Betpakdalite

\[ \text{Ca}_2\text{MgFe}_3^{3+}\text{As}_2^{5+}\text{Mo}_8^{6+}\text{O}_{36}^{\text{OH}}\cdot23\text{H}_2\text{O} \]

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Crystal Data: Monoclinic. Point Group: 2/m. Crystals are short prismatic, with \{hk\} and \{h0l\}, or pseudo-octahedra, to 0.2 mm; in crystalline aggregates, powdery, as thin coatings, massive. Twinning: Many crystals are “oriented intergrowths of two or three individuals.”

Physical Properties: Cleavage: \{001\}, very good. Hardness = ~3 D(meas.) = 2.98–3.05 D(calc.) = 2.90

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 (+). Pleochroism: Distinct; X = pale yellow; Y = greenish yellow; Z = bluish green. Orientation: Y = b; X ∧ c = 12°. Dispersion: Inclined, extreme. Absorption: \( Z > Y > X \). \( \alpha = 1.782–1.809 \) \( \beta = 1.797–1.821 \) \( \gamma = 1.850–1.857 \) \( 2V(\text{meas.}) = \text{n.d.} \) \( 2V(\text{calc.}) = 53°–88° \)

Cell Data: Space Group: \( C2/m \). \( a = 19.531(2) \) \( b = 11.061(1) \) \( c = 15.257(2) \) \( \beta = 131.57(1)^\circ \) \( Z = 2 \)

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:

\begin{align*}
\text{MoO}_3 & \quad 50.26 \quad 52.9 \quad 52.42 \quad \text{H}_2\text{O}^+ \quad 3.20 \\
\text{As}_2\text{O}_3 & \quad 13.94 \quad 10.0 \quad 10.46 \quad \text{H}_2\text{O}^- \quad 15.80 \\
\text{Fe}_2\text{O}_3 & \quad 12.30 \quad 11.2 \quad 10.90 \quad \text{H}_2\text{O} \quad [19.4] \quad 19.27 \\
\text{MgO} & \quad 1.8 \quad 1.84 \quad \text{insol.} \quad 0.80 \\
\text{CaO} & \quad 4.18 \quad 5.3 \quad 5.11 \quad \text{Total} \quad 100.48 \quad [100.6] \quad 100.00
\end{align*}

(1) Kara-Oba deposit, Kazakhstan. (2) Tsumeb, Namibia; by electron microprobe, total Fe as \( \text{Fe}_2\text{O}_3 \), \( \text{H}_2\text{O} \) calculated for stoichiometry; corresponds to \( \text{Ca}_2\text{Mg}_{1.0}\text{Fe}_{3.1}\text{Mo}_{8.00}\text{As}_{1.9}\text{O}_{36}^{\text{OH}}\cdot23\text{H}_2\text{O} \). (3) \( \text{Ca}_2\text{MgFe}_3\text{Mo}_3\text{As}_2\text{O}_{36}^{\text{OH}}\cdot23\text{H}_2\text{O} \).

Occurrence: Filling cracks in leached pyrite in the oxidized zone of a mineral deposit (Kara-Oba deposit, Kazakhstan); on vein quartz (Krupka, Czech Republic); in a deep oxidation zone of a dolostone-hosted hydrothermal polymetallic ore deposit (Tsumeb, Namibia).

Association: Ferrimolybdate, gypsum, jarosite, hydronica, “limonite”, “opal” (Kara-Oba deposit, Kazakhstan); molybdenite, molybdate, quartz (Krupka, Czech Republic); scorodite, powellite, adamite, gerdtremmelite, wulfenite, hidalgoite, chalcocite, digenite, kaolinite, quartz, hematite (Tsumeb, Namibia).

Distribution: In the Kara-Oba Mo–W deposit, Bet-Pak-Dal Desert, central Kazakhstan. 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.

Type Material: A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 62532, 62533.