Titanite $CaTiSiO_5$

Crystal Data: Monoclinic; may be metamict. *Point Group:* $2/m$. Crystals wedge-shaped, flattened ∥ {001} or prismatic by extension along [110], to 16 cm; compact, massive.
Twinning: On {100}, contact and penetration; less commonly lamellar on {221}.

Physical Properties: *Cleavage:* Good on {110}; parting due to twinning on {221}.
Hardness = 5–5.5 D(meas.) = 3.48–3.60 D(calc.) = [3.53]

Optical Properties: Transparent to opaque. *Color:* Black, brown, gray, colorless, green, yellow, red; colorless to yellow or brown in thin section. *Streak:* White. *Luster:* Adamantine to resinous.
Optical Class: Biaxial (+). *Pleochroism:* Distinct when deeply colored; X = nearly colorless; Y = yellow to green; Z = red to yellow-orange. *Orientation:* $Z \wedge c = 51°$. *Dispersion:* $r > v$, strong. $\alpha = 1.843–1.950$ $\beta = 1.870–2.034$ $\gamma = 1.943–2.110$ 2V(meas.) = 17°–40°

Cell Data: *Space Group:* $P2_1/a$ or $A2/a$. $a = 7.057$ $b = 8.707$ $c = 6.555$ $\beta = 113.81°$
Z = 4

X-ray Powder Pattern: "Tyrol," Switzerland (?). (ICDD 11-142).
3.233 (100), 2.989 (90), 2.595 (90), 2.058 (40), 1.643 (40), 1.494 (40), 1.418 (40)

Chemistry:

	(1)	(2)
SiO_2	30.61	30.75
TiO_2	39.43	30.39
Al_2O_3	0.09	4.93
RE_2O_3		1.22
Fe_2O_3	1.14	2.92
Nb_2O_5		1.0
CaO	28.57	27.96
F	0.00	2.27
$-O = F_2$		0.95
Total	99.84	100.49

(1) Goschener Alp, Switzerland; by electron microprobe, total Fe as Fe_2O_3; corresponding to $Ca_{1.00}(Ti_{0.97}Fe^{3+}_{0.03})_{\Sigma=1.00}Si_{1.00}O_{4.96}$. (2) Pierceville [*sic*], New York, USA; by electron microprobe, total Fe as Fe_2O_3, F by ion microprobe; corresponding to $(Ca_{0.97}Nb_{0.01}RE_{0.01})_{\Sigma=0.99}(Ti_{0.74}Al_{0.19}Fe^{3+}_{0.07})_{\Sigma=1.00}Si_{1.00}O_{4.91}F_{0.23}$.

Occurrence: A common accessory mineral in intermediate and felsic plutonic rocks, pegmatites, and alpine veins. In gneisses, schists, and some skarns; rarely detrital.

Association: Albite, chlorite, epidote, apatite, allanite, monazite, magnetite, ilmenite, nepheline, biotite, diopside, calcite.

Distribution: Fine specimens from: in Switzerland, at Tavetsch, Graubünden; St. Gotthard, Ticino; Zermatt, Valais, and elsewhere. At Val Maggia and St. Marcel, Val d'Aosta, Italy. In Austria, in the Schwartzenstein and Rothenkopf Mountains, Zillertal, Tirol. From Arendal, Norway. At Nordmark, Värmland, Sweden. From the Lovozero and Khibiny massifs, Kola Peninsula, and large crystals in the Dodo mine, about 100 km west-northwest of Saranpaul, Subpolar Ural Mountains, Russia. In the USA, at the Tilly Foster mine, Brewster, Putnam Co., at Diana, Lewis Co., Natural Bridge, Jefferson Co., and Monroe, Orange Co., New York. In Canada, at Eganville and on Turner's Island, in Lake Clear, Renfrew Co., Ontario, and at Litchfield, Quebec. In Mexico, from Baja California, at El Rodeo, La Huerta, and Piño Solo. From Campo do Boa, Capelinha, Minas Gerais, Brazil. At Naevatanana and Ambalavaokely, Madagascar.

Name: For TITANium in its composition.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 712–716, 717 [keilhauite]. (2) Deer, W.A., R.A. Howie, and J. Zussman (1982) Rock-forming minerals, (2nd edition), v. 1A, orthosilicates, 443–466. (3) Oberti, R., D.C. Smith, G. Rossi, and F. Caucia (1991) The crystal-chemistry of high-aluminum titanites. Eur. J. Mineral., 3, 777–792.