

Fluorowardite**NaAl₃(PO₄)₂(OH)₂F₂·2H₂O**

Crystal Data: Tetragonal. *Point Group:* 422. As tetragonal bipyramidal crystals, to 0.1 mm, displaying {001} (prominent and lustrous), {011} and/or {012} (prominent, irregular, and striated parallel to [100]), and {100} (common, irregular, and striated parallel to [100]).

Physical Properties: *Cleavage:* Perfect on {001}. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness = 5 D(meas.) = n.d. D(calc.) = 2.706

Optical Properties: Transparent to translucent. *Color:* Colorless to white or cream-colored. *Streak:* White. *Luster:* Vitreous to pearly. *Optical Class:* Uniaxial (+). $\omega = 1.576(2)$ $\varepsilon = 1.584(2)$

Cell Data: *Space Group:* P4₁2₁2. $a = 7.077(2)$ $c = 19.227(3)$ $Z = 4$

X-ray Powder Pattern: Silver Coin mine, Valmy, Humboldt County, Nevada, USA. 4.766 (100), 3.099 (75), 3.008 (62), 2.597 (56), 1.5228 (49), 1.7628 (32), 1.6592 (29)

Chemistry:	(1)	(2)
Na ₂ O	6.27	7.71
CaO	1.74	
MgO	0.42	
Al ₂ O ₃	35.21	38.05
Fe ₂ O ₃	0.72	
P ₂ O ₅	32.49	35.32
As ₂ O ₅	0.64	
F	6.76	9.45
-O = F ₂	2.85	3.98
H ₂ O	[13.35]	13.45
total	94.74	100.00

(1) Silver Coin mine, Valmy, Humboldt County, Nevada, USA; average of 8 electron microprobe analyses supplemented by FTIR and Raman spectroscopy, H₂O calculated from the structure; corresponds to (Na_{0.87}Ca_{0.13}Mg_{0.04}) $\Sigma=1.04$ (Al_{2.96}Fe³⁺_{0.04}) $\Sigma=3.00$ (P_{1.96}As_{0.03}) $\Sigma=1.99$ O_{8.12}(OH)_{2.35}F_{1.53}·2H₂O.
(2) NaAl₃(PO₄)₂(OH)₂F₂·2H₂O.

Occurrence: A secondary phase, in a F-rich secondary phosphate assemblage.

Association: Alunite, barite, cacoxenite, chlorargyrite, fluorapatite, goethite, gorceixite (F-rich), iangreyite, iodargyrite, jarosite, kidwellite, kintoreite/plumbogummite, krásnoite, leucophosphate, lipscombite/zinclipcombite, meurigite-Na, metavariscite, millisite (F-rich), morinite, quartz, rockbridgeite, strengite/variscite, turquoise/chalcosiderite. Minerals separated by slashes exhibit variations in chemistry between the two species.

Distribution: From the phosphate stope, Silver Coin mine, Valmy, Iron Point district, Humboldt County, Nevada, USA.

Name: The fluorine analog of wardite; with the prefix “fluoro-” rather than “fluor-” to make pronunciation more straightforward.

Type Material: Mineral Sciences Department, Natural History Museum of Los Angeles County, Los Angeles, California, USA (57659 and 63810).

References: (1) Kampf, A.R., P.M. Adams, R.M. Housley, and G.R. Rossman (2014) Fluorowardite, NaAl₃(PO₄)₂(OH)₂F₂·2H₂O, the fluorine analog of wardite from the Silver Coin mine, Valmy, Nevada. *Amer. Mineral.*, 99, 804-810.