NEW MINERAL NAMES* 

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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 NaO 4.73, CaO 1.04, BaO 20.38, CeO 24.21, LaO 10.92, Pr2O 0.62, Nd2O 10.04, Gd2O 0.13, F 2.50, CO2 (by gas chromatography) 24.64, O = F 1.05, sum 98.16 wt%, corresponding to NaBa(CeO4)(CO3)0.83, ideally NaBaCe2F(CO3)2. 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, Dm: 4.30(l 1), Dm: 4.45 g/cm3 with Z: 2.Uniaxial negative, a: 1.7450(5), e: 1.5990(5) at 589 nm; weakly dichroic, O: light greenish, E: pale brownish yellow. The precurve has a strong exothermic peak at 520 °C corresponding to evolution of CO2. The infrared curve has absorption bands, attributable to CO2 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 P63/mmc, a: 5.0875(15), c: 23.1680(1) Å. Strongest lines of the powder pattern (Fe radiation) are 3.840(70)(006), 3.510(90)(104), 3.200(100)(105), 2.547(80)(110), and 2.047(60)(1.0).10.

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, bastnaesite, 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.

Diaoyudaite*

The average of 13 electron-microprobe analyses gave NaO 4.54, Al2O3 93.00, Cr2O3 1.95, MgO 0.10, CaO 0.10, SiO2 0.23, K2O 0.12, sum 100.04 wt%, corresponding to NaAl5O8, ideally NaNaAl5O8. The mineral occurs as colorless to light green, transparent, thin tabular crystals mostly 0.4 x 0.2 x 0.02-0.04 mm, but up to 0.5 x 0.3 mm. Cleavage well developed, rare conchoidal fracture, H15: 1392.8 kg/mm2 (Mohs 7.6), Dm: 3.30 (suspension), Dm: 3.21 g/cm3 with Z: 2. Optically uniaxial negative, ω: 1.6876(2), ε: 1.6630(2), weak absorption. X-ray single-crystal study indicated hexagonal symmetry, space group P63/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)(02.13), and 1.460(40)(220). The results are in good agreement with data for synthetic β-NaAl5O8.

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, chloride, 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 (K1.63Na0.28Ca1.93(Cu2.85Zn0.02)2Pb0.01)228S3O93O13 and (K1.72Na0.2882O20(Cu3.84Zn0.02)2Pb0.01)228S3O93O13. Soluble in weak nitric acid, unstable in air. The prn 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 (SO4)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 pseudohexagonal from {010} and {001}. Color emerald to grass-green, streak light-gray-green, luster silky to vitreous, H = 2.5, perfect {100} cleavage, Dmeas = 3.17(3) g/cm3.

The mineral forms aggregates of poorly developed platy crystals up to 0.3 mm long, tabular (010), elongate [001], with Z = 8. Biaxial positive, straight extinction relative to cleavage, α = 1.577, β = 1.594, γ = 1.633, 2Vmeas = 68°, Z = b, Y ≈ c ≈ 0°. Transparent, pleochroic from green-yellow (X) to yellow (Y), X-ray study showed the mineral to be monoclinic, space group P21/c; the unit cell from powder data is a = 19.06(3), b = 9.47(1), c = 14.18(2) Å, β = 112.36(9)°. The strongest lines (39 given) are 8.83(100)(200), 6.59(4)(202), 6.54(4)(002), 4.38(5)(300), 4.07(3)(213), 2.943(12), and 2.844(5).

The mineral forms aggregates of poorly developed platy to micaceous crystals and fine-grained crusts 1 to 2 mm thick in incrustations around fumaroles of the second cone, 5–20 cm in diameter. The mineral occurs in the Kamoto-Est copper-cobalt deposit, 6 km west of Kolwezi, Zaire, in association with uraninite, schoepite, uranophane, curite, chalcocyanite, tolbachite, piypite, melilite, 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, scheelite, uranophane, curite, schuilingite, 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 (NH4 + 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, (NH4)2O 8.50, insoluble residue 12.49, sum 100.31 wt%. The insoluble residue is mostly finely dispersed quartz. After deducting this residue and normalizing to 100 wt%, the analysis corresponds to [NH4]0.95Mg0.05K0.02Ca0.012Pb0.01(Al2.05Fe3+0.95Ti0.05)20.95(SO4)20.80; or ideally (NH4)2(Al3+Fe3+)2(SO4)20.80. This mineral is insoluble in water. The dta curve has two endothermic peaks, one at 570 °C, corresponding to breakdown into simple sulfates and breakdown of (NH4)2SO4, the other at 810 °C, corresponding to desulfatization of Al2(SO4)3 and Fe2(SO4)3. The loss of 9.1 wt% at 570 °C is attributed to loss of (NH4)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

**Françoiseite-(Nd)**


The average and (range) of ten electron-microprobe analyses gave UO2 67.30 (66.70–68.02), Y2O3 1.53 (0.78–2.05), La2O3 0.71 (0.23–1.03), Ce2O3 1.00 (0.49–1.99), Pr2O3 0.92 (0.63–1.29), Nd2O3 4.60 (3.71–6.42), Sm2O3 1.60 (1.40–1.91), Dy2O3 0.79 (0.59–1.18), [REE2O3] 11.15 (10.10–12.37), P2O5 10.15 (9.91–10.39), H2O by gas chromatography 8.53, sum 97.13 (96.38–98.87) wt%, corresponding to the empirical formula 3.15UO3·0.49(REE2O3)·0.96P2O5·6.3H2O. X-ray crystal-structure study indicated a formula REE(UO3)3·OH(P2O7)·6H2O. The mineral occurs as aggregates of yellow, translucent, nonfluorescent crystals up to 0.3 mm long, tabular (010), elongate (001), and showing also {100} and {102}. Twinned on (100), white streak, vitreous luster, H about 3, uneven fracture, easy {010} cleavage, Dmeas = 4.63 g/cm3 with Z = 4. Optically biaxial negative, 2Vmeas = 35°, α = 1.65 (calc.), β = 1.74(1), γ = 1.75(1), Y = b, Z ≈ c = 14.5°, Z ∞ a = 8.3°. X-ray study indicated monoclinic symmetry, space group P21/c, α = 9.298(2), b = 15.605(4), c = 13.668(2) Å, β = 112.77(1)°. 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(50B)(040), 3.13(50)(124), 2.87(40)(322), and 2.84(40)(222).

The new name honors Dr. Armand Frangois, geologist and former director of the Geo1ogy 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, scheelite, uranophane, curite, schuilingite, and kamotoite-(Y). Type material is in the Institut royal des Sciences naturelles de Belgique, Brussels, Belgium. J.L.J.
Chelyabinsk coal basin of the Southern Urals, USSR. The mineral is one of the main constituents of the sulfate crusts formed by reaction of sulfuric acid with the material in the dumps. Together with (Al,Fe)\(_{2}\)\((SO_4)\)\(_3\), it occurs in the lower, hotter zones, which are up to 5 cm thick and up to 1 m\(^2\) in area. Luster of the aggregates is dull, fracture uneven, H = 2, \(D_{\text{meas}} = 2.53\) (suspension), \(D_{\text{calc}} = 2.52\) g/cm\(^3\) with \(Z = 1\). Uniaxial positive, \(\epsilon = 1.58(1), \omega = 1.57(2)\). Colorless. The powder X-ray pattern corresponds closely to that of synthetic NH\(_4\)Al(SO\(_4\))\(_2\), if allowance is made for an increase in \(d\) values because of substitution of Fe\(^{3+}\) for Al. Thus the mineral is assigned hexagonal symmetry and space group \(P\overline{3}1\). 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\((9)(001), 3.69\((100)(101), 2.92\((90)(102), 2.764\((70)(003), 2.374\((80)(110),\) and 1.848\((70)(102,202)\).

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 sylvinite body in Middle Asia. The size fractions >0.01 mm from the pre-Caspian rocks contain quartz, chalcedony, chlorite, biotite, oxylepidolomelane [= ferrian biotite], zircon, garnet, sphene [= 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 chlorine-swelling chlorite. Associated minerals in the Middle Asia salt bodies are authigenic quartz, chalcedony, anhydrite, and magnesite; the finest size fractions also contain Mg-rich chlorite and authigenic quartz.

The minerals form pyramidal-prismatic crystals visible under the scanning electron microscope; crystals from lowest density fractions (1.83–2.09 g/cm\(^3\)) 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 (\(e \parallel c\), negative elongation. Refractive indices \(\epsilon = 1.532–1.528, \omega = 1.520–1.513\) on the pre-Caspian sample (mineral unspecified); \(\epsilon = 1.546(2), \omega = 1.534(2)\) on the 11-A phase still enclosed in halite from Middle Asia, decreasing to \(\epsilon = 1.508–1.505\) and \(\omega = 1.489–1.488\) after dissolution of halite.

**7.56-Å CO\(_{3}\)-hydrotalcite-manasseite-2H**

Chemical analyses of the 2.15 ≤ \(D ≤ 2.16\) and 2.14 ≤ \(D ≤ 2.15\) fractions (where \(D =\) density in g/cm\(^3\)) of the sample from the pre-Caspian are respectively, SiO\(_2\), 4.37, 3.12, TiO\(_2\), 0.20, Al\(_2\)O\(_3\), 20.27, 21.28, Fe\(_2\)O\(_3\), 0.19, n.d. (not detected), FeO, P\(_2\)O\(_5\), CaO, MnO, n.d., MgO 31.38, 31.77, Na\(_2\)O 0.08, 0.08, K\(_2\)O 0.21, 0.12, H\(_2\)O\(_2\), 32.13, 31.41, H\(_2\)O\(_2\) 0.84, 1.77, C\(_n\)d., n.d., CO\(_2\), 7.08, 7.08, SO\(_3\) 1.84, 3.16, sums 98.59, 100.05 wt\%, leading to a formula \([\text{Mg}_{0.95}\text{Al}_{0.05}\text{FeO}_{0.10}(\text{OH})_{1.15}]\) \([\text{CO}_3]_0.3\text{SO}_3]_0.12\cdot3\text{H}_2\text{O}\). The SO\(_3\) is probably contained in admixed 16.5- and 18.5-A phases, and SiO\(_2\) 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. (17 lines 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), \(D_{\text{calc}} = 2.147\) g/cm\(^3\), in accord with the \(D_{\text{meas}} = 2.17–2.18\) g/cm\(^3\) 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, \(CO\(_2\) to the dominant anion accompanying H\(_2\)O molecules in the interlayers, hydrotalcite to the composition of the brucite layer (here Mg-Al), and 2H to the polytype.

**8.85-Å SO\(_4\)-hydrotalcite**

No chemical analysis is given. The dominant series of \(d\) values in the least dense fractions (1.98–2.04 g/cm\(^3\)) of the sample from the pre-Caspian, namely 8.85, 4.42 Å, etc., are attributed to a SO\(_4\)-containing member of the hydrotalcite group. For a mineral of composition \([\text{Mg}_{1.42}\text{Al}_{0.58}(\text{OH})_{1.15}]\) \([\text{SO}_4]\)\(_{3}\text{H}_2\text{O}\), the calculated and observed XRD intensities correspond satisfactorily, and \(D_{\text{calc}} = 1.962\) g/cm\(^3\), which is less than the observed densities because the mineral is overgrown with quartz.

The mineral is compared to the SO\(_4\)-hydrotalcite reported by Lisitzina and Drits (Litoligodo Poleznykh Iskopayemkh, 6, 20–39, 1985).

**11-Å SO\(_4\)-hydrotalcite-1H**

Chemical analysis of the 2.10 ≤ \(D ≤ 2.12\) g/cm\(^3\) fraction of the residue from halite from Middle Asia gave SiO\(_2\) 3.03, TiO\(_2\) 0.09, Al\(_2\)O\(_3\) 15.71, Fe\(_2\)O\(_3\) 0.71, FeO, MnO n.d., CaO 0.08, MgO 24.61, P\(_2\)O\(_5\) 0.08, Na\(_2\)O 2.70, K\(_2\)O 0.11, CO\(_2\) n.d., SO\(_3\) 15.86, H\(_2\)O\(_2\) and H\(_2\)O\(_2\) 37.02 (by difference from 100 wt%), corresponding to a formula \([\text{Mg}_{0.56}\text{Fe}_{0.44}\text{Al}_{0.08}\text{Si}_{0.06}\text{O}_{1.05}\text{(OH)}_{1.15}]\) \([\text{SO}_4]\)\(_{3}\text{H}_2\text{O}\) admixed with 3.03 wt% quartz and 6.10 wt% Na\(_2\)SO\(_4\). An alternative structural model, for which the calculated number of H\(_2\)O molecules per unit cell agrees better with the chemical analysis, is based on the assumption that the Na cations are present in the interlayers: \([\text{Mg}_{0.96}\text{Fe}_{0.04}\text{Al}_{0.08}\text{Si}_{0.06}\text{O}_{1.05}\text{(OH)}_{1.15}]\) \([\text{Na}_{0.56}(\text{SO}_4)_{0.30}]\cdot7.3\text{H}_2\text{O}\) cf. weimarianite. The X-ray powder data yield \(a = 5.293, c = 11.16\) Å (hexagonal). Oriented samples yield prominent 001 lines at 11.16, 5.58, and 3.72 Å, and \(d_{\text{cen}}\) 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, \(D_{\text{calc}} = 1.90\) g/cm\(^3\), less than the observed range of \(D_{\text{meas}} = 2.10–2.12\) g/cm\(^3\) because of quartz overgrowths.

The name is based on the nomenclature for the hydrotalcite-manasseite group of minerals proposed in this pa-
per. In this case, 11 Å refers to the interlayer spacing, SO₄ to the dominant anion accompanying H₂O molecules in the interlayers, hydrotalcite to the composition of the brucite layer (here Mg-Al), and 1H to the polytype.

16.5-Å mixed-layer CO₃SO₄·hydrotalcite

Chemical analyses of the 16.5-Å phase (mixed with the 8.85- and 11.16-Å phases) in the 2.09 ≤ D ≤ 2.11 and 2.11 ≤ D ≤ 2.13 fractions from the residue in the Middle Asia sylvite 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., 0.36, 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 [Mg₉₆Al₁₉Fe⁰.⁰⁷(OH)₆][(SO₄)₀₉₆(CO₃)₀₃₄·3H₂O].

X-ray patterns of oriented samples yield 700/ reflections. For an ordered mixed-layer structure consisting of 7.56-Å CO₃-bearing layers and 8.94-Å SO₄-bearing layers, Dcalc = 2.06 g/cm³, somewhat less than Dmean = 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 sylvite body of Middle Asia.

18.5-Å mixed-layer CO₃SO₄·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 2.11–2.13 g/cm³ fraction, gave CO₂ 5.74 and SO₄ 4.63 wt%; for the 2.09–2.11 g/cm³ fraction, CO₂ 5.19 and SO₄ 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 CO₃-bearing layers and 10.84-Å SO₄-bearing layers.

Discussion

7.56-Å CO₃-hydrotalcite-2H differs from an earlier-described hydrotalcite (7.6-Å CO₃-hydrotalcite-3R in the proposed nomenclature) in polytype, from an earlier-described manasseite (7.8-Å CO₃-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*


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, B₂O₃ 0.10, NO₃ 0.44, insol. 1.89, sum 100.057 wt%. Inclusions of gaylussite [Na₄Ca(CO₃)₂·5H₂O] and northupite [Na₈Mg(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 faces, with an angle of 15° between the 010 and 011 planes.

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 Ca₁₀Cu₂U₃O₉P₂O₅·H₂O·14H₂O, ideally Ca₄Cu(UO₂)₂(PO₄)₂·4H₂O. 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 (α), a = 1.622(2), γ = 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, β = 9.03(7)°, Dcalc = 3.71 g/cm³ with Z = 4. Strongest lines of the X-ray powder pattern are 6.389/(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 miarolitic 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.
A, $\beta = 114.6^\circ$, space group C2/c (by analogy with data for synthetic Li$_2$CO$_3$). Strongest lines of the powder pattern (57.3-mm Gandolfi camera, Cu radiation) are 4.15(80) (110), 2.92(80)(202), 2.81(100)(002), 2.48(40B)(020), and 2.42(40)(311) [indices from PDF 22-1141].

The mineral is named for the type locality, the Zabuye Salt Lake, Nagri, Tibet. Type material is in the Geology Museum, Beijing, China. J.L.J.

**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$_{0.058}$Zn$_{0.993}$Fe$_{0.003}$Al$_{0.003}$Cr$_{0.003}$. The mineral occurs as granular, irregular grains and also as tabular, dendritic; grain size is 0.13 $\times$ 0.15 to 0.1 $\times$ 0.35 mm. Golden yellow color, bronze streak, metallic luster, no cleavage, VHN$_{ro}$: 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 (WTIC 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) has only four Ka lines: 4.15(80)(101), 1.47(50)(200), 1.20(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, garnet, troilite, kamacite, taenite, chromite, ilmenite, magnesioferrite, pentlandite, graphite, wistite, and copper. The new mineral occurs in the hydrothermally kaolinitized zone of a Pre cambrian granitic pegmatite, and in dinks at St Anns mine, Karoi District, Zimbabwe.

**Discussion.** A repository for type material is not 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 Cmcm, and $D_{calc}$: 5.98 g/cm$^3$ for the formula Na$_4$(Pb$_{0.95}$Na$_{0.05}$)$_3$As$_4$(Ta$_{1.5}$Nb$_{0.5}$Ti$_{0.5}$)O$_{18}$. J.L.J.

**Zincovoltaite**


Wet-chemical analysis gave K$_2$O 4.11, CaO 0.69, ZnO 14.61, FeO 3.20, MnO 1.20, Fe$_2$O$_3$ 11.21, Al$_2$O$_3$ 2.50, SO$_3$ 46.93, H$_2$O 15.69, sum 100.14 wt%, corresponding to (K$_{1.79}$Ca$_{0.23}$)Z$_{0.32}$Fe$_{0.95}$Mn$_{0.35}$Fe$_{0.13}$Al$_{0.35}$SO$_{4.12}$O$_{12.03}$OH$_2$. The mineral occurs as yellowish-green, streak grayish-green, luster pitchy to resinous, vitreous on crystal surfaces, transparent to translucent, brittle, no cleavage, conchoidal fracture, hardness about 3, $D_{mean}$ = 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, \(a = 27.180(1) \text{ Å}\) from refinement of powder data. Strongest lines of the powder pattern (diffractometer, Co radiation, 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 volblaite, occurs in the oxidation zone of a sphalerite-galena-pyrite deposit in an arid climate at Xiiteshan, Qinghai Province, China. Associated sulfate minerals are roemerite, melanterite, and gypsum. Type material is at the Geological Department, Lanzhou University, and at the Geological Museum of the Ministry of Geology, Beijing. J.L.J.

**Unnamed phosphate**


With fluellite and secondary phosphates derived principally from triplite are phosphosiderite, strengite, berneinite, torbernite, and an unidentified mineral proposed to be new and to have the formula \(K\text{Ti}(\text{Mn,Fe,Mg})\text{F}_{x}\)(PO\(_4\))\(_y\)\((\text{OH})\), \(n\text{H}_2\text{O}\). It is suggested that the mineral may be isomorphous with paulkerrite. No analyses or other data are given. J.L.J.

**Unnamed layered titanosilicate**


Electron-microprobe analysis gave the empirical formula \(Na_{16.09} Ca_{2.51} Mn_{1.42} Mg_{9.38} Si_{7.21} Ni_{0.37} Zr_{0.25} Si_{6.00} P_{0.93} F_{1.5} O_{2.0}\) (only the formula is given). X-ray study showed the mineral to be triclinic, space group \(P1\), \(a = 5.412(2), b = 7.079(3), c = 26.56(1) \text{ Å}, \alpha = 95.21(4), \beta = 93.51(4), \gamma = 90.10(3)\), \(V = 1011.4 \text{ Å}^3\), \(Z = 1\). The microprobe F value could be too low.

**Discussion.** The empirical formula does not balance with respect to charge (84.77 positive, 85.5 negative) and differs considerably in F content from the structural formula for which charge balance (85.82 positive, 86 negative) is better. The microprobe F value could be too low. E.S.G.

**Unnamed layered titanosilicate**


Electron-microprobe analysis gave the empirical formula \(Na_{12.66} Ca_{1.45} Mg_{0.39} Ti_{1.6} Mn_{0.36} Zr_{0.46} Nb_{0.42} Si_{1.0} P_{3.84} O_{31} F_3\) (only the formula is given). X-ray study showed the mineral to be triclinic, space group \(P1\), \(a = 5.415(2), b = 7.081(3), c = 20.34(1) \text{ Å}, \alpha = 86.85(4), \beta = 94.40(4), \gamma = 98.94(3)\), \(V = 776.4(6) \text{ Å}^3\), \(D_{\text{calc}} = 3.1 \text{ g/cm}^3\), \(Z = 1\). The crystal-structure refinement gave \(Na_{12.41} Ca_{2.09} Mg_{0.39} Ti_{2.5} Mn_{1.0} Zr_{0.5} Nb_{0.4} Si_{4.0} P_{3.3} O_{31} F_3\). The mineral, referred to as mineral T, can be regarded as one member of a series. It consists of a lomonosovite block (idealized formula \(Na_2\text{Ti}_2\text{O}_4[Na\text{Ti}_2\text{O}_4],\text{Si}_4\text{O}_{12}\)) alternating with a sulfohalite block (\(Na_2\text{Ca}[\text{PO}_4]_2\)). Another mineral in this series is mineral X5 (see preceding abstract). Mineral T was discovered by A.P. Khomayakov in the ultraalkaline rocks of the Lovozozer 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 titanasilicates. No other properties are given. E.S.G.

**New Data**

**Kulanite**


Kulanite occurs abundantly disseminated and as veinlets in a granitic pegmatite containing montebrasite and other phosphates at Xiyuantou, Fujian Province, China. The chemical composition (well-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 \(P2_1\), or \(P2_1/m\), \(a = 9.024(1), b = 12.079(4), c = 4.924(1) \text{ Å}, \beta = 100.46^\circ\).

**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 symmetry, 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 wölsendorfite, 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 U₂O₃ 52.4 – 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 compositions between Ca and Ba suggest possible solid solution. Only one composition is significantly along the join Ba-Pb, and two suggest only limited ternary isomorphism.

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 cryptocrystalline 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 variation, 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.