Calciojohillerite $NaCaMg_3(AsO_4)_3$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As prismatic crystals to 1 cm in bunches, sheaf-like or radial aggregates, typically in crusts.

Physical Properties: *Cleavage*: Imperfect. *Tenacity*: Brittle. *Fracture*: Uneven. Hardness = ~3.5 D(meas.) = n.d. D(calc.) = 3.915

Optical Properties: Transparent. *Color*: Colorless, pale green, pale yellow, light blue, pale lilac or pink. *Streak*: White. *Luster*: Vitreous.
Optical Class: Biaxial (-). $\alpha = 1.719(3)$ $\beta = \gamma = 1.732(3)$ 2V(meas.) = 15(10)° 2V(calc.) = 0°
Dispersion: Medium, $r > v$. *Orientation*: $Y = b$.

Cell Data: *Space Group*: *C*2/*c*. $a = 11.8405(3)$ $b = 12.7836(2)$ $c = 6.69165(16)$ $\beta = 112.425(3)°$ $Z = 4$

X-Ray Diffraction Pattern: Arsenatnaya fumarole, Tolbachik Volcano, Russia.
2.758 (100), 2.735 (25), 3.220 (19), 2.910 (17), 3.509 (16), 1.661 (16), 2.620 (12)

Chemistry:

	(1)	(2)		(1)	(2)
Na_2O	7.32	5.61	Fe_2O_3	3.53	
K_2O	0.10		TiO_2	0.01	
CaO	6.82	10.15	SiO_2	0.03	
MgO	20.31	21.87	P_2O_5	1.25	
MnO	0.68		V_2O_5	0.10	
CuO	0.27		As_2O_5	58.77	62.37
ZnO	0.02		SO_3	0.13	.
Al_2O_3	0.56		Total	99.90	100.00

(1) Arsenatnaya fumarole, Tolbachik Volcano, Kamchatka, Russia; average electron microprobe analysis supplemented by Raman spectroscopy; corresponds to $(Na_{1.30}K_{0.01}Ca_{0.67}Mg_{2.78}Mn_{0.05}Cu_{0.02}Al_{0.06}Fe^{3+}_{0.24})_{\Sigma=5.13}(As_{2.83}P_{0.10}S_{0.01}V_{0.01})_{\Sigma=2.95}O_{12}$. (2) $NaCaMgMg_2(AsO_4)_3$.

Mineral Group: Alluaudite supergroup, alluaudite group - arsenates.

Occurrence: A sublimate at an active volcanic fumarole.

Association: Hematite, tenorite, johillerite, nickenichite, bradaczekite, hatertite, magnesiohatertite, badalovite, aphthitalite-group sulfates, langbeinite, calciolangbeinite, sanidine (As-bearing variety), fluorophlogopite, fluoborite, tilasite, anhydrite, pseudobrookite, rutile, sylvite, halite, lammerite, lammerite-β, urusovite, ericlaxmanite, kozyrevskite, arsmirandite, svabite, popovite, dmisokolovite, shchurovskyite, yurmarinite, krasheninnikovite, euchlorine, wulffite, alumoklyuchevskite, sellaite, gahnite, corundum (shallow zone); badalovite, fluorophlogopite, sanidine, diopside, hematite, cassiterite, anhydrite, metathénardite, belomarinaite, sylvite, tilasite, svabite, arsenowagnerite (medium zone); anhydrite, diopside, hematite, svabite, berzeliite, schäferite, forsterite, magnesioferrite, ludwigite, rhabdoborite-group fluoroborates, powellite, baryte, fluorapatite, udinaite, arsenudinaite, paraberzeliite (deep zone).

Distribution: From the Arsenatnaya fumarole, Second scoria cone, Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik Volcano, Kamchatka, Russia.

Name: The prefix, *calcio*, identifies the calcium analogue of *johillerite*.

Type Material: A.E. Fersman Mineralogical Museum, RAS, Moscow, Russia (95621).

References: (1) Pekov, I.V., N.N. Koshlyakova, A.A. Agakhanov, N.V. Zubkova, D.I. Belakovskiy, M.F. Vigasina, A.G. Turchkova, E.G. Sidorov, and D.Y. Pushcharovsky (2021) New arsenate minerals from the Arsenatnaya fumarole, Tolbachik volcano, Kamchatka, Russia. XV. Calciojohillerite, $NaCaMgMg_2(AsO_4)_3$, a member of the alluaudite group. Mineral. Mag., 85, 215-223.