New Mineral Names*†

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This New Mineral Names has entries for 18 new minerals, including aradite, chlorkyuygenite, chobarovite, crybostryxite, ferriakasakaite-(La), ferriandrosite-(La), ferro-pedrizite, flamite, flintite, fluorgegemite, flurkyuygenite, fluoraymetite, fluor-tsilaisite, gateladite, kononovite, mendigite, namibusaite, and zadovite.

ARADITE* AND ZADOVITE*


Two new minerals aradite (IMA 2013-047), ideally BaCa6[(SiO4)(VO4)](VO4)2F, and zadovite (IMA 2013-031), ideally BaCa6[(SiO4)(PO4)](VO4)2F, the members of the solid solution BaCa6[(SiO4)(PO4)](VO4)2F–BaCa6[(SiO4)(PO4)](VO4)2F, were discovered in a few centimeter thick paralava veins in gehlenite-bearing pyrometamorphic rocks of the Hatrurim Complex, Gurim Anticline, Hatrurim Basin (31°12′N 35°14′E), located near the town of Arad in the Negev Desert, Israel. Aradite and zadovite are associated with rock-forming gehlenite, pseudowollastonite, wollastonite, andradite–schorlomite garnet-series, rankinite, magnesioferrite, kalsilite and fluorapatite; accessory minerals are dorrite-khensite, barioferrite, walslomite, barite, garnite, fresnoite, defalsofissite, cuprite, vorlanite, perovskite, and hexacelsian. Zadovite and aradite are colorless, transparent with a white streak, and have vitreous luster and uneven fracture. Both are uniaxial (–) with ω = 3.503 g/cm3 (zadovite) and ω = 3.509 g/cm3 (aradite). Raman spectra of both minerals show bands above 800 cm−1 attributed to bending vibrations (ν3) and antisymmetric (ν4) stretching vibrations of (VO4)2− modules and Ba(TO4)2− modules. The name zadovite honors the Russian mineralogist Aleksandr Efimovich Zadov (1958–2012), author of 399 unique X-ray calculated powder diffraction lines [d Å (%hkl)] are: 8.734 (32; 003), 6.010 (33; 101), 3.565 (100; 110), 3.301 (48; 113), 3.201 (40; 107), 3.066 (32; 021), 2.762 (85; 116), 1.973 (55; 021), 1.783 (32; 220) for aradite. X-ray single-crystal diffraction study [refined to R(2) = 0.0304 for 399 unique I(hkl) reflections for aradite and to R(2) = 0.0146 for 702 unique I(hkl) reflections for zadovite] on an aradite crystal fragment of 30×20×10 μm and on a zadovite crystal fragment of 150×60×10 μm shows that the minerals are trigonal, space group R3m, Z = 3, with cell parameters a = 7.1300(1), c = 26.2033(9) Å, V = 1153.63 Å3 for aradite, and a = 7.0966(1), c = 25.7284(3) Å, V = 1122.13 Å3 for zadovite. The structure of zadovite-series minerals belonging to the namibusaite group is characterized by a 1:1 alternation of antiperovskite-like [{[Ca6]}(TO4)4]+ modules and Ba(TO4)2− modules. The name zadovite honors the Russian mineralogist Aleksandr Efimovich Zadov (1958–2012), author or co-author of more than 90 new mineral species. Aradite is named after the town of Arad near the type locality. Type material is deposited at the Museum of Natural History in Bern, Switzerland, catalog numbers NMBE 42103 (zadovite, the same type specimen is also the holotype for gurimite) and NMBE 42188 (aradite).

CHLORKYUGENITE*, FLUORKYUYGENITE*, FLUORAYMETITE*


Redefinition of the mayenite: The mayenite supergroup recommended nomenclature

The new mayenite supergroup nomenclature accepted by the IMA-CNMNC (proposal 2014/13-C) comprising two groups of minerals isostructural with mayenite (space group I43d, a = 12 Å) with the general formula \(X_2Y_{12}Z_{14}O_{32}(OH)_{x}(H_2O)_y\): the mayenite group (oxides and the wadalite group (silicates), for which the atomic charge over 6 W sites is \(-2\) and \(-6\), respectively (\(X = Ca; T = Al, Mg, Fe, Si; Ti; W = Cl, F, H_2O, or vacant). A detailed re-examination of the type specimens of mayenite, originally described as \(Ca_{12}Al_{14}O_{32}\), shows its correct end-member formula as \(Ca_{11.99}Al_{12.98}Fe_{0.03}O_{32}(Cl, F)\). Consequently, mayenite was redefined as chlormayenite, while the name mayenite is reserved for a potential mineral with the end-member composition \(Ca_{12}Al_{14}O_{32}(Cl, F)\). As a consequence, the mineral brearleite, \(Ca_{12}Al_{14}O_{32}(Cl, F)\), described in 2011 appeared to be identical with chlormayenite and is therefore discredited. By analogy with chlormayenite the kyunogenite recently approved by the IMA-CNMNC was renamed to chlorkyuygenite. Thus currently the mayenite group includes four species: chlormayenite \(Ca_{12}Al_{14}O_{32}(Cl, F)\) and three recently discovered minerals (see below) chlorkyuygenite, \(Ca_{12}Al_{14}O_{32}(H_2O)Cl\), fluormayenite \(Ca_{11.99}Al_{12.98}Fe_{0.03}O_{32}(H_2O)F_2\), and fluorkyuygenite, \(Ca_{12}Al_{14}O_{32}(H_2O)F_2\). Minerals of the mayenite group have a zeolite-like structure with a tetrahedral framework enclosing six big cages (\(-5\) Å) each occupied by two Ca\(^{2+}\) ions, leading to an excess of positive charges which is balanced by incorporation of Cl at two of six W sites. Chlorine is linearly coordinated by two Ca cations. The disordered character of Cl and H\(_2\)O within the cages did not allow the determination of the proton positions. The original name of chlorkyuygenite (kyuygenite) is for the Kuygen-Kaya Mountain in the northern part of the Upper Chegem caldera (type locality). Type material is deposited in the Naturhistorisches Museum of Bern, Switzerland and in the Fersman Mineralogical Museum Russian Academy of Sciences, Moscow, Russia (this specimen is the holotype for both chlorkyuygenite and chegemenite).

Two new minerals, fluor mayenite (IMA 2013-019), ideally \(Ca_{12}Al_{14}O_{32}(OH,F)_2\), and fluorkyuygenite (IMA 2013-043) ideally \(Ca_{12}Al_{14}O_{32}(OH,F)_2\), were discovered as major constituents of larnite pyrometamorphic rocks of the Hatrurim Complex (Mottled Zone) distributed along the Dead Sea rift on the territory of Israel, Palestinian Autonomy, and Jordan. The holotype specimens of fluor mayenite and fluorkyuygenite were collected at the Jabel Harmun, Judean Mts., Palestinian Autonomy and in the Hatrurim Basin, Negev Desert, Israel, respectively. Mineral associations for both minerals are similar and include larnite, shulamitite, Cr-containing spinel–magnesiolite series, ye’elimite, fluorapatite–fluorellestadite, periclase, brownmillerite, oldhamite as well as the retrograde phases portlandite, hematite, hillenbrandite, afwillite, foshagite, ettringite, katoite, and hydrocalumite. Fluorkyuygenite thought to be crystallized initially as fluor mayenite which later was altered by the water vapor–enriched gases during a combustion process. Fluor mayenite and fluorkyuygenite form crystals, usually <20 μm in size, are colorless, occasionally with greenish or yellowish tint with a white streak and a vitreous luster. The micro-indentation hardness of fluor mayenite and fluorkyuygenite is VHS\(_{100}\) = 771(38) and 712(83) kg/mm\(^2\) corresponding to ~5½–6 and 5–5½ of the Mohs scale respectively. Both minerals do not show fluorescence in UV light, are transparent, isotropic with n = 1.612(3) and 1.610(3) (589 nm), respectively. Raman spectra of fluor mayenite and fluorkyuygenite in the spectral region 200–1000 cm\(^{-1}\) are similar and are characterized by the bands at (cm\(^{-1}\)) ~320, 520, 770 (Al–O vibrations). Fluor mayenite shows a broad band between 2600–3500 cm\(^{-1}\) with a weak maxima at 3020 and 3200 (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite. Bands at 3560–3580 cm\(^{-1}\) related to OH groups substituting F. Fluor mayenite shows OH bands at 3550–3580 cm\(^{-1}\) (F. Fluor mayenite shows OH bands at 3560–3580 cm\(^{-1}\) (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite. Bands at 3560–3580 cm\(^{-1}\) related to OH groups substituting F. Fluor mayenite shows OH bands at 3550–3580 cm\(^{-1}\) (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite. Bands at 3560–3580 cm\(^{-1}\) related to OH groups substituting F. Fluor mayenite shows OH bands at 3550–3580 cm\(^{-1}\) (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite. Bands at 3560–3580 cm\(^{-1}\) related to OH groups substituting F. Fluor mayenite shows OH bands at 3550–3580 cm\(^{-1}\) (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite. Bands at 3560–3580 cm\(^{-1}\) related to OH groups substituting F. Fluor mayenite shows OH bands at 3550–3580 cm\(^{-1}\) (ν\(_{2}\) H\(_2\)O) shifted towards a lower frequencies compare to chlorkyuygenite.

The original name of chlorkyuygenite (kyuygenite) is for the Kyuygen-Kaya Mountain in the northern part of the Upper Chegem caldera (type locality). Type material is deposited in the Naturhistorisches Museum of Bern, Switzerland and in the Fersman Mineralogical Museum Russian Academy of Sciences, Moscow, Russia (this specimen is the holotype for both chlorkyuygenite and chegemenite).
(41; 521). The crystal structures of both minerals were solved by direct methods in the space group $\overline{R}3d$, $Z = 2$ and refined to $R = 0.0302$ using 686 unique $I > 2\sigma(I)$ reflections for fluorkyuygenite [$a = 11.9894(2)$ Å, $V = 1723.42$ Å$^3$] and to $R = 0.0274$ using 280 unique $I > 2\sigma(I)$ reflections for fluorkyuygenite [$a = 11.9662(2)$ Å, $V = 1713.4$ Å$^3$]. In fluorkyuygenite, the 2 of the structural cages of the tetrahedral framework are occupied by fluorine.

In fluorkyuygenite, the density of fluorine and negligible amounts of OH, H$_2$O molecules occupy about 2/3 of the cages. The new minerals were named as fluorine analogs of chlorophyry and chlorokyuygenite. The holotype of fluorkyuygenite is deposited in the Museum of Natural History in Bern, Switzerland. Fragments of the fluorkyuygenite holotype, which at the same time are fragments of the shulamitite holotype, were deposited in the Mineralogical Museum of St. Petersburg University, Russia, in the Central Siberian Geological Museum of the V.S. Sobolev Institute of Geology and Mineralogy, Novosibirsk, Russia and in the Fersman Mineralogical Museum of Russian Academy of Sciences, Moscow, Russia. Yu.U.

**CRYOBOSTRYXITE**


Cryobostryxite (IMA 2014-088), ideally KZnCl$_3$·2H$_2$O, is a new mineral formed in the upper, moderately hot (30–80 °C) zone of active fumaroles at the First scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. It is probably formed as a product of the interactions between high-temperature volcanic sublimes and meteoric water. Cryobostryxite occurs on a surface of basaltic scoria or in incrustations consisting of sellaite, fluorite, halite and/or anhydrite. Other associated minerals are gypsum, ralstonite and opal. Earlier, primary minerals of the assemblage are sellaite, fluorite, halite, anhydrite, cotunnite, soflite, flinteite, chubarovite, angleseite, chloralocollite, zincomine, saltenseite, hollandite, hematite, johannsenite, and olserchite. Cryobostryxite forms anhedral to 2 mm thick, their near parallel columnar or chaotic open-work aggregates up to 4–5 mm, sugar-like crusts up to 2–3 mm and up to 0.3 mm thick, rarely, coarse prismatic to acicular crystals up to 0.2–1 mm. The mineral is transparent, colorless, with a white streak and a vitreous luster. Cleavage was not observed. It is brittle with Mohs hardness ~2; $D_{meas} = 2.30(2)$, $D_{calc} = 2.30$ g/cm$^3$. Cryobostryxite is optically biaxial (+) with $\alpha = 1.522(2)$, $\beta = 1.530(2)$, $\gamma = 1.576(2)$ (589 nm); $2V_{meas} = 30(15)$. The strongest bands in the IR spectrum (cm$^{-1}$) are: 3600–3200 (O–H stretching), 1607 (H–O–H bending), 508 (vibrations of H$_2$O molecule as a whole). Weak bands in the range 600–1200 correspond to overtones and combination modes. Absorptions corresponding to B–O, C–O, N–O, and N–H bonds are absent. The average of 4 spot electron probe WDS analyses (wt%) is: K 14.85 (14.12–15.58), Ti4.08 (3.61–4.68), Zn 25.82 (24.83–27.11), Cl 41.70 (41.18–42.24), H$_2$O (calc. as 2 molecules pfu) 14.19, total 100.64. The empirical formula calculated on the basis of K+Ti+Zn+Cl = 5 apfu is (K$_{0.10}$Ti$_{0.09}$)$_{1.01}$Zn$_{10.10}$Cl$_{19.90}$H$_2$O$_{2.00}$2H$_2$O. Cryobostryxite belongs to a new chemical family of minerals, which includes flinteite K$_2$ZnCl$_3$, and mellizinkite K$_2$ZnCl$_3$. The strongest lines of the X-ray powder diffraction pattern are: $d$ Å (P%; hkl): 7.62 (30; 011), 5.986 (43; 100), 5.766 (35; 002), 3.907 (33; 212), 3.466 (20; 121), 3.062 (100; 211), 2.996 (24; 211), 2.712, 2.853 (27; T14). The crystal structure refined to $R = 0.0654$ for 1259 $I > 2\sigma(I)$ independent reflections. Cryobostryxite is monoclinic, space group $P2_1/c$, $a = 6.2795(3)$, $b = 10.1397(3)$, $c = 12.0829(7)$ Å, $\beta = 107.732(5)$, $V = 732.79$ Å$^3$, and $Z = 4$. The crystal structure contains isolated Zn-centered tetrahedra ZnCl$_4$(H$_2$O), which are connected via eight-coordinated K-centered polyhedra KCl$_6$(H$_2$O) to form a pseudo-framework. Both Zn- and K-centered polyhedra involve only O (1) atoms of the H$_2$O (1) molecules, whereas H$_2$O (2) molecules are located in holes of the K-Zn-H$_2$O (1) polyhedral pseudo-framework and form hydrogen bonds. The mineral name is based on two Greek words, κρύος, cold or ice, and βόστρυξ, curl, reflecting very similar appearance of the anhydrites of the mineral to ice curls. Cryobostryxite specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. D.B.
FERRIAKASAKAITE-(La)* and FERRIANDROSITE-(La)*

Ferriakasakaite-(La) and ferriaandrosite-(La): New epidote supergroup minerals from Ise, Mie Prefecture, Japan. Mineralogical Magazine, 79, 735–753.

Ferriakasakaite-(La) (IMA 2013-126), ideally $\text{Si}_{8}\text{O}_{22}(\text{OH})_2$, is a new amphibole-supergroup mineral discovered in the Sutlug pegmatite in the Targi River Basin, Tyva Republic, Eastern Siberia, Russia. The associated minerals are quartz, albite, microcline, spodumene, cassiterite, beryl, columbite-(Mn), fergusonite-β-(Y), fluorapatite, schorl, trillithionate and fluorate. Ferria-androsite forms dark-gray-blue to violet-blue acicular and long prismatic crystals up to 2×5×50 mm, with major crystal forms [110] prism and the {100} and {010} pinacoids, in random, radial or subparallel aggregates. Ferria-androsite is intensely colored, dark-gray-blue to violet-blue, with pale gray streak, and vitreous luster. Ferria-androsite is brittle, has a Mohs hardness of 6 and a splintery fracture. It has a perfect cleavage on {110} and a less perfect one on {001}. $D_{\text{meas}} = 3.13(1)$ g/cm$^3$ (by flotation in heavy liquids) and 3.16(1) g/cm$^3$ (by hydrostatic weighting), and $D_{\text{calc}} = 3.138$ g/cm$^3$. No fluorescence under UV light was observed. Ferria-androsite is biaxial (-), $a = 1.614(3)$, $b = 1.638(3)$, $c = 1.653(3)$ (589 nm); $2V_{\text{meas}} = 75(5)^\circ$, $2V_{\text{calc}} = 76^\circ$. The orientation is $X = b$, $Z = c$, $\alpha = 3–4^\circ$, $X^\perp \approx 16^\circ$. Positive elongation is observed for the crystals parallel to the planes {101} and {120}. The dispersion of the optical axes is weak, $r < v$. The mineral is weakly pleochroic X (colorless) < Y = Z (pale lilac-gray). IR spectrum of ferria-androsite show bands in the ranges 550–600 (Li–O-stretching vibrations), from 650 to 800 cm$^{-1}$ (O–Si–O and M–O–H stretching vibrations), from 900 to 1150 cm$^{-1}$ (Si–O stretching vibrations), and 3600–3750 cm$^{-1}$ (Si–O–H stretching vibrations). Bands below 600 cm$^{-1}$ correspond to M–O stretching and Si–O–Si bending modes. Average of 5 electron probe EDS analyses is [wt% (range)]: LiO 4.67 (by the ICP-MS), NaO 2.54 (4.23–6.76), KO 0.13 (0.02–0.23), CaO 0.29 (0.20–0.35), MgO 4.48 (4.27–4.64), MnO 0.59 (0.43–0.65), FeOtotal 13.20 (13.02–13.37), FeO 9.06 and Fe$^3+$ 4.60 (by Mössbauer spectroscopy), AlO 13.13 (12.80–13.46), SiO$^2-$ 57.59 (57.25–57.91), and 82.00 (81.70–82.30). The mineral is weakly pleochroic X (colorless) < Y = Z (pale lilac-gray). IR spectrum of ferria-androsite show bands in the ranges 550–600 (Li–O-stretching vibrations), from 650 to 800 cm$^{-1}$ (O–Si–O and M–O–H stretching vibrations), from 900 to 1150 cm$^{-1}$ (Si–O stretching vibrations), and 3600–3750 cm$^{-1}$ (Si–O–H stretching vibrations). Bands below 600 cm$^{-1}$ correspond to M–O stretching and Si–O–Si bending modes. Average of 5 electron probe EDS analyses is [wt% (range)]: LiO 4.67 (by the ICP-MS), NaO 2.54 (4.23–6.76), KO 0.13 (0.02–0.23), CaO 0.29 (0.20–0.35), MgO 4.48 (4.27–4.64), MnO 0.59 (0.43–0.65), FeOtotal 13.20 (13.02–13.37), FeO 9.06 and FeO 4.60 (by Mössbauer spectroscopy), AlO 13.13 (12.80–13.46), SiO$^2-$ 57.59 (57.25–57.91).
Reference cited

FLAMITE*

The new mineral species flinite (IMA 2013-122), with general formula (Ca,Na,K)₂(Si,P)O₄, a natural analog of the P,Na,K-doped high-temperature α-Ca₃SiO₅ modification, was discovered as a rock-forming mineral in Ca- and Al-rich paralava, an ultrahigh-temperature combustion metamorphic rock found in the Haturim Basin in Negev Desert, Israel. Thin paralava veinlets in gehlenite hornfels, had experienced slight retrograde alteration. The mineral assemblage consists of ~40% Ca₃SiO₅ solid solutions (flinite as a regular lamellar intergrowth with partially hydrated larnite), ~30% gehlenite, 15% rankinite, and 10% Ti-rich andradite. Minor phases (~5 vol%) are Fe-rich perovskite, magnesiopfannolite, and hematite, which contains tubular inclusions of cloudy flinite. Ettringite and calcium silicate hydrates are minor retrograde phases. Flinite occurs as 100–250 µm anhedral lamellar crystals filling interstitial areas between gehlenite and as intergrowths with rankinite and titanite. The mineral is pale yellow or gray, transparent with a white streak, vitreous luster and no parting or cleavage. The microindentation hardness VHN₁₀₀ = 706 (579–753) kg/mm² corresponding to 5–5.5 of Mohs scale. The density was not measured due to intense intergrowths with larnite; Dₐcl = 3.264 g/cm³. No fluorescence in UV light was observed. Flinite is optically uniaxial (+), with α = 1.634(2) and ε = 1.640(2) (589 nm); Z = ε. The main bands in the Raman spectrum (cm⁻¹) are: 170, 260, 520, 538, 850, 863, 885, 952, and 1003. Generally, the bands are associated with vibrations of isolated [SiO₄] groups and Ca²⁺ cations (translational modes). No bands related to the presence of CaO³⁻, OH groups or H₂O were detected. The average of 21 electron probe analyses of the holotype sample [wt% (range)] is: CaO 59.76 (58.27–61.23), SiO₂ 28.87 (28.14–30.17), Al₂O₃ 0.04 (0–0.08), FeO 0.15 (0–0.48), MgO 0.16 (0.08–0.55), BaO 0.05 (0–0.17), SrO 0.24 (0.17–0.35), V₂O₅ 0.10 (0–0.16), PbO 0.61–0.85, Na₂O 1.55 (1.12–1.98), K₂O 1.73 (1.40–2.04), total 100.03. The empirical formula is [Ca₁.82Na₀.09K₀.06(Mg,Fe,Sr,Ba)₀.02]Σ₁.99 (Si₀.82P₀.18)Σ₁.00O₄. Flinite dissolves in 10% HCl with the formation of a SiO₂ gel. The strongest lines in the calculated spectrum of flinite have maxima below 250 cm⁻¹. The intense, narrow band at 294 cm⁻¹ corresponds to Zn–Cl stretching vibrations, bands at 192, 140, and 113 cm⁻¹ correspond to lattice modes, Zn–Cl bending and K–Cl stretching vibrations. No bands indicating the presence of groups with O–H, C–H, C–O, N–H, N–O, B–O, Be–O, and Li–O bonds were observed. The average of 4 electron probe WDS analyses of the holotype [wt% (range)] is: K 24.97 (23.53–25.94), Ti 5.82 (5.27–6.11), Co 0.07 (0–0.29), Zn 22.23 (21.48–23.00), Cu 46.95 (45.76–47.60), total 100.04. The empirical formula based on the sum of all atoms = 7 pfu is: (K₁₋ₓSiₓ)₀.₉₁₋ₓ(OH)₀.₁₉₋ₓ[ZnₓCl₄]ₓ. Composition variations for all analyzed samples are (wt% range): K (16.34–28.34), Tl (0.31–27.74), Co (0–0.52), Zn (16.70–22.91), Cu (37.20–49.71), Zn (0–0.16), Be (0–0.24). Flinite dissolves very easily in H₂O at room temperature and is unstable in a humid atmosphere. The most common product of flinite alteration is cryobroystrite KZnCl₄·2H₂O. The strongest lines in the calcined powder X-ray diffraction pattern are [d(Å) (L∞; %; hkI)]: 2.765 (44; 082), 2.759 (42; 141.1), 2.713 (100; 16.0), 2.518 (29; 16.1), 1.762 (32). According to the average of X-ray crystallographic studies the structure is hexagonal, space group P6₃: a = 4.37326(18) Å, V = 11.222 Å³, Z = 12. The later re-examination of the holotype revealed that it is orthorhombic, crystallizes in the space group Pnnm, with a = 5.93845(6), b = 21.7310(14), c = 6.834(4) Å, V = 1393.81 Å³, Z = 4, and better described by the formulæ Ca₈₋ₓ(AlₓSi₂₋ₓ)₆(AlₓSi₅₋ₓ)₂O₁₆. It is isomorphous with the known synthetic P-doped clinker phase Ca₈₋ₓ(AlₓSi₂₋ₓ)₆(PO₄)₂. The flinite structure is a derivative of the hexagonal high-temperature variety of dicalcium-silicate, so-called α-CSI, and is characterized by a cyclic triplet of individuals rotated 120° around ε, interpreted as symplectite-like transformation “twinning” derived from α-CSI. The composition of intergrown flinite lamellae is chemically variable concerning the degree of Na, K, and P substitution. In terms of the structure flinite is closely related to nagelschmidtite, Ca₄(SiO₄)(PO₄)₂, and the high-temperature polymorphs of C-S. The mineral name is derived from “flame” and refers to the origin of the mineral by ultrahigh-temperature combustion metamorphism triggered by fossil-fuel ignition. The holotype specimen is stored in the collections of the Central Siberian Geological Museum of the V.S. Sobolev, Institute of Geology and Mineralogy, Novosibirsk, Russia. D.B.

FLINITE*
Fluorchegemite*  

Fluorchegemite (IMA 2011-112), ideally Ca₉(SiO₄)₃F₂, is a new mineral from an edgrewite-bearing zone of endokam at the contact of a large altered calciferous xenolith within ignimbrites of the Upper Chegem Caldera, Northern Caucasus, Kabardino-Balkaria, Russia. It is associated with larnite, edgrewite, wadalite, eulybyuite, rondonrite, lakargiite, Th-kerimasite, bultfonteinite, killalaite, hillebrandite, afwillite, and irregular fracture. It has a Mohs hardness of ~5½–6. Density was measured because of inclusions of other minerals, and MnO on the basis of electro neutrality and 12 O apfu. Not enough material was available to measure powder XRD data; the strongest lines of the X-ray powder diffraction pattern are: 2.531 Å (90; 364), 3.98° (759; 264). Single-crystal X-ray diffraction data collected on a crystal of size 0.20×0.22×0.26 mm refined to R₁ = 0.036 for 3496 unique reflections shows fluor-tsilaisite is rhombohedral, space group R3m, a = 15.9398(6) Å, β = 157.052 ± 0.03°, Z = 3. Fluor-tsilaisite is related to tsilaisite through the substitution [F ↔ (OH)] and with fluor-elbaite through the substitution [Al + Li] ↔ 2Mn⁺. The new mineral appears to be a stepwise intermediate during tourmaline evolution from tsilaisite to fluor-elbaite. The name is derived from the tsilaisite root of the tourmaline supergroup. The holotype of fluor-tsilaisite is deposited in the “Museo di Scienze della Terra, settore Mineralogico Petrografico Carlo Lorenzo Garavelli”, Università di Bari, Bari, Italy. O.C.G.

Gatedalite*  

Gatedalite (IMA 2013-091), ideally Zr(Mn²⁺Mn⁴⁺)₂O₄Sb₂O₇, is a new mineral found at the Långban Mn-Fe oxide deposit, Värmland, central Sweden. It is found in hausmannite-impregnated skarn with jacobsite, Mn-calcite, tephroite, Mn-phlogopite, lāngbanite, pinakolite, and oxyplumbomorite. The mineral occurs as irregularly rounded anhedral grains up to 60 µm. Gatedalite is gray and opaque with submetallic luster, shows no cleavage or parting, and is brittle. The hardness and density could not be determined due to small grain size and extreme scarcity of material; Dcalc = 4.783 g/cm³. The mineral shows very weak anisotropy and bireflectance and no pleochroism. Reflectance values for COM wavelengths [Rmin, Rmax, % (nm)] are: 20.0, 19.1 (470); 19.1, 18.1 (546); 18.9, 18.0 (589); 18.7, 17.4 (650). The average of 4 electron probe WDS analyses is [wt% (range)]: SiO₂ 9.82 (9.53–10.10), ZrO₂ 9.97 (9.44–11.10), Al₂O₃ 0.05 (0.05–0.06), MnO 57.90 (56.31–59.26), Fe₂O₃ 7.81 (7.35–8.28), CeO₂ 0.28 (0.16–0.37), MgO 3.20 (2.99–3.52), CaO 0.16 (0.14–0.20), MnO 11.34 (10.67–11.90), ZnO 0.13 (0.00–0.19), Na₂O 0.01 (0.00–0.02), total 100.68. This gives the empirical formula (Na₀.₆₉Ca₀.₂₉Mg₀.₀₂)(Mn³⁺₀.₂₉Ca₀.₀₂Mn⁴⁺₀.₅₀Al₀.₀₁Li₀.₅₆Ti₀.₀₃)₂⁺(O₂⁺₀.₂₈(OH)₀.₂₅O₀.₃₆)₂O₇. Fluor-tsilaisite is pale greenish yellow. Fluor-tsilaisite is uniaxial (+) with α = 1.610(2), β = 1.615(2), γ = 1.619(2) (589 nm); 2V = 80(8)°; 2V' = 54°; X = a, Y = b, Z = c. Dispersion of optical axis is weak, v > υ. The main lines in the Raman spectrum are: 258, 297 (vibrations of CaO, octahedra); 410s, 422, 560s (bending vibrations of CaO₆ octahedra); 817s, 843, 922s (stretching vibrations of SiO₄ tetrahedra); 1000, 1050, 1100s (O–H stretching). Fourier-transform IR spectrum is ν(OH) = 3437, 3445, 3453, 3484, 4050, 4100, 4119, 4181, 5079, 5109 cm⁻¹. Fluor-tsilaisite is greenish yellow with white streak and a vitreous luster. It is brittle with an imperfect cleavage on {110} and {100} paring and sub-conchoidal fracture. The Mohs hardness is ~5½. Density was not measured; Dcalc = 3.134 g/cm³. In transmitted light, fluor-tsilaisite is pleochroic with O = pale greenish yellow > E = very pale greenish yellow. Fluor-tsilaisite is uniaxial (+) with α = 1.645(5), e = 1.625(5) (white light). The mineral shows no fluorescence in UV light. The average of 10 electron probe WDS analyses is [wt% (St.dev.)]: SiO₂ 36.65 (4), TiO₂ 0.33 (8), B₂O₃ 10.44 (by stoichiometry), Al₂O₃ 35.52 (16), MnO 11.63 (20), FeO 0.19 (6), CaO 0.08 (2), Na₂O 1.92 (4), K₂O 0.02 (1), Li₂O 0.46 (by stoichiometry), F 0.66 (9), H₂O 2.97 (by structure refinement), O = F; O₂ = 0.00, total 100.00. This gives the empirical formula (Na₀.₆₉Ca₀.₂₉Mg₀.₀₂)(Mn³⁺₀.₂₉Ca₀.₀₂Mn⁴⁺₀.₅₀Al₀.₀₁Li₀.₅₆Ti₀.₀₃)₂⁺(O₂⁺₀.₂₈(OH)₀.₂₅O₀.₃₆)₂O₇. Mn and Fe were considered as divalent cations. Not enough material was available for powder-diffraction measurements, and the calculated spectrum was judged unsuitable for diagnostic identification of the mineral and was therefore not given. Single-crystal X-ray diffraction data collected on a crystal of size 0.20×0.22×0.26 mm refined to R₁ = 0.036 for 3496 unique reflections shows fluor-tsilaisite is rhombohedral, space group R3m, a = 15.9398 (6) Å, β = 157.052 ± 0.03°, Z = 3. Fluor-tsilaisite is related to tsilaisite through the substitution [F ↔ (OH)] and with fluor-elbaite through the substitution [Al + Li] ↔ 2Mn⁺. The new mineral appears to be a stepwise intermediate during tourmaline evolution from tsilaisite to fluor-elbaite. The name is derived from the tsilaisite root of the tourmaline supergroup. The holotype of fluor-tsilaisite is deposited in the “Museo di Scienze della Terra, settore Mineralogico Petrografico Carlo Lorenzo Garavelli”, Università di Bari, Bari, Italy. O.C.G.
unique reflections shows galedalite is tetragonal, space group $I4_1/acd$, with the unit-cell parameters $a = 9.4668(6)$ Å, $c = 18.8701(14)$ Å, $V = 1691.1$ Å$^3$, and $Z = 8$. Gatedalite is a member of the braunite group (general formula $AB_6SiO_{12}$) and is related to braunite via $(Zr^{4+} + Mn^{2+}) → 2Mn^{2+}$ substitution. The mineral is named in honor of amateur mineralologist Kjetil Gatedal (b. 1947) from Not, Örebro, Sweden, for his contributions to the mineralogy of Långban-type deposits. The holotype specimen of galedalite is deposited in the Swedish Museum of Natural History, Stockholm, Sweden. O.C.G.

**KONOVONITE**


Konovonite, (IMA 2013-116), ideally NaMg(SO$_4$)F, is a new sulfate member of the durangite group from the Arsenatnaya fumarole at the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. Konovonite found in a single specimen in close association with langbeinite, hematite, angesite, and euchlorine. Temperatures measured immediately after uncovering of the fumarole camera containing konovonite vary from 360 to 390 °C. Admixed ulkonskovite is a product of the konovonite supergene alteration. The new mineral occurs as prismatic to thick tabular crystals up to 0.04×0.06×0.1 mm, isolated or, more typically, forming clusters or interrupted crusts up to several square centimeters. The mineral is brown, has a brown streak, vitreous luster, perfect cleavage on {001}; $D_{calc} = 3.56$ g/cm$^3$. Mendigite is biaxial (−), with $\beta = 1.782(5)$, $\gamma = 1.796(5)$ (589 nm), $2V_{ext} = 50(10)$°; $\alpha$ was not measured due to a perfect cleavage, but was estimated to be 1.722 based on $\beta$, $\gamma$, and $2V$ values. Dispersion of optical axis is medium, $r > v$. Mendigite is non-pleochroic, with extinction angle of about 4–5° relative to [001]. The bands in IR spectrum $(\text{cm}^{-1}, s = \text{strong}, \text{sh} = \text{shoulder})$ are: 1088a, 1030s, 945s, 907s (Si-O stretching vibrations); 694, 655, 654 (O-Si-O bending vibrations); 515, 461s, 445s, 425s (lattice modes involving Si-O-Si bending and M·O·Si·O stretching vibrations, where M = Mn, Fe, Ca). The average of 4 electron probe EDS analyses with peaks (wt%, range) is: $\text{SiO}_2$ 43.80 (43.24–44.54), $\text{Al}_2\text{O}_3$ 1.08 (0.87–1.28), $\text{Fe}_2\text{O}_3$ 4.42 (4.15–4.70), $\text{Mn}_2\text{O}_3$ 2.91, $\text{MnO}$ 37.47 (39.37–40.80, for total Mn calculated as MnO). $\text{MgO}$ 0.36 (0.25–0.49), total 100.82. The amount of $\text{MnO}$ was calculated taking into account structural data and charge balance. The formula calculated on the basis of $(\text{Mg}^{2+}+\text{Ca}^{2+}+\text{Mn}^{2+}+\text{Fe}^{2+}+\text{Si})$ cations $p$:u is: $(\text{Ca}_{0.24}\text{Mg}_{0.41}\text{Mn}_{0.30}\text{Si}_{1.20}^1\text{Fe}_{1.12}^1\text{O}_{1.02}^1\text{Al}_{1.02}^2\text{F}_{0.07}^1)\text{O}_{18}$. The strongest lines of konovonite, ideally $	ext{NaMg(SO}_4\text{)}\text{F}$, are: 4.766 (38; 1120), 3.210 (21; 0220), 1.774 (55; 002), 1.617 (53; 2110). The monoclinic unit-cell parameters refined from the powder data are: $a = 6.662(2)$ Å, $b = 8.584(3)$ Å, $c = 7.035(2)$ Å, $\beta = 114.06(3)$°, $V = 367.4$ Å$^3$, $Z = 4$. Konovonite is isosstructural with fluorohydroxyl phosphates and fluorosilicates of the durangite group: isostruct $\text{CaMg(PO}_4\text{)}\text{F}$, lacroixite $\text{NaAl(PO}_4\text{)}\text{F}$, panasqueiraite $\text{Ca(Mg,Fe)(PO}_4\text{)(OH)}\text{F}$, durangite $\text{NaAl(AsO}_4\text{)}\text{F}$, and massifite $\text{CaMg(AsO}_4\text{)}\text{F}$. The name konovonite (Cyrillic: кононовит) honors the Russian mineralologist Oleg Vasili'evich Kononov (b. 1932), a specialist in general and technological mineralogy, teacher of mineralogy at Lomonosov Moscow State University for more than 50 years. The holotype is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. F.C.
NEW MINERAL NAMES

Nabimusaite is characterized by a variable chemical composition. Some spots in nabimusaite grains are enriched with Ba up to composition \( \text{Ba}_{0.55}\text{K}_{0.38}\text{Na}_{0.05}\text{Mg}_{0.03} \) with \( \text{Si}_{3.87}\text{P}_{0.14} \). The new mineral is trigonal, space group \( \text{R}3\text{m} \), \( a = 7.1905(4) \), \( c = 41.251(3) \) \( \AA \), \( V = 1847.1 \) \( \AA^3 \), \( Z = 3 \). The nabimusaite structure is representative of the intercalated antiperovskite type. It may be derived from the structure of hatrurite, also known as the clinker phase “alite” (\( \text{Ca}_3\text{SiO}_5 \)). Both structures are characterized by triplets of face-sharing, antiperovskite type anion-centred \([\text{O,F}]\text{Ca}_6\) octahedra of composition \([\text{FO}_2\text{Ca}_{12}\text{SO}_4]\)\(^{19+}\) in nabimusaite. Compared to hatrurite the antiperovskite modules \([\text{FO}_2\text{Ca}_{12}\text{SO}_4]\)\(^{19+}\) in nabimusaite are intercalated with \( \text{K(SO}_4)\)\(^{2–}\) slices. Tetrahedral tips of \( \text{Si}_4\text{O}_{10}^{2–}\) tetrahedra between the triplets within the antiperovskite layer in hatrurite all point in the same direction along [001], while in nabimusaite (as well as in nabimusaite-group minerals zadovite and aradite) the \( \text{Si}(1) \) and \( \text{Si}(2) \) tetrahedra point in opposite directions. The \( \text{Si}(1) \) sites are fully occupied by \( \text{Si} \) and \( \text{P} \) is accumulated at the \( \text{Si}(2) \) sites. The crystal structure of nabimusaite corresponds to the synthetic phase \( \text{KCa}_3(\text{SiO}_4)(\text{SO}_4)\)\(_2\text{O}_2\text{F} \). The mineral is named for its type locality near the village of Nabi Musa. Type material is deposited in the Museum of Natural History of Bern, Switzerland. D.B.