The Canadian Mineralogist
Vol. 39, pp. 1473-1502 (2001)

NEW MINERALS

JOSEPH A. MANDARINO[§]

94 Moore Avenue, Toronto, Ontario M4T 1V3, Canada

The abstracts that follow conform to the format adopted in New Minerals 1995–1999, published as *The Canadian Mineralogist, Special Publication* **4**. Publication of such abstracts will henceforth be a feature of regular issues of *The Canadian Mineralogist*, as space permits. Please notify the abstractor or the editor of any errors.

[§] *E-mail address*: j.a.mandarino@puffin.net

Arakiite

$(Zn,Mn^{2+})(Mn^{2+},Mg)_{12}(Fe^{3+},Al)_2(As^{3+}O_3)(As^{5+}O_4)_2(OH)_{23}$

MONOCLINIC

Locality: Långban, Värmland, Sweden.

Occurrence: Associated minerals are: hematite (specular), calcite and magnussonite.

General appearance: Aggregates of micaceous plates covering an area of 15 × 10 mm.

Physical, chemical and crystallographic properties: *Luster*: resinous to submetallic. *Diaphaneity*: opaque but translucent on thin edges. *Color*: red-brown to orange-brown. *Streak*: pale brown. *Luminescence*: nonfluorescent. *Hardness*: 3 to 4. *Tenacity*: brittle. *Cleavage*: {001} perfect. *Fracture*: uneven to almost subconchoidal. *Density*: could not be measured because of the small amount of material, 3.41 g/cm^3 (calc.). *Crystallography*: Monoclinic, *Cc*, *a* 14.248, *b* 8.228, *c* 24.23 Å, β 93.62°, *V* 2843 Å^3, *Z* = 4, *a*:*b*:*c* = 1.7316:1:2.9448. Morphology: no forms were observed. Twinning: none observed. *X-ray powder-diffraction data*: 12.07 (100) (002), 6.046 (100) (004), 4.119 (30) (020), 4.040 (90) (006), 3.148 (30) ($\bar{4}04$, $\bar{1}17$), 3.030 (70) (224), 2.411 (40) (424, $\bar{5}15$), 1.552 (70) (640, $\bar{3}51$). *Optical data*: Biaxial (–), α 1.723, β 1.744, γ 1.750, 2*V*(meas.) 40°, 2*V*(calc.) 56°; dispersion *r* > v, medium; nonpleochroic; *Y* = *b*, *X* ∧ *c* = 4° (in obtuse angle β). *Chemical analytical data*: Mean of thirteen sets of electron-microprobe data: MgO 12.76, MnO 34.32, ZnO 4.48, Al_2O_3 2.25, Fe_2O_3 6.76, As_2O_5 15.84, As_2O_3 6.56, H_2O (13.74), Total (96.71) wt.%. The amount of H_2O was established assuming stoichiometry. The crystal-structure results show that Mn is Mn^{2+}, Fe is Fe^{3+} and As is present as As^{3+} and As^{5+} in a 1:2 ratio. Empirical formula: $(Zn_{0.83}Mn_{0.17})_{\Sigma 1.00}(Mn_{7.12}Mg_{4.77})_{\Sigma 11.89}(Fe^{3+}_{1.28}Al_{0.67})_{\Sigma 1.95}(As^{3+}O_3)_{1.00}(As^{5+}O_4)_{2.08}(OH)_{22.99}$. *Relationship to other species*: The crystal structure resembles that of hematolite.

Name: After Takaharu Araki (b. 1929), structural crystallographer formerly of the University of Chicago, for his numerous crystal-structure contributions to mineralogy.

Comments: IMA No. 1998–062. Note that the crystal structure has been solved.

ROBERTS, A.C., COOPER, M.A., HAWTHORNE, F.C., GRICE, J.D. & FEINGLOS, M.N. (2000): Arakiite, a new Zn-bearing hematolite-like mineral from Långban, Värmland, Sweden. *Mineralogical Record* **31**, 253-256.

COOPER, M.A. & HAWTHORNE, F.C. (1999): The effect of differences in coordination on ordering of polyvalent cations in close-packed structures: the crystal structure of arakiite and comparison with hematolite. *Canadian Mineralogist* **37**, 1471-1482.

Bakhchisaraitsevite

$Na_2Mg_5(PO_4)_4 \bullet 7H_2O$

MONOCLINIC

Locality: Kovdor massif, southwestern Kola Peninsula, Russia (Lat. 67° 35' N, Long. 30° 20' E).

Occurrence: In a mineralized vuggy dolomite carbonatite. Associated minerals are: bobierrite, pyrite, collinsite, "chlorite", nastrophite and juonniite.

General appearance: Fan-shaped aggregates or single bladed tabular crystals (up to 0.5 × 1.5 × 2 mm).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent. *Color*: light yellow, colorless or greenish. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: 2 to 2½. *Tenacity*: brittle. *Cleavage*: {001} perfect. *Fracture*: not mentioned. *Density*: 2.50 g/cm^3 (meas.), 2.44 g/cm^3 (calc.) (given as 2.47 g/cm^3). *Crystallography*: Monoclinic, $P2_1/c$, a 8.324, b 12.926, c 17.519 Å, β 102.03°, V 1844 Å^3, Z = 4, a:b:c = 0.6440:1:1.3553. Morphology: no forms were mentioned. Twinning: none mentioned. *X-ray powder-diffraction data*: 10.31 (33) (011), 8.56 (100) (002), 3.562 (22) (123), 3.496 (23) ($\bar{1}$24), 3.314 (23) ($\bar{2}$04), 3.020 (28) ($\bar{1}$25), 2.849 (33) (231), 2.675 (25) (125, 232). *Optical data*: Biaxial (+), α 1.538, β 1.540, γ 1.543, 2V(meas.) not given, 2V(calc.) 79° (given as 72.5°); $X \wedge c$ = 45°, $Z = b$. *Chemical analytical data*: Ten sets of electron-microprobe data are given. One of these is: Na_2O 9.17, MgO 29.40, CaO 0.07, MnO 0.33, FeO 0.84, P_2O_5 41.57, H_2O (18.62), Total (100.00) wt.%. The amount of H_2O was calculated by difference. Empirical formula: $(Na_{2.01}Ca_{0.01})_{\Sigma 2.02}(Mg_{4.95}Fe_{0.08}Mn_{0.03})_{\Sigma 5.06}(PO_4)_{3.97}O_{0.12} \bullet 7.00H_2O$. *Relationship to other species*: It is somewhat similar to rimkorolgite, $Mg_5Ba(PO_4)_4 \bullet 8H_2O$.

Name: After Alexander Yu. Bakhchisaraitsev (1947–1998), who studied minerals of the Kola Peninsula for 30 years and discovered eight new mineral species.

Comments: IMA No. 1999–005. Note that the crystal structure has been solved.

LIFEROVICH, R.P., PAKHOMOVSKY, YA.A., YAKUBOVICH, O.V., MASSA, W., LAAJOKI, K., GEHÖR, S., BOGDANOVA, A.N. & SOROKHTINA, N.V. (2000): Bakhchisaraitsevite, $Na_2Mg_5[PO_4]_4 \bullet 7H_2O$, a new mineral from hydrothermal assemblages related to phoscorite–carbonatite complex of the Kovdor massif, Russia. *Neues Jahrbuch für Mineralogie, Monatshefte*, 402-418.

YAKUBOVICH, O.V., MASSA, W., LIFEROVICH, R.P. & PAKHOMOVSKY, YA.A. (2000): The crystal structure of bakhchisaraitsevite, $Na_2(H_2O)_2\{(Mg,Fe)_5(H_2O)_5[PO_4]_4\}$, a new mineral species from the Kovdor alkaline-ultramafic complex, Russia. *Canadian Mineralogist* **38**, 831-838.

Batiferrite

$Ba(Ti_2Fe^{3+}{}_8Fe^{2+}{}_2)O_{19}$

HEXAGONAL

Locality: The Slabik company quarry at Üdersdorf (5 km south-southwest of Daun), the Stolz quarry at Graulai (1 km north-northeast of Lammersdorf) and Altburg (1.5 km west of Schalkenmehren), western Eifel area, Germany.

Occurrence: In cavities and in rare pegmatite-type veins hosted in melilite nephelinite basalt (Üdersdorf and Graulai) and leucite nephelinite basalt (Altburg). Associated minerals are: hematite, magnetite, titanite, götzenite, clinopyroxene, nepheline and biotite. About another 40 minerals are known from the paragenesis.

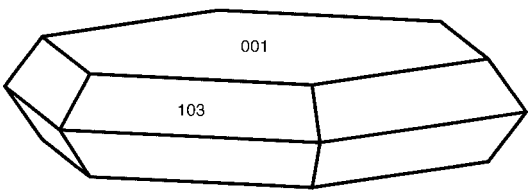
General appearance: Euhedral to subhedral platy grains (0.5 to 1 mm in diameter and 0.02 to 0.125 mm thick).

Physical, chemical and crystallographic properties: *Luster*: submetallic. *Diaphaneity*: opaque. *Color*: black. *Streak*: dark brown. *Hardness*: VHN_{50} 793 kg/mm^2, corresponding to Mohs 5½ to 6. *Tenacity*: brittle. *Cleavage*: {001}, perfection not stated. *Fracture*: given as "no special form". *Density*: not measured, 5.02 g/cm^3 (calc.). *Other properties*: ferrimagnetic. *Crystallography*: Hexagonal, $P6_3/mmc$, a 5.909, c 23.369 Å, V 706.6 Å^3, Z = 2, c:a = 3.9548. Morphology: {001}, {103} and {100}. Twinning: none mentioned. *X-ray powder-diffraction data*: 2.799 (80) (107), 2.631 (100) (114), 2.429 (60) (203), 1.672 (50) (217), 1.638 (40) (2.0.11, 304), 1.490 (40) (2.1.10, 1.0.15), 1.478 (47) (220), 1.397 (40) (2.0.14). *Optical data*: In reflected light: pale gray, moderate anisotropism, distinct (air) and weak (oil) bireflectance, nonpleochroic. R_O, R_E; $^{im}R_O$, $^{im}R_E$: (22.1, 20.1; 8.4, 7.1%) 470 nm, (21.0, 19.4; 7.8, 6.6%) 546 nm, (20.2, 18.8; 7.4, 6.3%) 589 nm, (19.3, 18.3; 6.8, 5.9%) 650 nm. *Chemical analytical data*: Mean of forty-seven sets of electron-microprobe data: Na_2O 0.18, K_2O 0.30, MgO 1.38, MnO 2.44, FeO 5.71, SrO 0.53, BaO 11.89, Al_2O_3 0.32, Fe_2O_3 62.61, TiO_2 13.38, Total 98.74 wt.%. Empirical formula: $(Ba_{0.84}K_{0.07}Na_{0.06}Sr_{0.06})_{\Sigma 1.03}(Fe^{3+}{}_{8.48}Fe^{2+}{}_{0.86}Ti_{1.81}Mg_{0.37}Mn_{0.37}Al_{0.07})_{\Sigma 11.96}O_{19.00}$. *Relationship to other species*: A member of the magnetoplumbite group.

Name: Reflects the main chemical composition and relationship to the hexaferrites.

Comments: IMA No. 1997–038. Details of the crystal structure are given. The crystal drawing in the paper has been redrawn here in the standard orientation. The ideal formula has been changed here to reflect the Fe^{3+} and Fe^{2+} contents necessary for charge balance.

LENGAUER, C.L., TILLMANNS, E. & HENTSCHEL, G. (2001): Batiferrite, $Ba[Ti_2Fe_{10}]O_{19}$, a new ferrimagnetic magnetoplumbite-type mineral from the Quaternary volcanic rocks of the western Eifel area, Germany. *Mineralogy and Petrology* **71**, 1-19.



Chabazite-Sr

$(Sr,Ca)[Al_2Si_4O_{12}]\bullet 6H_2O$

TRIGONAL

Locality: Suoluaiv Mountain, Lovozero alkaline complex, Kola Peninsula, Russia.

Occurrence: In a thin aegirine–K-feldspar pegmatite cross-cutting nepheline and nosean syenites. Associated minerals are: analcime, gonnardite, vinogradovite, phillipsite, låvenite, seidozerite, fluorapatite, aegirine, K-feldspar, nepheline, ilmenite, lorenzenite and sodalite.

General appearance: Coarse disk-like crystals (up to 0.3 mm). Open-book-like aggregates are in cavities of corroded analcime crystals.

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent. *Color*: colorless or yellowish. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: 4 to 4½. *Tenacity*: brittle. *Cleavage*: {101} medium. *Fracture*: rough. *Density*: 2.16 g/cm^3 (meas.), 2.25 g/cm^3 (calc.). *Crystallography*: Trigonal, $R\bar{3}m$, a 13.715, c 15.09 Å, V 2458 Å^3, Z = 6, c:a = 1.1003. Morphology: only {113} was observed. Twinning: on the "phacolite" law. *X-ray powder-diffraction data*: 9.38 (8) (101), 5.55 (6) (021), 4.34 (7) (211), 2.92 (10) (401), 1.697 (7) (524, 700, 530). *Optical data*: Uniaxial (+), ω 1.503, ε 1.507, nonpleochroic. *Chemical analytical data*: Electron-microprobe data: Na_2O 0.85, K_2O 2.97, CaO 4.79, SrO 10.32, BaO 0.36, Al_2O_3 21.74, SiO_2 40.33, H_2O 18.40, Total 99.76 wt.%. Empirical formula: $(Sr_{0.55}Ca_{0.48}K_{0.35}Na_{.015}Ba_{0.01})_{\Sigma 1.54}(Si_{3.73}Al_{2.37})_{\Sigma 6.10}\bullet 5.68H_2O$. *Relationship to other species*: A member of the zeolite group, the Sr-dominant member of the chabazite series.

Name: Reflects the relationship with the chabazite series of zeolites and the dominance of Sr.

Comments: IMA No. 1999–040.

PEKOV, I.V., TURCHKOVA, A.G., CHUKANOV, N.V., ZADOV, A.E. & GRISHIN, V.G. (2000): Chabazite-Sr, $(Sr,Ca)[Al_2Si_4O_{12}]\bullet 6H_2O$, a new zeolite mineral from Lovozero massif, Kola Peninsula. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(4), 54-58 (in Russ.).

Dashkovaite

$Mg(HCO_3)_2 \cdot 2H_2O$

MONOCLINIC

Locality: From a borehole at the Korshunovskoye boron deposit, Irkutsk district, Siberia, Russia.

Occurrence: In dolomite marble. Associated minerals are: shabynite, iowaite, ekaterinite, korshunovskite, halite, hydromagnesite and a serpentine mineral.

General appearance: Veinlets 1 mm thick made up of fibers (up to 3 mm long).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: translucent. *Color*: white. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: 1 (for aggregates). *Tenacity*: sectile. *Cleavage*: not observed. *Fracture*: uneven. *Density*: not measured, 1.76 g/cm^3 (calc.). *Crystallography*: Monoclinic, $P2_1/c$, a 8.64, b 7.15, c 9.38 Å, β 98.0°, V 574 Å^3, Z = 4, a:b:c = 1.2084:1:1.3119. Morphology: no forms were observed; the habit is prismatic. Twinning: none observed. *X-ray powder-diffraction data*: 4.90 (9) ($11\bar{1}$), 4.64 (8) (002), 4.30 (7) (200), 3.68 (8) (210), 3.40 (10) (112). *Optical data*: Biaxial (+), α 1.465, β 1.486, γ 1.516, 2V(meas.) not given, 2V(calc.) 81°; dispersion not observed; nonpleochroic; X = elongation direction. *Chemical analytical data*: Mean of two sets of electron-microprobe data (Mg and Mn), selective sorption of high-temperature combustion in oxygen (H and C), and O by difference: Mg 16.4, Mn 0.2, C 16.2, H 3.9, O 63.3, Total 100.0 wt.%. Empirical formula: $(Mg_{1.03}Mn_{0.01})_{\Sigma 1.04}H_{1.88}C_{2.06}O_{4.03} \cdot 2H_2O$. *Relationship to other species*: It is the second formate mineral found; the first is formicaite.

Name: After Ekaterina Romanovna Dashkova (1744–1810), Director of the St. Petersburg Academy of Sciences and President of the Russian Academy of Sciences (1783–1796).

Comments: IMA No. 2000–006.

CHUKANOV, N.V., BELAKOVSKIY, D.I., MALINKO, S.V. & ORGANOVA, N.I. (2000): Dashkovaite $Mg(HCO_3)_2 \cdot 2H_2O$ – a new formate mineral. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(6), 49-53 (in Russ.).

Dukeite

$Bi^{3+}_{24}Cr^{6+}_{8}O_{57}(OH)_6 \bullet 3H_2O$

TRIGONAL

Locality: São José mine, Lavra da Posse, São José de Brejaúba, Conceição do Mato Dentro County, Minas Gerais, Brazil.

Occurrence: Associated minerals are: pucherite, schumacherite, bismutite and hechtsbergite.

General appearance: Tightly bound sheaves of parallel growth acicular crystals (up to 1 mm × 0.3 mm).

Physical, chemical and crystallographic properties: *Luster*: resinous. *Diaphaneity*: translucent (sheaves) to transparent (crystals). *Color*: yellow to dirty yellow-brown. *Streak*: bright yellow. *Luminescence*: nonfluorescent. *Hardness*: 3 to 4 (estimated). *Tenacity*: brittle. *Cleavage*: none observed. *Fracture*: uneven. *Density*: could not be measured, 7.17 g/cm^3 (calc.). *Crystallography*: Trigonal, *P*31*c*, *a* 15.067, *c* 15.293 Å, *V* 3007 Å^3, *Z* = 2, *c*:*a* = 1.0150. Morphology: no forms were observed; habit acicular. Twinning: none observed. *X-ray powder-diffraction data*: 7.650 (50) (002), 3.812 (40) (004), 3.382 (100) (222), 2.681 (70) (224), 2.175 (40) (600), 2.106 (40) (226), 1.701 (50) (228). *Optical data*: In reflected light: gray to purplish gray with strong yellow internal reflections, anisotropy not observed, bireflectance very weak, nonpleochroic. R_1 & R_2: (17.9, 18.6%) 470 nm, (16.45, 17.0%) 546 nm, (16.0, 16.5%) 589 nm, (15.7, 16.2%) 650 nm. Calculated indices of refraction are 2.33 and 2.37 at 590 nm. *Chemical analytical data*: Mean of eight sets of electron-microprobe data: Bi_2O_3 85.06, CrO_3 11.65, V_2O_5 0.59, H_2O (1.67), Total (98.97) wt.%. The amount of H_2O was calculated assuming the ideal formula. Empirical formula: $Bi^{3+}_{23.95}(Cr^{6+}_{7.64}V^{5+}_{0.43})_{\Sigma 8.07}O_{56.84}(OH)_{6.16} \bullet 3.00H_2O$. *Relationship to other species*: None apparent.

Name: After Duke University, Durham, North Carolina, in whose collection the mineral was found, and in recognition of the contribution of the Duke family, to the advancement of scientific knowledge.

Comments: IMA No. 1999–021.

BURNS, P.C., ROBERTS, A.C., STIRLING, J.A.R., CRIDDLE, A.J. & FEINGLOS, M.N. (2000): Dukeite, $Bi^{3+}_{24}Cr^{6+}_{8}O_{57}(OH)_6(H_2O)_3$, a new mineral from Brejaúba, Minas Gerais, Brazil: description and crystal structure. *American Mineralogist* **85**, 1822-1827.

Fluorannite

$KFe^{2+}_3AlSi_3O_{10}F_2$

MONOCLINIC

Locality: The western suburb of Suzhou City, about 80 km west of Shanghai, People's Republic of China.

Occurrence: In the Huangshan granite. Associated minerals are: quartz, hafnian zircon, tantalite–columbite, fluorite and magnetite.

General appearance: Euhedral to subhedral grains and tabular sheets. Most grains are 2 to 4 mm long and 1 to 3 mm thick.

Physical, chemical and crystallographic properties: *Luster*: submetallic. *Diaphaneity*: translucent. *Color*: iron-black. *Streak*: gray. *Luminescence*: nonfluorescent. *Hardness*: VHN_{50} 109 kg/mm^2. *Tenacity*: sectile. *Cleavage*: {001} perfect. *Fracture*: not given. *Density*: 3.18 g/cm^3 (meas.), 3.30 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*m*, *a* 5.369, *b* 9.289, *c* 10.153 Å, β 100.49°, *V* 498 Å^3, *Z* = 2, *a*:*b*:*c* = 0.5780:1:1.0930. Morphology: no forms were mentioned. Twinning: none observed. *X-ray powder-diffraction data*: 10.09 (100) (001), 5.02 (13) (002), 3.336 (56) (003), 3.160 (10) (112), 2.933 (10) ($\bar{1}$13), 2.649 (10) (200), 2.507 (14) (131, 004), 2.004 (10) (204, 005), 1.671 (10) ($\bar{1}$35). *Optical data*: Biaxial (–), α 1.596, β 1.648, γ 1.648, 2*V*(meas.) ≈ 0°, 2*V*(calc.) 0°; pleochroism *X* pale brown, *Y* dark green, *Z* reddish; *Y* = *b*. *Chemical analytical data*: Mean of ten sets of electron-microprobe data: Li_2O 0.47, Na_2O 0.19, K_2O 8.73, Rb_2O 0.42, Cs_2O 0.02, MgO 1.49, MnO 0.68, FeO 26.19, NiO 0.01, ZnO 0.27, SrO 0.01, BaO 0.44, Al_2O_3 13.89, Fe_2O_3 7.86, SiO_2 34.12, TiO_2 1.29, H_2O 0.91, F 3.91, sum 100.90, less O = F 1.65, Total 99.25 wt.%. Empirical formula: $(K_{0.92}Na_{0.03}Rb_{0.02})_{\Sigma 0.98}(Fe^{2+}_{1.82}Fe^{3+}_{0.49}Al_{0.19}Mg_{0.18}Li_{0.16}Ti_{0.08}Mn_{0.05}Zn_{0.02})_{\Sigma 2.99}Al_{1.00}(Si_{2.83}Al_{0.17})_{\Sigma 3.00}O_{10.00}[F_{1.03}(OH)_{0.50}\square_{0.47}]_{\Sigma 2.00}$. *Relationship to other species*: It is a member of the mica group, specifically the F-dominant analogue of annite, $KFe^{2+}_3AlSi_3O_{10}(OH)_2$. It is the -1*M* polytype.

Name: Reflects the dominance of fluorine and relationship with annite.

Comments: IMA No. 1999–048.

SHEN GANFU, LU QI & XU JINSHA (2000): Fluorannite: a new mineral of mica group from western suburb of Suzhou City. *Acta Petrologica et Mineralogica* **19**(4), 356-362 (in Chinese with English abstr.).

Fluoro-magnesio-arfvedsonite

$NaNa_2(Mg,Fe^{2+})_4Fe^{3+}[Si_8O_{22}](F,H_2O)_2$

MONOCLINIC

Locality: The west slope of the Ilmen mountain ridge, Ilmen Nature Reserve, South Urals, near Miass, Chelyabinsk region, Russia.

Occurrence: In albite–microcline fenites in the contact zone of the Ilmen alkaline complex. Associated minerals are: microcline perthite, microcline, albite, phlogopite, quartz, titanite, rutile, apatite, pyrite and zircon.

General appearance: Short prismatic grains (up to 0.7 mm).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent to translucent. *Color*: gray. *Streak*: white. *Luminescence*: not given. *Hardness*: 5½. *Tenacity*: brittle. *Cleavage*: {110} good. *Fracture*: uneven. *Density*: 3.09 g/cm^3 (meas.), 3.05 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*m*, *a* 9.81, *b* 18.05, *c* 5.29 Å, β 103.9°, *V* 910.2 Å^3, *Z* = 2, *a*:*b*:*c* = 0.5435:1:0.2931. Morphology: {110} and {010}. Twinning: none observed. *X-ray powder-diffraction data*: 8.42 (34) (110), 3.392 (11) (041), 3.264 (23) (240), 3.129 (100) (310), 2.804 (28) (330), 2.716 (10) (33$\bar{1}$), 2.708 (17) (151), 1.895 (10) (510), 1.654 (10) (511). *Optical data*: Biaxial sign given as (+), but the indices and calculated 2*V* indicate (–), α 1.618, β 1.629, γ 1.632, 2*V*(meas.) 50 to 70°, 2*V*(calc.) 55°; dispersion *r* > *v*; pleochroism *X* yellowish, nearly colorless, *Y* pale lilac, *Z* greenish blue; *Y* = *b*, *Z* ∧ *c* = 15 to 16°. *Chemical analytical data*: Wet-chemical analysis gave: Na_2O 7.50, K_2O 1.62, MgO 20.10, CaO 2.86, MnO 0.29, FeO 0.79, Al_2O_3 1.47, Fe_2O_3 5.76, SiO_2 56.76, TiO_2 0.51, H_2O 0.84, F 2.80, sum 101.30, less O = F 1.18, Total 100.12 wt.%. Empirical formula: $(Na_{0.45}K_{0.29})_{\Sigma 0.74}(Na_{1.57}Ca_{0.43})_{\Sigma 2.00}(Mg_{4.16}Fe^{3+}_{0.60}Al_{0.12}Fe^{2+}_{0.09}Ti_{0.05}Mn_{0.03})_{\Sigma 5.05}(Si_{7.88}Al_{0.12})_{\Sigma 8.00}O_{21.99}[F_{1.23}(OH)_{0.78}]_{\Sigma 2.01}$. *Relationship to other species*: A member of the amphibole group.

Name: The fluorine-dominant analogue of magnesio-arfvedsonite. The name is based on the approved nomenclature of the Amphibole group. The name approved by the CNMMN of IMA is fluoro-magnesio-arfvedsonite, not fluormagnesioarfvedsonite.

Comments: IMA No. 1998–056.

BAZHENOV, A.G., NEDOSEKOVA, I.L., KRINOVA, T.V., MIRONOV, A.B. & KHVOROV, P.V. (2000): Fluormagnesioarfvedsonite (*sic*) $NaNa_2(Mg,Fe^{2+})_4Fe^{3+}[Si_8O_{22}](F,H_2O)_2$ – a new mineral species of the amphibole group. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(6), 28-35 (in Russ.).

Gottlobite

$CaMg(VO_4,AsO_4)(OH)$

ORTHORHOMBIC

Locality: On the dump of the long-abandoned Glücksstern mine at Gottlob hill, Friedrichroda, Thuringia (Thüringen), Germany.

Occurrence: In hydrothermal barite veins that cut conglomerate. Associated minerals are: hausmannite, barite, vanadian adelite and muscovite.

General appearance: Equant to tabular crystals and equant grains (up to 0.5 mm).

Physical, chemical and crystallographic properties: *Luster*: vitreous to adamantine. *Diaphaneity*: transparent. *Color*: orange to orange-brown. *Streak*: light brownish. *Luminescence*: not mentioned. *Hardness*: 4½. *Tenacity*: brittle. *Cleavage*: none observed. *Fracture*: conchoidal to irregular. *Density*: 3.31 g/cm^3 (meas.), 3.40 g/cm^3 (calc.) (given as 3.46 g/cm^3). *Crystallography*: Orthorhombic, $P2_12_12_1$, *a* 7.501, *b* 9.010, *c* 5.941 Å, *V* 401.5 Å^3, *Z* = 4, *a*:*b*:*c* = 0.8325:1:0.6594. Morphology: {010} dominant, {110}, {011}, {111}, {$\bar{1}$11} and {101}. Twinning: none observed. *X-ray powder-diffraction data*: 4.496 (72) (020), 4.139 (32) (111), 3.170 (100) (201), 2.785 (30) (130), 2.639 (27) (112), 2.523 (30) (131), 1.614 (41) (332, 133). *Optical data*: Biaxial (–) (but the indices indicate +), α 1.797, β 1.805 to 1.815, γ 1.828, 2*V*(meas.) very large, 2*V*(calc.) 62° to 80°, dispersion *r* > *v*; pleochroism medium strong, *X* orange-brown, *Y* pale yellowish brown, *Z* orange-brown, *Z* Æ *X* > *Y*; orientation unknown. *Chemical analytical data*: Mean of nineteen sets of electron-microprobe data: CaO 24.98, SrO 0.92, MgO 17.54, MnO 1.50, CuO 1.44, V_2O_5 27.47, As_2O_5 20.32, H_2O 5.40, Total 99.57 wt.%. The amount of H_2O was established by TGA. Empirical formula: $(Ca_{0.92}Sr_{0.02})_{\Sigma 0.94}(Mg_{0.90}Mn_{0.04}Cu_{0.04})_{\Sigma 0.98}[(VO_4)_{0.62}(AsO_4)_{0.36}]_{\Sigma 0.98}[OH)_{0.90}(H_2O)_{0.17}]_{\Sigma 1.07}$. *Relationship to other species*: A member of the adelite group.

Name: After the type locality.

Comments: IMA No. 1998–066.

WITZKE, T., STEINS, M., DOERING, T. & KOLITSCH, U. (2000): Gottlobite, $CaMg(VO_4,AsO_4)(OH)$, a new mineral from Friedrichroda, Thuringia, Germany. *Neues Jahrbuch für Mineralogie, Monatshefte*, 444-454.

Kapitsaite-(Y)

$(Ba,K)_4(Y,Ca)_2Si_8(B,Si)_4O_{28}F$

TRICLINIC

Locality: The moraine of the Dara-i-Pioz glacier, Garm region, Tajikistan (Lat. 39° 30' N, Long. 70° 40' E).

Occurrence: Associated minerals are: quartz, reedmergnerite, leucosphenite, polylithionite, pectolite, pyrochlore and aegirine.

General appearance: A sheaf-like aggregate (1 × 2 cm) of elongate grains (0.5 × 2 to 8 mm).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent to translucent. *Color*: pale pink. *Streak*: white. *Luminescence*: fluoresces pale pink in short-wave ultraviolet light. *Hardness*: 5. *Tenacity*: brittle. *Cleavage*: absent. *Fracture*: conchoidal. *Density*: 3.74 g/cm^3 (meas.), 3.80 g/cm^3 (calc.). *Crystallography*: Triclinic, $I\bar{1}$, *a* 11.181, *b* 10.850, *c* 10.252 Å, α 90.64°, β 90.05°, γ 89.97°, *V* 1243.6 Å^3, *Z* = 2, *a*:*b*:*c* = 1.0305:1:0.9449. Morphology: no forms were observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 7.80 (70) ($\bar{1}\bar{1}0$), 3.77 (100) (202), 3.73 (70) ($\bar{3}00$), 3.24 (75) (013), 2.93 (80) (321, $\bar{2}\bar{3}1$), 2.90 (90) ($\bar{3}12$), 2.74 (65) (040). *Optical data*: Biaxial (+), α 1.624, β 1.628, γ 1.637, 2*V*(meas.) 69°, 2*V*(calc.) 68°; dispersion *r* < *v*, weak; nonpleochroic; orientation not given. *Chemical analytical data*: Mean of seven sets of electron-microprobe data: Na_2O 0.46, K_2O 0.87, CaO 3.12, MnO 0.05, FeO 0.01, BaO 38.18, PbO 1.95, B_2O_3 8.68, Al_2O_3 0.04, Y_2O_3 7.93, La_2O_3 0.01, Ce_2O_3 0.09, Pr_2O_3 0.03, Nd_2O_3 0.32, Sm_2O_3 0.36, Gd_2O_3 0.64, Dy_2O_3 0.70, Ho_2O_3 0.14, Er_2O_3 0.36, Yb_2O_3 0.20, SiO_2 34.98, F 1.40, Cl 0.01, sum 100.53, less O = F + Cl 0.59, Total 99.94 wt.%. Empirical formula: $(Ba_{3.55}K_{0.26}Pb_{0.12}Na_{0.07})_{\Sigma 4.00}$ $(Y_{1.00}Ca_{0.79}Na_{0.14}Gd_{0.05}Dy_{0.05}Nd_{0.03}Sm_{0.03}Er_{0.03}Ce_{0.01}Ho_{0.01}Yb_{0.01})_{\Sigma 2.15}$ $(Si_{7.99}Al_{0.01})_{\Sigma 8.00}$ $(B_{3.55}Si_{0.30})_{\Sigma 3.85}O_{27.95}F_{1.05}$. *Relationship to other species*: It is the Y-dominant analogue of hyalotekite.

Name: After P'yotr Leonidovich Kapitsa (1894–1984), of Moscow, Russia, well-known solid-state physicist.

Comments: IMA No. 1998–057.

PAUTOV, L.A., KHVOROV, P.V., SOKOLOVA, E.V., FERRARIS, G., IVALDI, G. & BAZHENOVA, L.F. (2000): Kapitsaite-(Y) $(Ba,K)_4(Y,Ca)_2Si_8(B,Si)_4O_{28}F$ – a new mineral. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(6), 42-49 (in Russ.).

Krettnichite

$PbMn^{3+}{}_2(VO_4)_2(OH)_2$

MONOCLINIC

Locality: Dumps of the manganite deposit at Krettnich, Saarland, Germany.

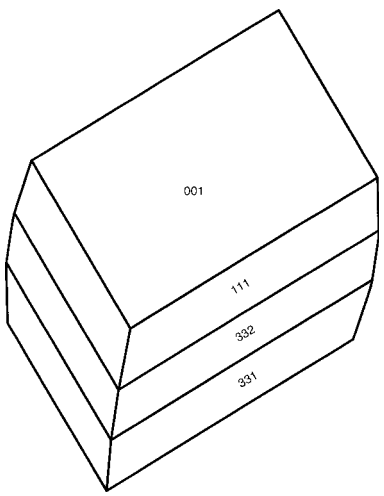
Occurrence: In vugs in a hydrothermal manganite–quartz vein. Associated minerals are: manganite, quartz, barite, ankerite, mottramite, barian brackebuschite and cuprian-cobaltoan pyrobelonite.

General appearance: Radiating aggregates (up to 3 cm in diameter) of platy crystals (less than 1 mm).

Physical, chemical and crystallographic properties: *Luster*: adamantine. *Diaphaneity*: transparent in thin cleavage plates. *Color*: brown to black with orange-red internal reflections. *Streak*: brown. *Luminescence*: nonfluorescent. *Hardness*: VHN_{100} 276 kg/mm^2 ⊥ (001), 347 kg/mm^2 || (001), Mohs hardness 4½. *Tenacity*: not given. *Cleavage*: {001} excellent and another at a high angle to {001} distinct. *Fracture*: not given. *Density*: could not be measured, but the mineral sinks in Clerici solution (D = 4.04 g/cm^3), 4.75 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*m*, *a* 9.275, *b* 6.284, *c* 7.682 Å, β 117.97°, *V* 395.4 Å^3, *Z* = 2, *a*:*b*:*c* = 1.4760:1:1.2225. Morphology: {001}, {111}, {332} and {331}; pseudo-rhombohedral. Twinning: polysynthetic on (001). ***X-ray powder- diffraction data***: 4.695 (34) (11$\bar{1}$), 3.388 (95) (002), 3.270 (100) (11$\bar{2}$), 2.946 (51) (201), 2.850 (49) (021), 2.4910 (93) (310, 112, 220), 1.8693 (35) (113), 1.6970 (83) (004). *Optical data*: In reflected light: reddish brown, strong anisotropism, but rotation tints are not very colorful; distinct bireflectance, slight pleochroism. R_1, R_2; $^{im}R_1$, $^{im}R_2$: (15.8, 19.2; 4.35, 6.45%) 470 nm, (14.8, 17.8; 3.79, 5.67%) 546 nm, (14.4, 17.3; 3.63, 5.35%) 590 nm, (14.1, 16.8; 3.48, 5.06%) 650 nm. Calculated indices of refraction are: n_1 2.21, n_2 2.39 for light of 590 nm wavelength. *Chemical analytical data*: Mean of fifty-four sets of electron-microprobe data: CaO 0.60, NiO 0.04, CoO 2.22, CuO 0.42, SrO 1.48, BaO 0.90, PbO 32.66, Al_2O_3 0.04, Mn_2O_3 24.03, Fe_2O_3 1.25, V_2O_5 29.26, As_2O_5 2.92, H_2O 3.54, Total 99.36 wt.% (given as 99.43). Empirical formula: $(Pb_{0.83}Co_{0.17}Sr_{0.08}Ca_{0.06}Ba_{0.03}Cu_{0.03})_{\Sigma 1.20}$ $(Mn_{1.73}Fe_{0.09})_{\Sigma 1.82}$ $[(V_{1.86}As_{0.14})O_4]_{1.97}(OH)_{2.23}$. The empirical formula has an excess –0.28 charge. ***Relationship to other species***: It is a member of the tsumcorite group and the Mn^{3+}-dominant analogue of mounanaite, $PbFe^{3+}{}_2(VO_4)_2(OH)_2$.

Name: After the type locality.

Comments: IMA No. 1998–044. The crystal drawing in the paper is not in a standard orientation; it has been redrawn here.



BRUGGER, J., ARMBRUSTER, T., CRIDDLE, A., BERLEPSCH, P., GRAESER, S. & REEVES, S. (2001): Description, crystal structure, and paragenesis of krettnichite, $PbMn^{3+}{}_2(VO_4)_2(OH)_2$, the Mn^{3+} analogue of mounanaite. *European Journal of Mineralogy* **13**, 145-158.

Levinsonite-(Y)

$(Y,Nd,Ce)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$

MONOCLINIC

Locality: Alum Cave Bluff, Great Smoky Mountains National Park, Tennessee, U.S.A.

Occurrence: In an evaporite assemblage. Associated minerals are: coskrenite-(Ce), zugshunstite-(Ce), melanterite, halotrichite, pickeringite, apjohnite, epsomite and other hydrated sulfates.

General appearance: Individual euhedral prismatic crystals or group of five to ten randomly oriented crystals (up to approximately 1 mm long).

Physical, chemical and crystallographic properties: *Luster*: not given but probably vitreous. *Diaphaneity*: transparent. *Color*: colorless. *Streak*: white. *Luminescence*: none observed. *Hardness*: not determined. *Tenacity*: brittle. *Cleavage*: {101} perfect. *Fracture*: irregular. *Other properties*: soluble in H_2O. *Density*: not determined, 2.18 g/cm^3 (calc.). *Crystallography*: Monoclinic, *P*2/*n*, *a* 10.289, *b* 9.234, *c* 11.015 Å, β 108.50°, *V* 992.5 Å^3, *Z* = 2, *a*:*b*:*c* = 1.1143:1:1.1929. Morphology: {101}, {010}, {$\bar{1}$01}, prismatic along [101] and flattened on {101}. Note: The third form is given by the authors as {101} but probably is {$\bar{1}$01}. Twinning: none mentioned. *X-ray powder-diffraction data*: 9.3 (100) (010), 6.28 (90) ($\bar{1}$01), 5.20 (40) (111), 4.89 (60) (200), 4.63 (30) ($\bar{1}$12), 4.09 (50) ($\bar{1}$21), 3.700 (30) (112, 121, $\bar{1}$03), 3.447 (30) (022, 301, $\bar{1}$13), 2.867 (30) (301, 113), 2.747 (30) (131, $\bar{3}$21, $\bar{3}$13, $\bar{2}$23, 311), 2.518 (30) ($\bar{4}$02, 014, 123, $\bar{2}$32). *Optical data*: Biaxial (sign not given, but +), α 1.48, β 1.49, γ 1.55, 2*V*(meas.) 7°, 2*V*(calc.) 46°; dispersion none observed; nonpleochroic; $X \approx c$, $Y = b$, $Z \wedge c$ given as 19°, but this must be $Z \wedge a = 19°$ (in obtuse angle β). *Chemical analytical data*: Mean of an unstated number of sets of electron-microprobe data: Y_2O_3 5.72, La_2O_3 0.50, Ce_2O_3 3.02, Pr_2O_3 0.76, Nd_2O_3 5.94, Sm_2O_3 3.21, Eu_2O_3 0.54, Gd_2O_3 2.23, Dy_2O_3 1.15, Er_2O_3 0.29, Al_2O_3 7.83, SO_3 24.58, C_2O_3 (11.05), H_2O (33.18), Total (100.00) wt.%. The amounts of C_2O_3 and H_2O were calculated to give $1.00(C_2O_4)$ and $12(H_2O)$, respectively. Empirical formula: $(Y_{0.33}Nd_{0.23}Ce_{0.12}Sm_{0.12}Gd_{0.08}Dy_{0.04}Pr_{0.03}La_{0.02}Eu_{0.02}Er_{0.01})_{\Sigma 1.00}\ Al_{1.00}(SO_4)_{2.00}(C_2O_4)_{1.00}\bullet 12.00H_2O$. *Relationship to other species*: None stated.

Name: After Prof. Alfred A. Levinson (b. 1927), University of Calgary, Calgary, Alberta, Canada, originator of the internationally used nomenclature for rare-earth-element minerals.

Comments: IMA No. 1996–057.

ROUSE, R.C., PEACOR, D.R., ESSENE, E.J., COSKREN, T.D. & LAUF, R.J. (2001): The new minerals levinsonite-(Y) [$(Y,Nd,Ce)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$] and zugshunstite-(Ce) [$(Ce,Nd,La)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$]: coexisting oxalates with different structures and differentiation of LREE and HREE. *Geochimica et Cosmochimica Acta* **65**, 1101-1115.

Lisitsynite

$KBSi_2O_6$

ORTHORHOMBIC

Locality: Koashva quarry, Khibina alkaline complex, Kola Peninsula, Russia.

Occurrence: In an intensely mineralized pipe-like pegmatite body intruded into ijolite–urtite along its contact with an apatite–nepheline rock. Associated minerals are: K-feldspar, sodalite, cancrinite, pectolite, aegirine, natrite, villiaumite, lomonosovite, chkalovite, nacaphite, fluorcaphite, vitusite, sphalerite and galena.

General appearance: Irregularly shaped grains and subhedral tabular crystals (0.2 to 0.5 mm across).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent. *Color*: colorless. *Streak*: white. *Luminescence*: fluoresces bright pink under short-wave ultraviolet light. *Hardness*: 5 to 6. *Tenacity*: brittle. *Cleavage*: {010} good. *Fracture*: subconchoidal. *Density*: 2.74 g/cm^3 (meas.), 2.75 g/cm^3 (calc.). *Crystallography*: Orthorhombic, $P2_12_12_1$, *a* 9.9630, *b* 10.4348, *c* 4.7044 Å, *V* 489.08 Å^3, *Z* = 4, *a*:*b*:*c* = 0.9548:1:0.4508. Morphology: {010} and {110}. Twinning: none mentioned. *X-ray powder-diffraction data*: 3.944 (5) (111), 3.495 (8) (021), 3.282 (10) (121, 130), 3.149 (4) (310), 2.704 (4) (301, 131), 2.293 (4) (012, 102). *Optical data*: Biaxial (–), α 1.561, β 1.563, γ 1.564, 2*V*(meas.) 51°, 2*V*(calc.) 70°; dispersion *r* > *v*, strong; nonpleochroic; orientation *X* = *a*, *Y* = *b*, *Z* = *c*. *Chemical analytical data*: Mean of five sets of electron-microprobe data: Na_2O 0.00, K_2O 23.50, B_2O_3 17.17, SiO_2 58.94, Total 99.61 wt.%. Empirical formula: $K_{1.01}B_{1.00}Si_{1.99}O_{6.00}$. *Relationship to other species*: A member of the *Zeolite* group.

Name: After Apollon E. Lisitsyn (1928–1999), well-known Russian specialist in the mineral resources, geology and mineralogy of boron deposits.

Comments: IMA No. 2000–008. Note that the structure has been solved.

KHOMYAKOV, A.P., NECHELYUSTOV, G.N., SOKOLOVA, E.V. & HAWTHORNE, F.C. (2000): New borosilicates: malinkoite, $NaBSiO_4$, and lisitsynite, $KBSi_2O_6$, from alkaline pegmatites of the Khibiny–Lovozero complex, Kola Peninsula. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(6), 35-42 (in Russ.).

SOKOLOVA, E.V., UVAROVA, YU.A., HAWTHORNE, F.C. & KHOMYAKOV, A.P. (2000): Crystal chemistry of a novel zeolite mineral from the Khibiny alkaline massif, Kola Peninsula. *In* Applied Mineralogy (D. Rammlmair, J. Mederer, T. Oberthür & H. Pentinghaus, eds.). Balkema, Rotterdam, The Netherlands (245-248).

SOKOLOVA, E.V., HAWTHORNE, F.C. & KHOMYAKOV, A.P. (2001): The crystal chemistry of malinkoite, $NaBSiO_4$, and lisitsynite, $KBSi_2O_6$, from the Khibina–Lovozero complex, Kola Peninsula, Russia. *Can. Mineral.* **39**, 159-169.

Malinkoite

$NaBSiO_4$

HEXAGONAL

Locality: Mount Karnasurt, Lovozero alkaline complex, Kola Peninsula, Russia.

Occurrence: In an intensely mineralized hyperagpaitic pegmatite intruded into foyaite. Associated minerals are: ussingite, chkalovite, nordite, gerasimovskite and neptunite.

General appearance: Rosette-like intergrowths of wedge-shaped crystals and spherulites (up to 3 mm across).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent to slightly turbid. *Color*: colorless, pale pink or greenish blue. *Streak*: white. *Luminescence*: fluoresces dull pinkish lilac under short-wave and bright greenish yellow under long-wave ultraviolet light. *Hardness*: 5. *Tenacity*: brittle. *Cleavage*: {*h*00} and {001} good. *Fracture*: uneven to splintery. *Density*: 2.90 g/cm^3 (meas.), 2.92 g/cm^3 (calc.). *Crystallography*: Hexagonal, $P6_3$, *a* 13.8964, *c* 7.7001 Å, *V* 1287.8 Å^3, *Z* = 18, *c*:*a* = 0.5541. Morphology: {*h*00} and {001}. Twinning: none mentioned. *X-ray powder-diffraction data*: 3.86 (6) (002), 3.61 (6) (012), 2.780 (10) (032), 2.320 (7) (330), 2.216 (9) (331), 1.928 (5) (250), 1.721 (7) (333). *Optical data*: Uniaxial (–), ω 1.591, ε 1.582, nonpleochroic. The abstract of the paper states that the mineral is biaxial (–), but it is clearly uniaxial (–). *Chemical analytical data*: Mean of seven sets of electron-microprobe data: Na_2O 24.36, K_2O 0.00, B_2O_3 26.88, SiO_2 47.83, Total 99.07 wt.%. Empirical formula: $Na_{1.00}B_{0.98}Si_{1.01}O_{4.00}$. *Relationship to other species*: It has some structural similarities to kalsilite, $KAlSiO_4$, and beryllonite, $NaBePO_4$.

Name: After Svetlana V. Malinko (b. 1927), well-known Russian mineralogist and discoverer of many boron minerals.

Comments: IMA No. 2000–009. Note that the crystal structure has been solved.

KHOMYAKOV, A.P., NECHELYUSTOV, G.N., SOKOLOVA, E.V. & HAWTHORNE, F.C. (2000): New borosilicates: malinkoite, $NaBSiO_4$, and lisitsynite, $KBSi_2O_6$, from alkaline pegmatites of the Khibiny-Lovozero complex, Kola Peninsula. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(6), 35-42 (in Russ).

SOKOLOVA, E.V., HAWTHORNE, F.C. & KHOMYAKOV, A.P. (2001): The crystal chemistry of malinkoite, $NaBSiO_4$, and lisitsynite, $KBSi_2O_6$, from the Khibina–Lovozero complex, Kola Peninsula, Russia. *Can. Mineral.* **39**, 159-169.

Manganonaujakasite

$Na_6(Mn,Fe)Al_4Si_8O_{26}$

MONOCLINIC

Locality: Lovozero alkaline complex, Kola Peninsula, Russia.

Occurrence: In lovozerite–lomonosovite lujavrite. Associated minerals are: feldspar, sodalite, nepheline, analcime, aegirine, lovozerite, lomonosovite, vuonnemite, lamprophyllite, tisinalite, manaksite, umbozerite, molybdenite and villiaumite.

General appearance: Irregular grains (0.5 to 5 mm across).

Physical, chemical and crystallographic properties: *Luster*: vitreous, pearly on the cleavage. *Diaphaneity*: transparent. *Color*: bright blue. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: 5. *Tenacity*: brittle. *Cleavage*: {001} perfect. *Fracture*: mica-like. *Density*: 2.67 g/cm^3 (meas.), 2.71 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*m*, *a* 15.033, *b* 8.001, *c* 10.478 Å, β 113.51°, *V* 1156 Å^3, *Z* = 2, *a*:*b*:*c* = 1.8789:1:1.3096. Morphology: no forms were mentioned. Twinning: none mentioned. *X-ray powder-diffraction data*: 3.995 (65) (020, 310), 3.623 (92) (112), 3.552 (56) ($\bar{4}02$), 3.485 (58) ($\bar{2}03$, $\bar{2}21$), 3.362 (33) (202), 3.068 (100) (022, $\bar{3}13$, 221), 2.613 (39) (420). *Optical data*: Biaxial (–), α 1.539, β 1.551, γ 1.554, 2*V*(meas.) 54°, 2*V*(calc.) 53°; dispersion *r* < *v*, medium; nonpleochroic; *Y* = *b*, *X* ∧ *c* = 45° (in acute angle β). *Chemical analytical data*: Mean of five sets of electron-microprobe data: Na_2O 19.44, K_2O 0.02, CaO 0.04, SrO 0.01, MnO 3.94, FeO 3.68, Al_2O_3 21.18, TiO_2 0.01, SiO_2 50.76, Total 99.08 wt.%. Empirical formula: $(Na_{5.96}Ca_{0.01})_{\Sigma 5.97}$ $(Mn_{0.53}Fe_{0.49})_{\Sigma 1.02}$ $Al_{3.95}Si_{8.03}O_{26.00}$. *Relationship to other species*: The manganese-dominant analogue of naujakasite, $Na_6(Fe,Mn)Al_4Si_8O_{26}$.

Name: Reflects the relationship with naujakasite and the dominance of manganese.

Comments: IMA No. 199–031.

KHOMYAKOV, A.P., NECHELYUSTOV, G.N., FERRARIS, G. & IVALDI, G. (2000): Manganonaujakasite, $Na_6(Mn,Fe)Al_4Si_8O_{26}$, a new mineral from the Lovozero alkaline massif, Kola Peninsula. *Zapiski Vserossiiskogo Mineralogicheskogo Obshchestva* **129**(4), 48-53 (in Russ.).

Paganoite

$NiBi^{3+}As^{5+}O_5$

TRICLINIC

Locality: Johanngeorgenstadt, Saxony, Germany.

Occurrence: Associated minerals are: quartz, nickeline, bismuth, bunsenite, aerugite, xanthiosite, rooseveltite and two probably new arsenate minerals.

General appearance: Individual crystals (up to 1 mm) and aggregates.

Physical, chemical and crystallographic properties: *Luster*: adamantine. *Diaphaneity*: transparent (crystals) to translucent (aggregates). *Color*: orange-brown to deep golden-brown. *Streak*: very pale orange-brown. *Luminescence*: nonfluorescent. *Hardness*: soft. *Tenacity*: brittle. *Cleavage*: none observed. *Fracture*: uneven. *Density*: could not be measured, 6.71 g/cm^3 (calc.). *Crystallography*: Triclinic, $P\bar{1}$, a 6.7127, b 6.8293, c 5.2345 Å, α 107.625°, β 95.409°, γ 111.158°, V 207.62 Å^3, Z = 2, a:b:c = 0.9829:1:0.7665. Morphology: {100} dominant, {010}, {001} and perhaps {$h0l$}. Twinning: none observed. *X-ray powder-diffraction data*: 3.233 (100) (011), 3.067 (60) ($0\bar{2}1$), 3.047 (50) (200), 2.116 (50) ($\bar{1}12$, $0\bar{3}1$, $\bar{3}11$, $\bar{1}\bar{2}2$, $2\bar{3}1$), 2.095 (40) ($\bar{2}30$, 102), 1.659 (40) ($\bar{4}20$). *Optical data*: In reflected light, gray with no bireflectance or pleochroism. Under crossed polars, the mineral shows dark orange internal reflections. R_1, R_2; $^{im}R_1$, $^{im}R_2$: (12.85, 13.1; 2.84, 2.99%) 470 nm, (12.35, 12.6; 2.63, 2.80%) 546 nm, (12.15, 12.5; 2.57, 2.77%) 589 nm, (12.0, 12.35; 2.52, 2.73%) 650 nm. Indices of refraction calculated from the reflectance values in air at 589 nm are 2.07 and 2.09. *Chemical analytical data*: Mean of two sets of electron-microprobe data: NiO 15.37, CoO 2.05, Bi_2O_3 55.06, As_2O_5 28.00, Total 100.48 wt.%. Empirical formula: $(Ni_{0.86}Co_{0.11})_{\Sigma 0.97}Bi_{0.99}As_{1.02}O_{5.00}$. *Relationship to other species*: The structure is closely related to that of jagowerite, $BaAl_2P_2O_8(OH)_2$.

Name: After Renato Pagano (b. 1938) and Adriana Pagano (b. 1939), of Cinisello, Milan, Lombardy, Italy. This husband-and-wife team are very competent amateur mineralogists who have made significant contributions to the advancement of specimen mineralogy in Europe for over thirty-five years.

Comments: IMA No. 1999–043. Note that the crystal structure has been solved.

ROBERTS, A.C., BURNS, P.C., GAULT, R.A., CRIDDLE, A.J., FEINGLOS, M.N. & STIRLING, J.A.R. (2001): Paganoite, $NiBi^{3+}As^{5+}O_5$, a new mineral from Johanngeorgenstadt, Saxony, Germany: description and crystal structure. *European Journal of Mineralogy* **13**, 167-175.

Pillaite

$Pb_9Sb_{10}S_{23}ClO_{0.5}$

MONOCLINIC

Locality: The Buca della Vena mine, Apuan Alps, northern Tuscany, Italy.

Occurrence: In thin, late calcite veins that cut a small Fe–Ba orebody and the phyllites and dolomitic limestones that host the deposit. Associated minerals are: scainiite, zinkenite, boulangerite, robinsonite, tintinaite, sorbyite and other incompletely characterized minerals. Other associated minerals are: sphalerite, cinnabar, galena, andorite, bournonite, tetrahedrite, chalcostibite, gersdorffite, barite, cerussite and stibiconite.

General appearance: Small acicular crystals (up to 1 cm long and 0.1 mm thick).

Physical, chemical and crystallographic properties: *Luster*: metallic. *Diaphaneity*: opaque. *Color*: black. *Streak*: black to dark brown. *Hardness*: VHN_{50} 175 kg/mm^2. *Tenacity*: brittle. *Cleavage*: nothing distinct. *Fracture*: irregular. *Density*: could not be determined because of the small size, 5.80 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*m*, *a* 49.65, *b* 4.150, *c* 21.91 Å, β 99.76°, *V* 4449 Å^3, *Z* = 4, *a*:*b*:*c* = 11.9639:1:5.2795. Morphology: no forms were observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.14 (27) (205), 3.88 (20) (12.0.1), 3.621 (26) ($\bar{4}$06, 12.0.2), 3.548 (40) ($\bar{1}\bar{2}$.0.4, $\bar{1}\bar{0}$.0.5), 3.480 (100) (206), 3.249 (24) ($\bar{1}\bar{2}$.0.5), 2.956 (47) ($\bar{5}$15, 16.0.1, $\bar{1}\bar{2}$.0.6, $\bar{9}$14), 2.780 (22) (13.1.0, 515). *Optical data*: In reflected light: color not given, weak anisotropism, weak bireflectance, nonpleochroic, rare red internal reflections. R, ^{im}R: (35.7, 20.10%) 470 nm, (34.2, 18.75%) 550 nm, (34.0, 17.60%) 590 nm, (32.7, 16.45%) 650 nm. *Chemical analytical data*: Mean of 13 sets of electron-microprobe data: Cu 0.16, Pb 49.07, Sb 30.36, S 18.73, Cl 0.98, O 0.21, Total 99.51 wt.%. Empirical formula: $Pb_{9.25}Sb_{9.74}Cu_{0.10}S_{22.82}Cl_{1.08}O_{0.51}$. *Relationship to other species*: Related to zinkenite. Pillaite is unusual in having both Cl and O that play an essential role in the stability of its structure.

Name: After Leopoldo Pilla (1805–1848), Professor of Mineralogy and Geology at the University of Pisa, one of the most important Italian volcanologists and mineralogists of his time.

Comments: IMA No. 1997–042.

ORLANDI, P., MOËLO, Y., MEERSCHAUT, A. & PALVADEAU, P. (2001): Lead–antimony sulfosalts from Tuscany (Italy). III. Pillaite, $Pb_9Sb_{10}S_{23}ClO_{0.5}$, a new Pb–Sb oxy-chloro-sulfosalt, from Buca della Vena mine. *European Journal of Mineralogy* **13**, 605-610.

MEERSCHAUT, A., PALVADEAU, P., MOËLO, Y. & ORLANDI, P. (2001): Lead–antimony sulfosalts from Tuscany (Italy). IV. Crystal structure of pillaite, $Pb_9Sb_{10}S_{23}ClO_{0.5}$, an expanded monoclinic derivative of hexagonal $Bi(Bi_2S_3)_9I_3$, from the zinkenite group. *European Journal of Mineralogy* **13**, 779-790.

Raadeite

$Mg_7(PO_4)_2(OH)_8$

MONOCLINIC

Locality: Near Tingelstadtjern, Modum district, southern Norway.

Occurrence: In nodules of apatite and magnesium phosphates in a serpentinite body. Associated minerals are: althausite, holtedahlite, apatite, magnesite and heneuite.

General appearance: Veinlets a few tens of μm wide; rare anhedral inclusions up to 150 μm; as fibrous coronae with apatite, althausite and magnesite replacing cm-size crystals of heneuite.

Physical, chemical and crystallographic properties: *Luster*: pearly. *Diaphaneity*: transparent. *Color*: colorless. *Streak*: white. *Luminescence*: not mentioned. *Hardness*: could not be determined. *Tenacity*: not given, probably brittle. *Cleavage*: could not be determined. *Fracture*: could not be determined. *Density*: could not be measured, 2.81 g/cm^3 (calc.). *Crystallography*: Monoclinic, $P2_1/n$, a 5.250, b 11.647, c 9.655 Å, β 95.94°, V 587.2 Å^3, Z = 2, a:b:c = 0.4508:1:0.8290. Morphology: no forms were observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.436 (75) ($\bar{1}11$), 3.521 (80) ($\bar{1}12$, 121), 3.145 (70) ($\bar{1}22$), 3.087 (70) (013), 2.905 (100) (131), 2.794 (75) (023, 041), 2.199 (80) (142, 202). *Optical data*: Biaxial (–), α 1.5945, β 1.6069, γ 1.6088, $2V$(meas.) 45.6°, $2V$(calc.) 43°; dispersion $r > v$, strong; nonpleochroic; $Y = b$, Z probably ≈ a. *Chemical analytical data*: Mean of eight sets of electron-microprobe data (with the amount of H_2O calculated to give 8 OH): MgO 55.35, CaO 0.02, MnO 0.30, FeO 0.25, SiO_2 0.05, P_2O_5 28.23, As_2O_5 0.40, SO_3 0.05, H_2O (14.34), Total (98.99) wt.%. Empirical formula: $(Mg_{6.90}Mn_{0.02}Fe_{0.02})_{\Sigma 6.94}[(PO_4)_{2.00}(AsO_4)_{0.02}]_{\Sigma 2.02}(OH)_{8.00}$. *Relationship to other species*: It is the Mg- and PO_4-dominant analogue of allactite, $Mn_7(AsO_4)_2(OH)_8$.

Name: After Gunnar Raade (b. 1944), Curator of Minerals, Natural History Museum, Oslo, Norway, in recognition of his contribution to the mineralogy of magnesium phosphates.

Comments: IMA No. 1996–034. The paper contains details of the crystal structure.

CHOPIN, C., FERRARIS, G., PRENCIPE, M., BRUNET, F. & MEDENBACH, O. (2001): Raadeite, $Mg_7(PO_4)_2(OH)_8$: a new dense-packed phosphate from Modum (Norway). *European Journal of Mineralogy* **13**, 319-327.

Rappoldite

$Pb(Co,Ni)_2(AsO_4)_2 \cdot 2H_2O$

TRICLINIC

Locality: The dumps of the Rappold mine, near Schneeberg, Saxony, Germany.

Occurrence: On quartz with cobaltlotharmeyerite. Other minerals in the dump material are: cobaltaustinite, scorodite, barium-pharmacosiderite, olivenite, conichalcite, erythrite, arseniosiderite, mimetite, beudantite, silver, bismuth, acanthite, galena, pyrite and skutterudite.

General appearance: Idiomorphic crystals (up to 1 mm long × 0.3 mm in diameter); also as aggregates of tabular crystals.

Physical, chemical and crystallographic properties: *Luster*: given as vitreous, but the indices of refraction indicate adamantine. *Diaphaneity*: transparent. *Color*: red to red-brown. *Streak*: light yellow brown. *Luminescence*: nonfluorescent. *Hardness*: 4½. *Tenacity*: brittle. *Cleavage*: none observed. *Fracture*: conchoidal. *Density*: could not be measured, 5.30 g/cm^3 (calc.). *Crystallography*: Triclinic, $P\bar{1}$, a 11.190, b 10.548, c 7.593 Å, α 100.38°, β 109.59°, γ 98.96°, V 807.6 Å^3, Z = 4, a:b:c = 1.0609:1:0.7199. Morphology: {210} and {001}, habit prismatic [$\bar{1}$20]. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.670 (97) ($\bar{2}$11), 3.256 (100) (022, $\bar{2}$12), 3.072 (56) (211), 2.890 (40) (2$\bar{3}$1, $\bar{2}$31), 2.760 (37) (401, 231), 2.568 (46) (022, $\bar{4}$02, 23$\bar{2}$, 400, 230), 1.731 (38) (0$\bar{6}$1, 44$\bar{1}$, 004, 42$\bar{4}$). *Optical data*: Biaxial (+), α 1.85 (calc.), β 1.87, γ 1.90, 2V(meas.) 85°, dispersion $r > v$, distinct; nonpleochroic; $Y \approx$ [$\bar{1}$20], $X \approx c$. *Chemical analytical data*: Mean of eleven sets of electron-microprobe data: PbO 35.27, CaO 0.12, CuO <0.05, ZnO 4.52, CoO 11.60, NiO 7.31, Al_2O_3 <0.05, Fe_2O_3 0.28, Bi_2O_3 0.11, As_2O_5 35.82, SO_3 0.11, H_2O (5.62), Total (100.76) wt.%. Empirical formula: $(Pb_{1.02}Ca_{0.01})_{\Sigma 1.03}$ $(Co_{0.98}Ni_{0.62}Zn_{0.35}Fe_{0.02})_{\Sigma 1.97}$ $[(AsO_4)_{1.98}(SO_4)_{0.01}]_{\Sigma 1.99}$ $[(OH)_{0.06}(H_2O)_{1.96}]_{\Sigma 2.02}$. *Relationship to other species*: It is a member of the tsumcorite group, specifically the Co-dominant analogue of helmutwinklerite.

Name: After the discovery locality.

Comments: IMA No. 1998–015. The crystal structure has been solved.

EFFENBERGER, H., KRAUSE, W., BERNHARDT, H.-J. & MARTIN, M. (2000): On the symmetry of tsumcorite group minerals based on the new species rappoldite and zincgartrellite. *Mineralogical Magazine* **64**, 1109-1126.

Rengeite

$Sr_4ZrTi_4Si_4O_{22}$

MONOCLINIC

Locality: Two localities in the Itoigawa-Ohmi district in the easternmost part of the Renge Belt, Niigata Prefecture, central Japan. The first occurrence is at Oyashirazu shore; it has been found also in the bed of the Kotaki-gawa River.

Occurrence: The mineral occurs in blue, lavender or green jade pebbles and boulders. Associated minerals in blue jade are: jadeite, titanian omphacite, sodic amphibole, titanite, rutile, anatase, strontium-apatite and tausonite. In lavender jade, associated minerals are: jadeite, titanian jadeite, rutile, titanite, zircon, natrolite, lamprophyllite, tausonite and an undetermined Sr–Ti silicate. In green jade, it is associated with jadeite, omphacite, titanite and zircon.

General appearance: Anhedral grains (up to ~0.5 mm) in blue jade. Fan-shaped aggregate of prismatic crystals (<0.3 mm long) in lavender jade. Elongate aggregates (~9 mm) of anhedral crystals in green jade.

Physical, chemical and crystallographic properties: *Luster*: adamantine. *Diaphaneity*: transparent. *Color*: dark greenish brown. *Streak*: pale greenish brown. *Luminescence*: nonfluorescent. *Hardness*: VHN_{100} 606 to 698 kg/mm^2, Mohs 5 to 5½. *Tenacity*: not given but probably brittle. *Cleavage*: none. *Fracture*: not given. *Density*: could not be measured, 4.12 g/cm^3 (calc.). *Crystallography*: Monoclinic, $P2_1/a$, a 13.97, b 5.675, c 11.98 Å, β 114.26°, V 866 Å^3, Z = 2, $a:b:c$ = 2.4617:1:2.1110. Morphology: no forms were observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.16 (m) ($\bar{1}12$), 3.13 (s) ($\bar{4}03$), 3.06 (vvs) ($\bar{3}13$), 3.00 (vs) ($\bar{2}04$), 2.86 (s) (020), 2.79 (m) (401), 2.30 (m) ($\bar{4}05$), 2.20 (vs) ($\bar{3}15$). *Optical data*: Biaxial (+), indices of refraction are higher than those of titanite and are too high to measure; pleochroism strong from pale green to pale greenish brown; orientation could not be determined. *Chemical analytical data*: Mean of six sets of electron-microprobe data for *REE*-poor material gave: CaO 0.43, FeO 0.10, SrO 34.32, BaO 0.13, Al_2O_3 0.20, Ce_2O_3 0.38, Pr_2O_3 0.10, Nd_2O_3 0.29, Sm_2O_3 0.04, SiO_2 22.58, TiO_2 29.88, ZrO_2 9.49, Nb_2O_5 0.24, Ta_2O_5 0.07, Total 98.25 wt.%. Empirical formula: $(Sr_{3.62}Ca_{0.08}Ce_{0.03}Nd_{0.02}Ba_{0.01}Pr_{0.01})_{\Sigma 3.77}$ $(Zr_{0.84}Ti_{0.09}Al_{0.04}Nb_{0.02}Fe_{0.02})_{\Sigma 1.01}$ $Ti_{4.00}Si_{4.11}O_{22.00}$. *Relationship to other species*: It is the Sr- and Zr-dominant analogue of perrierite.

Name: After the type locality.

Comments: IMA No. 1998–055.

MIYAJIMA, H., MATSUBARA, S., MIYAWAKI, R., YOKOYAMA, K. & HIROKAWA, K. (2001): Rengeite, $Sr_4ZrTi_4Si_4O_{22}$, a new mineral, the Sr–Zr analogue of perrierite from the Itoigawa-Ohmi district, Niigata Prefecture, central Japan. *Mineralogical Magazine* **65**, 111-120.

Rollandite

$Cu_3(AsO_4)_2 \bullet 4H_2O$

ORTHORHOMBIC

Locality: The South group of the Roua copper occurrences in the upper part of the Var valley (the Daluis gorge) at the western margin of the Barrot Dome, Alpes-Maritimes, France.

Occurrence: Associated minerals are: olivenite, conichalcite, clinotyrolite, cornubite, kolfanite, pharmacosiderite, gerhardtite, atacamite, gilmarite, wallkilldellite-(Fe), cuprite, domeykite, algodonite and native copper.

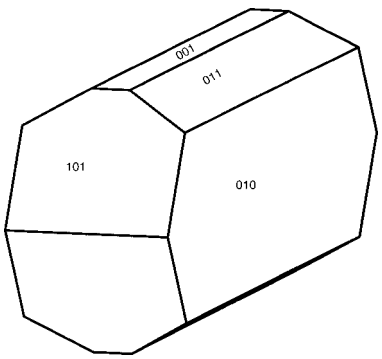
General appearance: Aggregates up to 1 mm in diameter made up of crystals (up to 0.5 × 0.15 × 0.1 mm).

Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent. *Color*: bottle-green. *Streak*: very light green. *Luminescence*: nonfluorescent. *Hardness*: 4 to 4½. *Tenacity*: very brittle. *Cleavage*: {001} good. *Fracture*: conchoidal. *Density*: 3.9 g/cm^3 (meas.), 3.85 g/cm^3 (calc.). *Crystallography*: Orthorhombic, *Pnma*, *a* 5.6906, *b* 17.061, *c* 9.732 Å, *V* 944.9 Å^3, *Z* = 4, *a*:*b*:*c* = 0.3335:1:0.5704. Morphology: {010}, {011}, {101}, {001}; habit elongate of [100] and slightly flattened on {010}. Twinning: none observed. *X-ray powder-diffraction data*: 8.520 (100) (020), 3.721 (60) (131), 3.221 (90) (141, 051), 3.102 (40) (132), 2.817 (35) (103, 033), 2.795 (35) (142), 2.366 (20) (240, 071), 2.350 (25) (143, 053), 2.133 (25) (080, 251). *Optical data*: Biaxial (–), α 1.745, β 1.755, γ 1.760, 2*V*(meas.) 71°, 2*V*(calc.) 70°; dispersion *r* < *v*, strong; nonpleochroic; orientation, *X* = *a*, *Y* = *c*, *Z* = *b*. *Chemical analytical data*: Mean of ten sets of electron-microprobe data: CuO 44.87, As_2O_5 42.44, H_2O (12.69), Total (100.00) wt.%. The amount of H_2O was calculated by difference. Empirical formula: $Cu_{3.09}(AsO_4)_{2.02}(OH)_{0.12} \bullet 3.80H_2O$. *Relationship to other species*: None apparent.

Name: After Pierre Rolland (b. 1940), an eminent collector of minerals from the Roua mines.

Comments: IMA No. 1998–001. The abstractor drew the crystal drawing produced here with the assistance of Dr. Halil Sarp and Prof. André Lalonde.

SARP, H. & ČERNÝ, R. (2000): Rollandite, $Cu_3(AsO_4)_2 \bullet 4H_2O$, a new mineral: its description and crystal structure. *European Journal of Mineralogy* **12**, 1045-1050.



Schiavinatoite

$(Nb,Ta)BO_4$

TETRAGONAL

Locality: Antsongombato, south of Betafo, some tens of kilometers south of the village of Mahaiza, Madagascar.

Occurrence: In a highly evolved granitic pegmatite. Associated minerals (in addition to the normal rock-forming minerals of granitic pegmatites) are: béhierite, rhodizite, spodumene, elbaite–liddicoatite series of the tourmaline group, danburite, cesian beryl, pollucite, manganoan fluorapatite, uranoan microlite, xenotime, monazite, manganocolumbite, manganotantalite, hübnerite and hafnian zircon. Schiavinatoite occurs intimately associated with béhierite, $(Ta,Nb)BO_4$.

General appearance: Part of a well-formed, flattened bipyramidal crystal about 4 mm across. Five similar crystals up, one up to 2 cm long, have been found but not exhaustively characterized.

Physical, chemical and crystallographic properties: *Luster*: vitreous, but the optical properties indicate adamantine. *Diaphaneity*: transparent in thin section. *Color*: grayish pink. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: about 8. *Tenacity*: not given, probably brittle. *Cleavage*: none observed. *Fracture*: not given. *Density*: not measured, 6.57 g/cm^3 (calc.). *Crystallography*: Tetragonal, $I4_1/amd$, a 6.219, c 5.487 Å, V 212.2 Å^3, $Z = 4$, $c:a = 0.8823$. Morphology: first- and second-order tetragonal bipyramid and a tetragonal prism. Twinning: none observed. *X-ray powder-diffraction data*: 4.115 (100) (101), 3.110 (84) (200), 2.481 (36) (211), 2.328 (49) (112), 1.939 (29) (301), 1.646 (25) (321), 1.598 (42) (312). *Optical data*: Uniaxial (+), approximate mean index of refraction 2.30. *Chemical analytical data*: In the crystal studied, 38 of the 54 points analyzed by electron microprobe represent béhierite. Mean of sixteen sets of electron-microprobe data (B_2O_3 calculated to give 1 B atom per formula unit): B_2O_3 (16.60), Nb_2O_5 33.08, Ta_2O_5 50.37, Total (100.05) wt.%. Empirical formula: $(Nb_{0.52}Ta_{0.48})_{\Sigma 1.00}BO_4$. *Relationship to other species*: It is the Nb-dominant analogue of béhierite, $(Ta,Nb)BO_4$.

Name: After Giuseppe Schiavinato (1915–1996), Professor of Mineralogy at the University of Milan, Italy, who helped the development of mineralogical sciences in Italy.

Comments: IMA No. 1999–051. The name is pronounced "skee-ah-vee-nat-toh-ite".

DEMARTIN, F., DIELLA, V., GRAMACCIOLI, C. & PEZZOTTA, F. (2001): Schiavinatoite, $(Nb,Ta)BO_4$, the Nb analogue of behierite. *European Journal of Mineralogy* **13**, 159-165.

Tamaite

$(Ca,K,Ba,Na)_{3-4}Mn_{24}(Si,Al)_{40}(O,OH)_{112}\bullet 21H_2O$

MONOCLINIC

Locality: The Shiromaru mine, Okutama, Tama district, Tokyo, Japan (Lat. 35° 48'30" N, Long. 139° 7'30" E), about 60 km WNW of Tokyo.

Occurrence: In a weakly metamorphosed manganese ore deposit. Associated minerals are: celsian, barian orthoclase, aegirine, manganoan grossular, native copper, strontiopiemontite, eggletonite and ganophyllite.

General appearance: Veinlets up to 1.5 mm thick composed of micaceous platy crystals less than 0.5 mm in diameter. Also as spotted crystals about 0.1 mm in diameter in veinlets.

Physical, chemical and crystallographic properties: *Luster*: vitreous to pearly. *Diaphaneity*: transparent. *Color*: colorless to pale yellowish brown. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: approximately 4 parallel to the cleavage. *Tenacity*: not mentioned. *Cleavage*: {001} perfect. *Fracture*: not mentioned. *Density*: 2.85 g/cm^3 (meas.), 2.83 g/cm^3 (calc.). *Crystallography*: Monoclinic, $P2_1/a$, a 16.64, b 27.11, c 25.35 Å, β 98.47°, V 11302.9 Å^3, Z = 4, $a:b:c$ = 0.6138:1:0.9351. Morphology: no forms were observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 12.6 (vvs) (002), 3.13 (s) (008), 2.84 (s) (38$\bar{2}$), 2.69 (vs) (38$\bar{4}$), 2.60 (s) (602), 2.46 (s) (60$\bar{6}$, 38$\bar{6}$). *Optical data*: Biaxial (–), β 1.612, 2V(meas.) small. *Chemical analytical data*: Mean of four sets of electron-microprobe data: Na_2O 0.34, K_2O 0.82, MgO 0.23, CaO 1.94, MnO 35.17, FeO 0.16, BaO 2.03, Al_2O_3 7.79, SiO_2 41.23, H_2O 11.07, Total 100.78 wt.%. Empirical formula: $(Ca_{1.65}K_{0.83}Ba_{0.63}Na_{0.52})_{\Sigma 3.63}$ $(Mn_{23.70}Mg_{0.27}Al_{0.12}Fe_{0.11})_{\Sigma 24.20}$ $(Si_{32.81}Al_{7.19})_{\Sigma 40.00}$ $[O_{95.26}(OH)_{16.74}]_{\Sigma 112.00}\bullet 21.00H_2O$. *Relationship to other species*: It is the calcium-dominant analogue of ganophyllite, $(K,Na)_6(Mn,Al,Mg)_{24}(Si,Al)_{40}(O,OH)_{112}\bullet 21H_2O$.

Name: After the type locality.

Comments: IMA No. 1999–011.

MATSUBARA, S., MIYAWAKI, R., TIBA, T. & IMAI, H. (2000): Tamaite, the Ca-analogue of ganophyllite, from the Shiromaru mine, Okutama, Tokyo, Japan. *Journal of Mineralogical and Petrological Sciences* **95**, 79-83.

Telluronevskite

Bi_3TeSe_2

TRIGONAL

Locality: Vihorlat Mountains, 8 km south-southeast of Snina, near Košice in eastern Slovakia, Slovak Republic.

Occurrence: As disseminated grains in quartzite. Associated minerals are: quartz, pyrite, pyrrhotite, sphalerite, chalcopyrite and stannite.

General appearance: Massive aggregates (up to 2 mm in diameter) and disseminated tabular crystals.

Physical, chemical and crystallographic properties: *Luster*: metallic. *Diaphaneity*: opaque. *Color*: steel gray. *Streak*: black. *Hardness*: VHN_{10} 100 kg/mm^2. *Tenacity*: flexible. *Cleavage*: {001} perfect. *Fracture*: not given. *Density*: 8.1 g/cm^3 (meas.), 8.08 g/cm^3 (calc.). *Crystallography*: Trigonal, $P\bar{3}m1$, a 4.264, c 23.25 Å, V 366 Å^3, Z = 2, c:a = 5.4526. Morphology: Only {001} was observed. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.66 (19) (005), 3.32 (13) (103, 007), 3.12 (100) (104), 2.28 (33) (108), 2.13 (36) (110, 109), 1.935 (16) (115, 00.12), 1.355 (18) (214, 1.0.16). *Optical data*: In reflected light: white with a yellow tint, moderate anisotropism, weak bireflectance, pleochroism not noted. $R_{max.}$, $R_{min.}$: (48.5, 46.6%) 470 nm, (51.1, 48.5%) 546 nm, (51.9, 49.5%) 589 nm, (52.8, 50.5%) 650 nm. *Chemical analytical data*: Mean of four sets of electron-microprobe data: Bi 68.84, Pb 0.42, Se 15.41, Te 14.58, S 1.14, Total 100.39 wt.%. Empirical formula: $(Bi_{2.92}Pb_{0.02})_{\Sigma 2.94}$ $Te_{1.01}$ $(Se_{1.75}S_{0.32})_{\Sigma 2.07}$. *Relationship to other species*: It is related to the members of the tetradymite group.

Name: Reflects the chemical similarity to nevskite, Bi(Se,S), with the addition of Te.

Comments: IMA No. 1993–027a.

ŘÍDKOŠIL, T., SKÁLA, R., JOHAN, Z. & ŠREIN, V. (2001): Telluronevskite, Bi_3TeSe_2, a new mineral. *European Journal of Mineralogy* **13**, 177-185.

Urusovite

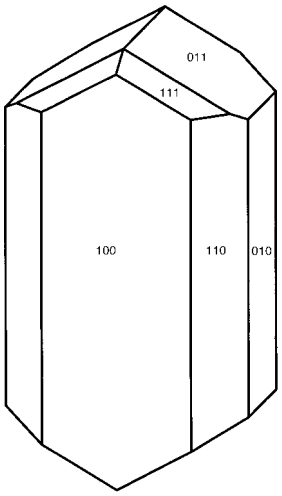
$Cu[AlAsO_5]$

MONOCLINIC

Locality: The North Breach of the great fissure Tolbachik eruption (1975–1976), Kamchatka Peninsula, Russia.

Occurrence: A product of fumarolic activity in the second cinder cone of the North Breach. Associated minerals are: ponomarevite, piypite, sylvite and lesser amounts of dolerophanite, euchlorine, tenorite, hematite and two unknown As-bearing minerals.

General appearance: Light green plates (up to 0.4 mm).



Physical, chemical and crystallographic properties: *Luster*: vitreous. *Diaphaneity*: transparent. *Color*: light green. *Streak*: white. *Luminescence*: nonfluorescent. *Hardness*: VHN_{10} 378 kg/mm^2. *Tenacity*: brittle. *Cleavage*: {100} perfect. *Fracture*: not mentioned. *Density*: could not be measured, 3.97 g/cm^3 (calc.). *Crystallography*: Monoclinic, $P2_1/c$, a 7.314, b 10.223, c 5.576 Å, β 99.79°, V 410.9 Å^3, Z = 4, a:b:c = 0.7154:1:0.5454. Morphology: {100}, {010}, {110}, {010}, {111}. Twinning: none mentioned. *X-ray powder-diffraction data*: 7.20 (100) ($\bar{1}$00), 4.844 (9) (011), 4.327 (23) ($\bar{1}$11), 3.604 (10) (200), 3.174 (10) (121), 3.125 (20) ($\bar{2}$11), 2.458 (8) (221). *Optical data*: Biaxial (–), α 1.672, β 1.718, γ 1.722, 2V(meas.) ~30°, 2V(calc.) 32°; slight pleochroism, X colorless, Y light green, Z light green; $X \approx c$, $Y = b$, $Z \wedge a \approx 10°$. *Chemical analytical data*: Mean of fifteen sets of electron-microprobe data: CuO 32.23, ZnO 0.25, Al_2O_3 20.89, Fe_2O_3 0.32, As_2O_5 46.02, V_2O_5 0.10, Total 99.81 wt.%. Empirical formula: $(Cu_{1.00}Zn_{0.01})_{\Sigma 1.01}(Al_{1.01}Fe_{0.01})_{\Sigma 1.01}As_{0.98}O_{5.00}$. *Relationship to other species*: None apparent.

Name: After Vadim Sergeevich Urusov (b. 1936), crystal chemist, Corresponding Member of the Russian Academy of Sciences and chair of the Department of Crystallography and Crystal Chemistry of Moscow State University.

Comments: IMA No. 1998–067. Note that the crystal structure has been solved. The crystal drawing produced here is slightly different from that given in the paper, which appears to depart slightly from the standard orientation.

VERGASOVA, L.P., FILATOV, S.K., GORSKAYA, M.G., MOLCHANOV, A.A., KRIVOVICHEV, S.V. & ANANIEV, V.V. (2000): Urusovite, $Cu[AlAsO_5]$, a new mineral from the Tolbachik volcano, Kamchatka, Russia. *European Journal of Mineralogy* **12**, 1041-1044.

KRIVOVICHEV, S.V., MOLCHANOV, A.A. & FILATOV, S.K. (2000): The crystal structure of $Cu[AlAsO_5]$: a novel type of aluminoarsenate tetrahedral polyanion. *Crystallographic Reports* (in press).

Woodallite

$Mg_6Cr_2(OH)_{16}Cl_2 \cdot 4H_2O$

TRIGONAL

Locality: The Mount Keith deposit, 94 km NNE of Leinster in the northeastern Goldfields district, Western Australia, Australia.

Occurrence: In lizardite+brucite-altered dunite in a large, low-grade disseminated nickel sulfide deposit. Associated minerals are: chromite. lizardite, iowaite, pentlandite, magnetite, tochilinite and brucite.

General appearance: Whorls and clusters (up to 6 mm across) of minute platelets (5 to 100 μm).

Physical, chemical and crystallographic properties: *Luster*: resinous to waxy. *Diaphaneity*: transparent. *Color*: deep magenta to purple. *Streak*: pale pink to white. *Luminescence*: nonfluorescent. *Hardness*: 1½ to 2. *Tenacity*: flexible but not elastic. *Cleavage*: {001} perfect. *Fracture*: not given. *Density*: 2.062 g/cm^3 (meas.), 2.04 g/cm^3 (calc.). *Crystallography*: Trigonal, $R\bar{3}m$, *a* 3.103, *c* 24.111 Å, *V* 201.14 Å^3, *Z* = 3/8, *c*:*a* = 7.7702. Morphology: no forms were mentioned, tabular on {001}. Twinning: none mentioned. *X-ray powder-diffraction data*: 8.0361 (100) (003), 4.0205 (48) (006), 2.6239 (3) (012), 2.3488 (5) (015), 2.0072 (6) (0.1.12), 1.6977 (2) (0.1.11), 1.5237 (2) (113, 1.0.13) Note: the last spacing is indexed erroneously as (2$\bar{1}$3, 1.0.13). *Optical data*: Uniaxial (–), ω 1.555, ε 1.535, pleochroism distinct from violet to pinkish lilac. *Chemical analytical data*: Mean of an unspecified number of sets of electron-microprobe data (corrected for loss of volatiles): Mg 22.90, Cr 9.56, Fe 4.30, Al 0.60, H_2O 10.96, OH 41.40, Cl 8.71, S 0.03, CO_3 1.52, Total 99.98 wt.%. The CO_3 content is based on total C measured by Leco carbon analyzer. Empirical formula: $Mg_{6.23}(Cr_{1.21}Fe_{0.51}Al_{0.15})_{\Sigma 1.87}(OH)_{16.08}[Cl_{1.62}(CO_3)_{0.17}(SO_4)_{0.01}]_{\Sigma 1.80} \cdot 4.02H_2O$. *Relationship to other species*: It is a member of the hydrotalcite group, specifically the Cr-dominant analogue of iowaite, $Mg_6Fe_2(OH)_{16}Cl_2 \cdot 4H_2O$.

Name: After Roy Woodall (b. 1930), eminent Australian geologist.

Comments: IMA No. 2000–042.

GRGURIC, B.A., MADSEN, I.C. & PRING, A. (2001): Woodallite, a new chromium analogue of iowaite from the Mount Keith nickel deposit, Western Australia. *Mineralogical Magazine* **65**, 427-435.

Zincgartrellite

$Pb(Zn,Fe,Cu)_2(AsO_4)_2(H_2O,OH)_2$

TRICLINIC

Locality: The Tsumeb mine, Tsumeb, Namibia.

Occurrence: From material mined during 1975–1980 and purchased by G. Tremmel. Associated minerals are: chalcocite, wulfenite, duftite, "β-duftite" (calcian conichalcite), "cupro-adamite" and olivenite.

General appearance: Aggregates (up to 0.5 mm) made up of tabular crystals (<0.1 mm).

Physical, chemical and crystallographic properties: *Luster*: given as vitreous, but the indices of refraction indicate adamantine. *Diaphaneity*: transparent to translucent. *Color*: green-yellow. *Streak*: yellow. *Luminescence*: nonfluorescent. *Hardness*: 4½. *Tenacity*: brittle. *Cleavage*: none observed. *Fracture*: not determined. *Density*: could not be measured, 5.37 g/cm^3 (calc.). *Crystallography*: Triclinic, $P\bar{1}$, *a* 5.550, *b* 5.620, *c* 7.621 Å, α 68.59°, β 69.17°, γ 69.51°, *V* 200.1 Å^3, *Z* = 1, *a*:*b*:*c* = 0.9875:1:1.3560. Morphology: {111}, tabular on {111}. Twinning: none mentioned. *X-ray powder-diffraction data*: 4.731 (74) (011), 4.669 (86) (101), 3.283 (89) (012), 3.252 (91) (102), 3.185 (66) ($1\bar{1}0$), 2.999 (100) ($11\bar{1}$), 2.894 (74) ($1\bar{1}\bar{1}$), 2.880 (70) ($1\bar{1}1$), 2.535 (65) ($10\bar{2}$, 120, $01\bar{2}$, 020) (Krause *et al.* 1998). *Optical data*: Biaxial (–), α 1.91, β 1.94 (calc.), γ 1.97, 2*V*(meas.) 87°, dispersion not determined; pleochroism weak, *X* = *Z* pale yellow, *Y* yellow; orientation not determined. *Chemical analytical data*: Mean of sixteen sets of electron-microprobe data: PbO 33.49, CaO 0.35, CuO 6.26, NiO <0.05, CoO <0.05, ZnO 11.40, Al_2O_3 0.26, Fe_2O_3 7.23, As_2O_5 34.72, SO_3 0.13, H_2O (4.3), Total (98.62) wt.%. Empirical formula: $(Pb_{0.99}Ca_{0.04})_{\Sigma 1.03}$ $(Zn_{0.92}Cu_{0.52}Fe_{0.60}Al_{0.03})_{\Sigma 2.07}$ $[(AsO_4)_{1.99}(SO_4)_{0.01}]_{\Sigma 2.00}[(OH)_{0.82}(H_2O)_{1.16}]_{\Sigma 1.98}$. *Relationship to other species*: It is a member of the tsumcorite group, specifically the Zn-dominant analogue of gartrellite.

Name: Denotes the relationship with gartrellite and the dominance of zinc.

Comments: IMA No. 1998–014.

EFFENBERGER, H., KRAUSE, W., BERNHARDT, H.-J. & MARTIN, M. (2000): On the symmetry of tsumcorite group minerals based on the new species rappoldite and zincgartrellite. *Mineralogical Magazine* **64**, 1109-1126.

KRAUSE, W., BELENDORFF, K., BERNHARDT, H.-J., MCCAMMON, C., EFFENBERGER, H. & MIKENDA, W. (1998): Crystal chemistry of the tsumcorite-group minerals. New data on ferrilotharmeyerite, tsumcorite, thometzekite, mounanaite, helmutwinklerite, and a redefinition of gartrellite. *European Journal of Mineralogy* **10**, 179-206.

Zincowoodwardite

$[Zn_{1-x}Al_x(OH)_2][(SO_4)_{x/2}(H_2O)_n]$

TRIGONAL

Locality: Laurion, Greece, and also the Hilarion and the Christiana mines, both at Kamariza, near Laurion, Greece.

Occurrence: Associated minerals are: glaucocerinite, natroglaucocerinite, zaccagnaite, serpierite and hemimorphite.

General appearance: Botryoidal crusts of tabular crystals (5 to 10 μm).

Physical, chemical and crystallographic properties: *Luster*: waxy. *Diaphaneity*: translucent. *Color*: pale bluish to bluish white. *Streak*: white to bluish white. *Luminescence*: not mentioned. *Hardness*: 1. *Tenacity*: sectile. *Cleavage*: not discernible. *Fracture*: not mentioned. *Density*: 2.66 g/cm^3 (meas.), 2.71 g/cm^3 (calc.). *Crystallography*: Trigonal (rhombohedral), probably $R\bar{3}m$ for the -3*R* polytype, *a* 3.065, *c* 25.42 Å, *V* 206.8 Å^3, *Z* = 3, *c*:*a* = 8.2936 (see Comments). Morphology: no forms were mentioned. Twinning: none mentioned. *X-ray powder-diffraction data*: The -3*R* polytype: 8.50 (100) (003), 4.248 (33) (006), 2.600 (5) (012), 2.354 (4) (015), 2.039 (3) (018), 1.532 (2) (110), 1.508 (2) (113). The -1*T* polytype: 8.9 (100) (001), 4.47 (90) (002), 2.65 (30) (100), 2.55 (60) (101), 2.28 (50) (102), 1.98 (30) (103), 1.53 (30) (110), 1.51 (30) (111). *Optical data*: Uniaxial (sign unknown), ω 1.5636, ε could not be measured, nonpleochroic. The -1*T* polytype has ω 1.558. *Chemical analytical data*: ICP–MS analysis gave: CaO 10.4, ZnO 33.3, Al_2O_3 17.2, SO_3 12.6, H_2O 25.1, Total 98.6 wt.%. Empirical formula: $[Zn_{0.47}Cu_{0.15}Al_{0.38}(OH)_{2.00}]\,[(SO_4)_{0.18}O_{0.01}(H_2O)_{0.59}]$. *Relationship to other species*: It is a member of the hydrotalcite group and closely related to woodwardite, honessite, glaucocerinite, hydrowoodwardite and zaccagnaite. The descriptions of natroglaucocerinite and zaccagnaite are in press.

Name: Denotes the relationship to woodwardite and the dominance of zinc.

Comments: IMA No. 1998–026. The -1*T* polytype gave the following data: Trigonal, probably *P*, *a* 3.063, *c* 8.91 Å, *V* 72.4 Å^3, *Z* = 1, *c*:*a* = 2.9089. Analysis by AAS and CHN gave the empirical formula: $[Zn_{0.55}Cu_{0.12}Al_{0.33}(OH)_{2.00}]\,[(H_3O)_{0.11}Na_{0.04}(SO_4)_{0.17}(CO_3)_{0.07}(H_2O)_{0.96}]$.

WITZKE, T. & RAADE, G. (2000): Zincowoodwardite, $[Zn_{1-x}Al_x(OH)_2][(SO_4)_{x/2}(H_2O)_n]$, a new mineral of the hydrotalcite group. *Neues Jahrbuch für Mineralogie, Monatshefte*, 455-465.

Zugshunstite-(Ce)

$(Ce,Nd,La)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$

MONOCLINIC

Locality: Alum Cave Bluff, Great Smoky Mountains National Park, Tennessee, U.S.A.

Occurrence: In an evaporite assemblage. Associated minerals are: coskrenite-(Ce), levinsonite-(Y), melanterite, halotrichite, pickeringite, apjohnite, epsomite and other hydrated sulfates.

General appearance: Equant, stubby individual crystals (up to 1.0 mm in diameter) and subparallel aggregates (up to 1.5 mm in diameter).

Physical, chemical and crystallographic properties: *Luster*: not given, but probably vitreous. *Diaphaneity*: transparent. *Color*: pale pink under incandescent light, pale blue under fluorescent light. *Streak*: white. *Luminescence*: none observed. *Hardness*: not determined. *Tenacity*: brittle. *Cleavage*: {010} poor. *Fracture*: irregular. *Density*: not determined, 2.12 g/cm^3 (calc.). *Crystallography*: Monoclinic, *C*2/*c*, *a* 8.718, *b* 18.313, *c* 13.128 Å, β 93.90°, *V* 2091.0 Å^3, *Z* = 4, *a*:*b*:*c* = 0.4761:1:0.7169. Morphology: {010}, {012} dominant; {111} minor. Twinning: none mentioned. *X-ray powder-diffraction data*: 7.9 (100) (110), 5.36 (50) (022), 5.01 (40) (130), 3.93 (70) (023, 220, $\bar{1}$13, 132), 3.74 (20) (042, $\bar{2}$02, 113), 3.29 (20) ($\bar{1}$15, 222, 004), 3.07 (20) ($\bar{1}$14, 024, 060). *Optical data*: Biaxial (sign not given, but +), α 1.455, β 1.485, γ 1.528, 2*V*(meas.) 85°, 2*V*(calc.) 82°, dispersion *r* > *v*, medium; nonpleochroic; orientation not observed. *Chemical analytical data*: Mean of an unstated number of sets of electron-microprobe data: Y_2O_3 n.d., La_2O_3 2.16, Ce_2O_3 13.17, Pr_2O_3 1.68, Nd_2O_3 6.50, Sm_2O_3 0.80, Eu_2O_3 0.27, Gd_2O_3 0.14, Dy_2O_3 n.d., Er_2O_3 n.d., CaO 0.04, Al_2O_3 6.92, Fe_2O_3 1.11, SO_3 24.01, C_2O_3 (10.80), H_2O (32.41), Total (100.01) wt.%. The proportion of C_2O_3 and H_2O were calculated to give 1.00(C_2O_4) and 12(H_2O), respectively. Empirical formula: $(Ce_{0.54}Nd_{0.26}La_{0.09}Pr_{0.07}Sm_{0.03}Eu_{0.01}Gd_{0.01})_{\Sigma 1.01}$ $(Al_{0.91}Fe^{3+}_{0.09})_{\Sigma 1.00}$ $(SO_4)_{2.00}(C_2O_4)_{1.00}\bullet 12.00H_2O$. *Relationship to other species*: None stated.

Name: After the locality; it is the authors' best approximation of an anglicized equivalent to words used by the Cherokee Indians to refer to the Great Smoky Mountains (Tsu-g-shv-sdi).

Comments: IMA No. 1996–055.

ROUSE, R.C., PEACOR, D.R., ESSENE, E.J., COSKREN, T.D. & LAUF, R.J. (2001): The new minerals levinsonite-(Y) [$(Y,Nd,Ce)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$] and zugshunstite-(Ce) [$(Ce,Nd,La)Al(SO_4)_2(C_2O_4)\bullet 12H_2O$]: coexisting oxalates with different structures and differentiation of LREE and HREE. *Geochimica et Cosmochimica Acta* **65**, 1101-1115.