Vanderheydenite $Zn_6(PO_4)_2(SO_4)(OH)_4 \cdot 7H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As pseudohexagonal bladed crystals to 0.5 mm flattened on {100} and displaying {100}, {010}, and {021}.

Physical Properties: *Cleavage*: None. *Fracture*: Uneven. *Tenacity*: Brittle. Hardness = ~3 D(meas.) = n.d. D(calc.) = 3.06-3.12

Optical Properties: Translucent. *Color*: Colorless. *Streak*: White. *Luster*: Vitreous. *Optical Class*: Biaxial (-). α = 1.565(4) β = 1.580(4) γ = 1.582(4) 2V(calc.) = 39.8°

Cell Data: Space Group: $P2_1/n$. a = 6.2040(12) b = 19.619(4) c = 7.7821(16) β = 90.67(3)° Z = 2

X-ray Powder Pattern: Block 14 Opencut, Broken Hill, New South Wales, Australia. 6.134 (100), 9.826 (57), 7.296 (20), 3.368 (10), 3.069 (9), 2.778 (8), 2.648 (8)

Chemistry:

	(1)
ZnO	55.63
CuO	0.07
FeO	0.11
MnO	0.06
P_2O_5	14.18
As_2O_5	4.33
SO_3	8.71
H_2O	18.31
Total	101.40

(1) Block 14 Opencut, Broken Hill, New South Wales, Australia; average of 13 electron microprobe analyses supplemented by FTIR spectroscopy, H_2O calculated from structure for charge balance; corresponds to $(Zn_{5.99}Cu_{0.01}Fe_{0.01}Mn_{0.01})_{\Sigma=6.02}[(PO_4)_{1.75}(AsO_4)_{0.33}]_{\Sigma=2.08}(SO_4)_{0.95}(OH)_{3.91} \cdot 6.96H_2O$.

Occurrence: A secondary mineral in a highly weathered recrystallized sulfide ore as a result of the release of Zn, S, As, and P from the breakdown of sphalerite, galena, and fluorapatite.

Association: Pyromorphite, anglesite, liversidgeite.

Distribution: From Block 14 Opencut, Broken Hill, New South Wales, Australia.

Name: Honors Arnold van der Heyden, mine geologist at the Broken Hill mine for the former Minerals Mining and Metallurgy Ltd (December 1985 until June 1991) in recognition of his contribution to the understanding of the secondary mineralogy of the Broken Hill ore body by the systematic collecting of mineral specimens from the oxidized zone.

Type Material: South Australian Museum, Adelaide, South Australia (G32512).

References: (1) Elliott P. and U. Kolitsch (2018) Description and crystal structure of vanderheydenite, $Zn_6(PO_4)_2(SO_4)(OH)_4 \cdot 7H_2O$, a new mineral from Broken Hill, New South Wales, Australia. Eur. J. Mineral., 30(4), 835-840. (2) (2019) Amer. Mineral., 104(12), 1871 (abs. ref. 1).