## Ahlfeldite $NiSe^{4+}O_3 \cdot 2H_2O$



**Crystal Data:** Monoclinic. *Point Group:* $2/m$. Rare crystals, to 1 mm, elongated along [001] or flattened parallel {110}, showing {110}, {011}, {032}, {103}, {$\bar{1}$01}; in crystalline crusts and spherical aggregates.

**Physical Properties:** *Cleavage:* On {110} and {103}, fair. *Tenacity:* Brittle. Hardness = 2–2.5 D(meas.) = 3.37(2) D(calc.) = 3.51

**Optical Properties:** Transparent. *Color:* Pale green, apple-green, olive-green; brown, brownish pink, becoming pink with increasing cobalt content. *Luster:* Vitreous. *Optical Class:* Biaxial (–). *Pleochroism:* $X$ = pale green; $Y$ = pale pink; $Z$ = pink. *Orientation:* $Y = b$; $Z \wedge c = -16°$. *Dispersion:* $r < v$, strong. $\alpha = 1.709(1)$ $\beta = 1.752(1)$ $\gamma = 1.787(2)$ 2V(meas.) = 85°

**Cell Data:** *Space Group:* $P2_1/n$. $a = 7.53(1)$ $b = 8.76(2)$ $c = 6.43(1)$ $\beta = 99°05(15)'$ Z = 4

**X-ray Powder Pattern:** Pacajake mine, Bolivia; close to cobaltomenite. 5.69 (100), 3.426 (80), 2.992 (75), 2.190 (75), 3.772 (60), 2.719 (60), 2.354 (50)

**Chemistry:**

| | (1) | (2) |
|---|---|---|
| $SeO_2$ | 50.01 | 50.03 |
| CoO | 3.55 | 16.89 |
| NiO | 30.24 | 16.84 |
| $H_2O$ | 16.2 | 16.24 |
| Total | 100.0 | 100.00 |

(1) Pacajake mine, Bolivia; by electron microprobe, $H_2O$ by evolved $H_2O$ analyzer; corresponds to $(Ni_{0.90}Co_{0.10})_{\Sigma=1.00}Se_{1.00}O_3 \cdot 2.00H_2O$. (2) $(Ni, Co)SeO_3 \cdot 2H_2O$ with Ni:Co = 1:1.

**Polymorphism & Series:** Forms a series with cobaltomenite.

**Occurrence:** A rare alteration product of nickel-bearing selenides and sulfides.

**Association:** Penroseite, chalcomenite, olsacherite, cerussite, anglesite (Pacajake mine, Bolivia); chalcomenite, olsacherite, lepidocrocite, goethite (El Dragón mine, Bolivia).

**Distribution:** In Bolivia, from the Pacajake mine, Hiaco, 24 km east-northeast of Colquechaca, and the El Dragón mine, 30 km southwest of Cerro Rico de Potosí, Potosí.

**Name:** To honor Friedrich E. Ahlfeld (1892–1982) German–Bolivian mining engineer and mineralogist.

**Type Material:** The Natural History Museum, London, England, 1972,347.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 635. (2) Aristarain, L.F. and C.S. Hurlbut, Jr. (1969) Ahlfeldite from Pacajake Bolivia; a restudy. Amer. Mineral., 54, 448–456. (3) Sturman, B.D. and J.A. Mandarino (1974) The ahlfeldite-cobaltomenite series. Can. Mineral., 12, 304–307. (4) Wildner, M. (1990) Crystal structure refinements of synthetic cobaltomenite ($CoSeO_3 \cdot 2H_2O$) and ahlfeldite ($NiSeO_3 \cdot 2H_2O$). Neues Jahrb. Mineral., Monatsh., 353–362.