Baiyuneboite-(Ce)


Electron-microprobe analyses of ten grains, whose validity was checked by single-crystal X-ray methods prior to analysis, gave an average of Na$_2$O 4.73, CaO 1.04, BaO 20.38, Ce$_2$O$_3$ 24.21, La$_2$O$_3$ 10.92, Pr$_2$O$_3$ 0.62, Nd$_2$O$_3$ 10.04, Gd$_2$O$_3$ 0.13, F 2.50, CO$_2$ (by gas chromatography) 24.64, O = F 1.05, sum 98.16 wt%, corresponding to Na$_{1.0a}$ (Ba$_{0.94}$Ca$_{0.12}$)$_{21.67}$(Ce$_{1.02}$La$_{0.48}$Nd$_{0.42}$Pr$_{0.05}$Gd$_{0.02}$)$_{21.99}$F$_{0.97}$C$_{3.87}$O$_{12.07}$, ideally NaBaCe$_2$F(CO)$_4$. The mineral occurs as yellow, irregular grains 0.3 to 3 mm in size, frequently as thin hexagonal tablets. White streak, resinous to adamantine luster, transparent, nonfluorescent, brittle, conchoidal fracture, perfect {001} cleavage, H = 4.5, $D_{\text{meas}}$ = 4.30(11); $D_{\text{calc}}$ = 4.45 g/cm$^3$ with Z = 2. Uniaxial negative, $\omega = 1.7450(5)$, $\epsilon = 1.5990(5)$ at 589 nm; weakly dichroic, $O = $ light greenish, $E = $ pale brownish yellow. The DTA curve has a strong exothermic peak at 520 °C corresponding to evolution of CO$_2$. The infrared curve has absorption bands, attributable to CO$_2$ groups, at 1470, 1400, 1080, 878, 855, 716, and 687 cm$^{-1}$. Crystal-structure X-ray determination ($R$ = 4.9%) showed the mineral to be hexagonal, space group $P6_3/mmc$, $a = 5.0875(15)$, $c = 23.1680(1)$ Å. Strongest lines of the powder pattern (Fe radiation) are 3.840(7)(006), 3.510(9)(010), 3.200(10)(002), 2.547(8)(011), and 2.047(6)(1010).

The mineral occurs in the Bayan Obo iron–niobium–rare-earth deposit in Inner Mongolia. Associated minerals are dolomite, fluorite, phlogopite, soda pyroxene, riebeckite, apatite, bafertisite, bastnasite, and magnetite. Type material is in the Institute of Geochemistry of the Chinese Academy of Sciences, Guiyang, Guizhou Province, China. The new name alludes to the locality [with which there is some obvious difficulty in transliteration].

**Discussion.** Information provided by J. A. Mandarino, Chairman of the CNMMN, IMA, is that this mineral and name were approved, but it was learned subsequently that the formula for cordylite-(Ce) requires revision such that cordylite-(Ce) and baiyuneboite-(Ce) may be identical. The Chairman therefore withdrew the approval and asked that the authors withhold publication of their description of baiyuneboite-(Ce) until the matter could be resolved. The request, unfortunately, was ignored. J.L.J.

Dioyudaite*


The average of 13 electron-microprobe analyses gave Na$_2$O 4.54, Al$_2$O$_3$ 93.00, Cr$_2$O$_3$ 1.95, MgO 0.10, CaO 0.10, SiO$_2$ 0.23, K$_2$O 0.12, sum 100.04 wt%, corresponding to (Na$_{0.37}$K$_{0.02}$Mg$_{0.02}$Ca$_{0.01}$)$_{20.92}$(Al$_{10.86}$Cr$_{0.13}$Si$_{0.02}$)$_{21.01}$O$_{17}$, ideally NaAl$_{11}$O$_{17}$. The mineral occurs as colorless to light green, transparent, thin tabular crystals mostly 0.4 × 0.2 × 0.02–0.04 mm, but up to 0.5 × 1.3 mm. Cleavage well developed, rare conchoidal fracture, H$_{\text{15}}$ = 1392.8 kg/mm$^2$ (Mohs 7.6), $D_{\text{meas}}$ = 3.30 (suspension), $D_{\text{calc}}$ = 3.21 g/cm$^3$ with Z = 2. Optically uniaxial negative, $\omega = 1.6876(2)$, $\epsilon = 1.6630(2)$, weak absorption. X-ray single-crystal study indicated hexagonal symmetry, space group $P6_3/mmc$, $a = 5.602(1)$, $c = 22.626(5)$ Å. Strongest lines of the X-ray powder pattern (57.3-mm camera, Fe radiation) are 11.2(100)(002), 5.65(60)(004), 2.680(70)(017), 2.505(50)(114), 2.028(40)(026), 1.413(40)(0.2.13), and 1.400(60)(220). The results are in good agreement with data for synthetic β-NaAl$_{11}$O$_{17}$.

The new mineral occurs abundantly in the heavy-mineral (S.G. > 2.8) fraction that makes up about 1.4 wt% of the surface layer of sea-floor muds taken at about 1500-m water depth near the island of Diaoyudao, a few kilometers northeast of Taiwan. The new mineral contains native chromium inclusions, thus indicating a magmatic origin; a relationship to nearby high-alumina basalts is suggested. Associated minerals in the heavy fraction are mainly hornblende, epidote, dolomite, chlorite, and biotite. Type material is in the Museum of Geology, Beijing. J.L.J.

Fedotovite*


Two chemical analyses gave Na2O 1.48, 1.50, K2O 13.97, 13.30, CuO 38.93, 38.81, ZnO 0.37, 0.21, PbO 0.70, 0.62, SO3 42.00, 41.79, H2O, trace, not analyzed, insoluble residue, 2.80, 2.30, sums 100.25, 98.53, corresponding to \( (K_{1.6}S_{NaO_{0.28}}) > : 1.93 \) \( (C_{u_{2.8}}S_{ZnO_{0.02}}P_{bO_{0.01}}) > : 2.88S_{3.0}S_{0.13} \) Soluble in weak nitric acid, unstable in air. The DTA curve shows two endothermic effects, the first at 692 °C with no weight loss and corresponding to breakdown with formation of tenorite, the second at 715 °C with a 20 wt% loss corresponding to desulfatization. The IR spectrum shows features at 600 cm⁻¹ and 1100 cm⁻¹ characteristic of \( (SO_{4})^{2-} \) groups. The absence of features at 1600 and 3400–3600 cm⁻¹ indicates that no water or hydroxyl is present. Crystals of the mineral, which are up to 5 mm long and 0.1 to 1 mm thick, are flattened on {100} and irregular in outline, rarely rectangular from {010} and {001} or pseudo-hexagonal from {001} and {011}. Color emerald to grass-green, streak light green, luster silky to vitreous, H = 2.5, perfect {100} cleavage, \( D_{meas} = 3.205(3) \) (suspension), \( D_{calc} = 3.17 \) and 3.18 g/cm³ for the first and second chemical analyses, respectively, with Z = 8. Biaxial positive, straight extinction relative to cleavage, \( a = 1.577, \beta = 1.594, \gamma = 1.633, 2V = 68° \). X-ray study showed the mineral to be monoclinic, space group \( P2_1/c \). The unit cell from powder data is \( a = 19.06(3), b = 9.47(1), c = 14.18(2) \) Å, \( \beta = 112.36(9)^\circ \). The strongest lines of the powder pattern (114-mm camera, Cu radiation) are 7.79 (100)(020), 5.76(50)(120), 4.44(40)(211), 4.33(40)(102), 3.88(50)(040), 3.13(50)(124), 2.87(40)(322), and 2.84(40)(222).

The new name honors Dr. Armand François, geologist and former director of the Geology Department of Gécamine, a Zairian mining company. The mineral occurs in the Kamoto-Est copper-cobalt deposit, 6 km west of Kolwezi, Zaire, in association with uraninite, schoepite, uranophane, curite, schullingite, and kamotoite-(Y). Type material is in the Institut royal des Sciences naturelles de Belgique, Brussels, Belgium. J.L.J.

Godovikovite*


A chemical analysis, involving gravimetry (sulfate) complexometric methods (Al and Fe³⁺), chlorplatinate (\( NH_4 + K \), and flame photometry (K)), gave SO₄ 57.02, TiO₂ 0.66, Fe₂O₃ 7.70, Al₂O₃ 11.98, CaO 0.40, MgO 1.00, MnO 0.04, Na₂O < 0.05, K₂O 0.52, \( (NH_4)_2SO_4 \) 8.50, insoluble residue 12.49, sum 100.31 wt%. The insoluble residue is mostly finely dispersed quartz. After deducing this residue and normalizing to 100 wt%, the analysis corresponds to \( [(NH_4)_{0.92}Mg_{0.07}K_{0.02}Ca_{0.01}(Al_{0.66}Fe_{0.34})_2(Ti_{0.02}S_3.05)SO_4]_{2.00} \) or ideally \( (NH_4)(Al,Fe³⁺)(SO_4)_2 \); if Mg and Ca are assumed to be admixed anhydrous Mg and Ca sulfates. The mineral is slowly soluble in water. The DTA curve has two endothermic peaks, one at 570 °C, corresponding to breakdown into simple sulfates and breakdown of \( (NH_4)_2SO_4 \), the other at 810 °C, corresponding to desulfatization of \( Al_2(SO_4)_3 \) and \( Fe_2(SO_4)_3 \). The loss of 9.1 wt% at 570 °C is attributed to loss of \( (NH_4)_2O \).

The mineral forms white, compact or porous chalky aggregates of fine hairs, 0.001 to 0.015 mm in size, in the burning dumps of coal mines near the town of Kopeysk in the
Chelyabinsk coal basin of the Southern Urals, USSR. The mineral is one of the main constituents of the sulfate crusts formed by reaction of sulfurous acid with the material in the dumps. Together with (Al,Fe)(SO₄)₂, it occurs in the lower, hotter zones, which are up to 5 cm thick and up to 1 m² in area. Luster of the aggregates is dull, fracture uneven, H = 2, D₆₉₈ = 2.53 (suspension), D₆₀ = 2.52 g/cm³ with Z = 1. Uniaxial positive, ε = 1.581(2), ω = 1.572(2). Colorless. The powder X-ray pattern corresponds closely to that of synthetic NH₄Al(SO₄)₂ if allowance is made for substitution of Fe³⁺ for Al. Thus the mineral is assigned hexagonal symmetry and space group P321. Unit-cell parameters calculated from the powder data are a = 4.75(1), c = 8.30(1) Å, and strongest lines (18 given) are 8.30(90)(001), 3.69(100)(101), 2.921(90)(102), 2.764(80)(110), and 1.848(70)(104, 202).

The name is for Aleksandr Aleksandrovich Godovikov (1927- ). Samples are deposited in the Fersman Mineralogical Museum, Moscow. E.S.G.

Hydrotalcite-manasseite group


The minerals were studied in three samples: one was from a clay lens within a boron-potassium-magnesium salt body in Lower Permian rocks of the pre-Caspian depression, and two were insoluble residues from a halite body and a sylvite body in Middle Asia. The size fractions >0.01 mm from the pre-Caspian rocks contain quartz, chaledony, chlorite, biotite, oxylepidomelane [= ferrian biotite], zircon, garnet, sphenite [= titanite], anhydrite, kieserite, langbeinite, and various borates, as well as minerals of the hydrotalcite-manasseite group; the <0.01-mm fraction contains "hydrated talc" (kerolite) [= talc], serpentine, and disordered chloride–swelling clorite. Associated minerals in the Middle Asia salt bodies are authigenic quartz, chaledony, anhydrite, and magnesite; the finest size fractions also contain Mg-rich chlorite and authigenic illite.

The minerals form pyramidal-prismatic crystals visible under the scanning electron microscope; crystals from lowest density fractions (1.83–2.09 g/cm³) display chiefly hexagonal or dihexagonal prismatic forms, whereas pyramidal–prismatic forms are more common in denser fractions. The trigonal–prism form is rare. Platy crystals cleave readily. Optically positive (ε < ω), negative elongation. Refractive indices ε = 1.532–1.528, ω = 1.520–1.513 on the pre-Caspian sample (mineral unspecified); ε = 1.546(2), ω = 1.534(2) on the 11-Å phase still enclosed in halite from Middle Asia, decreasing to ε = 1.508–1.505 and ω = 1.489–1.488 after dissolution of halite.

7.56-Å CO₃-hydrotalcite-manasseite-2H

Chemical analyses of the 2.15 ≤ D ≤ 2.16 and 2.14 ≤ D ≤ 2.15 fractions (where D = density in g/cm³) of the sample from the pre-Caspian are respectively, SiO₂ 4.37, 3.12, TiO₂ 0.20, 0.20, Al₂O₃ 20.27, 21.28, Fe₂O₃ 0.19, n.d. (not detected), FeO, P₂O₅, CaO, MnO, n.d., MgO 31.38, 31.77, Na₂O 0.08, 0.08, K₂O 0.21, 0.12, H₂O 32.13, 31.41, H₂O 0.84, 1.77, C n.d., 0.06, CO₂ 7.08, 7.08, SO₂ 1.84, 3.16, sums 98.59, 100.05 wt%, leading to a formula [Mg₂₆₋₇₆Fe₃₋₇₆Al₂₋₇₆(OH)₁₂][(CO₃)₀.₃₋₀.₆(SO₄)₀.₂₋₀.₃]·3H₂O. The SO₄ is probably contained in admixed 16.5- and 18.5-Å phases, and SiO₂ is probably from admixed quartz noted in the X-ray powder pattern. The X-ray powder data yield a = 3.042, c = 15.12 Å (hexagonal). Oriented samples yield prominent (001) (l even) lines of 7.56, 3.78 Å, etc. (l even) up to (1.0.10) are given from an unoriented sample. For a layer thickness (c' = c) of 7.56 Å (observed range of c' is 7.56 to 7.61 Å), D₆₀ = 2.147 g/cm³, in accord with the D₆₀ = 2.17–2.18 g/cm³ of the fraction lacking detectable amounts of the 16.5-Å and 18.5-Å phases.

The name is based on a nomenclature for the hydrotalcite-manasseite group of minerals proposed in this paper. In this case, 7.56 Å refers to the interlayer spacing, CO₂ to the dominant anion accompanying H₂O molecules in the interlayers, hydrotalcite to the composition of the brucite layer (here Mg-Al), and 2H to the polytype.

8.85-Å SO₄-hydrotalcite

No chemical analysis is given. The dominant series of d values in the densest fractions (1.98–2.04 g/cm³) of the sample from the pre-Caspian, namely 8.85, 4.42 Å, etc., are attributed to a SO₄-containing member of the hydrotalcite group. For a mineral of composition [Mg₃₋₇₆Fe₃₋₇₆Al₂₋₇₆(OH)₁₂][(SO₄)₀.₃H₂O], the calculated and observed x-ray intensities correspond satisfactorily, and D₆₀ = 1.962 g/cm³, which is less than the observed densities because the mineral is overgrown with quartz.

The mineral is compared to the SO₄-hydrotalcite reported by Lisitzina and Drits (Litologiya Poleznykh Iskopayemykh, 6, 20–39, 1985).

11-Å SO₄-hydrotalcite-III

Chemical analysis of the 2.10 ≤ D ≤ 2.12 g/cm³ fraction of the residue from halite from Middle Asia gave SiO₂, 3.03, TiO₂, 0.09, Al₂O₃, 15.71, Fe₂O₃, 0.71, FeO, MnO n.d., CaO 0.08, MgO 24.61, P₂O₅ 0.08, Na₂O 2.70, K₂O 0.11, CO₂ n.d., SO₂ 15.86, H₂O 0.270, H₂O 37.02 (by difference from 100 wt%), corresponding to a formula [Mg₁₂₋₂₆Fe₁₋₂₆Al₁₋₂₆(OH)₁₂][(SO₄)₁₋₀.₃][Na₀.₃₋₀.₆(SO₄)₀.₃₋₀.₆]·7.3H₂O admixed with 3.03 wt% quartz and 6.10 wt% Na₂SO₄. An alternative structural model, for which the calculated number of H₂O molecules per unit cell agrees better with the chemical analysis, is based on the assumption that the Na cations are present in the interlayers: [Mg₁₂₋₂₆Fe₁₋₂₆Al₁₋₂₆(OH)₁₂][Na₀.₃₋₀.₆(SO₄)₀.₃₋₀.₆]·7.3H₂O, cf. wermondite. The X-ray powder data yield a = 5.293, c = 11.16 Å (hexagonal). Oriented samples yield prominent 00/ lines at 11.16, 5.58, and 3.72 Å, and D₀₀ varies from 10.8–11.16 Å (a total of 22 lines up to 117 is given for the unoriented sample). For c = 11.16 Å, D₆₀ = 1.90 g/cm³, less than the observed range of D₆₀ = 2.10–2.12 g/cm³ because of quartz overgrowths.

The name is based on the nomenclature for the hydrotalcite-manasseite group of minerals proposed in this pa-
16.5-Å mixed-layer $\text{CO}_3\text{SO}_4$-hydrotalcite

Chemical analyses of the 16.5-Å phase (mixed with the 8.85- and 11.16-Å phases) in the 2.09-2.11 g/cm³ and 2.11-2.13 g/cm³ fractions from the Middle Asia sylvinite are, respectively, SiO₂ 3.61, 4.07, TiO₂ 0.05, 0.05, Al₂O₃ 19.16, 18.95, Fe₂O₃ 1.04, 1.01, FeO n.d., MnO n.d., 0.01, CaO n.d., 0.03, MgO 30.16, 30.12, P₂O₅ 0.10, 0.18, Na₂O 0.36, 0.34, K₂O n.d., 0.56, CO₂ 2.84, 2.49, SO₃ 10.43, 10.49, H₂O⁺ and H₂O⁻ 32.35, 31.70 (by difference from 100 wt%), from which a formula is calculated to be $[\text{Mg}_{396}\text{Al}_{19.9}\text{Fe}_{5.67}(\text{OH})_{12}] [(\text{SO}_4)_{0.6}\text{(CO}_3)_{0.3}\cdot3\text{H}_2\text{O}]$. X-ray patterns of oriented samples yield 700 reflections. For an ordered mixed-layer structure consisting of 7.56-Å $\text{CO}_3$-bearing layers and 8.94-Å $\text{SO}_4$-bearing layers, $D_{\text{calc}} = 2.06$ g/cm³, somewhat less than $D_{\text{meas}} = 2.09-2.13$ g/cm³ because the mineral is overgrown by quartz. The mineral occurs in the clay of the pre-Caspian deposits as well as in the sylvinite body of Middle Asia.

18.5-Å mixed-layer $\text{CO}_3\text{SO}_4$-hydrotalcite-3R

A complete chemical analysis was not done. Partial analyses of the low-density fractions (1.98-2.11 g/cm³) of the pre-Caspian clay in which this mineral occurs mixed with related phases, in particular for the 2.09-2.11 g/cm³ fraction, gave CO₂ 5.74 and SO₃ 4.63 wt%; for the 2.09-2.11 g/cm³ fraction, CO₂ 5.19 and SO₃ 5.70 wt%. These results, together with X-ray diffraction data, suggest two possible models for an ordered mixed-layer structure with an 18.5-Å spacing and consisting of alternating 7.56-Å and 10.84-Å layers. The corresponding formulas are $[\text{Mg}_{4.96}\text{Al}_{2}(\text{OH})_{12}] [(\text{CO}_3)_{0.5}\text{(SO}_4)_{0.5}\cdot6.5\text{H}_2\text{O}]$ and $[\text{Mg}_{4.96}\text{Al}_{2}(\text{OH})_{12}] [(\text{SO}_4)_{0.5}\text{(CO}_3)_{0.5}\cdot5.5\text{H}_2\text{O}]$. X-ray diffraction data for an unoriented sample yield $a = 3.046$, $c = 55.62$ Å. This pattern has 21 lines (up to 119). Oriented X-ray patterns have 001 reflections at 18.5-18.4, 9.25-9.20, 6.17-6.15 Å, etc.

Discussion

7.56-Å $\text{CO}_3$-hydrotalcite-2H differs from an earlier-described hydrotalcite (7.6-Å $\text{CO}_3$-hydrotalcite-3R in the proposed nomenclature) in polytype, from an earlier-described manasseite (7.8-Å $\text{CO}_3$-hydrotalcite-2H) in interlayer spacing, and from both in content of molecular water. The proposed system of nomenclature and new names have not been approved and should not have been published. E.S.G.

Ulrichite*


Electron-microprobe analysis gave CaO 9.23, CuO 11.02, UO₂ 46.36, P₂O₅ 22.09, H₂O (by CHN analyzer) 9.9, sum 98.60 wt%, corresponding to Ca₁₀₇Cu₀₉(U₂₀₄)₂P₂₀₆−H₃O₄, ideally $\text{CaCu(UO}_2\text{(PO}_4)_2\cdot4\text{H}_2\text{O}}$. The mineral occurs typically as radiating sprays of apple-green to lime-green acicular crystals up to 1 mm long and 0.05 mm thick, also as flat prisms, some twinned on (100) and with complex pyramidal terminations. Translucent to transparent, vitreous luster, white streak, H = 3.5, no cleavage, nonfluorescent, readily soluble in dilute HCl and HNO₃. Optically biaxial, negative(?) $\alpha = 1.622(2)$, $\gamma = 1.634(2)$, length slow, nonpleochroic. X-ray crystal-structure study showed the mineral to monoclinic, space group $C2/m$; cell dimensions refined from a Gandolfi pattern gave $a = 12.79(3)$, $b = 6.85(2)$, $c = 13.02(3)$ Å, $\beta = 91.03(7)^\circ$. $D_{\text{calc}} = 3.71$ g/cm³ with $Z = 4$. Strongest lines of the X-ray powder pattern are 6.389(100)(002,200), 5.602(14)(201), 4.498(15)(202,112), 3.480(14)(311), 3.193(45)(312,400), 2.879(20)(204), and 2.373(15)(024,511).

The new name is for George Henry Frederick Ulrich (1830–1900) in recognition of his contribution to the description of the minerals of Victoria. The new mineral occurs with turquoise and chalcosiderite in mafiroitic cavities in pegmatoidal granite in a granite quarry 10 km south of the township of Lake Boga in northwestern Victoria, Australia. Other associated minerals are fluorapatite, libethenite, cyrilovite, torbernite, saleeite, and an unidentified iron phosphate. Type material is in the Mineralogy Department, Museum of Victoria, Australia. J.L.J.

Zabuyelite*


Wet-chemical analysis gave Li₂O 34.20, Na₂O 2.49, K₂O 0.75, MgO 1.81, CaO 1.24, FeO 0.88, MnO 0.017, CO₂ 52.70, H₂O 1.88, Cl 1.09, SO₃ 0.57, B₂O₅ 0.10, NO 0.44, insol. 1.89, sum 100.057 wt%. Inclusions of gaylussite [Na₂Ca(CO₃)₂·5H₂O] and northupite [Na₃Mg(CO₃)₂Cl] were evident and probably account for the presence of Na, Ca, and Cl; the analytical results are considered to correspond to those for Li₂CO₃, the theoretical contents of which are Li₂O 40.44, CO₂ 59.56 wt%. The mineral occurs as crystals 1.5 to 20 µm long embedded in halite in rock-salt layers, and as doubly terminated crystals in precipitates on the periphery of a Li-rich salt lake at Nagri, Tibet. Crystal terminations are pyramids on prismatic crystals typically 0.1 to 0.5 mm long, 0.03 to 0.15 mm wide, and 0.02 to 0.5 mm thick; crystals up to 1.2 mm long have been observed. Colorless, transparent, vitreous luster, cleavages perfect (100) and moderate (011), H = 3, brittle, twinned (100), slightly soluble in water, reacts vigorously with dilute HCl, nonfluorescent, $D_{\text{meas}} = 2.09(1)$ by suspension, $D_{\text{calc}} = 2.096$ g/cm³ for the theoretical formula, and $Z = 4$. Optically biaxial negative, $\alpha = 1.4285(10)$, $\beta = 1.5672(10)$, $\gamma = 1.5743(10)$, $2V = 25^\circ$, $Y = b$, $Z \perp c = 10^\circ$. Monoclinic cell dimensions calculated from the X-ray powder pattern are $a = 8.356$, $b = 4.964$, $c = 6.185$
Zhanghengite


Six electron-microprobe analyses using metals as standards gave a range of Cu 50.46–53.68, Zn 45.83–49.32, Cr 0.00–0.25, Fe 0.11–0.16, Al 0.04–0.06, Ni 0.00–0.01, sums 99.98–99.99 wt%; the average corresponds to Cu_{0.55}Zn_{0.45}Cr_{0.03}Fe_{0.04}Al_{0.03}O_{1.00}. The mineral occurs as granular, irregular grains and also as tabular, dendritic; grain size is 0.13 x 0.15 to 0.1 x 0.35 mm. Golden yellow color, bronzestreak, metallic luster, no cleavage, VHN_{10} = 140–150, D_{calc} = 8.32 g/cm^3 with Z = 1; fresh surfaces darken readily in air. Bright yellow in reflected light, isotropic, no internal reflection; reflectance percentages (WTeT standard) are 405, 57.7; 437, 50.8; 480, 43.9; 549, 81.1; 591, 90.0; 645, 93.7. The X-ray powder pattern (57.3-mm Gandolfi camera, Cu radiation) are 4.15(80)(110), 2.089(100)(101), 1.470(50)(200), 1.201(80)(112), and 1.044 Å (60)(202). On the basis of these four lines, which were indexed on a cubic cell using the Bunn method, the space group is considered to be Im3m, a = 2.952(2) Å, with Cu and Zn disordered in the structure. A phase of equivalent composition is known in the system Cu-Zn.

The new mineral occurs in the matrix of a meteorite that fell on Boxian County, Anhui Province, China, on October 20, 1977. Associated minerals are olivine, orthopyroxene, clinopyroxene, plagioclase, orthoclase, whitlockite, quartz, biotite, dolomite, calcite, corundum, troilite, kamacite, taenite, chromite, ilmenite, magnesio-ferrite, pentlandite, graphite, wüstite, and copper. The new name is for Zhang Heng, a famous astronomer in ancient China.

Discussion. No repository for type material is given. A subsequent crystal-structure determination (Am. Mineral., 73, 1186–1190, 1988) gave a = 12.245(2), b = 15.287(4), c = 8.684(1) Å, space group Ccma, and D_{calc} = 5.97 g/cm^3 for the formula Na_{0.51}K_{0.49}As_{0.41}(Ta_{0.76}Nb_{0.24})O_{18}. J.L.J.

Zincovoltaite


Wet-chemical analysis gave K_2O 4.11, CaO 0.69, ZnO 14.61, FeO 3.20, MnO 1.20, Fe_2O_3 11.21, Al_2O_3 2.50, SO_3 46.93, H_2O 15.69, sum 100.14 wt%, corresponding to (K_{1.79}Ca_{0.21})(Zn_{3.69}Fe_{1.01}Mn_{0.30})SO_4Fe_{1.93}Al_{0.01}(SO_4)_{12.06}. 17.92H_2O. The mineral occurs as single grains, typically 1 to 2 mm in size, and as granular aggregates scattered in secondary quartz aggregates; also as irregular veinlets in pyrite. Color green to oil-green, streak grayish-green, luster pimy, resinous, vitreous on crystal surfaces, transparent to translucent, brittle, no cleavage, conchoidal fracture, hardness about 3, D_{mass} = 2.756 (by pycnometer), D_{calc} = 2.767 g/cm^3 with Z = 16 and the chemical formula. Slowly soluble in water, readily soluble in HCl. Decomposes slowly in air. Crystals have the forms {111}, {100}, {110}, and {211}; octahedra, cubes, and combinations of these are common. Optically yellowish-green, isotropic, sometimes anomalously uniaxial, n = 1.605(3) in Na light. Single-crystal
X-ray study indicated cubic symmetry, space group Fd3c, 
a = 27.180(1) Å from refinement of powder data. Strong-
est lines of the powder pattern (diffractometer, Co radi-
tion, 76 lines listed) are 5.53(48), 4.24(28), 3.54 (67), 3.39(100), 3.13(39), 3.03(28), and 2.84(32).

The mineral, which is the zinc analogue of voltaite, occurs in the oxidation zone of a sphalerite-galena-pyrite deposit in an arid climate at Xitieshan, Qinghai Province, China. Associated sulfate minerals are römerite, melan-
terite, and gypsum. Type material is at the Geology De-
partment, Lanzhou University, and at the Geological Mu-
seum of the Ministry of Geology, Beijing. J.L.J.

Unnamed phosphate

H.D. Gay, R. Lira (1987) Fluellite of Cerro Blanco, Tanti,

With fluellite and secondary phosphates derived principally from triplite are phosphosiderite, strengite, ber-
manite, torbernite, and an unidentified mineral proposed to be new and to have the formula KTi(Mn,Fe,Mg)Fe2-
(PO4)(OH)·nH2O. It is suggested that the mineral may
be isomorphous with paulkerrite. No analyses or other
data are given. J.L.J.

Unnamed layered titanosilicate

Ye.F. Sokolova, Yu.K. Yegorov-Tismenko, A.P. Khomy-
akov (1987) Features of the crystal structure of 

Electron-microprobe analysis gave the empirical for-
mula Na12.46Ca1.43Mg0.39Ti2.44Mn0.86Zr0.46Nb0.42Si6.02O34F1.4 (only the formula is given). X-ray study showed the mineral to be triclinic, space group P1, a = 5.415(2), b = 7.081(3), c = 20.34(1) Å, α = 86.85(4), β = 94.40(4), γ = 89.94(3)°, V = 776.4(6) Å3, D = 3.1 g/cm3, Z = 1. The crystal-structure refinement gave Na2.41Ca2.39Mg0.92Ti2.37-
Zr0.21Nb0.19Si4.15P3.45O4.49F1.7. The mineral, referred to as mineral T, can be regarded as one member of a series. It consists of a lomonosovite block (idealized formula Na1-
Ti2O2[NaTiO(Si2O7)]2[NaPO4]. Na2MgPO4) alternating
with a sulfohalite block (NaCa[PO4],F2). Another mineral
in this series is mineral X5 (see preceding abstract). Min-
eral T was discovered by A. P. Khomyakov in the ultra-
alkaline rocks of the Lovozero massif, Kola Peninsula, USSR. The paper is largely a discussion of the mineral's crystal structure and the relation of the mineral to other members of layered titanosilicates. No other properties are given. E.S.G.

New Data

Kulanite


Kulanite occurs abundantly disseminated and as vei-

nlets in a granitic pegmatite containing montebrasite and other phosphates at Xiuyuantou, Fujian Province, China. The chemical composition (wet-chemical and microprobe analyses) and the optical and physical properties are in good agreement with those for type kulanite. Single-crystal X-ray study gave monoclinic symmetry, space group P21, or P21/m, a = 9.024(1), b = 12.079(4), c = 4.924(1) Å, β = 100.462°.

Discussion. Kulanite is a member of the bjarebyite group in which bjarebyite (crystal structure described in Am. Mineral., 59, 567–572, 1974) and perloffite are reported to be monoclinic, whereas kulanite and penikisite are considered to be triclinic. All of the members have similar cell parameters, but kulanite (Can. Mineral., 14, 127–131, 1976) and penikisite (Can. Mineral., 15, 393–395, 1977) were concluded to be only pseudo-monoclinic: although the single-crystal X-ray studies showed monoclinic sym-
metry, asymmetrical dispersion of the optic axes indicated triclinic symmetry. For kulanite from China the optical
dispersion is reported, but symmetry or asymmetry is not, and the authors opine that the space group determined by X-rays is more fundamental than optics in assigning the correct symmetry. J.L.J.

Wölsendorfite group

Eight new chemical and four new microprobe analyses are reported for the wölsendorfite group, including wöl-sendorfite, calciouranoite (and the variety K-Sr calciouranoite), metacalciouranoite, and bauranoite. Ranges of some elements (exclusive of analyses extensively contaminated by silica, i.e., <4.20 wt% SiO₂) are UO₂ 52.41–74.53, CaO 1.91–6.46, PbO 0.94–27.33, BaO 0–13.68, K₂O 0–1.93, Na₂O 0.0–1.05, SrO 0–2.15, H₂O 6.98–9.26. In also considering 13 published analyses of these minerals (total 25), the ratios of U to other cations were found to range from 1.5 to 2.3, lower in bauranoite and closest to the ideal value 2 in calciouranoite. A plot of the compositions in terms of the three major cations shows nearly complete solid solution between Ca and Pb, but only a few com-
positions between Ca and Ba suggest possible solid sol-
ution. Only one composition is significantly along the join Ba-Pb, and two suggest only limited ternary iso-
morphism.

New X-ray powder data are presented for one wölsendorfite and one calciouranoite (considerable admixed quartz). Major lines (in Å) in the wölsendorfite pattern (22 given) are 7.707(30, broad), 7.029(30, broad), 3.400(70, broad), 3.088(100), 1.991(40), 1.906(40, broad), 1.723(30, broad); for calciouranoite major lines (12 given) are 3.435(20), 1.616(90), 1.2384(50), and 1.2369(50).

The four minerals form very fine grained to crypto-
crystalline pseudomorphs of pitchblende in the oxidation zones of uranium mineralization in Mesozoic rocks of the USSR. Calciouranoite is the most widespread, whereas wölsendorfite is restricted to galena-pitchblende ores and bauranoite to ore associated with barite and fluorite mineralization. A later generation of calciouranoite forms aggregates with calcite and uranophane precipitated by percolating solutions.

Discussion. The X-ray patterns show considerable vari-
ation, and nonindexable diffraction lines (compare PDF 12–159) appear both here and in some of the patterns in the literature. In view of the large range of reported ratios of U to other cations, further study is needed to verify group status for these minerals. E.S.G.