Betpakdalite-CaCa  \[\text{[Ca}_2\text{(H}_2\text{O})_{17}\text{Ca(H}_2\text{O})_8][\text{Mo}_6\text{As}_5\text{Fe}_3\text{O}_{36}\text{(OH)}]\]

**Crystal Data:** Monoclinic. *Point Group:* 2/m. Crystals are short prismatic, with \{hk0\} and \{h0l\}, or pseudo-octahedral, to 0.2 mm; in crystalline aggregates, powdery, as thin coatings, massive.

**Twining:** Many crystals are “oriented intergrowths of two or three individuals.”

**Physical Properties:** *Cleavage:* \{001\}, very good. Hardness \(\sim 3\) D(meas.) = 2.98-3.05 D(calc.) = 2.913

**Optical Properties:** Transparent. *Color:* Bright lemon-yellow with a pale greenish, rarely brownish, tint; greenish yellow in transmitted light. *Luster:* Dull to waxy. *Optical Class:* Biaxial (+). \(\alpha = 1.782\pm1.809\) \(\beta = 1.797\pm1.821\) \(\gamma = 1.850\pm1.857\) 2V(meas.) = n.d. 2V(calc.) = 53°-88° *Pleochroism:* Distinct; \(X = \) pale yellow; \(Y = \) greenish yellow; \(Z = \) bluish green. *Orientation:* \(Y = b; X \perp c = 12°.\) *Dispersion:* Inclined, extreme. *Absorption:* \(Z > Y > X.\)

**Cell Data:** *Space Group:* C2/m. \(a = 19.507(2)\) \(b = 11.0768(9)\) \(c = 15.2618(19)\) \(\beta = 131.488(5)^°\) \(Z = 2\)

**X-ray Powder Pattern:** Kara-Oba deposit, Kazakhstan. 8.75 (10), 3.63 (9), 1.532 (8), 1.480 (8), 2.95 (7), 1.732 (7), 1.191 (7)

**Chemistry:**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>MoO₃</td>
<td>50.24</td>
<td>53.15</td>
<td>99.94</td>
</tr>
<tr>
<td>As₂O₅</td>
<td>14.86</td>
<td>9.23</td>
<td>19.00</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>11.70</td>
<td>10.65</td>
<td>22.35</td>
</tr>
</tbody>
</table>

(1) Kara-Oba deposit, Kazakhstan; wet chemical and DTA analyses. (2) Do.; normalized electron microprobe analysis, \(\text{H}_2\text{O}\) calculated, total includes \(\text{Na}_2\text{O} (0.25), \text{K}_2\text{O} (0.25), \text{CuO} (0.05), \text{Al}_2\text{O}_3 (0.02), \text{SiO}_2 (0.06), \text{P}_2\text{O}_5 (0.03);\) corresponds to \([\text{Ca}_0.74\text{Na}_0.13\text{K}_{0.11}\text{Fe}_{1-1.02}\text{(H}_2\text{O})_{17.98}(\text{Ca}_{0.99}\text{Cu}^{2+}_{0.01})_{2-1.00}\text{(H}_2\text{O})_{16}]\)[\(\text{Mo}_8(\text{As}_{1.74}\text{P}_{0.04}\text{Si}_{0.02})_{2-1.80}(\text{Fe}^{3+}_{2.89}\text{Al}_{0.01})_{2-2.96}\text{O}_{32.44}\text{(OH)}_{4.56}\].

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

**Occurrence:** Filling cracks in leached pyrite in the oxidized zone of a mineral deposit (Kara-Oba deposit, Kazakhstan); on vein quartz (Krupka, Czech Republic).

**Association:** Ferrimolybdite, gypsum, jarosite, hydromica, “limonite”, “opal” (Kara-Oba deposit, Kazakhstan); molydbnode, molybdite, quartz (Krupka, Czech Republic).

**Distribution:** In the Kara-Oba Mo-W deposit, Bet-Pak-Dal Desert, central Kazakhstan. Well characterized material from the Descubridora mine, Pampa Larga district, Copiapó, Chile; at Bajan Cogto, Mongolia; from the Rustler mine, Gold Hill district, Tooele County, Utah, USA; and the Nedre Kvartsen quarry, Drag, Tysfjord, Nordland, Norway. At Krupka, Krušné hory Mountains, Czech Republic. From Vaulry, Haute-Vienne, France. At Tsumeb, Namibia. From Elsmore, New South Wales, Australia.

**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:** A.E. Fersman Mineralogical Museum, Moscow, Russia, 62532, 62533.