Fermiite

\[ \text{Na}_4(\text{UO}_2)(\text{SO}_4)_3 \cdot 3\text{H}_2\text{O} \]

**Crystal Data:** Orthorhombic.  
*Point Group:* mm2.  
As prisms elongated along [010] to ~ 0.5 mm and in subparallel or irregular aggregates. Crystals display \{101\}, \{011\}, \{110\}, \{010\}, and \{001\}.  
*Twinning:* Penetration twins by 180° rotation on [010].

**Physical Properties:**  
*Cleavage:* None.  
*Fracture:* Conchoidal.  
*Tenacity:* Brittle.  
*Hardness:* 2.5  
\[ D(\text{meas.}) = 3.23(2) \quad D(\text{calc.}) = 3.275 \]  
Slightly deliquescent and easily soluble in H\text{2}O.  
Bright greenish white fluorescence under UV.

**Optical Properties:**  
*Color:* Greenish yellow.  
*Luster:* Vitreous.  
*Streak:* White.  
*Orientation:* \(X = b, Y = c, Z = a\).  
\[ \alpha = 1.527 \quad \beta = 1.534 \quad \gamma = 1.567 \]  
Dispersion: Distinct, \(r < v\).  
*Absorption:* \(X = Y < Z\).  
*Pleochroism:* \(X = Y\) = colorless, \(Z\) = pale greenish yellow.

**Cell Data:**  
*Space Group:* Pmn2\(_1\).  
\[ a = 11.8407(12) \quad b = 7.8695(5) \quad c = 15.3255(19) \quad Z = 4 \]

**X-ray Powder Pattern:** Blue Lizard mine, White Canyon district, San Juan County, Utah, USA.  
7.01 (100), 3.476 (85), 3.131 (57), 3.336 (55), 6.00 (49), 7.71 (43), 4.70 (42)

**Chemistry:**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>\text{Na}_2\text{O}</td>
<td>17.10</td>
<td>17.60</td>
</tr>
<tr>
<td>\text{UO}_3</td>
<td>42.77</td>
<td>40.62</td>
</tr>
<tr>
<td>\text{SO}_3</td>
<td>33.85</td>
<td>34.11</td>
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<tr>
<td>\text{H}_2\text{O}</td>
<td>[7.70]</td>
<td>7.67</td>
</tr>
<tr>
<td>Total</td>
<td>101.42</td>
<td>100.00</td>
</tr>
</tbody>
</table>

(1) Blue Lizard mine, White Canyon district, San Juan County, Utah, USA; average of 6 electron microprobe analyses supplemented by Raman spectroscopy, H\text{2}O calculated from stoichiometry; corresponding to \(\text{Na}_{3.88}(\text{U}_{1.05}\text{O}_2)(\text{SO}_4)_{3.89}\cdot 3\text{H}_2\text{O}\).  
(2) \(\text{Na}_4(\text{UO}_2)(\text{SO}_4)_3 \cdot 3\text{H}_2\text{O}\).

**Occurrence:** A secondary mineral from post-mining oxidation of primary uraninite, pyrite, chalcopyrite, bornite, and covellite deposited as replacement of wood and other organic material and as disseminations in the enclosing sandstone.

**Association:** Oppenheimerite, blödite, bluelizardite, chalcanthite, epsomite, gypsum, hexahydrite, kröhnkite, manganoblödite, sideronatrite, tamarugite, wetherillite.

**Distribution:** From the Blue Lizard mine, Red Canyon, White Canyon district, San Juan County, Utah, USA.

**Name:** Honors Italian-American theoretical and experimental physicist Enrico Fermi (1901-1954), well known for his work for the Manhattan Project during World War II.

**Type Material:** Natural History Museum of Los Angeles County, Los Angeles, California, USA (65546-65548), and the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (94621).

**References:**

(1) Kampf, A.R., J. Plašil, A.V. Kasatkin, J. Marty and J. Čejka (2015) Fermiite, \(\text{Na}_4(\text{UO}_2)(\text{SO}_4)_3 \cdot 3\text{H}_2\text{O}\) and oppenheimerite, \(\text{Na}_2(\text{UO}_2)(\text{SO}_4)_2 \cdot 3\text{H}_2\text{O}\); two new uranyl sulfate minerals from the Blue Lizard mine, San Juan County, Utah, USA. Mineral. Mag., 79(5), 1123-1142.  