Vanarsite  
NaCa$_{12}$(As$^{3+}$V$^{4+}$)$_{3.5}$V$^{5+}_{18.5}$As$^{5+}$$O_{51}$)$^{2-}$·78H$_2$O

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

**Optical Properties:**  
*Luster:* Vitreous.  
*Optical Class:* Biaxial (-).  
$\alpha = 1.645(5)$  
$\beta$(calc.) = 1.677  
$\gamma$(calc.) = 1.681  
$2V$(meas.) = 37(2)°  
$2V$(calc.) = n.d.  
*Orientation:* $Y = b$, $X^a \approx 12^\circ$ in obtuse $\beta$.  
*Pleochroism:* $X =$ cornflower blue, $Y =$ dark blue, $Z =$ dark blue.  
*Absorption:* $X << Z < Y$.  
*Dispersion:* None.

**Cell Data:**  
Space Group: $P_2_1/c$.  
$a = 25.8815(5) m\ A$  
$b = 10.9416(2) m\ A$  
$c = 28.2861(6) m\ A$  
$\beta = 102.2150(10)^\circ$  
$Z = 2$  

**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:**  
<table>
<thead>
<tr>
<th>Formula</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na$_2$O</td>
<td>0.63</td>
<td>0.54</td>
</tr>
<tr>
<td>CaO</td>
<td>13.08</td>
<td>11.30</td>
</tr>
<tr>
<td>SrO</td>
<td>0.21</td>
<td>0.19</td>
</tr>
<tr>
<td>FeO</td>
<td>0.04</td>
<td>0.03</td>
</tr>
<tr>
<td>As$_2$O$_3$</td>
<td>[3.41]</td>
<td></td>
</tr>
<tr>
<td>As$_2$O$_5$</td>
<td>31.61</td>
<td>[23.34]</td>
</tr>
<tr>
<td>VO$_2$</td>
<td>[9.55]</td>
<td></td>
</tr>
<tr>
<td>V$_2$O$_5$</td>
<td>43.89</td>
<td>[27.44]</td>
</tr>
<tr>
<td>H$_2$O</td>
<td>[24.20]</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>89.47</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(1) Packrat mine, Gateway district, Colorado, USA; average of 16 electron microprobe analyses.  
(2) Analysis 1 normalized, H$_2$O 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+}$$_{0.02}$)$_{12-}$·12As$_{3.34}$V$^{4+}$$\times_{3.34}$V$^{5+}$$\times_{8.76}$As$^{5+}$$\times_{5.50}$O$_{51}$)$^{2-}$·78H$_2$O.

**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$_{3.34}$V$^{4+}$$\times_{3.34}$V$^{5+}$$\times_{8.76}$As$^{5+}$$\times_{5.50}$O$_{51}$)$^{2-}$·78H$_2$O heteropolyanion, a novel polyoxometalate cluster. Can. Mineral., 54, 145-162.  
(2) (2017) Amer. Mineral., 102, 1145-1146 (abs. ref. 1).