Vanarsite $NaCa_{12}(As^{3+}V^{4+}_{3.5}V^{5+}_{18.5}As^{5+}_{6}O_{51})_2 \cdot 78H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As blades flattened on {100} and elongated along [010], and as subparallel or fan-like aggregates to 5 mm.

Physical Properties: *Cleavage*: Fair on {100}. *Tenacity*: Brittle. *Fracture*: Curved. Hardness = ~ 2 D(meas.) = 2.48(2) D(calc.) = 2.460 Dissolves in dilute HCl.

Optical Properties: Transparent. *Color*: Very dark blue. *Streak*: Grayish blue. *Luster*: Vitreous. *Optical Class*: Biaxial (-). α = 1.645(5) β(calc.) = 1.677 γ(calc.) = 1.681 2V(meas.) = 37(2)° 2V(calc.) = n.d. *Orientation*: $Y = b$, $X \wedge a \approx 12°$ in obtuse β. *Pleochroism*: X = cornflower blue, Y = dark blue, Z = dark blue. *Absorption*: $X << Z < Y$. *Dispersion*: None.

Cell Data: Space Group: $P2_1/c$. a = 25.8815(5) b = 10.9416(2) c = 28.2861(6) β = 102.2150(10)° Z = 2

X-ray Powder Pattern: Packrat mine, Gateway district, Mesa County, Colorado, USA. 13.1 (100), 10.0 (98), 9.3 (63), 7.87 (56), 4.67 (35), 4.44 (31), 3.339 (33)

Chemistry:	(1)	(2)
Na_2O	0.63	0.54
CaO	13.08	11.30
SrO	0.21	0.19
FeO	0.04	0.03
As_2O_3		[3.41]
As_2O_5	31.61	[23.34]
VO_2		[9.55]
V_2O_5	43.89	[27.44]
H_2O		[24.20]
Total	89.47	100.00

(1) Packrat mine, Gateway district, Colorado, USA; average of 16 electron microprobe analyses. (2) Analysis 1 normalized, H_2O calculated from structure, As and V apportioned for charge balance and structural criteria; corresponds to $(Ca_{11.70}Na_{1.01}Sr_{0.11}Fe^{2+}_{0.02})_{\Sigma=12.84}(As^{3+}V^{4+}_{3.34}V^{5+}_{8.76}As^{5+}_{5.90}O_{51})_2 \cdot 78H_2O$.

Occurrence: A secondary mineral formed by the oxidation of montroseite-corvusite assemblages in a moist environment.

Association: Gatewayite, morrisonite, packratite, pharmacolite, montroseite, corvusite.

Distribution: From the Packrat mine, Gateway district, Mesa County, Colorado, USA.

Name: An acronym based on the composition and specifically the fact that it contains vanadate, arsenite, and arsenate groups.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (64149 and 64150).

References: (1) Kampf, A.R., J.M. Hughes, B.P. Nash, and J. Marty (2016) Vanarsite, packratite, morrisonite, and gatewayite: four new minerals containing the $[As^{3+}V^{4+,5+}_{12}As^{5+}_{6}O_{51}]$ heteropolyanion, a novel polyoxometalate cluster. Can. Mineral., 54, 145-162. (2) (2017) Amer. Mineral., 102, 1145-1146 (abs. ref. 1).