Zinnwaldite $KLiFe^{2+}Al(AlSi_3)O_{10}(F,OH)_2$

Crystal Data: Monoclinic; rarely hexagonal. *Point Group:* m. Well-formed short prismatic or tabular crystals, pseudohexagonal, to 20 cm. In rosettes or fan-shaped groups; lamellar or scaly aggregates; disseminated. *Twinning:* On composition plane {001}, twin axis [310].

Physical Properties: *Cleavage:* {001}, perfect. *Tenacity:* Laminae flexible, elastic. Hardness = 2.5–4 D(meas.) = 2.90–3.02 D(calc.) = 2.831

Optical Properties: Transparent to translucent. *Color:* Gray-brown, yellow-brown, pale violet, dark green, color zoning common; colorless to light brown in thin section. *Luster:* Vitreous, pearly on cleavage.
Optical Class: Biaxial (–). *Pleochroism:* Distinct; X = colorless to yellow-brown; Y = gray-brown; Z = colorless to gray-brown. *Orientation:* $Y = b$; $X \wedge a = 88°–90°$; $Z \wedge a = 0°–2°$. *Dispersion:* $r > v$, weak. *Absorption:* $Z > Y > X$. $\alpha = 1.535–1.558$ $\beta = 1.570–1.589$ $\gamma = 1.572–1.590$ 2V(meas.) = 0°–40°

Cell Data: *Space Group:* $C2$ (1M). $a = 5.296(1)$ $b = 9.140(2)$ $c = 10.096(3)$ $\beta = 100.83(2)°$ Z = 2

X-ray Powder Pattern: Cínovec, Czech Republic, 1M; resembles siderophyllite. 3.29 (100), 9.82 (82), 1.98 (54), 3.085 (38), 3.34 (36), 2.89 (32), 2.59 (30)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	46.74	40.70	Li_2O	3.72	2.19
TiO_2	0.00	0.20	Na_2O	0.54	0.36
Al_2O_3	21.78	21.95	K_2O	10.37	9.29
Fe_2O_3	1.19	2.85	F	7.54	5.67
FeO	10.22	12.19	H_2O^-		0.96
MnO	0.37	0.70	H_2O	0.89	
MgO	0.00	0.04	$-O = F_2$	3.17	[2.39]
CaO	0.00	0.00	Total	100.19	[94.71]

(1) Cínovec, Czech Republic; corresponds to $(K_{0.92}Na_{0.07})_{\Sigma=0.99}Li_{1.04}(Fe^{2+}_{0.60}Fe^{3+}_{0.06}Mn^{2+}_{0.04})_{\Sigma=0.70}Al_{1.05}(Si_{3.26}Al_{0.74})_{\Sigma=4.00}O_{10}[F_{1.66}(OH)_{0.41}]_{\Sigma=2.07}$. (2) Sadisdorf, Saxony, Germany; by electron microprobe, Li_2O and Fe^{2+}:Fe^{3+} by wet chemical analysis; corresponds to $(K_{0.90}Na_{0.05})_{\Sigma=0.95}Li_{0.67}(Fe^{2+}_{0.77}Fe^{3+}_{0.16}Mn_{0.04}Mg_{0.01}Ti_{0.01})_{\Sigma=0.99}Al_{1.05}(Si_{3.09}Al_{0.91})_{\Sigma=4.00}O_{10}[F_{1.21}(OH)_{0.79}]_{\Sigma=2.00}$.

Polymorphism & Series: 1M, $2M_1$, 3A polytypes.

Mineral Group: Mica group.

Occurrence: In tin-bearing pneumatolytic deposits in greisen; more rarely in granites, granite pegmatites, and high-temperature quartz veins.

Association: Topaz, cassiterite, wolframite, lepidolite, spodumene, beryl, tourmaline, fluorite.

Distribution: Numerous localities. From Cínovec (Zinnwald), Czech Republic. At Altenberg, Saxony, and Waldstein, Bavaria, Germany. From Törda l, Norway. Around St. Just, Cornwall, England. From Antaboaka and Ambatofinandrahana, Madagascar. In the USA, at Amelia, Amelia Co., Virginia; from the Pala district, San Diego Co., and Crestmore, Riverside Co., California; in the Black Hills, around Keystone, Pennington Co., South Dakota. From the York district, Seward Peninsula, Alaska. At Narssârssuk and on the Kangerdluarssuk Plateau, in the Ilímaussaq intrusion, southern Greenland. From Kurobera, Yamanashi Prefecture, and in the Naegi district, Gifu Prefecture, Japan.

Name: For the locality Cínovec (Zinnwald), Czech Republic.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 626–627. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 3, sheet silicates, 92–94. (3) Cundy, E.K., W. Windle, and I.H. Warren (1963) The occurrence of zinnwaldite in Cornwall. Clay Minerals Bull., 5, 151–156. (4) Guggenheim, S. and S.W. Bailey (1977) The refinement of zinnwaldite-1M in subgroup symmetry. Amer. Mineral., 62, 1158–1167.