Cheralite $CaTh(PO_4)_2$

Crystal Data: Monoclinic; commonly metamict. *Point Group:* 2/*m.* Subhedral to massive, to 5 cm.

Physical Properties: *Cleavage:* {010} distinct; {100} difficult; {001} a poor parting. Hardness = 5 *Fracture:* Uneven. *Tenacity:* Brittle. D(meas.) = 5.28 D(calc.) = 5.29 Radioactive.

Optical Properties: Semitransparent. *Color:* Pale to dark green, honey- to yellow-brown; pale green or pale brown in transmitted light. *Streak:* White. *Luster:* Resinous or greasy to vitreous. *Optical Class:* Biaxial (+). α = 1.779(2) β = 1.780(2) γ = 1.817(3) 2V(meas.) = 17°-20° 2V(calc.) = 17.9° *Pleochroism:* Faint; *X* = *Y* = green; *Z* = yellowish green. *Orientation: X* = *b*; *Z* /\ *c* = 7°.

Cell Data: *Space Group: P2dn.* *a* = 6.747-6.767 *b* = 6.960-6.975 *c* = 6.453-6.471 β = 103.71°-103.89° Z = 4

X-ray Powder Pattern: Kuttankuli, India.
3.074 (100), 2.862 (65), 3.277 (58), 3.481 (30), 4.167 (25), 2.177 (22), 4.664 (20)

Chemistry:	(1)	(2)		(1)	(2)		(1)	(2)
U_3O_8	4.33		Ce_2O_3	12.12	20.65	Dy_2O_3	0.06	
P_2O_5	27.10	20.20	Pr_2O_3	1.20		Ho_2O_3	0.01	
SiO_2	2.08	6.09	Nd_2O_3	5.91		Er_2O_3	0.03	
ThO_2	31.64	28.20	Sm_2O_3	1.81		Tm_2O_3	0.12	
Al_2O_3		0.29	Eu_2O_3	0.25		Fe_2O_3		1.13
Y_2O_3	0.08	0.94	Gd_2O_3	0.45		PbO	1.15	
La_2O_3	5.19	21.63	Tb_2O_3	0.05		CaO	5.99	0.10
						Total	99.57	99.23

(1) Kuttankuli, India; by electron microprobe, corresponding to $[Th_{0.29}Ca_{0.26}Ce_{0.18}Nd_{0.08}La_{0.08}U_{0.04}Sm_{0.02}Pr_{0.02}Pb_{0.01}Gd_{0.01}(Eu,Y,Tm,Tb,Dy,Er,Ho)_{0.01}]_{\Sigma=0.99}(P_{0.92}Si_{0.08})_{\Sigma=1.00}O_4$. (2) Ratnapura, Sri Lanka; corresponding to $[Ce_{0.32}Th_{0.27}(La,Pr,Nd)_{0.34}Fe_{0.05}Y_{0.02}Al_{0.01}]_{\Sigma=1.01}(P_{0.73}Si_{0.26})_{\Sigma=0.99}O_4$.

Mineral Group: Monazite group.

Occurrence: Disseminated in a kaolinized pegmatite dike and surrounding kaolinized granite gneiss; alluvial (Kuttankuli, India); in a carbonatite (Mt. Weld, Western Australia).

Association: Tourmaline, chrysoberyl, zircon, quartz (Kuttankuli, India).

Distribution: From Kuttankuli (Kuttakuzhi), about 42 km east-southeast of Trivandrum, Kerala State, India. At Ratnapura, Sri Lanka. In the Mt. Weld carbonatite, 35 km south of Laverton, Western Australia. At Binghampton, Broome Co., New York, and in the Uranium King mine, Encampment, Carbon Co., Wyoming, USA.

Name: For *Chera* (Kerala), an ancient Dravidian kingdom predating Travancore (now Kerala State), India.

Type Material: Institute of Geological Sciences, London (MI 28881); The Natural History Museum, London, England (1947,344).

References: (1) Bowie, S.H.U. and J.E.T. Horne (1953) Cheralite, a new mineral of the monazite group. Mineral. Mag., 30, 93-99. (2) (1954) Amer. Mineral., 39, 403 (abs. ref. 1). (3) Linthout, K. (2007) Tripartite division of the system $2REEPO_4$-$CaTh(PO_4)_2$-$2ThSiO_4$, discreditation of brabantite, and recognition of cheralite as the name for members dominated by $CaTh(PO_4)_2$. Can. Mineral., 45, 503-508. (4) Bowles, J.F.W., E.A. Jobbins, and B.R. Young (1980) A re-examination of cheralite. Mineral. Mag., 43, 885-888. (5) Hughes, J.M., E.E. Foord, M.A. Hubbard, and Y. Ni (1995) The crystal structure of cheralite, (Ce, LREE, Ca, Th, U)(P, Si)O_4, a monazite group mineral. Neues Jahrb. Mineral., Monatsh., 344-350. (6) Foord, E.E., J.J. Fitzpatrick, J.G. Crock, and F.E. Lichte (1992) A further re-examination of cheralite, (LREE, Ca, Th, U)(P, Si)O_4, from the type locality: Kuttakuzhi, Trivandrum, Kerala State, India. Trends in Mineral., 1, 103-105.