Betpakdalite-CaMg \(\text{[Ca}_2\text{(H}_2\text{O})_{17}\text{Mg(H}_2\text{O})_6]\text{[Mo}^{6+}_8\text{As}^{5+}_2\text{Fe}^{3+}_3\text{O}_{36}\text{(OH)}]}\)

**Crystal Data:** Monoclinic. \(\text{Point Group: 2}i\).m. As pseudo-octahedra, to ~1 mm.

**Twining:** Uncommon as contact twins on (001) by rotation of 120° about [012] and as penetration twins by rotation of 120° about [012].

**Physical Properties:** \(\text{Cleavage: }\{001\}, \text{ perfect. }\) \(\text{Tenacity: }\text{Brittle. }\) \(\text{Fracture: Irregular.}\)

\(\text{Hardness }\approx \text{3.5 }\) \(\text{D(meas.) }= 2.98(4)\) \(\text{D(calc.) }= 2.944\)

**Optical Properties:** Transparent. \(\text{Color: }\text{Yellow. }\) \(\text{Streak: Colorless to very pale yellow.}\)

\(\text{Luster: Vitreous to subadamantine.}\)

**Optical Class:** Biaxial (+). \(\text{Pleochroism: None. }\) \(\text{Orientation: }Y = b; Z = c.\) \(\text{Dispersion: }r < \nu, \text{ strong.}\)

\(\alpha = 1.818(3)\) \(\beta = 1.824(3)\) \(\gamma = 1.846(3)\) \(2V(\text{meas.}) = 55(2)°\) \(2V(\text{calc.}) = 55.7°\)

**Cell Data:** \(\text{Space Group: }C2i/m.\) \(a = 19.5336(7)\) \(b = 11.0637(4)\) \(c = 15.2559(11)\) \(\beta = 131.528(9)°\) \(Z=2\)

**X-ray Powder Pattern:** Tsumeb, Namibia.

8.971 (100), 2.965 (44), 2.817 (35), 7.341 (34), 3.656 (33), 2.662 (31), 3.143 (26)

**Chemistry:**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(1)</th>
<th>(2)</th>
</tr>
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<tbody>
<tr>
<td>(\text{MoO}_3)</td>
<td>52.9</td>
<td>52.42</td>
<td>(\text{CaO})</td>
<td>5.3</td>
</tr>
<tr>
<td>(\text{As}_2\text{O}_5)</td>
<td>10.0</td>
<td>10.46</td>
<td>(\text{H}_2\text{O})</td>
<td>[19.4]</td>
</tr>
<tr>
<td>(\text{Fe}_2\text{O}_3)</td>
<td>11.2</td>
<td>10.90</td>
<td>Total [100.6]</td>
<td>100.00</td>
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<tr>
<td>(\text{MgO})</td>
<td>1.8</td>
<td>1.84</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(1) Tsumeb, Namibia; by electron microprobe, total Fe as \(\text{Fe}_2\text{O}_3\), \(\text{H}_2\text{O}\) calculated for stoichiometry; corresponding to \(\text{[Ca}_2\text{(H}_2\text{O})_{17}\text{Mg(H}_2\text{O})_6]\text{[Mo}^{6+}_8\text{As}^{5+}_2\text{Fe}^{3+}_3\text{O}_{36}\text{(OH)}]}\)\).

(2) \(\text{[Ca}_2\text{(H}_2\text{O})_{17}\text{Mg(H}_2\text{O})_6]\text{[Mo}^{6+}_8\text{As}^{5+}_2\text{Fe}^{3+}_3\text{O}_{36}\text{(OH)}]}\).

**Mineral Group:** Betpakdalite supergroup, betpakdalite group.

**Occurrence:** In a deep oxidation zone of a dolostone-hosted hydrothermal polymetallic ore deposit, formed by alteration of \(\text{As}, \text{Fe}\) and \(\text{Mg}\) sulfides by solutions rich in \(\text{Ca}\) and \(\text{Mg}\) (Tsumeb, Namibia).

**Association:** Scorodite, djurleite, powellite, adamite, gerdtremmelite, wulfenite, hidalgoite, chalcocite, digenite, kaolinite, quartz, hematite (Tsumeb, Namibia).

**Distribution:** On the 35th level of the Tsumeb mine, Namibia.

**Name:** For the original occurrence in the Bet-Pak-Dal Desert, Kazakhstan. Two suffixes correspond to the dominant cations in the two different types of non-framework cation sites.

**Type Material:** Natural History Museum of Los Angeles County, Los Angeles, California, USA, (63327 and 63328).