Calzirtite $Ca_2Zr_5Ti_2O_{16}$

Crystal Data: Tetragonal. *Point Group:* $4/m\ 2/m\ 2/m$. Single crystals exhibit a prismatic dipyramidal habit; commonly in complex pseudotrapezohedral trillings, outwardly similar to garnet crystals, or with deep re-entrants, to 5 mm. *Twinning:* Cyclic, on an unknown law.

Physical Properties: *Cleavage:* Two partings at ∼80°. *Tenacity:* Brittle. Hardness = 6–7 VHN = 626–1035 D(meas.) = 4.90–5.01 D(calc.) = [5.15] Wavy red cathodoluminescence.

Optical Properties: Transparent. *Color:* Light brown, dark brown to nearly black, light green to brownish green, reddish brown in thin fragments; light gray in reflected light, internal reflections reddish brown; variegated brown in thin section. *Streak:* Brown. *Luster:* Semimetallic to adamantine, greasy on fractures.
Optical Class: Uniaxial (+). $\omega = 2.19$–2.27 $\epsilon = 2.26$–2.36 *Anisotropism:* Pronounced.

Cell Data: *Space Group:* $I4_1/acd$. $a = 15.094(2)$ $c = 10.043(2)$ $Z = 8$

X-ray Powder Pattern: Ozernyi massif, Russia.
2.945 (10), 1.801 (10), 1.537 (9), 1.170 (7), 2.552 (6), 0.9807 (6), 0.8597 (6)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
Nb_2O_5	0.10	1.58		Fe_2O_3	1.64	0.75	
SiO_2	0.41	0.80		CaO	11.26	12.22	12.63
TiO_2	16.04	17.62	17.99	H_2O			
$ZrO_2 + HfO_2$	70.56	66.09	69.38	P_2O_5		0.05	
$RE + ThO_2$		0.15		LOI	0.17	0.65	
				Total	100.18	99.91	100.00

(1) Ozernyi massif, Russia; corresponds to $Ca_{1.81}Zr_{5.16}(Ti,Fe)_2O_{16}$. (2) Kugda massif, Russia; Fe_2O_3 includes FeO, ZrO_2 includes HfO_2; corresponds to $(Ca_{1.82}Ce_{0.02})_{\Sigma=1.84}(Zr_{4.79}Ti_{0.28})_{\Sigma=5.07}(Ti_{1.69}Nb_{0.11}Si_{0.11}Fe_{0.09})_{\Sigma=2.00}O_{16.00}$. (3) $Ca_2Zr_5Ti_2O_{16}$.

Occurrence: A characteristic accessory mineral in alkalic and ultramafic complexes associated with carbonatites; typically found in residual soils and alluvium.

Association: Forsterite, pyroxene, calcite, magnetite, phlogopite, niobian perovskite, apatite, rutile, anatase, baddeleyite, zirconolite.

Distribution: In Russia, from the Ozernyi massif, near Lake Gornoye, Aldan, Sakha; in the Guli ultrabasic pluton, and the Kugda, Magan, and Odikhincha massifs, between the Maimecha and Kotui rivers, far northern Siberia; in the Tazheranskii alkalic massif, west of Lake Baikal, eastern Siberia; and the Seblyavr pluton, Kola Peninsula. Found near Chiesa, Val Malenco, Lombardy, Italy. In the Kaiserstuhl, Baden-Württemberg, Germany. From the Jacupiranga carbonatite, São Paulo, Brazil. In the Bukusu carbonatite complex, southeastern Uganda.

Name: For CALcium and ZIRconium in its composition.

Type Material: A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 61743, 62363.

References: (1) Zdorik, T.B., G.A. Sidorenko, and A.V. Bykova (1961) A new calcium titanozirconate – calzirtite. Doklady Acad. Nauk SSSR, 137, 681–684 (in Russian). (2) Pyatenko, Y.A. and Z.V. Pudovkina (1961) The crystal structure of calzirtite – a new derivative of the structural type of CaF_2-CeO_2. Kristallografiya (Sov. Phys. Crystal.), 6, 196–199 (in Russian). (3) (1961) Amer. Mineral., 46, 1515 (abs. refs. 1 and 2). (4) Vlasov, K.A., Ed. (1966) Mineralogy of rare elements, v. II, 340–341. (5) Bulakh, A.G., G.F. Anastasenko, and L.M. Dakhiya (1967) Calzirtite from carbonatites of northern Siberia. Amer. Mineral., 52, 1880–1885. (6) Zhabin, A.G., Z.V. Pudovkina, and A.V. Bykova (1962) Calzirtite from the carbonatites of the Guly ultrabasic intrusion in Polar Siberia. Doklady Acad. Nauk SSSR, 146, 1399–1400 (in Russian). (7) Sinclair, W., R.A. Eggleton, and G.M. McLaughlin (1986) Structure refinement of calzirtite from Jacupiranga, Brazil. Amer. Mineral., 71, 815–818.