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## **GEOCHEMICAL FEATURES OF CARBON-BEARING ROCKS OF AUMINZATAU MOUNTAINS, CENTRAL KYZYLKUM, UZBEKISTAN**

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### **ABSTRACT**

The article presents the results of studying the geochemical features of the carbon-bearing suites of the Auminzatau Mountains. The contents of a number of ore elements were determined by various analytical research methods and compared with the Clarke number and regional background values of these elements. In addition, correlation links were established between individual ore and rock-forming elements.

**Keywords:** *Carbon-Bearing Rocks, Geochemical Features, Main and Associated Components, Uranium-Vanadium-Molybdenum Mineralization, Dzholdas, Auminzatau*

### **INTRODUCTION**

In the world practice of exploration, the study of carbon-bearing strata is important, since carbonaceous rocks are a very favorable geochemical environment for the accumulation of many industrially important elements. Carboniferous rocks are potentially metal-bearing sorbents and contain precious metals, rare and rare-earth elements, and uranium. It is well known that throughout the world many large deposits of precious metals (Muruntau, Kokpatas, Daugyztau in Uzbekistan, Sukhoi Log, Olympiadinsky, Nezhdaninskoe, Mayskoye in the Russian Federation, Bakyrchik in Kazakhstan, Olympic Dam in Australia, etc.) are located in carbon-bearing strata.

In Russia, the predominant part of the reserves (more than 50%) of indigenous gold is concentrated in deposits associated with carbon-terrigenous complexes. These deposits are represented by objects of various scales - from small to unique (Khayrulina, 2015).

Zones of sulfidization in black slate strata are considered by Sidorov and Thomson as inexhaustible complex deposits of non-ferrous and especially noble metals, since their parameters in a number of Precambrian and Phanerozoic provinces are comparable with the largest geological bodies. On the basis of a general analysis of the metal content of carbon-bearing strata, it was concluded that gold-sulphide and tin-silver mineralization is characteristic of clay-terrigenous and carbonate - volcanogenic sequences, vanadium-molybdenum with phosphorus and volcanogenic-siliceous - for phosphorus, and carbonate - polymetallic iron-manganese (Sidorov and Thomson, 2010).

In the European part of Russia, there are several objects that are located in carbon-bearing rocks with complex U-Mo-Re mineralization (Engalychev, 2013).

Prospects for carbon-bearing deposits of the western slope of the southern Urals are studied by Snachev *et al.*, (2015), in the results, Novousmanovskaya area was allocated with high prospects for tungsten, molybdenum and rhenium.

In addition, the "black shale" type of uranium mineralization is widespread in Central Asia. Especially in Uzbekistan, where the main uranium deposits of black shale type such as Dzhanthar, Rudnoye and Koscheka are located in the Auminzatau mountains. Usually, ores of deposits localized in carbonaceous strata are characterized by their complexity, i.e. they contain high contents of associated components along with the main ones.

When studying the geochemical features of carbon-bearing rocks, special attention was paid to the determination of the geochemical specialization of carbon-bearing rocks at the ore objects of the Auminzatau mountains.

### **Study area**

The Auminzatau Mountains are located in the Central KyzylKum (Uzbekistan). Geological structure of the Central Kyzylkum is attended by intensively deployed pre-Mesozoic formations, which are represented by two

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main types of rocks: 1) sedimentary-metamorphized terrigenous, metavolcanogenic, siliceous and carbonate rocks of age PR-C<sub>2</sub>, and 2) intrusive rocks of age C<sub>2</sub>-P.

As for tectonics, sub-latitudinal, west - north-west, north-west directions for early tectonic structures dominate here; and northeast and north-northwest for later block-forming tectonic disturbances. Folded, threaded-thrust and rupture structures have been widely developed (Koloskova, 2014).

In the stratigraphic column of the mountains, the Auminzatau Taskazgan (R<sub>3</sub> ts) and Kurgantau (V<sub>1</sub> kr) are carbon-bearing (Abduazimova et al., 2001).

## **MATERIALS AND METHODS**

The method of studying carbon-bearing rocks consist of a complex of field geological, laboratory and analytical work. During the field work, more than 300 geochemical, about 50 silicate samples and 120 crushing samples from carbon-bearing rocks of individual suites and at selected sites were selected. Transparent thin sections and polished sections were made from the selected stone material for further study of the main rock-forming and ore minerals.

The elemental composition of rocks is determined by various methods of analysis: a semi-quantitative spectral method of spillage, silicate, chemical into individual components, atomic absorption and ICP-mass spectrometry. In addition, the mineral form of the useful components is established by X-ray local microprobe analysis.

The obtained results were processed and compared with the Clarke number and background values of these elements. Comparison revealed areas with anomalous contents of a number of elements in carbon-bearing rocks. Correlations between individual ore and rock-forming elements were established.

## **RESULTS AND DISCUSSION**

The results obtained were normalized relative to the Clarke number in the earth's crust and the regional background. According to the concentrations obtained by the Clarke and the anomalous contents, the geochemical specialization of individual suites in certain areas was revealed. The latter are promising for complex mineralization and have been studied in more detail.

The carbon-bearing Taskazgan and Kurgantau Formations of the Auminzatau Mountains were studied at sites of 1 September, Auminzatau, Daugyztau, Dzholdas and Peschanoye.

In the areas of Daugyztau, Auminzatau, 1<sup>st</sup> September, except for gold, other elements are of no interest. In Auminzatau and Daugyztau, the excess of the gold content over the Clarke number is about 10.

On Peschanoe, molybdenum content exceeds the regional background (4 ppm according to S.M. Koloskova) up to 37.5 times. The total content of REE elements is up to 71.46 ppm, uranium up to 17 ppm, and vanadium up to 400 ppm.

Carboniferous rocks of the Taskazgan Formation were studied at the Dzholdas ore occurrence, which is the most prospective from the point of view of complex mineralization.

According to the ICP-mass spectrometric analysis, high contents of Mo, V, U, Se, Re, Te, Au, Ag were found in the Dzholdas ore occurrence carbonaceous rocks (Table 1).

According to the degree of concentration of elements (content, normalized to the average content in the earth's crust) can be divided into three groups: 1) moderately concentrating 1.5–10 times (in the sequence of increasing the degree of concentration: Pb < Tm < Cr < B < Ni < W < Cu < Zn < Ba < Yb; 2) strongly concentrating 10–40 times: V < Sb < Cd 3) anomalously concentrating 40–1000 times: U < Bi < Au < Ag < As < Mo < Re < Se < Te. The remaining elements are represented by sub Clarke and lower-than Clarke numbers.

The carbonaceous-mica-feldspar-quartz aleuroslate and the carbon-quartz metasomatites of the Dzholdas ore occurrence contain vanadium content from 255 to 3300 ppm and average 1310 ppm (Tables 1, 2). The contents of vanadium vary with the contents of Mo, Re, and U (Fig. 1, 3). Vanadium has a strong correlation with Mo, Re, Sb, W, Cr, etc. (Table 3). In the carbonaceous-mica-feldspar-quartz aleuroslate below the oxidation zone, contents >110 • 10<sup>-3</sup>% (76.9%) prevail. The rest of the samples of these rocks (23.1%) contain vanadium 7-100 • 10<sup>-3</sup>%. In the oxidation zone, 57.1% of the samples of silt shalers contain > 110 • 10<sup>-3</sup>% vanadium. In 42.9% of samples, the content of vanadium is 10-100 • 10<sup>-3</sup>%. In carbonaceous-quartz metasomatites, the content of vanadium >110•10<sup>-3</sup>% (56.4%, Fig. 3) prevail.

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The frequency of vanadium occurrence heightened concentrations  $>110 \cdot 10^{-3}\%$  decreases in other types of rock. For example, such contents are noted in 26.7% of quartz samples and 39.2% of meta- effusive. Brown iron ore is also characterized by a high frequency of occurrence of elevated levels of vanadium  $>110 \cdot 10^{-3}\%$  in 62.5% of samples (Fig. 3). High vanadium contents are accompanied by high contents of uranium, molybdenum (Fig. 3).

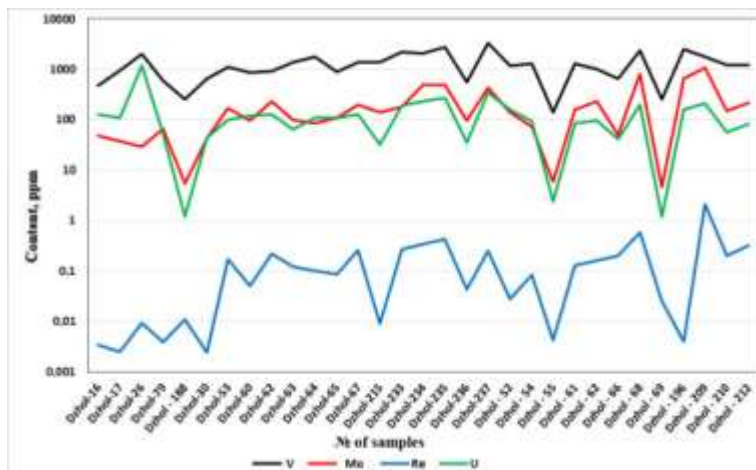
Molybdenum is one of the main widespread elements. The element content varies widely from 4.66 to 1069 ppm (according to the ICP-mass spectrometric analysis). On average, carbonaceous rocks of ore occurrence is 214.40 ppm. Samples with a content of  $>50 \cdot 10^{-3}\%$  in slurries below the oxidation zone (35.89%) prevail. In the oxidation zone (clarification), the maximum frequency of occurrence of molybdenum (85.7%) in silty slate is within  $0.5-7 \cdot 10^{-3}\%$  (Fig. 3). Apparently, this is due to the connection of molybdenum with carbonaceous matter, and in the oxidation zone the carbonaceous substance burns out, the rock is clarified and molybdenum is washed off. In brown iron ore samples are predominant (62.5%) with a molybdenum content of  $10-30 \cdot 10^{-3}\%$ . Half of the samples of meta-effusions contain molybdenum from 10 to  $50 \cdot 10^{-3}\%$ . Molybdenum has direct correlations with V, Re, Zn, Ni, etc.

The average copper content in carbonaceous-micaceous-feldspar-quartz silty slates and carbonaceous-quartz metasomatites is 165.996 ppm according to ICP-mass spectrometric analysis (Table 1). 43.6% of samples of these rocks contain Cu  $70-300 \cdot 10^{-3}\%$  below the oxidation zone. In the oxidation zone, these indicators decrease (Fig. 3).

Rhenium is one of the main components that may be of practical interest. The content of the element in carbonaceous silt alloys is from 0.004 to 2.08 ppm, an average of 0.20 ppm in 31 samples. The content of rhenium in carbonaceous-micaceous-feldspar-quartz aleur shafts is sufficiently higher than carbonaceous-quartz metasomatites. Clark concentration of rhenium 421.6. The content of rhenium varies depending on the contents of W, Mo (Fig. 1, 3).Characteristic of carbon-bearing rocks of the ore occurrence is a sharp predominance of the uranium content over thorium. The content of uranium in carbonaceous rocks reaches up to 1200 ppm. The average content of 31 samples according to ICP mass spectrometry analysis is 148.4 ppm. Strong correlations between uranium and vanadium are noted.

Gold is presented in the native form, electrum. Also included in native silver. The element content is from  $<0.005$  to 7.5 ppm according to ICP-mass spectrometric analysis. According to atomic absorption analysis, the gold content reaches up to 9.5 ppm. A strong geochemical relationship has been established for gold with Ag, Bi, and Te, which is due to the presence of tetradiamite-telluriumbismuthine and gold-silver paragenetic mineral associations of the gold-silver mineral formation stage.

Selenium and tellurium are elements that have high Clarke concentrations in samples of Dzholdas ore occurrence (445.87 and 471, respectively). In samples, the selenium content is up to 330.5 ppm, tellurium up to 9.1 ppm. The total content of rare earth elements in carbon-bearing rock of Dzholdas ore occurrence is below the Clarke.



**Figure 1: A relationship graph of the contents of elements in carbon-bearing rocks of Dzholdas ore occurrence**

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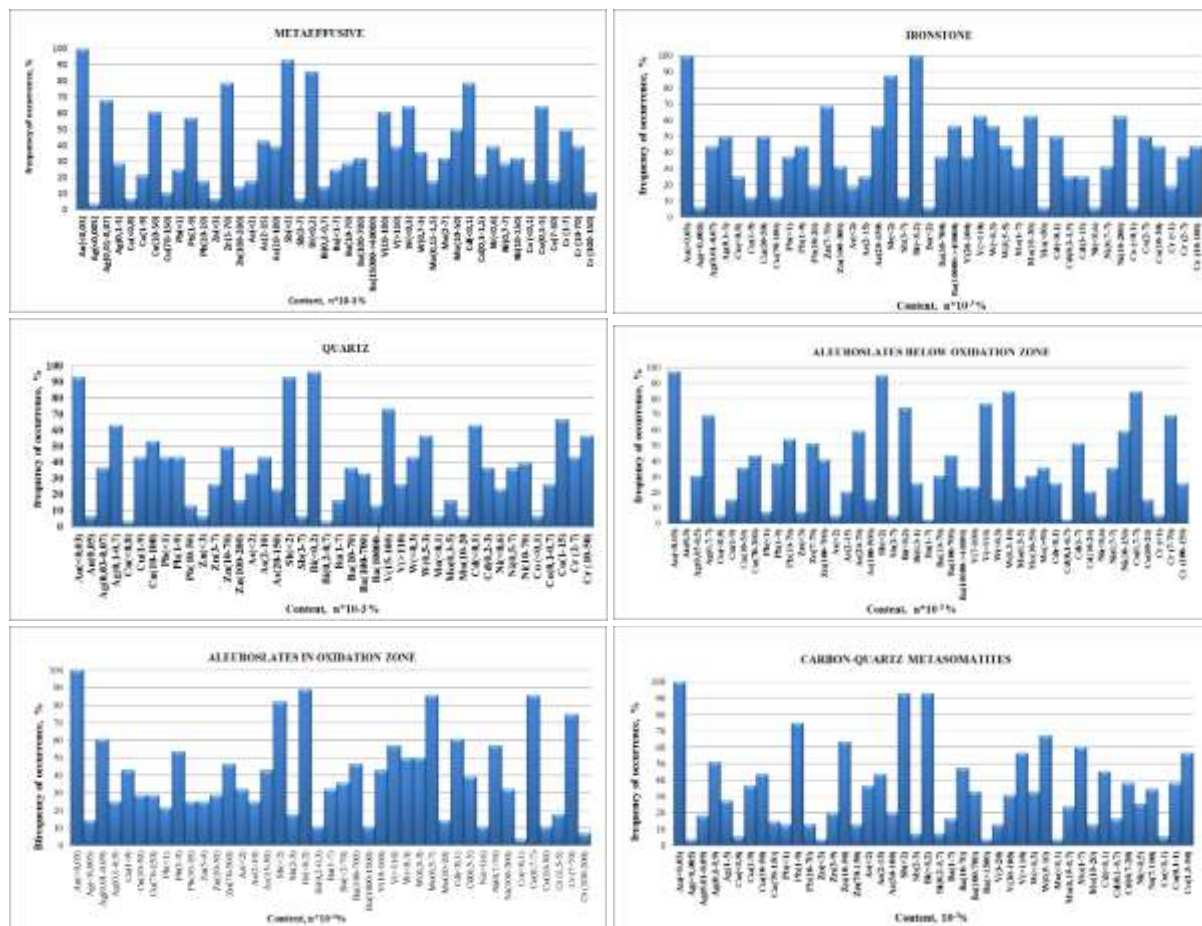
**Table 1: The content of ore elements in carbon-bearing rocks of the Dzholdas ore occurrence, ppm**

N o.	Sample No.	Rock	V	Cu	Zn	As	Se	Mo	Ag	Cd	Sb	Te	Ba	$\Sigma R$ EE	Re	Au	Bi	Th	U
1	Dzhol-16	Carbonaceous quartz metasomatite	480	68	160	170	3.7	49	0.68	0.26	12	0.1 10	3300	46	0.00 3	0.224	0.0 71	0.6 2	13 0
2	Dzhol-17		940	57	120	140	3.8	38	0.73	0.19	9.5	0.1 70	820	59	0.00 3	0.113	0.0 79	1.1	11 0
3	Dzhol-26		2000	140	34	250	3.5	29	1.30	0.05	16	0.1 50	260	174	0.00 9	0.002 5	0.5 0	1.4	12 00
4	Dzhol-79		600	200	430	350	4.3	66	1.20	1	15	0.0 79	440	118	0.00 4	0.002 5	0.2 4	2.3	53
5	Dzhol-188		255.1 6	51.0 9	81.4 3	44.2 7	0.7 2	5.47	0.34	0.13	1.59	0.0 9	159.7 5	140	0.01 1	0.002 5	0.0 9	3.2 7	1.2 2
6	Dzhol-30	Carbonaceous-mica-feldspar-quartz aleuro-slate	660	58	360	110	7.6 0	43.0	0.820	0.46	48	0.2 90	3400	134	0.00 2	0.002 5	0.9 2	3.7	44. 0
7	Dzhol-53		1100	48	240	160	5.2 0	170	1	1.6	6.6	0.0 99	1000 0	75	0.17 0	0.002 5	0.1 9	2	10 0
8	Dzhol-60		870	170	160	170	9.7 0	98	3	1.9	8.5	0.0 99	690	80	0.05 1	0.002 5	0.4 2	2.9	12 0
9	Dzhol-62		920	200	240	140	9.1 0	230	7.7	3.2	7.6	0.2 10	710	176	0.22 0	0.002 5	1.7 0	5.6	13 0
10	Dzhol-63		1400	160	410	33	16	100	4	5.2	5.6	0.0 79	960	126	0.12 0	0.002 5	0.2 5	6.3	64
11	Dzhol-64		1800	190	400	54	10	85.0	4.3	5.8	5.5	0.0 99	760	116	0.10 0	0.002 5	0.2 2	4.6	11 0
12	Dzhol-65		890	150	280	46	10	110	3.4	3.7	7	0.0 99	690	95	0.08 6	0.002 5	0.2 0	4.4	11 0
13	Dzhol-67		1400	180	450	45	11	200	4.5	6.7	5.3	0.1 10	6200	85	0.26 0	0.002 5	0.2 0	1.9	13 0
14	Dzhol-215		1400	350	400	200	12	140	0.6	19	12	0.1 30	830	296	0.00 9	0.002 5	0.6 8	6.5	32. 0
15	Dzhol-233		2200	170	590	170	9.2	180	8.7	10.0	38	0.0 99	1000 0	46	0.27 0	0.002 5	0.1 9	0.7 8	19 0

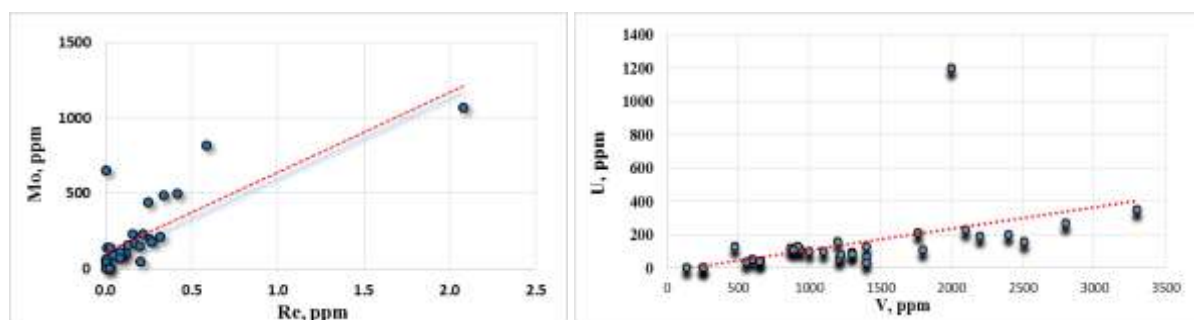
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1 6	Dzhol- 234	2100	240	350	100	16	490	7.4	7.50	38	0.0 79	9000	100	0.34 0	0.002 5	0.2 9	2.1	23 0
1 7	Dzhol- 235	2800	280	490	180	14	500	15	10	42	0.0 59	1500 0	134	0.42 0	0.002 5	0.4 6	3.1	27 0
1 8	Dzhol- 236	560	110	140	48	8.7	97	3	1.1	7.7	0.3 20	850	139	0.04 3	0.002 5	0.4 1	5.9	35
1 9	Dzhol- 237	3300	310	820	100	22	440	9.2	11	55	0.1 40	1000	258	0.25 0	0.002 5	0.5 3	5.6	35 0
2 0	Dzhol - 52	1200	190	360	67	8.8	140	5.6	5	13	0.2 1	6300	43	0.02 8	0.002 5	0.5 6	0.8 9	16 0
2 1	Dzhol - 54	1300	130	220	52	12	74	5.4	2.9	6.2	0.1 4	1000 0	65	0.08 4	0.002 5	0.2 0	1.9	93
2 2	Dzhol - 55	140	120	89	20	58	5.9	23	0.23	3.4	9.1 0	110	51	0.00 4	7.50	2.8 0	1.9	2.4 0
2 3	Dzhol - 61	1300	190	360	29	9	160	7.1	5.3	9.4	0.4 8	750	151	0.13 0	0.17	2.0 0	4.6	84. 0
2 4	Dzhol - 62	1000	170	230	19	9.2	230	6.8	2.3	6.5	0.2 7	630	158	0.16 0	0.002 5	1.2 0	4.9	98. 0
2 5	Dzhol - 66	654.7	90.1	157. 5	137. 4	8.6 7	49.50	2.04	1	2.2	0.0 7	526.1	57	0.20 3	0.002 5	0.4 3	0.9 4	41
2 6	Dzhol - 68	2400	250	890	31	20	820	8.1	10	9.9	0.3 3	1700	117	0.59 0	0.002 5	0.4 7	3.3	20 0
2 7	Dzhol - 69	257.6	53.2	105. 48	64.3	5.0 6	4.66	0.55	0.15	2.17	0.0 7	1579. 7	90	0.02 5	0.002 5	0.1 6	1.1 8	1.2
2 8	Dzhol - 196	2508. 7	388. 6	172. 57	423. 3	33 0.5	654.2 8	9.57	0.95	6.25	0.9 5	2703. 9	55	0.00 4	0.002 5	0.3 6	2.1 2	15 9
2 9	Dzhol - 209	1764. 7	41.4	143. 15	372. 8	5.6	1069. 5	1.37	1.57	2.38	0.1 3	6261. 9	121	2.07 8	0.002 5	0.4 5	2.5 8	21 3.3
3 0	Dzhol - 210	1211. 5	227. 2	214. 62	209. 6	28. 42	150.9 9	4.27	4.24	3.7	0.2 1	763.2 4	104	0.19 8	0.002 5	0.2 9	2.7 7	57. 3
3 1	Dzhol - 212	1224. 2	162. 4	255. 29	578. 6	19. 29	217.0 9	4.15	4.25	11.5 5	0.1 4	1663. 78	80	0.32 1	0.002 5	0.2 9	1.9 1	82





**Figure 2: Frequency of occurrence of various ore elements according to spectral analysis in different types of rocks of Dzholdas ore occurrence.**



**Figure 3: Relationship between the average Mo-Re and U-V contents (ppm) in carbon-bearing rocks of Dzholdas ore occurrence**

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**Table 2: General statistical parameters of the distribution of chemical elements (ppm) in carbon-bearing rocks of Dzholdas ore occurrence (31 samples)**

	Min.	Max.	Med.	Disp.	St.Dev	Var.	Mode	Median	CN	CC (Med/CN)	BC	CC (Med/BC)
<b>V</b>	140	3300	<b>1310.9</b>	606458	778.8	59.41	1400	1211	90	<b>14.57</b>	82	<b>15.99</b>
<b>Cu</b>	41.4	388.6	<b>166</b>	7985	89.4	53.8	170	170	47	<b>3.53</b>	50	<b>3.32</b>
<b>Zn</b>	34	890	<b>301.7</b>	40361	200.9	66.59	360	240	83	<b>3.64</b>	68	<b>4.44</b>
<b>As</b>	19	578.6	<b>145.6</b>	17521	132.4	90.9	170	110	1.7	<b>85.66</b>	30	<b>4.85</b>
<b>Se</b>	0.72	330.5	<b>22.29</b>	3380.9	58.15	260.84	16	9.2	0.05	<b>445.84</b>		
<b>Mo</b>	4.7	1069.5	<b>214.4</b>	63736	252.46	117.75	230	140	1.1	<b>194.9</b>	4	<b>53.6</b>
<b>Ag</b>	0.34	23	<b>4.99</b>	23.4	4.84	96.85	3	4.15	0.07	<b>71.35</b>	0.04	<b>124.9</b>
<b>Cd</b>	0.05	19	<b>4.09</b>	18.87	4.34	106.3	10	2.9	0.13	<b>31.44</b>	0.1	<b>40.87</b>
<b>Sb</b>	1.59	55	<b>13.47</b>	207.98	14.42	107.1	12	7.7	0.5	<b>26.94</b>	2.5	<b>5.39</b>
<b>Te</b>	0.06	9.1	<b>0.47</b>	2.59	1.61	341.8	0.1	0.13	0.001	<b>471.1</b>		
<b>Ba</b>	110	15000	<b>3163.2</b>	15307915	3912.5	123.69	10000	960	650	<b>4.87</b>	322	<b>9.82</b>
<b>ΣREE</b>	43.13	295.8	<b>112.5</b>	3438	58.6	52.1	45.7	103.7	178	<b>0.63</b>		
<b>W</b>	1.1	19.52	<b>4.27</b>	13.7	3.7	86.77	3.2	3.3	1.3	<b>3.28</b>	2.5	<b>1.71</b>
<b>Re</b>	0.0024	2.08	<b>0.2</b>	0.14	0.38	188.76	-	0.1	0.0007	<b>285.56</b>		
<b>Au</b>	0.0025	7.5	<b>0.26</b>	1.81	1.34	516.2	0.0025	0	0.0043	<b>60.58</b>	0.004	<b>65.12</b>
<b>Pb</b>	5.4	95	<b>26.81</b>	420.44	20.5	76.47	10	21	16	<b>1.68</b>	13	<b>2.06</b>
<b>Bi</b>	0.07	2.8	<b>0.54</b>	0.37	0.61	111.97	0.2	0.36	0.009	<b>60.4</b>	0.01	<b>54.36</b>
<b>Th</b>	0.62	6.5	<b>3</b>	3.11	1.76	58.74	1.9	2.58	13	<b>0.23</b>		
<b>U</b>	1.2	1200	<b>148.4</b>	44585.7	211.15	142.29	130	110	2.5	<b>59.36</b>		

\* **Note: Background contents of elements according to Koloskova (2014)**

St.Dev -standard deviation;

CC - Clarke concentration;

CN – Clarke number of elements in the Earth's crust (Vinogradov, 1962);

BC - background content;

Along with gold, there is a accompanying uranium-vanadium-molybdenum mineralization with rhenium at Dzholdas ore occurrence. Near the ore occurrence are uranium-vanadium deposits Rudnoye, Koschek and Dzhanthar. The high contents of U, V, Re, Mo, Se and other elements in the carbon-bearing rocks of the object are explained by its proximity to the listed deposits. Therefore, in the process of searching, it is necessary to pay attention to the possibility of identifying complex gold with accompanying uranium-vanadium-molybdenum mineralization with rhenium.

## CONCLUSION

The established maximum frequency of occurrence of high contents of molybdenum ( $>50 \cdot 10^{-3}\%$ ), vanadium ( $>10 \cdot 10^{-3}\%$ ) and anomalous contents of Re, U, Mo, Se, Te in carbonaceous rocks of the Dzholdas ore occurrence is of interest for further study and staging prospecting not only for gold, but also complex U-V-Mo-Re mineralization.

Gold forms geochemical associations with silver, bismuth and tellurium.

According to geochemical features, carbonaceous rocks of Dzholdas ore occurrence are very similar to uranium-vanadium type of ores located in black-shale rocks. A strong correlation has been established between U-V-Mo-Re.

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**Table 3: Correlation of contents of chemical elements in carbon-bearing rocks of the Dzholdas ore occurrence  
 (Critical value of correlation coefficient 0.35; 31 samples)**

0.35	Au	Ag	As	Se	Zn	Pb	Ti	V	Cu	Co	Ni	Sb	Te	W	Re	U	Po	Mo	Ba	Bi	Cd	Cr
Au	1.00																					
Ag	<b>0.69</b>	1.00																				
As	-0.17	-0.16	1.00																			
Se	0.12	0.31	<b>0.37</b>	1.00																		
Zn	-0.20	0.25	-0.16	-0.09	1.00																	
Pb	-0.05	0.30	-0.09	0.02	<b>0.47</b>	1.00																
Ti	0.24	-0.09	-0.29	-0.10	-0.33	-0.17	1.00															
V	-0.28	0.32	0.19	0.29	<b>0.64</b>	<b>0.44</b>	<b>-0.51</b>	1.00														
Cu	-0.08	0.41	0.18	<b>0.50</b>	<b>0.53</b>	<b>0.38</b>	-0.43	<b>0.67</b>	1.00													
Co	0.19	-0.11	0.12	0.21	-0.27	-0.20	<b>0.56</b>	<b>-0.41</b>	0.07	1.00												
Ni	-0.15	0.06	-0.01	-0.10	<b>0.62</b>	0.24	-0.07	0.24	<b>0.40</b>	0.32	1.00											
Sb	-0.15	0.23	0.02	-0.09	<b>0.55</b>	<b>0.60</b>	-0.19	<b>0.55</b>	0.30	-0.27	0.27	1.00										
Te	<b>0.99</b>	<b>0.71</b>	-0.16	0.20	-0.20	-0.05	0.23	-0.25	-0.05	0.22	-0.14	-0.14	1.00									
W	-0.18	0.02	0.31	-0.08	0.19	0.07	-0.26	<b>0.44</b>	-0.06	-0.27	0.25	0.33	-0.16	1.00								
Re	-0.10	0.00	0.30	-0.10	0.11	-0.02	-0.17	0.32	-0.11	-0.20	0.25	-0.02	-0.11	<b>0.82</b>	1.00							
U	-0.14	-0.01	0.18	-0.02	0.00	0.00	-0.31	<b>0.48</b>	0.12	-0.24	-0.22	0.26	-0.13	0.27	0.08	1.00						
REE	-0.22	-0.10	-0.07	-0.19	0.31	0.14	0.03	0.29	0.40	0.27	<b>0.57</b>	0.29	-0.20	0.10	0.04	0.23	1.00					
Mo	-0.15	0.23	0.31	0.33	<b>0.38</b>	0.13	-0.32	<b>0.65</b>	0.36	-0.18	<b>0.39</b>	0.16	-0.12	<b>0.67</b>	<b>0.79</b>	0.13	0.11	1.00				
Ba	-0.15	0.22	0.04	-0.04	0.22	0.41	-0.30	<b>0.40</b>	0.04	<b>-0.47</b>	0.01	<b>0.40</b>	-0.16	<b>0.42</b>	0.28	0.06	-0.28	0.32	1.00			
Bi	<b>0.69</b>	<b>0.62</b>	-0.24	0.05	-0.08	-0.04	0.09	-0.19	0.08	0.22	0.23	-0.04	<b>0.71</b>	-0.05	-0.05	-0.08	0.18	-0.06	-0.25	1.00		
Cd	-0.17	0.21	-0.07	-0.10	<b>0.72</b>	<b>0.46</b>	-0.32	<b>0.60</b>	<b>0.68</b>	-0.15	<b>0.55</b>	<b>0.41</b>	-0.18	0.18	0.09	0.00	<b>0.53</b>	0.29	0.25	-0.04	1.00	
Cr	-0.14	0.13	-0.32	-0.25	<b>0.45</b>	0.27	0.34	<b>0.40</b>	0.15	-0.09	0.18	0.35	-0.17	0.02	0.08	0.00	0.30	0.11	0.11	-0.21	<b>0.43</b>	1.00

Correlatable geochemical associations: Au-Ag-Bi-Te; U-V-Mo- Re; Ni-Cr-Cd; Pb-Zn-Cu-Sb;  
 Elements with negative geochemical association: Ti-V; Co-V; Co-Ba



### **Research Article**

The studied carbon-bearing rocks have a wide areal distribution, significant thickness, elevated concentrations of rhenium, molybdenum, uranium, vanadium, and other elements and can be considered as potential sources of complex mineralization, including huge reserves of valuable components. Based on this, when conducting prospecting in the Central KyzylKum region one should pay attention to carbon-bearing rocks that are potentially prospective for the presence of gold and uranium-vanadium-molybdenum mineralization. A high degree of carbonization of rocks is a direct indication of complex U-V-Mo mineralization with Re.

### **REFERENCES**

- Abduazimova ZM (2001).** Stratigraphic Dictionary of Uzbekistan. *Institute of Mineral Resources, Tashkent* 580.
- Engalychev SYu (2013).** Rhenium sedimentary complexes of a cover of European Russia: structural and real characteristics and issues of genesis. *Geochemistry, Mineralogy, Petrology, Vestnik of VSU, Series: geology* **2** 46-52.
- Khayrulina LA (2015).** Gold deposits in black shales. *Institute of Geology, UC RAS, Bashkir State University, Ufa, Russia*.
- Mirhodzhaev BI (2010).** Geological and industrial types of uranium deposits of Dozeozoic southern and middle Tien Shan. *Bulletin of Tomsk Polytechnic University. Tomsk.* **1** 42-46.
- Sayitov SS, Tsoi VD, Alimov ShP (2017).** Rhenium carbon-bearing rocks of the Aitym deposit (Central Kyzylkum). *Geology and mineral resources. Tashkent.* **3** 13-18.
- Sidorov AA, Thomson IN (2010).** Ore-bearing black-slate strata: the convergence of alternative concepts. *Bulletin of the Russian Academy of Sciences*, **70**(8) 719-724.
- Snachev VI, Snachev AV, Rykus MV (2015).** Prospects for carbon-bearing strata of the western slope of the southern Urals. *Electronic Scientific Journal "Oil and Gas Business"* **3** 48-63.