FIND OF WEEKSITE-GROUP MINERALS IN AFGHANISTAN[1]

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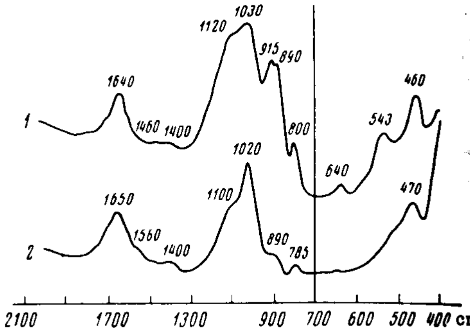

Fig. 1. Infrared spectra of Afghanistan weeksite samples of first (1) and second (2) generations.

The weeksite group consists of little known hydrous uranyl silicates with layered structure and containing K, Na, Ca and Mg. Minerals of this group can be subdivided into three structural varieties on the basis of similarity of structural motif and presence of diorthogroups (Si_2O_5) in uranyl silicate layers, namely, weeksite, haiweeite and ursilite (Mg ursilite) [3]. They occur predominantly in oxidation zones of uranium deposits.

While studying the mineralogy of a Pliocene-Quaternary carbonatite complex in Afghanistan [1], we found weeksite in zones of secondary uranium enrichment. Here mineralization is localized within red polymict Neogene sandstone, surrounding carbonatite near the old vent of a volcanic dome. The mineralized patches are steeply dipping linear stockworks and are confined to an area of extensively bleached (carbonatized) sandstone at the margin of a tectonic breccia zone, radiating from the volcanic vent. These stockworks are composed of a fine, uniform network of stringers, which exhibit complex zoning and consist of the following mineral complexes, successively deposited on walls of open joints: 1) premineral complex—dolomite containing TR, Sr and Ba, iron chlorite of the chamosite series, manganese hydroxide; 2) ore complex—magnesian calcite, weeksite, uraniferous chalcedonic hyalite, quartz, uraniferous aragonite; 3) supergene complex—gypsum, calcite, uranium and iron hydroxide.

Mineralization was deposited near the surface[2] from carbonated ground water that had risen toward the surface along fractures within the volcanic dome and was enriched in uranium at depth as it leached uranothorite, pyrochlore and other hypogene uraniferous carbonatite minerals. The age of this mineralization is Quaternary.

We studied thoroughly two generations of weeksite. The early generation forms felted masses and druses of acicular crystals as long as 0.5 mm, and the later generation spherulitic compact segregations with a fibrous-radial or sectorial texture, as well as fine-grained continuous masses and crusts. The crystal habit is flaky and acicular or elongate. The color is bright yellow. The refractive indices are: $\gamma = 1.69$ to 1.7, $\alpha = 1.62$ to 1.63. The mineral is biaxial and has a large 2V. Its density is 3.69 to 3.73 g cm^{-3}.

The luminescence of weeksite under ultraviolet radiation is weak and tobacco-colored. The spectrum consists of three overlapping absorption bands with peaks at 535, 556 and 578 nm, forming one broad band with a luminescence range of 480 to 690 nm. The absorption spectrum of weeksite in the visible range is analogous to that of other uranyl silicates [2].

The two weeksite generations are similar in overall chemical composition, although the earlier is much richer in barium and strontium (Table 1).

X-ray study by the single-crystal method (R.G. Sizova) showed that our weeksite is monoclinic. Its lattice parameters are: $a = 9.63 \pm 0.01$ Å, $b = 7.12 \pm 0.01$ Å, $c = 7.1$ ± 0.01 Å, $\beta = 111° 56'$, $V = 450$ Å^3. These parameters fit a single-layer monoclinic cell, formed upon displacement of uranyl silicate layers[3] at right angles to uranyl bands, this displacement being one-third of the distance

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[1] Translated from: Nakhodka mineralov gruppy viksita v Afganistane. Doklady Akademii Nauk SSSR, 1977, Vol. 237, No. 5, pp. 1191-1193.

[2] The erosion depth, according to geologic evidence, ranges from 70 to 80 m.

[3] a and b are in the layer plane.

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Table 1

Chemical composition of weeksite from Afghanistan (in weight percent)

Oxide	Generation 1	Generation 2
UO_3	49.84	53.98
SiO_2	31.37	30.40
Al_2O_3	0.25	0.23
K_2O	5.12	5.40
Na_2O	2.05	2.29
CaO	2.01	0.03
MgO	0.18	0.21
BaO	1.90	0.19
SrO	0.20	0.14
P_2O_5	N.f.	N.f.
ThO	N.f.	N.f.
H_2O+	6.29	6.29
Σ	99.21	99.16

Note. Analyst N.N. Kuznetsova (All-Union Institute of Mineral Resources). Spectral analysis disclosed 0.02 percent Be and 3 ppm Cu.

Table 2

Interplanar spacings in weeksite (DRON-1 diffractometer, Cu radiation, 30 kV, 10 mA, V = 2°/min)

Thomas Range, Utah [5]		Afghanistan						
		generation 1		generation 2				
I	*d/n*, Å	*I*	*d/n*, Å	*I*	*d/n*, Å	*hkl*	$1/d^2$ exp.	$1/d^2$ calc.
8	8.98	44	8.83	57	8.89	100	0,01254	0.01253
—	—	2	7.90	—	—			
10	7.11	100	7.09	100	7.11	010	0.01978	0.01973
9	5.57	67	5.58	76	5.59	110	0.03212	0.03226
9	4.83	3	4.85	8	4.85	011	0.04251	0.04246
4	4.58	10	4.57	28	4.57	201	0.04788	0.04769
3	4.48	9	4.48	6	4.48	200	0.04983	0.05011
5	3.84	12	3.85	30	3.85	210	0.06746	0,06983
7	3.55	83	3.56	78	3.57	020	0.07890	0.07890
4	3.34*	--	--	--	—			
4	3.30	67	3.31	58	3.31	120	0.09127	0.09143
5	3.20	21	3.20	56	3.20	301	0.09766	0.09771
4	2.99	19	2,99	32	2.99	300	0.11186	0.11273
6	2.91	25	2.92	67	2.92	311	0.11728	0.11779
3	2.80	4	2.81	7	2.81	221	0,12664	0 12657
3	2.51	3	2.52	7	2.51			
4	2,41	5	2.41	15	2.41			
5	2.37	49	2,37	25	2.38			
5	2.28	33	2.29	19	2.29			
2	2.24	13	2.24	15	2.24			
3	2.20	3	2.20	10	2.20			
4	2.13	10	2.14	11	2,14			
4	2.11	12	2.11	14	2,11			
4	1.99	7	1.996	11	1.994			
3	1.97	8	1.977	18	1.975			
5	1.92	5	1,928	10	1.929			
4	1,90	13	1.904	25	1.902			
4	1.89							
1	1.87	3	1,872	6	1.873			
2	1,83	3	1.830	6	1.831			
4	1,78	47	1.780	15	1.783			
3	1,74	18	1.745	8	1.739			
1	1.73	2	1.728	6	1.728			
4	1.70	5	1.691	16	1.689			
5	1,65	7	1.660	7	1.661			

*Quartz.

between neighboring bands in adjacent layers. The interlayer spacing is 6.63 Å. The orthorhombic (pseudotetragonal) cell with layer parameters of $a' = 14.24$ Å, $b' = 35.84$ Å and $c' = 14.2$ Å, previously published for weeksite [5], can be transformed as follows into the normalized, or monoclinic, cell derived by us: $b = c'/2$; $c' = a/2$; $a = a'^2 + b'^2/4$; $\beta = 180 - \mathrm{arctg}\, a/b$.

In our weeksite the ratio of (K, Na) :(Ca, Ba, Mg) : U:Si:H_2O is 2:0.68:2:3:4.01 for the first generation and 2:0:2:2.68:3.7 for the second. Thus, it is close to the ideal theoretical formula of weeksite, namely, $(K, Na)_2 \cdot [(UO_2)_2(Si_2O_5)_3] \cdot 4H_2O$.

Tarkhanova et al. [4] report that it is not clear whether Me^{+}-Me^{2+} substitution is a characteristic of the weeksite structure. The excess of divalent cations, observed in first-generation weeksite from Afghanistan, should evidently be attributed to the presence of a mixed-layer weeksite-metahaiweeite form because calcium-uranyl silicate of the weeksite group in the metahaiweeite metaform, according to Sidorenko et al. [3], is isostructural with weeksite. This is confirmed by the presence of a distinct, but weak "metaweeksite" reflection at 7.9 A on the X-ray pattern of first-generation weeksite, (Table 2), by the asymmetry and intensity differences of various strong X-ray reflections, and by the presence of additional strong absorption bands in the infrared spectrum of the same first-generation weeksite (Fig. 1). The existence of mixed-layer forms also is postulated [3] for other groups of layer-type uranyl silicates, particularly for the uranophane-kasolite group.

Finally, we should emphasize the urgent need for determining the crystal structure of weeksite-group minerals because this would enable us to fill in another empty space on the "mineralogic map".

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ZOISITE AS AN INDICATOR OF COEXISTENCE OF ECLOGITES AND ROCKS ORIGINALLY CONTAINING LAWSONITE[1]

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Eclogite-glaucophane schist suites commonly contain rocks that have lawsonite mineral groupings and are not found in eclogite-gneiss complexes. As noted by most investigators [4, 5, 11, 13], glaucophane schists are extremely unstable and may be completely destroyed by subsequent metamorphism, as well as by the action of intrusions. Therefore, schists with glaucophane and lawsonite must have existed in a special tectonic environment that existed after the early stages of glaucophane metamorphism, as otherwise they would have been destroyed.

The determination of the age of schists with glaucophane and lawsonite also is related to the problem of their preservation [5] because it had been assumed [1, 4] that they are confined entirely to post-Paleozoic metamorphic belts, and that this reflects the irreversible trend of change in type of metamorphism through time. However, as shown by Dobretsov [5], the statement of Winkler [1] that the geologically very young age of all rocks of the lawsonite-glaucophane facies is inexplainable, and that their Paleozoic age has never been proved is incorrect because there is much evidence of the wide extent of glaucophane and lawsonite-glaucophane schists in metamorphic belts at least as old as Riphean. Moreover, differences between Mesozoic, Paleozoic and Precambrian metamorphic belts are due primarily to different tectonic and geologic evolution.

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[1] Translated from: Tsoizit kak indikator sushchestvovaniya pervichno lavsonitovykh porod v assotsiatsii s eklogitami. Doklady Akademii Nauk SSSR, 1977, Vol. 237, No. 5, pp. 1194-1196.

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