Carnotite $K_2(UO_2)_2(V_2O_8)\cdot 1{-}3H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Rarely in crystals, with a diamond-shaped outline, to 2 mm, flattened on {001}; typically in fine aggregates or powdery; disseminated, compact massive. *Twinning:* On {001} as both twin and composition plane.

Physical Properties: *Cleavage:* Perfect on {001}, micaceous. Hardness = Soft. D(meas.) = 4.70 D(calc.) = 4.91 Radioactive.

Optical Properties: Semitransparent. *Color:* Bright yellow to lemon-yellow, may be greenish yellow. *Streak:* Strontian-yellow. *Luster:* Dull, earthy; silky when crystalline. *Optical Class:* Biaxial (–). *Pleochroism:* X = nearly colorless to pale grayish yellow; $Y = Z$ = canary-yellow to lemon-yellow. *Orientation:* $X = c$; $Y = b$; $Z \wedge a \simeq 14°$. *Dispersion:* $r < v$. $\alpha = 1.750$ $\beta = 1.925$ $\gamma = 1.950$ 2V(meas.) = 40°–50°

Cell Data: *Space Group:* $P2_1/a$ (anhydrous synthetic). $a = 10.47(2)$ $b = 8.41(1)$ $c = 6.91(1)$ $\beta = 103°50(5)'$ Z = 2

X-ray Powder Pattern: Olary, Australia.
6.56 (10), 3.12 (7), 3.53 (5), 4.25 (3), 3.25 (3), 2.156 (3), 2.571 (2)

Chemistry:

	(1)	(2)		(1)	(2)
UO_3	62.26	63.41	CaO	0.66	
SO_2	0.26		Na_2O	0.16	
V_2O_5	20.57	20.16	K_2O	10.00	10.44
Fe_2O_3	0.55		H_2O	4.90	5.99
CuO	0.07		insol.	0.04	
MgO	0.30		Total	99.77	100.00

(1) Temple Mountain, Utah, USA. (2) $K_2(UO_2)_2(V_2O_8)\cdot 3H_2O$.

Occurrence: An important ore mineral of uranium, typically in paleochannels in sandstone Colorado Plateau-type U–V deposits, found near fossil carbonaceous matter, and in calcretes and near playas; an alteration product of uraninite, montroseite, or davidite.

Association: Tyuyamunite, metatyuyamunite, volborthite, tangeite, metatorbernite, rossite, hewettite, other U–V oxides, gypsum, barite.

Distribution: Known from hundreds of localities. In the USA, in Colorado, from the Rajah mine, Roc Creek, and many other localities in the Uravan district, along Paradox Valley, Bull Canyon and La Sal Creek, also Gypsum Valley, Montrose Co., the Gateway district, Mesa Co., and the Slick Rock district, San Miguel Co.; in Utah, from the San Rafael Swell, Emery Co., around Thompsons and Richardson, Grand Co.; from mines in the Grants district, McKinley Co., New Mexico; crystallized from the Anderson mine, Yavapai Co., and an ore mineral in Monument Valley, Apache and Navajo Cos., Arizona. In Australia, at El Sherana, Northern Territories; in a large deposit at Yeelirrie, and other smaller deposits in Western Australia; from the Radium Hill mine, near Olary, South Australia. Around Tyuya-Muyun and Uigursai, Fergana Valley, Alai Range, Kyrgyzstan.

Name: To honor Marie-Adolphe Carnot (1839–1920), French mining engineer and chemist.

Type Material: University of Colorado, Boulder, Colorado, 2218; Harvard University, Cambridge, Massachusetts, USA, 106253.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 1043–1045. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 243–247. (3) Appleman, D.E. and H.T. Evans, Jr. (1965) The crystal structures of synthetic anhydrous carnotite, $K_2(UO_2)_2V_2O_8$, and its cesium analogue, $Cs_2(UO_2)_2V_2O_8$. Amer. Mineral., 50, 825–842.