Bulgakite* and New Data on Nalivkinite


Bulgakite, (IMA 2014-041), ideally Li₂(Ca,Na)F₂+Ti₂(SiO₄)₃(OH)(F,O)(H₂O), is a new astrophyllite-supergroup mineral. It occurs in the moraine of the Darai-Pioz glacier (39°30’N 70°40’E) in the upper Darai-Pioz alkaline massif in the upper reaches of the Darai-Pioz river, in the area of the joint Turekstan, Zeravshan, and Alay Ranges, Tajikistan. The Darai-Pioz massif is a multiphase intrusion and occupies a large synclinal fold of Carboniferous (Pennsylvanian) slates. Rocks of the massif have been infiltrated by fine-grained dikes of biotite tourmaline granites and veins of calcite carbonatites and feldspars. Bulgakite was found in a naturally tumbled amphibole–quartz–feldspar boulder of spotty texture, as individual crystals and intergrowths in small cavities (up to 0.5 cm) and as intergrowths (up to 1 cm) of plagioclase crystals and aggregates of poorly crystallized grains. Associated minerals are alkali amphibole, quartz, microcline, bafertisite, aegirine, calcybeborosilite-(Y), astrophyllite-ribbon, joanneumite, mendeleevite-(Nd), morrisonite, nolzeite, packratite, vanarsite and a new data on nalivkinite.

This New Mineral Names has entries for 10 new minerals, including bulgakite, dyeaesite-(La), eleonorite, gatewayite, joanneumite, mendelevite-(Nd), morrisonite, nolzeite, packratite, vanarsite and a new data on nalivkinite.

The description of bulgakite brought a new development in the crystal chemistry of the astrophyllite-supergroup minerals, the location of an H₂O group in the intermediate (I) block of bulgakite, which required reinvestigation of the crystal structure of nalivkinite, ideally Li₂NaFe⁺Ti₃(SiO₄)₂(OH)₂(OH)₂F (Agakanov et al. 2008; Uvarova et al. 2008). This H₂O group is a ligand of the Li atom at the [6]-coordinated A(2) site. Uvarova et al. (2008) reported [5]-coordinated Li at the A(2) site. In the proposal on bulgakite (IMA 2014-041), the issue of the [6]-coordinated A(2) site in bulgakite was outlined and it
was suggested a revision of the crystal structure of nalivkinite that would result in the following ideal formula: Li$_7$NaFe$_3^+$Ti$_4$(Si$_8$O$_{24}$)(OH)$_2$F (H$_2$O). The proposal was approved by the CNMNC (Agakhanov et al. 2014). An amount of 1.14 H$_2$O pru (at the W site) was calculated to achieve the [6]-coordinated environment of Li [A2] and thus re-calculated the amount of H$_2$O as 4.32 wt%. The presence of H$_2$O groups in the nalivkinite structure was confirmed by infrared spectroscopy. FTIR spectra show sharp absorption peaks that are characteristic of stretching vibrations of OH groups: peaks occur at ~3639 cm$^{-1}$ (with a shoulder at ~3630 cm$^{-1}$) and 3590 cm$^{-1}$ (with a shoulder at ~3600 cm$^{-1}$). A broad band at ~3490 cm$^{-1}$ is attributed to H$_2$O stretches. The H$_2$O bend peak is observed at 1622 cm$^{-1}$. The amount of 4.32 wt% of H$_2$O calculated from crystal-structure analysis was added to the analysis published by Uvarova et al. (2008): SiO$_2$ 36.11, Al$_2$O$_3$ 0.58, Na$_2$O 1.88, K$_2$O 2.68, CaO 0.93, C$_{tot}$ 1.24, MgO 0.11, ZnO 0.23, FeO 30.84, MnO 4.86, BPO 0.39, TiO$_2$ 9.48, NbO$_2$ 2.40, TaO$_2$ 0.61, ZrO$_2$ 1.47, SnO$_2$ 0.89, F 1.45, Li$_2$O 1.30 (ICP-OES), Rh$_2$O n.d., F = 0.61, total 106.16 wt%. The revised empirical formula of nalivkinite is based on 32.14 (O+OH+F+H$_2$O) pfu: (Li$_{13.360(6)}$K$_{0.75}$Cs$_{0.03}$Ba$_{0.02}$Ca$_{0.01}$Sr$_{0.01}$Mg$_{0.00}$Fe$_{0.03}$Na$_{0.01}$)$_6$Ti$_{20.23}$Si$_{8}$V$_{7.86}$Fe$_{0.15}$Mn$_{0.08}$O$_{1.88}$, K$_{0.75}$Cs$_{0.09}$Sr$_{0.01}$Fe$_{0.04}$Ca$_{0.02}$Mg$_{0.04}$Na$_{0.02}$O$_{2.40}$ (PO$_4$)$_6$, F, a new anion, A(2) = 3.682 g/cm$^3$; s = strong, sh = shoulder) are: 3553, 3506, 3265s, 3205, 3120sh, 2930sh (O–H stretching vibrations of OH anions), 1147, 1095sh, 810sh, 676 (Fe$^{2+}$O–F, a new anion), 1032, 988s [ν$_3$(F$_2$O) – antisymmetric P–O stretching vibrations of PO$^4$ anions]. 962, 937s [ν$_1$(A) – symmetric P–O stretching vibrations of PO$^4$ anions], 810sh, 676 (Fe$^{2+}$O–F, a new anion). 588s [triply degenerate v$_2$(F)] O–P–O bending mode of PO$^4$ anions]. 588s [triply degenerate v$_2$(F)] O–P–O bending mode of PO$^4$ anions].
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vibrations, possibly combined with libration modes of H₂O molecules. The average of 5 electron probe EDS analyses is [wt% (range)]: Al₂O₃: 1.03 (0.81–1.36), MnO₃: 0.82 (0.60–0.97), FeO: 51.34 (50.60–52.08) (Mössbauer), P₂O₅: 31.06 (30.57–3.49), H₂O: 16.4 (by chromatography of ignition products at 1200 °C), total 99.58. The empirical formula based on 27 apfu and structural refinement data is (Fe7.0H1.91Mn0.08Ca0.01Na0.01(PO4)2.63O5.98H2O. The strongest lines in the X-ray powder-diffraction pattern [d Å (hkl): kβ]: are 10.41 (100; 200), 9.67 (38; 002), 7.30 (29; 202), 4.816 (31; 111.004), 3.432 (18; 600;114,404,313), 1.197 (18; 510; 516.314,602), 3.071 (34; 314,115). The unit-cell parameters refined from powder-diffraction data is: a = 20.694(6), b = 5.143(1), c = 19.236(7), Å, β = 93.52(2), γ = 2044.5 Å. Single-crystal X-ray diffraction data collected on a crystal of size 0.13 × 0.15 × 0.08 mm refined to R = 0.068 for 2230 unique I ≥ 2σ(I) reflections shows eleonorite is monoclinic, space group C2/c, a = 20.697(10), b = 5.148(2), c = 19.223(9), Å, β = 93.574(9), γ = 2042.5 Å, and Z = 4. Eleonorite is the novel [As4+3+5+2–] heteropolyanion, [As49.77(4)] heteropolyhedral framework formed by one Fe3+ ion as Fe3+ + O2– + Fe3+ + OH+. The structure of eleonorite is based on a heteropolyedral framework formed by (M1–4OH)octahedra (where M = Fe3+; O = O2–, OH-, or H₂O) and isolated PO4 tetrahedra, with a wide channel occupied by H₂O molecules. Eleonorite is named after the Eleonore Iron mine. The neotype from the Rotliäufchen mine and a specimen from the Gutgliück mine, Braunfels, Wetzlar, Hesse, Germany are deposited in the Fersman Mineralogical Museum of Russian Academy of Sciences, Moscow, Russia. O.C.G.

References cited


GATEWAYITE*, MORRISONITE*, PACKRATITE*, VANARSITE*


The holotype and/or cotype specimens of all those new species are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A.

Gatewayite (IMA 2014-096), ideally Ca(V3+4+9+)As3+O31H2O, occurs as very dark greenish-blue blades are more or less flattened on {010} and elongated on {010}, which are up to 0.5 mm long and form divergent intergrowths. It also occurs as crude prisms, up to 1 mm long, with rounded faces and as composite crystals consisting of subparallel intergrowths of narrow prisms up to 2 mm long. Streak is greenish blue and fuser is vitreous. Mohs hardness is ~2, fracture is curved, tenacity is brittle and cleavage is fair on {010} and {101}. Dcalc = 2.342(4) g/cm³ (by floatation in mixtures of methylene iodide and toluene) Dmax = 2.337 g/cm³. The mineral is insoluble in H₂O at room T and easily soluble in diluted HCl at room T. Optically, gatewayite is biaxial (-), α = 1.621(1), β = 1.654(5), γ = 1.668(5) (light not reported), 2Vmax = 66.1°, 2V = 65.0°. Dispersion is extreme (sense not determined). Y = b, X′ = a + 30° in obtuse β. It is pleochroic: X′ = pale olive green, Y′ = medium greenish blue, Z′ = dark greenish blue; X′′ < Y < Z. The average of electron probe WDS analysis (9 points in 7 crystals) [wt% (ranges)] is: NaO 0.21 (0.09–0.37), CaO 12.31 (11.90–12.79), SrO 0.41 (0.20–0.66), AsO3 32.18 (29.62–34.43), V₂O₅ 42.97 (41.95–44.32), total 88.02. The H₂O loss results in higher concentrations for the remaining constituents than is to be expected for the fully hydrated phases; the analyzed constituents normalized to provide a total of 100% when combined with the calculated H₂O are: NaO 0.19, CaO 31.31, SrO 0.31, AsO3 3.60, V₂O₅ 25.40, VO₃ 7.40, VO₃ 31.39, H₂O (on the basis of crystal structure) 20.33, total 100.00. The empirical formula based on V+As = 19 and 82 O apfu is: (Ca0.99Na0.09Sr0.00(As8.18V4.16As0.37)31H2O. The strongest lines of the X-ray powder diffraction pattern [d Å (%); kbl not reported by the authors] are: 13.2 (47), 11.1 (8), 9.7 (100), 3.246 (9), 2.953 (9), 2.866 (14), 2.810 (17), and 2.758 (9). The single-crystal-unit-cell parameters are: a = 11.1850(4), b = 16.8528(4), c = 20.7146(15), Å, β = 91.166(6), and γ = 139.03 Å, Z = 2, space group P2₁. The structure was refined to R = 0.053 for 9888 unique, observed [F > 4σ(F)] reflections. In the structure of gatewayite, the interstitial unit consists of nine isolated H₂O groups, four of which are partially occupied, and six Ca-O polyhedra that are sixfold- or sevenfold-coordinated. The Ca-O polyhedra share one, two, or three of their vertices with O atoms of the VO₃ octahedra and/or AsO₄ tetrahedra of the structural unit. The remaining vertices of the Ca polyhedra are H₂O groups. The structural units are linked via the Ca-O polyhedra into a sheet parallel to {101}. The Ca polyhedra do not link to one another. The only linkage between these sheets is via hydrogen bonds. The interstitial unit, [Ca₂(H₂O)₃(8H₂O)]⁺, combines with the [AsV4+5+3+] polyanion structural unit in the formula unit. Gatewayite is named for the Gateway mining district in which the Packrat mine is located. Gateway is also the nearest town to the Packrat mine.

Morrisonite (IMA 2014-088), ideally Ca(V3+4+9+)As3+O31H2O, occurs as very dark blue blades are flattened on {010} and elongated on {100}. They are up to about 1 mm long, striated lengthwise, and grow in sub-parallel and divergent intergrowths. Streak is grayish blue and fuser is vitreous. Mohs hardness is ~2, fracture is curved, tenacity is brittle, and cleavage is perfect on {010} and good on {100}. Dcalc = 2.292(2) g/cm³ (by floatation in mixtures of methylene iodide and toluene) Dmax = 2.221 g/cm³. The mineral is insoluble in H₂O at room T and easily soluble in diluted HCl at room T. Optically, morrisonite is biaxial (-), α = 1.611(2), β = 1.631, γ = 1.637(2) (light not reported), 2V = 58°(±5). Dispersion is not observable. Y = b, X′ = a, Z′ = c. It is pleochroic: X′ = blue, Y′ = dark blue, Z′ = dark blue; X′′ < Y < Z. The average of electron probe WDS analysis (33 points in 13 crystals) [wt% (ranges)] is: NaO 0.21 (0.01–0.57), CaO 11.82 (10.98–12.30), AsO3 32.71 (30.59–34.58), VO₃ 42.79 (41.43–44.73), total 87.53. The H₂O loss results in higher concentrations for the remaining constituents than is to be expected for the fully hydrated phases; the analyzed constituents normalized to provide a total of 100% when combined with the calculated H₂O are: NaO 0.18, CaO
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10.36, As₂O₅ 3.44, As₂O₄ 24.63, VO₂ 5.14, V₂O₅ 31.82, H₂O (on the basis of crystal structure) 24.44, total 100.00. The empirical formula based on V₁+As = 38 and 180 O apfu is: (Ca₄₋₁Na₅₋₁Al₋₁₄O₂₄V₆₋₇As₁₋₈O₁₋₆)0.01·87H₂O. The strongest lines of the X-ray powder diffraction pattern [d Å (P%)]; hkl not reported by the authors] are: 2.22 (69), 11.4 (100), 9.9 (16), 9.2 (23), 6.81 (12), 6.10 (11), 2.936 (16), and 2.839 (12). The single-crystal unit-cell parameters are: a = 14.9566(18), b = 48.208(6), c = 23.838(3) Å, β = 90.034(6)°, and V = 17187.1 Å³, Z = 4, space group P2₁/c. The structure was refined to R = 0.075 for 4194 unique, observed |F| > 4σ(F)| reflections. In the structure of mosr0n0ite the interstitial unit consists of 10 well-defined Ca–O polyhedra in all of which the Ca atom is sevenfold coordinated. These Ca–O polyhedra share one, two, or three of their vertices with O atoms of the VO₂ octahedra and/or AsO₄ tetrahedra of the structural unit. The remaining vertices of these Ca–O polyhedra are H₂O groups. A further 11th Ca site could not be well defined in the refinement. The structural units are linked via the Ca–O polyhedra, as well as by an extensive system of hydrogen bonds. The interstitial unit, [Ca₄₋₁(OH)₄]0.01, combines with two [As₅V₄O₁₆]0.01 polyhedral structural units in the formula unit. Morrisonite is named for the Morrison Formation, in which the Packrat mine and other U–V minerals of the Urvan mineral belt occur.

Packratite (IMA 2014-059), ideally Ca₄₋₁(OH)₂V₄O₄As₆O₁₈(OH)₈·3H₂O, occurs as very dark greenish-blue blades flattened on {110} and elongated on [010]. They are up to about 1 mm long, striated lengthwise, and grow in sub-divergent and divergent intergrowths. It also occurs as pearly brown, botryoidal aggregates. Streak is grayish blue and luster is vitreous. Mohs hardness is ~2, fracture is curved, tenacity is brittle and cleavage is fair on {110}. D₉₅₀ = 2.480(2) g/cm³ (by floatation in mixtures of methylene iodide and toluene). D₉₅₀ = 2.460 g/cm³. The mineral is insoluble in H₂O at room T and easily soluble in diluted HCl at room T. Optically, vanarsite is biaxial (~), α = 1.645(5), due to the dark color in the Y and Z optical directions β and γ calculated based upon the independently measured retardation (α – γ = 0.04) and 2V value: δₑ = 1.677, γₑ = 1.681 (light not reported), 2Vₑ = 37°. Dispersion not observed. Y = β = X α = 12° in obtuse β. It is pleochroic: X = cornflower blue, Y = dark blue, Z = dark blue; X << Z = Y. The average of electron probe WDS analysis (16 points in 8 crystals) [wt% (ranges)] is: Na₂O 0.63 (0.43–1.22), CaO 13.08 (12.65–13.46), SrO 0.21 (0.10–0.35), FeO 0.04 (0.00–0.08), As₂O₅ 31.61 (28.55–34.24), V₂O₅ 43.89 (41.41–45.33), total 89.47. The H₂O loss results in higher concentrations for the remaining constituents than is to be expected for the fully hydrated phases; the analyzed constituents normalized to provide a total of 100% when combined with the calculated H₂O are: Na₂O 0.54, CaO 11.30, SrO 0.19, FeO 0.03, As₂O₅ 3.41, As₂O₆ 23.34, VO₂ 9.55, V₂O₅ 0.57, H₂O (on the basis of crystal structure) 24.10, total 100.00. The empirical formula based on V₁+As = 38 and 180 O apfu is: (Ca₁₋₂Na₂₋₃Al₋₁₄O₂₄V₆₋₇As₁₋₈O₁₋₆)0.01·87H₂O. The strongest lines of the X-ray powder diffraction pattern [d Å (P%)]; hkl not reported by the authors] are: 13.1 (100), 19.9 (30), 9.6 (30), 4.7 (36), 4.4 (31), 3.339 (33), and 3.012 (32). The single-crystal cell-unit parameters are: a = 25.8515(5), b = 10.9416(2), c = 28.2661(6) Å, β = 102.215(1)° Y = 7828.9 Å³, Z = 2, space group P2₁/c. The structure was refined to R₁ = 0.048 for 14592 unique, observed [F > 4σ(F)] reflections. In the structure of vanarsite, the interstitial unit consists of seven isolated H₂O groups, one insular Na(H₂O)octahedron, and six Ca–O polyhedra that are either sevenfold or eightfold coordinated. The Ca–O polyhedra share two, three, or four of their vertices with O atoms of the VO₂ octahedra and/or AsO₄ tetrahedra of the structural unit. The remaining vertices of the Ca polyhedra are H₂O groups. The interstitial unit, [Na(H₂O)O₁₂Ca₄₋₁(OH)₂V₄O₄As₆O₁₈(OH)₈]0.01, combines with two [As₅V₄O₁₆]0.01 polyhedral structural units in the formula unit. The name vanarsite is based on the composition of the mineral and specifically the fact that it contains vanadate, arsenite, and arsenate groups. E.C. JOANNEUMITE*


The new mineral joanneumite (IMA 2012-001) ideally Cu₅(NiO)₄(H₂O)₂(NH₄)₂, triclinic, is the first mineral containing the isocyanurate anion, (CN₃O·H₂O). It was discovered in the guano deposit at Pabellón de Pica Mountain, Iquique Province, Tarapacá Region, Chile (20°54′05″S, 70°08′25″W). A convergence of a small disseminated Cu mineralization in the hosting gabbro with the nitrogen-rich guano sites on its top led to formation of unique mineralization. Three minerals containing NH₃ (ammine) group (amminite, shilovite, chanabalite) were discovered here along with an alkali-ammonia-copper-sulfate möhnite and alkali-copper-oxalate antipinite. Joanneumite is closely associated with salammoniac, dittmarite, möhnite, and gypsum filling small cracks in gabbroic rocks. It forms violet microcrystalline aggregates up to 2 mm showing sometimes well-shaped cubic crystals which are pseudomorphs after unidentified mineral. The new mineral is transparent, vitreous with a pale violet streak and is non-fluorescent. Mohs hardness is 1. The density was not measured due to the lack of the suitable material; D₉₅₀ = 2.020 g/cm³ for an ideal chemical formula. The optical properties were not obtained. The FTIR spectrum of joanneumite is identical to its synthetic analogue Cu₅(Cu cyan·x·CN)₂(NH₄)₂. The main absorption bands of the IR spectrum (cm⁻¹): s = strong, m = medium, w = weak) are: 3331,
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3266w, 3182m, 3159m, 3012s, 2986w, 2852s, 2805m (N-H stretching vibrations of amine groups); 1768w, 1733s and 1097m, 1089w (C-O stretching vibrations of the isocyanurate complex); 1678m, 1682m, 1602s, 1512w, 1482m, 1453m, 1423m, 1478s (C-N stretching); 1249s (N-H deformation vibrations); 816m (C-N deformation); 773s, 755w, 738s, 712w (O=C-O); 689m, 551s, 454s, 427s (C–N–C, C–O, and N–C–O deformation vibrations). The bands related to H2O molecules and OH− ions were not detected. The average of 10 electron probe EDS analyses (using a rasterized beam and gold-coated samples) is [wt% (range)]: C 20.33 (19.21–21.50), N 31.11 (30.31–32.00), O 28.24 (27.27–27.42), Cu 17.27 (16.72–17.57), Zn 0.24 (0.0–0.60), H 2.82 (calculated from the structural formula), total 100.11. No other elements with an atomic number >8 were detected. This corresponds to empirical formula Cu6−xZnxO15−x(NH)x, based on 31 atoms pfu. The idealized formula is CuN3C3O10H4(NH)4. The strongest lines of the powder X-ray diffraction pattern are [d Å (% hkl)]: 6.52 (68; 010), 5.15 (47; 011), 4.35 (9; 111), 3.29 (6; 220), 3.22 (7; 220), 3.14 (100; 212), 2.074 (7; 322). The unit-cell parameters refined from powder data are: a = 5.042(1), b = 6.997(1), c = 9.092(2), β = 98.11(2), γ = 110.95(3), V = 296.3 Å3. Joanneumite is triclinic, space group P̅T. The powder diffraction patterns of joanneumite and its synthetic analog are identical. Due to the lack of suitable natural single crystals the synthetic analog of joanneumite was prepared for the single-crystal structure refinement. The crystal structure was solved and refined to R = 0.025 based upon 1166 unique I > 2σ(I) reflections. The unit-cell parameters obtained from single-crystal data at 100 K: a = 4.982(1), b = 6.896(1), c = 9.115(2), β = 90.53(3), β = 98.75(3), γ = 110.08(3), V = 290.8 Å3, Z = 1. The basic structural unit consists of two isocyanurate rings and two ammine ligands each bound through nitrogen atoms to a central Cu atom located at the inversion center, having a distorted square-planar coordination of N atoms. The isocyanurate rings build a topological crenellated ribbon by pairs of hydrogen bonds. The isocyanurate rings are oriented to a layer parallel to (T̅21). The three hydrogens of the ammonium groups connect these layers into a three-dimensional network by hydrogen bonds. Practical identity of chemical, powder XRD and FTIR data allows to conclude that the crystal structure of joanneumite is identical with the structure of the synthetic bis(isocyanurate) diamminecopper (II). The basic structural unit in the joanneumite structure is similar to that of ammineite, CuCl2(NH3)2. The two Cl atoms in the ammineite structure are replaced by two isocyanurate groups in the joanneumite structure. Joanneumite is named for the Universalmuseum Joanneum, Graz, Austria which had its bicentennial in 2011 and where the type specimen has been deposited. D.B.

MENDELEEVITE-(Nd)*


Mendeleevite-(Nd) (IMA 2015-031), ideally (Cs,Si)3(Al,Si)3(O,Mg)3(REE,Ca)6(Si3O10)(OH,H2O,F)3brit, is a new mineral species coming from the upper Darai-Pioz alkaline massif (located at the junction of Turkestan, Alay, and Zarvashan Ranges), a ring structure of biotite granites, and aegirine- and quartz-bearing syenites, which occupies the core of a large synclinal fold of terrigenous rocks and schists. The massif has been intruded by alkaline pegmatites, fentes, and carbonatites. Mendeleevite-(Nd) was found in a pegmatite aggregate in quartz-rich rocks, which consist mainly of medium-coarse to granular quartz. Brownish-gray nest-like clusters of pegmatite aggregate (1 to 30 cm wide) mainly consist of fine to medium pegmatite grains, quartz, aegirine, and fluorite, with minor khvorovite, mendeleevite-(Ce), sokolovite, hyalotekite, orlovite, kirchhoffite, pekovite, neptunite, zverashanite, senkevichite, nordite-(Ce), alamosite, pyrochlore-group minerals, and baratovite. Mendeleevite-(Nd) occurs as transparent, colorless, sometimes with a pale brown hue, crystals 10–40 μm in size. It is brittle, with conchoidal fracture. streak is white, luster is vitreous, while cleavage and parting have not been observed. The indentation hardness VHN461 = 621 (491–672) kg/mm2 corresponding to Mohs hardness of 5–5.5. Mendeleevite-(Nd) is not soluble either in water, or in HCl (1:1). It does not luminesce under UV light. D(calc) = 3.202 g/cm3 by (flotation), D(meas) = 3.155 g/cm3. Mendeleevite-(Nd) is optically isotropic, n = 1.582(2). IR spectrum shows the following absorption bands 408, 1612, 1011, 980(shoulder), 547(shoulder). The average of 12 electron probe WDS analyses in 2 grains is (wt%, range): SiO2: 42.30 (41.65–42.23), GoO: 1.69 (1.41–2.07), Eu2O4: 0.47 (0.18–1.06), Sm2O3: 4.19 (3.57–4.56), Nd2O3: 16.15 (15.19–16.85), Pr2O3: 2.79 (2.28–3.53), Ce2O3: 10.12 (9.72 – 10.78), La2O3: 3.60 (3.23–4.11), SrO: 2.99 (2.15–3.60), CaO: 8.50 (7.18–9.55), K2O: 0.85 (0.12–1.73), F: 1.25, H2O [calculated form charge balance and stoichiometry by analogy with mendeleevite-(Ce)] 3.85, O=F, 0.53, total 100.46. The empirical formula calculated on the basis of 210 (O+F) = apfu: Cs8(Si30,5O30)(Al8.5O17.5)O[(Nd6.25,Sm2.79,Ce1.80,Mn0.96)2(Pr0.53,Eu0.27,O)14]0.01×205.1587 Å2. The extinction laws in the X-ray powder data are in accord with the space group Pn̅m, as in mendeleevite-(Ce) (Sokolova et al. 2011). The same space group has been therefore assigned mendeleevite-(Nd) structure. Mendeleevite-(Nd) is the Nd-analog of mendeleevite-(Ce). Both minerals differ in the dominant REE element, Nd and Ce, with a slight change in amount of REE and Ca(+Sr): REE (Ca(+Sr)) with the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia. F.C.

Reference cited


NOLZEITE*


Nolzeite (IMA 2014-086), ideally Na(Al,Mn)3[(Si8,B8)O24(OH)2]:2H2O, is a new mineral found in altered sodalite syenite at the Poudrette quarry, La Vallée-du-Richelieu, Montérégie (formerly Rouville County), Quebec, Canada. Nolzeite is a late-stage mineral likely forming under alkaline conditions over a narrow range of low pressures and temperatures. The new mineral was found in ~ 1 cm diameter vugs in a loose boulder (~1 × 1 m) of sodalite syenite in association with aegirine, nepheline, sodalite, eudialyte-group minerals, analcime, natron, pyrrhotite, catapleite, steedite, and an unidentified mineral. Crystals are euhedral,
acicular and elongate along (001) with average dimensions of 5 × 8 × 55 μm and occur as radiating to loose, randomly oriented groupings within vugs. Pinacoid forms [100], [010], and [001] are observed. Crystals are pale green to colorless with a white streak and a vitreous luster. Density and Mohs hardness and full set of an optical data were not measured due to small crystal size. Nolzeite is assumed to be a bi-axial, \( n_{\text{e}} = 1.616(2) \) and \( n_{\text{m}} = 1.636(2) \). It has positive elongation, and is non-pleochroic. Unlike the closely related species steedeite, nolzeite does not show any fluorescence under short-, medium-, or long-wave UV radiation. Absorption bands of the IR spectrum (cm\(^{-1}\)) are observed at ~2800–3600 (O-H stretching), a moderately sharp band is observed at ~650–700, ~800–840 (symmetric Si-O bending), and ~900–1100 (asymmetric Si-O bending or possibly B-O bending). Absorption bands of the Raman spectrum (cm\(^{-1}\)) are observed at ~3600–3300 and 1600–1500 (O-H and H-O-H bending), 1300–1200 (B-OH bending), 1030–800 (O-H and H-O-H bending), 1631 (H-O-H bending), and strong, sharp bands are observed at ~2800–3600 (O-H stretching), a moderately sharp band is observed at ~3600–3300, and a strong, sharp band is observed at 1631 (H-O-H bending).

The caption on page 493, the second part of Figure 17, should read as follows:

**FIGURE 17.—Continued** (e) Photomosaic of polished slabs showing sulfide (Sul) as interstitial network and ellipsoidal globules capped by amygdales (Amg) filled with very fine-grained serpentine. Olivine pseudomorphs as equant and aligned platy grains (black); orthocumulate (ooc) micro-domains with low sulfide content (gray) separated by sulfide-rich, trapped-liquid poor net-textured micro-domains. (f) Tornado XFM image (S = red, Ca = green, and Al = blue) of same area as e, highlighting distribution of chlorite (Chl) as alteration product of original trapped liquid component. (g) Perspective view of volume-rendered 3D tomography image of same sample shown in a and b, with sulfide network in yellow and large oblate spherical globules in red. Interactive 3DE visualization at https://data.csiro.au/dap/SupportingAttachment?collectionId=17878&fileId=1235.

### Erratum