Yttrobetafite-(Y) $(Y,U,Ce)_2(Ti,Nb,Ta)_2O_6(OH)$

Crystal Data: Cubic; metamict. *Point Group:* $[4/m\ \overline{3}\ 2/m]$ (by analogy to betafite). As grains, to 200 μm.

Physical Properties: *Fracture:* [Conchoidal to uneven.] *Tenacity:* [Brittle.]
Hardness = [3–5.5] D(meas.) = 4.90 D(calc.) = 5.05 Radioactive.

Optical Properties: Transparent. *Color:* Greenish to reddish. *Luster:* Dull, greasy on fresh fractures.
Optical Class: Isotropic. n = n.d.

Cell Data: *Space Group:* $[Fd3m.]$ a = n.d. Z = [8]

X-ray Powder Pattern: Alakurtti, Russia; after heating at 900 °C.
1.694 (10), 3.258 (8), 2.985 (7), 2.501 (6), 1.180 (6), 1.631 (3), 1.104 (3)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
UO_3		5.80		Ce_2O_3	6.03	4.01	3.13
WO_3			0.44	RE_2O_3			9.98
U_3O_8	12.84			Fe_2O_3	4.30	4.00	
Nb_2O_5	27.87	36.35	17.67	FeO			5.91
Ta_2O_5	7.73	8.50	1.16	MnO	0.75	1.10	0.20
SiO_2	3.40	3.92		PbO	0.55		8.94
TiO_2	15.20	14.90	22.69	MgO	0.09	0.30	
ZrO_2	0.11		0.26	CaO	2.23	1.66	7.79
ThO_2	1.20	0.90	6.95	$(Na,K)_2O$	0.20	0.34	
UO_2		0.20	4.33	F	0.30		
Al_2O_3	0.86	0.98		H_2O^+	4.47	5.93	
Y_2O_3	10.60	5.12	10.85	H_2O^-	1.20	5.80	
La_2O_3			0.63	$-O = F_2$	0.12		
				Total	99.81	[99.81]	100.93

(1) Alakurtti, Russia. (2) Do.; original total given as 99.88%. (3) Moon; by electron microprobe, total Fe as FeO, average of 13 analyses of several grains; $RE_2O_3 = Sm_2O_3$ 0.76%, Eu_2O_3 0.03%, Gd_2O_3 1.11%, Yb_2O_3 1.38%, remaining RE 6.70%; Fe^{2+}:Fe^{3+} calculated from stoichiometry, then corresponding to $(Ca_{0.61}Y_{0.42}RE_{0.32}Fe^{2+}_{0.25}Pb_{0.18}Th_{0.12}U_{0.07}La_{0.02}Mn_{0.01})_{\Sigma=2.00}(Ti_{1.24}Nb_{0.58}Fe_{0.14}Ta_{0.02}Zr_{0.01}W_{0.01})_{\Sigma=2.00}O_{6.80}$.

Mineral Group: Pyrochlore group, betafite subgroup; $RE_A > 20\%$ (with Y > Ce); $2Ti_B \geq (Nb + Ta)_B$.

Occurrence: In replacement bodies in a quartz-plagioclase-microcline pegmatite (Alakurtti, Russia); in a fragment of granophyre from soil and breccia (Moon).

Association: Yttropyrochlore-(Y), plumbian uranpyrochlore, garnet, fergusonite, columbite (Alakurtti, Russia); potassian feldspar, zircon, apatite, quartz, silica glass (Moon).

Distribution: From Alakurtti, northwestern Karelia, Russia. On the surface of the Moon.

Name: As the YTTRium-dominant *betafite* member of the pyrochlore group.

Type Material: A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, vis337.

References: (1) Kalita, A.P., A.V. Bykova, and M.V. Kukharchik (1962) Varieties of pyrochlore and betafite in pegmatites. Inst. mineral. geokhim. kristallokhim. redkikh. elementov., Trudy, 8, 210–211 (in Russian). (2) Kalita, A.P. (1959) New data on some minerals of the Alakurtti veins. Inst. mineral. geokhim. kristallokhim. redkikh. elementov., Trudy, 2, 164–172 (in Russian). (3) (1964) Amer. Mineral., 49, 440–441 (abs. refs. 1 and 2). (4) Hogarth, D.D. (1977) Classification and nomenclature of the pyrochlore group. Amer. Mineral., 62, 403–410. (5) Meyer, C. and S. V. Yang (1988) Tungsten-bearing yttrobetafite in lunar granophyre. Amer. Mineral., 73, 1420–1425.