New Mineral Names*

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BURNSITE*

S.V. Krivovichev, L.P. Vergasova, G.L. Starova, S.K. Filatov, S.N. Britvin, A.C. Roberts, I.M. Steele (2002) Burnsite, $KCdCu_7O_2(SeO_3)_2Cl_9$, a new mineral species from the Tolbachik Volcano, Kamchatka Peninsula, Russia. Can. Mineral., 40, 1171–1175.

The mineral forms round, anhedral, equidimensional grains not exceeding 0.1 mm in size. Electron microprobe analysis gave K_2O 4.3, CuO 46.74, CdO 10.45, SeO_2 19.91, Cl 25.46, O ≡ Cl 5.75, sum 101.11 wt%, corresponding to $K_{1.08}Cd_{0.97}Cu_{6.98}O_{2.05}(Se_{1.07}O_{3.21})_2Cl_{8.53}$, ideally $KCdCu_7O_2(SeO_3)_2Cl_9$ for O + Cl = 17. Opaque to translucent, color dark red, streak red, vitreous (metalloid) luster, good {001} cleavage, uneven fracture, $H = 1$–$1½$, VHN = 12, brittle, $D_{calc} = 3.85$ g/cm³ for $Z = 2$. Optically uniaxial negative, $\varepsilon = 1.912(5)$, $\omega = 1.920(5)$. Not dichroic. Bireflectance weak, estimated to be 0.01. Single-crystal X-ray structure study gave hexagonal symmetry, space group $P6_3mmc$, $a = 8.7805(8)$, $c = 15.521(2)$ Å, $V = 1036.3(2)$ Å³. Strongest lines of the powder pattern (41 lines given, 114.6 mm Debye–Scherrer camera, Cu$K\alpha$ radiation, no standard): 7.779(100,002), 7.645(40,100), 6.823(50,101), 4.391(80,110), 3.814(80,200), 3.066(70,203), 2.582(50,006), 2.501(60,213), 2.272(40,303), 2.190(50,220), and 1.919(40,216).

The mineral occurs within a fumarole in the North Breach of the great fissure Tolbachik eruption, Kamchatka Peninsula, Russia. Associated minerals include cotunnite, sophiite, ilinskite, georgbokiite, chloromenite, and an undefined Cu-Pb selenite. Temperature of formation is estimated to be ~450–500 °C. The new mineral name is for Canadian-born mineralogist and crystallographer Peter C. Burns (b. 1966). Type material is in the Mining Museum, Mining Institute, Saint Petersburg, Russia.

Discussion. The ideal formula was confirmed by refinement of the crystal structure, $R_1 = 0.019$ (*Can. Mineral.*, 40, 1587–1595). **E.S.G.**

CATTIITE*

S.N. Britvin, G. Ferraris, G. Ivaldi, A.N. Bogdanova, N.V. Chukanov (2002) Cattiite, $Mg_3(PO_4)_2 \cdot 22H_2O$, a new mineral from Zhelezny Mine (Kovdor Massif, Kola Peninsula, Russia). Neues Jahrb. Mineral. Mon., 160–168.

The mineral forms masses up to 1.5 cm in size consisting of single crystals, some showing {001} as the dominant form. Wet chemical analysis gave MgO 18.0, FeO 0.1, P_2O_5 21.5, H_2O 60.8 (weight loss at 1000 °C), sum 100.7 wt%, corresponding to $(Mg_{2.92}Fe_{0.01})_{\Sigma2.93}P_{2.01}O_{7.955} \cdot 22.055H_2O$, ideally $Mg_3(PO_4)_2 \cdot 22H_2O$ for 30 O atoms. Transparent, colorless, streak presumably white, vitreous luster, pearly on cleavage planes, perfect {001} cleavage, uneven fracture, $H = 2$, $D_{meas} = 1.65(2)$, $D_{calc} = 1.64$ g/cm³ for the ideal formula and $Z = 1$. Optically biaxial negative, $\alpha = 1.459(1)$, $\beta = 1.470(1)$, $\gamma = 1.470(1)$ at $\lambda = 589$ nm, $2V_{meas} = 25(5)°$, $2V_{calc} = 0°$. Orientation $X \wedge [001] = 80°$, $Y \wedge [100] = 10°$, $Z \perp [001]$; the optic axis plane is nearly parallel to the cleavage. No pleochroism. Dispersion weak, $r < v$. The infrared spectrum includes features at 3490, 3390, and 3050 cm⁻¹ indicative of molecular H_2O, additional bands are at 2410, 2102, 1665, 1602, 1055, 1006, 900, 805, 787, and 557 cm⁻¹. X-ray structure study gave triclinic symmetry, space group $P\bar{1}$, $a = 6.932(2)$, $b = 6.925(3)$, $c = 16.154(5)$ Å, $\alpha = 82.21(4)$, $\beta = 89.70(4)$, $\gamma = 119.51(3)°$ $V = 666.3(3)$ Å³. Strongest lines of the powder pattern (76 lines given, diffractometer, Co$K\alpha$ radiation, no standard): 7.98(100,002), 5.32(63,003), 4.96(27, $\bar{1}12$), 4.44(26,01$\bar{2}$), 4.13(26,$\bar{1}13$), 3.19(45,1$\bar{1}4$,005,2$\bar{1}2$), 2.896(33,202), 2.867(30,$\bar{2}22$), 2.728(32,1$\bar{1}5$), and 2.658 (37,006,02$\bar{2}$).

The mineral occurs in cavities in a dolomite carbonatite vein that cuts forsterite-magnetite ore in the Zhelezny (Iron) mine, Kovdor carbonatite massif, Kola Peninsula, Russia. It is associated with nastrophite, bakhchisaraitsevite, sjogrenite, magnetite, and carbonate-fluorapatite. The new mineral name is for Michele Catti, Professor of Physical Chemistry, University of Milano Bicocca. Holotype material is in the Mineralogical Museum, Department of Mineralogy, Saint Petersburg State University, Saint Petersburg, Russia.

Discussion. The mineral corresponds to the synthetic polytype 1A2 of $Mg_3(PO_4)_2 \cdot 22H_2O$. **E.S.G.**

CERITE-(LA)*

Ya.A. Pakhomovsky, Yu.P. Men'shikov, V.N. Yakovenchuk, G.Yu. Ivanyuk, S.V. Krivovichev, P.C. Burns (2002) Cerite-(La), $(La,Ce,Ca)_9(Fe,Ca,Mg)(SiO_4)_3[SiO_3(OH)]_4(OH)_3$, a new mineral species from the Khibina alkaline massif: occurrence and crystal structure. Can. Mineral., 40, 1177–1184.

The mineral forms crystals, either equant or flattened on c and up to 2 mm across, with dominant rhombohedron {102} and pinacoid {001} faces. The averaged electron microprobe analyses (H_2O by the Penfield method) gave La_2O_3 37.57, Ce_2O_3

23.67, Pr_2O_3 0.61, Nd_2O_3 1.48, Sm_2O_3 0.10, Gd_2O_3 0.24, SrO 1.97, CaO 5.09, Fe_2O_3 1.40, MgO 0.51, SiO_2 22.38, P_2O_5 0.63, H_2O 3.20, sum 98.85 wt%, corresponding to $(La_{4.23}Ce_{2.65}Ca_{1.37}$ $Sr_{0.35}Nd_{0.16}Pr_{0.07}Gd_{0.07}Sm_{0.01})_{\Sigma 8.86}(Fe_{0.32}Ca_{0.30}Mg_{0.23})_{\Sigma 0.85}$ $[SiO_4]_3$ $[(Si_{0.84}P_{0.16})_{\Sigma 1.00}O_3(OH)]_4(OH)_{2.78}$, ideally $(La,Ce,Ca)_9$ (Fe,Ca,Mg) $(SiO_4)_3[SiO_3(OH)]_4(OH)_3$ for Si + P = 7. Translucent, color light yellow to pinkish brown, streak white, vitreous luster, no cleavage, conchoidal fracture, $H = 5$, brittle, $D_{meas} = 4.7(1)$, $D_{calc} = 4.74$ g/cm^3 for $Z = 6$. Optically uniaxial positive, $\varepsilon = 1.820(5)$, $\omega = 1.810(5)$ for $\lambda = 589$ nm. Not dichroic. X-ray structure study ($R_1 = 0.036$) gave hexagonal symmetry, space group $R3c$, $a = 10.7493(6)$, $c = 38.318(3)$ Å, $V = 3834.4(4)$ Å^3. Strongest lines of the powder pattern (40 lines given, diffractometer, Cu$K\alpha$ radiation): 3.53(26,1.0.10, 211), 3.47(40,122), 3.31(38,214), 3.10(25,300), 2.958(100,0.2.10), 2.833(37,128), 2.790(24,306), 2.689(34,220), 1.949 (34,238,1.3.13), and 1.755(23,3.0.18).

The mineral occurs as a late-stage, low-temperature, secondary phase in a zoned aegirine-natrolite-microcline vein that cuts foyaite at Mt. Yuksporr, Khibina massif, Kola Peninsula, Russia. The mineral forms porous pseudomorphs, up to 7×2 cm, of an unidentified prismatic, hexagonal mineral, possibly belovite-(Ce), which is associated with ilmenite, anatase, and cerite-(Ce) in columnar natrolite. The new mineral name is for its being the La-dominant analog of cerite-(Ce). Holotype material is in the Mining Museum of the Saint Petersburg Mining Institute (Technical University), Saint Petersburg; the Mineralogical Museum of the Saint Petersburg State University, Saint Petersburg; and in the Geological and Mineralogical Museum of the Geological Institute of the Kola Science Center, Apatity, Russia. **E.S.G.**

FERROHÖGBOMITE-2*N*2*S**

C. Hejny, E. Gnos, B. Grobety, T. Armbruster (2002) Crystal chemistry of the polysome ferrohögbomite-2*N*2*S*, a long-known but newly defined mineral species. Eur. J. Mineral., 14, 957–967.

The mineral forms euhedral grains up to 0.3 mm in size, many with hexagonal contours. The average electron microprobe analyses (H_2O and Fe_2O_3/FeO ratio calculated assuming stoichiometry) gave TiO_2 5.04, SnO_2 0.38, SiO_2 0.04, Al_2O_3 59.28, Cr_2O_3 0.09, Ga_2O_3 0.25, Fe_2O_3 8.05, FeO 16.35, MgO 3.27, MnO 0.25, ZnO 5.88, NiO 0.05, CaO 0.02, H_2O 1.42, sum 100.37 wt%, corresponding to $(Fe^{2+}_{2.91}Zn_{0.92}Mg_{1.04}Mn_{0.05}Ni_{0.01}$ $Al_{1.07})_{\Sigma 6}(Al_{13.82}Fe^{3+}_{1.29}Ga_{0.03}Cr_{0.02}Ti_{0.81}$ $Sn_{0.03}Si_{0.01})_{\Sigma 16.01}O_{30}(OH)_2$, ideally $(Fe^{2+}_3ZnMgAl)_{\Sigma 6}(Al_{14}Fe^{3+}Ti)_{\Sigma 16}O_{30}(OH)_2$ for 22 cations and 62 anionic charges. Translucent, color reddish brown, streak brownish, adamantine luster, pronounced {001} cleavage, conchoidal fracture, $H = 6$–7, brittle, $D_{calc} = 4.04$ g/cm^3 for $Z = 1$. Optically uniaxial negative, $\varepsilon = 1.83$, $\omega = 1.85$. Dichroism from orange-brown to yellow. Single-crystal X-ray structure study gave hexagonal symmetry, space group $P6_3mc$, $a = 5.712(1)$, $c = 18.317(7)$ Å, $V = 517.6(4)$ Å^3. Strongest lines of the powder pattern (26 lines given, diffractometer, Cu$K\alpha$ radiation, NaCl standard, cited from Čech et al., 1976, *Neues Jahrb. Mineral. Mon.*, 1976, 525–531): 2.948(32,015), 2.860(53,110), 2.603(88,016), 2.427(100,114), 2.392(28,022), 2.053(34,025),

1.597(34,126), 1.475(44,0.2.10), and 1.430(56,220).

The mineral occurs at Aïn Taïba, Grand Erg Oriental, Algerian Sahara. Associated minerals are ilmenite, pseudorutile, hercynite, and magnetite, with the last largely replaced by hematite. The Fe-Ti oxides constitute an isolated rock of unknown provenance in the desert. The new mineral name is for its being the Fe-dominant member of the högbomite polysomatic series (see *Am. Mineral.*, 88, 254–255). The holotype specimen is in the Museum of Natural History, Bern.

Discussion. Although not recognized as a distinct species at the time, ferrohögbomite-2*N*2*S* was first reported in 1976 from Lusaka, Zambia, and later at three other localities; it is typically a mineral of metamorphic environments (T from ≤500 °C to 730 °C). **E.S.G.**

GREIFENSTEINITE*

N.V. Chukanov, S. Möckel, R.K. Rastsvetaeva, A.E. Zadov (2002) Greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5(PO_4)_6(OH)_4 \cdot 6H_2O$– a new mineral from Greifenstein, Saxony. Zapiski Vseross. Mineral. Obshch., 131(4), 47–52 (in Russian).

R.K. Rastsvetaeva, O.A. Gurbanova, N.V. Chukanov (2002) Crystal structure of greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5$ $(PO_4)_6(OH)_4 \cdot 6H_2O$. Doklady Akad. Nauk 383, 354–357 (in Russian; English translation in Doklady Chemistry, 383, 78–81).

The mineral forms subparallel and radial aggregates of poorly formed crystals up to 5 mm in size. Electron microprobe analysis (mean of 5) of the holotype specimen, combined with atomic absorption spectroscopy for BeO and vacuum thermogravimetry for H_2O gave MgO 0.34, CaO 9.98, FeO 22.42, Fe^{3+} is absent (Mössbauer spectrum), MnO 5.56, Al_2O_3 1.05, P_2O_5 38.36, BeO 9.24, H_2O 13.6, sum 100.55 wt%, corresponding to $Ca_{0.99}Be_{2.05}(Fe^{2+}_{1.73}Mn^{2+}_{0.44}Al_{0.11}Mg_{0.05})_{\Sigma 2.33}$ $[PO_4]_3(OH)_{1.86} \cdot 3.26H_2O$ for P = 3. Transparent or translucent, color dark olive-green. Brittle, $H = 4\frac{1}{2}$, no cleavage, parting {100}, uneven fracture, $D_{meas} = 2.93(2)$, $D_{calc} = 2.95(2)$ g/cm^3 for $Z = 4$. Optically biaxial negative, $\alpha = 1.624(2)$, $\beta = 1.634(2)$, $\gamma = 1.638(2)$, $X = b$. Pleochroism: X = light bluish green, Y = light green, Z = brownish green. The infrared spectrum includes a feature at 1658 cm^{-1} indicative of molecular H_2O, and a BeO_4 feature at 720 cm^{-1}; additional bands are at 3450, 3345, 1100, 1079, 1032, 960, 813, 760, 695, 610, 559, 523, 490, and 440 cm^{-1}. Single-crystal X-ray structural study ($R = 0.047$) showed the mineral to have monoclinic symmetry, space group $C2/c$, $a = 15.903(7)$, $b = 11.885(7)$, $c = 6.677(3)$ Å, $\beta = 94.68(4)°$, $V = 1258(1)$ Å^3. The strongest lines, of 33 lines listed in the powder pattern (86 mm Debye–Scherrer, Fe$K\alpha$ radiation, Si standard), are: 9.48(100,110), 5.94(80,020), 4.82(60,310), 3.96(90,400), 3.068(60,510), 2.982(70,202), 2.783(80,240), and 2.638(70,600).

The mineral occurs in miarolitic cavities in Li-rich granite pegmatite at Greifenstein, Saxony, Germany, in association with albite, K-feldspar, roscherite, viitaniemiite, childrenite, quartz, an apatite-group mineral, herderite, elbaite, and montmorillonite. The new name is for the locality. Type material is in the State Museum of Mineralogy and Geology, Dresden, Germany.

Discussion. A formula consistent with the structure refinement and chemical analysis is $Ca(\square_{0.67}Mn_{0.33})(Fe^{2+}_{1.73}Mn_{0.11}Al_{0.11}Mg_{0.05})_{\Sigma2}Be_2(PO_4)_3(OH)_2 \cdot 3H_2O$ ($Z = 4$). The formula in the title of the two papers is misleading because it implies full occupancy of the two octahedral sites and Fe dominance in both. The mineral is the Fe-dominant analog of monoclinic roscherite and zanazziite and had been reported from several other localities prior to its recognition as a distinct species. **N.N.P.**

HUBEITE*

F.C. Hawthorne, M.A. Cooper, J.D. Grice, A.C. Roberts, W.R. Cook, Jr., R.J. Lauf (2002) Hubeite, a new mineral from the Daye Mine near Huangshi, Hubei Province, China. Mineral. Record, 33, 465–471.

The mineral forms radiating fan-like or "bow-tie" aggregates up to 5 mm of intergrown crystals not exceeding 1 mm in size. Dominant forms are {001} and {101}, with minor {100}, {0$\overline{1}$1}, and {35$\overline{2}$}. Electron microprobe analysis (H$_2$O calculated on basis of structural refinement) gave SiO$_2$ 44.39, Al$_2$O$_3$ 0.38, Fe$_2$O$_3$ 13.94, MgO 0.29, MnO 11.34, CaO 21.91, H$_2$O 8.32, sum 100.57 wt%, corresponding to $Ca_{2.00}(Mn^{2+}_{0.87}Ca_{0.12})_{\Sigma0.99}(Fe^{3+}_{0.94}Al_{0.04}Mg_{0.04})_{\Sigma1.02}Si_{4.00}O_{12}(OH)(H_2O)_2$, ideally $Ca_2Mn^{2+}Fe^{3+}Si_4O_{12}(OH)(H_2O)_2$ for 15 anions with OH = 1 and H$_2$O = 2 per formula unit. Transparent, color pale to dark brown, streak pale orange-brown, vitreous luster, good {001} cleavage, conchoidal fracture, $H = 5\frac{1}{2}$, brittle, $D_{meas} = 3.02(2)$, $D_{calc} = 3.01$ g/cm^3 for $Z = 2$. Optically biaxial, sign indeterminate, $\alpha = 1.667(1)$, $\beta = 1.679(1)$, $\gamma = 1.690(1)$, $2V_{meas} = 89(2)°$, $2V_{calc} = 87(5)°$ (for $2V_x$). Orientation $X \wedge b = 20°$ (in γ obtuse), $Y \wedge c = 13°$ (in α acute), $Z = a$. Pleochroism is strong: $X =$ yellow-brown (greenish tint), $Z =$ dark yellow-brown, with absorption $Z > X$ (Y not given). The infrared spectrum includes an OH feature at ~3609 cm^{-1}, and H$_2$O features at 3455, ~3215, 3115, and ~1609 cm^{-1}. Single-crystal X-ray structure study (M.A. Cooper and F.C. Hawthorne, *Can. Mineral.*, submitted) gave triclinic symmetry, space group $P\overline{1}$. Powder data gave $a = 9.960(6)$, $b = 13.87(2)$, $c = 6.562(7)$ Å, $\alpha = 133.19(6)$, $\beta = 101.50(6)$, $\gamma = 66.27(5)°$, $V = 601(1)$ Å^3. Strongest lines of the powder pattern (50 lines given, 114.6 mm Debye–Scherrer camera, Co$K\alpha$ radiation, no standard): 9.072(100,100), 8.238(90,110), 5.000(30,120), 3.192(30,230), 3.126(70,320), 3.095(70,$\overline{1}$42), 2.781(60,$\overline{2}$20), 2.695(30,$\overline{1}$52), 1.993(30,331), and 1.627(30,$\overline{1}$54,1$\overline{7}$3).

The mineral occurs at the Daye mine, near Huangshi, Hubei province, China. Associated minerals include inesite, natroapophyllite-fluorapophyllite, quartz, pyrite, and calcite. The new mineral name is for the type locality. The holotype specimen is in the Canadian Museum of Nature, Ottawa. **E.S.G.**

POTASSICLEAKEITE*

S. Matsubara, R. Miyawaki, M. Kurosawa, Y. Suzuki (2002) Potassicleakeite, a new amphibole from the Tanohata mine, Iwate Prefecture, Japan. J. Mineral. Petrol. Sci., 97, 177–184.

The mineral forms prismatic crystals up to 2 mm in length

and 0.2 mm in width, elongate along c and having a rhombic cross-section. Electron microprobe analysis (Li by laser ablation microprobe inductively coupled plasma mass spectrometry, H$_2$O calculated from stoichiometry) gave SiO$_2$ 55.34, TiO$_2$ 0.29, Al$_2$O$_3$ 0.44, V$_2$O$_3$ 5.52, Fe$_2$O$_3$ 9.45, MnO 7.81, MgO 7.23, CaO 0.13, K$_2$O 3.1, Na$_2$O 8.73, Li$_2$O 1.2, F 0, H$_2$O 2.08, sum 100.12 wt%, corresponding to $(K_{0.57}Na_{0.46})_{\Sigma1.03}(Na_{1.98}Ca_{0.02})_{\Sigma2.00}(Mg_{1.55}Fe^{3+}_{1.02}Mn_{0.95}Li_{0.70}V_{0.64}Al_{0.05}Ti_{0.03})_{\Sigma4.94}(Si_{7.98}Al_{0.02})_{\Sigma8.00}O_{22}(OH)_2$, ideally $KNa_2Mg_2Fe^{3+}_2LiSi_8O_{22}(OH)_2$ for O + OH = 24, i.e., the K-dominant analog of leakeite. Transparent, color reddish brown, streak pale brownish yellow, vitreous luster, perfect {110} cleavage, uneven fracture, brittle, $H \sim 5$, $VHN_{100} = 425$–572, $D_{calc} = 3.18$ g/cm^3 for the empirical formula and $Z = 2$. Optically biaxial positive, $\alpha = 1.672(2)$, $\beta = 1.680(2)$, $\gamma = 1.692(2)$, $2V_{calc} = 79°$. Orientation $X \wedge c = +35$ to $40°$, $Z = b$. Pleochroism is distinct: $X =$ yellowish brown, $Y =$ pale brown, $Z =$ reddish brown. X-ray structure study ($R_1 = 0.0258$) gave monoclinic symmetry, space group $C2/m$, $a = 9.932(3)$, $b = 18.003(5)$, $c = 5.2893(12)$ Å, $\beta = 104.04(2)°$, $V = 917.5(4)$ Å^3. Strongest lines of the powder pattern (64 lines given, 114.6 mm Debye–Scherrer camera, Cu$K\alpha$ radiation, Si standard): 8.48(67,110), 4.50(89,040), 3.40(46,131), 3.28(45,240), 3.16(72,310,201), 2.83(49,330), 2.74(44,$\overline{3}$31), 2.71(41,151), and 2.53(100,$\overline{2}$02).

The mineral occurs in pegmatite-like veinlets that cut a Mn ore body in the Tanohata mine, Iwate Prefecture, Japan. It is associated with quartz, K-feldspar, V-dominant mangan-neptunite, suzukiite, roscoelite, and serandite. The new mineral is a member of the amphibole group and is named for being the K-dominant analog of leakeite. Type material is in the National Science Museum, Tokyo. **E.S.G.**

RADOVANITE*

H. Sarp, L. Guenee (2002) Radovanite, $Cu_2Fe^{3+}(As^{5+}O_4)(As^{3+}O_2OH)_2H_2O$, a new mineral: its description and crystal structure. Archs Sci. Genève, 55(1), 47–55.

The mineral forms aggregates up to 2 mm in size consisting of equidimensional to slightly elongate (along a or b) crystals up to $0.15 \times 0.08 \times 0.02$ mm. The best developed forms are {101}, {011}, {001}, {010}, {hk0}, and {hkl}. Electron microprobe analysis (H$_2$O estimated by difference, Fe valence from the structure refinement) gave CuO 26.3, Fe$_2$O$_3$ 12.7, Al$_2$O$_3$ 0.04, P$_2$O$_5$ 0.3, As$_2$O$_5$ 19.93, Al$_2$O$_3$ 34.32, H$_2$O 6.41, sum 100.00 wt%, corresponding to $Cu_{1.93}Fe^{3+}_{0.92}Al_{0.01}P_{0.02}As^{5+}_{1.01}As^{3+}_{2.01}H_{4.15}O_{11}$, ideally $Cu_2Fe^{3+}(As^{5+}O_4)(As^{3+}O_2OH)_2H_2O$ for 11 oxygens, which was confirmed by crystal structure determination ($R = 0.059$). Transparent, color pistachio green, streak green, vitreous luster, no cleavage, conchoidal fracture. H could not be determined, brittle, $D_{meas} = 3.9(1)$, $D_{calc} = 3.79(1)$ g/cm^3 for the empirical formula and $Z = 4$. Optically biaxial negative, $\alpha = 1.80(1)$, $\beta = 1.84(1)$, $\gamma = 1.86(1)$ at $\lambda = 589$ nm, $2V_{meas} = 65(5)°$, $2V_{calc} = 70(3)°$. Orientation $X = c$, $Y = a$, $Z = b$. Pleochroism is moderate: $X =$ light green to colorless, $Y =$ yellow green, $Z =$ pistachio green. X-ray structure study gave orthorhombic symmetry, space group $Pnma$, $a = 9.585(1)$, $b = 13.143(1)$, $c = 8.0884(7)$ Å, $V = 1018.9(2)$ Å^3. Strongest lines of the powder pattern (29 lines given, 114.6 Gandolfi camera, Cu$K\alpha$ radia-

tion, no standard): 6.88(25,011), 6.179(90,101), 3.871(20,220), 3.241(40,122), 3.090(100,202), 2.710(25,240,321), 2.551(20,042), and 2.214(25,251,223).

The mineral occurs in the Roua copper deposit in the upper part of the Var valley (Daluis gorge), Alpes-Maritimes, France. It is associated with cuprite, native copper, malachite, trippkeite, olivenite, and algodonite. The new mineral name is for Dr. Radovan Černý, crystallographer at the University of Geneva. Type material is in the Department of Mineralogy of the Natural History Museum of Geneva. **E.S.G.**

SEWARDITE*

A.C. Roberts, M.A. Cooper, F.C. Hawthorne, A.J. Criddle, J.A.R. Stirling (2002) Sewardite, $CaFe_2^{3+}(AsO_4)_2(OH)_2$, the Ca-analog of carminite, from Tsumeb, Namibia: description and crystal structure. Can. Mineral., 40, 1191–1198.

The mineral forms platy to compact anhedral to subhedral masses up to 0.3 mm in size in a single specimen; individual fragments are 50–100 m. The averaged electron microprobe analyses (H_2O calculated by stoichiometry) gave CaO 11.77, ZnO 1.68, CuO 0.28, Fe_2O_3 31.65, As_2O_5 48.81, H_2O 4.04, sum 98.23 wt%, corresponding to $Ca_{0.99}(Fe_{1.87}^{3+}Zn_{0.10}Cu_{0.02})_{\Sigma 1.99}$ $As_{2.01}^{5+}O_{8.00}[(OH)_{1.88}(H_2O)_{0.12}]_{\Sigma 2.00}$, ideally $CaFe_2^{3+}(AsO_4)_2(OH)_2$ for 10 anions. The presence of H_2O as OH and very minor H_2O was confirmed by crystal structure analysis, $R = 0.061$, and infrared spectroscopy. Translucent, dark red, streak reddish brown, vitreous luster, imperfect {100} and {011} cleavages, splintery (in the [011] direction) to uneven fracture, $H = 3\frac{1}{2}$, brittle, $D_{calc} = 4.156$ g/cm³ for $Z = 8$. Indices calculated from reflectances in air at 589 nm are $n_1 = 1.87$, $n_2 = 1.92$. Light bluish gray in plane-polarized reflected light; internal reflections bright pink to red, weak bireflectance, no anisotropy and no pleochroism. Representative reflectance percentages for R_1 and R_2, given in 20 nm steps (a few in steps <20 nm) from 400 to 700 nm in air, SiC standard, are 10.12, 10.71 (460), 9.53, 10.07 (540), 9.30, 9.98 (580), and 8.99, 9.66 (640). The infrared spectrum includes absorption bands at 3150, 1560, 1181, 1084, 1015, 895, 817, and 768 cm⁻¹. X-ray structure study gave orthorhombic symmetry, space group $Cccm$, $a = 16.461(2)$, $b = 7.434(1)$, $c = 12.131(2)$ Å, $V = 1484.5(6)$ Å³. Strongest lines of the powder pattern (57 lines given, 114.6 mm Debye–Scherrer camera, Cu$K\alpha$ radiation, no standard): 4.874(90,202), 3.473(50,113), 3.389(60,220), 3.167(100,022), 3.015(50,510), 2.988(50,313), 2.919(70,511), 2.503(90,422,314), and 1.775(50,533,026).

The mineral occurs within a 3 cm vug at the 31st level of the Tsumeb mine, Namibia. It is intergrown with ferrilotharmeyerite and another mineral, possibly cuprian, zincian ferrilotharmeyerite or the Zn-dominant analog of lukrahnite. The new mineral name is for Terry Maxwell Seward (b. 1940), who collected the specimen and recognized its potential as a new species. Holotype material is in the National Mineral Collection at the Geological Survey of Canada, Ottawa; the studied polished section is in the The Natural History Museum, London, UK. **E.S.G.**

NEW DATA

ALLANITE SUBGROUP

T.C. Ercit (2002) The mess that is "allanite". Can. Mineral., 40, 1411–1419.

It is recommended that all members of the epidote group in which lanthanon (Ln = rare-earth elements and yttrium) are dominant at the A2 site be referred to as belonging to an allanite subgroup (Table 1), or more simply, allanite-subgroup minerals have more than 0.5 Ln per formula unit. The two large cation sites (A) and three octahedrally coordinated sites (M) are highly ordered. The proposed classification is based on end-members derived from occupancies of each of these sites considered separately. The preferred method for calculating formulae from electron microprobe data is to assume that M + T cations total 6 and anions total 12 (O,F,Cl) + 1 (OH), i.e., normalizing M + T to 6 and adjusting Fe^{2+}/Fe^{3+}ratio so that the total number of positive charges totals 25 minus the (F + Cl) content. If this procedure yields negative Fe^{2+} or Fe^{3+}, anion-site vacancies or OH-O disorder, then compositions should be calculated on a fixed number of total anions, i.e., (O,F,Cl) + 1 (OH) = 12, and Fe assumed to be either all Fe^{2+} or all Fe^{3+}. Several unusual compositions reported in the literature appear to be new species based on dominant constituents at the various sites, but in terms of end-members, they are intermediate between known species, e.g., ceroan clinozoisite between clinozoisite and allanite-(Ce), and solid solutions between epidote and allanite-(Ce). Five new end members are dominant components in other reported compositions (Table 1), but more work is needed for these to be described as new species.

Discussion. Defining end-members on the basis of site occupancies clarifies the distinctions both between the allanite subgroup and other minerals in the epidote group and among the individual allanite-subgroup minerals. As with all formulae-calculation protocols based on electron microprobe data alone, the one proposed here requires several critical assumptions. It generates a very high degree of cation order in the calculated formulae, more than has been found in detailed studies. Definitions of new species involving complex compositions will probably require crystal-structure refinements for proper documentation. **E.S.G.**

TABLE 1. Nomenclature and formulae of end-members in the allanite subgroup ($Z = 2$)

Species	Composition based on site occupancies A1 A2 M3 M1 M2 (Si$_2$O$_7$) (SiO$_4$) O4 (OH)
Known end-members	
Allanite-(Ce)	$CaCeFe^{2+}Al_2(Si_2O_7)(SiO_4)O(OH)$
Allanite-(La)	$CaLaFe^{2+}Al_2(Si_2O_7)(SiO_4)O(OH)$
Allanite-(Y)	$CaYFe^{2+}Al_2(Si_2O_7)(SiO_4)O(OH)$
Dissakisite-(Ce)	$CaCeMgAl_2(Si_2O_7)(SiO_4)O(OH)$
Dollaseite-(Ce)	$CaCeMg_2Al(Si_2O_7)(SiO_4)F(OH)$
Khristovite-(Ce)	$CaCeMn^{2+}MgAl(Si_2O_7)(SiO_4)F(OH)$
Androsite-(La)	$Mn^{2+}LaMn^{2+}Mn^{3+}Al(Si_2O_7)(SiO_4)O(OH)$
Potentially new end-members	
Unnamed	$(Ca_{0.5}\square_{0.5})CeFe^{3+}Al_2(Si_2O_7)(SiO_4)O(OH)$
Unnamed	$CaLaV^{3+}Al_2(Si_2O_7)(SiO_4)O(OH)$
Unnamed	$CaCeFe^{2+}Fe^{3+}Al(Si_2O_7)(SiO_4)O(OH)$
Unnamed	$CaLaFe^{2+}Fe^{3+}Al(Si_2O_7)(SiO_4)O(OH)$
Unnamed	$CaLaMgAl_2(Si_2O_7)(SiO_4)O(OH)$

FERSMANITE

E. Sokolova, F.C. Hawthorne, A.P. Khomyakov (2002) The crystal chemistry of fersmanite, $Ca_4(Na,Ca)_4(Ti,Nb)_4$ $(Si_2O_7)_2O_8F_3$. Can. Mineral., 40, 1421–1428, 1743.

Single-crystal X-ray structure study ($R = 0.041$) of fersmanite from the type locality, the Khibina massif, Kola Peninsula, Russia, indicated monoclinic symmetry, $C2/c$ with $a = 10.183(2)$, $b = 10.183(2)$, $c = 20.396(4)$ Å, $\beta = 97.19(3)°$, $V = 2098.2(2)$ Å^3, $D_{calc} = 3.159$ g/cm^3 for $Z = 4$. Electron microprobe analysis gave SiO$_2$ 22.09, Nb$_2$O$_5$ 20.00, Ta$_2$O$_5$ 0.40, TiO$_2$ 17.06, FeO 0.15, MnO 0.16, CaO 27.24, SrO 0.83, Na$_2$O 7.29, F 5.24 (by stoichiometry), F 6.16 (by electron microprobe), O $\equiv$ F 2.20 (F by stoichiometry), sum 99.85 wt%, corresponding to $(Ca_{5.29}Na_{2.56}Sr_{0.09}Fe^{2+}_{0.02}Mn^{2+}_{0.03})_{\Sigma7.99}(Ti_{2.32}$ $Nb_{1.64}Ta_{0.02})_{\Sigma3.98}Si_{4.00}O_{22}F_3$ for 25 anions with F = 3 per formula unit, ideally $Ca_4(Na,Ca)_4(Ti,Nb)_4(Si_2O_7)_2O_8F_3$, where the two octahedrally coordinated A sites occupied solely by Ca are distinguished from [8]-coordinated A sites occupied by Na, Ca, and Sr. This composition corresponds closely to a 0.46/0.54 mixture of the end members $Ca_4(Na_3Ca)Ti^{4+}_4(Si_2O_7)_2O_8F_3$ and $Ca_4Na_4Ti^{4+}Nb_3(Si_2O_7)_2O_8F_3$, respectively.

Discussion. The structure refinement confirms the formula and symmetry reported by Saf'yanov et al. (1984, *Sov. Phys. Crystallogr.*, 29, 31–33), except that the two octahedrally coordinated A sites lack Na and that the standard setting with *b* unique was used. The triclinic symmetry and anion composition reported by Machin (1977, *Can. Mineral.*, 15, 87–91) for fersmanite, also from the type locality, is not confirmed by either of the more recent studies. **E.S.G.**

HUMMERITE

J.M. Hughes, M. Schindler, J. Rakovan, F.E. Cureton (2002) The crystal structure of hummerite, $KMg(V_5O_{14})$ $8H_2O$: bonding between the $[V_{10}O_{28}]^{6-}$ structural unit and the $\{K_2Mg_2(H_2O)_{16}\}^{6+}$ interstitial complex. Can. Mineral., 40, 1429–1435.

Single-crystal X-ray structure study ($R = 0.021$) of hummerite from the type locality, Hummer mine, Montrose County, Colorado, gave triclinic symmetry, $P\bar{1}$bar, with $a = 8.8178(4)$, $b = 10.7236(5)$, $c = 11.0707(5)$ Å, $\alpha = 65.798(1)$, $\beta = 74.057(1)$, $\gamma = 71.853(1)°$. Qualitative energy dispersion electron microprobe analysis showed that, of elements with Z $\geq$ 8, only K, Mg, V, and O were present.

Discussion. The triclinic symmetry (pinacoidal class) was recognized in the original description (*Am. Mineral.*, 36, 326–327, 1951). However, the cell orientation used in the first crystallographic study (*Am. Mineral.*, 40, 314–315, 1955) and in a subsequent crystal structure refinement (D.T. Griffen, 1990, *Brigham Young Uni. Geology Studies*, 36, 1–14) differs from the one given above: Griffen reported $a = 10.735(2)$, $b = 11.085(2)$, $c = 8.831(1)$ Å, $\alpha = 106.01(1)$, $\beta = 108.04(1)$, $\gamma = 65.81(1)°$, $V = 897.9(2)$ Å^3. **E.S.G.**

KUTINAITE

L. Karanović, D. Poleti, E. Makovicky, T. Balić-Žunić, M. Makovicky (2002) The crystal structure of synthetic kutinaite, $Cu_{14}Ag_6As_7$. Can. Mineral., 40, 1437–1449.

Powder X-ray structure study, using the Rietveld method ($R_{wp} = 0.182$), of synthetic kutinaite, $Cu_{14.35}Ag_{6.02}As_7$ by electron microprobe analysis, indicated isometric symmetry, $Pm\bar{3}m$, with $a = 11.78079(2)$ Å, $V = 1635.020(5)$ Å^3, $D_{calc} = 8.400$ g/cm^3 for $Z = 4$. $D_{meas} = 8.36$ g/cm^3. The study presents the first determination of the space group of the mineral. **E.S.G.**

LIZARDITE-SAPONITE INTERSTRATIFICATION

A.I. Gorshkov, N.N. Zinchuk, D.D. Kotel'nikov, V.G. Shlykov, A.P. Zhukhlistov, A.V. Mokhov, A.V. Sivtsov (2002). A new ordered mixed-layer mineral lizardite-saponite from South Africa kimberlites. Doklady Akad. Nauk 382, 374–378 (in Russian).

A mixed-layer mineral occurs with lizardite in the <1 m fraction of an unusual layer in kimberlite. The ratio of the mineral to lizardite is 1 to 1.17; larger flakes of lizardite are present in a fine-grained mass of the mixed-layer mineral. Wet chemical analysis of the <1 m fraction gave SiO$_2$ 38.81, TiO$_2$ 0.17, Al$_2$O$_3$ 1.75, Fe$_2$O$_3$ 6.00, FeO 1.55, NiO 0.19, MnO 0.93, MgO 30.50, CaO 0.97, Na$_2$O 0.13, K$_2$O 0.073, P$_2$O$_5$ 0.11, H$_2$O$^-$ 3.30, H$_2$O$^+$ 16.10, sum 99.74 wt%. After deducting for the contribution from lizardite, the analysis was recalculated to give $(Mg_3Si_2)[Ca_{0.25}(Mg_{2.6}Fe_{0.4})(Si_{3.5}Al_{0.5})]O_{15}(OH)_6 \cdot nH_2O$ for the mixed-layer mineral in terms of two components alternating as ABAB. The mixed-layer mineral was studied by diffractometry (dry and saturated with ethylene glycol and glycerol), electronography, analytical electron microscopy, and IR spectroscopy. A microdiffractogram showed ordered alternation of lizardite and saponite layers, with a 16.8 Å period and reflections at 16.8 (intensity obscured by beam spot, 001), 8.40 (strong, 002), 5.60 (weak, 003), 4.20 (weak, 004), 3.36 (strong, 005), 2.80 (weak, 006), 2.40 (very weak, 007), 2.10 (very weak, 008), 1.87 (very weak, 009), and 1.68 (very weak, 0.0.10) Å; calculated intensities for basal reflections (001) to (0.0.10) are, respectively, 11.3, 72.8, 11.8, 10.1, 78.2, 9.8, 2.3, 1.3, 7.8, and 1.2. A crystallochemical model shows an ordered alternation of 1:1 layers of lizardite and 2:1 layers of saponite. Two kinds of interlayer spaces separate the tetrahedral sheets in the lizardite and saponite layers: one kind has exchangeable cations (mostly Ca), and the other does not have exchangeable cations; water molecules are present in both. The mineral occurs in an autolith in kimberlite from an unspecified South African pipe at a depth of 299 m.

Discussion. The lizardite-saponite interstratification could merit a species name if it were sufficiently regular to meet the criteria given in the report by the Nomenclature Committee of the International Association for the Study of Clays (Bailey, *Am. Mineral.*, 67, 394–398), e.g., that even and odd (00*l*) reflections have closely similar diffraction breadths and that the coefficient of variation of the *d* (00*l*) values not exceed 0.75. Another criterion has been met: a minimum of ten 00*l* values was observed. **N.N.P.**

PROTOFERRO-ANTHOPHYLLITE, PROTOMANGANO-FERRO-ANTHOPHYLLITE

S. Sueno, S. Matsuura, M. Bunno, M. Kurosawa (2002) Occurrence and crystal chemical features of protoferro-

anthophyllite and protomangano-ferro-anthophyllite from Cheyenne Canyon and Cheyenne Mountain, U.S.A. and Hirukawa-mura, Suisho-yama, and Yokone-yama, Japan. J. Mineral. Petrol. Sci., 97, 127–136.

These minerals were first described by Sueno et al. (1998, *Phys. Chem. Mineral.*, 25, 366–377; see *Am. Mineral.*, 84, 196). New data in the 2002 paper include measured powder diffraction patterns and additional details on the occurrence.

Protoferro-anthophyllite

The optical data reported in 1998 paper were obtained on the Hirukawa-mura specimen, not on the Cheyenne area specimen, as incorrectly reported in 1998. Strongest lines of the powder pattern for the Hirukawa-mura sample (25 lines given, Gandolfi camera, Fe$K\alpha$ radiation, no standard): 8.353(100,110—erroneously given as 100), 3.277(33,240), 3.074(64,310), 2.879(27,151), 2.807(24,330), 2.761(25,002), 2.560(92,102,161), 2.537(24,112,251), 2.317(31,202), and 1.535(31,0.12.0).

Protomangano-ferro-anthophyllite

The optical data reported in 1998 paper were obtained on the Yokone-yama specimen, not on the "Hiruka" specimen, as incorrectly reported in 1998. Strongest lines of the powder pattern for the Yokone-yama sample (15 lines given, diffractometer, Fe$K\alpha$ radiation, no standard): 8.366(92,110), 4.584(20,040), 3.701(24,131), 3.285(55,240), 3.098(100,310), 2.881(29,151), 2.548(58,161,251,112), and 2.027(21,361). **E.S.G.**

TSCHERNICHITE

A. Alberti, G. Cruciani, E. Galli, S. Merlino, R. Millini, S. Quartieri, G. Vezzalini, S. Zanardi (2002) Crystal structure of tetragonal and monoclinic polytypes of tschernichite, the natural counterpart of synthetic zeolite beta. J. Phys. Chem., B106, 10277–10284.

Two polytypes of the mineral occur on Fe-rich smectite in fractures of basalts at Mt. Adamson, Northern Victoria Land, Antarctica. The monoclinic polytype forms dipyramidal crystals up to $0.6 \times 0.6 \times 1.2$ mm, terminating in a basal pinacoid. Electron microprobe analyses (thermogravimetric for water) gave a uniform composition $Na_{1.6}K_{0.4}Mg_{0.4}Ca_{7.8}(Al_{17.8}Si_{46.2})O_{128}$ $\cdot 67H_2O$ (wt% oxides not given). Single-crystal X-ray structure study ($R_1 = 0.129$) gave monoclinic symmetry, space group $C2/c$, $a = 17.983(3)$, $b = 17.966(2)$, $c = 14.625(2)$ Å, $\beta = 114.31(1)°$, $V = 4306$ Å^3. The tetragonal polytype forms radiating hemispherical groups of smaller crystals showing basal pinacoids. Electron microprobe analyses (water content based on thermogravimetric analysis of the monoclinic polytype) gave compositions ranging from $Na_{1.6}K_{0.4}Mg_{1.7}Ca_{3.8}(Al_{12.8}Si_{51.2})O_{128}$ $\cdot 65H_2O$ for the lowest Mg/Ca ratio to $Na_{1.6}K_{0.3}Mg_{3.5}Ca_{2.0}$ $(Al_{12.8}Si_{51.2})O_{128}\cdot 65H_2O$ for the highest Mg/Ca ratio (wt% oxides not given). Single-crystal X-ray structure study ($R_1 = 0.106$) gave tetragonal symmetry, space group $P4_122$, $a = 12.634(1)$, $c = 26.608(3)$ Å, $V = 4247$ Å^3. Tschernichite is an OD (order-disorder) family with two MDO (maximum degree of order) structures, which correspond to the monoclinic and tetragonal polytypes described here.

Discussion. According to Rule 1b for nomenclature recommended by the Subcommittee on Zeolites, compositions in which Mg is the dominant extra-framework cation should qualify as a species distinct from compositions in which Ca is dominant. **E.S.G.**