

Ardealite

Ca₂(HPO₄)(SO₄)·4H₂O

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Crystal Data: Monoclinic. *Point Group:* *m*. Crystals platy and very thin, minute; as thin crusts and fine-grained powdery, pulverulent to clayey masses, generally intimately intermixed with brushite and gypsum.

Physical Properties: Hardness = n.d. D(meas.) = 2.34(1) D(calc.) = [2.32]

Optical Properties: Semitransparent. *Color:* Pale yellow, yellow, brownish yellow, colorless. *Optical Class:* Biaxial (-). $\alpha = 1.531(2)$ $\beta = 1.539(2)$ $\gamma = 1.546(2)$ $2V(\text{meas.}) = 86^\circ$

Cell Data: *Space Group:* *Cc* (synthetic). $a = 5.721(5)$ $b = 30.992(5)$ $c = 6.250(4)$
 $\beta = 117.26(6)^\circ$ $Z = 4$

X-ray Powder Pattern: La Guangola Cave, Italy.
7.73 (100), 3.08 (55), 3.87 (36), 1.810 (27), 2.813 (25), 2.849 (24), 3.93 (21)

Chemistry:	(1)	(2)	(3)
SO ₃	21.25	22.75	23.26
P ₂ O ₅	21.85	21.31	20.61
CaO	31.61	31.14	32.58
H ₂ O ⁺	25.14	24.86	23.55
insol.	0.39		
Total	100.24	100.06	100.00

(1) Cioclovina Cave, Romania; H₂O by the Penfield method. (2) La Guangola Cave, Italy; average of three analyses. (3) Ca₂(HPO₄)(SO₄)·4H₂O.

Occurrence: In limestone caves, as an early stage of the breakdown of bat guano, in reaction with calcite.

Association: Brushite, gypsum, carbonate-hydroxylapatite, newberyite, taranakite.

Distribution: From the Cioclovina Cave, Transylvania, Romania. In Italy, in the La Guangola Cave, near Altamura, Apulia. At the Magurata and Bacho Kuo Caves, Bulgaria. From the Baobab and Uisib Caves, Namibia. In the Moora Pave Cave, Jurien Bay, Western Australia. At the Onino-Iwaya Cave, Hiroshima Prefecture, Japan. From the Niah Great Cave, Sarawak, Malaysia.

Name: From *Ardeal*, the old Romanian name for Transylvania.

Type Material: The Natural History Museum, London, England, 1933,87.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 1010–1011. (2) Sakae, T., H. Nagata, and T. Sudo (1978) The crystal structure of synthetic calcium phosphate-sulfate hydrate, Ca₂HPO₄SO₄·4H₂O, and its relation to brushite and gypsum. *Amer. Mineral.*, 63, 520–527. (3) Balenzano, F., L. Dell'Anna, M. Di Pierro, and S. Fiore (1984) Ardealite, CaHPO₄CaSO₄·4H₂O : a new occurrence and new data. *Neues Jahrb. Mineral., Monatsh.*, 461–467.