

THE SYSTEM OF  
MINERALOGY

*of James Dwight Dana and Edward Salisbury Dana  
Yale University 1837-1892*

SEVENTH EDITION

*Entirely Rewritten and Greatly Enlarged*

*By*

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VOLUME II

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

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**Opt.** In transmitted light, colorless.

|             |                               |                       |
|-------------|-------------------------------|-----------------------|
| ORIENTATION | $n$ (California) <sup>1</sup> |                       |
| X           | $1.528 \pm 0.003$             | Biaxial negative (-). |
| Y           | $1.537 \pm 0.003$             | 2V rather large.      |
| Z           | $1.545 \pm 0.003$             | $r > v$ .             |

**Chem.** Ferrous sulfate pentahydrate,  $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$  (?). The water content is uncertain, and the natural material may be the tetrahydrate. Analysis gave:

|    | FeO   | SO <sub>3</sub> | H <sub>2</sub> O | Total  |
|----|-------|-----------------|------------------|--------|
| 1. | 29.76 | 33.10           | 37.20            | 100.00 |
| 2. | 30.0  | 34.3            | [34.0]           | [98.3] |

1.  $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$ . 2. Idria. On a few milligram weight sample.  $\text{Fe}_2\text{O}_3$  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<sup>1</sup> in California, and from the Mt. Diablo mercury mine, Contra Costa County, California.<sup>2</sup>

**Artif.**<sup>3</sup> The existence of  $\text{FeSO}_4 \cdot 5\text{H}_2\text{O}$  as an artificial compound is doubtful; the tetrahydrate is ordinarily formed by dehydration of the heptahydrate or by crystallization from water at temperatures ( $56^\circ$  to  $64^\circ$ ) above those affording the heptahydrate.

**Name.** From  $\sigma\acute{\iota}\delta\eta\rho\sigma$ , *iron*, and  $\tau\acute{\iota}\lambda\omicron\varsigma$ , *fiber*, in allusion to its composition and structure.

#### Ref.

- Larsen (134, 1921). Dehydrated artificial  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  is said to have identical optical properties.
  - Ross, *U. S. Geol. Sur., Bull. 922B*, 44 (1940).
  - Mellor (14, 249, 1935).
  - On the morphology of the artificial salt see Marignac, *Ann. mines*, 9, 11 (1856).
- 29.6.5.3 **Pentahydrate** [ $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$ ]. Epsomite *Hobbs* (*Am. Geol.*, 36, 184, 1905). Double Sulphate of Copper and Magnesium *Keller* (*Proc. Am. Phil. Soc.*, 47, 81, 1908). Pentahydrate *Fronde* (priv. comm., 1948). Magnesium sulfate pentahydrate.

Minerals probably identical with artificial triclinic  $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$  and isostructural with chalcantite 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.<sup>1</sup> A light blue mineral found with chalcantite at Copaqueire, Tarapacá Province, Chile,<sup>2</sup> apparently is a cuprian variety with  $\text{Cu}:\text{Mg} \sim 1:1.5$  (anal. 3). A granular pseudomorphous dehydration product of epsomite from The Geysers, Sonoma County, California,<sup>3</sup> is essentially pure  $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$  (anal. 4). A mineral found with pickeringite as a deposit on mine timbers in the Comstock Lode, Nevada,<sup>4</sup> is close to  $(\text{Mg,Cu,Zn,Fe,Mn})\text{SO}_4 \cdot 5\text{H}_2\text{O}$  with  $\text{Mg}:\text{Cu}:\text{Zn}:\text{Fe}:\text{Mn} = 55:26:16:4.5:1$  (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,  $2V$   $55^\circ$ , dispersion  $r < v$ .

**Anal.**

|                  | 1      | 2     | 3     | 4     | 5        |
|------------------|--------|-------|-------|-------|----------|
| MgO              | 19.15  | 19.35 | 11.39 | 17.91 | 9.40     |
| CuO              |        |       | 12.43 |       | 9.00     |
| ZnO              |        |       |       |       | 5.60     |
| FeO              |        |       | 1.01  | 0.23  | 1.36     |
| MnO              |        |       | 0.32  | 0.14  | 0.30     |
| NiO              |        |       | 0.06  | 0.11  |          |
| SO <sub>3</sub>  | 38.07  | 38.51 | 35.70 | 38.13 | 35.07    |
| H <sub>2</sub> O | 42.78  | 42.03 | 38.38 | 42.97 | [39.07]  |
| Rem.             |        |       |       | 0.13  | 0.20     |
| Total            | 100.00 | 99.89 | 99.29 | 99.62 | [100.00] |

1. MgSO<sub>4</sub>·5H<sub>2</sub>O. 2. Cripple Creek, Colorado.<sup>1</sup> 3. Copaquire, Chile.<sup>2</sup> 4. Sonoma County, California.<sup>3</sup> Rem. is CaO. 5. Comstock Lode, Nevada.<sup>4</sup> Rem. is insol.

**Artif.**<sup>5</sup> MgSO<sub>4</sub>·5H<sub>2</sub>O is triclinic pinacoidal, with  $a:b:c = 0.621:1:0.5605$ ;  $\alpha 98^\circ 30'$ ,  $\beta 109^\circ 00'$ ,  $\gamma 75^\circ 05'$ . Observed forms:  $b 010$ ,  $a 100$ ,  $m 110$ ,  $u \bar{1}\bar{1}0$ ,  $q 011$ ,  $x 0\bar{1}1$ ,  $w \bar{1}11$ ,  $\xi \bar{1}21$ . Crystals are elongated [001] with  $a$  and  $w$  prominent. No cleavage.  $G. 1.718$ . Optically negative (-), with  $n_Y 1.491$ ,  $2V 45^\circ 08'$ ,  $r < v$ . Obtained<sup>6</sup> in crystals together with the hexahydrate and tetrahydrate by evaporation over H<sub>2</sub>SO<sub>4</sub> of a solution of magnesium sulfate containing added H<sub>2</sub>SO<sub>4</sub> or magnesium chloride; also reported by dehydration over H<sub>2</sub>SO<sub>4</sub> of the heptahydrate.

**Ref.**

1. Hobbs (1905).
2. Keller (1908).
3. Allen and Day, *Carnegie Inst. Washington Publ.*, **378**, 42 (1927).
4. Milton and Johnston, *Econ. Geol.*, **33**, 749 (1938).
5. Wyruboff, *Bull. soc. min.*, **12**, 371 (1889).
6. Mellor (**4**, 523, 1923) and Wyruboff (1889).

COBALT-CHALCANTHITE *Larsen and Glenn (Am. J. Sc., 50, 225, 1920).*

A name given to triclinic (?) CoSO<sub>4</sub>·5H<sub>2</sub>O formed by the partial dehydration of bieberite or of artificial CoSO<sub>4</sub>·7H<sub>2</sub>O or 6H<sub>2</sub>O. Biaxial negative (-),  $2V$  medium, with  $n_X 1.531$ ,  $n_Y 1.549$ ,  $n_Z 1.552$ ; 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— $2/m$

|  | $a:b:c$         | $\beta$                                      |
|--|-----------------|--|
| Hexahydrate, MgSO <sub>4</sub> ·6H <sub>2</sub> O    | 1.4018:1:3.3890 | 98°14'                                       |
| Bianchite, (Zn,Fe)SO <sub>4</sub> ·6H <sub>2</sub> O | 1.3847:1:3.3516 | 98 12 [ZnSO <sub>4</sub> ·6H <sub>2</sub> O] |

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.