

Carmichaelite

(Ti, Cr)₂O₃(OH)

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Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Crystals rare, pseudohexagonal; pyramidal, also thick tabular on pseudo-{0001}; commonly granular, massive, in beds several m thick. *Twinning:* Polysynthetic twin lamellae can be developed by pressure.

Physical Properties: *Fracture:* Conchoidal. Hardness = 2.5 D(meas.) = 1.602 D(calc.) = 1.598 Soluble in H₂O; deliquescent in high humidity, then dissolving; taste bitter.

Optical Properties: Transparent to translucent. *Color:* Colorless to milk-white, reddish from included hematite scales; rarely yellow or blue; colorless in transmitted light. *Luster:* Greasy, shining.

Optical Class: Biaxial (+). *Orientation:* $X = c$; $Y = b$; $Z = a$. *Dispersion:* $r < v$.
 $\alpha = 1.465\text{--}1.466$ $\beta = 1.474\text{--}1.475$ $\gamma = 1.494\text{--}1.496$ $2V(\text{meas.}) = 70^\circ 03'$ $2V(\text{calc.}) = 66^\circ$

Cell Data: *Space Group:* $Pnna$. $a = 16.119(3)$ $b = 22.472(4)$ $c = 9.551(2)$ $Z = 12$

X-ray Powder Pattern: Locality unknown. (ICDD 24-869).
3.322 (100), 2.932 (95), 3.604 (70), 3.038 (70), 3.555 (55), 2.346 (50), 3.753 (45)

Chemistry:

	(1)	(2)	(3)
K	13.51	14.07	14.07
Mg	8.80	8.80	8.75
Cl	38.16	38.32	38.28
Br		0.12	
H ₂ O	[39.53]	38.38	38.90
insol.		0.04	
Total	[100.00]	99.73	100.00

(1) Königslutter, Lower Saxony, Germany; H₂O by difference. (2) Eddy Co., New Mexico, USA.
(3) KMgCl₃•6H₂O.

Occurrence: Thought to form in saline marine deposits by reaction of pre-existing saline minerals with fluids high in potash.

Association: Kieserite, sylvite, halite, polyhalite, bischofite.

Distribution: Found in many saline marine deposits. At Leopoldshall and Westeregeln, near Stassfurt, Magdeburg district, Germany. From Kalusz, Ukraine. At Maman, Azerbaijan. In Spain, in Barcelona and Lerida Provinces. At Mt. Dallol, Danakil, Ethiopia. From Orzinki, Saratov, Russia. In England, at Aislaby, near Whitby, Yorkshire. In the USA, in New Mexico, in the Carlsbad potash district, Eddy Co., and adjacent parts of Texas; from the Paradox basin, Grand Co., and other places in Utah.

Name: For Rudolph von Carnall (1804–1874), Prussian mining engineer.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 92–94. (2) Schlemper, E.O., P.K. Sen Gupta, and T. Zoltai (1985) Refinement of the structure of carnallite, Mg(H₂O)₆KCl₃. Amer. Mineral., 70, 1309–1313.