NOTES AND NEWS

STUDIES OF URANIUM MINERALS (XXI): SYNTHETIC HYDROGEN-AUTUNITE

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The amount of hydrogen occurring in autunite is apparently quite variable and dependent on the extent of base-exchange from acid solution. C. Frondel synthesized the pure, hydrogen end-member of the autunite series employing Bourgeois' method (1898) from solutions of ammonium dihydrogen phosphate and uranyl nitrate. Re-crystallization from a boiling solution of dilute hydrochloric acid yielded tiny, brilliant lemon-yellow crystals of hydrogen-autunite.

Chemical analysis† yielded the data of column 1, below.

	1	2
UO_3	65.08%	65.29%
P_2O_5	16.03	16.20
H_2O	19.33 (Penfield)	18.51
	100.44%	100.00%

indicating the composition: $HUO_2PO_4 \cdot 4H_2O$. Of the total water of hydration, 9.28% is lost at 110° C. The calculated weight percentages for this formula are given in column 2.

Harris and Scott (1949) synthesized uranyl-hydrogen-phosphate-tetrahydrate crystals from solutions of uranyl nitrate and concentrated phosphoric acid. From their description, this phase appears to be identical with hydrogen-autunite. The density of their material, determined by pycnometer measurement was 3.399 g./cc. at 25° C.

Optical Data

The hydrogen-autunite synthesized by Frondel consisted of microscopic, square and octagonal plates exhibiting parallel extinction with no perceptible biaxial character. The refraction data are as follows:

Uniaxial negative

$$\left.\begin{matrix} n\mathrm{E}=1.568 \\ n\mathrm{O}=1.579 \end{matrix}\right\} \pm .001$$

Harris and Scott reported the following values:

$$n\mathrm{E}=1.577$$
$$n\mathrm{O}=1.588$$

X-Ray Data

The *x*-ray powder diffraction analysis of synthetic hydrogen-autunite reveals that it is the tetragonal meta-phase with probable space group:

† Analysis by H. J. Hallowell, 1951.

TABLE 1

X-Ray Powder Diffraction Data: Hydrogen-Autunite, $HUO_2PO_4 \cdot 4H_2O$, synthetic. Tetragonal, $c_0 = 9.043$ Å, $a_0 = 7.020 \pm .005$ Å, $c/a = 1.288$. Space Group, probably, $P4/nmm$. CuK radiation. Ni filter. Corrected for shrinkage

I	$d_{meas.}$	hkl	$d_{calc.}$	I	$d_{meas.}$	hkl	$d_{calc.}$
10	9.032	001	9.043	2	1.755	400	1.755
5	5.556	011	5.546			105	1.751
4	4.971	110	4.964	2	1.722	401	1.723
½	4.542	002	4.522	3	1.697	115	1.699
3	4.360	111	4.352	3	1.633	402	1.636
9	3.799	102	3.801			323	1.635
7	3.511	200	3.510	VB-D	1.61–1.57	314, etc.	1.854, etc.
8	3.270	021	3.272	1	1.546	421	1.547
6	2.964	121	2.966	1	1.477	324	1.475
7	2.765	022	2.773			106	1.474
		103	2.770	1	1.439	116	1.442
3	2.576	122	2.579	2	1.401	315	1.402
		113	2.576	1	1.383	206	1.385
3	2.488	220	2.482			511	1.361
4	2.397	221	2.393	1	1.359	414	1.360
2	2.267	301	2.265			216	1.359
		004	2.261	½	1.338	334	1.335
3	2.216	310	2.220	½	1.288	424	1.289
B-5	2.163	311	2.156			226	1.288
		104	2.152	1	1.270	107	1.270
B-4	2.075	302	2.078			306	1.267
2	1.902	321	1.905	B-2	1.249	316	1.246
		204	1.901	½	1.221	335	1.221
B-3	1.844	303	1.848	3	1.194	531	1.194
3	1.789	322	1.789			504	1.193
		313	1.788			326	1.192

I—Relative Intensity. *hkl*—interplanar spacing. B—broad line, VB—very broad line, D—Diffuse.

$P4/nmm$. The cell dimensions are $c_0 = 9.043$ Å and $a_0 = 7.020 \pm .005$ Å The spacings were refined by the method of least squares. The calculated cell contents are $2(HUO_2PO_4 \cdot 4H_2O)$ and the density is 3.28 g./cc. The *x*-ray *d*-spacings are tabulated below. Hydrogen-autunite is closely similar to or isostructural with meta-autunite.

Acknowledgment

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References

Bourgeois, L. (1898), *Bull. Soc. Min.*, **21**, 32.

Harris, W. W., Scott, Roberta H. (1949), Optical properties of three uranium phosphates; *AEC Report 2746*. (Sept., 1949). Carbide and Carbon Chemicals Corp., Oak Ridge, Tenn.

MANGANESE CONTENT OF GARNETS FROM THE FRANCISCAN SCHISTS

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Introduction

Some years ago the writer (Pabst, 1931) described the garnets found in the Franciscan schists of California and reported that their composition could be expressed in terms of end members as being roughly 50 mole % almandite, usually with substantial proportions of pyrope, grossularite and andradite, but with only a very little spessartite. In summarizing the range of spessartite content was given as "0–1%."

Several years ago, at the suggestion of Dr. Max D. Crittenden, Jr., some of these garnets were reexamined and it was found that the manganese content previously reported was far too low. Additional analyses and spectrographic examination now permit a revised statement of the composition range of these garnets.

About two years ago, in response to an inquiry, the writer informed Dr. H. M. E. Schürmann of the Hague of the old error in a letter closing with the words "Reexamination of garnet *A* has shown that it contains about 2% MnO, equivalent to about $4\frac{1}{2}$ mol % spessaritite." This was acknowledged by Dr. Schürmann in a letter dated 31 December, 1952, in these words:—"Many thanks for your letter of November 25th with your information on literature on glaucophane and on chemical analysis of spessartite." In view of this correspondence it is surprising that Dr. Schürmann (1953) nearly a year later cited my old erroneous figures (his Tabelle 7 and Tabelle 8) without comment.

Dr. Max D. Crittenden, Jr., and Dr. Iris P. Borg have kindly permitted the use of unpublished data which makes possible the corrected statement of the composition of garnets from the Franciscan schists given below.

New Data

A new analysis of garnet from eclogite associated with glaucophane schist $\frac{1}{4}$ mile north of the Junction School near Healdsburg, California, has recently been reported by Mrs. Borg (1954, II, p. 57) in an unpublished thesis. The locality is but a few hundred yards from the source of