

Betpakdalite-CaCa

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals are short prismatic, with $\{hk0\}$ 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 $D(\text{meas.}) = 2.98\text{--}3.05$
 $D(\text{calc.}) = 2.913$

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

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

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:	(1)		(2)	
	MoO ₃	50.24	53.15	CaO
As ₂ O ₅	14.86	9.23	H ₂ O	19.00
Fe ₂ O ₃	11.70	10.65	Total	99.94
				100.01

(1) Kara-Oba deposit, Kazakhstan; wet chemical and DTA analyses. (2) Do.; normalized electron microprobe analysis, H₂O calculated, total includes Na₂O (0.25), K₂O (0.25), CuO (0.05), Al₂O₃ (0.02), SiO₂ (0.06), P₂O₅ (0.03); corresponds to $[(\text{Ca}_{0.74}\text{Na}_{0.17}\text{K}_{0.11})_{\Sigma=1.02}(\text{H}_2\text{O})_{17.98}(\text{Ca}_{0.99}\text{Cu}^{2+}_{0.01})_{\Sigma=1.00}(\text{H}_2\text{O})_6][\text{Mo}_8(\text{As}_{1.74}\text{P}_{0.04}\text{Si}_{0.02})_{\Sigma=1.80}(\text{Fe}^{3+}_{2.89}\text{Al}_{0.01})_{\Sigma=2.90}\text{O}_{32.44}(\text{OH})_{4.56}]$.

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: Ferrimolybdate, gypsum, jarosite, hydromica, “limonite”, “opal” (Kara-Oba deposit, Kazakhstan); molybdenite, molybdate, 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.

References: (1) Yermilova, L.P. and V.M. Senderova (1961) Betpakdalite – a new mineral from the oxidation zone of the Karaoba wolframite deposit. *Zap. Vses. Mineral. Obshch.*, 90, 425–430 (in Russian). (2) (1962) *Amer. Mineral.*, 47, 172–173 (abs. ref. 1). (3) Čech, F. (1962) The yellow molybdate ochre from Krupka in the Krušné Mountains. *Casopis Mineral. Geol.* 7, 195–197. (4) (1962) *Chem. Abs.*, 57, 3093–3094 (abs. ref. 3). (5) Kampf, A.R., S.J. Mills, M.S. Rumsey, M. Dini, W.D. Birch, J. Spratt, J.J. Pluth, I.M. Steele, R.A. Jenkins, and W.W. Pinch (2012) The heteropolymolybdate family: structural relations, nomenclature scheme and new species. *Mineral. Mag.*, 76(5), 1175–1207.