

Crystal Data: Monoclinic; hexagonal; orthorhombic; commonly metamict. *Point Group:* 2/m; 32; 2/m 2/m 2/m. Crystals, typically prismatic, elongated along [001], to 5 cm; polytypes are commonly intergrown. *Twinning:* Polysynthetic.

Physical Properties: *Cleavage:* {100}, {010} in traces. *Fracture:* Irregular to conchoidal. *Tenacity:* Brittle. Hardness = 6.5 D(meas.) = 4.017–4.237; 4.77–4.85 D(calc.) = [4.38] Radioactive.

Optical Properties: Opaque, transparent in thin fragments. *Color:* Brown to black; yellowish or brownish in thin section. *Streak:* Brownish yellow to dark brown. *Luster:* Submetallic; adamantine to greasy. *Optical Class:* Isotropic. $n = 2.06$ – 2.17 ; 2.215 (“polymignyte”).

Cell Data: *Space Group:* C2/c or Cc (2M), with $a = 12.431(1)$ $b = 7.224(1)$ $c = 11.483(3)$ $\beta = 100.33(1)^\circ$ $Z = 8$, or *Space Group:* P3₁21 (3T), with $a = 7.287(2)$ $c = 16.886(9)$ $Z = 3$, or *Space Group:* Acam (3O), with $a = 10.148(4)$ $b = 14.147(5)$ $c = 7.278(3)$ $Z = [8]$

X-ray Powder Pattern: Afrikanda massif, Russia; after heating at 1000 °C for two hours; polytypes cannot be distinguished by powder X-ray methods. 2.914 (10), 1.980 (9), 1.792 (9), 2.506 (4), 3.176 (3), 1.517 (1), 1.156 (1)

Chemistry:	(1)	(2)	(1)	(2)	(1)	(2)
U ₃ O ₈	1.53		UO ₂	1.4	MgO	0.45
Nb ₂ O ₅	3.26	15.7	Al ₂ O ₃	1.03	CaO	11.05 12.5
SiO ₂	2.05		RE ₂ O ₃	6.22 0.9	Na ₂ O	0.37
TiO ₂	31.69	22.7	Fe ₂ O ₃	5.49 5.32	H ₂ O	3.35
ZrO ₂	32.84	34.8	FeO	2.28	Total	99.97 99.9
ThO ₂	0.58	4.1	MnO	0.06 0.2		

(1) Afrikanda massif, Russia; LOI taken as H₂O, corresponds to (Ca_{0.76}Ce_{0.15}Na_{0.04}U_{0.02}Th_{0.01})_{Σ=0.98}Zr_{1.03}(Ti_{1.53}Fe_{0.27}Nb_{0.09}Al_{0.08}Mg_{0.04})_{Σ=2.01}O₇. (2) Kaiserstuhl, Germany; by electron microprobe, corresponding to (Ca_{0.85}Th_{0.06}U_{0.02}RE_{0.02})_{Σ=0.95}Zr_{1.08}(Ti_{1.08}Nb_{0.45}Fe_{0.25}³⁺Fe_{0.12}²⁺Mn_{0.01})_{Σ=1.91}O₇.

Polymorphism & Series: Polytypoids 2M, 3T, 3O are known.

Occurrence: In alkaline rocks, as carbonatites, kimberlites, syenites, sanidinites; more rarely in ultramafic rocks; in felsic pegmatite in gabbro; a detrital mineral.

Association: Apatite, clinohumite, phlogopite, richterite, pyrochlore, baddeleyite, perovskite, titanite, pyrrhotite, calcite.

Distribution: In the Afrikanda pyroxenite massif, Kola Peninsula, Russia. At Fredriksvärn, and Agnes Sandefjord, Vestfold, Norway. In the Kaiserstuhl carbonatite, Baden-Württemberg, Germany. From Monte di Procida, Campi Flegrei, Campania, Italy. In the Laouni intrusive, 250 km south of Tamanrasset, Algeria. In Sri Lanka, from Walaweduwa; in the Alupola stream, Bambarabotuwa district; and elsewhere in Sabaragamuwa Province. In some basalt samples from the Moon.

Name: As a ZIRCONium-bearing mineral.

Type Material: A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 59249–59251, vis6008, vis6012, vis6018.

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References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 764–766 [polymignyte]; 741–742 [unnamed mineral]. (2) Borodin, L.S., I.I. Nazarenko, and T.L. Richter (1956) On a new mineral zirconolite – a complex oxide of AB_3O_7 type. Doklady Acad. Nauk SSSR, 110, 845–848 (in Russian). (3) (1957) Amer. Mineral., 42, 581–582 (abs. ref. 2). (4) Sinclair, W. and R.A. Eggleton (1982) Structure refinement of zirkelite [zirconolite] from Kaiserstuhl, Germany. Amer. Mineral., 67, 615–620. (5) Mazzi, F. and R. Munno (1983) Calciobetafite (new mineral of the pyrochlore group) and related minerals from Campi Flegrei, Italy; crystal structures of polymignyte and zirkelite: comparison with pyrochlore and zirconolite. Amer. Mineral., 68, 262–276. (6) Bayliss, P., F. Mazzi, R. Munno, and T.J. White (1989) Mineral nomenclature: zirconolite. Mineral. Mag., 53, 565–569 [polymignite = zirconolite].