NOTES AND NEWS

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

VIRGINIA ROSS

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.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>UO₂</td>
<td>65.08%</td>
<td>65.29%</td>
</tr>
<tr>
<td>P₂O₅</td>
<td>16.03</td>
<td>16.20</td>
</tr>
<tr>
<td>H₂O</td>
<td>19.33 (Penfield)</td>
<td>18.51</td>
</tr>
<tr>
<td></td>
<td>100.44%</td>
<td>100.00%</td>
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</table>

indicating the composition: HUO₉P₂O₄·4H₂O. 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
nₑ = 1.568 ± .001
nₒ = 1.579 ± .001

Harris and Scott reported the following values:

nₑ = 1.577
nₒ = 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, HUO₃PO₄•4H₂O, synthetic.


<table>
<thead>
<tr>
<th>I</th>
<th>d₁ₐₐₐₐₐₐₐ</th>
<th>hkl</th>
<th>d₁ₐₐₐₐₐₐₐ</th>
<th>I</th>
<th>d₁ₐₐₐₐₐₐₐ</th>
<th>hkl</th>
<th>d₁ₐₐₐₐₐₐₐ</th>
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<tbody>
<tr>
<td>10</td>
<td>9.032</td>
<td>001</td>
<td>9.043</td>
<td>2</td>
<td>1.755</td>
<td>400</td>
<td>1.755</td>
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<tr>
<td>5</td>
<td>5.556</td>
<td>011</td>
<td>5.546</td>
<td>3</td>
<td>1.697</td>
<td>115</td>
<td>1.699</td>
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<tr>
<td>4</td>
<td>4.971</td>
<td>110</td>
<td>4.964</td>
<td>2</td>
<td>1.722</td>
<td>401</td>
<td>1.723</td>
</tr>
<tr>
<td>½</td>
<td>4.426</td>
<td>002</td>
<td>4.522</td>
<td>3</td>
<td>1.633</td>
<td>402</td>
<td>1.636</td>
</tr>
<tr>
<td>3</td>
<td>4.360</td>
<td>111</td>
<td>4.352</td>
<td>3</td>
<td>1.633</td>
<td>402</td>
<td>1.636</td>
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<tr>
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<td>3.799</td>
<td>102</td>
<td>3.801</td>
<td>3</td>
<td>1.633</td>
<td>402</td>
<td>1.636</td>
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<tr>
<td>7</td>
<td>3.511</td>
<td>200</td>
<td>3.510</td>
<td>3</td>
<td>1.633</td>
<td>402</td>
<td>1.636</td>
</tr>
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</table>

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

*P₄/nmm.* The cell dimensions are ε₀ = 9.043 Å and a₀ = 7.020 ± .005 Å. The spacings were refined by the method of least squares. The calculated cell contents are 2(HUO₃PO₄•4H₂O) 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**

This work was done on behalf of the Division of Raw Materials of the U. S. Atomic Energy Commission.
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. Schürrmann 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 4½ mol % spessartite.” This was acknowledged by Dr. Schürrmann 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. Schürrmann (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 ¼ 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