Clarkeite $(Na, Ca, Pb)(UO_2)O(OH)\cdot 0{-}1H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}\ 2/m$. As dense microcrystalline replacements of uraninite, which may be mineralogically zoned.

Physical Properties: *Fracture:* Conchoidal to splintery. *Tenacity:* Brittle. Hardness = 4–4.5 D(meas.) = 6.29–6.39 D(calc.) = 6.74 Radioactive.

Optical Properties: Opaque, transparent in thin grains. *Color:* Dark brown, mahogany-brown, chocolate-brown, or reddish orange; reddish brown to orange-brown or orange in transmitted light. *Streak:* Yellowish brown. *Luster:* Slightly waxy.
Optical Class: Biaxial (–). *Pleochroism:* Weak; in darker oranges. *Dispersion:* $r < v$, weak.
$\alpha = 1.997$ $\beta = 2.098$ $\gamma = 2.108$ 2V(meas.) = 30°–50°

Cell Data: *Space Group:* $R\overline{3}m$. $a = 3.954(1)$ $c = 17.660(3)$ Z = 3

X-ray Powder Pattern: Fanny Gouge mine, North Carolina, USA.
3.195 (100), 5.903 (64), 3.365 (56), 2.707 (34), 1.9772 (33), 2.945 (28), 1.6410 (23)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
UO_3	81.72	79.9	83.14	MgO	0.28		
SiO_2	0.50		0.03	CaO	2.84	2.1	0.37
UO_2		0.8		SrO			0.29
ThO_2		2.4	0.49	Na_2O	3.44	2.3	7.01
Al_2O_3	0.92			K_2O	0.48		0.42
Y_2O_3			0.82	H_2O^+	3.36	4.2	
RE_2O_3	2.62			H_2O^-		1.3	
Fe_2O_3	0.18			H_2O			[3.47]
PbO	3.71	7.9	3.96	insol.	0.14	0.2	
				Total	100.19	101.1	[100.00]

(1) Spruce Pine, North Carolina, USA. (2) Ajmer district, India. (3) Fanny Gouge mine, North Carolina, USA; by electron microprobe, H_2O by difference; corresponds to $(Na_{0.73}Pb_{0.06}K_{0.03}Ca_{0.02}Y_{0.02}Sr_{0.01}Th_{0.01})_{\Sigma=0.88}(UO_2)_{0.94}O_{0.92}(OH)_{1.08}\cdot 0.07H_2O$.

Occurrence: Replacing uraninite, as a late-stage hydrothermal alteration product.

Association: Uraninite, uranophane, wölsendorfite, fourmarierite, vandendriesscheite, becquerelite, curite, "gummite", quartz.

Distribution: In the USA, in the Spruce Pine district, from the Deer Park and other mines, Mitchell Co., and the Fanny Gouge mine, Yancey Co., North Carolina. In India, from the Ajmer district, Rajputana.

Name: Honors Frank Wigglesworth Clarke (1847–1931), prominent American geochemist of the U.S. Geological Survey.

Type Material: National Museum of Natural History, Washington, D.C., USA, 96510, R6607.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 624–625. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 95–99. (3) Finch, R.J. and R.C. Ewing (1997) Clarkeite: new chemical and structural data. Amer. Mineral., 82, 607–619.