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Exploration and Historic Estimate calculation report on results on the uranium deposit of «Jusandalin» (as of 01.01.1991)

Volume II

Methodology and results of historic estimate calculation

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1991

HISTORIC ESTIMATE CALCULATION METHODOLOGY

The principle of exploration of the mineralisation-bearing zone, mineralisation bodies of the Northern deposit, in particular mineralisation body number 4, predetermined the method of calculation of the historic estimate, within the explored horizon. The calculation was made by the method of parallel vertical sections per mineralisation mass.

According to a number of existing classifications of uranium deposits, based on mineralogical-geochemical, genetic and geological-formation division features or their combination, the Jusandalin uranium deposit, especially in its detailed explored part, can be attributed to subgroup 1a - steep-dipping (veined and vein-like) with predominance of structural elements.

The mineralisation bodies of the Jusandalin deposit are confined to fracture zones of meridional and northeastern directions. Deposits represented by vein-shaped fracture zones with vein-disseminated uranium mineralization are morphologically quite diverse. A characteristic feature of them is the lack of clear geological boundaries of industrial mineralisations in terms of thickness, which are established only by sampling data, taking into account condition limits.

Despite the fact that the mineralisation bodies are confined to fracture zones in homogeneous crystalline rocks (granites), they have a rather complex morphological shape due to the junction of fracture zones of meridional and northeastern directions, and differently oriented apophysis, controlled by the feathering fractures.

The texture of the mineralisation is veined, disseminated and even brecciated.

By quality and contrast, the mineralisation of the Jusandalin deposit are very heterogeneous; among them, there are both high grade and ordinary mineralisations, and even low grade ones.

As mentioned above, the mineralisation at the deposit are both primary and redeposited. Often the post-mineralisation dikes of dioritic porphyrites, in their most permeable parts, turn out to be mineralized.

As noted above, the Jusandalin deposit historic estimate were calculated by the section method.

In this method, the mineralisation body is geometrized into a system of simple geometric shapes (prisms, truncated pyramids or cones, wedges, etc.), the bases of which are the cross-sections of the body in the exploration sections, and the heights are the distances between sections.

The volume of deposits is calculated by summing the volumes of elementary geometric figures based on two cuts and taken as prisms at close values of the section areas in adjacent sections or truncated pyramids at their significant (more than 40%) difference.

Accordingly, two calculation formulas are used:

$$V = \frac{S_1 + S_2}{2} \cdot H$$ -prism;

$$V \equiv \frac{S_1+S_2+\sqrt{S_1 \cdot S_2}}{3} * H$$ -truncated pyramid;

Where **S₁+S₂** are the values of the section area in the adjacent sections;

H is the height of the figure (i.e. the distance between the sections).

The volume of areas of deposits (mineralisation bodies) located behind the extreme sections, in which they are uncovered, are calculated by the wedge or cone formulas:

$$V = \frac{S_1}{2} \cdot \frac{H}{2} \text{и} V = \frac{S_1}{2} \cdot \frac{H}{2},$$ correspondingly,

Where **S₁** is the cross-sectional area of the mineralisation body in the outermost section;

H- the accepted distance between the sections.

It should also be noted that the exploration sections are located across the strike of the main mineralisation-controlling structures of northeastern strike (mineralisation bodies No. No. 2ᵇ, 3ᵇ, 4).

In relation to the mineralisation bodies confined to the meridional disturbances, the section lines are located at angles. In this case, the cross-sectional area of the mineralisation body is slightly overestimated in the sections.

However, we do not introduce a correction for the angle between the strike of the mineralisation body and the section plane. It is compensated by the fact that the H-accepted distance between the sections is taken into account, but not the distance between the sections along the strike of the mineralisation body.

CONDITIONS

The standards for two options of calculation were set by the letter No. 640s of July 24, 1990 for estimation of historic estimate on Jusandalin deposit as of January 01, 1991.

OUTLINING OF MINERALISATION BODIES

The outline of mineralisation bodies according to the conditions for both options is made on the same drawings in order to reduce the volume of graphical applications to the calculation of historic estimate and their clarity.

The outlining of industrial mineralization by thickness was carried out in accordance with the established conditions. The main indicators were the cutoff content and the maximum thickness of non-metallic rocks allowed to be included in the industrial outline.

If mineralization is characterized by a relatively uniform distribution of uranium with a gradual decrease in its concentration to the boundaries of mineralisation intervals, delineation was performed using cutoff grades. In this case the outline was carried out by samples with content equal to the cutoff grade. In the integral interpretation of radiometric sampling, the boundaries of the interval were determined by the method of a given intensity.

If the mineralisation interval is represented by above-grade intervals separated by unconventional and substandard intervals with thickness less than the established limit, the delineation was performed so that each elementary mineralisation interval included in the outline, together with the mineralisation-free interval separating it, would provide an average grade in the mineralisation added to the contour not lower than the established cut-off grade.

If the content was lower than the cutoff content, this interval was not included in the industrial contour, or was transferred to the substandard one and was taken into account by the coefficient of mineralisation bearing capacity.

Industrial mineralization in the section was outlined according to the allocated mineralisation intervals, according to the requirements of the conditions (minimum content across the section).

In those cases, where the drillhole was stopped in the mineralisation for technical reasons, the outline of the mineralisation body was limited according to the results of gamma-ray logging.

Between drillholes with balance mineralization and empty (or off-balance) drillholes, the mineralisation body was outlined to the middle of the distance between intersections, but not more than 4 thicknesses of the mineralisation interval, intersected by the well.

The accepted restriction is caused by the ratio of average sizes of most mineralisation bodies along the strike and across it, which is approximately 1:4.

The same principle is adopted for delineation of mineralisation bodies in plan.

If the mineralisation body is outlined between the balance intersection and an empty section (or with an off-balance mineralization), the outlining is performed to the middle of the distance between the sections, but not more than 4 drillhole thicknesses of the mineralisation interval, intersected by mine workings (drillholes).

If the mineralisation body is delineated between the balance in content section and the balance in content, but substandard in terms of metro percentage, then the contour of industrial mineralization is drawn in the middle of the distance between the sections.

body 2^b within the explored horizon was intersected by 5 holes (C-95, C-154, C-156; C-158, C-160). From the northeast and southwest, the mineralisation body is bounded by tectonic fault zones of meridional strike, to which mineralisation bodies 8 and 5, respectively, are confined. According to the accepted specifications, commercial mineralization limited by three holes (C-156, C-158, C-160) is taken into calculation of historic estimate. The mineralisation body is limited to the middle of the distance between profiles II and II in the northeast, and, to the middle of the distance between profiles 1V and V in the southwest. In both cases, the volume of outlining blocks was calculated according to the wedge formula. The mineralization uncovered by drillhole C-95 was not included in the calculation of historic estimate and attributed to mineralisation body 5.

Since the mineralisation body in the profiles is cut by single drillholes, its outlining along the dip is carried out at a distance of not more than 4 times the drillhole thickness.

body 3^b. Only its northeastern closure in the area of profile 123 has been explored within the exploration horizon. It was intersected by cross measure drift 123 and b holes (C-153, C-91, C-81, C-64, C-72, C-33). From the northeast, the mineralisation body is outlined along the strike at half the distance between holes C-153 and C-5, and from the southwest, at half the distance between profiles. The mineralisation body above the explored horizon is only evaluated by surface drillholes along the upwelling in the southwestern direction.

body 4 within the explored horizon is uncovered along strike by mineralisation drifts 1 and 2, and across the strike by intersections from them, as well as by underground drilling drillholes. It is represented by a series of lumps of differently arranged mineralisation lenses (bodies).It is confined, like mineralisation bodies 2^b and 3^b, to the zone of tectonic disturbances of the north-eastern strike. It is represented by a series of backstage-shaped mineralisation lenses (bodies).

body 4-1 within the explored horizon is revealed by fans of drillholes in profiles IV|+IX. It is not outlined along the rise and fall. The boundary of outlining counting blocks is drawn on the line of intersection of the mineralisation block boundary with the plane of the corresponding horizon, and the zone of influence of the last section is removed from the projection of the mineralisation body on the vertical plane. The volume of the outlining block was calculated using the wedge formula.

body 4-2 is intersected by fans of holes in profiles I+IV, drilled from mineralisation drift 2, as well as by deep holes. From the northeast, mineralisation body 4-2 is contoured to the distance of 4-bore thicknesses of the mineralisation interval, intersected by well C-131, and from the southwest - intersected by intersection 4. Departure from the accepted contours and outlining principles is allowed along the section of the mineralisation body, intersected by one hole (C-131). In this case, section 1 was taken as the outermost mineralisation section, the volume of the block was calculated using the wedge formula, and the average uranium content by drillholes C-162 and C-131.

On the dip, the mineralisation body 4-2 in the sections, in most cases, is conventionally contoured, at a distance from the mineralisation undercut equal to a 4-fold drillhole thickness.

In section II, hole C-160 uncovered the lower part of mineralisation body 4-2, drillhole thickness 0.33m with a content of 0.113%. The outline of the mineralisation body in the section is made as an average between sections I and III. In this case, the volume of the block is calculated between sections 1- III. The average uranium content was calculated taking into account the content in drillhole C-160.

body 4-3 was intersected by drillholes in three sections 120, II, III (C-204, C-205, C-202, C-201, C-85). Contouring of the mineralisation body 4-3 along the dip is also contoured rather conventionally, according to the accepted principle. Along the strike, the mineralisation body is delineated by half the distance between the adjacent sections, but no more than 4 times the drillhole thickness of the mineralisation interval.

The mineralisation bodies confined to the meridional tectonic disturbances of the Jusandalin fault zone are characterized by a narrow elongated shape. In most sections, these mineralisation bodies are uncovered by single intersections of drillholes. The same principle was used to delineate these mineralisation bodies along the dip - not more than 4 times the drillhole thickness of the mineralisation interval. Practically, these mineralisation bodies are not delineated even within the exploration horizon along the dip and rise. In the sections presented to historic estimate estimation, the dip of these mineralisation bodies is more gentle than that of mineralisation bodies confined to

zones of northeastern strike. This is explained by the sharp angle of encounter of the exploration profiles with the strike of the mineralisation bodies.

body 5 was intersected by crescent 123 and a number of holes in exploration fans V, VII, VIII and IX. The most complete cross-section of the mineralisation body was obtained in section 123. Here, it is intersected by crescent 123 and holes C-98, C-94, C-86, but it is not outlined either along the rise or along the strike. Given the northern declination of mineralisation body 5, we can assume its junction with mineralisation body 2b below hole C-153. Taking into account mineralization, revealed by the well C-1394 (drawings No.9,18), mineralisation body 5 joins mineralisation body 2b from the north and is contoured at half the distance between the well C-95 and profile V (C-154). From the south, mineralisation body 5 was intersected by well C-46 on profile IX and contoured at a distance of 12 m. The volume of outlining blocks is calculated using the wedge formula. The average content of the block between sections 123 and V was calculated taking into account the results of interpretation in well C-96.

body 6 was intersected by drillholes in profiles V, VI, 123. In the sections, the mineralisation body is not delineated by drillholes. In section V, the mineralisation body was intersected by one-hole C-154 and contoured 14m behind it, from the south by half the distance between sections 123 and VI.

body 7 was intersected by 5 holes in sections V±V1. The mineralisation body is delineated 3 m to the north from section V and 12 m to the south from section VI along the strike, adjoining mineralisation body 3^b. In both cases, the volume of outlining blocks is calculated using the wedge formula.

body 8 is traced by drillholes in sections II+V. From the server, mineralisation body 8 joins mineralisation body 2^b at a distance of 7 m from profile II. From the south, the mineralisation body is contoured at half the distance between sections V and V.

BRIEF CHARACTERISTIC OF MINERALISATION BODIES AND MINERALISATION DEPOSITS

The deposit is represented by two main mineralisation deposits - South and North, which are located en echelon to each other. In addition, according to preliminary exploration by drillholes from the surface, mineralisation intersections of industrial interest were encountered by individual drillholes on the flanks of the deposit.
The mineralisation bodies are confined to tectonic faults (zones of crushing and foliation) and have a clearly pronounced narrow-linear orientation with a 60-80° dip to the southeast. The mineralization extends practically from the surface to a depth of 800 m, although sporadic undercutting occurs at a depth of 1000 m.
It should be noted that mineralisations are mainly non-industrial in the interval of depths up to 300m. The high gradeest in uranium content and significant in thickness mineralisation intervals are noted at depths of 350 m and lower.

The Southern deposit was explored only by drilling drillholes from the surface, its characteristics are given in all previous calculations of historic estimate, since no additional exploration work was carried out on it, it does not participate in this calculation of historic estimate, and detailed

characteristics of mineralisation bodies and the deposit as a whole are not given. According to preliminary exploration data, the South deposit is represented by three mineralisation bodies and explored in six profiles (132-127) over 300m at depths from 20 to 500m.

The Northern deposit was represented by four mineralisation bodies according to preliminary exploration data V and explored by drillholes in II profiles over 1050m at depths ranging from 37 to 597m. The mineralisation bodies were confined to tectonic fault zones of northeastern direction (Dyke fault zone).

However, rock-drilling exploration at a depth of 500 m from the surface showed a much more complex structure of the Northern deposit. Mineralization was noted in both northeastern and meridional strike zones, and often mineralisation undercutting in the meridional strike zones was related and linked to mineralisation bodies in the northeastern strike zones.

Below is a description and degree of exploration of individual mineralisation bodies of the Northern deposit. For those mineralisation bodies that have not been explored by underground mining detailed exploration, the characteristics are given according to preliminary exploration data, without recalculation of the average uranium content.

body I was explored in two profiles (124-123) by drillholes No. 1636, 1608, 1399 at depths from 38 to 352 meters and on strike of 170 meters. It is characterized by low grade uranium content in mineralisation (0.069%).

body 2^a is explored in three profiles (125-123) at depths of 37-106m and along the strike at 245m. It is characterized by the same low grade (0.065%) uranium content in the mineralisation.

body 2^b was explored from the surface in four profiles (125-123 and 121.5) at depths of 405-597m and outlined along the dip within absolute marks of +150+-162m and along the strike at 433m. Mineralisation body 2^b was intersected by drillholes from the surface (No.1408 1461,1394, 1448). Mineralisation bodies 2^a and 2^b are confined to the same tectonic zone of northeast trending, but are located at different hypsometric levels.

body 2^b was explored by single holes from mineralisation drift 2, in profiles II, III,IV, V-V (drillholes 154, 156, 153, 160, C-95) within the exploration horizon.

It is traced at 230m horizon along the strike. Average content within the explored horizon in these drillholes was 0.175%. Only intersected by drillholes C-156, C-158, C-160.

body 3b was explored from the surface in six profiles (129-124) at depths from 76 to 473 m and outlined along the dip within the RL of +453RL to -62RL and along the strike of 570 m. Only its northeastern closure in the area of profile 123 has been evaluated by underground exploration work. Here, it was intersected by cross measure drift 123 and drill holes in profiles VI, VI', VII. The main mineralization is located above the exploration horizon further to the southwest.

Within the explored part of the mineralisation body the average uranium content was 0.128%.

body 4 was explored in five profiles (125-123; 122.5 and 121.5) by drillholes from the surface at depths from 109 to 570m and outlined along the dip within the RL +372mRL and -194mRL and along the strike at 413m. This is the largest mineralisation and uranium mineralisation body with a fairly high grade content. It was the object of detailed exploration. On the exploration horizon, it is uncovered along the strike by mineralisation drifts I and 2, and across the strike by a number of cuts and drill holes. It is confined, as well as mineralisation bodies 2b, 3b, to one of the zones of tectonic disturbances of north-eastern strike. It is represented by a series of mineralisation lenses located in a echelon manner within the tectonic zone. Its general declination to the northeast has been confirmed. Five down-hole holes were drilled from drillholes 1,2,3 which intersected this mineralisation-bearing zone and mineralisation lenses of mineralisation body 4. Within the explored horizon, historic estimate were calculated for individual mineralisation lenses (bodies).

body 4-1 is the most thoroughly explored by mine workings and drill holes. It has a complex internal structure within the mineralisation contour. It has been explored by means of drillholes 50-25m apart on average within RL of -88mRL and +12m RL. The cross-section of the mineralisation body on the exploration horizon has dimensions of 35x165m, with apophysises along the peripheral fractures.

body 4-2 was intersected by fans of holes in sections I+IV. It is a narrowly elongated mineralisation lens along the tectonic fault zone with 185m strike parameters on the exploration horizon. The average uranium content is 0.108%.

body 4-3 was intersected by drillholes in three sections: 120, II, III. It is located slightly to the southwest and lower in dip than mineralisation body 4-2 within the same tectonic zone. The average uranium grade was 0.100%.

body 5 is the most explored of all other mineralisation bodies near the meridional direction. It has been intersected by the cross measure drift 123 and a number of holes in the VII+IX profiles.

It also represents a narrow mineralisation body stretched in the meridional direction by 200m. Its average uranium content is 0.063%.

body 6 was uncovered by drillholes in sections V, VI, and 123. It is not outlined along the rise and fall. The average uranium content in the mineralisation body is 0.137%.

body 7 was intersected by 5 holes in sections V-VI. The average uranium content is 0.111%.

body 8 is traced by a narrow strip in sections II+V. It was intersected in each section usually by one well, and only in section V it was outlined by 3 drillholes. The average uranium content is 0.079%.

DETERMINATION OF THE BASIC CALCULATION PARAMETERS

The main calculation parameters include calculation of the average uranium content in the cuts (sections) by mineralisation bodies, determination of mineralisation areas, volumes of calculation blocks, etc.

Calculation of average uranium contents in the cross-section (section).

Average uranium content for individual mineralisation bodies in the cross-sections was determined as a weighted average per thickness for each drillhole. According to the established conditions, the calculation of the average contents of the intervals intersected by drillholes and mine workings included non-bearing areas, or represented by off-balance mineralisation, with a drillhole thickness of up to 3 m.

The average content of well intervals was calculated on the basis of the results of gamma-ray logging interpretation. The average uranium content in the intervals, intersected by mine workings, was determined by the results of radiometric sampling, within the same intervals as the drillhole sampling.

Methods of interpretation of gamma-ray logging and radiometric sampling are given in the section "Geophysical research" (Volume I)

It should be noted that the average uranium content in the section was calculated by the full intervals, intersected by drillholes and limited by the conditional boundaries of horizons (+12m RL -88 mRL).

Methodology of determination and accounting of hurricane samples.

Samples with high uranium content are noted only for mineralisation body 4-1. Analysis of the results of sampling by both mine workings and drillholes shows the presence of high-content mineralisations, often confined to separate seams of tectonic disturbances. 245 mineralisation samples were analyzed, which were distributed according to the classes of contents as follows:

- 0.030 - 0.100% - 121 samples (45.4%);
- 0.100 - 0.300% - 80 samples (32.7%);
- > 0.300% - 44 samples (17.9%).

The average content across sections for mineralisation body 4-1 varies between 0.172% and 0.397%.

It was decided not to limit hurricane samples, for individual drillholes, workings. The only exception is well C-16 with a uranium content of 0.926% in section IX.

As mineralisation body 4-1 is outlined by only one of these holes in this section, its influence will affect the increase in the average content in the estimated block (13.0%). Therefore, the average content for well C-16 for the calculation of historic estimate was replaced by the average content for block VIII.-IX (0.351%).

Mineralisation area calculation.

Mineralisation areas were calculated within the outlined mineralisation bodies in the cuts. The selected outline was divided into a number of elementary geometric shapes, the areas of which were calculated using appropriate formulas. The calculation of mineralisation areas was performed twice by different performers. The average value was taken into account in historic estimate calculation.. The mineralisation areas were calculated on 1:200 scale sections.

The volume of counting blocks

The volume of estimated blocks for mineralisation bodies was made by summing the volumes of elementary blocks bounded by sections. The volumes of elementary blocks were calculated using the prism formula:

$$v = \frac{s_1 + s_2}{2} \cdot H$$

The block volume was calculated using the truncated pyramid formula in the case where the mineralisation areas in adjacent sections differ from each other by 40% or more:

$$v \equiv \frac{s_1 + s2^{+\sqrt{s_1 \cdot s_2}}_{-}}{3} \cdot H$$

The volume of estimated blocks by outlining sections more often was determined by the wedge formula:

$$v = \frac{s_1}{2} \cdot \frac{H}{2}$$

in some cases, using the cone formula:

$$v = \frac{s_1}{3} \cdot \frac{H}{2}$$

The volume of blocks was determined within the boundaries of conditional horizons with RL -88mRL and +12mRL.

Radiometric and furrow sampling was carried out at the level of the RL +38mRL, calculation of historic estimate was carried out within 50-meter intervals above and below the exploration horizon.

Volume weight.

The volumetric weight of mineralisation and host granites was determined in the laboratory of physicochemical laboratory of the mine according to standard methods. The study was subjected to both the core material of surface drilling drillholes, and selected samples from mine workings. The study of the dependence of the volumetric weight on the uranium content in mineralisations did not establish any regularity. The volumetric weight of the mineralisation does not practically differ from the volumetric weight of the host rocks, and obeys the law of standard distribution.

Volumetric weight of 2.55 t/m^3 was taken for the calculation of historic estimate.

RESULTS OF THE HISTORIC ESTIMATE CALCULATION

If the 4-1 mineralisation body at mount. -38mRL is outlined by drillholes and mine workings, then on horizons +12mR and -88mRL it is outlined only by drillholes, taking into account the interpretation by exploratory sub-sections of scale 1:200.

The mineralisation areas in the horizons were calculated by elementary geometric formulas.

The results of this calculation are shown in Table below.

Table 1 below presents the historic estimate.

Bodies	Volume Vm^3	Kt.	%U	%U3O8
2b	39,643	101.1	0.175	0.21
3b	18,729	47.8	0.128	0.15
I-I	480,980	1,226.5	0.271	0.32
I-2	9,735	24.8	0.108	0.13
I-3	737	1.9	0.092	0.11
5	34,676	88.4	0.063	0.08
6	17,853	45.5	0.137	0.16
7	6,178	15.8	0.111	0.13
8	12,981	33.1	0.079	0.09
Total	621,512	1,584.9	0.239	0.28

- Grade conversion factor Uranium (1) to Uranium Oxide (1.1792)