New Mineral Names*

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This New Mineral Names has entries for 12 new minerals, including: agardite-(Nd), ammineite, byzantievite, chibaite, ferroericssonite, fluor-dravite, fluorocronite, litochlebite, magnesioneptunite, manitobaite, orlovite, and tashelgite. These new minerals come from several different journals: *Canadian Mineralogist*, *European Journal of Mineralogy*, *Journal of Geosciences*, *Mineralogical Magazine*, *Nature Communications*, *Novye dannye o mineralakh* (*New data on minerals*), and *Zap. Ross. Mineral. Obshch.* We also include seven entries of new data.

AGARDITE-(ND)*

I.V. Pekov, N.V. Chukanov, A.E. Zadov, P. Voudouris, A. Magganas, and A. Katerinopoulos (2011) Agardite-(Nd), $NdCu_6(AsO_4)_3(OH)_6 \cdot 3H_2O$, from the Hilarion Mine, Lavrion, Greece: mineral description and chemical relations with other members of the agardite–zálesíite solid-solution system. Journal of Geosciences, 57, 249–255.

Three agardites with different species-defining REE were known as valid, IMA-approved mineral species before this work: agardite-(Y), agardite-(La), and agardite-(Ce). Agardite with dominant Nd has been reported in literature several times for different localities, but not approved by the IMA. Agardite-(Nd) (IMA no. 2010-056) is reported from the famous ancient Lavrion mining district in Greece. The empirical formula of agardite-(Nd) based on 3 As atoms is $[(Nd_{0.19}La_{0.14}Y_{0.12}Pr_{0.05}Gd_{0.02}Ce_{0.02}Sm_{0.02}Dy_{0.02})_{\Sigma REE0.58}Ca_{0.39}]_{\Sigma 0.97}(Cu_{5.49}Zn_{0.44})_{\Sigma 5.93}(AsO_4)_3(OH)_{5.38} \cdot 2.64H_2O$. Its simplified, end-member formula is $NdCu_6(AsO_4)_3(OH)_6 \cdot 3H_2O$, which requires CuO 43.45, Nd_2O_3 15.32, As_2O_5 31.39, H_2O 9.84, total 100.00 wt%. Single-crystal X-ray studies of agardite-(Nd) were not carried out because crystals are very thin and typically divergent. Agardite-(Nd) is hexagonal, space group $P6_3/m$; unit-cell parameters are: $a = 13.548(8)$, $c = 5.894(6)$ Å, $V = 937(2)$ Å³, and $Z = 2$.

The mineral occurs as thin, acicular to hair-like, commonly divergent crystals up to 0.5 mm long and 1–3 μm, rarely up to 5 μm thick, with hexagonal cross section. Crystals are elongated along [001], the prismatic belt is formed by faces {100} or {110}. Twinning was not observed. More typically, agardite-(Nd), as well as agardite-(Y) and agardite-(La), form marginal zones (up to 3 μm thick) of larger (up to 1.2 mm long and 10–15 μm thick) zoned acicular crystals with a core consisting of zálesíite. Crystals of both types are usually combined in sprays or radiating

clusters up to 2 mm across. Agardite-(Nd) is transparent, light bluish green (turquoise-colored) in aggregates to almost colorless in separate thin needles or fibers. Streak is white. Luster is vitreous in relatively thick crystals and silky in aggregates. Mohs hardness is <3. Crystals are brittle, cleavage nor parting were observed, fracture is uneven. Density could not be measured because crystals are too thin and form open-work aggregates; density calculated from the empirical formula is 3.81 g/cm³. Optically, agardite-(Nd) is uniaxial positive. Refractive indexes for one sample are: $\omega = 1.709(3)$, $\varepsilon = 1.775(5)$; for another sample, they are slightly higher: $\omega = 1.712(3)$, $\varepsilon = 1.780(5)$. Dichroism is strong: O = pale turquoise, E = bright green-blue. The absorption scheme is: $E > O$. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, with registration no. 4020/1. **K.T.T.**

AMMINEITE*

H-P. Bojar, F. Walter, J. Baumgartner, and G. Färber (2010) Ammineite, $CuCl_2(NH_3)_2$, a new species containing an ammine complex: mineral data and crystal structure. Canadian Mineralogist, 48, 1359–1371.

Ammineite (IMA 2008-32), ideally $CuCl_2(NH_3)_2$, has been discovered at Calleta Pabellon de Pica, Tarapaca region, Chile. It is the only known mineral containing an ammine complex and is likely to be the product of the interaction between NH_3 from guano and Cu from the plutonic rocks. Crystals of ammineite are associated with halite, atacamite, salammoniac, and darapskite. The mineral name is given because it is the first mineral with amine complex in its crystal structure. Electron microprobe (Cu and Cl) and elemental (N and H) analysis yielded: Cu 37.60, Cl 41.67, N 16.54, H 3.32 (wt%), corresponding to $Cu_{1.00}Cl_{1.99}N_{1.99}H_{5.57}$. FTIR spectroscopy on ammineite shows absorptions in the regions 3400–3000, 1650–1550, 1370–1000 and 950–590 cm⁻¹, which have been assigned to the (NH_3) group. Ammineite occurs as hypidiomorphic millimetric blue crystals and also as powdery masses. Crystals, up to 3 mm across, elon-

gate along [100], with the dominant form {001}. $H \sim 1$, D_{calc} = 2.31 g/cm³ (at 293 K), the streak is light blue and the luster is vitreous. Ammineite is soluble in HCl and ammonia, and in water transform into an amorphous phase. The mineral is biaxial positive, with α = 1.676(2), β = 1.715(2), γ = 1.785(2), $2V_{calc}$ = 76° (for λ 589 nm). The pleochroism for β and γ is dark blue, whereas for α is light blue. The optical orientation is: X = **c**, Y = **b** and Z = **a**. Strongest six X-ray powder diffraction lines of ammineite (based on the following unit-cell constants measured at 293 K: a = 7.790(1), b = 10.643(1), c = 5.838(1) Å) are [d_{obs} in Å (I_{obs}%, hkl)]: 6.285 (69, 110), 4.278 (55, 111), 3.898 (56, 200), 2.920 (100, 002), 2.763 (36, 221), and 2.660 (90, 040,112). The crystal structure of ammineite was solved by direct methods and refined in the space group $Cmcm$ to R_1 = 0.024 on the basis of single-crystal diffraction data collected at 100 K (Bruker AXS Smart Apex CCD Mo$K\alpha$ radiation), with a = 7.688(1), b = 10.645(2), c = 5.736(1) Å, and V = 469.4(2) Å³ (Z = 4). The building-block unit of the structure is the trans-diammine-dichloridocopper(II) complex, layered parallel to (001) and connected to the parallel layered complexes up and down nearly perpendicular by two long Cu–Cl bonds. The holotype material is deposited at the Universalmuseum Joanneum, Graz, Austria (mineralogical collection, catalogue number 84.935). **G.D.G and F.C.**

BYZANTIEVITE*

L.A. Pautov, A.A. Agakhanov, E.V. Sokolova, F. Hawthorne, and V.Yu. Karpenko (2011) Byzantievite Ba$_5$ (Ca,REE,Y)$_{22}$(Ti,Nb)$_{18}$(SiO$_4$)$_4$[(PO$_4$),SiO$_4$]$_4$(BO$_3$)$_9$O$_{21}$ [(OH),F]$_{43}$(H$_2$O)$_{1.5}$—a new mineral. Novye dannye o mineralakh (New data on minerals), 46, 5–12 (in Russian).

E. Sokolova, F.C. Hawthorne, L.A. Pautov and A.A. Agakhanov (2010) Byzantievite Ba$_5$(Ca,REE,Y)$_{22}$(Ti,Nb)$_{18}$(SiO$_4$)$_4$[(PO$_4$), (SiO$_4$)]$_4$(BO$_3$)$_9$O$_{21}$ [(OH),F]$_{43}$(H$_2$O)$_{1.5}$: the crystal structure and crystal chemistry of the only known mineral with the oxyanions (BO$_3$), (SiO$_4$) and (PO$_4$). Mineralogical Magazine, 74, 2, 285–308.

A new mineral—silico-phospho-borate—byzantievite was discovered at the Darai-Pioz alkaline massif, at the junction of Turkestan, Zeravshan, and Alay Mt. Ranges, Tajikistan, 39°27′N, 70° 43′E. This multiphase igneous complex consists of various syenites and granitoids of Carboniferrous to Middle Triassic age and abundant with pegmatites, hydrotermalites, carbonatites, and albitites of different composition and age. The most of intruded phases are enriched with boron. An average boron content varies (parts per million) from 53 in quartz syenites to 900 in tourmalinized granites of the massif's marginal zone. Currently, 24 minerals with B as a species defining element are known in the massif including 9 minerals discovered at Darai-Pioz: tienshanite, tadzhikite-(Y), tadzhikite-(Ce), calcybeborosilite-(Y), kapitsaite-(Y), maleevite, pekovite, kirchhoffite, and byzantievite. The latter one found in moraine boulder of coarse-grained rock consisting mostly of microcline-perthite, quartz, aegirine, and ferrileakeite in approximately equal amounts. Byzantievite occurs as intergrowths in quartz, microcline, and often in aegirine, zircon, thorite, calcybeborosilite-(Y), and pyrophanite. Other associated minerals are: titanite, nalivkinite, stillwellite-(Y), danburite, and

pyrochlore. Byzantievite forms lamellar or tabular grains flattened by (001) up to 0.5×1.8 mm and their aggregates. Grains have poorly formed faces and usually deformed and fractured. The mineral is brown (pale yellow streak), vitreous to slightly greasy on conchoidal fracture surfaces, translucent to transparent in small flakes. It does not fluoresce in UV light in range 240–400 nm. Cleavage was not observed. The Mohs hardness = 4.5–5. VHN$_{50}$ = 486 (463–522) kg/mm². D_{meas} = 4.10(3), D_{calc} = 4.15 g/cm³. Byzantievite is optically uniaxial, negative, ω = 1.940(5), ϵ = 1.860(5) for λ = 589 nm. It is strongly pleochroic from light brown (ϵ) to very pale brownish (ω); $\epsilon \gg \omega$. IR spectra were obtained using Avatar (Thermo Nicolet) and Specord-75IR spectrometers. No pure spectrum was obtained due to inclusions of other phases. The major absorption bands are (cm^{-1}): broad band with maxima 550, 590, 650 (superposition of Si-O, P-O bending vibrations and M-O stretching vibrations M = Ca, Y, REE), 740 (supposedly Ti-O stretching vibrations), 950, 1000 (Si-O stretching vibrations), 1190, 1270 (P-O and B-O stretching vibrations, respectively). Chemical composition was determined by MPA in EDS and WDS modes in 3 different laboratories. The Li and Be contents were measured by SIMS and ICP-OES; B by SIMS and H$_2$O calculated based on structural data. The average for 60 analyses gave (the average for the set of 10 analysis for the grain used for single-crystal study is in parentheses) wt%: SiO$_2$ 4.73 (4.52), Nb$_2$O$_5$ 10.97 (11.38), P$_2$O$_5$ 3.83 (3.58), TiO$_2$ 15.21 (15.90), ThO$_2$ 1.48 (1.65), UO$_2$ 0.55 (0.74), La$_2$O$_3$ 4.01 (4.06), Ce$_2$O$_3$ 9.19 (9.17), Nd$_2$O$_3$ 3.35 (3.26), Pr$_2$O$_3$ 1.02 (0.79), Sm$_2$O$_3$ 0.71 (0.73), Dy$_2$O$_3$ 1.25 (1.22), Gd$_2$O$_3$ 0.95 (0.93), Y$_2$O$_3$ 7.39 (6.44), B$_2$O$_3$ 5.09 (5.00), FeO 0.49 (0.49), BaO 13.30 (12.51), CaO 8.01 (8.15), SrO 1.95 (1.61), Na$_2$O 0.16 (0.10), BeO 0.002 (n.a.), Li$_2$O 0.07 (n.a.), H$_2$O 6.00 ([6.00]) , F 1.80 (1.50), O=F *0.76 (0.63), total is 100.75 (99.10). The empirical formula, calculated on the basis of 124.5 anions for the grain used for the structure analysis is: Ba$_{5.05}$ [(Ca$_{8.99}$Sr$_{0.96}$Fe$^{2+}_{0.42}$Na$_{0.10}$)$_{\Sigma10.47}$(Ce$_{3.46}$La$_{1.54}$Nd$_{1.20}$ Pr$_{0.30}$Sm$_{0.26}$Dy$_{0.41}$ Gd$_{0.32}$Th$_{0.39}$U$^{4+}_{0.17}$)$_{\Sigma8.03}$ Y$_{3.53}$] (Ti$_{12.31}$ Nb$_{5.30}$)$_{\Sigma17.61}$ (SiO$_4$)$_{4.65}$(PO$_4$)$_{3.12}$(BO$_3$)$_{8.89}$O$_{22.16}$(OH)$_{38.21}$F$_{4.89}$(H$_2$O)$_{1.5}$. The simplified formula written **on the basis of cation groups [site occupancies determined by structure refinement, (Ti + Nb) adjusted to 18 apfu, vacancies are omitted] is** Ba$_5$(Ca,REE,Y)$_{22}$(Ti,Nb)$_{18}$(SiO$_4$)$_4$ [(PO$_4$),(SiO$_4$)]$_4$(BO$_3$)$_9$O$_{21}$[(OH),F]$_{43}$(H$_2$O)$_{1.5}$. Powder X-ray data were obtained using Debay-Scherer camera D = 57.3 mm (filtered Fe$K\alpha$ radiation). The strongest lines on the diffraction pattern [d_{obs} in Å (I_{obs}%, hkl)] include: 4.02 (2, $\bar{1}$ 2 12), 3.95 (2, $\bar{2}$22), 3.112 (10, 1 1 24; $\bar{1}$ 2 24), 2.982 (4, $\bar{3}$21; $\bar{2}$31), 2.908 (2, 1 1 27; $\bar{1}$38; 128), 2.885 (2, $\bar{3}$ 2 10; $\bar{2}$ 3 10), 2.632(2, 030), 2.127 (2, 0 0 48). The hexagonal unit-cell dimensions: a = 9.128(5); c = 102.1(1), Z = 3. The single-crystal X-ray data for byzantievite were obtained using Bruker $P4$ diffractometer equipped with a CCD detector (Mo$K\alpha_1$ radiation). The mineral is hexagonal, space group $R3$ with unit-cell dimensions: a = 9.1202(2), c = 102.145(5) Å, V = 7358.0(5) Å³, Z = 3. The crystal structure was solved by direct methods and refined to R_1 = 13.14% based on 3794 reflections with [$F_o > 4\sigma(F_o)$]. The crystal structure is a framework of Ti-, Ba-, Ca-, REE-dominant polyhedral, and SiO$_4$, PO$_4$, and BO$_3$ groups. In the structure, there are 50 cation sites: 23 sites are 100% occupied and 27 sites are partly occupied: 6 sites are >50% occupied and 21 sites are <50% occupied. The crystal structure of byzantievite is an intercalation of three com-

ponents, one fully ordered with 100% occupancy of cation sites, and two partly ordered with cation-site occupancies of 67 and 17%. The name byzantievite reflects the complexity and beauty of its structure and is after the Byzantine Empire. The structure of the Empire was extremely complex but still functioned very efficiently. Both the mineral and its name have been approved by the IMA CNMNC (IMA 2009-001). The holotype specimen has been deposited at the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **D.B.**

CHIBAITE*

K. Momma, T. Ikeda, K. Nishikubo, N. Takahashi, C. Honma, M. Takada, Y. Furukawa, T. Nagase, and Y. Kudoh (2011) New silica clathrate minerals that are isostructural with natural gas hydrates. Nature Communications, 2, Article 196, 1–7.

Chibaite (IMA 2008-067) is a new mineral analogous to the synthetic MTN-type silica clathrate compound. It was discovered in marine sediments of Early Miocene age (Hota Group or Emi Group at Arakawa, Minami-boso City, Chiba Prefecture, Japan, with a yet unnamed other silica clathrate mineral. The Hota Group is a series of forearc sediments deposited near the plate margin by the Paleo-Izu arc and the triple junction of the Pacific, Philippine Sea, and North America plates. The chemical analysis of chibaite using an electron probe micro-analyzer (EPMA) resulted in the empirical formula $Na_{0.99}(Si_{134.53}Al_{1.63})$ O_{272}, excluding guest gas molecules in the cages. These constituents compose 90–92 wt% (average: 90.89 wt%), and the remaining 8–10 wt% is attributed to the gas molecules. The chemical compositions of optically isotropic and anisotropic chibaite grains do not differ significantly. The hydrocarbons CH_4, C_2H_6, C_3H_8, and i-C_4H_{10} were detected to be present from the C-C and C-H stretching bands in the Raman spectra. Raman peaks attributable to guest molecules other than hydrocarbons were not detected. Therefore, the ideal formula of chibaite is $SiO_2 \cdot n(CH_4,C_2H_6,C_3H_8,C_4H_{10})$ with $n_{max}= 3/17$ and $Z = 136$, or $Na_x(Si_{136-x}Al_x)_{\Sigma136}O_{272} \cdot (CH_4,C_2H_6,C_3H_8,C_4H_{10})_{24-x}$ if Na and Al are considered essential constituents. The calculated density of chibaite is 2.03(1) g/cm^3.

From the single-crystal X-ray diffraction (XRD) study using a four-circle diffractometer, the lattice parameters of a low-symmetry domain of chibaite in the $P1$ setting were refined from 36 strong reflections as $a = 1.3678(5)$ nm, $b = 1.3684(6)$ nm, $c = 1.9463(9)$ nm, $\alpha = 90.01(4)°$, $\beta = 89.99(3)°$, and $\gamma = 90.03(3)°$, which correspond to $a = 19.347$ Å and $c = 19.463$ Å in the setting of the F lattice. However, some of the diffraction peak profiles were split, and the data could not be used for structure determination. Furthermore, single-crystal XRD experiments with a two-dimensional imaging plate detector system suggested that the Laue group of the low-symmetry chibaite is $I4/m$. The type specimen of chibaite was deposited in the Tohoku University Museum (Mineral Collection A-151). **K.T.T.**

FERROERICSSONITE*

A.R. Kampf, A.C. Roberts, K.E. Venance, G.E. Dunning, and R.E. Walstrom (2011) Ferroericssonite, the Fe^{2+} analogue of ericssonite, from eastern Fresno County, California, U.S.A. Canadian Mineralogist, 49, 587–594.

Ferroericssonite (IMA 2010-025), ideally $BaFe^{2+}_2Fe^{3+}(Si_2O_7)$ $O(OH)$ is a new mineral species found at both the Esquire 7 and 8 claims, situated along Big Creek in eastern Fresno County, and also at Trumbull Peak in Mariposa County, California, U.S.A. The species is a member of the lamprophyllite group and is named as the Fe^{2+} analogue of *ericssonite*, $BaMn^{2+}_2Fe^{3+}(Si_2O_7)$ $O(OH)$, in which Fe^{2+} takes the place of Mn^{2+} in the trioctahedral layer. Ferroericssonite is found in a parallel-bedded quartz–sanbornite vein assemblage. It occurs along cleavage planes of altered gillespite and is closely associated with anandite, bazirite, celsian, devitoite, quartz, and titantaramellite. Ferroericssonite and devitoite appear to be alteration products of gillespite. Its origin is related to a fluid interaction with the quartz–sanbornite vein along its margin with the country rock. It occurs as dark reddish brown foliated masses several millimeters in length flattened on {100} and striated parallel to [001]. No twinning has been observed. The streak is brown. Crystals are transparent with a vitreous luster. The mineral is brittle with an irregular fracture and a Mohs hardness of approximately 4½. It has two cleavages: {100} perfect and {011} good. Insufficient material did not allowed a direct determination of density. Calculated density based on the structural formula is 4.425 g/cm^3. Crystals react very slowly in dilute or concentrated HCl, forming a colorless residue. Ferroericssonite is biaxial positive with $\alpha = 1.827(3)$, $\beta = 1.845(3)$, and $\gamma = 1.920(6)$, (white light), with X = **b**, Y ≈ **c**, Z ≈ **a**; $2V_{obs} = 63(2)°$, $2V_{calc} = 63.0°$. The dispersion is parallel, $r < v$, pleochroism is brown, Z > X > Y. Chemical analysis with an electron microprobe (Cameca SX-100) of Esquire 7 and Esquire 8 material gave, respectively, BaO 30.11, 29.76, MgO 0.21, 0.10, MnO 1.19, 0.79, FeO 26.01, 26.24, Fe$_2$O$_3$ 15.30, 15.35, Al$_2$O$_3$ 0.02, 0.04, SiO$_2$ 22.89, 23.34, F 0.09, 0.05, Cl 1.29, 0.88, H$_2$O 1.33, 1.42, F+Cl≡O –0.33, –0.22, total 98.11, 97.75 wt%, with FeO and Fe$_2$O$_3$ assignments and H$_2$O based on the structure. The empirical formulas for Esquire 7 and Esquire 8 material, based on Mg + Fe + Mn + Si = 5 apfu, are: $Ba_{1.02}(Fe^{2+}_{1.89}Mn^{2+}_{0.09}Mg_{0.03})_{\Sigma2.01}Fe^{3+}_{1.00}$ $(Si_{1.99}O_7)O[(OH)_{0.77}O_{0.02}Cl_{0.19}F_{0.02}]_{\Sigma1}$ and $Ba_{1.01}(Fe^{2+}_{1.90}Mn^{2+}_{0.06}$ $Mg_{0.01})_{\Sigma1.97}Fe^{3+}_{1.00}(Si_{2.02}O_7)O[(OH)_{0.82}O_{0.04}Cl_{0.13}F_{0.01}]_{\Sigma1}$, respectively. For ferroericssonite, the Gladstone-Dale compatibility index is –0.0126 (superior) based on the structural formula. Both powder and single-crystal X-ray studies were carried out using a Rigaku R-Axis Rapid II curved imaging plate microdiffractometer (MoKα radiation). The five strongest calculated powder diffraction lines are [d_{obs} in Å (I_{obs}%, hkl)]: 3.708 (42, $\bar{3}$11), 3.506 (81, 311, 510, 020), 2.880 (42, 420), 2.788 (100, 221) and 2.663 (83, $\bar{2}$02, 710). Unit-cell parameters refined from the powder data using JADE 9.1 with whole pattern fitting are: $a = 20.395(13)$, $b = 7.025(13)$, $c = 5.389(13)$ Å, $\beta = 94.872(17)°$, and $V = 769(2)$ Å^3. The crystal structure of ferrieericssonite was determined by direct methods using single-crystal diffraction data in the space group $C2/m$ and was refined to R_1 values of 3.56%. Single-crystal unit-cell dimensions are $a = 20.3459(10)$, $b = 7.0119(3)$, $c = 5.3879(4)$ Å, $\beta = 94.874(7)°$, $V = 765.89(7)$ Å^3 (Z = 4). H were located from Fourier difference maps. Ferrieericssonite has a heterophyllosilicate structure with a Fe^{2+} trioctahedral (O) sheet flanked on either side by heterophyllosilicate (H) layers, forming a *HOH* composite sheet. The heterophyllosilicate layers are composed of Si$_2$O$_7$ groups linked by Fe^{3+} square pyramids. The region between the composite sheets is occupied by Ba^{2+}. Ferrierics-

sonite and *orthoericssonite* (orthorhombic, *Pnmn*) are polytypes having different orientations of successive *HOH* layers. In the monoclinic structure, all *HOH* layers are in the same orientation, whereas in the orthorhombic structure, alternate layers are flipped relative to one another. If the orthorhombic polytype of ferroer-icssonite is found, the monoclinic and orthorhombic polytypes should be named using the same polytype suffix approach, i.e., ferroericssonite-2*M* and ferroericssonite-2*O*, as *ericssonite* and *orthoericssonite* have been recently renamed to ericssonite-2*M* and ericssonite-2*O*, respectively. The two cotype specimens used in the description of the mineral are housed in the mineral collection of the Natural History Museum of Los Angeles County under catalog numbers: 63206 (Esquire 7) and 63207 (Esquire 8). **F.C. and G.D.G.**

FLUOR-DRAVITE*

C.M. Clark, F.C. Hawthorne, and L. Ottolini (2011) Fluor-dravite, $NaMg_3Al_6Si_6O_{18}(BO_3)_3(OH)_3F$, a new mineral species of the tourmaline group from the Crabtree emerald mine, Mitchell County, North Carolina: Description and crystal structure. Canadian Mineralogist, 49, 57–62.

Fluor-dravite (IMA 2009-085), ideally $NaMg_3Al_6Si_6O_{18}$ $(BO_3)_3(OH)_3F$, is a new mineral species of the tourmaline group from the Crabtree emerald mine, Mitchell County, North Carolina, U.S.A. This mineral is named for the chemical composition as recommended by Henry et al. (2011). Fluor-dravite occurs at the boundary of the pegmatite and the country rock, in association with K-feldspar, plagioclase, quartz, beryl, muscovite, garnet, biotite, and fluorite. It occurs as isolated anhedral crystals few mm across. It is blackish-brown, with vitreous luster, pale-brown streak. It is brittle, with conchoidal fracture and has Mohs hardness of 7. Calculated density is 3.120 g/cm³. Fluor-dravite does not fluoresce under *lw*- or *sw*-ultraviolet light. It is uniaxial positive with $\omega = 1.645(2)$ and $\varepsilon = 1.621(2)$, (gel-filtered Na light, $\lambda = 589.9$ nm). It is pleochroic with O = pale yellow-brown, E = colorless. Chemical analysis with an electron microprobe (Cameca SX-100, WDS-mode) gave SiO_2 36.02, Al_2O_3 31.69, TiO_2 0.25, FeO 6.41, MnO 0.67, ZnO 0.05, MgO 7.71, CaO 0.25, Na_2O 2.80, B_2O_{3calc} 10.86, Li_2O_{calc} 0.20, F 1.45, H_2O 3.19, for a total of 100.94 wt%. H was determined by SIMS. Because Si was <6 apfu, B_2O_3 content was adjusted during the normalization procedure until $^{[4]}Al \approx {}^{[4]}B$ following crystal structure evidences. The lithium content was calculated as Li = 9 – (Si + Al + Mg + Fe^{2+} + Mn^{2+} + Ti^{4+} + Zn) apfu. The formula unit based on electron microprobe WDS, SIMS analysis and crystal structure data (calculated on the basis of 31 anions) is: $(Na_{0.88}Ca_{0.04})_{\Sigma0.92}(Mg_{1.87}Fe_{0.87}Mn_{0.09}Zn_{0.01}Ti_{0.03}Li_{0.13})_{\Sigma3.01}$ $Al_6(Si_{5.87}B_{0.05}Al_{0.08})O_{18}(BO_3)_3(OH)_3[(OH)_{0.47}F_{0.75}])_{\Sigma1.22}$. The 10 strongest powder X-ray diffraction lines are [d_{obs} in Å (I_{obs}%, *hkl*)]: 3.475 (100, 102), 2.583 (67, 051), 2.961 (60, 212), 1.920 (27, 432), 3.998 (22, 220), 6.375 (19, 011), 2.043 (19, 512), 2.392 (14, 003), 2.123 (14, 303), and 1.660 (14, 063). The crystal structure of fluor-dravite was refined in the space group *R*3*m* to a final R_1 index of 1.6%. Unit-cell dimensions (Siemens P3 single-crystal diffractometer, MoKα radiation) are $a = 15.955(3)$, $c = 7.153(2)$ Å, $V = 1576.9(6)$ (Å³) ($Z = 3$). Crystal chemical formula based on the <Y-O> and <Z-O> relations of Bosi and Lucchessi

(2004), corrected for the effect of F being dominant at the W site, yields $^ZAl = 5.43$ apfu and $^ZMg = 0.57$ apfu, and consequently ^YAl and ^ZMg are 0.58 and 1.30 apfu, respectively. Fluor-dravite, ideally $NaMg_3Al_6Si_6O_{18}(BO_3)_3(OH)_3F$, may be derived from the root composition of dravite, $NaMg_3Al_6Si_6O_{18}(BO_3)_3(OH)_3(OH)$, *via* the homovalent substitution F → (OH) at the *W* position of the ideal formula $X Y_3 Z_6 T_6 O_{18} (BO_3)_3 V_3 W$. The holotype material is deposited in the Smithsonian Institution, catalogue number 121341. **F.C. and G.D.G.**

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Henry, D., Novák, M., Hawthorne, F.C., Ertl, A., Dutrow, B.L., Uher, P. and Pezzotta, F. (2011) Nomenclature of the tourmaline supergroup minerals. American Mineralogist, 96, 895–913.

FLUOROCRONITE*

S.J. Mills, P.M. Kartashov, G.N. Gamyanin, P.S. Whitfield, A. Kern, H. Guerault, A.R. Kampf, and M. Raudsepp (2011) Fluorocronite, the natural analogue of β-PbF₂, from the Sakha Republic, Russian Federation. Eur. J. Mineral. 23, 695–700.

Fluorocronite (IMA2010-023), ideally PbF_2, is a new mineral from the Kupol'noe deposit, Sarychev range, Sakha Republic, Russian Federation. The empirical formula (based on 3 apfu) is $Pb_{0.98}F_{2.02}$. The simplified formula is PbF_2, which requires Pb 84.50, F 15.50, total 100.00 wt%. Fluorocronite forms flattened leaf-like microcrystals up to about 20 mm across, but generally less than 10×10 μm, with a thickness of less than 1 mm. The main form developed appears to be {100} due to the rectangular outline observed in the leaf-like crystals, although crystals may also be flattened on {111}. Fluorocronite crystals are translucent with a pearly luster. The streak is white and Mohs hardness is estimated at between 3 and 4. Fluorocronite has perfect cleavage on {111} by analogy with other minerals of the fluorite structure type. No parting or twinning was observed. The density could not be measured because of the small grain size. The calculated density from the empirical formula and powder unit-cell is 7.619 g/cm³. Single-crystal X-ray studies could not be carried out due to the nature and size of the fluorocronite crystals. The unit-cell parameter refined from the powder data using whole-pattern fitting is $a = 5.9306(5)$ Å. The space group is *Fm*3*m* and $Z = 4$. One cotype specimen is housed in the collections of the Fersman Mineralogical Museum, catalogue number 3987/1 and another is in the collections of Mineral Sciences Department, Natural History Museum of Los Angeles County, registration number 63316. **K.T.T.**

LITOCHLEBITE*

J. Sejkora, E. Makovicky, D. Topa, H. Putz, G. Zagler, and J. Plášil (2011) Litochlebite, $Ag_2PbBi_4Se_8$, a new mineral species from the Zálesí, Czech Republic: description and crystal-structure determination. Canadian Mineralogist, 49, 639–650.

Litochlebite (IMA 2009-036) ideally $Ag_2PbBi_4Se_8$, was found, among other selenide minerals, at the abandoned Zálesí uranium deposit, Czech Republic. It forms as a primary mineral at the uraninite stage of mineralization, associated with primary

quartz, uraninite, hematite, and supergene uranophane and a heterogeneous Bi-Se-O phase. The name *litochlebite* honors the Czech mineralogist Dr. Jiří Litochleb. Electron microprobe analysis (JEOL Superprobe JXA-8600) yielded: Cu 0.10, Ag 10.27, Cd 0.05, Pb 11.73, Bi 43.27, Se 32.93, S 0.01 (wt%), corresponding to $(Ag_{1.84}Cu_{0.03})_{\Sigma1.87}(Pb_{1.09}\ Cd_{\ 0.01})_{\Sigma1.10}Bi_{3.99}Se_{8.04}$, on the basis of 15 atoms per formula units. The ideal formula is $Ag_2PbBi_4Se_8$. Litochlebite occurs as irregular grains up to 0.2 mm, which form aggregates up to 1–2 mm in size in a quartz gangue. Crystals are opaque, dark gray to black, having a dark gray streak and a metallic luster. The mineral is brittle, with an irregular fracture. No cleavage was reported. $H \sim 3$, $D_{calc} = 7.90$ g/cm^3. In reflected light, litochlebite is white, with weak bireflectance (observed only in oil) and pleochroism from white/faint yellowish tint to white/faint bluish tint. Optical anisotropy is moderate both in air and in oil, with dark gray to brown polarization-colors. Reflectance values in air (R_{min}, R_{max} in %, λ nm) are: 44.5–49.9 (470), 45.1–50.5 (546), 45.6–51.3 (589), 45.4–51.8 (650). Strongest five X-ray powder diffraction lines of litochlebite are [d_{obs} in Å (I_{obs}%, hkl)]: 3.684 (53, 301), 3.201 (76, 104), 3.028 (100, 31$\bar{1}$), 2.980 (88, 31$\bar{2}$), and 2.892 (95, 005). The crystal structure of litochlebite was solved by direct methods and refined in the space group $P2_1/m$ to $R_1 = 0.0389$. Cell parameters (Bruker AXS diffractometer, CCD area detector, Mo$K\alpha$ radiation) are $a = 13.182(2)$, $b = 4.1840(8)$, $c = 15.299(2)$ Å, $\beta = 109.11(1)°$, and $V = 797.3(2)$ Å^3 ($Z = 2$). The structure contains one Pb site, four independent Bi sites, four Ag sites and eight independent Se sites. Litochlebite is an Ag-dominant isotype of watkinsonite, $Cu_2PbBi_4Se_8$. The holotype specimen of litochlebite has been deposited in the mineral collection of the National Museum, Prague, Czech Republic (catalog number P1P 11/2009). **G.D.G. and F.C.**

MAGNESIONEPTUNITE*

A.E. Zadov, V.M. Gazeev, O.V. Karimova, K.N. Pertsev, I.V. Pekov, E.V. Galuskin, I.O. Galuskina, A.G. Gubanov, D.I. Belakovskiy, S.E. Borisovsky, P.M. Kartashov, A.G. Ivanova, and O.V. Yakubovich (2011) Magnesioneptunite $KNa_2Li(Mg,Fe)_2Ti_2Si_8O_{24}$ = new mineral of the neptunite group. Zap. Ross. Mineral. Obshch., 140(1), 57–66 (in Russian, English abstract). English translation: Geol. Ore Deposits (2011), 53 (8), 775– 782.

O.V. Karimova, O.V. Yakubovich, A.E. Zadov, A.G. Ivanova, and V.S. Urusov (2012) Crystal structure of magnesioneptunite. Kristallografiya, 57, 4, 574–582 (in Russian). English translation: Crystallography Reports (2012), 57, 4, 505–513.

New member of the neptunite group—magnesioneptunite—the Mg-dominant analog of neptunite and mangano-neptunite has been discovered at Upper Chegem (Verkhnechegemskaya) Caldera near the Lakargi Mt. in interfluve of Chegem and Kenstanta Rivers, Kabardino-Balkaria, Northern Caucasus, Russia. The mineral found in volcanic caldera in fragments up to 10–15 cm of hornfelsed fine-grained sandstone between a skarn carbonate xenolith and hosting ignimbrite. There are reaction zones on the sandstone with both contacting rocks. Beside the dominating quartz and isotropic matrix sandstone contains

minor amount of sanidine, microcline, albite, aegirine, rutile, Mg-ilmenite, micrograins of monazite-(Ce), Cs-analcime, and pollucite. Magnesioneptunite along with Mg-neptunite concentration in this rock is up to 1%. Sandstone crosscutted by thin calcite veinlets with andradite. Magnesioneptunite occurs as subisometric grains or prismatic crystals up to 0.08 mm and aggregates up to 0.1 mm. It forms central zones in some grains of Mg-neptunite with Mg/(Fe+Mn) = 0.7–1.0. Neptunite-group minerals here are always closely intergrown with rutile and were formed as a result of ilmenite alteration. Magnesioneptunite is dark-brown to red-brown, translucent, vitreous. Mohs hardness is 5–6, brittle. Cleavage by {110} is perfect. Density was not measured, $D_{calc} = 3.151$ g/cm^3. The mineral is optically biaxial positive, $\alpha = 1.697(2)$, $\beta = 1.708(3)$, $\gamma = 1.725(3)$, $2V_{meas} = 45(15)°$, $2V_{calc} = 78$. It is moderately pleochroic Z (brown) > Y (light brown) > X (light greenish-brown). Orientation is not given. Chemical composition of magnesioneptunite and Mg-neptunite was defined by microprobe. The average (range) of 29 analyses (H$_2$O and F were not measured, other elements heavier then Na were not detected) gave (wt%): Li$_2$O 1.71 (calculated by stoichiometry), Na$_2$O 8.08 (7.78–8.36), K$_2$O 3.61 (3.34–3.77), CaO 0.08 (0.03–0.40), MgO 5.36 (4.73–6.47), MnO 0.07 (0.00–0.38), FeO 7.30 (5.78–8.43), Al$_2$O$_3$ 0.12 (0.06–0.31), Cr$_2$O$_3$ 0.06 (0.00–0.24), TiO 18.38 (17.59–19.87), SiO2 54.78 (53.22–55.37), V$_2$O$_5$ 0.07 (0.00–0.25), ZrO$_2$ 0.05 (0–0.17); total 99.67. The empirical formula based on O = 24 is $(K_{0.67}Na_{0.27}Ca_{0.01})_{\Sigma0.95}$ $Na_{2.00}Li_{1.00}(Mg_{1.16}Fe_{0.89})_{\Sigma2.05}Ti_{2.00}(Si_{7.90}Al_{0.01}V_{0.01})_{\Sigma7.92}O_{24}$. Simplified formula is $KNa_2Li(Mg,Fe)_2Ti_2Si_8O_{24}$. Powder X-ray diffraction data were obtained using a Debye-Scherer camera D = 57.3 mm (filtered Fe$K\alpha_1$ radiation). The strongest lines of the X-ray powder diffraction pattern [d_{obs} in Å (I_{obs}%, hkl)] are: 9.7 (8, 110), 4.55 (4, 11$\bar{2}$, 002), 3.56 (10, 131), 3.20 (9, 13$\bar{2}$, 330), 2.90 (4, 222), 2.81 (4, 132), 2.48 (8, 62$\bar{2}$), 2.16 (6, 043), 1.50 (7, 751, 006), and 1.47 (4, 841). The single-crystal X-ray data were collected using XCalibur-S diffractometer with a CCD detector (Mo$K\alpha_1$ filtered radiation). Magnesioneptunite is monoclinic, $C2/c$; the unit-cell parameters are: $a = 16.327(7)$, $b = 12.4788(4)$, $c = 9.9666(4)$ Å, $\beta = 115.651(5)°$, $V = 1830.5(1)$ Å^3, $Z = 4$. The structure was resolved by direct methods and refined to $R = 0.0244$ based on 2667 independent reflections. The magnesioneptunite crystal structure as the structures of other representatives of this mineral group, is the only example of anionic framework described by the formula $[Si_4O_{11}]_\infty$ however this structure significantly differs from the other members of group by the disordered distribution of Ti, Mg, and Fe^{+2} cations in the octahedra of cationic framework and, as a consequence, by the centrosymmetric crystal structure. That suggested to be caused by the high-temperature (~800 °C) crystallization of the mineral. The simplified crystallochemical magnesioneptunite formula is $KNa_2Li(Ti_2Mg_{1.1}Fe_{0.9})[Si_8O_{22}]O_2$. The mineral was named for its composition. Both the mineral and its name have been approved by the IMA CNMNC (IMA 2009-009). The type specimen is deposited at the Fersman Mineralogical Museum of Russian Academy of Sciences, Moscow. **D.B.**

MANITOBAITE*

T.S. Ercit, K.T. Tait, M.A. Coper, Y. Abdu, N.A. Ball, A.J. Anderson, P. Černý, F.C. Hawthorne, and M. Galliski (2012)

Manitobaite, $Na_{16}Mn^{2+}_{25}Al_8(PO_4)_{30}$, a new phosphate mineral species from Cross Lake, Manitoba, Canada. Canadian Mineralogist, 48, 1455–1463.

Manitobaite (IMA 2008-064), ideally $Na_{16}Mn^{2+}_{25}Al_8(PO_4)_{30}$, is a new mineral species from Cross Lake, Manitoba, Canada, which is also the type locality for bobfergusonite. This mineral is named after the province of Manitoba (Canada) in which the mineral was discovered. Manitobaite occurs in both the inner intermediate zone and the core zone of a pegmatite that intrudes metagreywacke. It is associated with (interior-wall zone of the pegamatite): fluorapatite, chlorapatite, bobfergusonite, eosphorite, dickinsonite, triploidite, goyazite, perloffite, beusite, triplite, plus quartz, K-feldspar, muscovite, schorl, beryl, spessartine, gahnite, and (Nb,Ta,Sn) oxides; core zone: phosphates: fluorapatite, chlorapatite, triploidite, eosphorite, dickinsonite, fillowite, plus quartz, K-feldspar, muscovite, schorl, beryl, gahnite, and (Nb,Ta,Sn) oxides. It occurs as large (up to 4 cm) opaque crystals, and transparent to translucent in small (<1 mm) grains. The streak varies from colorless to very pale green or very pale greenish brown, and the luster is vitreous to resinous. The cleavage is perfect on {010}, there is no parting, the tenacity is brittle, and the fracture is hackly. Measured density is 3.621(6) g/cm^3 (Berman balance), calculated density is 3.628 g/cm^3. Manitobaite does not fluoresce under ultraviolet light. Color varies from green to brown, and small transparent fragments vary in color from bright green to brown. The mineral is biaxial negative with $\alpha = 1.682$, $\beta = 1.691$, $\gamma = 1.697$, (all ±0.001; monochromatic Na light), with X ^ **a** = 31.7° (in β obtuse), Y ‖ **b**, Z ^ **c** = 20.2° (in β acute); $2V_{(obs)}$ = 78.1(6)° (Bloss spindle stage and the program EXCALBR II), $2V_{(calc)}$ = 77.9°. It is pleochroic: X = orange brown, Y = green, Z = greenish brown, with absorption Y ≥ Z > X and dispersion $r > v$, medium. Chemical analysis with an electron microprobe (Cameca SX-100) gave P_2O_5 44.19, Al_2O_3 6.91, FeO 7.79, MnO 27.57, ZnO 0.54, MgO 0.73, CaO 1.71, Na_2O 9.97, for a total of 99.58 wt%. The valence states of Fe were determined by Mössbauer spectroscopy. Infrared powder absorption spectrometry showed the absence of bands in the 3000–3600 or 1610–1640 cm^{-1} regions. The formula on the basis of 120 O^{2-} anions pfu is $Na_{15.55}Ca_{1.47}\ Mg_{0.88}Fe^{2+}_{4.19}Mn^{2+}_{18.78}\ Zn_{0.32}Al_{6.54}Fe^{3+}_{1.05}P_{30.08}O_{120}$. The general formula is $(Na,Ca,\square)_{16}\ (Mn^{2+},Fe^{2+},Ca,Al,Fe^{3+},Mg,Zn)_{25}$ $(Al,Fe^{3+},Mg,Mn^{2+},\ Fe^{2+})_8(PO_4)_{30}$, and the end-member formula is $Na_{16}Mn^{2+}_{25}Al_8(PO_4)_{30}$. The major differences between the green and brown varieties of manitobaite involves a decrease in the amount of sodium and a corresponding increase in the amount of vacancy (□) at the Na sites, and an increase in the amount of Fe^{3+} and a decrease in the amount of Fe^{2+} at the (M, Al) sites, i.e. the vector $\square + Fe^{3+} \rightarrow Na + Fe^{2+}$, observed in alluaudite-subgroup mineral. The seven strongest calculated X-ray powder diffraction lines are [d_{obs} in Å (I_{obs}%, hkl)]: 2.715 (100, $\overline{2}42$), 2.730 (50, $\overline{4}04$), 3.494 (47, $\overline{3}13$), 3.078 (27, $\overline{3}17$), 2.518 (22, $\overline{5}15$), 2.881 (21, $\overline{1}19$), and 6.260 (20, 020). The crystal structures of the green and brown varieties of manitobaite were determined by direct methods in the space group Pc and were refined to R_1 values of 0.05 and 0.06, respectively. Unit-cell dimensions (Bruker single-crystal diffractometer, MoKα radiation) are a = 13.4517(7), b = 12.5266(7), c = 26.6765(13) Å, β = 101.582(1)°, and V = 4403.9 ($Å^3$) (Z = 2). The crystal structure of manitobaite is an ordered

superstructure of the alluaudite arrangement with a cell volume five times that of alluaudite. There are 30 tetrahedral P sites, 31 $M(1–23)Al(1–8)$ octahedral sites, 2 sevenfold-coordinated $Z(1–2)$ and 16 $Na(1–16)$ sites (variable coordination from 5- to 8-fold). Manitobaite is chemically similar to bobfergusonite, but can be readily distinguished by their Na_2O contents: manitobaite (9–10% Na_2O), bobfergusonite (6–7% Na_2O). Bobfergusonite has also a cell volume twice that of alluaudite. The holotype specimen of manitobaite has been deposited in the mineral collection of the Royal Ontario Museum (100 Queens Park, Toronto, Ontario M5S 2C6, Canada, catalog number M53321). **F.C. and G.D.G.**

Orlovite*

A.A. Agakhanov, L.A. Pautov, V.Yu. Karpenko, G.K. Bekenova, and Yu.A. Uvarova. (2011) Orlovite $KLi_2TiSi_4O_{10}(OF)$ a new mineral of the mica group. Novye dannye o mineralakh (New data on minerals), 46, 13–19 (in Russian).

Orlovite is a new mineral of the mica group and is first Ti member of the group-Ti analogue of polylithionite. It was discovered at the Darai-Pioz alkaline massif, at the junction of Turkestan, Zeravshan and Alay Mt. Ranges, Tajikistan. One of specific features of that massif is a diversity of mica-group minerals including muscovite, annite, tainiolite, polylithionite, sokolavaite, orlovite, and 3 potentially new Li–Cs mica-group species now being under investigations. Orlovite was found in several tumbled specimens of predominantly (up to 80%) quartz rock on the glacier moraine. Typical for this very specific coarse-grained icy quartz rocks are crystals of aegirine, polylithionite, sogdianite, stillwellite-(Ce), reedmergnerite, turkestanite, and leucosphenite. Other associated minerals are: pectolite, neptunite, tadzhikite-(Y), sugilite, pyrochlore, baratovite, faizievite, kapitsaite-(Y), pekovite, zeravshanite, sokolavaite, eudialyte, galena, sphalerite, bismuth, calcite, fluorite, fluorapatite, and fluorapophyllite. Orlovite occurs in common for this rock segregations (up to 25 cm) of the brown aggregates of pectolite with quartz, fluorite, polylithionite, aegirine and others. It forms flakes up to 2 mm or flaky aggregates up to 2 cm. Orlovite is colorless (white in aggregates), vitreous to pearly, has a white streak. It is hardly recognizable from polylithionite. The mineral fluoresces yellow in short UV radiation and does not fluoresce under long-wave UV. Cleavage is perfect by {001}. Mohs hardness is 2–3. VHN_{10} = 94 (87–106) kg/mm^2. D_{meas} = 2.91(2) g/cm^3, D_{calc} = 2.914 g/cm^3. The mineral is optically biaxial, negative, α = 1.600(2), β = 1.620(2), γ = 1.625(2)° for λ = 589 nm, $2V_{meas}$ = 52(2)°, $2V_{calc}$ = 52.6°, $r < v$ weak. Orientation is not given. IR spectra were obtained using Fourier spectrometer Avatar (Thermo Nicolet). The major absorption bands are (cm^{-1}): 3600, 1130, 1087, 985, 961, 878, 776, 721, 669, 613, 567, 530, 512, 458, and 405. Chemical composition was determined by MPA using EDS (F = WDS; Li and Rb = ICP OES; H_2O = SIMS). The average (range) of 10 analyses gave (wt%): SiO_2 58.31 (57.56–59.34), TiO_2 18.05 (17.56–18.54), Nb_2O_5 0.50 (0.30–0.69), Al_2O_3 0.22 (0.07–0.44), FeO 0.40 (0.25–0.55), MnO 0.03 (0.00–0.07), K_2O 11.13 (10.87–11.45), Cs_2O 0.24 (0.02–0.40), Li_2O 7.25, Rb_2O 0.69, H_2O 0.21, F 4.35, $–O=F_2$ –1.83, total 99.55. Its empirical formula based on Si = 4 is $(K_{0.97}Rb_{0.03}Cs_{0.01})_{1.01}Li_{2.00}\ (Ti_{0.93}Nb_{0.02}Fe_{0.02}Al_{0.02})_{0.99}$

$Si_4O_{11.04}(F_{0.94}OH_{0.10})_{1.04}$. Simplified formula of $KLi_2TiSi_4O_{10}(OF)$. Powder X-ray data were obtained using diffractometer DRON-2 (filtered Cu$K\alpha$ radiation) and Debye-Scherer camera D = 114.6 mm (filtered Fe$K\alpha$ radiation). The strongest lines on the diffraction pattern [d_{obs} in Å (I_{obs}%, hkl)] are: 9.96 (40, 001), 4.48 (67, 002), 3.87 (40, 111), 3.33 (100, $\bar{1}$21), 2.860 (35, $\bar{1}$13), 2.600 (28, 130), 2.570 (30, $\bar{1}$31), 2.400 (31, 014), and 1.507 (20, $\bar{2}$06). It was indexed in monoclinic cell, space group $C2$, a = 5.199(3), b = 9.068(7), c = 10.070(4) Å; β = 99.35(2)°, V = 468.4(4) Å³, Z = 2. No undeformed crystals of orlovite suitable for single-crystal structure study were found. Electron diffraction study of orlovite was performed using EMR-100M electronograph. Oblique texture electron diffraction patterns revealed high degree of crystal structure perfection and confirmed monoclinic symmetry, trioctahedral type of occupancy, polytype modification 1M(3T), space group $C2$ and unit-cell parameters: a = 5.21(1), b = 9.026(3), c = 10.05(1) Å, β = 99.6(1)°, V = 466(2) Å³. The mineral was named in honor of well-known Russian mineralogist Yuriy Leonidivich Orlov (1926–1980), director of the A.E. Fersman Mineralogical museum RAS (1976–1980), specialist in the mineralogy of diamonds. Both the mineral and its name have been approved by the IMA CNMNC (IMA 2009-006). The holotype specimen has been deposited at the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **D.B.**

TASHELGITE*

S.A. Ananyev, S.I. Konovalenko, R.K. Rastsvetaeva, S.M. Aksenov, N.V. Chukanov, A.N. Sapozhnikov, V.E. Zagorskiy, and A.A. Viryus (2011) Tashelgite $CaMgFe^{2+}Al_9O_{16}(OH)$—a new mineral species from calcareous skarnoids of Gornaya Shoria. Zap. Ross. Mineral. Obshch., 140(1), 49–57 (in Russian, English abstract). English translation: Geol. Ore Deposits (2011), 53 (7), 751–757.

R.K. Rastsvetaeva, S.M. Aksenov, and N.V. Chukanov (2010) Structure of the tashelgite mineral $Ca_2Mg_2Fe_2^{2+}Al_{18}O_{32}(OH)_2$ from Western Siberia: A new structure type. Doklady Akademii Nauk, 2010, 434, 2, 196–199 (in Russian). English translation: Doklady Chemistry (2010), 434, 233–236.

The mineral had first been found at Tashelga River area by E.I. Nefedov (1953, 1955) who provided the data on occurrence, association, optical and other physical properties of "new complex Al, Mg, Ca, and Fe oxide" (without a chemical formula) and named it "lodochnikovite". A new name tashelgite is given for the locality near the mouth of Tashelga River at the area between Rivers Mras-Su and Tom', Kuznetsky Alatau Mts., Gornaya Shoria, Russia (53°22′40″ N, 88°17′07″ E). The mineral found in skarn-like rocks anomaly enriched with Al_2O_3. Those rocks form zones up to a few tenths of cm thick in Proterozoic–Paleozoic age host rocks and consist of calcite (~50%), hibonite-Ca (~25%), vesuvianite (~20%), grossular, hercynite, and corundum (1–1.5% each). Other minerals are: magnetite, perovskite, scapolite, diopside, apatite, and tashelgite. The new mineral occurs as prismatic or fibrous crystals or their parallel growths up to $0.2 \times 0.3 \times 2$ mm elongated by [100] and flattened by (001) on and in late vesuvianite and hercynite. It also forms isolated polysynthetic twins by (001) in calcite or felt-like aggregates up

to 10 mm in interstitions in hibonite–vesuvianite–grossular–hercynite intergrowths. The mineral is bluish-green, translucent to transparent, vitreous. Felt-like aggregates are white. It is brittle, has no cleavage or parting. Mohs hardness 7.5. The mineral is not soluble in hydrochloric nor in sulfuric acids. Density is not given. D_{calc} = 3.67 g/cm³. Tashelgite is optically biaxial negative α = 1.736(2), β = 1.746(2), γ = 1.750 (2), $2V_{meas}$ = 20(2)°. Dispersion of optical axes is strong, $r < v$. X = **a**; Y ~ **b**; X = **c**. Pleochroism: X (blue-green) > Y (yellowish-green) > Z (almost colorless). IR spectra obtained using Fourier spectrometer Alpha (Bruker). IR absorption bands (cm⁻¹, strongest lines in italics, w = weak) are: 3655w; 3035w, 2985w (stretching vibrations of OH groups); 929w (supposedly bending vibrations M··(O–H), 790, 761, 740, *668* (stretching vibrations of the tetrahedra), 610, *556*, *508*, 486, 470, 429 (stretching vibrations of the octahedra). The spectrum does not contain any bands related to CO_3, BO_3, BO_4, and H_2O groups. The chemical composition of tashelgite was obtained by electron microprobe (EDS). The size of analyzed area was 16×16 μm. The content of Fe_2O_3 defined by the ratio of intensities $I(FeK_{\beta5})/I(FeK_{\beta1})$ in the X-ray spectrum (WDS), H_2O determined by weight loss during the heating in vacuum up to 1000 °C. The average (range) of 5 analyses gave: CaO 7.98 (7.75–8.33), MgO 6.75 (6.51–7.09), MnO 0.45 (0.26–0.59), FeO 11.32, Fe_2O_3 1.40 (12.09–12.84 for Fe⁺² + Fe⁺³ as FeO), Al_2O_3 70.70 (70.10–71. 61), H_2O 1.8 (2), total 100.40 wt%. The empirical formula based on 17 O atoms is: $H_{1.27}Ca_{0.90}Mg_{1.06}Mn_{0.04}Fe^{+2}_{1.00}Fe^{+3}_{0.11}Al_{8.80}O_{17.00}$. The idealized formula is $CaMgFe^{2+}Al_9O_{16}(OH)$. Powder X-ray diffraction data were obtained using a DRON-3 diffractometer (filtered Cu$K\alpha$ radiation). The strongest lines on the diffraction pattern [d_{obs} in Å (I_{obs}%, hkl)] are: 11.79 (48, 002), 9.63 (15, 012), 5.61 (19, 014), 2.845 (43, 061), 2.616 (100, 108), 2.584 (81, 146), 2.437 (44, 163), 2.406 (61, 057), 2.202 (72, 244). The unit-cell parameters refined from powder X-ray data are: a = 5.697(1), b = 17.183(3), c = 23.571(3) Å; β = 90°; V = 2307.7(2) Å³, Z = 8. Single-crystal X-ray data were collected using diffractometer Xcalibur Oxford Diffraction with CCD detector (Mo$K\alpha$ radiation); 116 independent positions were refined based on 4773 unique reflections to R = 5.16%. Tashelgite is monoclinic (pseudoorthorhombic), space group Pc; unit-cell parameters are in good agreement with powder X-ray data: a = 5.6973(1), b = 17.1823(4), c = 23.5718(5) Å; β = 90.046(3)°; V = 2307.5(1) Å³, Z = 8. Tashelgite represents the new structure type characterized by the high degree of cation ordering. Edge-sharing Al-octahedra form ribbons along a. Another part of Al octahedra are between those bands. The bands are superimposed with a shift along b forming stair-step layers. Three different types of Al-tetrahedra unite the stair-step layers into a framework. Mg and Fe⁺² are in tetrahedral coordination and, alternating, connect bands into layers. Ca atoms are in interstitions between stacked layers. The crystallochemical formula of the mineral = $Ca_2Mg^{IV}_2Fe^{IV}_2{}^{(2+)}[Al^{VI}_{14}O_{31}(OH)][Al^{IV}_2O][Al^{IV}][Al^{IV}(OH)]$ for Z = 4. In square brackets are Al-octahedra ribbons, interlayer Al-diorthogroups and other interlayer Al-tetrahedra of 2 types (with and without OH groups). Both the mineral and its name have been approved by the IMA CNMNC (IMA 2010-017). Type specimen of tashelgite is deposited at the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Discussion: *The data of E.I. Nefedov despite the lack of*

chemical formula proved the identity of the mineral. Obviously, authors of tashelgite studied the same mineral from the same locality. It could be a fair to keep the original name lodochnikovite, which has a priority and mentioned in a later literature and reference books. **D.B.**

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NEW DATA

BARBERTONITE*

S.J. Mills, P.S. Whitfield, S.A. Wilson, J.N. Woodhouse, G.M. Dipple, M. Raudsepp, and C.A. Francis, (2011) The crystal structure of stichtite, re-examination of barbertonite, and the nature of polytypism in MgCr hydrotalcites. American Mineralogist, 96, 179–187.

Barbertonite, ideally $Mg_6Cr_2CO_3(OH)16\cdot4H_2O$, was described as the hexagonal polymorph of stitchtite from Kaapsehoop asbestos mine, Kaapsehoop, Barberton district, Mpumalanga, South Africa. Unit-cell parameters of barbertonite from the co-type specimens were $a = 3.09689(6)$, $c = 15.6193(8)$ Å, $V = 129.731(8)$ Å³, and $a = 3.09646(6)$, $c = 15.627(1)$ Å, $V = 129.76(1)$ Å³, $Z = \frac{1}{4}$. Rietveld refinements of both stichtite and barbertonite show that they are polytypes rather than polymorphs and do not represent distinct mineral species. Therefore, because stichtite has historical priority (1914) over barbertonite (1941), these polytypes should be denoted as stichtite-$3R$ and stichtite-$2H$ (=barbertonite). **K.T.T.**

GAGARINITE-(CE)

M.J. Sciberras, P. Leverett, P.A. Williams, D.E. Hibbs, A.C. Roberts, and J.D. Grice, (2011) The single-crystal X-ray structure of gagarinite-(Ce). Canadian Mineralogist, 49, 1111–1114.

The single-crystal X-ray structure of gagarinite-(Ce) has been solved using a fragment taken from the type specimen of "zajacite-(Ce)". "Zajacite-(Ce)" is isomorphous with gagarinite-(Y), with Ce^{3+} dominating the REE site. The mineral is hexagonal, space group $P6_3/m$, with $a = 6.0861(12)$ and $c = 3.6810(8)$ Å. The mineral name "zajacite-(Ce)" is discredited, and the mineral is renamed gagarinite-(Ce) approved by the IMA-CNMNC (2010 proposal 10-C). **K.T.T.**

MATULAITE*

A.R. Kampf, S.J. Mills, M.S. Rumsey, J. Spratt, and G. Favreau, (2012) The crystal structure determination and redefinition of matulaite, $Fe^{3+}Al_7(PO_4)_4(PO_3OH)_2 (OH)_8(H_2O)_8\cdot8H_2O$. Mineralogical Magazine, 76(3), 517–534.

Matulaite was first described from the Bachman mine, Hellertown, Northampton County, Pennsylvania, U.S.A. Its ideal formula was reported as $CaAl_{18}(PO_4)_{12}(OH)_{20}\cdot28H_2O$, based on wet-chemical analysis. Re-examination of both existing cotype specimens of matulaite revealed no material matching the powder or single-crystal X-ray diffraction data reported for the species. Other samples examined from the type locality, as well as from the LCA pegmatite in North Carolina, U.S.A., and Fumade, Tarn, France, provided material crystallographically consistent with matulaite: $P2_1/n$, $a = 10.604(2)$, $b = 16.608(4)$, $c = 20.647(5)$ Å, $β = 98.848(7)°$ and $Z = 4$. Electron microprobe and crystal structure analysis of newly studied material from the type locality showed the ideal formula of matulaite to be $Fe^{3+}Al_7(PO_4)_4(PO_3OH)_2(OH)_8(H_2O)_8\cdot8H_2O$. The chemical composition reported previously was most probably determined on a mixture of mostly kobokoboite and afmite, with lesser amounts of crandallite. The neotypes used for this study and new data have been approved by the CNMNC, proposal 11-F. The crystal structure of matulaite contains seven-member chain segments of AlO_6 octahedra decorated by PO_4 tetrahedra. The PO_4 tetrahedra also link to isolated FeO6 octahedra, resulting in a "pinwheel" $Fe(PO_4)_6$ group. The linkage of octahedra and tetrahedra defines a thick layer parallel to {001}. The only linkage between layers is via hydrogen bonding to interlayer water molecules. **K.T.T.**

NANLINGITE*

Z. Yang, G. Giester, K. Ding, and E. Tillmanns (2011) Crystal structure of nanlingite—the first mineral with a $[Fe(AsO_3)_6]$ configuration. Eur. J. Mineral., 23, 63–71.

Nanlingite is a rare mineral and was first described as a new mineral in 1970 from a dolomitic limestone along a contact between greisenized granite and dolomitic limestone in the Nanling area, Hunan Province, China. In the first report of this mineral, the crystal structure and the chemical formula were unconfirmed.

The structure was solved and refined in space group $R\bar{3}m$, with $a = 10.2114(10)$, $c = 25.689(3)$ Å, $V = 2319.2(6)$ Å³, to $R_1 = 0.0208$, wR2 = 0.0487. The revised formula obtained in the present work by crystal-structure refinement is $Na(Ca_5Li)_6Mg_{12}(AsO_3)_2[Fe^{2+}(AsO_3)_6]F_{14}$, indicating that the previous formulae, either $CaMg_3(AsO_3)_2F_2$ or $CaMg_4(AsO_3)_2F_4$, are erroneous and should be corrected. **K.T.T.**

PEISLEYITE*

S. Mills, C. Ma, and W.D. Birch (2011) A contribution to understanding the complex nature of peisleyite. Mineralogical Magazine, 75(6), 2733–2737.

The type specimen of peisleyite has been reinvestigated because morphological investigation showed that mats of peisleyite crystals, individually <3 mm across, are intergrown with wavellite veinlets to form the white cryptocrystalline material that is typical of "peisleyite". New EPMA data (mean of 12 analyses) gave the empirical formula of peisleyite as $(Na_{1.69}Ca_{0.18})S_{\Sigma1.87}(Al_{9.04}Fe_{0.03})S_{\Sigma9.07}[(P_{6.28}S_{1.38}Si_{0.25})O_4]S_{\Sigma7.91}(OH)_{6.66}\cdot27.73H_2O$, or ideally $Na_2Al_9[(P,S)O_4]_8(OH)_6\cdot28H_2O$. The associated wavellite was found to be F-rich. Synchrotron powder data were indexed and refined and gave the following unit cell: $P\bar{1}$, $a = 9.280(19)$, $b = 11.976(19)$, $c = 13.250(18)$ Å, $α = 91.3(1)$, $β = 75.6(1)$, $γ = 67.67(1)°$, $V = 1308(5)$ Å³, and Z

= 4. These data are significantly different to those reported in the original description of peisleyite. **K.T.T.**

VLADIMIRITE*

H. Yang, S.H. Evans, R.T. Downs, and R.A. Jenkins (2011) The crystal structure of vladimirite, with a revised chemical formula, $Ca_4(AsO_4)_2(AsO_3OH)\cdot4H_2O$. Canadian Mineralogist, 49, 1055–1064.

Two samples of vladimirite, one from Bou Azzer, Morocco, and the other from a new occurrence in Copiapó, Chile (designated as R100075 and R080001, respectively), were examined with an electron microprobe, single-crystal X-ray diffraction, and Raman spectroscopy. These results show that vladimirite is monoclinic with space group $P2_1/c$ and unit-cell parameters $a = 5.8279(2)$, $b = 10.1802(4)$, $c = 22.8944(10)$ Å, $\beta = 96.943(2)°$, and $V = 1348.35(9)$ Å^3 for R100075 and $a = 5.8220(1)$, $b = 10.1750(2)$, $c = 22.8816(6)$ Å, $\beta = 96.902(1)°$, and $V = 1345.66(5)$ Å^3 for R080001. The structure determinations, with $R_1 = 0.022$ and 0.023 for R100075 and R080001, respectively, yielded an ideal chemical formula $Ca_4(AsO_4)_2(AsO_3OH)\cdot4H_2O$ ($Z = 4$) for this mineral, in contrast to $Ca_5(AsO_4)_2(AsO_3OH)_2\cdot5H_2O$ ($Z = 3$) documented in the literature. Vladimirite is remarkable inasmuch as one of the hydrogen-bonded O–H···O distances (O12H–H···O3) is only 2.465(2) Å, which is the shortest donor–acceptor distance of all known Ca-bearing arsenate minerals, similar to the short donor–acceptor distances observed in several synthetic compounds containing AsO_3OH groups. **K.T.T.**

WEEKSITE*

K. Fejfarova, J. Plášil, H. Yang, J. Čejka, M. Dušek, R.T. Downs, M.C. Barkley, and R. Škoda (2012) Revision of the crystal structure and chemical formula of weeksite, $K_2(UO_2)_2(Si_5O_{13})\cdot4H_2O$. American Mineralogist, 97, 750–754.

The previously published structure determination of weeksite from the Anderson mine, Arizona, U.S.A., suggested that it is orthorhombic, $Cmmb$, with $a = 14.209(2)$, $b = 14.248(2)$, $c = 35.869(4)$ Å, and $V = 7262(2)$ Å^3, and an ideal chemical formula $(K,Ba)_{1–2}(UO_2)_2(Si_5O_{13})\cdot H_2O$. New results demonstrate that weeksite is monoclinic, with the space group $C2/m$ and unit-cell parameters $a = 14.1957(4)$, $b = 14.2291(5)$, $c = 9.6305(3)$ Å, $\beta = 111.578(3)°$, $V = 1808.96(10)$ Å^3, and an ideal formula $K_2(UO_2)_2(Si_5O_{13})\cdot4H_2O$. The previously reported orthorhombic unit cell is shown to result from twinning of the monoclinic cell. **K.T.T.**