THE SYSTEM OF
MINERALOGY
of James Dwight Dana and Edward Salisbury Dana
Yale University 1837–1892

SEVENTH EDITION
Entirely Rewritten and Greatly Enlarged

By
CHARLES PALACHE
the late HARRY BERMAN
and CLIFFORD FRONDEL
Harvard University

VOLUME II

HALIDES, NITRATES, BORATES, CARBONATES,
SULFATES, PHOSPHATES, ARSENATES, TUNGSTATES,
MOLYBDATES, ETC.

JOHN WILEY AND SONS, INC.
NEW YORK  LONDON  SYDNEY

**Orientation**

\[
\begin{align*}
X &= 1.528 \pm 0.003 \\
Y &= 1.537 \pm 0.003 \\
Z &= 1.545 \pm 0.003
\end{align*}
\]

Biaxial negative (–).

2V rather large.

**Chem.** Ferrous sulfate pentahydrate, FeSO\(_4\cdot5\)H\(_2\)O (?). The water content is uncertain, and the natural material may be the tetrahydrate. Analysis gave:

<table>
<thead>
<tr>
<th></th>
<th>FeO</th>
<th>SO(_3)</th>
<th>H(_2)O</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>29.70</td>
<td>33.10</td>
<td>37.20</td>
<td>100.00</td>
</tr>
<tr>
<td>2.</td>
<td>30.6</td>
<td>34.3</td>
<td>[34.0]</td>
<td>[98.3]</td>
</tr>
</tbody>
</table>

1. FeSO\(_4\cdot5\)H\(_2\)O. 2. Idria. On a few milligram weight sample. Fe\(_2\)O\(_3\) 31.7 per cent as residue after ignition.

**Occur.** Originally found with melanterite at Idria, Gorizia, Italy. Also reported as an alteration of melanterite from an unstated locality in California, and from the Mt. Diablo mercury mine, Contra Costa County, California.²

**Artificial.**³ The existence of FeSO\(_4\cdot5\)H\(_2\)O as an artificial compound is doubtful; the tetrahydrate is ordinarily formed by dehydration of the heptahydrate or by crystallization from water at temperatures (56° to 64°) above those affording the heptahydrate.

**Name.** From σιδηρος, iron, and τιλος, fiber, in allusion to its composition and structure.

**Ref.**

1. Larsen (134, 1921). Dehydrated artificial FeSO\(_4\cdot7\)H\(_2\)O is said to have identical optical properties.

**29.6.5.3 Pentahydrite [MgSO\(_4\cdot5\)H\(_2\)O].** Epsomite Hobbs (*Am. Geol.*, 36, 184, 1905).


Minerals probably identical with artificial triclinic MgSO\(_4\cdot5\)H\(_2\)O and isostructural with chalcanthite have been described from several localities. An “epsomite” found with alunogen at Cripple Creek, Colorado, corresponds in composition with the pentahydrate (anal. 2) but is not otherwise described.¹ A light blue mineral found with chalcanthite at Copaquire, Tarapacá Province, Chile,² apparently is a cuprian variety with Cu:Mg ≈ 1:1.5 (anal. 3). A granular pseudomorphous dehydration product of epsomite from The Geysers, Sonoma County, California,³ is essentially pure MgSO\(_4\cdot5\)H\(_2\)O (anal. 4). A mineral found with pickeringite as a deposit on mine timbers in the Comstock Lode, Nevada,² is close to (Mg,Cu,Zn,Fe,Mn)SO\(_4\cdot5\)H\(_2\)O with Mg:Cu:Zn:Fe:Mn = 55:26:16:4.5:1 (anal. 5). The latter mineral is massive with a fine-granular or slightly platy texture; color light greenish blue; optically negative with \(nX\ 1.495, nY\ 1.512, nZ\ 1.518, 2V\ 55°, dispersion \(r < v\).
HEXAHYDRITE 493

Anal.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>MgO</td>
<td>19.15</td>
<td>19.35</td>
<td>11.39</td>
<td>17.91</td>
<td>9.40</td>
</tr>
<tr>
<td>CuO</td>
<td>12.43</td>
<td></td>
<td></td>
<td></td>
<td>9.00</td>
</tr>
<tr>
<td>ZnO</td>
<td></td>
<td></td>
<td></td>
<td>5.60</td>
<td></td>
</tr>
<tr>
<td>FeO</td>
<td>1.01</td>
<td>0.23</td>
<td></td>
<td></td>
<td>1.36</td>
</tr>
<tr>
<td>MnO</td>
<td>0.32</td>
<td>0.14</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NiO</td>
<td>0.06</td>
<td>0.11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SO₃</td>
<td>38.07</td>
<td>38.51</td>
<td>35.70</td>
<td>35.07</td>
<td></td>
</tr>
<tr>
<td>H₂O</td>
<td>42.78</td>
<td>42.03</td>
<td>38.38</td>
<td>42.97</td>
<td>[39.07]</td>
</tr>
<tr>
<td>Rem.</td>
<td></td>
<td></td>
<td>0.13</td>
<td>0.20</td>
<td></td>
</tr>
</tbody>
</table>

Total 100.00 99.89 99.29 99.62 [100.00]

1. MgSO₄ · 5H₂O. 2. Cripple Creek, Colorado. 3. Copaquire, Chile. 4. Sonoma County, California. Rem. is CaO. 5. Comstock Lode, Nevada. Rem. is insol.

Artif. MgSO₄ · 5H₂O is triclinic pinacoidal, with a:b:c = 0.621:1:0.5605; α 98°30', β 109°00', γ 75°05'. Observed forms: b 010, a 100, m 110, u 110, q 011, x 011, w 111, ξ 121. Crystals are elongated [001] with a and w prominent. No cleavage. G. 1.718. Optically negative (−), with nX 1.491, 2V 45°08', r < v. Obtained in crystals together with the hexahydrate and tetrahydrate by evaporation over H₂SO₄ of a solution of magnesium sulfate containing added H₂SO₄ or magnesium chloride; also reported by dehydration over H₂SO₄ of the heptahydrate.

Ref.
6. Mellor (4, 523, 1923) and Wyrouboff (1889).

A name given to triclinic (?) CoSO₄ · 5H₂O formed by the partial dehydration of bieberite or of artificial CoSO₄ · 7H₂O or 6H₂O. Biaxial negative (−), 2V medium, with nX 1.531, nY 1.549, nZ 1.552; faintly pleochroic with X eosine-pink and Z pale rose-pink; dispersion not strong. There is no evidence that this compound has formed directly in nature.

29.6.6 HEXAHYDRITE GROUP
MONOCLINIC; PRISMATIC—2/m

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a:b:c</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>β</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexahydrite, MgSO₄ · 6H₂O</td>
<td>1.4018:1:3.3890</td>
<td>98°14'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bianchite, (Zn,Fe)SO₄ · 6H₂O</td>
<td>1.3847:1:3.3516</td>
<td>98°12' [ZnSO₄ · 6H₂O]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The minerals of this group, not yet analyzed structurally, are isostructural with the monoclinic artificial hexahydrated sulfates and selenates of Mg, Co, Ni, and Zn. Several of these compounds have tetragonal polymorphs isostructural with retgersite. The pure Fe" member is not known artificially, although Fe" substitutes for Zn to a considerable extent in bianchite.