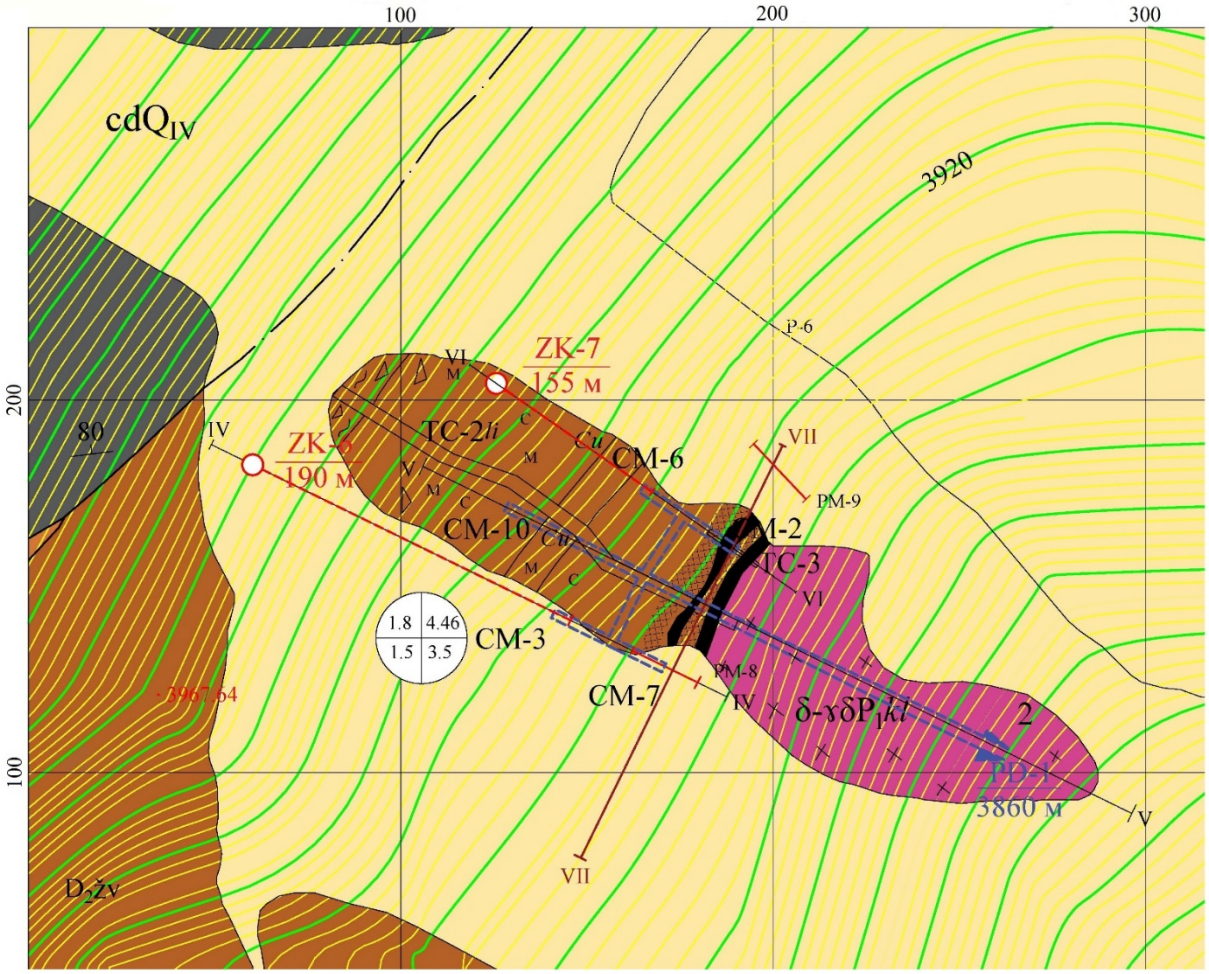
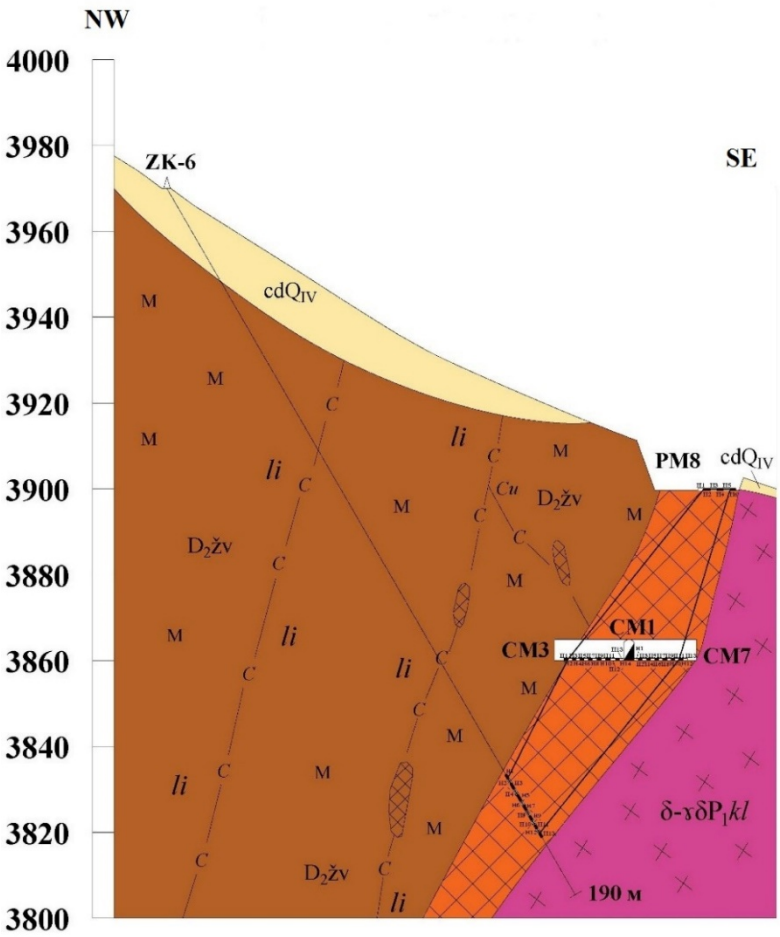
Note: When developing this report, the author used a large amount of literature from geological funds, which, for confidentiality purposes, are not referenced.

APPENDICES

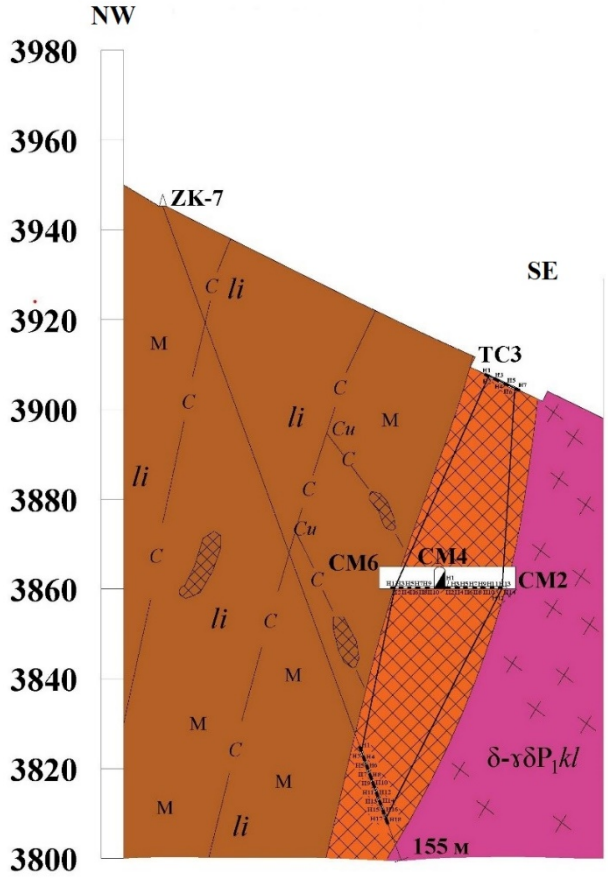
Appendix 1. Map of the actual material of the calculating ore body No.1 of deposit No. 1



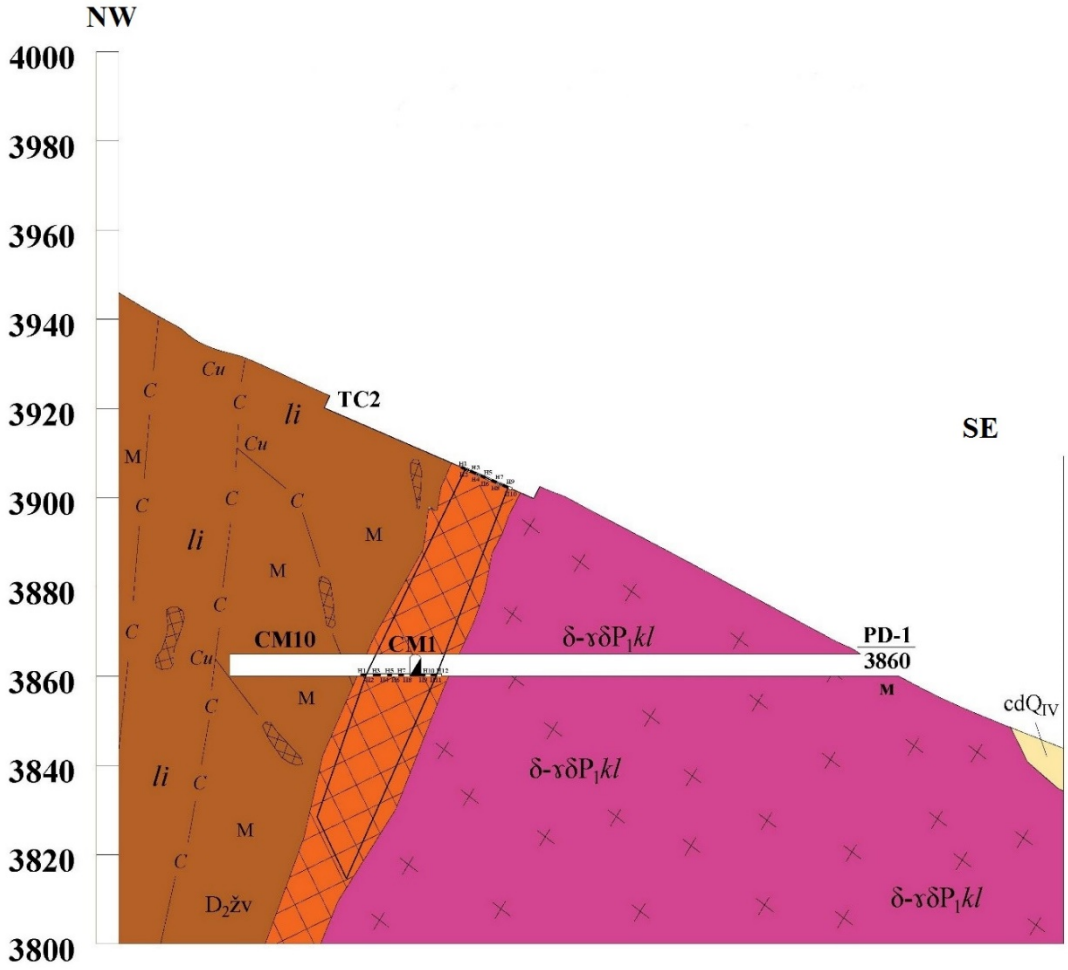
Appendix 2. Exploration section IV-IV of deposit No.1



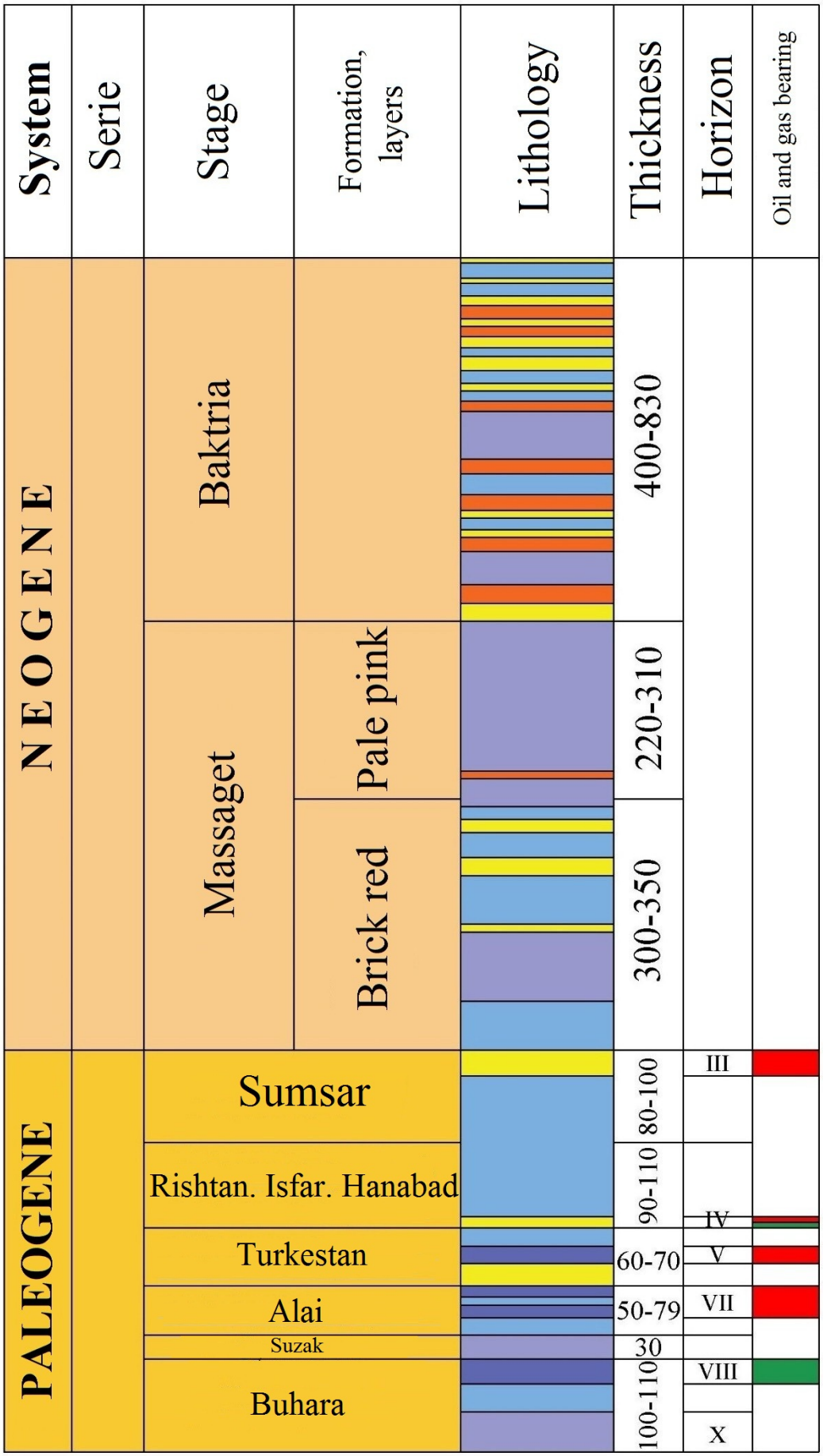
Appendix 3. Exploration section VI-VI of deposit No.1



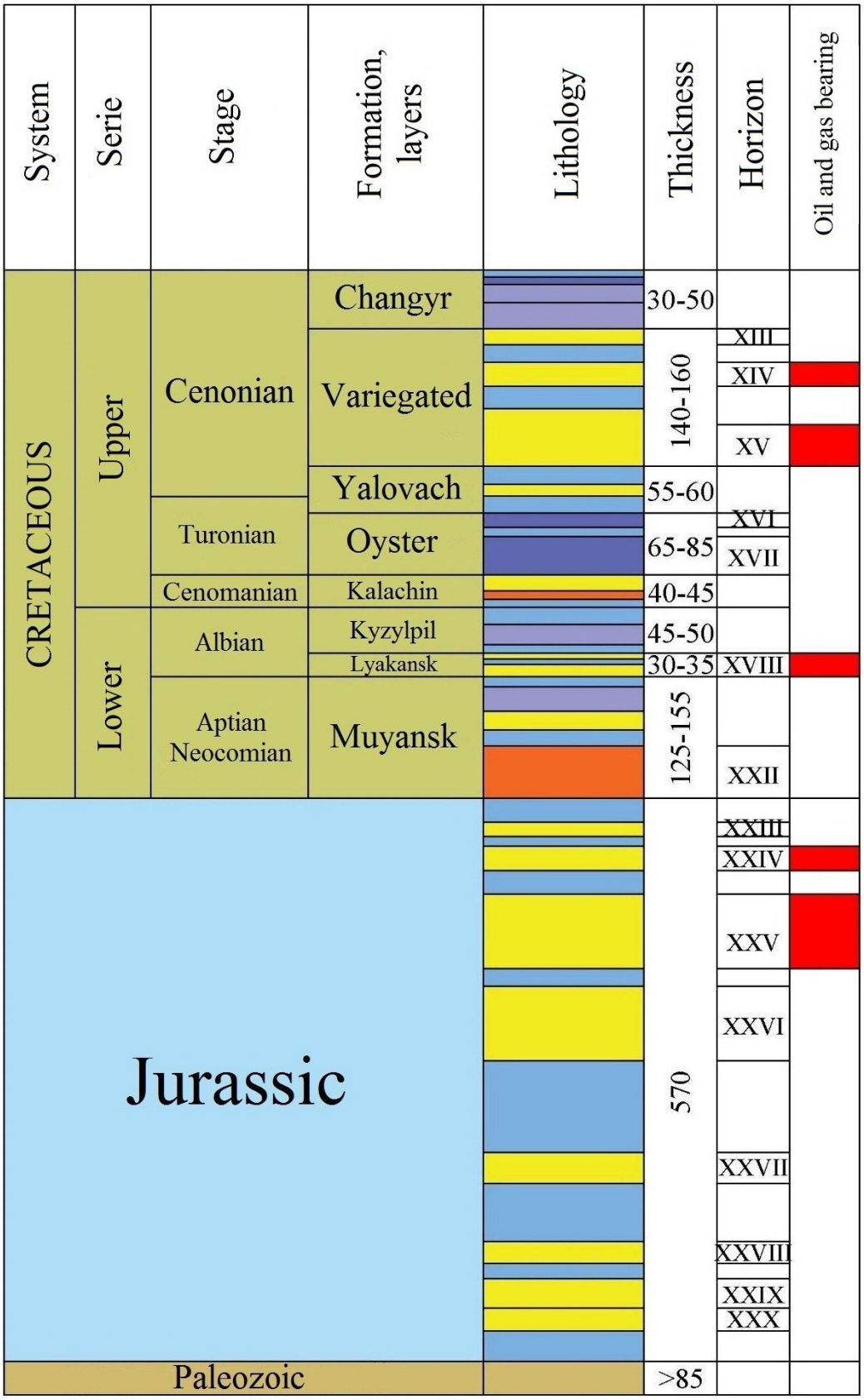
Appendix 4. Exploration section V-V of the deposit No.1



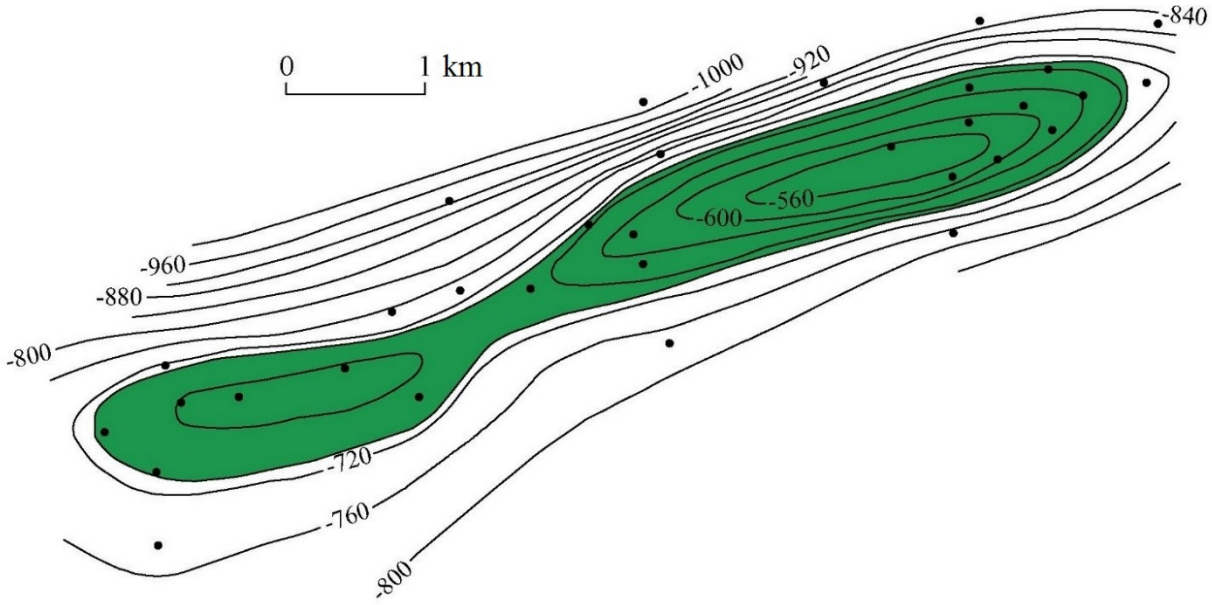
Appendix 5. Lithological and stratigraphic section of the deposit No.2



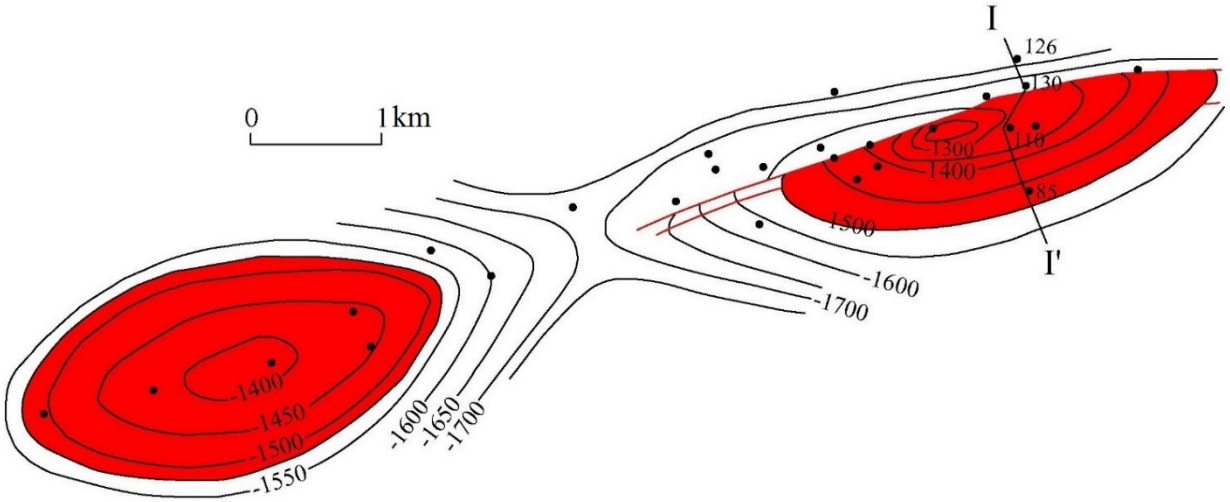
Appendix 5. Lithological and stratigraphic section of the deposit No.2 (cont.)



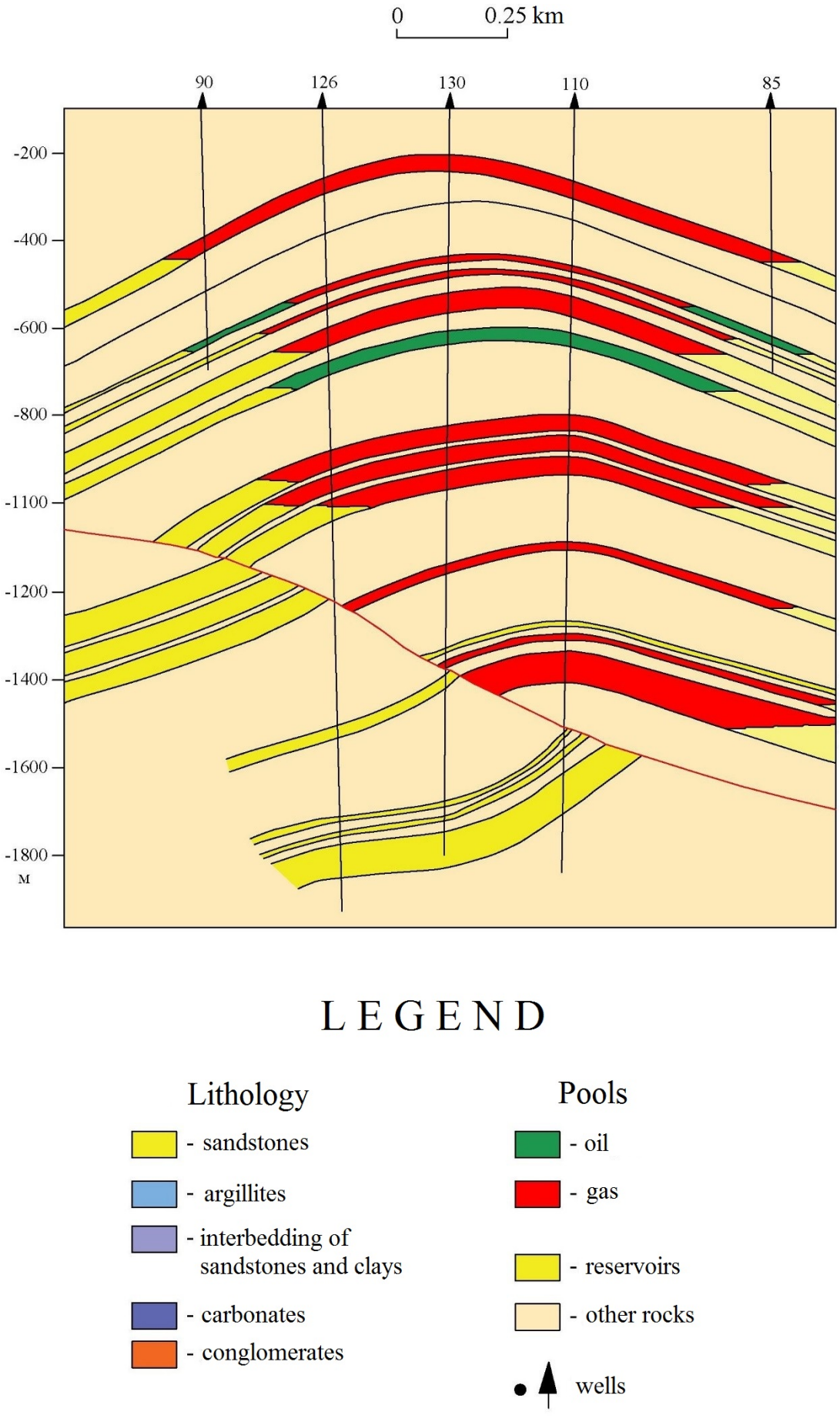
Appendix 6. Structural map on the roof of horizon VIII of the deposit No.2



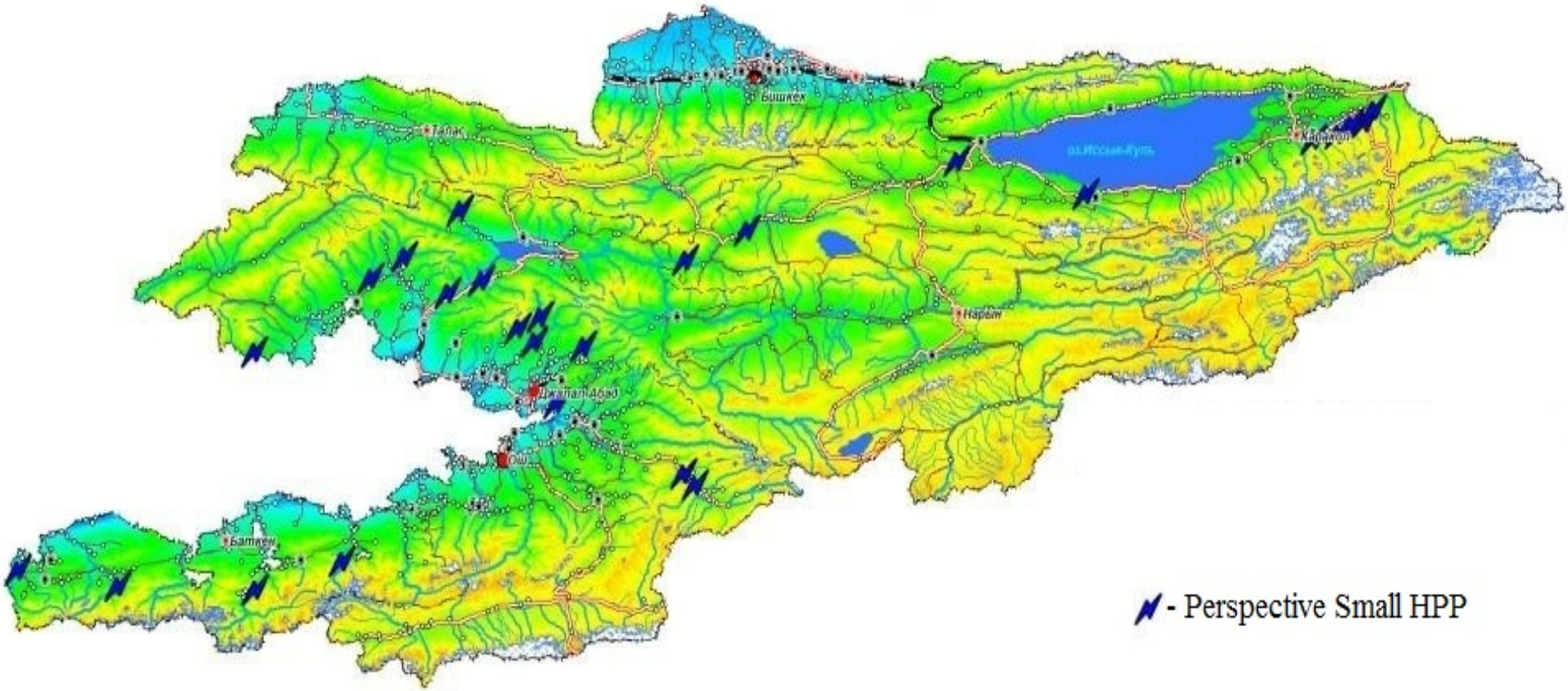
Appendix 7. Structural map on the roof of horizon XXV of the deposit No.2



Appendix 8. Section along the line I-I ’



Appendix 9. Map of perspective Small Hydropower Plants in Kyrgyzstan



Appendix 10. Renewable Energy Sources in Kyrgyzstan

Kyrgyzstan has enormous potential for the use of renewable energy sources, the topic of using these sources every day is becoming increasingly important.

According to the estimation of the State Committee for Industry, Energy and Subsoil Use of the Kyrgyz Republic and data from foreign institutions, the energy potential of renewable energy sources in Kyrgyzstan are:

- Solar energy – 490 million kWh per year;
- Water energy, small rivers and watercourses - 5-8 billion kWh per year;
- Wind energy – 44.6 million kWh per year;
- Biomass energy - about 1.3 billion kWh per year.

However, the practical use of renewable energy in Kyrgyzstan is less than 1%.

Difficulties in attracting investment are the main obstacle to the development of renewable energy in Kyrgyzstan.

Small HPP

Dozens of large and hundreds of small rivers and canals flow through the territory of the Kyrgyz Republic, into which thousands of alpine streams flow. The republic ranks third in the CIS after Russia and Tajikistan. Country has a huge hydropower potential, which amounts to 142.5 billion kWh per year of electricity generation, only 10% is used in our Republic.

Currently, 16 small hydropower plants are operated in the Republic.

On proposals of specialists, now it is possible to build 87 new small hydropower plants with a total capacity of 178 MW and an average annual output of up to 1.0 billion kWh of electricity. In addition, it is possible to restore 39 previously existing small hydropower plants with a total capacity of 22 MW and an average annual output of up to 100 million kWh of electricity.

The total hydropower potential of the 172 rivers and watercourses surveyed in the republic with a water flow of 0.5 to 50 m^3/s exceeds 80 billion kWh per year, of which the technically acceptable hydropower potential for development is 5-8 billion kWh per year [4].

Appendix 9 provides a map of perspective small hydropower plants in the Kyrgyz Republic.

Solar energy

There are enough sunny days in Kyrgyzstan, therefore, solar energy is in the second place on perspectivity. But in the current conditions, Kyrgyzstan needs large capital expenditures and investments. With current electricity tariffs in the Kyrgyz Republic, attracting investors is problematic due to the long payback period of such project.

Presently, there are no large solar stations in Kyrgyzstan; small photovoltaic panels are mainly used in small enterprises and households.

Under the One Programme of the UN UNIDO, together with UNDP and WHO, the project “Reliable energy supply to rural medical and obstetrical stations” installed photovoltaic stations (3 kW and 1.5 kW) in all regions of the Republic in 19 medical and obstetrical stations, which ensured uninterrupted operation of these stations, thereby ensured the continuous provision of medical services to the population, including women and children [3].

In 2018, in Kyrgyzstan, together with the Asian Development Bank, a project was launched to introduce new technologies in the field of renewable energy resources (RES) energy-saving technologies in the Kyrgyz Republic.

Presently, 300 W autonomous power supply kits are being installed with household appliances (a set of solar panels, a controller with rechargeable batteries, a TV, a fridge / freezer, LED bulbs / lamps).

So, as a result of the analysis and consultations, taking into account the fact that this year has been declared the Year of Regional Development, the State Committee of Industry, Energy and Subsoil use suggested distributing these kits for the electrification of several villages, including Ken-Suu village of the Zhumgal region of the Naryn province. The complexity of the mountainous terrain and the lack of roads was an obstacle to the electrification of the village.

In addition, in the Ken-Suu village of Zhumgal Region of Naryn Province, the State Committee of Industry, Energy and Subsoil use together with the technical team of ADB consultants and employees of "National Energy Holding Company" OJSC have already installed 15 sets of the above installations.

On successful use of such devices, the State Committee of Industry, Energy and Subsoil use together with ADB will analyze the implementation of these sets of autonomous energy supply throughout the country for partial electrification of non-electrified areas [6].

Wind energy

According to weather stations, in the regions of the Kyrgyz Republic wind velocity ranges from 0.8 to 6 m/s and the potential of wind energy also varies depending on its velocity.

The reserve of wind energy potential, calculated by the average annual wind velocities, is set at approximately $49.2 \cdot 10^5$ tons of reference fuel.

The specific power of the wind flow energy also fluctuates in a fairly large range:

- according to annual data, it is 40 - 180 W/m^2;
- monthly – 30 - 230 W/m^2;
- average 100 W/m^2.

The average annual specific energy of the wind flow varies from 170 to 1300 kWh/m^2, and the average monthly value does not exceed 50 - 60 kWh/m^2.

Wind flows energy gross potential is 2 billion kWh/year, of which 44.6 million kWh are technically feasible, about 4 million kWh can be considered economically viable for development. Such a spread is explained by the distribution conditions of the wind rose in high mountain regions.

The analysis carried out according to the static data of weather stations showed that more than 50% of all winds are light winds and calms (0-1.5 m/s), 30-40% are weak winds (2-5 m/s), and 10-20% - for moderate and fresh winds (6-10 m/s). Low-energy autonomous consumers are mainly located in lowland and foothill zones, where the energy potential of the wind flow is low. In areas where the winds with significant velocities (8-12 m/s) and with high-energy potential, consumers are almost absent [5].

A perspective object of the Kyrgyz Republic for wind energy is the Boom Gorge. A cascade of wind turbines can be established along this gorge. But due to the fact that hurricane winds often occur there, wind generators must be structurally protected from strong winds. Ultimately, all costs will be justified. If there was interest and finances, it would be possible to establish at least a few experimental facilities, obtain the results and draw the appropriate conclusions.

Application of the UNFC in the field of RES

To date, the main problems in the implementation of projects for the introduction of renewable energy sources are insufficiently developed appropriate regulatory framework and low electricity prices. In addition, as mentioned above, in Kyrgyzstan there is no classification of reserves and prognostic resources for renewable energy sources, which complicates the attraction of investors in this field.

The cost of electricity produced by large hydropower plants is lower than that generated from renewable energy sources. Considering the basic tariff for electricity generated by large

hydropower plants, established in the Kyrgyz Republic, the payback period for investments in renewable energy sources is much longer than in Europe, which repels most investors.

Every year, the area of glaciers in Kyrgyzstan is reduced, as a result of which the water content of rivers is reduced. According to predictions, in 2022 the Kyrgyz energy system will experience a shortage of electricity from 0.8 billion kWh/year, in 2028 to 6 billion kWh/year. The power shortage will continue even after the completion of the projects currently underway for commissioning the 2nd hydraulic unit of the Kambarata HPP-2, reconstruction of the Toktogul, Atbashy and Uchkurgan HPPs [7]. In addition, by 2100, Kyrgyzstan's glaciers may disappear altogether. Given the fact that 90% of the electricity is generated through the generation of water resources, Kyrgyzstan has to import all the missing volume from other countries. To avoid such costs, the state must expand its energy sources now. Despite the long payback periods for investments in renewable energy sources, a certain percentage of electricity generation, which should increase every year, in Kyrgyzstan should be obtained through renewable sources. Compulsory transition to RES will not only provide the state with electricity in the future, but will also act as a backup in emergency situations.

On August 15, 2019, a new version of the Law "On Renewable Energy Sources" of the Kyrgyz Republic (dated 24.07.19, No. 99) came into force, which provided for a number of legislative measures aimed at the development and widespread use of RES in Kyrgyzstan. Now the government faces the task to finalize some moments and harmonize all related regulations of the current law.

The application of the UNFC in this field, in my opinion, will help to harmonize the regulatory framework of the Kyrgyz Republic in the shortest time. In addition, the application of the UNFC will allow get more accurate information on the potential of the Kyrgyz Republic in the field of RES, which will attract investment and allow the development of this sector.

The start of the UNFC implementation in Kyrgyzstan, in my opinion, should begin with this sector of production, because now there are no established classifications in this area. The implementation will be simpler, and on its example, the government will gain some working experience with the UNFC, which come in handy later.