

Espadaite**Na₄Ca₃Mg₂[AsO₃(OH)]₂[AsO₂(OH)₂]₁₀(H₂O)₆·H₂O**

Crystal Data: Orthorhombic. *Point Group:* 2/m 2/m 2/m. As blades to ~0.2 mm forming fans, jumbled sprays, and random intergrowths. Blades are flattened on {001}, elongate along [100] and exhibit {001}, {010}, {110}, and {111}.

Physical Properties: *Cleavage:* Perfect on {001}. *Tenacity:* Brittle. *Fracture:* Curved. Hardness = ~2 D(meas.) = 2.73(2) D(calc.) = 2.730 Easily soluble in dilute HCl.

Optical Properties: Transparent. *Color:* Colorless. *Streak:* White. *Luster:* Vitreous. *Optical Class:* Biaxial (-). $\alpha = 1.531(1)$ $\beta = 1.568(1)$ $\gamma = 1.574(1)$ 2V(meas.) = 44(1)° 2V(calc.) = 43.0° *Orientation:* X = c, Y = a, Z = b. *Dispersion:* Very slight, $r < v$. Nonpleochroic.

Cell Data: *Space Group:* Ccca. $a = 12.3649(10)$ $b = 22.181(2)$ $c = 18.3292(13)$ Z = 4

X-Ray Diffraction Pattern: Torrecillas mine, Iquique Province, Tarapacá Region, Chile. 9.26 (100), 3.499 (80), 3.068 (79), 4.118 (73), 4.582 (49), 2.766 (39), 2.710 (39)

Chemistry:	(1)	(2)
Na ₂ O	4.39	[4.95]
CaO	7.89	8.15
MgO	4.24	4.38
As ₂ O ₅	64.60	66.74
H ₂ O	n.d.	[15.78]
Total		100.00

(1) Torrecillas mine, Iquique Province, Tarapacá Region, Chile; average electron microprobe analysis supplemented by Raman spectroscopy. (2) Do.; average electron microprobe analysis supplemented by Raman spectroscopy, Na₂O and H₂O calculated from structure; normalized corresponds to (Na_{0.83}Mg_{0.06}□_{0.11})₄Ca_{3.00}Mg_{2.00}[AsO₃OH]_{1.80}[AsO₂(OH)₂]_{10.20}(H₂O)₆·H₂O.

Occurance: A low-temperature secondary phase on massive quartz-hematite veins and formed under hyperarid conditions from the oxidation of native arsenic, and possibly other As-bearing primary phases by reaction with fluids (derived from fog) rich in dissolved Na, Ca, and Mg.

Association: Camanchacaite, anhydrite, gypsum, halite, talmessite.

Distribution: From the Torrecillas mine, northern Atacama Desert, Salar Grande, Iquique Province, Tarapacá Region, Chile.

Name: From the Spanish, *espada*, for 'sword', in allusion to the shape of the crystals.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (67285).

References: (1) Kampf, A.R., B.P. Nash, A.J. Celestian, M. Dini, and A.A. Molina Donoso (2019) Camanchacaite, chinchorroite, espadaite, magnesiofluckite, picaite and riosecoite: six new hydrogen-arsenate minerals from the Torrecillas mine, Iquique Province, Chile. *Mineral. Mag.*, 83, 655-671.