Esperanzaite

\[ \text{NaCa}_2\text{Al}_2(\text{AsO}_4)_2\text{F}_4(\text{OH})\cdot2\text{H}_2\text{O} \]

**Crystal Data:** Monoclinic.  
Point Group: 2/m.  
As radiating crystals, in spherulites, to 1.5 mm, which may form botryoidal aggregates.

**Physical Properties:**  
Cleavage: One, perfect, || [001].  
Tenacity: Brittle.  
Hardness = 4.5  
D(meas.) = 3.24  
D(calc.) = 3.36(3)

**Optical Properties:**  
Transparent to translucent.  
Color: Pale blue-green; colorless in transmitted light.  
Streak: White.  
Luster: Vitreous.  
Optical Class: Biaxial (−).  
Orientation: Y = b; X ∧ c = 35°; Z ∧ a = 50.5°.  
Dispersion: \( r < v \), medium.  
α = 1.580(1)  
β = 1.588(1)  
γ = 1.593(1)  
2V(meas.) = 74(1)°  
2V(calc.) = 76.3°

**Cell Data:**  
Space Group: P2\(_1\)/m.  
a = 9.687(5)  
b = 10.7379(6)  
c = 5.5523(7)  
β = 105.32(1)°  
Z = 2

**X-ray Powder Pattern:**  
La Esperanza mine, Mexico.  
2.966 (100), 3.527 (90), 2.700 (90b), 5.364 (80), 4.796 (80), 3.801 (80), 2.246 (60)

**Chemistry:**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
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</thead>
<tbody>
<tr>
<td>As(_2)O(_5)</td>
<td>40.67</td>
<td>40.75</td>
</tr>
<tr>
<td>Al(_2)O(_3)</td>
<td>19.20</td>
<td>18.08</td>
</tr>
<tr>
<td>ZnO</td>
<td>0.87</td>
<td></td>
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<tr>
<td>CaO</td>
<td>20.75</td>
<td>19.89</td>
</tr>
<tr>
<td>Na(_2)O</td>
<td>3.86</td>
<td>5.49</td>
</tr>
<tr>
<td>F</td>
<td>13.9</td>
<td>13.47</td>
</tr>
<tr>
<td>H(_2)O</td>
<td>8.65</td>
<td>7.99</td>
</tr>
<tr>
<td>−O = F(_2)</td>
<td>5.83</td>
<td>5.67</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>102.07</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

(1) La Esperanza mine, Mexico; by electron microprobe, average of three analyses on two grains; 
H\(_2\)O by Karl Fischer coulometric titration; (AsO\(_4\))\(^{3−}\), (OH)\(^{−}\), H\(_2\)O confirmed by IR; calculated from an original analysis As 26.50%, Al 10.16%, Zn 0.70%, Ca 14.83%, Na 2.86%, F 13.9%, H\(_2\)O 8.65%, O 24.45% calculated for charge balance, total 102.15%; corresponds to Na\(_{0.68}\)Ca\(_{2.63}\)Zn\(_{0.07}\)Al\(_{2.06}\)(As\(_{0.97}\)O\(_{4.94}\))\(_2\)F\(_{4.00}\)(OH)\cdot2.13H\(_2\)O. (2) NaCa\(_2\)Al\(_2\)(AsO\(_4\))\(_2\)F\(_4\)(OH)\cdot2H\(_2\)O.

**Occurrence:** Very rare from a tin-bearing rhyolite.

**Association:** Hematite, cassiterite, quartz, tridymite, cristobalite, “opal”, calcite, zeolites, mimetite, clay minerals.

**Distribution:** From the La Esperanza mine, 3.7 km southeast of Madero, Zaragosa district, Durango, Mexico.

**Name:** For the La Esperanza mine, Mexico, from which the mineral was collected.

**Type Material:** National Museum of Natural History, Washington, D.C., USA, 171530.

**References:**  