

Table 20. Optical Properties and Specific Gravity of Synthetic and Natural Hydrogen Autunite

	Synthetic hydrogen autunite			Natural hydrogen autunite	
	V. Ross	Harris and Scott	E. N. Leonova	Just taken from a pit	Kept at 30-40°C during a week
N_g	0.579	1.588	1.581	1.583	1.590
N_p	1.568	1.577	—	1.569	1.576
Specific gravity	3.399	Uniaxial, negative		Uniaxial, negative	
		—	—	—	3.41

NEW DATA ON SOME URANIUM AND URANIUM-BEARING MINERALS

Hydrogen Autunite

By A. A. Chernikov

Hydrogen autunite was found for the first time by G. S. Gritsaenko in 1952. The small amounts of the mineral she had at her disposal limited her study to the measurement of the indices of refraction, to the establishment of the main components by spectral analysis, and to the determination of the fluorescence spectrum. For the purpose of more detailed examination of the properties of the mineral in the laboratory of G. S. Gritsaenko, experiments were made on its artificial reproduction. Synthesis was made by E. N. Leonova. Judging by its properties and the comparison data on natural and synthetic minerals it was classified as hydrogen autunite.

Later on A. A. Chernikov was able to examine it with more detail.

Natural hydrogen autunite occurs in the form of thin transparent mica-like plates, elongated by (010) (Fig. 13), of pale-yellow colour, vitreous-lustre, perfect cleavage by (001) and imperfect by (100); imperfect cleavage is sometimes observed by (010).

In the ultraviolet hydrogen autunite gives an intensive yellow-green fluorescence. Its fluorescence spectrum is analogous to that of autunite, while its microphotogram (Fig. 14) is characterized only by more significant maxima than that of autunite (Fig. 15).

Optic properties and specific gravity of natural hydrogen autunite (Table 20) complies with the optical properties and the specific gravity of synthetic hydrogen autunite described § in the literature.¹⁻⁴

The hydrogen autunite just taken out of a pit has indices of refraction similar to those for synthetic hydrogen autunite described by V. Ross and E. N. Leonova. The mineral kept at 30-40° during a week has considerably larger indices of refraction. This is due, as in other micas, to water loss in heating. The synthetic hydrogen autunite described by Harris and Scott has optical properties similar to those of natural hydrogen autunite kept at 30-40°.

The small amount of hydrogen autunite mineral did not permit its chemical analysis.

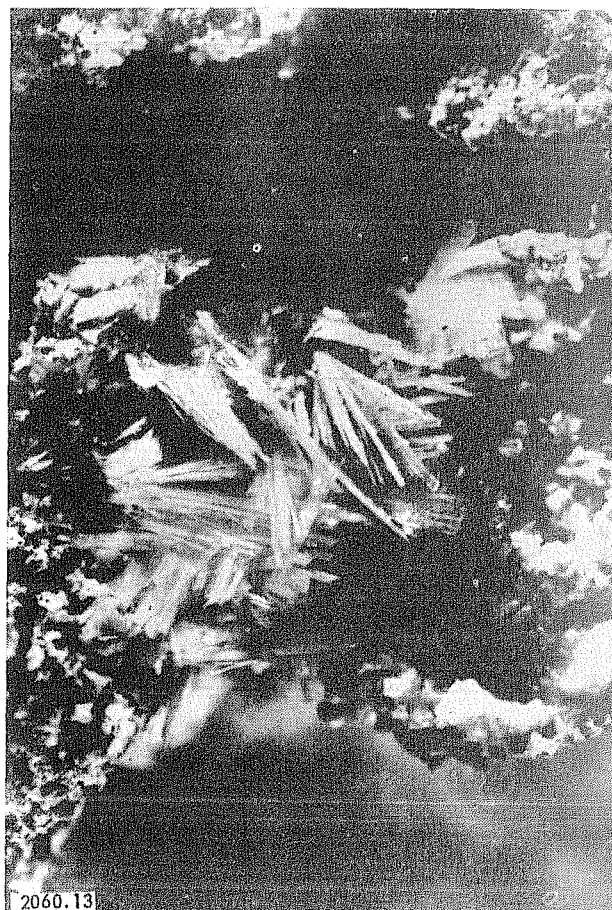


Figure 13. Crystals of hydrogen autunite, $\times 5$

Spectral analysis of the mineral showed strong lines only of uranium and phosphorus. Other elements (Ca, Al, Si and others) were found in small amounts and are due to mechanical impurities.

According to C. Frondel's² and V. Ross⁴ data, synthesized hydrogen autunite has the following formula: $H_2(UO_2)_2(PO_4)_2 \cdot 8H_2O$; according to E. N. Leonova's¹ data, its formula is $H_2(UO_2)_2(PO_4)_2 \cdot 10.5 H_2O$.

X-ray data for natural hydrogen autunite are completely analogous to those for synthesized hydrogen autunite (Table 21).

In a synthetic hydrogen autunite hydrogen is known to be easily replaceable by calcium, potassium, sodium and other cations. That is why in natural conditions it can be found only in rare cases.

§ References at end of section.

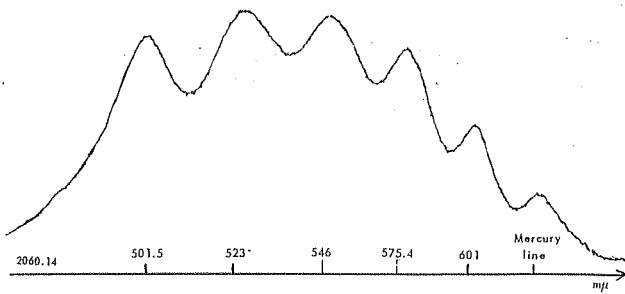


Figure 14. Microphotogram of hydrogen autunite

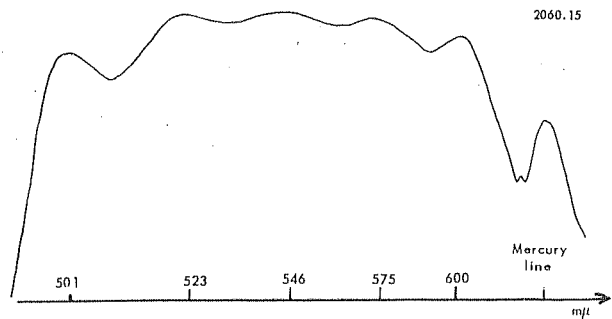


Figure 15. Microphotogram of autunite (taken by E. S. Rudnitskaya)

Table 21. X-ray Data for Hydrogen Autunite
Fe radiation, 2R = 57.9, d = 0.6, Cu radiation, Ni filter

Natural hydrogen autunite		Hydrogen autunite synthesized by E. N. Leonova		Synthesized hydrogen autunite (according to Ross's data)	
<i>l</i>	<i>d</i>	<i>l</i>	<i>d</i>	<i>l</i>	<i>d</i>
4	8.89	5	8.47	9	9.038
9	5.51	9 ^a	5.77	5	5.556
10	4.99	10	5.04	4	4.97
				1/2	4.542
5	4.29	6	4.30	3	4.360
8	3.28	10	3.85	9	3.799
—	—	8	3.71	—	—
10	3.54	10	3.56	7	3.511
10	3.26	10	3.28	8	3.270
6	2.957	7	2.97	6	2.964
4	2.77	5	2.77	7	2.765
4	2.57	4	2.57	3	2.576
5	2.49	4	2.49	3	2.488
6	2.40	7	2.39	4	2.397
6	2.27	8	2.25	2	2.267
—	—	8 ^b	2.19	3	2.216
7	2.16	—	2.14	5 ^b	2.163
7	2.09	6	2.09	4	2.075
5	2.01	4	2.00	—	—
4	1.906	4	1.908	2	1.902
4 ^b	1.85	3 ^a	1.856	3 ^b	1.844
			1.827		
5	1.795	4	1.797	3	1.789
2	1.749	2	1.745	2	1.755
2	1.727	3	1.729	2	1.722
2	1.68	4	1.673	3	1.697
3	1.642	4	1.655	3	1.633
3	1.618	3	1.624	.. ^c	1.61
5 ^b	1.57	5 ^b	1.574	—	1.57
2	1.55	—	—	1	1.546
1	2.473	2	1.468	1	1.477
—	—	1	1.435	1	1.439
1	1.401	1	1.407	2	1.401
4	1.381	1	1.380	1	1.383
—	—	—	—	1	1.352
1	1.335	1 ^b	1.330	1/2	1.338
—	—	—	—	1/2	1.288
1	1.271	2	1.267	1	1.270
1	1.245	2	1.243	2 ^b	1.249
2	1.221	2	1.224	1/2	1.221
1	1.201	1	1.204	—	—
2	1.192	1	1.193	3	1.194
5	1.172	6	1.171	—	—
2	1.109	2	1.110	—	—
2	1.097	1	1.099	—	—
—	—	6	1.086	—	—
2	1.064	2	1.072	—	—
—	—	6	1.039	—	—
1	1.021	—	—	—	—
1	1.006	—	—	—	—

^a Doublet.
^b Multiplet.
^c Diffused line.

References

1. E. N. Leonova, *Synthesis of Secondary Uranium Phosphates and Arsenates* (in press).
2. C. Frondel, *Am. Mineralogist*, 36 (1951 a).
3. W. W. Harris and R. H. Scott, *Atomic Energy Comm. Report 2746*, Carbide and Carbon Chemicals Corp., Oak Ridge, Tenn. (1949).
4. V. Ross, *Am. Mineralogist*, 40, No. 9-10 (1955).

Nenadkevite

By V. A. Polikarpova

This mineral is one of the terminal members of the isomorphous series ThSiO₄ (U, Th)SiO₄ USiO₄.

At present some of its varieties have been distinguished by colour and other physical properties. The data of chemical analysis (Table 22) are given in terms of crystal-chemical formulas (Table 23).

Nenadkevite occurs in the form of crystals and their concretions. The size of crystals is usually submicroscopic (0.001-0.05 mm and very seldom 0.1-1 mm). Nenadkevite crystals are scattered in the form of thin disseminations in albite, aegirine and rodsite, more seldom forming veinlets (Fig. 16).

It is characteristic of nenadkevite to develop crystals on the boundaries of the aggregates of alkaline amphibole, aegirine and albite (Fig. 17), its precipitations being concentrated in the interstices of their grains. Nenadkevite crystals often bear a chlorite or goethite "shirt" (Fig. 18).

Nenadkevite is of later origin than the hematite and magnetite-bearing rocks. It cements and replaces their crushed aggregates (Fig. 19) and also fills fissures and covers crystals of uranium-bearing malacon, apatite and ytrosphene.

Later sulphides and carbonates cement and cross nenadkevite crystals (Fig. 20).

Nenadkevite monocrystals could not be separated and their morphology could be established only by judging the outlines of their cross sections in the polished sections.

The most widespread are the cross sections of prismatic form with pyramidal confinements on one or both sides (Fig. 21). A trend to sharply elongated prismatic forms (Fig. 22) was observed. Under the microscope one can see different cross sections across the prism (Figs. 17, 18, 20) often with rhombic outlines (Fig. 23).