**Gatewayite**  \( \text{Ca}_6(\text{As}^{3+}\text{V}^{4+}_3\text{V}^{5+}_9\text{As}^{5+}_6\text{O}_{51})\cdot31\text{H}_2\text{O} \)

**Crystal Data:** Monoclinic.  \( \text{Point Group}: 2 \).  As blades flattened on \{101\} and elongated along [010] to 0.5 mm; as crude prisms with curved faces, to 1 mm, and as composite crystals of subparallel narrow prisms to 2 mm.

**Physical Properties:**  
- **Cleavage:** Fair on \{010\} and \{101\}.  
- **Tenacity:** Brittle.  
- **Fracture:** Curved.  
- **Hardness:** \( ~2 \)  
- **D(meas.)** = 2.34(2)  
- **D(calc.)** = 2.337  
- **Dissolves in dilute HCl.**

**Optical Properties:**  
- **Transparent.**  
- **Color:** Very dark greenish blue.  
- **Streak:** Grayish blue.  
- **Luster:** Vitreous.  
- **Optical Class:** Biaxial (-).  
- **\( \alpha \) = 1.621(1) \quad \beta = 1.654(5) \quad \gamma = 1.668(5) \quad 2V(\text{meas.)} = 66(1)^\circ \)**
- **Orient.:** \( b, X^\parallel a \approx 30^\circ \) in obtuse \( \beta \).  
- **Absorption:** \( X << Y < Z \).  
- **Pleochroism:** \( X = \) pale olive green, \( Y = \) medium greenish blue, \( Z = \) dark greenish blue.  
- **Dispersion:** Extreme.

**Cell Data:**  
- Space Group: \( \text{P2}_1 \).  
- \( a = 11.1850(4) \quad b = 16.8528(4) \quad c = 20.7146(15) \quad \beta = 91.166(6)^\circ \)
- \( Z = 2 \)

**X-ray Powder Pattern:** Packrat mine, Gateway district, Mesa County, Colorado, USA.  
9.7 (100), 13.2 (47), 2.810 (17), 2.866 (14), 3.246 (9), 2.953 (9), 2.758 (9)

**Chemistry:**

<table>
<thead>
<tr>
<th>Element</th>
<th>Formula</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na(_2)O</td>
<td>0.21</td>
<td>0.19</td>
<td></td>
</tr>
<tr>
<td>CaO</td>
<td>12.31</td>
<td>11.31</td>
<td></td>
</tr>
<tr>
<td>SrO</td>
<td>0.41</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>As(_{52})O(_3)</td>
<td>[3.60]</td>
<td>[25.40]</td>
<td></td>
</tr>
<tr>
<td>As(_{52})O(_5)</td>
<td>32.18</td>
<td>[25.40]</td>
<td></td>
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<tr>
<td>VO(_2)</td>
<td>[7.40]</td>
<td>[31.39]</td>
<td></td>
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<tr>
<td>V(_2)O(_5)</td>
<td>42.97</td>
<td>[31.39]</td>
<td></td>
</tr>
<tr>
<td>H(_2)O</td>
<td>[20.33]</td>
<td>[20.33]</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>88.08</td>
<td>100.00</td>
<td></td>
</tr>
</tbody>
</table>

(1) Packrat mine, Gateway district, Colorado, USA; average of 9 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 \( \text{Ca}_{5.54}\text{Na}_{0.17}\text{Sr}_{0.10}\Sigma_{5.81}(\text{As}^{3+}\text{V}^{4+}_2\text{V}^{5+}_9\text{As}^{5+}_6\text{O}_{51})\cdot31\text{H}_2\text{O} \).

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

**Association:** Morrisonite, packratite, vanarsite, pharmacolite, montroseite, corvusite.

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

**Name:** For the Gateway mining district in which the Packrat mine is located. Gateway is also the nearest town to the Packrat mine.

**Type Material:** Natural History Museum of Los Angeles County, Los Angeles, California, USA (64513, 64514, 65554, 65555 and 65559).

**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 \( \text{[As}^{3+}\text{V}^{4+}_2\text{V}^{5+}_9\text{As}^{5+}_6\text{O}_{51}] \) heteropolyanion, a novel polyoxometalate cluster.  
(2) (2017) Amer. Mineral., 102, 1145-1146 (abs. ref. 1).