Mineralogical composition of the Santonian deposits of the North Konimekh deposit in Uzbekistan

Isomiddin Togaev[1], *Doston* Buriboyev[2], *Shoxrux* Toshtemirov[1*], and *Baxtinur* Abdujabborov[1]

[1]National University of Uzbekistan after named Mirzo Ulugbek, 4, University str.100174, Tashkent, Uzbekistan
[2]Geology of uranium and rare metals, Scientific production center, str. Navoi 7 A 100011, Tashkent, Uzbekistan

Abstract. The article presents information about the results of studying the material composition, mineralogy and geochemistry of deposits formed in the Upper Cretaceous (K2) Santon strata of the North Konimekh uranium deposit located in the Kyzylkum region. Prospecting, appraisal and exploration at the North Konimekh uranium mine is an urgent problem, as it is in the focus of attention of many researchers. This article provides extensive information on underground alkalization, one of the methods for extracting uranium raw materials. Currently, it is emphasized that this method is convenient, has high financial efficiency in the extraction of uranium raw materials, and is also one of the cheapest and most effective methods.

1 Introduction

Today, the need to search for radioactive and rare earth mineral deposits in the world is increasing year by year. In the decision of the President of the Republic of Uzbekistan №. PQ-3578 dated March 1, 2018 "On measures to fundamentally improve the activities of the State Committee for Geology and Mineral Resources of the Republic of Uzbekistan", as well as in other regulatory and legal documents adopted in this field, defining important tasks in the search for mineral deposits given.

In particular, the search and exploration of uranium-rich deposits, which is one of the raw materials necessary for industry, is now of great importance for the economy of Uzbekistan [1]. The significance of the modern methods of the field of geology is very effective in determining the material composition of underground ore-forming deposits, studying mineralogical-geochemical properties. The reason is that when studying the obtained materials, traditional methods of mineralogical research were used: description and classification of rocks under a microscope, a complate mineralogical analiysis with a detailed description of minerals, their satellite elements, the mont important auxilliary minerals and clay. Study and characterization of light and heavy fractions of minerals under a microscope

* Corresponding author: toshtemirovshohruxjon@gmail.com

(quantitative mineralogical analysis), as well as special research methods - phase analysis of X-ray radiation to determine the composition and quantity of clay and related minerals, mass spectral analysis, inductively to determine the amount of ore complex elements bound plasma, quantitative X-ray analysis for 6 elements, as well as selected samples for objective geochemical characterization of epigenetic zones Fe and S, CO_2, C_{org}, P_2O_5, U^{+6}, U^{+4}. were also analyzed by chemical methods for their forms.

2 Methods and materials

According to the results of the conducted geological research, the oxidation zones of the ore-forming layer in the "North Konimekh" mine were realized by drilling wells along the defined geological sections of the drilling grid with a length of 1.6-0.8x0.8-0.05 km. In the mining area, the regional movement of groundwater from the Tien-Shan orogenic region is in the northwest direction.

Studies show that epigenetic barriers that form ore in the mine are the southwest direction of the regional front in the Upper Cretaceous deposits. The main ore prospects of ore formation in the North Konimekh mine are associated with the boundary of the formation oxidation zones in deposits of the Turonian, Cognac, Santonian, Campanian and Maastrichtian horizons [2-4].

After studying and summarizing all the materials of the geological results of the mining area, the Turonian, Cognac, Santonian, Campanian and Maastrichtian deposits are clearly separated from each other by sandstone and siltstone layers. It is clearly shown that the separation of these deposits from each other can be divided into layers by marking the boundaries of the geophysical research method recorded and confirmed by sectioning. According to the core material taken from the wells, it was observed that sandstones alternate with clay. In the preparation of this article g.Under the leadership of D.Buriboev materials were used.

3 Results and discussion

North Konimekh mine in 1979, exploration works were carried out in the southern wing of the South Bukinay mine (L.A. Sininkiy) by the Bukinay geological department No. 18 of the state enterprise "Kyziltepageologiya". In 1979-1982, exploration and evaluation of the mine, preliminary exploration in 1983-1985, detailed exploration of the mine in 1986-1993 were carried out on a large scale. The description of this object is given according to the materials of E.P. Tikhonov and L.A. Sininkiy.

As a result of geological exploration, the North Konimekh mine was formed as a large object. Until now, the North Konimekh mine is used as the main raw material base of the "Navoiyuran" S.E. (Fig. 1).

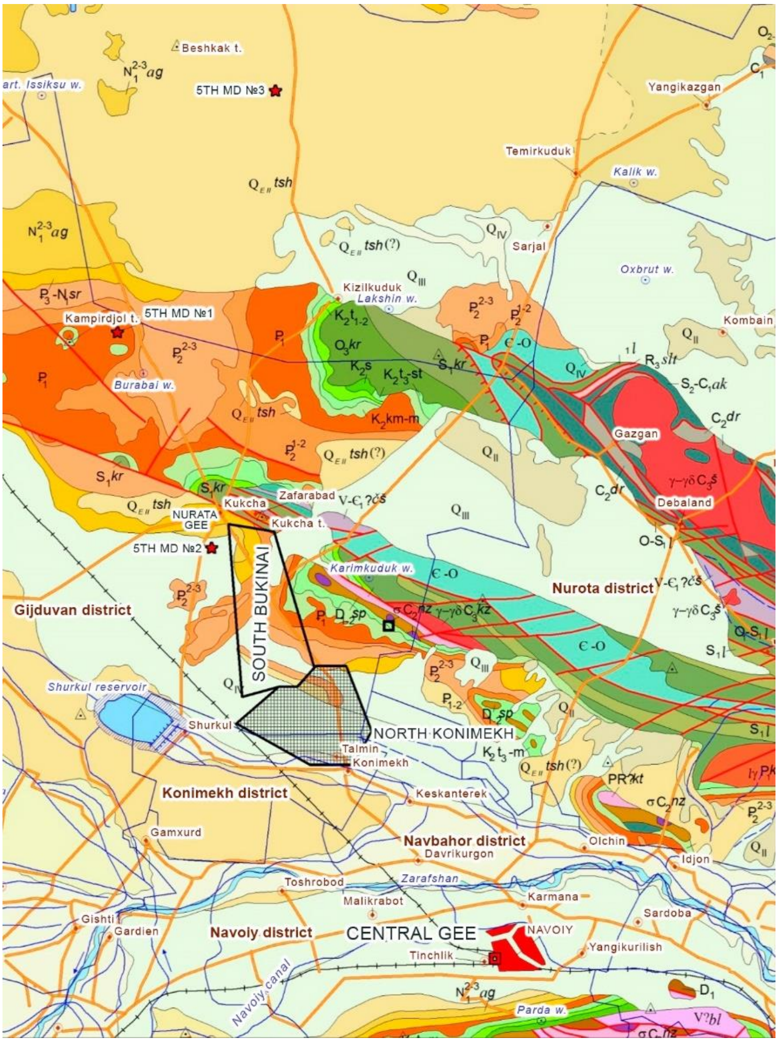

Fig. 1. Representative map of the North Konimekh uranium mine area (scale: 1:500 000).

The mineralogical and geochemical characterization of the productive horizon was initially accepted for the Santon deposits - 10 samples, but due to the need to conduct additional exploration by drilling, it was decided to further study the Santon deposits and one other horizon that localizes uranium mineralization.

Below are the results of studying the material composition and geochemical properties of rock minerals from the Santon (10 samples) layer deposits of the North Konimekh field [5-7].

However, it should be noted that at the next stages of geological exploration, a large amount of mineralogical research was required for objective conclusions.

Based on work experience, it is necessary to consider the selection and study of 10-15 mineralogical samples for each mineralization zone, which characterizes the ore zone of layer oxidation for each productive horizon, including the mineralization of rare earth elements and the rhenium zone at the contact of oxidized gray rocks [8-10].

The material for the study was obtained from duplicate core samples of drilling exploratory wells, and a sequence of non-mineralized gray and limonited rocks, as well as mineralized rock sequences, containing the following mineralization zones:

- uranium diffusion halo;
- diffusion halo of uranium and selenium;
- selenium diffusion halo;
- uranium mines;
- rhenium mines;
- selenium ores.

Below are the results of studying the mineralogical-geochemical properties of uranium ores in Santon deposits and the material composition of rocks and minerals (tables 1-2).

Table 1. The material composition of rocks and minerals of the Santon deposit

Mineral	**Gray rocks**					**Gray rocks**		**Limonite rocks**		
	Culturless	The scattering halo of Uranus		Uranium ore		Selenium ore	Se diffusion halo	U and Se diffusion halo	Se diffusion halo	Without ore
	Sand and Sandstone	Sand and Sandstone	Siltstone	Sand and Sandstone	Siltstone	Sandstone	Sand	Sand	Sand	Sandstone
1	**2**	**3**	**4**	**5**	**6**	**8**	**9**	**10**	**11**	**12**
Quartz	51.3-59.1 55.2	53.3-56.2 54.7	42.7-45.3 44	49.7-60.4 57.6	47.1-48.2 47.54	50.3-58.6 54.45	52.6-57.56 55.08	46.71-48.28 47.49	48.9-61.4 55.15	53.8-58.62 56.21
Feldspars	21.5-27.7 24.6	21.5-26.1 23.8	15.8-19.6 17.7	22.2-24.8 23.5	20.6-22.8 21.7	20.15-27.9 24.02	19.4-28.3 23.85	18.11-19.8 17.95	23.4-24.81 24.1	20.55-28.9 24.73
Lumpy rocks	9.8-17.3 13.5	16.5-25.9 21.2	2.4-2.6 2.5	10.9-18.2 14.5	2.3-2.45 2.36	8.9-13.38 11.14	9.8-22.34 16.07	13.76-18.34 6.05	11.9-21.73 17.18	10.8-18.72 14.76
The size of the material	88.6-95.5 92	90.3-97.4 93.8	61.2-71.5 66.3	84.2-94.6 91.9	70.4-73.45 71.92	89.65-96.7 93.17	92.6-97.4 95	76.2-91.47 83.8	84.2-94.6 89.4	88.6-95.5 92.05
Muscovite	0.5-2.3 1.4	0.9-2.7 1.8	0.22-0.3 0.15	0.5-2.3 1.4	0.2-0.3 0.25	1.19-1.22 1.21	0.90-1.57 1.23	1.12-1.34 1.23	0.83-1.13 0.98	0.28-1.34 0.81
Chlorite	units.-1.22 0.14	units.-0.17 0.05	0.14-4.32 3.22	units.-0.18 0.05	0.66-2.96 1.81	units.-1.18 0.17	units.-0.68 0.18	0.11-1.32 0.71	units.-0.18 0.05	0.36-0.56 0.46
Size of mica	0.5-3.5 2	0.9-2.24 1.57	0.36-4.62 2.49	0.5-2.48 1.49	1.04-3.57 2.3	1.19-2.40 1.79	0.90-2.25 1.57	1.23-2.66 1.94	0.83-1.31 1.07	0.64-1.90 1.27
Hydrolyzed	1.55-5.51	0.56-2.36	8.19-14.35	2.48-3.46	8.20-12.28	1.56-5.53	0.56-2.37	1.23-2.35	1.48-3.46	1.20-3.29
	3.53	1.46	11.27	2.97	10.24	3.55	1.47	1.79	2.47	2.24
Kaolinite	0.85-1.57 1.21	2.23-2.72 2.47	6.82-13.33 10.07	3.37-5.82 5.6	6.12-12.53 9.32	0.82-1.54 1.18	2.45-2.84 2.64	2.82-3.36 3.09	1.37-3.12 2.24	1.12-3.53 2.32
Montmorillonite	units.-0.20 0.08	units.-0.14 0.06	units.-1.43 0.81	units.-1.08 0.53	units.-1.28 0.59	units.-0.31 0.12	units.-0.14 0.07	units.-1.46 0.75	units.-1.30 0.49	units.-1.38 0.46
Volume of clays	2.40-7.28 4.84	2.79-5.22 4	14.11-29.11 21.61	5.85-10.36 8.1	4.56-12.38 8.47	2.38-7.38 4.88	3.01-5.35 4.18	4.05-7.17 5.61	2.85-7.88 5.36	2.32-8.20 5.26
Accessories *	0.09-0.31 0.2	0.11-0.21 0.16	0.21-0.48 0.35	0.19-0.55 0.37	0.23-0.43 0.33	0.1-0.31 0.21	0.15-0.23 0.19	0.12-0.28 0.18	0.19-0.25 0.22	0.13-0.23 0.17
Calcite	units.-2.53 0.89	1.06-5.28 3.17	1.14-4.88 3.01	1.92-4.16 3.04	1.02-7.87 4.44	units.1,68 0.95	0.31-1.28 0.79	1.15-2.89 2.02	1.05-1.98 1.51	1.02-3.84 2.43
Dolomite	0.02-1.36 0.69	0.02-0.58 0.3	0.06-0.84 0.45	0.1-2.38 1.24	0.11-1.77 0.94	0.04-1.28 0.66	0.03-0.67 0.35	0.04-0.98 0.51	0.16-1.12 0.64	0.16-1.77 0.97
Anchorite	units.-0.49 0.15	-	units.-0.53 0.39	units	units.-0.33 0.13	units	-	units.-0.56 0.35	units.	units.-0.28 0.12

Aggregate of carbonates	0.02-4.38 2.2	1.08-5.86 3.47	1.20-6.25 3.72	2.02-10.54 6.28	2.12-8.17 5.15	0.04-2.96 1.5	0.34-1.95 1.14	1.19-4.43 2.81	1.21-3.10 2.15	1.18-5.89 3.5
Pyrite	0.06-0.14 0.1	0.08-0.11 0.1	0.10-0.14 0.12	0.12-0.34 0.23	0.09-0.34 0.21	0.34-0.62 0.48	0.08-0.12 0.1	units.-0.12 0.09	0.06-0.08 0.07	0.07-0.11 0.09
Phosphorite	0.06-0.22 0.14	0.07-0.31 0.19	0.33-0.37 0.35	0.07-0.17 0.12	0.04-0.19 0.11	units.-0.28 0.1	0.07-0.12 0.1	units	units	units
Zeolites	0.8 0.12	-	-	0.82 0.12	0.32 0.08	-	-	-	-	-
Uranium oxide	-	-	-	0.016-0.018 0.017	0.016-0.018 0.017	0.06-0.12 0.09	-	-	-	-
Congenital selenium	-	-	-	-	-					
Iron hydroxides (goethite)	0.01-0.07 0.04	0.04-0.06 0.05	0.09-0.12 0.11	0.03-0.04 0.03	0.03-0.04 0.03	0.06-0.14 0.1	0.08-0.18 0.13	1.08-3.58 2.33	0.54-1.82 1.18	0.46-1.22 0.84
Number of samples	2	2	2	2	2	2	2	2	2	2

Table 2. Geochemical characteristics of rocks and minerals of Santon deposit

Component	Gray rocks				
	Without ore	The scattering halo of Uranus		Uranium ore	
	Sand and Sandstone	Sand and Sandstone	Siltstone	Sand and Sandstone	Siltstone
1	2	3	4	5	6
Fe gross	0.37-0.91 0.67	0.31-0.8 0.53	1.91-4.27 3.34	052-0.77 0.61	1.83-4.09 3.22
Fe^{+2} gross	0.31-0.60 0.39	0.17-0.35 0.29	1.41-1.54 1.48	0.21-0.52 0.35	1.44
Fe^{+2} soluble	0.15-0.31 0.20	0.09-0.18 0.15	1.35-1.45 1.40	0.11-0.28 0.18	1.34
Fe^{+3} soluble	0.03-0.05 0.03	0.02-0.03 0.02	0.06-0.07 0.06	0.02-0.03 0.02	0.06
Fe sulfide	0.04-0.06 0.04	0.04-0.05 0.04	0.10-0.14 0.12	0.04-0.05 0.04	0.17
Fe^{+2} gross Fe gross	0.71-0.79 0.75	0.68-0.77 0.75	0.77-0.79 0.78	0.70-0.81 0.76	0.80
Fe sulfide Fe gross	0.06-0.12 0.08	0.09-0.16 0.11	0.05-0.07 0.06	0.06-0.13 0.09	0.09
Fe^{+2} gross + Fe sulfide Fe gross	0.82-0.85 0.83	0.82-0.87 0.86	0.84-0.84 0.84	0.83-0.87 0.85	0.89
Fe^{+3} soluble Fe gross	0.06-0.09 0.07	0.04-0.08 0.06	0.03-0.04 0.03	0.03-0.07 0.05	0.05
CO_2	0.2-1.1 0.4	<0.2-0.3 0.2	0.6-1.3 0.95	0.2-0.6 0.3	0.8
C_{org}	0.06-0.19 0.14	0.05-0.20 0.10	0.22-0.24 0.23	0.04-0.15 0.08	0.26
P_2O_5	0.03-0.09 0.05	0.03-0.13 0.07	0.14-0.16 0.15	0.03-0.07 0.05	0.10
S_{gross}	0.04-0.06 0.05	0.05-0.06 0.05	0.12-0.12 0.14	0.05-0.06 0.05	0.20
U g/t	2.7-7.9 3.9	10.8-98.5 53.3	15.6-86.9 51,3	122-155 134	350
Th g/t	3.2-4.7	2.7-3.5	4.3-7.6	2.9-3.4	3.4

	3.8	3.2	5.9	3.1	
Se g/t	<3-5.1 <3	<3-3.2 <3	3.1-3.7 3,4	<3-<3 <3	<3
Mo g/t	0.7-1.2 1.0	0.9-1.1 0.95	0.3-0.4 0.35	0.7-1.2 0.9	0.7
Sr g/t	43.3-87.0 64.0	19.9-52.1 36.5	83.9-96.2 90.0	22.3-49.6 40.8	80.4
Re g/t	0.01-0.05 0.02	0.02-0.08 0.05	0.03-0.05 0.4	0.09-0.13 0.12	0.08
V g/t	15.6-40.0 30.5	10.4-30.5 17.5	77.3-78.2 77.8	11.5-21.6 14.5	75.5
Number of samples	2	2	2	2	2

The average amount of quartz in sands is 53.44-60.27% (between 42.7-60.4%), 18.62-21.5% (between 15.8-22.2%) in feldspars and 10 is 2-14.25%. The total amount of unsorted materials on average 84.20-94.6% (between 76.2-97.48%). In additional amounts and as a mixture, mica (muscovite, chlorite) averages 0.97-2.82% (between 0.50-3.50%), clay minerals - 2.74-9.36% (2.38-12, between 38%) is observed. The highest amount of clay particles was found to be associated with the presence of significant amounts of inclusions and granules of clay material in silty sands and sandstones.

As a result of studies, the composition of accessory minerals (zircon, garnet, epidote, tourmaline, staurolite, etc.) - 0.15-0.48% (between 0.09-0.55%), carbonates - 1.04-4.90% (between 0.02-10.54%), pyrite - 0.08-0.52% (between 0.06-0.62%), phosphorite - 0.06-0.26% (0.37% per grain up to), zeolites - up to a maximum of 0.82%, uranium oxide (nasturan) - 0.01% (between 0.016-0.018%), selenium - 0.09% (between 0.06-0.012%), iron hydroxides in limonited sands (goethite) on average 0.69-2.20% (between 0.46-3.58%).

The mass of fine-shelled clay (particle size 0.005 mm and less) in sands averages 1.34-4.45% of hydromica (between 0.56-5.51%, average 2.97% in the mining zone), kaolinite 1.87-3 .31%, 0.82-5.82% in the mining zone, average 5.6%, and montmorillonite - from one grain to 0.32% (variation of one grain - 1.46%, average 0.53% in the mining zone).

Carbonates are represented by calcite, which is on average 0.77-3.14% in sands (the average of single grains is 4.16%), dolomite - 0.06-1.28% (between 0.02-2.38%), and ankerite - from one piece to 0.56%.

4 Results and discussion

Based on the results of the work, the following main conclusions were drawn:

- Similarity of rocks in different epigenetic subzones in terms of mineral composition;
- The high content of clay in the ore horizon of Santon deposits has a negative effect on the extraction of minerals by means of solutions. The presence of montmorillonite in clays complicates this process.

1 out of 10 samples from Santon deposits have high carbonate content. In 2 out of 9 ore samples from the mining zone (19.5%), the carbonate content exceeds the accepted standard values and ranges from 2.27% to 5.45%. 2 out of 7 samples (37%) consist of siltstones with high clay content.

The high amount of carbonates in the ore zone has a negative effect on the process of leaching useful components from the ores.

The presence of calcite in carbonates complicates the process of extracting minerals with leaching solutions.

Carbonates occur in the form of irregular, irregular rhombic and rhomboidal grains and their intergrowths, 0.01-0.7 mm in size. Pyrite is in the form of dispersed cubic and octahedral grains and crystalline granular aggregates with a size of 0.015-0.09 mm. Phosphorite is represented by pieces of bone detritus of light and dark brown color, 0.05-2.0 mm in size, in the intergranular space of sands.

Iron hydroxides (goethite) are formed during the oxidation of pyrite and other iron-bearing minerals. They occur in detrital grains in the form of films, symmetrical and yellow psefits.

Ore mineralization in uranium mines is represented by uranium oxide - small uranium blacks; in selenium ores - the presence of native selenium was observed. Uranium oxide is observed as a black powder and thin films and stains on the surface of blackened grains.

Comprehensive exploration works in this field, the use of modern technological equipment on a large scale, will have an effect not only on Santon deposits, but also on other deposits in terms of volume expansion.

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