American Mineralogist, Volume 72, pages 1023–1028, 1987

NEW MINERAL NAMES*

Frank C. Hawthorne, John Jambor, Kenneth W. Bladh, Ernst A. J. Burke,
Joel D. Grice, Don Phillips, Andrew C. Roberts,
Robert A. Schedler, James E. Shigley

Cameronite*

A.C. Roberts, D.C. Harris, A.J. Criddle, W.W. Pinch (1986) Cameronite, a new copper-silver telluride from the Good Hope mine, Vulcan, Colorado. Can. Mineral., 24, 379–384.

Two closely matching microprobe analyses of cameronite, ideally Cu_7AgTe_{10}, give an average of Cu 24.45, Ag 6.34, Te 69.11, sum 99.90 wt%, corresponding to $Cu_{7.10}Ag_{1.09}Te_{10}$ assuming 10 Te atoms. Single-crystal X-ray study indicates tetragonal symmetry, $a = 3a' = 12.695(2)$, $c = 7c' = 42.186(6)$ Å, space groups $P4_2/mmc$, $P4_2mc$, or $P\bar{4}_2c$, $D_{calc} = 7.144$ g/cm³ for the ideal formula with Z = 16. The strongest lines (26 given) are 3.456(100)(307), 2.118(100)(33.14,600), 1.804(60)(637), 1.377(40)(63.21,907), and 1.222(40)(93.14).

In hand specimen, cameronite resembles tetrahedrite: opaque, gray, metallic, brittle, subconchoidal fracture, no cleavage, calculated Mohs' hardness 3½–4, VHN_{100} 163 (150–170), VHN_{200} (151–172). In reflected light, slightly bireflectant and pleochroic from pale gray to pale brownish gray; anisotropism distinct with colors in air from medium gray to slate gray to brownish gray. Reflectance spectra in air and in oil for six grains are given in 10-nm steps; average values in air in 50-nm steps from 400 to 700 nm for R_o, R_e' are 23.8, 28.2; 27.8, 31.6; 30.6, 33.2; 31.9, 33.5; 32.7, 33.3; 33.1, 32.8; 33.4, 32.3. Bireflectance positive from 400 to about 625 nm, negative from about 645 to 700 nm. Color indices (2856 K) in air for R_o, R_e' are x .456–.457, .447–.452; y .413–.414, .411–.412; λ_d 583–584; 546–580; P_e% 10.0–10.8; 1.9–6.3.

Cameronite masses up to 2 × 2 mm are associated with native tellurium, rickardite, vulcanite, arsenopyrite, and pyrite. The name is for E. N. Cameron, who with I. M. Threadgold originally identified and partly characterized the mineral in 1961 (Am. Mineral., 46, 258–268). Type material is in several repositories, including the National Mineral Collection at the Geological Survey of Canada, Ottawa, the British Museum (Natural History), London, and the Pinch Mineralogical Museum, Rochester, New York. **J.L.J.**

Chvaleticeite*

J. Pašava, K. Breiter, M. Huka, J. Korecký (1986) Chvaleticeite, $(Mn,Mg)SO_4 \cdot 6H_2O$, a new mineral. Neues Jahrb. Mineral. Monatsh., 121–125.

Classical chemical analyses gave MnO (by titration) 15.81, MgO (by EDTA titration) 6.41, CaO 0.04 (by AAS), FeO trace, Fe_2O_3 (by AAS) 0.10, Al_2O_3 trace, K_2O (by AAS) 0.005, Na_2O (by AAS) 0.011, SO_3 (determined gravimetrically as $BaSO_4$) 31.48, P_2O_5 trace, H_2O^+ (by modified Penfield method) 0.37, H_2O^- (by modified Penfield method) 45.22, insoluble 0.36, sum 99.81 wt%, corresponding to (on the basis of SO_3 = 1) $(Mn_{0.567}Mg_{0.405}Ca_{0.002}Fe^{+3}_{0.003})_{\Sigma 0.977}SO_4 \cdot 6.39H_2O$ or (on the basis of anhydrous O = 4) $Mn_{0.570}Mg_{0.407}Ca_{0.002}Fe^{+3}_{0.003})_{\Sigma 0.982}S_{1.005}O_4 \cdot 6.42H_2O$. The ideal formula is $(Mn,Mg)SO_4 \cdot 6H_2O$ with Mn > Mg and Z = 8. DTA-TGA analysis showed major peaks at 105 (H_2O), 310 (H_2O), 987 (SO_3), and 1000°C (SO_3). Chvaleticeite (as described, magnesian chvaleticeite) is the Mn-dominant member of the hexahydrite group.

Material suitable for single-crystal study was not found so that unit-cell parameters were calculated by analogy with hexahydrite. The mineral is monoclinic, space group $C2/c$ with a = 10.05 (2), b = 7.24 (2), c = 24.3 (1) Å, β = 98.0(2)°. The strongest lines of the Guinier powder film (32 given) are 5.45(8)$(11\bar{2})$, 4.91(10)$(20\bar{2})$, 4.47(8)$(11\bar{4})$, 3.98(8)(114), 3.42(7)$(20\bar{6})$, 3.25(8)(116), and 2.967(7)$(31\bar{3})$.

Chvaleticeite forms white, relatively hard, fine-grained aggregates as well as pinkish to yellowish-green loose coatings. Grains do not exceed 0.05 mm in longest dimension and are translucent with a vitreous luster. H = 1.5. D_{meas} = 1.84, D_{calc} = 1.84. Soluble in water. Optically, only α' (= 1.457(2)) and γ' (= 1.506(2)) could be measured because of the fine-grained nature of the material. In thin section the mineral is colorless and transparent.

Chvaleticeite is a rare constituent of a sulfate-rich paragenesis within the oxidation zone of an upper Proterozoic volcano-sedimentary deposit of pyrite-manganese ores at Chvaletice, Bohemia, Czechoslovakia. It is associated with melanterite, Mg-Mn melanterite (= magnesian, manganoan melanterite), epsomite, Mg-Fe mallardite (= magnesian, ferroan mallardite), Mg-jokokuite (= magnesian jokokuite), Mg-ilesite (= magnesian ilesite), rozenite, copiapite, and gypsum. Chvaleticeite forms by dehydration of Mg-mallardite (= magnesian mallardite) and dehydrates to Mg-jokokuite (= magnesian jokokuite). The name is for the locality. Type material is deposited at the Geological Survey in Prague, Czechoslovakia.

Discussion. The use of unapproved Mg-, Mn-, and Fe-modified mineral names is deplorable. **A.C.R.**

Erlianite*

X. Feng, R. Yang (1986) Erlianite, a new vanadium- and iron-bearing silicate mineral. Mineral. Mag., 50, 285–289.

Analysis by colorimetric microanalysis yielded SiO_2 38.80, FeO 26.67, Fe_2O_3 21.26, V_2O_5 1.15, MgO 1.00, CaO 0.83, MnO 0.55, P_2O_5 0.051, K_2O 0.079, Na_2O 0.09, Al_2O_3 0.19, TiO_2 0.38, H_2O^+ 7.65, H_2O^- 0.90, sum 99.60 wt%. Major-element contents were confirmed by electron-microprobe analysis. K, Na, Ca, P, and H^- are assumed to be minor contaminants or interlayer elements. The provisional empirical formula is $(Fe^{2+}_{19.96}Fe^{3+}_{2.19}Mg_{1.33}Mn_{0.42})_{\Sigma 23.90}(Fe^{3+}_{11.32}V_{0.68})_{\Sigma 12.00}(Si_{34.73}Ti_{0.26}Al_{0.20}Fe^{3+}_{0.81})_{\Sigma 36.00}O_{90}(OH,O)_{48}$. The mineral is soluble in dilute HCl. The TGA curve is smooth, and the lack of a distinct exothermic peak shows that the water contained in the mineral escaped slowly. The water content may therefore be structural. The DTA curve exhibits three

---

* Minerals marked with asterisks were approved before publication by the Commission on New Minerals and Mineral Names, International Mineralogical Association.

exothermic peaks at 320, 720, and 940°C. At 320°C the crystal structure was destroyed and quartz was found; at 720°C no new phase was produced; and at 940°C the specimen was converted to quartz and hematite. Data from Mössbauer and infrared spectroscopy are also presented.

Selected-area electron-diffraction patterns gave unit-cell data of $a = 23.2$, $b = 9.2$, $c = 13.2$ Å and indicated the space group to be *Pmmn* or $Pm2_1n$. No suitable crystals have been found for a single-crystal diffraction study. X-ray powder diffraction data show the mineral to be orthorhombic with unit cell $a = 23.20(\pm 0.01)$, $b = 9.20(\pm 0.01)$, $c = 13.18(\pm 0.01)$ Å, $V = 2813$ Å^3, and Z = 1. The strongest lines (27 given) are 11.5(100)(200,101), 3.05(50)(223,130), 2.89(60)(603,800,231), 2.61(60)(523,105,332,224), 2.52(50)(324,901,115,033,531), and 2.42(30)(424,803,614,821).

Erlianite is found at the Harhada iron mine along the Jining-Erlian railway, Inner Mongolia Autonomous Region, People's Republic of China. The mineral occurs sparingly in a fractured zone within the upper part of the deposit. Associated minerals include magnetite, minnesotaite, stilpnomelane, deerite, quartz, siderite, albite, and other phases. The distribution of erlianite is closely related to structural features, and it is often developed with red-brown stilpnomelane and dark brown minnesotaite along shear planes.

Erlianite occurs as opaque fibers, flakes, and lathlike aggregates. Color black, streak brownish gray, and luster silky. The grain size is 1–2 cm. The mineral is not fluorescent; it has two perfect cleavages on {001} and {100}. H = 3.7, $D_{meas} = 3.11$. In thin section the mineral is brown with moderate relief. Biaxial negative, $\alpha = 1.667$, $\beta = 1.674$, $\gamma = 1.679$, $2V = 56$–$59°$. The orientation is $X = b$, $Y = c$, and $Z = a$. Slightly pleochroic with Z (dark brown) $\simeq$ Y (dark brown) $>$ X (light brown). Weak dispersion with $r < V$; either positive or negative elongation. Most elongate sections show parallel extinction, although extinction angles up to 29° have been measured. **J.E.S.**

Hochelagaite*

J.L. Jambor, A.P. Sabina, A.C. Roberts, M. Bonardi, D.R. Owens, B.D. Sturman (1986) Hochelagaite, a new calcium-niobium oxide mineral from Montreal, Quebec. Can. Mineral., 24, 449–453.

Microprobe analyses of four globules of the mineral gave CaO 6.3–7.7, SrO 0.0–1.2, Na_2O 0.0–1.3, Nb_2O_5 71.7–78.3, TiO_2 1.2–1.5, Al_2O_3 0.0–0.8, SiO_2 0.4–1.5, H_2O (by diff.) 10.3–18.9, corresponding to the formula $(Ca,Na,Sr)(Nb,Ti,Si,Al)_4O_{11} \cdot nH_2O$ (n = 8?).

Owing to the fine grain size of the mineral, single-crystal X-ray studies were not undertaken. The powder pattern was indexed on the basis of similarity of the mineral with franconite and gave $a = 19.88$, $b = 12.83$, $c = 6.44$ Å, $\beta = 93.20°$, with Z = 4. The six strongest powder-diffraction lines are 10.0(100), 3.115(80), 3.208(70), 5.39(50), 4.96(50), and 2.799(40).

Hochelagaite occurs as white globules, 150 µm across, in vugs of a dawsonite-bearing sill in the Francon limestone quarry, Montreal, Quebec. The globules mainly consist of radiating bladed crystals with a vitreous luster and white streak; H = 4. Optically negative and biaxial with $\alpha = 1.72$, $\beta = 1.81$, $\gamma = 1.82$; $2V = 35°$. Optical orientation: $Z = c$ and $X = b$ (perpendicular to the blades). $D_{meas} = 2.85$–2.94, $D_{calc} = 2.82$–2.88.

The mineral is named after the original name for Montreal (Hochelaga).

Holotype specimens are deposited in the National Mineral Collection at the Geological Survey of Canada (64285 and 64288) and at the Royal Ontario Museum (M37547, M37548). **R.A.S.**

Hydrodelhayelite*

M.D. Dorfman, M.I. Chiragov (1979) Hydrodelhayelite, a product of supergene alteration of delhayelite. New Data on Minerals of the USSR, 28, 172–175.

Chemical analysis gives SiO_2 55.53, TiO_2 0.01, Al_2O_3 8.46, Fe_2O_3 0.65, MnO 0.18, CaO 12.72, SrO 0.22, MgO 0.21, Na_2O 0.22, K_2O 6.18, F 0.00, Cl 0.15, $H_2O^+ = 9.62$, $H_2O^- = 5.85$, sum = 99.64 wt%, corresponding to the idealized formula $KCa_2(Si_7Al)O_{17}(OH)_2 \cdot 6H_2O$.

Hydrodelhayelite is orthorhombic, $a = 6.648$, $b = 23.846$, $c = 7.073$ Å, space group $Pnm2_1$, Z = 2. The strongest lines in the X-ray powder pattern are 2.923(100), 3.069(75), 2.800(55), 3.319(43), and 6.79(38).

The mineral occurs as an alteration product of delhayelite in an ijolite-urtite pegmatite of the Khibina alkaline massif; greenish-gray delhayelite alters to grayish-white hydrodelhayelite in the supergene zone. Hydrodelhayelite is grayish white with a vitreous luster; H $\approx$ 4. It has three orthogonal cleavages with {010} very perfect, {100} and {001} imperfect; $D = 2.168$ g/cm^3. It is biaxial with $\alpha = 1.503$, $\gamma = 1.518$.

The name is for the composition and its relationship to delhayelite. **F.C.H.**

Kimrobinsonite*

E.H. Nickel, B.W. Robinson (1985) Kimrobinsonite, a new tantalum mineral from Western Australia, and its association with cesstibtantite. Can. Mineral., 23, 573–576.

Electron-microprobe analysis gave Na_2O 0.7, FeO 0.4, Sb_2O_3 0.7, Ta_2O_5 78.5, Nb_2O_5 6.6. Adjusted values from CHN microanalysis gave H_2O 8.9, CO_2 4.2. The sum equals 100.0 wt%. The ideal formula is $(Ta,Nb)(OH)_{5-2x}(O,CO_3)_x$ with $x \approx 1.2$.

X-ray analysis revealed a primitive isometric cell of the perovskite type with $a = 3.812(1)$ Å, $D_{calc} = 6.865$ (law of Gladstone and Dale), Z = 1. The strongest lines (21 given) are 3.808(100)(100), 2.696(70)(110), 1.702(50)(210), 1.555(40)(211), 1.907(30)(200), and 2.202(20)(111).

Kimrobinsonite occurs in aggregates of cryptocrystalline white individuals whose luster is dull and chalky; the material has a white streak. Friable and soft (VHN 70 with a 20-g load), the mineral is isotropic.

The name honors Mr. Kim Robinson of Perth, who discovered the material in weathered pegmatite near Mt. Holland in Western Australia (32°10′S, 119°44′E). Kimrobinsonite occurs intergrown with cesstibtantite as a mass in the skeletal void of a precursor Ta-Sb mineral of unknown identity. Associated minerals in the pegmatite include montmorillonite, K-feldspar, lithium-bearing muscovite, tourmaline, and several rare element–bearing minerals. Type material resides at the Government Chemical Laboratories of Western Australia, the British Museum of Natural History, and the Smithsonian. **K.W.B.**

Laphamite*

P.J. Dunn, D.R. Peacor, A.J. Criddle, R.B. Finkelman (1986) Laphamite, an arsenic selenide analogue of orpiment, from burning anthracite deposits in Pennsylvania. Mineral. Mag., 50, 279–82.

Analysis by electron microprobe gave As 47.0, Se 43.7, S 8.7, sum 99.4 wt%. Although Se always dominated, crystals displayed variable Se:S ratios. The ideal formula is $As_2(Se,S)_3$.

X-ray analysis reveals a monoclinic lattice, $P2_1/n$, with a = 11.86(1), b = 9.756(9), c = 4.265(9), Å, β = 90.17(30)°, Z = 4, D_{calc} = 4.60, D_{meas} = 4.5(1) g/cm³. The strongest lines (42 given) are 2.833(100)$(221,22\bar{1})$, 2.773(80)$(31\bar{1},311)$, 4.87(70)(020), 2.905(60)$(30\bar{1},301)$, 1.777(50)(051,032), and 1.709(50).

Laphamite occurs as dark red, resinous, prismatic crystals (< 5 mm). The larger crystals are nearly opaque. The streak is red orange; crystals are flexible but not elastic. Cleavage on (010) is perfect. Laphamite is so malleable that hardness could only be determined as "soft." Crystals are tabular on (010), are elongate on [100], and are composed of the forms {100}, {110}, {101}, and {301}. Many of the crystals resemble resorbed solids.

In plane-polarized light (3200 K) in polished section, laphamite is moderately bireflectant from white to gray. Strong, fiery-red internal reflections and golden-yellow reflections along scratches are characteristic. On (001), anisotropism is moderate with gray tints during rotation. Reflectance in air: 400 (34.4, 42.1), 420 (33.9, 41.0), 440 (33.8, 39.9), 460 (33.8, 38.75), 480 (33.25, 37.45), 500 (32.3), 36.3), 520 (30.9, 35.1), 540 (29.5, 34.0), 560 (28.45, 33.1), 580 (27.6, 32.3), 600 (26.9, 31.55), 620 (26.4, 31.1), 640 (26.4, 30.9), 660 (26.3, 30.6), 680 (26.1, 30.4), and 700 nm (25.9, 30.1) (R_1 and R_2, respectively). Color values for the CIE illuminant C are Y%, 29.0, 33.5; λ_d 480, 478; P_e%, 9.1, 8.7 for R_1 and R_2, respectively.

Laphamite occurs with orpiment, arsenolite, and NH_4AlF_4 on a clinker found at the surface near a gas vent from a burning coal-waste dump at Burnside, Northumberland County, Pennsylvania (40°46′14″N, 76°34′12″W). The name honors Dr. David M. Laphman, former Chief Mineralogist of the Pennsylvania Geological Survey. Type material resides at the Smithsonian (catalogue no. 163039) and at the British Museum (E. 1036, BM 1984, 843). **K.W.B.**

Mathewrogersite*

P. Keller, P.J. Dunn (1986) Mathewrogersit, ein neues Bleisilikatmineral von Tsumeb, Namibia. Neues Jahrb. Mineral. Monatsh., 203–208 (in German).

Combined results of electron-microprobe analysis and elemental analyzer (for H_2O) gave PbO 57.5, MgO 0.1, FeO 1.7, CuO 0.8, Al_2O_3 5.9, GeO_2 3.9, SiO_2 26.2, H_2O 1.9, sum 98.0 wt%, corresponding (on the basis of 12 Si atoms) to $Pb_{7.08}(Fe_{0.65}Cu_{0.28}Mg_{0.07})Ge_{1.03}Al_{3.18}Si_{12}O_{41.81}H_{5.81}$, or idealized $Pb_7(Fe,Cu)GeAl_3Si_{12}O_{36}(OH,H_2O\square)_6$.

Single-crystal X-ray study with several methods shows the mineral to be hexagonal, with possible space groups $R3$, $R\bar{3}$, $R32$, $R3m$, or $R\bar{3}m$. The unit-cell parameters were calculated from 25 diffraction lines of a Debye-Scherrer pattern: a = 8.457, c = 45.970 Å, Z = 3, D_{calc} = 4.76, D_{meas} = about 4.7 g/cm³. The strongest X-ray diffraction lines (34 listed) are 15.30(70)-(003), 7.68(60)(006), 4.08(50)$(113,1\bar{2}3)$, 3.257(100)$(119,1\bar{2}9)$, 2.860(50)(0.2.10), 2.766(60)$(211,1\bar{3}1, 3\bar{2}\bar{1})$, 2.439(50)$(300,3\bar{3}0)$, 2.030(70)$(131,3\bar{4}1,4\bar{1}\bar{1})$, 1.762(60)$(1.3.13,3.\bar{4}.13)$.

The mineral is a lead silicate without any structural relationship with other minerals or chemical compounds.

Mathewrogersite occurs in cavities of corroded lead-zinc ore from the Tsumeb mine, Namibia. Associated minerals are queitite, alamosite, melanotekite, kegelite, larsenite, schaurteite, anglesite, willemite, leadhillite, and mimetite. The grain size of mathewrogersite does not exceed 0.3 mm in diameter. Idiomorphic crystals are flattened along {0001} and are six-sided with possibly rhombohedral faces; the crystals form subparallel intergrowths. The mineral also occurs in radiating aggregates, up to 1 mm in diameter, of scales and blades. Perfect {0001} cleavage.

The mineral is colorless, translucent, white or pale greenish yellow, with glassy luster (weak pearly luster on cleavage planes); white streak. H about 2. Soluble in HNO_3. Its optical properties are uniaxial negative with ω = 1.810, ϵ = 1.745.

The name is for Mathew Rogers, the first prospector in Tsumeb. Type material is at the Institute of Mineralogy and Crystal Chemistry of Stuttgart (FRG) University and at the Smithsonian Institution in Washington. **E.A.J.B.**

Montroyalite*

A.C. Roberts, A.P. Sabina, M. Bonardi, J.L. Jambor, R.A. Ramik, B.D. Sturman, M.J. Carr (1986) Montroyalite, a new hydrated Sr-Al hydroxycarbonate from the Francon quarry, Montreal, Quebec. Can. Mineral., 24, 455–459.

Microprobe analyses of the mineral (TGA and EGA for H_2O and CO_2) gave Al_2O_3 28.8, SrO 27.7, CaO 1.1, CO_2 9.2, H_2O 24.6, F 11.5, less O ≡ F 4.84, sum 98.06 wt%, yielding an ideal formula $Sr_4Al_8(CO_3)_3\{(OH),F\}_{26}\cdot 10\text{–}11H_2O$.

The material was not suitable for single-crystal X-ray studies. Strongest eight lines in the powder pattern are 6.57(100), 4.00(50), 3.283(55), 3.190(50), 2.356(45b), 2.862(40), 2.551(40b), and 2.841(40). TEM reveals twin lamellae approximately 50 Å wide parallel to a net plane with translations of 7.14 and 6.55 Å and with an interrow angle of approximately 77.5°.

Montroyalite occurs as white translucent 1-mm-sized hemispheres in cavities in a silicocarbonatite sill exposed at the Francon quarry, Montreal, Quebec. Indistinct fibers radiate from the cores of these hemispheres. Individual grains are irregular to lath shaped, up to 20 μm long and 5 μm thick. Brittle. White streak. Uneven to splintery fracture and no visible cleavage. Soluble in 1:1 HCl and fluoresces white under both long- and short-wavelength ultraviolet light. H = 3.5, D_{meas} = 2.677. Montroyalite is biaxial and negative, α = 1.515, β = 1.530, γ = 1.545; $2V_{meas}$ = 80°, $2V_{calc}$ = 89°. Y nearly parallel to elongation of lath; X and Z make angles of about 45° with the plane of the lath.

Major associated minerals: albite, quartz, strontiodresserite, calcite, dawsonite, ankerite, and fluorite.

Montroyalite is named after the Monteregian hill Mont Royal, a landmark in Montreal. Type material is deposited in the Systematic Reference Series of the National Mineral Collection at the Geological Survey of Canada, Ottawa, under the catalogue numbers 64261 and 64265. **R.A.S.**

Moolooite*

R.M. Clarke, I.R. Williams (1986) Moolooite, a naturally occurring hydrated copper oxalate from Western Australia. Mineral. Mag., 50, 295–298.

Partial microchemical analysis by CHN analyzer gave C 14.10 and H 0.52% corresponding to C_2O_3 42.3 and H_2O 4.65%. A microchemical test for the oxalate radical gave a positive result. Cu and Si were detected by microprobe scan but could not be determined quantitatively owing to rapid sample degradation under the electron beam. Si is variable and attributed to intergrown opaline silica. Assuming sufficient Cu^{+2} for stoichiometry requires CuO 46.7, C_2O_3 42.3, H_2O 4.65, total 93.6 wt%. Assuming that the shortfall from 100% is due to silica impurity, the derived empirical formula is $CuC_2O_4\cdot 0.44H_2O$ and the general formula is $CuC_2O_4\cdot nH_2O$ with $0 \leq n < 1$ and Z = 1. Extensive studies of the analogous artifical compound indicate that the water is zeolitic and not essential to maintaining structural integrity.

The material is too fine grained for single-crystal study. Orthorhombic unit-cell parameters, $a = 5.35$, $b = 5.63$, $c = 2.56$ Å, were calculated with reference to the artificial compound $CuC_2O_4 \cdot 0.1H_2O$ (PDF 21-297). The strongest lines of the X-ray powder pattern (25 given) are 3.88(100)(110), 2.50(30)(120), 2.33(18)(011), 2.31(25)(101), 2.14(20)(111), 1.938(18)(220), 1.787(25)(121,300), and 1.753(30)(211).

Moolooite occurs as variable blue-green microconcretions that have a dull to waxy luster. Individual crystallites are lathlike or prismatic in shape and are less than 1 μm in size. $D_{calc} = 3.43$. The maximum refractive index, 1.95, is perpendicular to the axis of elongation. The minimum refractive index, 1.57, is parallel to the axis of elongation. The mineral dissolves in warm dilute HCl without effervescence.

Moolooite was found 12 km east of the homestead on Mooloo Downs pastoral station in the Precambrian Gascoyne province of Western Australia, Australia, approximately 1 km north of Bunbury Well, at 25°01′30″S, 116°06′30″E. The mineral was discovered on an outcrop of white glassy quartz intimately associated with sampleite, libethenite, and an unidentified mineral believed to be an oxalate. Other associated minerals are chalcopyrite, digenite, and covellite; their oxidation has produced a variety of secondary minerals including brochantite, antlerite, atacamite, gypsum, barite, and jarosite. Moolooite is believed to have formed by reaction between solutions derived from bird excreta and the soluble secondary copper minerals. A second occurrence is reported from the Sainte-Marie-aux-Mines silver mining district of Vosges Mountains, France.

The name is for the locality. Type material is preserved at Perth, Western Australia, in the mineral collection of the Government Chemical Laboratories. **A.C.R.**

Obradovicite*

J.J. Finney, S.A. Williams, R.D. Hamilton (1986) Obradovicite, a new complex arsenate-molybdate from Chuquicamata, Chile. Mineral. Mag., 50, 283–284.

Wet-chemical analysis gave Na_2O 0.56, K_2O 2.48, CuO 5.85, Fe_2O_3 10.12, As_2O_5 8.46, MoO_3 55.29, H_2O 18.33, sum 101.09 wt%. The ideal formula is $H_4(K,Na)CuFe_2(AsO_4)(MoO_4)_5 \cdot 12H_2O$, with K > Na.

X-ray analysis reveals an orthorhombic cell, *Pcnm*, with $a = 15.046$, $b = 14.848$, $c = 11.056$ Å, Z = 4, $D_{meas} = 3.55(5)$, $D_{calc} = 3.68$. The strongest lines (28 given) are 8.906(100)(101), 10.565(80)(110), 7.424(80)(020), 2.969(60)(303,050), 5.733(50)(211), and 2.898(50)(133).

Obradovicite occurs as clusters of platy, translucent, pea-green (RHS 149A) crystals (<0.1 mm) with a paler streak (RHS 149C). No twinning was observed. The most prominent forms on crystals that are elongated slightly along *c* are {100}, {110}, and {011}. The faces of {100} are striated along *c*. Mohs' hardness = 2.5; no cleavage observed. The mineral is insoluble in cold 1:1 HNO_3 but dissolves readily when heated, readily soluble in cold 1:1 HCl, rapidly turns dull brick orange in 40% KOH, and is unaffected by 20% NH_4OH.

Optically biaxial positive with $2V_Z = 81°$, $\alpha = 1.790$, $\beta = 1.798$, $\gamma = 1.811$ (Na_D line), $a = Z$, $b = X$, $c = Y$, obradovicite shows strong dispersion and weak yellow pleochroism ($Z > X = Y$). The mineral does not fluoresce under short-wavelength ultraviolet light.

Obradovicite occurs on brecciated and leached vein-quartz and on crusts of jarosite. Tiny wulfenite crystals are also associated with obradovicite. Known only from Chuquicamata, Chile, the mineral is named for Martin T. Obradovic from whose collection the type material came. Type material resides at the Colorado School of Mines Museum, the Smithsonian, and the Mining Museum in Copiapó, Chile. **K.W.B.**

Orthoserpierite*

H. Sarp (1985) Orthoserpierite $Ca(Cu,Zn)_4(SO_4)_2(OH)_6 \cdot 3H_2O$, a new mineral from the Chessy mine, France; a polymorph of serpiérite. Schweiz. Mineral. Petrogr. Mitt., 65, 1–7 (in French).

Electron-microprobe analysis gave CuO 43.61, CaO 9.33, ZnO 7.29, SO_3 21.20, H_2O (by difference) 18.57, which yields a formula (based on 17 oxygen atoms) of $Ca_{1.08}(Cu_{3.54}Zn_{0.58})_{\Sigma 4.12}S_{1.71}O_{17}H_{13.33}$.

Single-crystal and powder X-ray diffraction studies show the mineral to be orthorhombic, space group $Pca2_1$, unit cell $a = 22.10(2)$, $b = 6.20(2)$, $c = 20.39(2)$ Å, Z = 8. The strongest X-ray lines (48 given) are 10.21(100)(002), 5.10(90)(004), 3.400(90)(006,512), 3.184(50)(513), 2.610(50)(117,442,713), 2.558(50)(217,803,008), 2.511(40)(521,423,811), 2.384(60)(424), and 2.111(35)(119,426,10.03).

The mineral occurs as masses and fibrous crusts associated with gypsum, devilline, and calcite on a brecciated argillite. The sky-blue crystals have a vitreous luster and a light green streak. Tabular crystals, flattened on {001} are elongate parallel to the *b* axis and measure up to 0.2 mm. Splintery fracture. Soluble in HCl. Mauve fluorescence in LW or SW. $D_{meas} = 3.00$ g/cm³, $D_{calc} = 3.07$ g/cm³. Optically biaxial negative, $\alpha = 1.586(2)$, $\beta = 1.645(2)$, $\gamma = 1.650(2)$, $2V_{meas} = 32(2)°$, $2V_{calc} = 32°$. Dispersion distinct $r > v$. Weak pleochroism with *X* colorless or very pale green, *Y* and *Z* pale green. Orientation matrix $X = c$, $Y = a$, $Z = b$.

The name delineates the species as the orthorhombic polymorphic of serpierite. The holotype is preserved in the Muséum d'Histoire Naturelle de Genève. **J.D.G.**

Otjisumeite*

P. Keller, H. Hess, P.J. Dunn (1981) Otjisumeit, $PbGe_4O_9$, ein neues Mineral aus Tsumeb, Namibia. Neues Jahrb. Mineral. Monatsh., 49–55 (in German).

Analysis of two homogeneous crystals by electron microprobe gave GeO_2 64.7, PbO 35.5, sum 100.2 wt%, corresponding to $Pb^{+2}_{1.03}Ge^{+4}_{3.99}O_9$, or idealized $PbGe_4O_9$.

Single-crystal X-ray study with different methods shows the mineral to be triclinic, space group $P1$ or $P\bar{1}$, with $a = 6.945$, $b = 6.958$, $c = 9.279$ Å and $\alpha = 102.94$, $\beta = 103.05$, $\gamma = 114.77°$, Z = 2, $D_{calc} = 5.77$ g/cm³. The strongest X-ray diffraction lines (18 listed) are 5.87(30)$(010,100,1\bar{1}0)$, 4.20(40)$(10\bar{2},0\bar{1}2,002)$, 3.41(50)$(1\bar{1}\bar{2},1\bar{1}2,110)$, 2.95(100)$(102,2\bar{1}\bar{2},1\bar{2}2,020,1\bar{2}\bar{1})$, 2.41(30)$(12\bar{1},21\bar{1},2\bar{2}\bar{2},2\bar{1}2)$, 2.26(30)$(11\bar{4},10\bar{4},01\bar{4})$, 2.22(50)$(1\bar{3}0,2\bar{3}1,3\bar{1}0,2\bar{3}0)$, 1.847(40)$(3\bar{2}2,11\bar{5})$, and 1.782(40)$(13\bar{2},31\bar{2},1\bar{3}\bar{2},031)$.

Otjisumeite could be a low-temperature modification of the synthetic hexagonal phase $PbGe_4O_9$. The mineral forms pseudohexagonal crystals, and the unit-cell parameters can be expressed in pseudohexagonal symmetry with $a' = 11.76$, $b' = 11.79$, $c' = 9.279$ Å, and $\alpha' = 89.78$, $\beta' = 89.73$, $\gamma' = 59.65°$.

Otjisumeite occurs in small replacement cavities in germanium ore from the Tsumeb mine, Namibia. The primary ore consists of tennantite, germanite, and renierite. The secondary minerals in the cavities include chalcocite, calcite, quartz, siderite, gypsum, otjisumeite, and schaurteite. The otjisumeite crystals are up to 1 mm in length and have a diameter of less than 0.1 mm; they are elongated parallel to the *c* axis, and they have a columnar to fibrous habit; they usually form radiating aggregates. Weak {001} cleavage.

The mineral is white or colorless and often translucent, with greasy luster. H about 3. Its optical properties are biaxial positive with $\alpha = 1.920$, $\beta_{calc} = 1.922$, $\gamma = 1.943$ and $2V_{meas} = 20°$; $\alpha \wedge c = 3–5°$, no dispersion.

The name is derived from the Herero indication of the locality. Type material is at the Institute of Mineralogy and Crystal Chemistry of Stuttgart (FRG) University and at the Smithsonian Institution in Washington. **E.A.J.B.**

Spheniscidite*

M.J. Wilson, D.C. Bain (1986) Spheniscidite, a new phosphate mineral from Elephant Island, British Antarctic Territory. Mineral. Mag., 50, 291–293.

Analysis by X-ray fluorescence spectrometry and pyrolysis methods yielded (after correction for SiO_2 and TiO_2 impurities) Al_2O_3 9.33, Fe_2O_3 (total Fe) 30.10, CaO 0.50, MgO 0.30, K_2O 4.45, $(NH_4)_2O$ 3.27, P_2O_5 32.42, H_2O^- (105°C) 5.84, H_2O^+ (105–1000°C) 13.79, sum 100.0 wt%. This corresponds to $((NH_4)_{0.55}K_{0.41}Ca_{0.04}Mg_{0.03})_{\Sigma 1.03}(Fe^{3+}_{1.20}Al_{0.80})_{\Sigma 2.00}P_2O_{8.05}(OH)\cdot H_2O$, or $(NH_4,K)(Fe^{3+},Al)_2(PO_4)_2(OH)\cdot 2H_2O$. The mineral is soluble in acids but insoluble in water. The DTA curve shows two marked endothermic peaks at 110 and 195°C (loss of water crystallization), and two exothermic reactions at 538 and 572°C (decomposition and recrystallization).

X-ray data show the mineral to be monoclinic, $P2_1/n$, with unit cell $a = 9.75(1)$, $b = 9.63(2)$, $c = 9.70(1)$ Å, $\beta = 102°34(7)'$, $V = 888(2)$ Å^3, and Z = 4. The strongest lines (40 given) are 6.79(100)(110), 5.99(90)($\bar{1}11$), 3.053(45)($\bar{3}11,202,\bar{1}13$), 7.62(40)($\bar{1}01$), 4.75(35)(020,200,002), and 4.26(35)(021,210).

The mineral occurs in an ornithogenic soil (associated with a penguin rookery) developed on till derived from chloritic phyllites on Elephant Island, British Antarctic Territory. The island is at the eastern end of the South Shetland Islands about 800 km southeast of Cape Horn. The mineral occurs in the soil profile as fine-grained, brown aggregates concentrated mainly in the 75–2000-μm fraction from which it was separated electromagnetically. Optical properties could not be determined in detail because of the very fine grain size of the material. In thin section the mineral is colorless with refractive indices of close to 1.7 and moderate birefringence. It is brown in color, has an earthy luster, and is very soft. $D_{calc} = 2.71$.

The name is for Sphenisciformes, the order name for penguins. Type material is preserved at the Macaulay Institute for Soil Research, Craigiebuckler, Aberdeen, Scotland, and at the British Museum (Natural History), London. **J.E.S.**

Sztrokayite, kitaibelite

B. Nagy (1983) New mineral phases in the composition of wehrlite from Nagybōrzsōny, northern Hungary. Fōldtani Kōzlōny, Bull. Geol. Soc., 113, 247–259 (Hungarian with English translation).

Re-examination of previously studied material considered to be wehrlite, under the microprobe, revealed that material described over the years either as "wasserblei," "wehrlite," "pilsenite," etc. is indeed a complex mixture of Bi_2S_3, tetradymite, hessite, joseite B, Bi_2TeS_2, and bismuthinite.

Two further mineral phases have been found during the microprobe study, for which the author proposes the names *sztrokayite*, Bi_3TeS_2, and *kitaibelite*, $15Bi_2S_3\cdot 5Ag_2S\cdot PbS$. No chemical analyses or X-ray data are offered. The author also identified a single phase that is in fact wehrlite, Bi_2Te_2.

Sztrokayite is completely similar to the other Te sulfides as far as cleavage, opacity, reflection, etc., are concerned. Kitaibelite possesses a reflectivity lower than that for bismuthinite and contains gas bubbles and a few unidentified mineral inclusions. No further data are presented.

Previous work on the wehrlite problem is discussed, as well as on the Te-Bi minerals in general. **R.A.S.**

Unidentified Pt-group minerals

E. Hänninen, R. Törnroos, S.I. Lahti (1986) Stillwaterite and associated platinum group minerals from the Siikakämä layered mafic intrusion, northern Finland. Lithos, 19, 87–93.

The outer parts of a hollingworthite grain contain minute inclusions of stillwaterite, probable guanglinite, and three unidentified minerals. Microprobe (EDX) analyses of two of these give possible formulas of $(Pt,Rh,Pd)(As,S)_2$ and $(Pd,Rh,Pt)_3Pb(Bi,Te)$. Analysis of the third and largest grain, 3 × 8 μm, gave Pd 14.8, Rh 12.8, Pt 2.0, Ir 1.8, Re 0.7, Fe 11.5, Cu 1.58, S 24.3, As 15.7, sum 99.4 wt%, corresponding to $(Pd_{0.57}Rh_{0.51}Pt_{0.04}Ir_{0.04}Re_{0.01})_{\Sigma 1.17}Fe_{0.85}Cu_{1.01}S_{3.11}As_{0.86}$, approximately $CuFe(Pd,Rh)(S,As)_4$. Some of the analytical As (as well as some of the Rh in the smaller inclusions) may have been derived from the hollingworthite host.

Discussion. The authors note that the formula ratios for $CuFe(Pd,Rh)(S,As)_4$ are similar to those of unnamed $Pt(Rh,Ir)CuS_4$ described by Cabri et al. (1981, Bull. Minéral., 104, 508–525). If the Cabri et al. formula is written as $(Pt,Rh,Ir)_2CuS_4$, the equivalent formula of the largest inclusion is $(Fe,Pd,Rh)_{2.02}Cu_{1.01}(S,As)_{3.97}$. The small inclusion having the composition $(Pt,Rh,Pd)(As,S)_2$ could be platarsite. **J.L.J.**

Unnamed Sn mineral

P.J. Dunn, W.L. Roberts (1986) Unnamed tin mineral from the Etta mine. Mineral. Record, 17, Nov–Dec.

Microprobe analysis of the mineral gave SnO_2 58.2, Sb_2O_5 11.2, CuO 10.1, FeO (total Fe as FeO) 9.0, SiO_2 2.7, CaO 0.4, Al_2O_3 0.3, H_2O (by difference) 9.1, sum 100.0 wt%, yielding an ideal formula $CuFeSn_3(Sb,Si)O_7(OH)_7$.

X-ray powder-diffraction pattern of the mineral resembles that of cassiterite, but all peaks are very weak and diffuse.

The mineral is pale green with a vitreous luster and occurs in fine veinlets of transparent material (mushistonite?). **R.A.S.**

New Data

Cesstibtantite

E.H. Nickel, B.W. Robinson (1985) Kimrobinsonite, a new tantalum mineral from Western Australia, and its association with cesstibtantite. Can. Mineral., 23, 573–576.

Electron-microprobe analysis gave Na_2O 2.2, Cs_2O 6.5, FeO 0.1, Sb_2O_3 17.0, Ta_2O_5 65.3, Nb_2O_5 5.1, H_2O 1.9 (calculated to maintain electrical neutrality as OH), sum 98.1 wt%.

The material of this occurrence differs from material described elsewhere in that it is black and opaque, except in the very thinnest particles. **K.W.B.**

Ganomalite

P.J. Dunn, D.R. Peacor, J.W. Valley, C.A. Randall (1985) Ganomalite from Franklin, New Jersey, and Jakobsberg, Sweden: New chemical and crystallographic data. Mineral. Mag., 49, 579–582.

Electron-microprobe analysis of four ganomalite specimens from Franklin and seven from Jakobsberg gave, on average, SiO_2 19.46, CaO 11.17, PbO 67.69, MnO 2.18, with traces of MgO, BaO, Cl, and Al_2O_3, sum 100.5 wt%. With Mn present in a relatively constant 1 to 5 ratio with Ca, a new formula of $Pb_9Ca_5MnSi_9O_{33}$ is indicated, with Z = 1.

Preliminary crystal-structure data indicate that the Mn and Ca are ordered, as implied by the chemical analysis; ganomalite is hexagonal, space group $P3$, with $a = 9.82$ and $c = 10.13$ Å. **D.P.**

Glaucocerinite

G. Raade, C.J. Elliott, V.K. Din (1985) New data on glaucocerinite. Mineral. Mag., 49, 583–590.

Chemical analysis on the type specimens of glaucocerinite from Laurion, Greece, yields the formula $[(Zn,Cu)_5Al_3(OH)_{16}][(SO_4)_{1.5}\cdot 9H_2O]$, based on a pyroaurite-like structure.

The strongest lines in the X-ray powder pattern, indexed on a hexagonal pseudocell, are 10.9(100)(003), 5.45(90)(006), 3.63(80)(009), 2.62(60)(012), 2.46(60)(015), 2.231(50)(018), and 1.981A(50)(0.1.11). Optical data are $2V \approx 60°$, $\alpha = 1.540$, $\beta = 1.554$, $\gamma = 1.562$; $D_{meas} = 2.40 \pm 0.1$ g/cm³, $D_{calc} = 2.33$ g/cm³.

The authors also present evidence that a so-called "woodwardite" from Caernarvonshire, Wales, is a Cu analogue of glaucocerinite, and an 11-Å mineral occurring with carrboydite in Western Australia is the Ni analogue. **D.P.**

Likasite

H. Effenberger (1986) Likasite, $Cu_3(OH)_5(NO_3)\cdot 2H_2O$: Revision of the chemical formula and redetermination of the crystal structure. Neues Jahrb. Mineral. Monatsh., 101–110.

The crystal structure of likasite was determined and refined to an R index of 10.8% for 1017 reflections. The chemical formula was revised from $Cu_6(OH)_7(NO_3)_2(PO_4)$ to $Cu_3(OH)_5(NO_3)\cdot 2H_2O$. **F.C.H.**

Motukoreaite

J. Rius, F. Plana (1986) Contribution to the superstructure resolution of the double layer mineral motukoreaite. Neus Jahrb. Mineral. Monatsh., 263–272.

The average structure of motukoreaite was determined and refined to an R index of 11.4% for 336 observed reflections. The unit-cell dimensions are $a = b = 9.172$, $c = 33.51$ Å; space group $R\bar{3}m$. **F.C.H.**

Rhodizite

A. Pring, V.K. Din, D.A. Jefferson, J.M. Thomas (1986) The crystal chemistry of rhodizite: A re-examination. Mineral. Mag., 50, 163–172.

The crystal chemistry of rhodizite was re-examined using data from high-resolution electron microscopy (HREM), magic-angle-spinning nuclear magnetic resonance (MASNMR), single-crystal X-ray structure refinement, and a new chemical analysis. Material from Ambatofinandrahana, Ankarata Mountains, Madagascar (20°33′S, 46°49′E), has the formula $(K_{0.46}Cs_{0.36}Rb_{0.06}Na_{0.02})_{\Sigma 0.90}Al_{3.99}Be_4(B_{11.35}Be_{0.55}Li_{0.02})O_{28}$, is cubic with $a = 7.318(1)$ Å and has space group $P\bar{4}3\,m$. A lengthy discussion of the crystal-chemical aspects of the rhodizite structure is presented. **A.C.R.**

Rosasite

A.C. Roberts, J.L. Jambor, J.D. Grice (1986) The X-ray crystallography of rosasite from Tsumeb, Namibia. Powder Diffraction, 1, 56–57.

The unit cell of rosasite, $(Cu,Zn)_2CO_3(OH)_2$, was determined and refined to $a = 12.873(3)$, $b = 9.354(3)$, $c = 3.156(2)$ Å $\beta = 110.36(3)°$; space group $P2_1/a$. **F.C.H.**

Santafeite

P.J. Dunn, D.R. Peacor (1986) Santafeite, a re-examination and new empirical formula. Mineral. Mag., 50, 299–300.

Santafeite, originally described by Sun and Weber (1958) from the Grants uranium district, McKinley County, New Mexico, was re-examined using single-crystal and microprobe techniques. The new idealized formula, consistent with equipoint rank requirements for space group $B22_12$, is $(Mn^{2+},Fe^{3+},Al,Mg)_8(Mn^{4+},Mn^{2+})_8(Ca,Sr,Na)_{12}((VO_4),(AsO_4))_{16}(OH)_{20}\cdot 8H_2O$. A microprobe analysis yielded Al_2O_3 1.1, Fe_2O_3 1.1, MgO 0.9, CaO 5.2, SrO 8.5, Na_2O 5.0, V_2O_5 36.5, As_2O_5 3.2, MnO_2 16.5, MnO 13.3, H_2O 8.8, sum 100.1 wt%. In determining the formula, the H_2O content and the $Mn^{4+}:Mn^{2+}$ ratio reported in the original description of this mineral were used. This analysis corresponds to $(Mn^{2+}_{5.48}Fe^{3+}_{0.49}Al_{0.77}Mg_{0.80})_{\Sigma 7.54}$ $(Mn^{4+}_{6.78}Mn^{2+}_{1.22})_{\Sigma 8.00}$ $(Ca_{3.31}Sr_{2.93}Na_{5.76})_{\Sigma 12.00}((VO_4)_{14.35}(AsO_4)_{0.99})_{\Sigma 15.34}(OH)_{18.12}\cdot 8.40H_2O$ or to the simplified formula given above.

X-ray diffraction data confirmed the unit cell and space group of santafeite as originally reported, but also showed that there is significant disorder in the crystal structure. A structural analysis is needed to clarify several uncertainties regarding the structure and crystal chemistry of the mineral. **J.E.S.**

Schneiderhöhnite

F.C. Hawthorne (1985) Schneiderhöhnite, $Fe^{2+}Fe^{3+}_3As^{3+}_5O_{13}$, a densely packed arsenite structure. Can. Mineral., 23, 675–679.

from the Tsumeb mine, Namibia, yielded the following results. The mineral is triclinic, space group $P\bar{1}$, $a = 8.924$, $b = 10.016$, $c = 9.103$ Å, $\alpha = 59.91$, $\beta = 112.41$, $\gamma = 81.69°$, $V = 590.8$ Å³, Z = 2. Structure refinement to a final residual R of 4.5% on 3184 unique observed ($I > 2.5\sigma I$) reflections. The determination of the structure leads to the new formula $Fe^{2+}Fe^{3+}_3As^{3+}_5O_{13}$ instead of the previously reported $Fe^{2+}_8As^{3+}_{10}O_{23}$ (Am. Mineral., 59, 1139). A survey of recently refined arsenite minerals shows a constant geometry for the arsenite group with ⟨As–O⟩ = 1.776 Å and ⟨O–As–O⟩ = 97.2°. **E.A.J.B.**

American Mineralogist, Volume 72, pages 1029–1030, 1987

BOOK REVIEWS

MICROTEXTURES OF IGNEOUS AND METAMORPHIC ROCKS. By J. P. Bard. D. Reidel Publishing Company, Kluwer Academic Publishers Group, Boston and Dordrecht, Holland. 1986. 264 pages. $74.50.

This book is the enlarged and updated from the original French edition that was published in 1980, translated into English by Marianne Mareschal.

The book is in three parts: (1) Nucleation and Crystal Growth, (2) Order of Crystallization in Igneous and Metamorphic Rocks, and (3) Examples of Microtextures. The first section addresses the theories of nucleation, crystal defects, the nature of grain boundaries, types of growth on a molecular and microscopic scale, liquid-solid and solid-solid transformations, crystal form, and crystal size. The coverage is largely nonmathematical, though a few formulas for free energy are included. Illustrative material is generally clear and easily understood.

The second section deals with the criteria for determining the order of crystallization of minerals. It discusses the textures formed during eutectic and peritectic crystallization, making comparison between those in experiments and in natural rocks, emphasizing the simplest kinds of systems and largely leaving it up to the reader to extrapolate to more complex systems. Various aspects of cumulate and spinifex textures are also discussed. However, it does not consider other igneous processes such as magma mixing or liquid immiscibility. Sketches in this section are generally very well done, illustrating important points clearly and simply.

The second section also considers the determination of order of the crystallization of minerals in metamorphic rocks. It addresses the textures formed during reaction, including various reaction rims and skeletal growths, the textures formed during deformation and following it, and various types of interaction between mineral growth and deformation. It discusses differences in the nature of deformation and growth of grains of different minerals.

The third section, examples of microtextures, consists of full-page detailed drawings of specific igneous and metamorphic textures of real rocks in thin section, with the name of the texture and an explanation of how it apparently forms. In many respects this is the most useful part of the book for practical laboratory use. The reader is thereby permitted to identify the texture and read about how it relates to the origin of the rock in one of the previous sections. In some cases, igneous textures are related to specific positions on binary or ternary phase diagrams. Some metamorphic textures are related to sequence and spans of crystallization of the minerals illustrated.

The book is generally well organized and easy to follow. Theory is integrated quite well to the textures. The content is reasonably modern, though references end at 1978. The level of discussion is appropriate for use by advanced undergraduate and graduate students in petrographic and related study. My students found the book practical and useful in their own study of thin sections. It is easy to read and understand and easier to use than some of its competitors. Mylonitic textures and S/C surfaces are not discussed though two or three are illustrated.

The book could be useful as a text in a specialized course on the same subject, even more so as a lab manual in courses concerned with petrographic aspects of igneous or metamorphic petrology.

Ninety-five references help to document the discussion of textures. Unfortunately, however, titles of the papers are not included.

Except for main headings and running heads, the type style and layout appear to be the photographic reproduction of a double-spaced manuscript without justified right margins. If one can get over the initial negative reaction to such a production approach in a book costing $74.50 for 264 pages, the content should be found useful by students who can afford it and, to some extent, even seasoned researchers.

Donald W. Hyndman
University of Montana

GEOLOGY AND GEOCHEMISTRY OF CENOZOIC TOPAZ RHYOLITES FROM THE WESTERN UNITED STATES (Geological Society of America Special Paper 205). By E. H. Christiansen, M. F. Sheridan, and D. M. Burt. Published by Geological Society of America, P.O. Box 9140, Boulder, CO 80301, U.S.A. 1986. Paperback, v + 82 pages. $16.00.

GSA Special Paper 205 is a compact and timely review of the occurrence, mineralogy, and geochemistry of topaz rhyolites of the western U.S. Because of the sometimes spectacular presence of vapor-phase minerals (e.g., topaz, garnet) lining vugs and cavities in rhyolite, these unusual rocks have been known since the late nineteenth century. The fact that they may be associated with ore deposits (Be, U, F, Sn, Li, and possibly Climax-type Mo) has also provoked interest.

The bulk of this Special Paper is a methodical review of 26 occurrences of topax rhyolites in Utah, Nevada, Idaho, Montana, Colorado, New Mexico, and Arizona. These rocks are all Cenozoic in age, ranging from 50 to 0.06 Ma, although the majority are younger than 30 Ma. The emplacement of all topaz rhyolites was coincident with extensional tectonism. Their magmatic affinities are less straightforward, however, as topaz rhyolites may be associated with calc-alkaline suites (andesite-dacite-rhyolite), with potassic basalts of tholeiitic or alkaline affinities, and with alkaline to peralkaline tuffs and lavas.

Chemically, these rocks are high-SiO_2 rhyolites showing enrichment in F, Na, K, Fe/Mg, and the incompatible lithophile elements (Rb, U, Th, Ta, Nb, Y, Be, Li, Cs). Depletion in Ti, Mg, Ca, P, Sr, Eu, Ba, Co, Ni, Cr, Zr, and Hf is also characteristic. The authors present a welcome amount of geochemical information that includes both a review of the literature and new data obtained in collaboration with a large number of investigators. Included are major- and trace-element analyses; Sr- and Pb-isotope ratios; two-feldspar and Fe-Ti oxide geothermometry; compositions of biotite, hornblende, and garnet; and REE patterns. Also, a number of trace-element discriminant diagrams are presented. The chemical characteristics of topaz rhyolites are compared with those of calc-alkaline and peralkaline rhyolites and with the ongonites of Mongolia, which they resemble in many aspects.

On the basis of chemical and isotopic data, the authors propose that topaz rhyolites may be the extrusive equivalents of anorogenic (A-type) granites and that they may be derived by the partial melting of granulite source rocks in the lower or middle crust. Melting may have been initiated by the passage of contemporaneous mafic magmas through the lower crust. The enrichment in F was attributed to melting of small amounts of F-rich biotite in the crustal parent rocks, and the distinctive trace-element patterns are explained by extensive fractionation of sanidine, quartz, plagioclase, biotite, and Fe-Ti oxides.

Although the last word has yet to be written on topaz rhyolites, the authors are to be commended on a useful and up-to-date review. The very extensive reference list (more than 350 entries) is especially valuable.

James L. Munoz
University of Colorado

THE QUANTITATIVE DATA FILE FOR ORE MINERALS OF THE COMMISSION ON ORE MICROSCOPY OF THE INTERNATIONAL MINERALOGICAL ASSOCIATION, second issue. Edited by A. J. Criddle and C. J. Stanley. British Museum (Natural History), Cromwell Road, London SW7 5BD, 1986. XLIX plus 420 pages. £45.00.

The first issue of the *Quantitative Data File* (QDF) for ore minerals appeared in 1977. It was edited by N.F.M. Henry and consisted of 204 cards with more or less complete data on some 155 minerals. It was out of print already in 1982 in spite of widespread lack of reliable standards and at a time when there was a scarcity of instrumentation for reflectance measurements.

At the present time, reflectance theory is essentially understood, standards are available, measurement techniques are much improved, and computer-assisted microscope photometers routinely can measure spectra at selected wavelengths from 400 to 700 nm in a matter of minutes. Thus, when reference spectra are available, identification of a mineral is feasible with reflectance-measurement methods in a time period much shorter than that required for microprobe or X-ray powder-diffraction analyses.

This second issue of QDF for ore minerals contains the data from 420 sets of cards, 327 for individual species and 93 for compositional and structural variants. The common ore minerals are represented as are a large number of less common and rare species.

The format of the book (roughly 6 in. high by 8 in. wide) is determined by the shape of the reflectance data cards. In this volume, individual data sets are arranged alphabetically by mineral name (acanthite first and zinckenite last), one set to a page. Each page is arranged in essentially three major columns, of which the first lists (from top to bottom) chemical formula, symmetry, sample provenance, reflectance standard, monochromator type, and $\Delta\lambda$, photomultiplier, effective numerical aperture (N.A.) of the objective, chemical composition with method of analysis, and X-ray data. The second column lists the results of reflectance measurements performed in air and oil immersion at 19 selected wavelengths between 400 and 700 nm. The third column lists color values in air and oil immersion relative to two (A and C) illuminants, Vickers micro-indentation hardness number and the weight of the load with which it was obtained, polishing methods, and references.

The book offers a one-page introduction, a two-page section on historical background, a one-page editorial policy statement, a three-page description of the format of the second issue, a two-page section on keys for identification, and a two-page bibliography. An eight-page (Key 1) COM wavelength list presents reflectance data in air only in the sequence 546, 470, 589, and 650 nm where the order of the minerals is based on the ascending order of reflectance at 546 nm. This list also gives with each mineral name the page in the book that carries the full set of data on the mineral in question. Another eight-page table provides the color value (Key 2) for all minerals. The color values obtained in air only are presented relative to the C illuminant, and the minerals are organized in ascending order of luminance and are cross-referenced as in Key 1. A 15-page table (Key 3) lists air and oil data at 440, 500, 600, and 700 nm. The minerals are organized in ascending order of reflectance starting at 440 nm. The minerals are again cross-referenced as in Keys 1 and 2.

This data file represents a large amount of carefully performed measurements. The editors have generously contributed a lot of their own unpublished data to make this a very worthwhile and up-to-date compilation.

Leafing through these tables, one readily notices that the chemical formulas given do not always agree with those in the standard literature. For instance, mackinawite is assigned the formula FeS. Minerals such as troilite and hexagonal pyrrhotite are missing. Next to pyrite, pyrrhotites are the most common sulfides in ores, so the lack of hexagonal pyrrhotite is a drawback.

It would be useful in a compilation such as this one to show variations in reflectivity as a function of composition of certain common minerals such as the hexagonal pyrrhotite series, which displays Fe omission, and sphalerites having increasing substitution of Fe for Zn.

It was also noted that, whereas chromite is given the formula $FeCr_2O_4$, the specimen that was measured contained only 23.1 wt% FeO and 34.7 wt% Cr_2O_3, the balance of the composition being accounted for by MgO, MnO, NiO, Fe_2O_3, and Al_2O_3.

This book constitutes a rich source of information for the increasing number of researchers who, in a variety of fields, have access to the required equipment for reflectance measurements and who need the best available reflectance data on ore minerals.

Gunnar Kullerud
Purdue University