# Ogdensburgite

## a new calcium-zinc-ferric iron arsenate mineral from Sterling Hill, New Jersey

by **Pete J. Dunn**
Department of Mineral Sciences
Smithsonian Institution
Washington, D.C. 20560

**ABSTRACT**

Ogdensburgite, ideally $Ca_3ZnFe_6^{+3}(AsO_4)_5(OH)_{11}\cdot 5H_2O$, is a new mineral from the Sterling Hill mine in Ogdensburg, New Jersey. The strongest lines in the X-ray powder diffraction pattern (*d* in Å, I/Io) are: 14.8 *100;* 2.656 *30;* 4.52 *30;* 2.734 *25;* 2.793 *25*. Chemical analysis by electron microprobe yielded $Fe_2O_3$ = 31.3, $Al_2O_3$ = 1.0, $SiO_2$ = 0.5, MgO = 0.5, CaO = 10.8, ZnO = 3.1, MnO = 2.2, $As_2O_5$ = 38.2 percent, together with 12.4 percent $H_2O$ by difference.

Ogdensburgite occurs as dark reddish brown platelets associated with secondary arsenates and several pitticite-like compounds. Ogdensburgite is biaxial (+) with refractive indices $\alpha = 1.765$, $\beta = 1.775$ and $\gamma = 1.800$ (all $\pm 0.005$). The density is 2.92 g/cm³; the hardness (Mohs) is approximately 2; the streak is bright reddish orange. Ogdensburgite was locally abundant. The name is for the locality.

**INTRODUCTION**

In 1972 and 1973, some suites of secondary arsenate minerals were encountered in the Sterling Hill mine, Ogdensburg, Sussex County, New Jersey. Many of the rare arsenates known only from localities in Sweden, such as synadelphite, magnussonite, akrochordite, retzian, manganese-hoernesite and allactite, have been found at the Sterling Hill mine in recent years, and more species may be forthcoming. The assemblage described here contains three compounds which were referred to locally as pitticite. Two of these, one waxy in texture and the other as remnant laths after parasymplesite, are very likely related to pitticite or yukonite and are still under study. A third one, possessing a perfect cleavage and micaceous appearance, is a new species, here named ogdensburgite after the town of Ogdensburg.

The new mineral and the name were approved by the Commission on New Minerals and Mineral Names, IMA. Holotype material is preserved in the Smithsonian Institution under catalog # NMNH 146880. Cotype samples are preserved in the Spex-Gerstmann mineral collection in the town of Franklin, New Jersey.

**PHYSICAL and OPTICAL PROPERTIES**

Ogdensburgite occurs as thin encrustations of dark brownish red platelets, arranged with the direction of cleavage normal to the surface of the specimens. On all samples examined, the crusts are exceedingly (0.1 mm) thin, in some cases forming botryoidal knobs or protuberances. In hand-specimen ogdensburgite resembles dark red velvet. This dark surface color is likely the result of oxidation; the true color is a very bright reddish orange. The streak is light orange; the luster is resinous on cleavage surfaces; the hardness (Mohs) is approximately 2; the density, determined with heavy liquid techniques, is 2.92 g/cm³ (meas.). There is one perfect cleavage, easily developed but with undetermined orientation.

Optically, ogdensburgite is biaxial (+) with 2V approximately 25°. The refractive indices are $\alpha = 1.765$, $\beta = 1.775$ and $\gamma = 1.800$ (all $\pm$ 0.005). Pleochroism is moderate, absorption X ‹ Y = Z. Extinctions are undulatory; $\beta$ and $\gamma$ are in the plane of the cleavage. Ogdensburgite is not fluorescent under ultraviolet radiation.

**CHEMISTRY**

Ogdensburgite was chemically analyzed using an ARL-SEMQ electron microprobe utilizing an operating voltage of 15 kV and a beam current of 0.15 $\mu$A. Two standard-sets were used in the analysis: analysis #1 was made with olivenite (As), zincite (Zn), hornblende (Ca,Fe,Mg,Al Si) and manganite (Mn); analysis #2 was made with the same standards except Mazapil arseniosiderite (using the composition of Moore and Araki, 1977) for Fe, Ca and As. The data were corrected using a modified version of the *MAGIC-4* program. There was too little material for the direct determination of water. These analyses are presented in Table 2 and their average yields the empirical formula:

$$(Ca_{2.81}Mn_{0.45}Zn_{0.56}Mg_{0.18})_{\Sigma 4.00}(Fe^{+3}_{5.73}Al_{0.29})_{\Sigma 6.02}$$
$$(As_{4.86}Si_{0.12})_{\Sigma 4.98}O_{19.92}(OH)_{11.00}\cdot 4.64H_2O$$

or, ideally, $Ca_4Fe_6^{+3}(AsO_4)_5(OH)_{11}\cdot 5H_2O$. Ogdensburgite gave a strong reaction for $Fe^{+3}$ by microchemical test and a very weak one

*Table 1. Microprobe analyses of ogdensburgite.*

| | Analysis #1 | Analysis #2 | Average | Theory* |
|---|---|---|---|---|
| $SiO_2$ | 0.5 | 0.5 | 0.5 | |
| $Al_2O_3$ | 1.0 | 1.0 | 1.0 | |
| $Fe_2O_3$ | 30.1 | 32.5 | 31.3 | 32.10 |
| MgO | 0.5 | 0.5 | 0.5 | |
| CaO | 10.5 | 11.1 | 10.8 | 11.27 |
| ZnO | 3.1 | 3.1 | 3.1 | 5.45 |
| MnO | 2.1 | 2.2 | 2.2 | |
| $As_2O_5$ | 39.2 | 37.3 | 38.2 | 38.50 |
| $H_2O$ | | | 12.4** | 12.68 |
| Total | | | 100.0 | 100.00 |

Accuracy of data: ±3% of the amount present.
*Theory for $Ca_3ZnFe_6^{+3}(AsO_4)_5(OH)_{11}\cdot 5H_2O$.
**Water by difference.

for $Fe^{+2}$. Accordingly, all the iron was calculated as ferric. The formula must be considered tentative in the absence of the direct determination of water, or a crystal structure determination.

Ionic radius considerations and the geochemical environment at Sterling Hill suggest that zinc may be essential to ogdensburgite. An alternative formula, here preferred, would assume limited substitution of manganese for calcium and yield:

$$(Ca_{2.81}Mn_{0.19})_{\Sigma 3.00}(Zn_{0.56}Mg_{0.18}Mn_{0.26})_{\Sigma 1.00}$$
$$(Fe^{+3}_{5.73}Al_{0.29})_{\Sigma 6.02}(As_{4.86}Si_{0.12})_{\Sigma 4.98}O_{19.92}(OH)_{11.00}\cdot 4.64H_2O$$

or ideally, $\mathbf{Ca_3ZnFe^{+3}_6(AsO_4)_5(OH)_{11}\cdot 5H_2O}$.

*Table 2. X-ray powder diffraction data for ogdensburgite.*

| *d*Å | I/Io | *d*Å | I/Io |
|---|---|---|---|
| 14.8 | 100 | 1.996 | 2 |
| 7.47 | 20 | 1.975 | 2 |
| 5.70 | 20 | 1.895 | 2 |
| 5.32 | 20 | 1.884 | 2 |
| 4.52 | 30 | 1.852 | 2 |
| 3.731 | 15 | 1.838 | 2 |
| 3.284 | 20 | 1.770 | 5 |
| 3.198 | 10 | 1.748 | 5 |
| 3.132 | 10 | 1.639 | 15 |
| 2.998 | 10 | 1.629 | 15 |
| 2.836 | 2 | 1.563 | 5 |
| 2.793 | 25 | 1.513 | 2 |
| 2.734 | 25 | 1.498 | 2 |
| 2.656 | 30 | 1.485 | 5 |
| 2.488 | 15 | 1.437 | 2b |
| 2.475 | 15 | 1.419 | 2b |
| 2.287 | 5 | 1.400 | 2b |
| 2.270 | 5 | 1.368 | 5 |
| 2.222 | 2 | 1.360 | 5 |
| 2.149 | 5 | 1.332 | 2 |
| 2.134 | 2 | | |

Data obtained with a polycrystalline sample in a Gandolfi 114.6 mm camera utilizing nickel-filtered CuK$\alpha$ X-radiation, and NBS silicon as an internal standard. b = broad line.

Ogdensburgite is chemically homogeneous and analysis of a cotype specimen (presumably from the same occurrence) indicated the composition is relatively invariant for the two samples.

## X-RAY POWDER DIFFRACTION DATA

No single-crystals of ogdensburgite were found. Those examined were of mosaic texture and unsuitable for single-crystal studies. X-ray powder diffraction data for ogdensburgite were obtained using a polycrystalline sample in a 114.6 mm diameter Gandolfi camera, employing NBS silicon as an internal standard. The powder data are presented in Table 2.

## OCCURRENCE

Ogdensburgite was found in 1972 in the Sterling Hill mine, Ogdensburg, Sussex County, New Jersey. The specimens were reported to have come from the 960 stope at the 340 level of the mine. Ogdensburgite is associated with parasymplesite, koettigite, a mineral similar to pharmacosiderite, and several ill-defined ferric iron arsenates possibly related to pitticite or yukonite. These minerals encrust a low-grade willemite-franklinite-calcite-sphalerite ore which has been severely weathered. Ogdensburgite, together with the associated koettigite, may have been locally abundant, and at least a dozen specimens are estimated to have been preserved in public and private collections.

## ACKNOWLEDGMENTS

The author is indebted to Ewald Gerstmann, John Kolic and George Pigeon for providing specimens of ogdensburgite for study. I thank Donald Peacor for his confirmation of the lack of single crystals. This study was supported, in part, by a grant from Mrs. E. Hadley Stuart, Jr.

## REFERENCES

MOORE, P. B., and ARAKI, T. (1977) Mitridatite, $Ca_6(H_2O)_6[Fe^{III}_9O_6(PO_4)_9]\cdot 3H_2O$. A noteworthy octahedral sheet structure. *Inorganic Chemistry,* **16**, 1096–1106. w:w:pbm:re