## Kainosite-(Y) $Ca_2(Y,Ce)_2Si_4O_{12}(CO_3)\cdot H_2O$



**Crystal Data:** Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Crystals short, equant, to slender, prismatic, elongated along [001], up to 2 cm; most crystals display a granular core. Also as sheaflike aggregates of crystals.

**Physical Properties:** *Cleavage:* Good on {110}. *Fracture:* Subconchoidal. *Tenacity:* Brittle. Hardness = 5–6 D(meas.) = 3.52 D(calc.) = 3.542

**Optical Properties:** Transparent to translucent. *Color:* Colorless, white, straw-yellow, yellow-brown, chestnut-brown, may be tipped with rose or pink. *Luster:* Vitreous to resinous. *Optical Class:* Biaxial (–). *Orientation:* $X = c$; $Y = b$; $Z = a$. $\alpha$ = 1.662–1.665 $\beta$ = 1.682–1.689 $\gamma$ = 1.687–1.691 2V(meas.) = 40° 2V(calc.) = 49.5°

**Cell Data:** *Space Group: Pmnb.* $a = 13.011(1)$ $b = 14.310(1)$ $c = 6.757(1)$ Z = 4

**X-ray Powder Pattern:** Bancroft, Canada.
6.52 (100), 2.764 (100), 3.29 (80), 3.19 (75), 3.45 (70), 2.170 (70), 1.929 (60)

**Chemistry:**

| | (1) | (2) | | (1) | (2) |
|---|---|---|---|---|---|
| $SiO_2$ | 35.24 | 34.55 | CaO | 16.78 | 16.69 |
| $TiO_2$ | 0.02 | | $Na_2O$ | 0.04 | |
| $ThO_2$ | 0.03 | | $K_2O$ | 0.01 | |
| $Al_2O_3$ | 1.20 | 1.02 | $H_2O^+$ | 2.59 | [2.68] |
| $Y_2O_3$ | 25.27 | 25.63 | $H_2O^-$ | 0.06 | |
| $RE_2O_3$ | 12.62 | 12.65 | $CO_2$ | 4.60 | 6.55 |
| $Fe_2O_3$ | 0.57 | 0.23 | $FeS_2$ | 0.98 | |
| | | | Total | 100.01 | [100.00] |

(1) Bancroft, Canada; RE and Th by XRF, Fe reported as $Fe_2O_3$ above that required to form pyrite with S 0.52%; $RE_2O_3 = Ce_2O_3$ 0.38%, $Nd_2O_3$ 0.19%, $Sm_2O_3$ 0.27%, $Gd_2O_3$ 2.44%, $Dy_2O_3$ 3.10%, $Er_2O_3$ 3.53%, $Yb_2O_3$ 2.71%; corresponds to $Ca_{2.02}(Y_{1.50}RE_{0.50})_{\Sigma=2.00}(Si_{4.02}Al_{0.08})_{\Sigma=4.10}O_{12}(CO_3)_{0.70}\cdot 1.93H_2O$. (2) Baveno, Italy; Ca, Y, RE by gamma-ray spectrometry, Si, Al, Fe by AA, $CO_2$ by gas volumetric analysis, $H_2O$ by difference; $RE_2O_3 = La_2O_3$ 0.24%, $Ce_2O_3$ 0.39%, $Pr_2O_3$ 0.09%, $Nd_2O_3$ 0.20%, $Sm_2O_3$ 0.29%, $Eu_2O_3$ 0.08%, $Tb_2O_3$ 0.68%, $Ho_2O_3$ 0.22%, $Tm_2O_3$ 0.20%, $Lu_2O_3$ 0.21%, $Gd_2O_3$ 1.89%, $Dy_2O_3$ 3.08%, $Er_2O_3$ 2.65%, $Yb_2O_3$ 2.71%; corresponds to $Ca_2(Y_{1.53}RE_{0.45}Fe_{0.02})_{\Sigma=2.00}Si_{3.87}O_{12}(CO_3)\cdot H_2O$.

**Occurrence:** In vugs in pegmatites in granites and alkalic complexes.

**Association:** Chamosite, pyrite, quartz, calcite, sphalerite, fluorite, uraninite, zircon, molybdenite (Bancroft, Canada); diopside, magnetite, clinochlore, apatite (Nordmark, Sweden).

**Distribution:** At Igeltjern, on Hitterö Island, Flekkefjord, Norway. In the Ko mine, Nordmark, Värmland, Sweden. In Switzerland, at Grubhorn, Baltschiedertal, Valais; near Guttannen, Uri; Piz Gannaretsch, Val Curnera, in the Gotthard freeway tunnel, Ticino; at Tavetsch, Graubünden; and elsewhere. From Hopffeldboden, in the Obersulzbachtal, Salzburg, Austria. At Baveno, Piedmont, Italy. In the Dodo mine, about 100 km west-northwest of Saranpaul, Subpolar Ural Mountains, Russia. In the USA, from near Cotopaxi, Fremont Co., Colorado; in Washington Pass, Okanogan Co., Washington; and east of Porthill, Boundary Co., Idaho. In Canada, from North Burgess Township, Lanark Co., and from the Bicroft mine, near Bancroft, Ontario; in the Evans-Lou quarry, near Wakefield Lake, and at Mont Saint-Hilaire, Quebec; and in a commercial deposit at the Strange Lake complex, northern Quebec and Labrador, Newfoundland.

**Name:** From the Greek for *unusual*, for its rarity and exotic composition.

**References:** (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 698.
(2) Vlasov, K.A., Ed. (1966) Mineralogy of rare elements, v. II, 246–247. (3) Pouliot, G., J.A. Maxwell, and S.C. Robinson (1964) Cenosite from Bancroft, Ontario. Can. Mineral., 8, 1–10.
(4) Giuseppetti, G., C. Tadini, and M. Oddone (1989) Cenosite-(Y) from Baveno, Novara (Italy): crystal structure. Neues Jahrb. Mineral., Monatsh., 153–164.