Service/News

Only starred items (*) are available from New Mexico Bureau of Mines & Mineral Resources

New publications

NMBMMR

*Bulletin 110—Bibliography of New Mexico geology and mineral technology 1981–1983, by J. C. Love, C. A. Hjellming, and D. C. Boyle, 1986, 166 pp. $10.00

This volume adds roughly 3,500 new geologic references to the comprehensive series of bibliographies maintained by the Bureau. Both published and unpublished literature pertinent to the geology of New Mexico have been included. References are listed alphabetically by senior author and are listed additionally as cross references following the names of junior authors. All references are indexed by subject and geographic location.

*Bulletin 112—Palynology and age of South Hospah coal-bearing deposits, McKinley County, New Mexico, by Abolfazl Jameossanaie, 1986, 64 pp. $7.00

In this volume 172 species assigned to 91 form genera of spores, gymnospermous pollen, and angiospermous pollen are described. Two new genera, eight new species, nine new combinations, and two new ranks are proposed. The palynomorph assemblages indicate a Late Cretaceous (early Campanian) age for the South Hospah deposits. According to palynological evidence, assignment of these strata to the Menefee Formation is appropriate. The source of some of the clastic material in the South Hospah deposits is interpreted based on the occurrence of palynomorphs recycled from older strata.

*Bulletin 115—Stratigraphy of the Upper Cretaceous Niobrara Formation in the Raton Basin, New Mexico, by G. R. Scott, W. A. Cobban, and E. A. Merewether, 1986, 34 pp. $6.00

This volume contributes new detailed descriptions of the stratigraphy, fossils, and organic matter in the Niobrara Formation in northeastern New Mexico. The discovery of natural gas in the Denver Basin focused much attention on the Niobrara. Correlating the formation in the Raton Basin with the Niobrara near Pueblo, Colorado, the authors found very similar faunal sequences but significant lithologic differences. Additionally, the authors collected and analyzed samples from eight localities as part of an evaluation of oil and gas resources in the Raton Basin.

*Directory—Directory of sources for New Mexico mapping and remote sensing data, compiled by Heather Rex and Amelia Budge, 1986, 24 pp. $3.50

A compilation of sources for maps, aerial photography, satellite imagery, thermal data, and radar data in New Mexico. This volume, which was put together by the New Mexico Geographic Information Advisory Committee, also contains a concise glossary and nine handy conversion tables.

USGS

MISCELLANEOUS INVESTIGATIONS MAPS

MF–1183–A–K—Geochemical maps showing distribution and abundance of lead **(A)**, copper **(B)**, zinc **(D)**, molybdenum **(E)**, silver **(F)**, tungsten **(G)**, bismuth and beryllium **(H)**, tin **(I)**, manganese **(J)**, barium **(K)** in two fractions of stream-sediment concentrates, Silver City 1° × 2° quadrangle, New Mexico and Arizona, by K. C. Watts, J. R. Hassemer, C. L. Forn, and D. F. Siems, 1986, scales 1:250,000. **C** is still in press.

MF–1759—Geologic map of surficial deposits and basaltic rocks near the Rio Chama, Rio Arriba County, New Mexico, by G. R. Scott and R. F. Marvin, 1985, lat. about 36°37′30″ to 37°, long. about 106°30′ to about 106°45′, scale 1:50,000.

MF–1853–A—Metallogenic map of volcanogenic massive-sulfide occurrences in New Mexico, by J. M. Robertson M. S. Fulp and M. D. Daggett, III, 1986, scale 1:1,000,000.

WATER-RESOURCES INVESTIGATIONS

WRI–85–4290—Harmonic analyses of stream temperatures in the upper Colorado River basin, by T. D. Steele, 1985, 51 pp.

WRI–85–4294—Plan of study for the regional aquifer-system analysis of the San Juan structural basin, New Mexico, Colorado, Arizona, and Utah, by G. E. Welder, 1986, 23 pp.

WRI–85–4325—Ground-water levels and direction of ground-water flow in the central part of Bernalillo County, New Mexico, by G. Kues, 1986, 24 pp.

WRI–86–4096—Evaluation of the matrix exponential for use in ground-water-flow and solute-transport simulations—theoretical framework, by A. M. J. Umari and S. M. Gorelick, 1986, 33 pp.

WATER SUPPLY PAPER

W–2205—Mathematical model of the Tesuque aquifer system near Pojoaque, New Mexico, by G. A. Hearne, 1985, 75 pp.

Other publications

Aldrich, M. J., Jr., Laughlin, A. W., Meade, J. S. Pierce, H. W., 1986, The Jemez lineament—structural boundaries and control on sedimentary facies, tectonism, and mineralization: Proceedings of the 6th International Conference on Basement Tectonics, pp. 104–113.

Brennan, D. J., 1986, Oil and gas developments in Four Corners–Intermountain area in 1983–1985: American Association of Petroleum Geologists Bulletin, v. 70, no. 10, pp. 1315–1319.

Chenoweth, W. L., 1986, Developments in uranium in 1985: American Association of Petroleum Geologists Bulletin, v. 70, no. 10, pp. 1632–1637.

Dickerson, P. W., 1986, Evidence for Laramide transpression in west Texas and adjacent New Mexico: Proceedings of the 6th International Conference on Basement Tectonics, pp. 52–63.

Friedman, S. A., Jones, R. W., Jackson, M. L. W., Treworgy, C. G., 1986: American Association of Petroleum Geologists Bulletin, v. 70, no. 10, pp. 1643–1649.

Hadley, R. F., 1986, Drainage basin sediment delivery: International Commission on Continental Erosion and the Department of Geology at the University of New Mexico, 487 pp.

Harville, D. G., and Fritz, S. J., 1986, Modes of diagenesis responsible for observed succession of potash evaporites in the Salado Formation, Delaware Basin, New Mexico: Journal of Sedimentary Petrology, v. 56, no. 5, pp. 648–656.

Love, D. W., Gutjhar, A., Robinson-Cook, S., 1986, Location-dependent sediment sorting in bedforms under waning flow in the Rio Grande, central New Mexico: Society of Economic Paleontologists and Mineralogists, Special Publication 39, pp. 37–47.

Mack, G. H., and James, W. C., 1986, Cyclic sedimentation in the mixed siliciclastic-carbonate Abo–Hueco transitional zone (Lower Permian), southwestern New Mexico: Journal of Sedimentary Petrology, v. 56, no. 5, pp. 635–647.

Marvin, R. F., Bohor, B. F., and Mehnert, H., 1986, Tonsteins from New Mexico—touchstones for dating coal beds: Isochron/West, no. 45, pp. 17–18.

Phillips, F. M., Peeters, L. A., Tansey, M. K., and Davis, S. N., 1986, Paleoclimatic inferences from an isotopic investigation of groundwater in the central San Juan Basin, New Mexico: Quaternary Research 26, pp. 179–193.

Tschudy, R. H., Tschudy, B. D., 1986, Extinction and survival of plant life following the Cretaceous/Tertiary boundary event, Western Interior, North America: Geology, v. 14, pp. 667–670.

Turner-Peterson, C. E., Santos, E. S., Fishman, N. S. (eds.), 1986, A basin analysis case study—the Morrison Formation, Grants uranium region, New Mexico: Energy Minerals Division of American Association of Petroleum Geologists, Studies in Geology, no. 22, 21 articles, 391 pp.

Williams, S. M., Adams, D. R., Dufford, S., Garvey, C. F., Gibson, W. R., Miller, H. A., Jr., Pausé, P. H., Robbins, L. D., 1986, Oil and gas developments in west Texas and eastern New Mexico in 1985: American Association of Petroleum Geologists Bulletin, v. 70, no. 10, pp. 1323–1329.

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Topographic maps

USGS

PROVISIONAL (scale 1:24,000)

	yr	lat.	long.	contour (ft)	
*Estancia	1982–86	34°45′	106°	10	5
*Ewing	1982–86	34°37′30″	106°7′30″	20	10
*King Draw	1982–86	35°7′30″	106°	10	
*Manzano Peak	1982–86	34°30′	106°22′30″	40	
*Moriarty North	1982–86	35°	106°	10	5
*Moriarty South	1982–86	34°52′30″	106°	10	5
*Mountainair	1982–86	34°30′	106°7′30″	20	10
*Mountainair NE	1982–86	34°37′30″	106°	10	5
*Punta de Agua	1982–86	34°30′	106°15′	20	
*Willard	1982–86	34°30′	106°	20	10

Open-file reports

NMBMMR

***220**—Geologic map of Fence Lake, New Mexico, 1:100,000 metric sheet, compiled by O. J. Anderson, 1986, 4 pp., 4 over-sized pls. $6.80

***220-A**—Geology and mineral resources of York Ranch SE quadrangle, Cibola and Catron Counties, New Mexico, by O. J. Anderson, 1986, 21 pp., 2 over-sized pls. $7.20

***229**—A preliminary mineral-resource potential of Valencia County, northwestern New Mexico, by V. T. McLemore, R. F. Broadhead, J. M. Barker, G. S. Austin, K. Klein, K. B. Brown, D. Murray, M. R. Bowie, J. S. Hingtgen, 1986, 197 pp., 13 maps. $58.90

***247**—Hydrocarbon source-rock evaluation study, selected outcrop samples of Paleozoic and Mesozoic rocks, Grant, Hidalgo, and Luna Counties, New Mexico, by L. P. Tybor, 1982, 21 pp. $4.20

***248**—Hydrocarbon source-rock evaluation study, Marshall R. Young Oil Co. No. 1 Bisbee Hills unit well, Luna County, New Mexico, by D. A. Muckelroy, 1983, 74 pp. $14.80

***249**—Hydrocarbon source-rock evaluation study, Marshall R. Young Oil Co. No. 1 Saltys well, Grant County, New Mexico, by D. A. Muckelroy, 1986, 214 pp. $42.80

***250**—Hydrocarbon source-rock evaluation study, ARCO Exploration Co. No. 1 Fitzpatrick well, Hidalgo County, New Mexico, by R. Perlis and A. B. Reaugh, 1985, 12 pp. $2.40

***251**—Geological characterization of New Mexico uranium deposits for extraction by in situ leach recovery, by H. K. Holen and W. O. Hatchell, 1986, 93 pp., 2 maps. $21.60

***252**—Geology of the east-central San Mateo Mountains, Socorro County, New Mexico, by C. A. Ferguson, 1986, 135 pp., 4 maps. $33.00

***253**—Paleontology and the Arizona Interconnection Project, by D. L. Wolberg, 1986, 98 pp., 1 map. $19.60

***254**—Cretaceous rocks and coal resources of the Magdalena, New Mexico, 1:100,000 sheet, by J. C. Osburn, 1986, 8 pp., 1 map (reproducible). $3.10

USGS

84-939—Structure of the Tertiary Questa caldera, New Mexico—an eroded analog for current activity at Long Valley, by P. W. Lipman; in Proceedings of workshop XIX, Active tectonic and magmatic processes beneath Long Valley caldera, eastern California, 1985, pp. 851-885.

***86-401**—Annual water-resources review, White Sands Missile Range, New Mexico, 1985, by R. R. Cruz, 1986, 26 pp. $5.20

***86-413**—Hydrologic test data from wells at hydrologic-test pads H-7, H-8, H-9, and H-10 near the proposed Waste Isolation Pilot Plant site, southwestern New Mexico, by S. F. Richey, 1986, 132 pp. $26.40

USBM

16-86—Mineral resources of a part of the Big Hatchet Mountains Wilderness study area (NM-030-035), Hidalgo County, New Mexico, by D. C. Scott, 1986.

***44-86**—Mineral investigation of a part of the Sierra Ladrones Wilderness study area (NM-020-016), Socorro County, New Mexico, by J. T. Neubert, 1986, 74 pp., 1 plate (not reproducible). $14.80

***51-86**—Mineral investigation of the Sierra de las Cañas Wilderness study area (NM-020-038), Socorro County, New Mexico, by S. L. Korzeb, 1986, 14 pp., 1 plate (not reproducible). $2.80

MINING REGISTRATIONS

(August 20, 1986, through November 20, 1986)

Bureau of Mine Inspection   Energy & Minerals Dept.   2825-E Broadbent Pkwy. NE   Albuquerque, NM 87107

Date and operation	Operators and owners	Location
8-20-86 limestone	Operator—San Antone Thoreau Pit #3, C & E Concrete Sales, Box 2547, Milan, NM 87021; Gen. Mgr.—Walter Meech, Jr., 1713 Del Norte, Grants, NM, phone: 287-2944; Person in charge—Abe Serna, 1400 Roosevelt, Grants, NM. Property owner—Lawrence Elkins, Box 36, Prewitt, NM 87045.	McKinley County; sec. 21, T14N, R12W, private land; directions to pit: approximately 7 mi north of Thoreau, NM, directly east of NM-56.
9-2-86 gold	Operator—Grandpa's Old Fortune, R&L Ventures, 908 Green Valley NW, Albuquerque, NM 87107; Gen. Mgr.—Randy Gins, same address, phone: 344-4570; Persons in charge—Randy Gins and Larry Smith, same address, other phone: 344-8366; Gen. Supt.—Larry Smith. Property owner—Randy Gins, same address.	Santa Fe County; T12N, R7E; private land; directions to mine: just west of old San Pedro mine.
9-23-86 coal	Operator—Fence Lake No. 1, Williams Fork Mining Co., P.O. Box 187, Craig, CO 81626; Proj. Mgr.—Ed Johnson, same address, phone: (303) 824-4401; Other officials: Pres.—J. D. Edgerley; Vice Pres.—G. M. Stubblefield; Treasurer—F. P. DiBartolo; Sec.—W. E. Sowards, all same address. Property owner—Salt River Project, Agricultural Improvement and Power District, P.O. Box 52025, Phoenix, AZ 85072-2025.	Catron County; sec. 10, 11, T3N, R17W; state land; directions to mine: Follow US-60 west from Quemado 1.5 mi, turn right on CR-32 and follow it northwest for 14 mi; turn right on Hubbell Road and follow it northeast for 9 mi; turn right onto unnamed road, go through gate, and follow it another 1.75 mi to mine.
10-24-86 gold, silver	Operator—U.S. Treasury, Fulton Associates, Box 101, Winston, NM 87943; Gen. Mgr.—Caesar Fulton, same address, phone: 894-3341. Property owner—St. Cloud Mining Co., Winston, NM.	Sierra County; private land; directions to mine: 6 mi west of the St. Cloud mill.
10-24-86 gold, silver	Operator—Weber, Fulton Associates, Box 101, Winston, NM 87943; Gen. Mgr.—Caesar Fulton, same address, phone: 894-3341. Property owner—Jimmie Zook, T or C, NM 87901.	Catron County; sec. 34, T9S, R9W; federal land; directions to mine: from Winston go 15 mi north on Beaverhead Rd., and 0.25 mi north off road.

Abstracts

New Mexico Mineral Symposium

The 7th annual Mineral Symposium was held November 8-9, 1986, at New Mexico Institute of Mining and Technology, Socorro. Following are abstracts from talks given at the meeting that concern New Mexico; one abstract, entitled "Fluorescent minerals of New Mexico," will appear in the next issue. The numbers in parentheses refer to locations on the map.

MINERALOGY OF THE BLACK RANGE TIN DISTRICT, SIERRA AND CATRON COUNTIES, NEW MEXICO, by *Eugene E. Foord* and *Charles H. Maxwell*, U.S. Geological Survey, Denver, CO 80225 (1)

Recent geologic studies of the Black Range tin district have indicated that there are several different types of cassiterite occurrences that are associated with the Taylor Creek peraluminous rhyolite. Four types have been distinguished, from early to late: I) high-temperature vapor dominated; II) high-temperature hydrothermal fluid dominated; III) low-temperature hydrothermal fluid dominated; and IV) supergene(?). Type I deposits consist of sparse amounts of cassiterite occurring in lithophysae, miarolytic cavities, and tiny gash veins. Type II deposits consist of well-defined gash veins and anastomosing systems of veinlets that vary widely in orientation and size (1-10 cm thick and 1-8 m long). Type III deposits consist of veins and stockwork-like areas of reticulate veinlets in the distal edges of rhyolite flow domes and in the underlying tuffs and ash-flow tuffs. Some veins are as much as 30-40 cm wide and 100+ m long. The exposed surface area of the veins may encompass several thousand square meters. Type IV deposits consist of supergene accumulations of woodtin and stannic acid, $SnO_2 \cdot xH_2O$, occurring in porous zones in sandstone, conglomerate, and tuff. They also occur in subsurface pockets of intensely altered or weathered rock, most commonly in

Type I	Type II	Type III	Type IV
High-temperature vapor dominated	High-temperature hydrothermal fluid dominated	Low-temperature hydrothermal fluid dominated	Supergene(?)
specular hematite	quartz	hematite	cassiterite (var. wood-tin)
beryl	specular hematite	quartz	stannic acid
pseudobrookite	cassiterite	cassiterite (var. wood-tin)	disordered smectite
bixbyite	cristobalite	durangite	
topaz	fluorite	tridymite	
cassiterite	sanidine	cristobalite	
quartz	zeolites	chalcedony	
sanidine	Sb–Sn–Ti–Fe-oxide	hyaline opal	
titanite (sphene)	Na–Ca–Fe–Ti–Mg–Mn fluoroarsenate	fluorite	
clinopyroxene	Ce-group arsenate or fluoroarsenate	beudantite	
calcite		hidalgoite	
		jarosite	
		smectite	
		cryptomelane	
		todorokite	

pockets filled with red clay. Thus, deposition of cassiterite and associated minerals occurred over a wide range of conditions. Some of the tin mineralization (type I) is derived from the host Taylor Creek Rhyolite, but most of the tin mineralization (type III) is characterized by colloform (wood-tin) cassiterite and is derived from a source outside of the rhyolite flow domes. Most of the tin was deposited in vein systems after the host rocks had solidified, cooled, and fractured. A list of the minerals identified from each of the four types of deposits is shown above.

Electron microprobe and emission spectrographic analyses of cassiterite from all four types of deposits indicate that there is substantial variation in the chemical composition. The earliest formed (types I and II) cassiterite is characterized by the presence of minor to major amounts of Sb, Fe, ± Ti. Essentially pure cassiterite is a paragenetically intermediate product, followed by the most abundant type of cassiterite, wood-tin, in type III deposits. Cassiterite from type III deposits generally contains as much as 1 wt. % or more of all or some of the following metals: In, As, Si, Pb, Fe, Zn, and Sb. Mineralogical investigations have shown that a monoclinic(?) derivative of cassiterite, amber to caramel colored, most likely related to the trirutile structure, and containing major amounts of Sb, Sn, Fe, and Ti, exists in rhyolite at Squaw Creek. Some of the material has epitaxial overgrowths of cassiterite. Crystals are all small, usually less than 100 microns long and 10–20 microns wide. Detailed microprobe studies of this material have been done by Paul Hlava of Sandia National Laboratories. Hematite, particularly high-temperature varieties, may contain as much as 1% Ti, 1.5% Mn, 0.07% Nb, 0.15% Zn, and 0.7% Sn (based on emission spectrographic analyses). To date, three fluoroarsenates (and/or arsenates) have been found at multiple localities. Durangite, $NaAlAsO_4F$, has been found at two different localities (the Clearing and 74–draw) and has been described in detail in the *Canadian Mineralogist* (1985, vol. 23, pp. 241–246). A new red to red–orange Na–Ca–Fe–Mn–Ti–Al–Mg fluoroarsenate occurs at Squaw Creek and Willow Creek. At Squaw Creek, very small amounts of a new bright yellow Ce-group fluoroarsenate or arsenate, with minor amounts of Ca and Th, coexist with the red fluoroarsenate. Maximum dimensions of crystals of the red fluoroarsenate are as much as 0.5 mm, and those of the yellow REE fluoroarsenate (or arsenate) are about 0.25 mm. Clinopyroxene, ranging in color from orange to red brown to amber, occurs at several localities (Willow Creek, Squaw Creek, 74–draw, and Lookout Mountain Road). Material from the Lookout Mountain Road locality shows the alexandrite effect, being violet-purplish red under tungsten light and green under natural light. Crystals are typically 0.5–1 mm in mean dimension. Some of the titanite from Willow Creek, east of the Black Range, has a very unusual composition. It may contain as much as several percent or more of REE, Pb, Nb, F, and other elements. The color is very similar to that of the clinopyroxene from the same locality. Mean dimension is approximately 0.5 mm. Single-phase high sanidine adularia with the unusual composition $(K_{0.51}Na_{0.45}Rb_{0.004})_{\Sigma 0.964}(Al_{0.98}Fe_{0.01})_{\Sigma 0.99}Si_{3.01}O_8$ occurs at Alexander along with Sb-Fe-bearing cassiterite. The adularia coats fracture and/or vein surfaces, and individual euhedral colorless to white crystals are as much as several mm across. A continuous progression from high- to low-temperature minerals is present. This mineral progression along with the occurrence of typically hydrothermal elements, such as Zn, Sb, Pb, and As, combined with the geologic observations point toward a principally hydrothermal origin for the deposits.

UNUSUAL ZONING PATTERNS IN TWO SECONDARY MINERALS FROM NEW MEXICO, by *Paul F. Hlava*, Sandia National Laboratories, Albuquerque, NM 87185

Solid solutions between end members of isomorphous series are responsible for most of the variations seen in mineral compositions and are useful for recording genetic conditions. Indeed, by determining the exact composition of a specimen the mineralogist may be able to tell much about the temperature, pressure, and chemical conditions present when the mineral formed. In the case of zoned crystals the varying compositions also indicate the trends in conditions with time. Recent microprobe examinations of two specimens from different places in New Mexico not only revealed some interesting and unusual zoning patterns but also identified four uncommon mineral species and gave information about the solid solubilities of the mineral pairs. The first specimen of interest came from a cavity in altered andesite found in some old mine workings in the Bear Mountains north and a bit west of Magdalena. These crystals are bright, lustrous tablets with a rhombic outline and vary from a bright emerald-green to very dark green. Microprobe analyses of the crystal surfaces indicated major amounts of Cu, Ca, V, and As, a composition not represented by any known mineral species. In cross section, the zoned nature of the crystals became obvious; bands rich in either As or V alternated with constant amounts of Ca and Cu. Quantitative analyses confirmed that the crystals were intermediate between conichalcite $CaCu(AsO_4)OH$ and calciovolborthite $CaCu(VO_4)OH$. The oscillatory- and sector-zoning records repeated major changes in the chemistry of the fluids from which the crystals formed. These may represent influxes of fresh As-rich fluid from the weathering of primary minerals. Continuous zoning within each sector or band indicates that the As-rich species is less soluble than the V-rich and that there is complete solid solubility between the two even if they do occur in different crystallographic space groups. The other specimen comes from the Tyrone mine of Phelps Dodge Corp. near Silver City. These crystals are modified rhombohedra with a poor luster and a strange whitish-yellow color. Analyses of the surfaces indicated a confusing mix of Ca, Al, Si, P, and S—again not easily recognizable as any known species. Analyses of a cross-sectioned crystal revealed the outer layer to be quite different from the bulk, which turned out to be the mineral corkite $PbFe^3(PO_4)(SO_4)(OH)_6$. Corkite is one member of a large family of isomorphous minerals that also contains a Ca–Al–P member, crandallite, and a third member in which Si is substituted for P. By integrating all of this information it appears that this specimen consists of a thin layer of siliceous crandallite on a core of corkite. These crystals contain minor amounts of K and Ba that, together with the major elements, create a complex pattern showing (again) oscillatory, sector, and continuous zoning. In this material the oscillations are mainly between Pb and K + Ba. Continuous zoning involves the enrichment from core to rim of P, Al, Pb, and Ca at the expense of S, Fe, and K. Sector zoning is exhibited by the sudden disappearance of Pb, Fe, and S, the appearance of Si, and the abrupt enrichment in Ca and Al. The suddenness of the change suggests that the two minerals do not form a continuous solid solution even though they are isomorphous. Another interesting observation is that the corkite seldom contains S and P in a perfect one-to-one ratio, indicating that the formula ratios are somewhat flexible and not rigid. In fact, these nonstoichiometric ratios in the corkite seem to indicate that there may be solid solutions between the three groups. This work was performed at Sandia National Laboratories and was supported by the U.S. Department of Energy under contract no. DE–AC04–76DP00789.

PHOSPHATE MINERALIZATION AT THE TYRONE MINE, GRANT COUNTY, NEW MEXICO, by *Ronald B. Gibbs*, P.O. Box 448, Tyrone, NM 88065 (2)

Phosphate mineralization has been known in the Tyrone area since 1871. Small pits and stone tools are evidence of earlier mining by Indians. The Azure mine was opened in 1891 and became one of the largest turquoise mines in the country. Turquoise mining declined as copper mining became prominent. Small underground mines gave way to the opening of the Tyrone open-pit mine in 1967, and more phosphates came to light. Today, 16 species have been recognized, some rarely found in New Mexico. They include turquoise, libethenite, torbernite, autunite, lead-meta-autunite(?), pseudomalachite, cornetite, chalcosiderite, apatite, wavellite, plumbogummite, crandallite, corkite, strengite, cacoxenite, and pyromorphite.

A NEW OCCURRENCE OF CYPRINE (BLUE IDOCRASE) IN NEW MEXICO, by *Ramon S. DeMark*, 6509 Dodd Place, N.E., Albuquerque, NM 87110 and *Paul F. Hlava*, Sandia National Laboratories, Albuquerque, NM 87185 (3)

The Picuris Range of the Sangre de Cristo Mountains has long been known for producing bright red piemontite crystals. Piemontite is a ma- ☞

jor constituent of the upper portion of the Vadito Formation, a Precambrian muscovite-quartz schist and quartzite that is exposed extensively on the west slopes of the range near Pilar, New Mexico. The piemontite in stratified layers within the quartzite occurs as individual crystals in quartz stringers and as eyes in the quartzite. Although the quartzite in this area is generally compact, separation along seams in the layers has allowed, in some cases, the growth of free-standing crystals. One such seam, which is exposed on the west slope of the Picuris Range approximately 300 ft above NM-68 and roughly 0.5 mi south of Pilar, has revealed the occurrence of cyprine, the rare blue variety of idocrase, in direct association with free-standing crystals of zoisite (thulite), piemontite, and grossular. The seam is restricted laterally to approximately 3 m and is from 1 to 5 cm thick. This seam is composed of disintegrated rock that is predominantly zoisite (thulite), piemontite, and grossular in the core whereas the idocrase is restricted to the surface. Most of the idocrase is opaque, but a small percentage of the crystals is transparent and sapphire blue. Crystals range in size from 2 to 8 mm and are heavily striated. Many crystals are zoned with the blue color abruptly changing to gray. Microprobe analyses reveal almost identical chemical compositions in the blue and the gray zones. There are only subtle variations in the minor-element contents; the blue zone is richer in Cu and Ti whereas the gray is richer in Mn and Fe. Weathering along the seam has destroyed the integrity of most crystals so that freestanding, terminated crystals on matrix are scarce. Minor seams located stratigraphically above and below the described seam show minor evidence of idocrase, but the thinness of the seams has precluded the growth of free-standing crystals. In addition to the occurrence of attractive specimens of cyprine, thulite, and piemontite, several other minerals of interest can be found as float in the arroyos and on the talus slopes. Dravite has been identified as the brown tourmaline that is found quite commonly in the schistose rocks of the Vadito Formation. Andalusite and its green Mn-rich variety viridine are also common. The other aluminosilicate polymorphs, kyanite and sillimanite, occur, although not in noteworthy specimens. Finally, a muscovite of unusual appearance has been found in a canyon directly south of the idocrase area. It is found in a seam similar to that in which the idocrase occurs although the maximum seam width is only 4–5 mm. The muscovite at this location occurs in distinct but somewhat rounded crystal aggregates about 1 mm in size with a distinctive lilac to purple color. They are found in association with free-standing crystals of piemontite and, to a minor extent, grossular. We feel that this assemblage of unusual minerals and mineral varieties in such a restricted area is noteworthy but not unique. We expect that diligent searching of the appropriate stratigraphic horizons will reveal other occurrences of these minerals in the metamorphic rocks of northern New Mexico.

GREAT MINERAL HOAXES OF THE SOUTHWEST, by *Robert W. Eveleth,* New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

Throughout New Mexico's long history of mineral production thousands of mining companies, some successful, many otherwise, have come and gone. Regardless of their success or failure, the majority were aboveboard operations with noble intentions. A small portion, however, were based upon shaky foundations; a few of the more notorious were carefully planned, outright frauds. In general the creators of these hoaxes were men of some intelligence with a flair for telling a good story. Armed with the knowledge that few of us are capable of resisting our gambling instincts, particularly when confronted with the vision of sudden wealth so vividly painted, the con artist/mineral promoter lines up the suckers as easily today as did his predecessors from the previous century. This presentation focused on a few of the more sensational promotions from the Ralston diamond hoax to the multimillion-dollar platinum-gold scams of the 1980's.

SULFOSALT AND SEMIMETAL SULFIDE DISTRIBUTION IN THE SOUTHWESTERN UNITED STATES, by *Virgil W. Lueth, Philip C. Goodell,* and *Diedrich A. Kropp,* Department of Geological Sciences, University of Texas (El Paso), El Paso, TX 79968

The use of semimetal-bearing sulfides as petrologic tools has not yet been applied in most ore-deposit studies although ore deposits containing sulfosalts or semimetal sulfides have been located and symbolized by deposit type. This compilation of sulfosalt localities and the plotting of relative abundances of arsenic, antimony, and bismuth have been done to test the usefulness of these minerals and elements as ore-deposit and metallogenic indicators. Gross distribution of the semimetals follows closely the general distribution of metallic ore deposits related to Laramide and Cenozoic volcanism. However, certain semimetal elements appear confined to particular tectonic environments. Bismuth displays an affinity for continental crust areas, especially in spacial relation to exposed Precambrian rocks. Antimony, although widely distributed, is concentrated in areas of crustal thinning (i.e., the Great Basin and Rio Grande rift). Arsenic is the most widely distributed semimetal element, but interestingly occurs in high crustal deposits not necessarily related to magmatism (e.g., sandstone uranium deposits of the Colorado Plateau). Semimetal distribution in particular ore-deposit environments is fairly consistent and often zoned, indicating possible geochemical factors unique to each deposit type. Bismuth is most commonly found in pegmatites (bismuthinite), porphyry coppers, and skarns (Pb–Ag–Bi sulfosalts). Bismuthinite also is found in epithermal gold veins, usually with other semimetal phases absent. Antimony is most often associated with epithermal veins (tetrahedrite and polybasite) and hot-spring deposits (pyrargyrite and stibnite) and in massive sulfides (tetrahedrite). Arsenic species are found in skarns (arsenopyrite), veins (arsenopyrite, pearceite, and proustite), stratabound deposits (arsenopyrite and tennantite), and the upper zones of porphyry coppers (enargite). The details of sulfosalt geochemistry and tectonics are still poorly known and are subject to continuing study. This relatively simple treatment of the data does reveal potential in the field of semimetal geochemistry, perhaps converting sulfosalts from mineralogic curiosities to interpretive tools.

MINERALOGY AND TEXTURES OF A EUDIALYTE-BEARING DIKE, WIND MOUNTAIN, OTERO COUNTY, NEW MEXICO, by *Russell C. Boggs,* Department of Geology, Eastern Washington University, Cheney, WA 99004 (4)

A eudialyte-bearing dike approximately 1 m thick by 100 m long has intruded the surrounding country rocks near the western edge of the Wind Mountain laccolith. The dike consists predominantly of albite, potassium feldspar, nepheline, and acmite. The main accessory mineral is eudialyte. The eudialyte makes up about 5% of the rock although it is irregularly distributed in the dike and locally makes up 20% of the rock. The dike shows interesting textures with margins consisting of large crystals of acmite up to 4 cm long arranged perpendicular to the walls. The spaces between these crystals and the center of the dike consist of smaller (1–2 mm) crystals of feldspars, nepheline, acmite, and eudialyte. Quartz is found locally very near the margins of the dike and has presumably formed by assimilation of silica from the country rock, which is a marly shale to impure silty limestone. Eudialyte is concentrated toward the center of the dike. In thin sections many of the eudialyte crystals show color zoning with a pink to brown pleochroic rim and a colorless core. Compositionally the acmites are close to pure $NaAlSi_2O_6$; minor amounts of CaO, Al_2O_3, ZrO_2, and TiO_2 are the main other oxides present. CaO ranges from 0.7 to 4.6 wt %. The larger crystals near the margin of the dike show Ca-rich cores (up to 1.7 wt. % CaO) and Ca-poor rims (0.7 to 0.8 wt. % CaO). The cores of smaller crystals appear to be richer in Ca with some as high as 4.6 wt. % CaO. The acmites also show uncommonly high contents of ZrO_2—from 0.8 to 3.4 wt %. The eudialytes tend to be quite uniform in composition with little core-to-rim variation. Apparently the variation that accounts for the color zoning is an increase in MnO (from 3–4 wt. % in the core to 5 wt. % at the rim) and a corresponding decrease in FeO (from 3.5–4 wt. % in the core to 2.7–3 wt. % at the rim). A typical analysis of the eudialyte yields the following results expressed as percentages: SiO_2, 47.07; ZrO_2, 13.39; TiO_2, 0.18; Al_2O_3, 0.01; La_2O_3, 1.22; Ce_2O_3, 2.05; Pr_2O_3, 0.30; Nd_2O_3, 0.37; Sm_2O_3, 0.05; Eu_2O_3, 0.74; Gd_2O_3, 0.46; CaO, 3.69; FeO, 2.71; MnO, 5.12; MgO, 0.21; Na_2O, 13.22; K_2O, 0.40; F, 0.59; Cl, 2.71 (estimated); total 92.16. The albites range from Ab_{98} to Ab_{99}, and the potassium feldspars range from Or_{64} to Or_{94}. Both feldspars contain less than 0.5% of the anorthite end member. The nephelines show considerable silica in solid solution and approach the maximum silica content that can occur in nepheline ($Ne_{85}Qz_{15}$). The dike can be traced into the main body of the Wind Mountain laccolith (an analcime-nepheline syenite) where it appears to grade into a zone of poorly defined dike-like bodies. The dike is interpreted to have formed from a late-stage Zr-rich pegmatitic magma that was injected into the surrounding country rock from the laccolith, possibly along a fracture formed during the doming of the overlying sediments. The dike began to crystallize under water-rich conditions that lead to the formation of the large acmite crystals. Before crystallization was complete, however, the system lost water pressure (presumably by further fracturing and venting to the surface), and the remaining magma was pressure quenched, producing the fine-grained center of the dike. The quenching was due to the shallow level of emplacement of the laccolith, which has been estimated to have been less than 1 km. The center of the dike is enriched in eudialyte because of further concentration of Zr in the remaining magma during crystallization of the acmite.

NEWLY DISCOVERED MINERALS FROM NEW MEXICO, 1959–1986; NORTHROP + 27 YEARS, by *Robert M. North,* New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

In 1959 the University of New Mexico Press published the second edition of *Minerals of New Mexico* by Dr. Stuart A. Northrop. This book was a remarkably complete compilation of the minerals then known to occur in the state. In the 27 years that have elapsed, however, many discoveries have been made that would greatly expand Northrop's book. The following list represents some of the minerals that could be added to a third edition. This list does not include new localities for minerals that Northrop listed in the second edition, but only new mineral entries. The list is certainly not comprehensive, and it is hoped that all of the attendees at the Seventh New Mexico Mineral Symposium will help to complete it. Tentative identifications are starred. Numbers in the reference column refer to numbered citations in the reference list. A name in the reference column indicates personal communication unless otherwise noted.

Mineral	Formula	Locality	Reference
Agardite	$(Y,Ca)Cu_6(AsO_4)_3(OH)_6 \cdot 3H_2O$	Copper Hill	2
		Red Cloud mine	2
Andersonite	$Na_2CaUO_2(CO_3)_3 \cdot 6H_2O$	Grants uranium district	6
*Apachite	$Cu_9Si_{10}O_{29} \cdot 11H_2O$	Bear Mountains	P. Hlava
Bayleyite	$Mg_2UO_2(CO_3)_3 \cdot 18H_2O$	Grants uranium district	6
Bertrandite	$Be_4Si_2O_7(OH)_2$	Harding mine	8
Betekhtinite	$Cu_{13}(Pb,Fe,Ag)_2S_9$	St. Cloud mine	10
Beudantite	$PbFe_3AsO_4SO_4(OH)_4$	Black Range	4
Beyerite	$(Ca,Pb)Bi_2(CO_3)_2O_2$	Taos(?)	F. Cureton
*Birnessite	$Na_4Mn_{14}O_{27} \cdot 9H_2O$	Point of Rocks Mesa	9
Bismutotantalite	$Bi(Ta,Nb)O_4$	Harding mine	11
*Brenkite	$Ca_2CO_3F_2$	Point of Rocks Mesa	9
Brockite	$(Ca,Th,Ce)PO_4 \cdot H_2O$	Laughlin Peak area	15
Catapleiite	$Na_2ZrSi_3O_9 \cdot 2H_2O$	Wind Mountain	1
Chalcosiderite	$CuFe_6(PO_4)_4(OH)_8 \cdot 4H_2O$	Tyrone mine	A. Tlush
Conicalcite	$CaCuAsO_4OH$	Red Cloud mine	2
Crandallite	$CaAl_3(PO_4)_2(OH)_5 \cdot H_2O$	Laughlin Peak area	15
Duftite	$PbCuAsO_4OH$	Silver Hill area	12
Dundasite	$Pb_2Al_4(CO_3)_4(OH)_8 \cdot 3H_2O$	Juanita mine	17
Durangite	$NaAlAsO_4F$	Black Range	4
Ferroselite	$FeSe_2$	Grants uranium district	6
Fornacite	$(Pb,Cu)_3[(Cr,As)O_4]_2OH$	Silver Hill	12
Geerite	Cu_8S_5	St. Cloud mine	F. Cureton
Georgechaoite	$NaKZrSi_3O_9 \cdot 2H_2O$	Wind Mountain	1
*Glaucodot	$(Co,Fe)AsS$	E-Town-Baldy district	R. North, unpublished
Gonnardite	$Na_2CaAl_4Si_6O_{20} \cdot 7H_2O$	Gila Cliff Dwellings area	13
Holmquistite	$Li_2(Mg,Fe)_3Al_2Si_8O_{22}(OH)_2$	Harding mine	11
Kettnerite	$CaBiCO_3OF$	Victorio(?)	F. Cureton
Khademite	$AlSO_4F \cdot 5H_2O$	Lone Pine mine	19
Kupletskite	$(K,Na)_3(Mn,Fe)_7(Ti,Nb)_2 Si_8O_{24}(O,OH)_7$	Point of Rocks Mesa	8
Lannonite	$HCa_4Mg_2Al_4(SO_4)_8F_9 \cdot 32H_2O$	Lone Pine mine	19
Levyne	$(Ca,Na_2,K_2)_3Al_6Si_{12}O_{36} \cdot 18H_2O$	Gila Cliff Dwellings area	7
Lorenzenite	$Na_2Ti_2Si_2O_9$	Point of Rocks Mesa	3
Mackayite	$FeTe_2O_5OH$	Lone Pine mine	18
Mangan-neptunite	$KNa_2Li(Mn,Fe)_2Ti_2Si_8O_{24}$	Point of Rocks Mesa	3
Mckinstryite	$(Ag,Cu)_2S$	Mogollon	F. Cureton
Mesolite	$Na_2Ca_2Al_6Si_9O_{30} \cdot 8H_2O$	Gila Cliff Dwellings area	7
Montroseite	$(V,Fe)O(OH)$	Grants uranium district	6
Nacrite	$Al_2Si_2O_5(OH)_4$	Laughlin Peak area	15
Neptunite	$KNa_2Li(Fe,Mn)_2Ti_2Si_8O_{24}$	Point of Rocks Mesa	3
Paragonite	$NaAl_2(Si_3Al)O_{10}(OH)_2$	Truchas Range	5
Paranatrolite	$Na_2Al_2Si_3O_{10} \cdot 3H_2O$	Point of Rocks Mesa	9
Polylithionite	$KLi_2AlSi_4O_{10}(F,OH)_2$	Point of Rocks Mesa	3
Poughite	$Fe_2(TeO_3)_2SO_4 \cdot 3H_2O$	Lone Pine mine	R. DeMark
Rajite	$CuTe_2O_5$	Lone Pine mine	18
*Rosenbuschite	$(Ca,Na)_3(Zr,Ti)Si_2O_8F$	Point of Rocks Mesa	9
Searlesite	$NaBSi_2O_5(OH)_2$	Point of Rocks Mesa	3
Selenium	Se	Grants uranium district	6
Serandite	$Na(Mn,Ca)_2Si_3O_8OH$	Point of Rocks Mesa	16
Strengite	$FePO_4 \cdot 2H_2O$	Tyrone mine	A. Tlush
Tetranatrolite	$Na_2Al_2Si_3O_{10} \cdot 2H_2O$	Point of Rocks Mesa	3
Thermonatrite	$Na_2CO_3 \cdot H_2O$	Grants uranium district	6
*Thorbastnaesite	$Th(Ca,Ce)(CO_3)_2F_2 \cdot 3H_2O$	Point of Rocks Mesa	9
Todorokite	$(Mn,Ca,Mg)Mn_3O_7 \cdot H_2O$	Black Range	4
		Grants uranium district	6
Treasureite	$Ag_7Pb_6Bi_{15}S_{32}$	Tyrone mine	F. Cureton
Tripuhyite	$FeSb_2O_6$	Bear Mountains	14
*Tundrite	$Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2 (CO_3)_3O_4(OH) \cdot 2H_2O$	Point of Rocks Mesa	9
Villiaumite	NaF	Point of Rocks Mesa	16
Vishnevite	$(Na,Ca,K)_6(Si,Al)_{12}[(SO_4), (CO_3),Cl_2]_{2-4} \cdot nH_2O$	Point of Rocks Mesa	9
Weissite	Cu_5Te_3	Winston(?)	F. Cureton
Wilcoxite	$MgAl(SO_4)_2F \cdot 32H_2O$	Lone Pine mine	19
Xenotime	YPO_4	Laughlin Peak area	15

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New Mexico Bureau of Mines and Mineral Resources staff notes

March 14th will mark the 60th anniversary of the New Mexico Bureau of Mines and Mineral Resources. We appreciate the cooperation and support from geologists and mineral resources people, and plan continuation of service and applied research of benefit to New Mexico.

Cindie Salisbury was promoted to Assistant Head of the drafting group; Norma Baca joined us as Reception Secretary; Brenda Broadwell left for Virginia; Dolores Gomez resigned to attend TVI in Albuquerque; Mark Tuff left to head an x-ray lab in San Francisco; Bob and JoAnne Osburn moved to St. Louis where Bob is working for Washington University; and Cherie Pelletier left for Las Cruces to attend New Mexico State University. Anniversaries of staff who had five or more years of service from December 1986 through February 1987 were: Richard Chavez, 30, Lois Devlin, 25; Mickey Wooldridge, 16; Ruben Crespin, 12; Bob Eveleth, 9; and Don Wolberg, 8.

At the GSA national meeting, Lois Devlin handled the NMBMMR exhibit booth, Gretchen Roybal participated in the lignite field trip, Jamie Robertson attended the Society of Economic Geologist's council, Don Wolberg represented the Society of Vertebrate Paleontologists, and Frank Kottlowski attended the Association of American State Geologist's breakfast meeting. Posters or talks given at the meeting included Bill Stone's "Estimating Quaternary recharge rates from chloride in the unsaturated zone"; "An examination of the geochemical controls infrared transparency in the mineral wolframite" by Sylveen Robinson-Cook, Andrew Campbell, Philip Kyle, and Jacques Renault; "Tectonic and petrogenetic implications of the Datil Group, west-central New Mexico" by Steve Cather; "Stratigraphic framework for Mogollon–Datil volcanic field based on paleomagnetism and high-precision $^{40}Ar/^{39}Ar$ dating of ignimbrites" by Bill McIntosh, John Sutter, and Chuck Chapin; "Structure of Mt. Withington cauldron, Mogollon–Datil volcanic field, New Mexico" by Charles Ferguson and Bob Osburn; and "Fluid inclusion microthermometry in coexisting wolframite and quartz" by Andrew Campbell and Sylveen Robinson-Cook. There were numerous other presentations on New Mexico geology.

The seventh annual Mineral Symposium was chaired by Bob North, with help from Judy Vaiza, Zana Wolf, Norma Meeks, and Carol Hjellming. Talks given at the symposium that deal with New Mexico are included in this issue (pp. 20–23). The New Mexico Mining Association meeting was held in Albuquerque in October; Jim Barker was in charge of the field trip to the Belen travertine plant, Rocky Mountain Stone; Frank Kottlowski chaired the technical sessions and participated in the Board of Directors meeting; and Virginia McLemore attended the meeting. Dave Love represented us at the New Mexico Geographic Information Advisory Committee meeting. Orin Anderson attended the USGS workshop in Denver on San Juan Basin studies.

Bob Eveleth and Mike Harris testified in Burbank, California, concerning the Goldex "gold" operations. Lynn Brandvold represented us at the award presentation by the National Environmental Protection Agency to the Albuquerque Southside Water Reclamation Plant, and she attended the executive committee meeting of the Society of Applied Spectroscopy at Sandia Corporation. John Hawley and Don Wolberg have attended the monthly meetings of the state Environmental Roundtable. John Hawley testified concerning the proposed EID asbestos-disposal regulations. Mike Gobla transported Charles Mardirosian's hugh donation of mineral-district maps and books from Laredo. Don Wolberg is on a subcommittee of the Initiatives in Geology Committee of the National Research Council.

George Austin gave a paper, written with H. D. Glass and R. E. Hughes, at the Clay Society meeting in Mississippi, entitled "Determination of illite polytypes: their structural significance and geologic implications." At the Western States Seismic Policy Council meeting in Jackson Hole, Gary Johnpeer gave a talk called "Update on New Mexico earthquake predictions." Don Wolberg attended the SVP meeting in Philadelphia; he serves on the Government Liaison Committee of the society.

Bill Stone and Kelly Summers' talk at the annual water conference in Santa Fe was "Hydrogeology in river management, Rio Grande valley, New Mexico." Dave Love is compiling a chapter on the Cenozoic of the Navajo section of the Colorado Plateau for DNAG. John Hawley traveled to Texas Tech for a thesis defense by Jaya Chitali on "Petrography of calcrete in west Texas and southern New Mexico." In December, Frank Kottlowski chaired the Mine Safety Advisory Board meeting in Albuquerque concerning blasting regulations and a meeting of the Surface Mining Permanent Program Committee in Santa Fe concerning alternate sediment control guidelines, approximate original contour guidelines, and blasters' certification. Peggy Barroll gave a poster session with Marshall Reiter at the American Geophysical Union meeting in San Francisco entitled "Comments on heat flow in southwestern US." Virginia McLemore and Jim Barker ran cathodoluminescence samples at the USGS laboratories in Denver. Don Wolberg took nontype paleontologic specimens (large bones) to the paleo museum at the University of Kansas, helping our storage problem. Richard Chamberlin is working with TERA on their tunnel blasting experiments. Chuck Chapin served as chairman of the search committee for the Petroleum Recovery Research Center director, the position Dr. Joe Taber has held with distinction. Bob North and Mike Harris investigated the rare-earth/yttrium occurrences in Colfax County near Laughlin Peak. The SIMCO drill rig, which was donated to NMBMMR by Dr. Charles Reynolds, was remodeled recently to use for our drilling projects; it has been operated by Gary Johnpeer and Danny Bobrow in the Estancia Basin for the SCC project. On the strenuous side, at the October Nine Mile Mountain run, Cecilia McCord was first in the women's age 19–29 class, and Ron Broadhead, John Hawley, and Lynne Robertson did well in their respective classes.

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