Sabinaite $Na_4Zr_2TiO_4(CO_3)_4$

Crystal Data: Monoclinic, pseudo-orthorhombic. *Point Group:* $2/m$. Flaky to blocky crystals, {001}, {010}, {100}, {110}, to 0.4 mm, with irregular pseudohexagonal outlines, in compact chalky aggregates and powdery coatings.

Physical Properties: *Cleavage:* Perfect on {001}; distinct on {100}. Hardness = n.d. D(meas.) = 3.36 D(calc.) = 3.44–3.48

Optical Properties: Transparent. *Color:* Colorless. *Luster:* Vitreous, silky in aggregates *Optical Class:* Biaxial (–) or (+). *Orientation:* $Y = b$; $X \wedge c = 13°$. *Dispersion:* $r > v$, moderate. $\alpha = 1.72$–1.74 $\beta = 1.79$–1.80 $\gamma = 1.85$–[1.90] 2V(meas.) = 82°–85°

Cell Data: *Space Group:* $C2/c$. $a = 10.196(1)$ $b = 6.616(1)$ $c = 17.958(3)$ $\beta = 94.14(1)°$ Z = 4

X-ray Powder Pattern: Mont Saint-Hilaire, Canada.
8.96 (100), 3.251 (50), 2.990 (50), 2.017 (45), 2.239 (40), 1.795 (35), 4.48 (25)

Chemistry:

	(1)	(2)	(3)
CO_2	27.1	[27.56]	28.11
TiO_2	12.0	10.91	12.75
ZrO_2	39.1	40.64	39.35
HfO_2	0.47	0.45	
CaO	0.2	0.02	
Na_2O	20.7	19.53	19.79
Total	99.57	[99.11]	100.00

(1) Francon quarry, Canada; by electron microprobe, TiO_2, ZrO_2, HfO_2 by neutron activation, CO_2 determined by wet methods and confirmed by IR; corresponds to $(Na_{4.18}Ca_{0.02})_{\Sigma=4.20}(Zr_{1.99}Hf_{0.01})_{\Sigma=2.00}Ti_{0.94}O_{4.14}(CO_3)_{3.86}$. (2) Mont Saint-Hilaire, Canada; by electron microprobe, average of five analyses of one crystal, CO_2 calculated for stoichiometry; corresponds to $Na_{4.02}(Zr_{1.99}Hf_{0.01})_{\Sigma=2.00}(Ti_{0.87}Zr_{0.12})_{\Sigma=0.99}O_4(CO_3)_4$. (3) $Na_4Zr_2TiO_4(CO_3)_4$.

Occurrence: A rare mineral in vugs in a silicocarbonatite sill (Francon quarry, Canada); in cavities in sodalite syenite associated with an intrusive alkalic gabbro-syenite complex (Mont Saint-Hilaire, Canada).

Association: Calcite, dawsonite, weloganite, cryolite, pyrite, galena, barite, ilmenorutile, ankerite, siderite, quartz (Francon quarry, Canada); albite, microcline, dawsonite, analcime, sodalite, pectolite, dolomite, aegirine (Mont Saint-Hilaire, Canada).

Distribution: From the Francon quarry, Montreal Island, Montreal, and at Mont Saint-Hilaire, Quebec, Canada.

Name: To honor Ann Phyllis Sabina Stenson (1930–), mineralogist, Geological Survey of Canada, who collected sufficient of the mineral to allow its characterization.

Type Material: National School of Mines, Paris, France; Canadian Geological Survey, Ottawa, 61017–61024; Royal Ontario Museum, Toronto, Canada, M35902; National Museum of Natural History, Washington, D.C., USA, 145916.

References: (1) Jambor, J.L., B.D. Sturman, and G.C. Weatherly (1980) Sabinaite, a new anhydrous zirconium-bearing carbonate mineral from Montreal Island, Quebec. Can. Mineral., 18, 25–29. (2) (1981) Amer. Mineral., 66, 1277 (abs. ref. 1). (3) Chao, G.Y. and G. Jiexiang (1985) Sabinaite: a new occurrence and new data. Can. Mineral., 23, 17–19. (4) McDonald, A.M. (1996) The crystal structure of sabinaite, $Na_4Zr_2TiO_4(CO_3)_4$. Can. Mineral., 34, 811–815.