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New Mineral Names*

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NEW MINERALS

ALUMOÅKERMANITE*

D. Wiedenmann, A.N. Zaitsev, S.N. Britvin, S.V. Krivovichev, and J. Keller (2009) Alumoåkermanite, $(Ca,Na)_2(Al,Mg,Fe^{2+})(Si_2O_7)$, a new mineral from the active carbonatite-nephelinite-phonolite volcano Oldoinyo Lengai, northern Tanzania. Mineral. Mag., 73, 373–384.

Alumoåkermanite is a new member of the melilite group from the Oldoinyo Lengai volcano, northern Tanzania. The new mineral was found in several samples from the volcano and surrounding area. It occurs in evolved, olivine-free melilite-nephelinitic ashes and lapilli-tuffs from the 1966/67 and pre-1966 eruptions along with nepheline, aegirine-augite, and microcrysts of matrix-minerals including nepheline, aegirine-augite, combeite, spinel-group minerals, wollastonite, melanite, titanite, and sodalite. Alumoåkermanite occurs as tabular phenocrysts up 1.5 mm, and as microphenocrysts in the fine-grained groundmass. It is transparent, light brown, has a white streak, a Mohs hardness of ~4.5–5, is brittle with an uneven fracture, and no discernible fracture or cleavage. It does not fluoresce in either short-wave or long-wave UV light. It has a D_{meas} = 2.96(2) g/cm^3 and D_{calc} = 3.00 g/cm^3. Alumoåkermanite is uniaxial negative (–), with ω = 1.635(1) for both samples, and ε = 1.626(1) (OL244) and 1.624(2) (OL218). Under cross-polarized light, alumoåkermanite has a yellow to orange-red interference color, straight extinction, positive elongation, and is non-pleochroic.

The average chemical composition (WDS) of eight analyses gave SiO_2 43.73, TiO_2 0.09, Al_2O_3 8.32, Fe_2O_3 2.14, FeO 4.55, MnO 0.22, MgO 4.36, CaO 30.24, SrO 0.91, Na_2O 5.70, K_2O 0.10, sum 100.23 wt%, corresponding to $(Ca_{1.48}Na_{0.50}Sr_{0.02}K_{0.01})_{\Sigma 2.01}(Al_{0.44}Mg_{0.30}Fe^{2+}_{0.17}Fe^{3+}_{0.07}Mn_{0.01})_{\Sigma 0.99}(Si_{1.99}Al_{0.01}O_7)$ based on seven oxygen atoms, and an ideal formula of $(Ca,Na)_2(Al,Mg,Fe^{2+})(Si_2O_7)$.

Powder X-ray diffraction data were collected on a Stoe Stadi P diffractometer (Cu$K\alpha$ radiation) in transmission geometry. Refined unit-cell parameters for the powder X-ray diffraction data are a = 7.7661(4), c = 5.0297(4) Å, V = 303.4(1) Å^3. The strongest lines on the pattern [d_{obs} in Å(I_{obs}%, hkl)] include: 3.712(13,111), 3.476(11,3.473), 3.075(25,201), 2.859(100,211), 2.4563(32,310), 1.9413(11,400), 1.8303(13,330), 1.7634(11,411), 1.7569(19,312), 1.7364(13,420), and 1.3859(13,521). The crystal structure of alumoåkermanite was solved and refined using a 0.22 × 0.14 × 0.12 mm crystal mounted on a Stoe IPDS II Image-Plate-based X-ray diffractometer. The structure was refined using starting parameters from a synthetic sodic melilite (Louisnathan 1970, *Z. Kristallogr.*, 23, 314–321) inverted to obtain the absolute correct structure model. The data were refined to R_1 = 0.018 based on 439 unique reflections with $|F_o| \geq 4\sigma F$. The mineral is tetragonal, $P\bar{4}2_1m$, a = 7.7620(7), c = 5.0311(5) Å, V = 303.12(5) Å^3, Z = 2. The structural formula can thus be written as $(Ca_{1.5}Na_{0.5})(Al_{0.5}Fe_{0.3}Mg_{0.2})(Si_2O_7)$, which agrees with the WDS data. The structure of alumoåkermanite is identical in topology to other melilite-group minerals with $[(Al,Mg)Si_2O_7)]$ sheets interwoven with layers of (Ca,Na) cations. The absence of Al in the silicate tetrahedra site is unique in alumoåkermanite.

The name is for its composition and relationship to other members of the melilite group. The mineral and name have been approved by the IMA CNMNC (IMA no. 2008-049). Co-type specimens have been deposited in the Mineralogical Museum, Department of Mineralogy, St. Petersburg State University, St. Petersburg, Russia (OL218, catalog no. 1/19407), and the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (OL244, catalog no. 3823/1). **P.C.P.**

CÁMARAITE*

E. Sokolova, Y. Abdu, F.C. Hawthorne, A.V. Stepanov, G.K. Bekenova, and P.E. Kotel'Nikov (2009) Cámaraite, $Ba_3NaTi_4(Fe^{2+},Mn)_8(Si_2O_7)_4O_4(OH,F)_7$. I. A new Ti-silicate mineral from the Verkhnee Espe Deposit, Akjailyautas Mountains, Kazakhstan. Mineral. Mag., 73, 847–854.

F. Cámara, E. Sokolova, and F. Nieto (2009) Cámaraite, $Ba_3NaTi_4(Fe^{2+},Mn)_8(Si_2O_7)_4O_4(OH,F)_7$. II. The crystal structure and crystal chemistry of a new group-II Ti-disilicate mineral. Mineral. Mag., 73, 855–870.

Cámaraite is a new mineral from the Verkhnee Espe rare-element deposit located at the northern exo-contact of the large Akjailyautas granite massif, northern Tarbagatai mountain range, eastern Kazakhstan. It was found within a part of the deposit where alkali-rich fenites have been extensively recrystallized.

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*All minerals marked with an asterisk have been approved by the IMA CNMNC.

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Cámaraite is a hydrothermal mineral and occurs along with bafertisite, jinshajiangite, zircon, pyrochlore-group minerals, thorite, monazite, and xenotime at the exo-contact of the fenitized and granitized host rock. The mineral occurs on fracture surfaces, intergrown with jinshajiangite and bafertisite (8 × 15 × 2 mm intergrowths), and as star-shaped aggregates of crystals. Cámaraite is orange-red to brownish-red, platy on {001}, has a pale-yellow streak, a vitreous luster, is brittle with a {001} cleavage, no observed parting, a Mohs hardness of <5, and does not fluoresce under cathode or UV light. The mineral has D_{meas} = 3.871(1) and D_{calc} = 4.018 g/cm^3. Cámaraite is biaxial positive (+), $2V_{meas}$ = 93(1)°, with refractive indices > 1.80 (r_{calc} = 1.866). It is strongly pleochroic, X = light brown, Y = reddish brown, Z = yellow-brown, Z < X < Y.

The chemical composition of cámaraite was determined by WDS methods with the average (range) of 13 analyses giving Nb_2O_5 1.57(1.36–1.82), SiO_2 25.25(25.09–25.40), TiO_2 15.69(15.41–15.88), ZrO_2 0.33(0.22–0.52), Al_2O_3 0.13(0.09–0.22), Fe_2O_3 = 2.77, FeO_{tot} 16.54(18.76–19.37), MnO 9.46(9.34–9.60), ZnO 0.12(0.09–0.17), MgO 0.21(0.20–0.22), CaO 0.56(0.48–0.70), BaO 21.11(20.60–21.66), Na_2O 1.41(1.32–1.48), K_2O 0.84(0.80–0.89), H_2O_{calc} 1.84, F 3.11(2.93–3.33), O≡F –1.31, sum 99.63 wt%, corresponding to the empirical formula based on 39 anions of $(Ba_{2.61}K_{0.34})_{\Sigma 2.95}(Na_{0.86}Ca_{0.14})_{\Sigma 1}(Ti_{3.72}Nb_{0.22}Al_{0.05})_{\Sigma 3.99}(Fe^{2+}_{4.36}Fe^{3+}_{0.66}Mn_{2.53}Mg_{0.10}Zr_{0.05}Zn_{0.03}Ca_{0.05})_{\Sigma 7.78}Si_{7.97}O_{35.89}H_{3.88}F_{3.11}$, ideally $Ba_3NaTi_4(Fe^{2+},Mn)_8(Si_2O_7)_4O_4(OH,F)_7$. Mössbauer spectroscopy (RT, ^{57}Co source) allowed for the determination of the Fe^{3+}/Fe_{tot} ratio [0.13(8)] and the confirmation that all Fe is octahedrally coordinated.

Powder X-ray diffraction data were collected on a 57.3 mm Debye-Scherrer camera (Co*K*α radiation). Refined unit-cell parameters are *a* = 10.678(4), *b* = 13.744(8), *c* = 21.40(2) Å, α = 99.28(8), β = 92.38(5), γ = 90.00(6)°, *V* = 3096(3) Å^3. The strongest lines in the diffraction pattern [d_{obs} in Å(I_{obs}%, *hkl*)] are: 3.83(30,$\bar{2}04$), 3.39(50,$2\bar{2}4$), 3.26(20,$0\bar{4}3$), 3.18(50,$\bar{2}\bar{2}5$), 2.87(40,043), 2.79(90,$\bar{2}\bar{4}3$), 2.63(100,401), 2.212(20,405), 2.101(50,$\bar{4}\bar{4}2$), 2.012(30,$\bar{4}\bar{2}7$), and 1.721(70,$\bar{2}\bar{4}$.11). A single-crystal of cámaraite (0.03 × 0.14 × 0.14 mm) was mounted on a Bruker P4 diffractometer with a 4K CCD Smart detector (Mo*K*α radiation). The structure was solved by direct methods and refined based on 6682 unique reflections with $F_o > 4\sigma F$ to R_1 = 0.0627, wR_2 = 0.1245, GoF = 1.178. Cámaraite is triclinic, $C\bar{1}$, *a* = 10.6965(7), *b* = 13.7861(9), *c* = 21.478(2) Å, α = 99.345(1), β = 92.315(2), γ = 89.993(2)°, *V* = 3122.6(4) Å^3, Z = 4. The structure of cámaraite can be described by a TS (titanium silicate) block with an HOH structure (H = heteropolyhedral and O = octahedral) and an intermediate (I) block. Within the O-sheet, there are eight 6-coordinated M^O sites occupied mainly by Fe^{2+} and Mn. In the H-sheet, there are four 6-coordinated M^H sites containing Ti and eight 4-coordinated sites containing solely Si. Ba and Na atoms are found in six peripheral P sites, with four [8-12]-coordinated Ba-dominant A^P sites and two [10]-coordinated B^P sites containing Na. The topology of the TS block is that of a Group II Ti-disilicate. It is the only member of the group with two types of TS block linkages and two types of I blocks in its structure.

Cámaraite is named for Fernando Cámara (b. 1967) of Melilla, Spain, in recognition of his contribution to the fields of mineralogy and crystallography, particularly with respect to Ti-silicates, amphiboles, arrojadite-group minerals and cancrinite-group minerals. The mineral and name have been approved by IMA CNMNC (IMA no. 2009-11). Holotype material has been deposited at the Fersman Mineralogical Museum, Moscow, Russia (catalog no. 3828/1 and 3828/2). **P.C.P.**

DALIRANITE*

W.H. Paar, A. Pring, Y. Moëlo, C.J. Stanley, H. Putz, D. Topa, A.C. Roberts, and R.S.W. Braithwaite (2009) Daliranite, $PbHgAs_2S_6$, a new sulfosalt from the Zarshouran Au-As deposit, Takab region, Iran. Mineral. Mag., 73, 871–881.

Daliranite is a new sulfosalt mineral from the Zarshouran Au-As deposit, 42 km north of the town of Takab, West Azarbaijan Province, northwest Iran. The mineral has been known from this locality since the 1970s, often mislabeled as ludlockite, which it resembles. Daliranite occurs growing on orpiment and quartz, or, rarely, as matted nests along cracks and fractures. The matted nests consist of acicular, flexible hair-like fibers <200 μm long and <3μm in diameter elongated parallel to [010]. The mineral is vibrant orange-red, has a pale orange-red streak, is transparent with an adamantine luster, and has a Mohs hardness of >2. Neither cleavage nor fracture was observed, nor is it fluorescent. Optically, daliranite has a gray color with a distinctly higher reflectance than that of orpiment and abundant orange-red internal reflections. Reflectance data were determined in air (%/nm): 32.9/470, 30.5/546, 34.0/589, and 39.5/650.

Chemical analyses of daliranite (EMPA) gave an average composition (eight analyses) of Pb 23.26, Hg 24.77, Tl 0.19, As 18.75, S 22.48, sum 89.44%, resulting in an empirical formula based on 10 apfu (and after normalizing the EMPA data) of $Pb_{0.95}Tl_{0.01}Hg_{1.04}As_{2.10}S_{5.91}$, with an ideal formula of $PbHgAs_2S_6$, which requires Pb 27.63, Hg 26.75, As 19.98, S 25.65, sum 100.00 wt%. It has a calculated density of 5.93 g/cm^3.

Powder X-ray diffraction data were collected using a 114.6 mm Debye-Scherrer camera (Cu*K*α radiation). Selected area electron diffraction (SAED) data were used to acquire a starting unit cell, which was then used to index the powder X-ray diffraction pattern. Daliranite is thought to be monoclinic, with refined unit-cell parameters *a* = 19.113(5), *b* = 4.233(2), *c* = 22.958(8) Å, β = 114.78(5)°, *V* = 1686.4 Å^3, *Z* = 8. The strongest lines on the pattern [d_{obs} in Å(I_{obs}%, *hkl*)] include: 8.67(80,200), 5.68(30,103), 4.65(50,$\bar{4}01$), 4.34(30,400), 3.94(30,$\bar{4}05$), 3.87(40,$\bar{2}11$), 3.63(25,$\bar{2}13$), 3.53(20,$\bar{4}06$), 3.40(50,113), 3.31(30,014), 3.15(40,$\bar{6}02$), 3.04(25,$\bar{4}14$), 2.894(50,$\bar{6}00$), 2.833(25,214), 2.722(100,$\bar{7}03$), 2.530(30,$\bar{6}14$), 2.246(20,208), 2.187(50,$\bar{3}19$), 2.121(20,514), and 1.932(20,614). The structure of daliranite could not be determined due to the nature of the hair-like crystals, but the *a* unit-cell parameter (~4 Å) is characteristic of the majority of Pb sulfosalts whose structures are derived directly from the PbS or SnS archetypes. Daliranite is the 18th mineral species in which Hg is a specific chemical constituent, and the 5th Pb-Hg sulfosalt mineral. It likely formed as a by-product of a reaction between a (Pb,Hg)-bearing fluid, derived from remobilization of galena and cinnabar, with earlier orpiment. It is a late-stage mineral, with fluid inclusion temperatures in coeval sphalerite suggesting temperatures of formation between 157 and 193 °C.

The mineral is named for Farahnaz Daliran (b. 1953), mineralogist and economic geologist at the University of Karlsruhe, Germany, for her research on ore deposits in Iran. The mineral and name have been approved by the IMA CNMMN (IMA no. 2007-010). Co-type material has been deposited at the Mineralogical Museum, Department of Materials Engineering and Physics (Mineralogy), University of Salzburg, Austria (sample nos. 14947/14948), and in the collection at the South Australian Museum (catalog no. G29976). **P.C.P.**

DALNEGROITE*

F. Nestola, A. Guastoni, L. Bindi, and L. Secco (2009) Dalnegroite, $Tl_{5-x}Pb_{2x}(As,Sb)_{21-x}S_{34}$, a new thallium sulfosalt from Lengenbach quarry, Binntal, Switzerland. Mineral. Mag., 73, 1027–1032.

Dalnegroite is a new Tl-sulfosalt from the Lengenbach quarry, Binntal, Switzerland. The quarry is host to 15 Tl-sulfosalts, 12 of which are new species. The mineral occurs as dark gray, anhedral to subhedral crystals (200–300 μm long), and tiny parallel aggregates with realgar and pyrite in centimeter-sized irregular cavities in marble. It is associated with Sb-rich hutchinsonite, jordanite, Sb-rich seligmanite, and sinnerite. Dalnegroite is opaque, has a submetallic luster, a brownish-red streak, is brittle with uneven fracture, and has no cleavage. Microindentation measurements (VHN load of 25 g) gave an average value of 87 kg/mm^2, corresponding to a Mohs hardness of 3–3.5. In plane-polarized light, dalnegroite is highly bireflectant and weakly pleochroic from white to greenish-gray. In cross-polarized light, it is highly anisotropic with blue to green rotation tints and red internal reflections. Reflectance measurements (R_{min}/R_{max}/nm) include: 45.6/46.1/471.1, 46.1/46.6/548.3, 46.3/47.0/586.6, and 46.4/47.1/652.

The average (range) of 11 chemical analyses of dalnegroite (WDS) gave: Pb 10.09(8.46–12.38), Tl 20.36(19.56–21.50), Sb 23.95(22.18–25.57), As 21.33(21.09–21.84), and S 26.16(25.99–26.37), sum 101.89 wt%, corresponding to the empirical formula (based on 34 S atoms pfu) of $Tl_{4.15}Pb_{2.03}(As_{11.86}Sb_{8.20})S_{34}$, with a simplified formula of $Tl_{5-x}Pb_{2x}(As,Sb)_{21-x}S_{34}$.

Powder X-ray diffraction data were collected using a 114.6 mm Gandolfi camera (Cu$K\alpha$ radiation) with intensities measured using an automated densitometer. The strongest lines [d_{obs} in Å(I_{obs}%, hkl)] on the powder pattern include: 4.67(35,$\bar{2}80$), 4.02(40,400), 3.927(100,$\bar{2}$.10.0), 3.921(25,$\bar{4}40$), 3.810(25,$0\bar{6}2$), 3.775(45,$2\bar{2}2$), 3.685(45,$\bar{4}60$), 3.620(50,440), 3.600(25,$\bar{2}\bar{4}2$), 3.551(40,2.10.0), 3.524(35,$\bar{2}42$), 3.379(25,$\bar{2}\bar{6}2$), 3.363(30,$\bar{2}$.12.0), 3.287(25,$\bar{2}62$), 3.124(50,$\bar{2}\bar{8}2$), 3.084(30,2.12.0), 2.929(60,$4\bar{2}2$), 2.916(30,$4\bar{4}2$), 2.850(70,$\bar{4}42$), 2.827($\bar{4}\bar{4}2$), 2.735(25,$\bar{4}62$), 2.710(25,2.14.0), 2.702(40,$\bar{4}\bar{6}2$), 2.590(25,$\bar{2}$.16.0), 2.579(45,0.$\overline{14}$.2), 2.547(30,462), 2.390(25,482), 2.141(30,0.16.2), and 2.097(60,024). Dalnegroite is triclinic, $P\bar{1}$, a = 16.217(7), b = 42.544(9), c = 8.557(4) Å, α = 95.72(4), β = 90.25(4), γ = 96.78(4)°, V = 5832(4) Å^3, Z = 4. Dalnegroite is presumed to be isotypic with chabournéite and is its As-analogue.

The mineral is named for Alberto Dal Negro (b. 1941), Professor of Mineralogy and Crystallography, University of Padova. The mineral and its name have been approved by the IMA CNMMN (IMA no. 2009-085). Holotype material has been deposited at the Museum of Mineralogy, Department of Geosciences, University of Padova (catalog no. MMP M7620). **P.C.P.**

FLUORO-ALUMINOLEAKEITE*

R. Oberti, F. Camara, F.C. Hawthorne, and N.A. Ball (2009) Fluoro-aluminoleakeite, $NaNa_2(Mg_2Al_2Li)Si_8O_{22}F_2$, a new mineral of the amphibole group from Norra Kärr, Sweden: description and crystal structure. Mineral. Mag., 73, 817–824

Fluoro-aluminoleakeite was found in a rock sample from Norra Kärr, Gränna, Jönköping, Småland, Sweden. The rock is from a Proterozoic alkaline intrusion consisting mainly of fine-grained schistose agpaitic nepheline-syenite. Fluoro-aluminoleakeite occurs as prismatic crystals 0.1 to 2 mm long with albite and aegirine in a syenitic matrix. Fluoro-aluminoleakeite is light greenish-blue with a vitreous luster and a greenish-blue streak. No fluorescence was observed in ultraviolet light. The Mohs hardness is 6; it has a perfect {110} cleavage and a splintery fracture. The calculated density is 3.14 g/cm^3. It is biaxially negative with with α = 1.632(1), β = 1.638(1), γ = 1.643(1), 2V_{obs} = 98.0(4)°, 2V_{calc} = 95.5°. It is pleochroic with X = pale green, Y = dark green, Z = pale green, X^a = 62.9° (in β obtuse), Y||b. The compatibility index is 0.0015 (superior).

The composition of fluoro-aluminoleakeite was determined using WDS. The average of 10 analyses on a single grain is SiO_2 58.61, TiO_2 0.32, Al_2O_3 7.06, Fe_2O_3(from structure refinement) 6.05 FeO 3.27, MnO 0.73, ZnO 0.43, MgO 8.61, CaO 0.05, Na_2O 9.90, K_2O 2.43, Li_2O 1.62 (from structure refinement), F 3.37, and H_2O 0.05 (from stoichiometry), total 101.08 wt% with an empirical formula (on the basis of 24 O,H,F) of $^{A}(Na_{0.65}K_{0.43})_{\Sigma 1.09}{}^{B}(Na_{1.99}Ca_{0.01})_{\Sigma 2.00}{}^{C}(Mg_{1.77}Fe^{2+}_{0.38}Mn_{0.09}Zn_{0.04}Fe^{3+}_{0.63}Al_{1.16}Ti_{0.01}Li_{0.90})_{\Sigma 5.00}{}^{T}Si_{8.00}O_{22}{}^{W}(F_{1.47}OH_{0.53})_{\Sigma 2.00}$. The ideal formula is $^{A}Na^{B}Na_2{}^{C}(Mg_2Al_2Li)^{T}Si_8O_{22}{}^{W}F_2$.

An X-ray powder diffraction pattern was collected using a Gandalfi camera and Fe-filtered Cu$K\alpha$ radiation. The eight strongest lines in the diffraction pattern are [d_{obs} in Å(I_{obs}%, hkl)]: 2.687(100,$\bar{3}31$,151), 4.435(80,021,040), 3.377(80,131), 2.527(60,$\bar{2}02$), 8.342(50,110), 3.096(40,310), 2.259(40,$\bar{1}71$,$\bar{3}12$), and 2.557(30,002,061). A single-crystal X-ray structure refinement was carried out using Mo$K\alpha$ graphite-monochromated radiation with 1339 unique reflections and R_1 = 0.0266. Fluoro-aluminoleakeite is monoclinic, space group $C2/m$ with a = 9.7043(5), b = 17.7341(8), c = 5.2833(3) Å, β = 104.067(4)°, V = 882.0(2) Å^3, and Z = 2. Results of structure refinement indicate that T1 is completely filled by Si, Mg and Zn are in the M3 site, Mn is ordered to the M3 site, and Fe^{2+} is distributed between the M1 and M2 sites. Ferric iron is ordered at the M2 site and Li is completely ordered at the M3 site. Fluoro-aluminoleakeite is related to leakeite by substitution of ^{C}Al for $^{C}Fe^{3+}$ and ^{W}F for ^{W}OH.

The name and species have been approved by the IMA CNMMN (2009-12) and the holotype is held in the collection of the Royal Ontario Museum (catalog no. M53897). **G.P.**

FLUORO-SODIC-FERROPEDRIZITE*

R. Oberti, M. Boiocchi, N.A. Ball, and F.C. Hawthorne (2009) Fluoro-sodic ferropedrizite, $NaLi_2(Fe^{2+}_2Al_2Li)Si_8O_{22}F_2$, a new mineral of the amphibole group from the Sutlug River, Tuva

Republic, Russia: description and crystal structure. Mineral. Mag., 73, 487–494.

Fluoro-sodic-ferropedrizite occurs in parallel to sub-parallel aggregates with feldspar and calcite. The crystals are prismatic to acicular, 50 μm wide, and 0.1 to 3.0 mm long. Crystals are pale bluish-gray with a vitreous luster. The streak is grayish-white, and there is no fluorescence. Crystals are prismatic to acicular [001] and bounded by {110} cleavage faces, the prism direction is bounded by irregular fracture. Fluoro-sodic-ferropedrizite is brittle with a splintery fracture. Cleavage is perfect on {110} with an intersection angle of 56°. The calculated density is 3.116 g/cm^3. Fluoro-sodic-ferropedrizite is biaxial positive with $\alpha = 1.642(1)$, $\beta = 1.644(1)$, $\gamma = 1.652(1)$, $2V_{\text{obs}} = 68.0(3)°$, $2V_{\text{calc}} = 56.4°$. It is pleochroic with X = pale purple-gray, Y = light gray, Z = colorless, X^$a = 71.2°$ (in β acute), $Y \| b$, Z^$c = 83.4°$ (in β obtuse). The compatibility index is 0.0018 (superior).

The composition of fluoro-sodic-ferropedrizite was determined using WDS. The average of 10 analyses on a single grain is SiO_2 59.81, TiO_2 0.09, Al_2O_3 12.66, FeO 10.32, MnO 0.73, ZnO 0.17, MgO 5.56, CaO 0.20, Na_2O 2.81, Li_2O 4.80 (from structure refinement), F 2.43, and H_2O 1.10 (from stoichiometry), sum 99.66 wt%. This composition gives an empirical formula of (based on 24 O,H,F) of $^{A}(Na_{0.68})^{B}(Li_{1.92}Na_{0.05}Ca_{0.03})^{C}(Fe^{2+}_{1.16}Mg_{1.10}Mn^{2+}_{0.08}Zn_{0.02}Al_{1.97}Ti_{0.01}Li_{0.66})^{T}(Si_{7.98}Al_{0.02})O_{22}{}^{W}(F_{1.03}OH_{0.97})$. The ideal formula is $^{A}Na^{B}\,Li_2{}^{C}(\,Fe^{2+}_2Al_2Li)^{T}Si_8O_{22}{}^{W}F_2$.

An X-ray powder diffraction pattern was collected using a Gandalfi camera and Fe-filtered Cu*K*α radiation. The 10 strongest lines in the diffraction pattern are [d_{obs} in Å(I_{obs}%, *hkl*)] 8.146(100,110) 2.686(90,151), 3.008(80,310), 4.430(70,021), 2.485(60,$\bar{2}02$), 3.383(40,131), 2.876(30,$\bar{1}51$,$\bar{3}11$), 2.119(30,$\bar{3}12$), 4.030(20,111), and 3.795(20,$\bar{1}31$). A single-crystal X-ray structure refinement was carried out using Mo*K*α graphite-monochromated radiation with 984 unique reflections, $R_1 = 0.0306$, GoF = 0.982. Fluoro-sodic-ferropedzrite is monoclinic, space group *C*2/*m* with $a = 9.3720(4)$, $b = 17.6312(8)$ Å, $c = 5.2732(3)$ Å, $\beta = 102.247(4)°$, $V = 851.5(2)$ Å^3, and $Z = 2$. The refinement shows that the T site is entirely filled with Si, all Mg occurs in the M1 site and the Mn and Fe are divalent. Na is ordered at the *A*(*m*) site and Li is completely ordered at the M3 and M4 sites.

The holotype sample was collected from the endogenic contact of a lithium pegmatite with country rock and formed by reaction of the pegmatitic melt with the country rock. The sample comes from the collection of the Fersman Mineralogical Museum (64715) and the collection location was given as Sutlug River, Tuva Republic, Russia. The species and name have been approved by the IMA CNMMN (2007-070). **G.P.**

NYHOLMITE*

P. Elliott, P. Turner, P. Jensen, U. Kolitsch, and A. Pring (2009) Description and crystal structure of nyholmite, a new mineral related to hureaulite, from Broken Hill, New South Wales, Australia. Mineral. Mag., 73, 723–735.

Nyholmite is a new late-stage, supergene Cd-Zn arsenate mineral from the Block 14 Opencut, New South Wales, Australia. Nyholmite is the second new Cd-dominant mineral to be described from Broken Hill after birchite, and is only the third known natural Cd-bearing arsenate mineral after keyite and andyrobertsite. The mineral forms as isolated white globules and tufted aggregates of fibrous crystals (1 mm across), and as radiating hemispheres of thin, bladed, colorless crystals up to 0.5 mm across. Single crystals are up to 0.2 mm in length and 0.05 mm in width. Nyholmite is transparent to translucent, non-fluorescent, has a white streak, is vitreous, brittle with uneven fracture, no observed cleavage and has a Mohs hardness of 3–3.5. The calculated densities are 4.23 g/cm^3 for the empirical formula and 4.42 g/cm^3 for the ideal formula. Only a single refractive index was obtained ($\beta \sim 1.70$). Nyholmite is slowly soluble in cold 10% hydrochloric acid.

Chemical analyses of nyholmite were performed by EMPA (WDS). The average (range) of 14 analyses gave: P_2O_5 6.29(5.50–6.61), As_2O_5 34.55(33.66–35.91), Al_2O_3 0.20(0.14–0.24), MnO 3.59(3.44–3.84), CaO 0.16(0.13–0.19), CuO 3.39(3.16–3.73), ZnO 9.72(9.53–10.01), CdO 34.58(33.81–35.26), PbO 0.37(0.16–0.59), H_2O_{calc} 8.21, sum 101.06 wt%, corresponding to the empirical formula (based on 20 O atoms pfu) of $Cd_{2.80}Zn_{1.24}Mn_{0.53}Cu_{0.44}Al_{0.04}Ca_{0.03}Pb_{0.02}[(AsO_4)_{3.13}(PO_4)_{0.92}]_{\Sigma 4.05}H_{1.91}\cdot 3.79H_2O$. The ideal formula is $Cd_3Zn_2(AsO_3OH)_2(AsO_4)_2\cdot 4H_2O$ which requires CdO 35.09, ZnO 14.83, As_2O_5 41.88, H_2O 8.21, sum 100.00 wt%.

Powder X-ray diffraction data were collected on a 100 mm Guinier-Hägg camera (Cr*K*α radiation) with intensities visually estimated. The strongest lines on the pattern [d_{obs} in Å(I_{obs}%, *hkl*)] include: 8.985(30,200), 8.283(85,110), 6.169(25,111), 4.878(25,002), 3.234(100,$2\bar{2}\bar{2}$,420), 3.079(65,222,511), and 2.976(45,113). Refined unit-cell parameters for the powder X-ray diffraction data are $a = 18.042(2)$, $b = 9.315(1)$, $c = 9.797(1)$ Å, $\beta = 96.14(1)°$, $V = 1637.2(2)$ Å^3. Single-crystal X-ray intensity data were obtained by synchrotron methods at the ChemMatCARS facility at APS, Argonne National Laboratory. Data were collected on a 0.050 × 0.010 × 0.003 mm crystal using a 3-circle diffractometer and a Bruker SMART-6000 CCD detector ($\lambda = 0.49594$ Å). The structure was refined using the starting para-meters of hureaulite (Moore and Araki, *Am. Mineral.*, 58, 302–307, 1973), $R_1 = 0.0373$ for 2045 observed unique reflections with $F_o > 4\sigma F$, $wR_2 = 0.0861$, GoF = 1.081. Nyholmite is monoclinic, *C*2/*c*, $a = 18.062(4)$, $b = 9.341(2)$, $c = 9.844(2)$ Å, $\beta = 96.17(3)°$, $V = 1651.2(6)$ Å^3, $Z = 4$. The structure of nyholmite is characterized by kinked, short five-membered chains of composition $M_5\phi_{22}$ (where M = Cd, Zn, Cu, etc.) which extend along *a*. The chains are linked by corner-sharing via O1 and O5 atoms, forming sheets in the (001) plane. Corner-sharing AsO_4 groups further link the chains to form slabs in the (001) plane. The slabs link in the *c* direction by corner-sharing between the octahedra and tetrahedra to form a densely packed heteropolyhedral framework. Channels within the framework are host to OH atoms. Nyholmite is isostructural with other members of the hureaulite group.

Nyholmite is named for Sir Ronald Sydney Nyholm (1917–1971), born at Broken Hill, New South Wales, and Chair and professor of Chemistry, University College, London, from 1955–1971. The mineral and name have been approved by IMA CNMMN (2008-047). The type specimen has been deposited in the South Australian Museum, Adelaide, South Australia (catalog no. G32511). **P.C.P.**

NEW DATA

$Ba_2F_2(S^{6+}O_3S^{2-})$

A.R. Kampf (2009) The crystal structure of $Ba_2F_2(S^{6+}O_3S^{2-})$, a natural thiosulfate weathering product of old smelting slags at the Surrender Mill, Yorkshire, U.K. Mineral. Mag., 73, 251–255.

The crystal structure of a natural barium thiosulfate, $Ba_2F_2(S^{6+}O_3S^{2-})$, from the Surrender mill in Yorkshire, U.K., has been determined. The compound is a weathering product of slags derived from the smelting of sulfide ores where barite was an important gangue mineral. A single untwinned crystal (0.07 × 0.03 × 0.01 mm) was used for collection of intensity data obtained using a Rigaku R-Axis Spider curved imaging plate microdiffractometer (Mo$K\alpha$ radiation). The structure was solved by direct methods and refined to $R_1 = 0.0088$ for 399 reflections with $F_o > 4\sigma F$ (3749 total reflections, 407 unique reflections). The compound is monoclinic, $C2/m$, $a = 15.3172(5)$, $b = 4.5898(1)$, $c = 4.6320(2)$ Å, $\beta = 101.449(1)°$, $V = 319.17(2)$ Å^3, $Z = 2$, $D_{calc} = 4.419$ g/cm^3. The structure consists of layers of BaF_2Ba parallel to (001) with alternate layers of thiosulfate groups, resulting in a sequence of $(S^{6+}O_3S^{2-})$-BaF_2Ba-$(S^{6+}O_3S^{2-})$ in one unit cell. The structure is similar to grandreefite, $Pb_2F_2SO_4$. **P.C.P.**

MEREHEADITE*

S.V. Krivovichev, R. Turner, M. Rumsey, O.I. Siidra, and C.A. Kirk (2009) The crystal structure and chemistry of mereheadite. Mineral. Mag., 73, 103–117.

The crystal structure of mereheadite was re-determined on a sample from a manganese pod at the Merehead Quarry, near Cranmore, Somerset, England. The mineral was first described by Welch et al. (*Mineral. Mag.*, 62, 387–393, 1998), but it is suspected that the crystal used for the structure determination at this time was impure as mereheadite is often intergrown with other species including cerussite and mendipite.

A crystal of mereheadite (0.10 × 0.09 × 0.09 mm) collected in 2005 was mounted on a Stoe IPDS II Image-Plate-based X-ray diffractometer (Mo$K\alpha$ radiation) and more than a hemisphere of data were collected. The structure was refined by least-squares methods to $R_1 = 0.058$ (w$R_2 = 0.137$) for 6279 reflections with $|F_o| \geq 4\sigma F$ (total reflections = 16893; unique reflections = 8855). The mineral is monoclinic, Cm, $a = 17.372(1)$, $b = 27.9419(19)$, $c = 10.6661(6)$ Å, $\beta = 93.152(5)°$, $V = 5169.6(5)$ Å^3, $Z = 2$, $D_{calc} = 7.236$ g/cm^3. Mereheadite is an example of a 1:1 lead oxyhalide comprised of Pb-O/OH blocks and Pb-Cl sheets oriented parallel to the (201) plane. The structure contains 30 independent Pb sites, 28 of which belong to PbO blocks and the remaining two which lie within sheets of Cl^- anions. Mereheadite is the first naturally occurring lead oxychloride to contain interlayer Pb ions. The structure of mereheadite is related to that of symesite and is not a polymorph of blixite. The structural formula derived from the single-crystal structure analysis is different than that originally proposed by Welch et al. (*Mineral. Mag.*, 62, 387–393, 1998). The empirical formula, as calculated from the single-crystal structure refinement, for mereheadite can now be written as $Pb_{48}O_{25.14}(OH)_{4.56}Cl_{24.54}(BO_3)_{3.06}(CO_3)_{3.72}$, with a simplified formula of $Pb_{47}O_{24}(OH)_{13}Cl_{25}(BO_3)_2(CO_3)$. **P.C.P.**

TEDHADLEYITE*

M.A. Cooper and F.C. Hawthorne (2009) The crystal structure of tedhadleyite, $Hg^{2+}Hg^{1+}_{10}O_4I_2(Cl,Br)_2$, from the Clear Creek Claim, San Benito County, California. Mineral. Mag., 73, 227–234.

The crystal structure of tedhadleyite, a recently described new mineral species from a small prospect pit near the abandoned Clear Creek mercury mine, New Idria district, San Benito County, California, has been determined using a fragment of the original sample used for the IMA description. Single-crystal X-ray diffraction intensity data were collected using a Bruker four-circle diffractometer (Mo$K\alpha$ radiation) with a 1K CCD detector (crystal-detector distance = 4 cm). The structure was solved by direct methods in $P\bar{1}$, transformed to $A\bar{1}$ ($110/011/0\bar{1}1$) and refined by least-squares methods against F^2, $R_1 = 0.045$, w$R_2 = 0.126$, for 7918 total reflections with 2677 unique reflections. The mineral is triclinic, $A\bar{1}$, $a = 7.0147(5)$, $b = 11.8508(7)$, $c = 12.5985(8)$ Å, $\alpha = 115.583(5)$, $\beta = 82.575(2)$, $\gamma = 100.619(2)°$, $V = 927.0(2)$ Å^3, $Z = 2$, $D_{calc} = 9.43$ g/cm^3. The structure contains six symmetrically distinct Hg sites, with Hg(1) occupied by Hg^{2+} and Hg(2–6) occupied by Hg^+ which form three $[Hg\text{-}Hg]^{2+}$ dimers. The dimers are covalently bonded to O, forming pseudo-linear O-Hg-Hg-O arrangements, and weakly bonded to halogen and O atoms. The [O-Hg-Hg-O] groups share anions to form four-membered square rings of $[Hg_8O_4]$ that link along [100] via [O-Hg-Hg-O] groups, and along [001] via [O-Hg-O] groups to form rectangular rings of $[Hg_{14}O_8]$, which further forms corrugated layers interwoven with symmetrically related layers. Tedhadleyite occurs as a spheroidal, partially hollow mass that is suspected of forming in situ as a replacement of native mercury in the presence of a high activity of I (with lower Cl and Br) in a fluid or vapor phase. **P.C.P.**