Garrelsite $Ba_3NaSi_2B_7O_{16}(OH)_4$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals steep dipyramidal, prismatic, to 3 mm, bounded by {110}, {1$\bar{1}$0}, {21$\bar{1}$}, and {2$\bar{1}\bar{1}$}; commonly striated.

Physical Properties: *Cleavage:* Perfect on {001}. Hardness = ~6 D(meas.) = 3.68 D(calc.) = 3.89

Optical Properties: Transparent. *Color:* Colorless. *Streak:* White. *Luster:* Vitreous. *Optical Class:* Biaxial. *Orientation:* $Y = b$; $Z \wedge [101]$ (the edge of the {$\bar{1}$11} form) = 33°; one optic axis is nearly normal to this edge. $\alpha = 1.620(3)$ $\beta = 1.633(3)$ $\gamma = 1.640(3)$ 2V(meas.) = 53°–57°

Cell Data: *Space Group:* $C2/c$. $a = 14.639(3)$ $b = 8.466(2)$ $c = 14.438(3)$ $\beta = 114.21(2)°$ Z = 4

X-ray Powder Pattern: Uintah Co., Utah, USA.
3.05 (100), 3.64 (80), 2.026 (60), 2.873 (45), 2.757 (45), 6.13 (30), 4.23 (30)

Chemistry:

	(1)	(2)	(3)
SiO_2	14.6	13.49	13.49
B_2O_3	24.0		27.35
MgO	1.2		
CaO	7.7		
BaO	46.1	51.41	51.64
Na_2O		3.50	3.48
H_2O	[5.9]		4.04
rem.	0.06		
Total	[99.56]		100.00

(1) Uintah Co., Utah, USA; contains visible impurities, original total given as 100.1%, H_2O by loss on ignition, remainder is trivalent oxides. (2) Do.; by electron microprobe, partial analyses on pure material, Na by AA. (3) $Ba_3NaSi_2B_7O_{16}(OH)_4$.

Occurrence: Of authigenic origin, in dolomitic shale in drill core from the Green River Formation (Uintah Co., Utah, USA).

Association: Nahcolite, shortite, searlesite, wurtzite (Uintah Co., Utah, USA).

Distribution: In the USA, from several drill holes in Uintah Co., Utah; in the Kramer borate deposit, Kern Co., and at Searles Lake, San Bernardino Co., California.

Name: For Professor Robert Minard Garrels (1916–1988), American geochemist and educator.

Type Material: n.d.

References: (1) Milton, C., J.M. Axelrod, and F.S. Grimaldi (1955) New mineral, garrelsite $(Ba_{.65}Ca_{.29}Mg_{.06})_4H_6Si_2B_6O_{20}$, from the Green River Formation, Utah. Bull. Geol. Soc. Amer., 66, 1597 (abs.) (2) Milton, C. and A. Pabst (1974) Garrelsite, $NaBa_3Si_2B_7O_{16}(OH)_4$ from the Green River Formation of Utah. J. Res. U.S. Geol. Sur., 2, 213–218. (3) Ghose, S., C. Wan, and H.H. Ulbrich (1976) Structural chemistry of borosilicates. I. Garrelsite $NaBa_3Si_2B_7O_{16}(OH)_4$: a silicoborate with the pentaborate $[B_5O_{12}]^{9-}$ polyanion. Acta Cryst., 32, 824–832.