Calamaite $Na_2TiO(SO_4)_2 \cdot 2H_2O$

Crystal Data: Orthorhombic. *Point Group*: 2/*m* 2/*m* 2/*m*. As acicular to hair-like crystals, to 2mm, combined in bunches or radial spherulitic clusters to 4 mm. Rarely as prismatic crystals to 3 mm, elongated on [001]. *Twinning*: Common, cross-like interpenetration twins by 90° rotation || [001].

Physical Properties: *Cleavage*: Good on (001), assumed based on structure data.
Fracture: Uneven to stepped. *Tenacity*: Brittle. Hardness = ~3 D(meas.) = n.d. D(calc.) = 2.45

Optical Properties: Transparent. *Color*: Colorless to white (aggregates). *Streak*: n.d.
Luster: Vitreous.
Optical Class: Biaxial (+). α = 1.557(2) β = 1.562(2) γ = 1.671(3) 2V(meas.) = 30(10)°
2V(calc.) = 25° *Dispersion*: None observed. *Orientation*: *XZ* is coplanar to cleavage; if cleavage is on (100), then *Y* = *a*. *Extinction*: Straight. *Elongation*: Positive.

Cell Data: Space Group: *Ibam*. *a* = 16.0989(11) *b* = 16.2399(9) *c* = 7.0135(4) Z = 8

X-ray Powder Pattern: Alcaparrosa mine, Calama, El Loa province, Antofagasta region, Chile.
8.10 (100), 5.04 (55), 3.417 (27), 3.787 (26), 2.943 (20), 2.895 (20), 3.619 (18)

Chemistry:

	(1)	(2)
Na_2O	18.21	18.34
K_2O	0.06	
Fe_2O_3	1.58	
TiO_2	21.80	23.64
SO_3	48.25	47.36
H_2O	[10.74]	10.66
Total	100.73	100.00

(1) Alcaparrosa mine, Calama, El Loa province, Antofagasta region, Chile; average of 8 electron microprobe analyses supplemented by FTIR spectroscopy, Fe^{3+} determined from color reactions with potassium hexaferricyanide and potassium hexaferrocyanide, H_2O calculated from structure analysis; corresponds to $Na_{1.97}(Ti_{0.92}Fe^{3+}_{0.07})_{\Sigma=0.99}S_{2.02}O_9 \cdot 2H_2O$. (2) $Na_2TiO(SO_4)_2 \cdot 2H_2O$.

Occurrence: A secondary mineral in the weathering zone of a pyrite deposit. The result of the oxidation of pyrite under the extremely arid conditions of the Atacama Desert.

Association: Coquimbite, römerite, metavoltine, tamarugite, halotrichite, szomolnokite, rhomboclase, ferrinatrite, krausite.

Distribution: From the Alcaparrosa mine, Calama, El Loa province, Antofagasta region, Chile.

Name: For *Calama* commune and *Calama* city, the capital of El Loa province, where the first specimens were collected.

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (95619).

References: (1) Pekov, I.V., O.I. Siidra, N.V. Chukanov, V.O. Yapaskurt, D.I. Belakovskiy, A.G. Turchkova, and G. Möhn (2018) Calamaite, a new natural titanium sulfate from the Alcaparrosa mine, Calama, Antofagasta region, Chile. Eur. J. Mineral., 30(4), 801-809. (2) (2019) Amer. Mineral., 104(9), 1361-1362 (abs. ref. 1).