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New Publications

NMBMMR

***Guidebook**—Chaco Canyon Country, edited by S. G. Wells, D. W. Love, and T. W. Gardner, 1983, 253 pp. $15.00

American Geomorphological Field Group's field-trip guidebook to their northwest New Mexico field conference at Chaco Canyon.

USGS

MISCELLANEOUS FIELD STUDIES MAPS

***MF-1425-B**—Mineral-resource potential map of Bunk Robinson Peak and Whitmire Canyon roadless areas, Hidalgo County, New Mexico, and Cochise County, Arizona, by P. T. Hayes, K. C. Watts, and J. R. Hassemer, U.S. Geological Survey, and S. D. Brown, U.S. Bureau of Mines, 1983, lat 31°20′ to 31°35′, long 109° to 109°05′, scale 1:62,500

***MF-1425-C**—Geochemical maps of Bunk Robinson Peak and Whitmire Canyon roadless areas, Hidalgo County, New Mexico, and Cochise County, Arizona, by K. C. Watts, J. R. Hassemer, and G. W. Day, 1983, lat 31°20′ to about 31°35′, long about 109° to about 109°05′, scale 1:125,000

***MF-1468**—Mineral-resource potential and geologic map of the Little Dog and Pup Canyons roadless area, Otero County, New Mexico, by P. T. Hayes, U.S. Geological Survey, and P. R. Bigsby, U.S. Bureau of Mines, 1983, lat about 32°15′ to about 32°22′30″, long 104°52′30″ to about 105°, scale 1:50,000

***MF-1496-A**—Isopach and contour structure maps of the Burro Canyon(?) Formation in the Mesa Golondrina and Mesa De Los Viejos areas, Chama Basin, New Mexico, by J. L. Ridgley, 1983, two sheets, lat 36°20′ to 36°30′,long 106°30′ to 106°45′, scale 1:24,000

***MF-1496-B**—Isopach and structure contour maps of the Burro Canyon(?) Formation in the Canjilon-Ghost Ranch area, Chama Basin, New Mexico, by J. L. Ridgley, 1983, lat 36°21′08″ to 36°28′30″, long 106°20′ to 106°30′, scale 1:24,000

***MF-1496-C**—Isopach and structure contour maps of the Burro Canyon(?) Formation in the Chama–El Vado area, Chama Basin, New Mexico, by J. L. Ridgley, 1983, lat about 36°40′ to about 36°50′, long 106°30′ to 106°45′, scale 1:62,500

***MF-1523-A**—Mine and prospect map of the Chama River Canyon Wilderness and contiguous roadless area, Rio Arriba County, New Mexico, by T. D. Light, U.S. Bureau of Mines, 1983, lat about 36°10′ to 36°35′, long 106°30′ to 106°55′, scale 1:48,000

WATER-RESOURCES INVESTIGATIONS

WRI-82-4096—Estimated natural streamflow in the Rio San Jose upstream from the pueblos of Acoma and Laguna, New Mexico, by D. W. Risser, 1982, 56 pp.

WRI-82-4111—Geologic and well-construction data for the H-9 borehole complex near the proposed Waste Isolation Pilot Plant site, southeastern New Mexico, by S. L. Drellack, Jr. and J. G. Wells, 1982, 36 pp., 1 over-sized sheet

WRI-82-4118—Geologic and well-construction data for the H-8 borehole complex near the proposed Waste Isolation Pilot Plant site, southeastern New Mexico, by S. L. Drellack, Jr. and J. G. Wells, 1982, 46 pp., 1 over-sized sheet

WRI-83-4123—Estimating 1980 ground-water pumpage for irrigation on the High Plains in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, by F. J. Heimes and R. R. Luckey, 1983, 40 pp.

U.S. Bureau of Mines

29(1)-83—High-angle conveyor study (vol. 1), by E. A. Mevissen, A. C. Siminerio, and J. A. Dos Santos, 1983

29(2)-83—High-angle conveyor study (vol. 2), by E. A. Mevissen, A. C. Siminerio, and J. A. Dos Santos, 1983

Open-file reports

NMBMMR

***182**—Geology and coal resources of Pasture Canyon quadrangle, Catron County, New Mexico, by J. C. Osburn, 1983, 27 pp., 1 map $6.90

***183**—Uranium and thorium occurrences in New Mexico: distribution, geology, production, and resources, with selected bibliography, by V. T. McLemore, 1983, 950 pp., 10 tables, 76 figures, 6 appendices, 13 maps $203.00

Cooperative report with the U.S. Department of Energy that lists and describes more than 1,300 uranium and thorium occurrences in more than 100 formational units in New Mexico. Included are chemical analyses, production statistics, and a bibliography. The report may be purchased in sections.

USGS

82-106—Modeling of a transient streambed in the Rio Grande, Cochiti dam to near Albuquerque, New Mexico, by R. C. Mengis, 112 pp.

82-857—Supplement to the New Mexico three-dimensional model, by G. A. Hearne, 95 pp.

***83-191**—The nonopague, detrital heavy mineralogy of the Morrison Formation near Crownpoint, San Juan Basin, New Mexico, by P. L. Hansley

***83-194**—Geochemical characteristics of the Church Rock 1 and 1 East uranium deposits, Grants uranium region, New Mexico, by N. S. Fishman and R. L. Reynolds, 28 pp.

83-201—Floods of November 1978–March 1979 in Arizona and west-central New Mexico, by B. N. Aldridge and T. A. Hales, 170 pp., 2 over-sized sheets

***83-316**—Report of reprocessing of reflection seismic profile x-5 Waste Isolation Pilot Plant (WIPP) site, Eddy County, New Mexico, by J. J. Miller

***83-340**—Audio-magnetotelluric data log and station-location map for the Latir Peak Wilderness and Columbine–Hondo roadless areas, New Mexico, by C. L. Long, 51 pp.

***83-358**—Seismic energy release and hazard estimation in the Basin and Range province, by S. T. Algermissen, B. L. Askew, P. C. Thenhaus, D. M. Perkins, S. Hanson, and B. L. Bender, 17 pp., 10 over-sized sheets

***83-407**—Analytical and statistical results for samples collected from the Sandia Mountain wilderness, Bernalillo and Sandoval Counties, New Mexico, by A. L. Gruzensky, B. M. Adrian, and D. E. Hendzel

***83-434**—New Mexico: basic data for thermal springs and wells as recorded in Geotherm, by J. D. Bliss, 176 pp.

***83-443**—Slides showing aeromagnetic and gravity data for regional mineral exploration in Colorado, New Mexico, and Arizona, by D. P. Klein, 10 pp., five 35-mm color slides

***83-478**—Bibliography of reports by U.S. Geological Survey personnel of studies of underground nuclear test sites and on waste management studies at the Nevada test site and the Waste Isolation Pilot Plant site, New Mexico, from January 1 to December 31, 1981, by V. M. Glanzman, 15 pp.

***83-494**—Methodology, statistical summary, and listing of analyses of geochemical samples, lower San Francisco River Wilderness study area and contiguous roadless area (RARE II), Catron and Grant Counties, New Mexico, and Greenlee County, Arizona, by J. R. Hassemer, 35 pp.

***83-777**—Analytical results for 26 water samples from southern New Mexico, by J. B. McHugh, W. R. Miller, and W. H. Ficklin, 9 pp.

Geographic names *(continued from page 10)*

sion revised; *not:* Beclabato Spring, Biclabito Spring, Biltabito Spring (BGN 1915), Bitlabito Spring (BGN 1937).

Beclabito Wash—watercourse, 24.1 km (15 mi) long, heads in Arizona on the northeast slope of the Carrizo Mountains at 36°50′44″ N., 109°04′22″ W., trends northeast into New Mexico to the San Juan River 0.97 km (0.6 mi) northwest of the mouth of Red Wash and 25.4 km (15.8 mi) northwest of Shiprock; a Navajo Indian name reportedly meaning "water underneath"; San Juan County, New Mexico and Apache County, Arizona; 36°54′22″ N., 108°55′32″ W.; *not:* Biltabito Creek, Bitlabito Wash.

Borrego Crossing—ford, on the Rio Chiquito in the Sangre de Cristo Mountains 22.5 km (14 mi) southeast of Taos; borrego is a Spanish word meaning "lamb not yet a year old"; the ford is an old sheep crossing; Taos County, New Mexico; 36°17′27″ N., 105°21′50″ W.

Brush Canyon—canyon, 4.2 km (2.6 mi) long, heads at 33°25′10″ N., 105°51′28″ W., trends southwest to Lincoln Canyon 21 km (13 mi) northwest of Ruidoso; Lincoln County, New Mexico; sec. 27, T. 10 S., R. 10 E., NMPM; 33°24′24″ N., 105°53′42″ W.; *not:* Rattlesnake Canyon.

Casita de Piedra Peak—peak, elevation 3,112 m (10,210 ft) at the head of Casita de Piedra Canyon; in the Sangre de Cristo Mountains 0.64 km (0.4 mi) east of Capulin Peak and 14.5 km (9 mi) east of Taos; Taos County, New Mexico; sec. 11, T. 25 N., R. 14 E., NMPM; 36°24′30″ N., 105°24′53″ W.; *not:* Caseta Piedra Peak, Casita Piedra Peak.

Cottonwood Creek—stream, 23.3 km (14.5 mi) long, heads in the Sacramento Mountains at 33°29′02″ N., 105°52′45″ W., flows northwest to disappear in El Malpais 22.5 km (14 mi) SW of Carrizozo and 51 km (32 mi) NW of Ruidoso; Lincoln County, New Mexico; sec. 2, T. 9 S., R. 8 E., NMPM; 33°33′44″ N. 106°05′03″ W.

Abstracts

New Mexico Academy of Science

The New Mexico Academy of Science met on October 22, 1983, on the campus of the University of New Mexico (Albuquerque). Following are abstracts from talks given at the meeting, entitled Quaternary geology and paleontology of New Mexico—a symposium.

Post-Miocene history of New Mexico—an overview, by *John W. Hawley*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

A brief overview of the past 5 million years of New Mexico's history is given in order to provide a stratigraphic and paleogeographic framework for symposium discussions of Quaternary geology and paleontology. The Pliocene and Quaternary stratigraphic record comprises a variety of sedimentary and igneous rock types, and it reflects a wide range of geomorphic settings. Major components of the present landscape (ranges, basins, plateaus, plains, and river valleys) are products of deep-seated (hypogene) processes that probably culminated in late Miocene and early Pliocene, but to some extent are still active. Epeirogenic uplift and differential movement of crustal blocks have affected the entire region, with the effects of tectonism and volcanism being most pronounced in and near the Basin and Range province. There has been widespread basaltic volcanism since the late Miocene, and rhyolitic ash-flow tuffs and tephra were produced by caldera-forming eruptions in the Jemez Mountains in the early and middle Pleistocene. Deep-seated processes have been major factors that have influenced regional climate, topographic relief, and thus, the epigenetic processes involving mass wasting and water, wind and glacial action. On both regional and local scales, climatic shifts in the arid to subhumid range have been the primary factors that controlled effectiveness of vegetative cover and erosion processes. Many erosional and depositional landforms record a climate-controlled sequence of instability and stability intervals, with episodes of active erosion/sedimentation interspersed with long periods of surface stability and soil formation. The oldest relict landscapes in the state are constructional and erosional surfaces in the southern High Plains and Pecos Valley sections. These late Miocene and early Pliocene surfaces have formed on alluvial and eolian deposits and caprock calcretes of the Ogallala Formation. Ancient graded surfaces that form mesa and plateau summits in a broad belt extending from west-central to northeast New Mexico are locally capped by widespread basalt flows of late Miocene and Pliocene age. Intermontane-basin fill of the upper Santa Fe and Gila Groups (Pliocene to middle Pleistocene) is particularly thick and widespread in the Basin and Range province and includes the oldest deposits of the ancestral Rio Grande and Gila fluvial systems. Large depressions in the Great Plains region that formed by a combination of solution subsidence, deflation, and stream erosion also may have thick fills. Quaternary and upper Pliocene deposits associated with deep-valley systems of major river basins occupy relatively narrow belts. Eolian deposits include extensive sheets that cover much of the Great Plains area east of the Pecos River, and major Quaternary dune complexes are to the leeward of pluvial-lake basins and stream valleys throughout the state. Glacial and periglacial deposits are usually confined to mountain areas above 9,000 ft.

Plio-Pleistocene vertebrates from Socorro-area outcrops, gravel pits, museum cases, and apartments, by *Donald L. Wolberg, Adrian P. Hunt,* and *Wayne Wentworth*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

The Socorro area has offered tantalizing glimpses of a potentially rich Plio-Pleistocene fossil record over the last 50 yrs, sometimes in bizarre and interesting ways. In this area, the Sierra Ladrones formation (Santa Fe Formation of earlier authors) consists of locally derived piedmont and interdigitated axial-river facies of an ancestral Rio Grande, well dated by interbedded basalts and other volcanics. Some of the fossil material collected has found its way into the New Mexico Bureau of Mines and Mineral Resources collections, but generally there is little locality data. Almost 50 yrs ago, C. E. Needham briefly reported the occurrence of *"Rhynchotherium,"* equines, and *Capromeryx* from Ojo de La Parida, near Escondida, NM. Needham's *"Rhynchotherium"* jaws are in the New Mexico Bureau of Mines and Mineral Resources collections. A well preserved, undocumented ulna is probably associated with the jaws. We have no knowledge of the disposition of the other material. Recently, additional equine, *Capromeryx* and bird remains have been recovered from Needham's localities. It is possible that the *"Rhynchotherium"* skull and jaws were discovered about 30 yrs ago by students at New Mexico Tech. Lack of interest in this discovery resulted in its eventual loss. Northward, near gravel pits at Lemitar, NM, mastodontid jaw fragments have been recovered and are in our collections. Little or no locality data accompany these fossils. Southward, near San Antonio, NM, Needham reported turkey remains from pumice-bearing sands. Later discoveries note *Equus* and *Camelops*. These have been dated as Blancan–Irvingtonian. Recently, partial jaws of a large equine, cf. *E. Scotti*, were recovered from gravels at an apartment-house building in downtown Socorro. The jaws were picked up over a period of days by an electrician working on the apartments. An investigation could determine only that the gravels were probably hauled from the Lemitar, NM, area. Obviously, a more concerted and organized study of Socorro-area vertebrates is warranted.

Plio-Pleistocene proboscidean *Stegomastodon* from the Palomas formation, south-central New Mexico, by *Spencer G. Lucas*, Department of Geology, University of New Mexico, Albuquerque, NM, *Richard P. Lozinsky*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM, and *Thomas R. Logan*, Department of Geology, University of New Mexico, Albuquerque, NM

University of New Mexico (UNM) P–041 is a lower jaw bearing heavily worn M_3's of a proboscidean from just northwest of Truth or Consequences, NM (NW¼SW¼NE¼, sec. 16, T. 13 S., R. 4 W.). This jaw was collected from a bed of well-sorted, crossbedded, and well-cemented sandstone in the middle to upper part of the Palomas formation (Santa Fe Group). This bed is part of the axial river facies (total thickness approximately 30 m) of the Palomas formation (total thickness approximately 180 m) and is near the intertonguing contact with the piedmont facies of the formation. The axial-river facies of the Palomas formation represents deposition of a large braided-river system, the ancestral Rio Grande. The following features of UNM P–041 justify its assignment to *Stegomastodon mirificus* (Leidy, 1858): 1) lower jaw relatively short; 2) symphysis short and spout-like; 3) no lower tusks; 4) M_3 length = 18+ cm, width = 7.5+ cm; 5) M_3 has six lophids; 6) M_3 crown is worn to a simple, single trefoil pattern; and 7) no enamel plication (ptychodonty). The relatively small size, simple M_3 trefoil pattern, and lack of ptychodonty of UNM P–041 indicate that it is more similar to medial Blancan (Benson, Rexroad) specimens of *S. mirificus* than to later representatives of the species. Thus, UNM P–041 probably indicates a medial Blancan age (late Pliocene, about 3 m.y. B.P.) for the horizon in the Palomas formation from which it was collected. This age assignment is consistent with other paleontological and radiometric age determinations that suggest an age range of about 3.8–0.5 m.y. B.P. for the Palomas formation.

Blancan–Irvingtonian boundary in the Ceja member of the Santa Fe Formation, Tijeras Arroyo, Albuquerque area, New Mexico, by *Thomas R. Logan, Spencer G. Lucas,* and *Jay C. Sobus*, Departments of Geology and Anthropology, University of New Mexico, Albuquerque, NM

Fossil mammals from the upper part of the "Ceja member" of the Santa Fe Formation (Upper Buff formation of Lambert, 1968; University of New Mexico, PhD. thesis) in Tijeras Arroyo (T. 9 N., R. 3 E., Bernalillo County, NM) are of late Blancan and early Irvingtonian age. Late Blancan mammals are *Hypolagus* sp. (right dentary fragment with P_3) and *Equus simplicidens* (partial skull) from a horizon stratigraphically low in the upper part of the "Ceja member" exposed in this area. Early Irvingtonian mammals are *Mammuthus hayi* (lower jaw), *Mammuthus* sp. (pelvis), *Glyptotherium* cf. *arizonae* (caudal scute), cf. *Camelops* sp. (partial astragalus) and *Equus* aff. *scotti* (various teeth and lower-jaw fragments). These mammals were collected from horizons near the top of the "Ceja member" exposures in Tijeras Arroyo. Pumice-bearing strata between the Blancan mammal-producing horizon and the Irvingtonian mammal-producing horizons almost certainly represent the Guaje Pumice Bed (of the Otowi Member of the Bandelier Tuff), which has been radiometrically dated elsewhere at about 1.4 m.y. B.P. By definition, *Mammuthus* first appeared in North America at the beginning of the Irvingtonian land-mammal "age." *Mammuthus hayi* and/or *Glyptotherium arizonae* are present in well recognized early Irvingtonian faunas, including Gilliland (Texas), Rock Creek (Texas), and Holloman (Oklahoma). Therefore, the age of the uppermost part of the "Ceja member" in Tijeras Arroyo is early Irvingtonian, and the Blancan–Irvingtonian boundary is about 1.4 m.y. B.P.

Taphonomy of mammoth occurrences—Ceja member of the Santa Fe Formation, Tijeras Arroyo, Bernalillo County, New Mexico, by *Jay C. Sobus* and *Thomas R. Logan*, Departments of Anthropology and Geology, University of New Mexico, Albuquerque, NM

Two *Mammuthus* localities, University of New Mexico (UNM) V–129 (NE¼SW¼NW¼, sec. 10, T. 9 N., R. 3 E.) and UNM–V–131 (SW¼NW¼SW¼, sec. 15, T. 9 N., R. 3 E.), Bernalillo County, New Mexico, were systematically excavated to determine their local depositional environments. The sites are in the uppermost part of the "Ceja member" of the Santa Fe Formation. The "Ceja member" in this region represents a piedmont facies deposited by a system of braided streams. The presence of *Mammuthus, Equus,* and *Glyptotherium* suggests the early Pleistocene of the Tijeras Arroyo area was a mosaic of subtropical gallery forests and open grassland. UNM–V–129 produced an isolated jaw of *Mammuthus hayi* (UNM–P–040). The locality consists of an upward-fining sequence of clast-supported pebbles to poorly sorted, medium-grained sand. Clay bodies directly associated with the jaw indicate cut-bank failure which contributed to rapid burial of the specimen. The surface of the jaw exhibits exfoliation indicative of subaerial weathering and subsequent abrasion in a high-energy fluvial environment. UNM–V–131 produced a nearly complete pelvis of *Mammuthus* sp. (UNM–P–046). The locality is characterized by discontinuous lenses of sand, sandy gravel, and gravelly sand. Small trough sets (approximately 1 m thick) and planar crossbedding suggest a high-energy, braided-stream deposit. The innominates were in natural position; therefore, the cartilaginous bridge of the pubic symphysis was intact at the time of deposition. The surface of the bone is considerably less eroded than in UNM–P–040. The occurrence of large, isolated elements with damage due to transport and in-place scouring at these two localities is consistent with the high-energy nature of this paleoenvironment. Microfauna and articulated elements are expected to be rare or absent in these deposits.

TYPES OF QUATERNARY SEQUENCES OF FLUVIAL AGGRADATION IN NEW MEXICO, by *David W. Love*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

Quaternary fluvial deposits along many streams in New Mexico reflect a wide range of stream-channel conditions. In the past, stream channels have ranged from being practically unconfined to being confined in deep and narrow arroyos. Cross-sectional shapes of channels include: broad, shallow, relatively flat rectangles; deep, wide rectangles; deep, narrow rectangles; shallow parabolas; deep parabolas; and combinations of rectangles and parabolas. Streams that were practically unconfined extended laterally over broad areas and aggraded coarse sand-dominated or gravel-dominated braided facies. Streams that were confined in relatively narrow incised channels exhibit either: 1) sand-dominated, braided facies; 2) sand-silt-clay meandering channel, floodplain, and oxbow facies; 3) repetitive, graded sand-silt-clay channel facies; 4) silt- and clay-dominated meandering channel facies; 5) poorly sorted, clay-dominated facies; or 6) poorly sorted, gravel-dominated facies. Yazoo channels, other tributary channels, shallow swales, and other erosional, topographically low areas ajacent to streams may fill with sediments from overbank floods from the axial stream, but these fills do not reflect depositional processes acting within the erosional forms. Other valleys have aggraded during late Quaternary time with relatively fine-grained sheetwash deposits; they exhibit no buried channels above the base of the fill. Only extremely steep and/or narrow valleys and canyons have not aggraded during Holocene time.

LATE PLEISTOCENE AND EARLY HOLOCENE LIFE ZONES IN NEW MEXICO, by *Arthur H. Harris*, Laboratory for Environmental Biology, University of Texas (El Paso), El Paso, TX

Data from the western USA suggest there were four recognizable major vegetative complexes in New Mexico during the full-glacial era. The Northern Highland zone included elements of today's tundra, boreal forest, sagebrush, and grassland habitats. This zone descended to approximately 2,100 m in northern New Mexico, and to approximately 2,650 m in southern New Mexico. No vertebrate faunas are known. The lower border merged into the middle-elevation Forestlands zone where vegetation was similar, but tundra habitat absent. The forestlands occurred to an elevation as low as 1,600 m in the south. Major vertebrate faunas are from the Isleta Caves, Sloth Caves, Dust Cave, Muskox Cave, Hermit's Cave, and Howell's Ridge Cave. Below these forestlands boreal elements disappeared, with woodland, grassland, and sagebrush habitats forming the sagebrush Steppe–Woodland zone. Only southern New Mexico has elevations low enough to have been included within the zone. Vertebrate faunas include those from Blackwater Draw, Williams Cave, Burnet Cave, Shelter Cave, Conkling Cavern, Dry Cave, and Dark Canyon Cave. Below this zone, a warmer and drier Steppe–Woodland zone may have occurred; however, there are no vertebrate faunas in New Mexico from this zone. The zone would have been limited to elevations below 1,100 m. The number of vertebrate taxa tended to increase with elevation because of the greater vegetational complexity at higher elevations. This was a consequence of organisms extending their lower elevational ranges drastically downward, while their upper altitudinal limits were depressed to a much lesser degree. Faunas predating full-glacial conditions indicate that the climate was cooler and moister than present-day climates, but warmer and drier than during full-glacial conditions. Early Holocene faunas reflect cooler, moister conditions than current climates, with the Steppe–Woodland zone probably persisting until at least 8,000 B.P. in the lowlands of southern New Mexico. Long-range dispersal at some time after 8,000 B.P. probably caused the invasion of ponderosa pine into the mountains south of the Sangre de Cristo Mountains and east of the Rio Grande.

GEOMORPHIC HISTORY OF PART OF THE NORTHERN CHACO RIVER DRAINAGE BASIN, NORTHWEST NEW MEXICO, by *Larry N. Smith*, Department of Geology, University of New Mexico, Albuquerque, NM

Four base-level stands along the Chaco River between its confluence with Brimhall and Escavada washes are represented by alluvial deposits preserved on terraces, pediments, and mesas in the northern Chaco River drainage basin. These alluvial deposits range in topographic position from present-day drainage divides to valley floors. Nine surficial-deposit units and five geomorphic surfaces have been defined by soil development and topographic position. The oldest alluvium in the study area exists along the Chaco River drainage divide on Moncisco Mesa. The alluvium is characterized by a soil with a 75-cm-thick stage III calcic horizon. This soil development suggests an early or mid-Pleistocene(?) age for the unit. The Moncisco surface was apparently formed when an ancestral Chaco River stood approximately 180 m above the present Chaco floodplain. The oldest extensively preserved alluvial unit in the study area, alluvial unit 1, is characterized by its occurrence on mesas along drainage divides of the northern tributary basins to the Chaco River and by a 20–30-cm-thick stage IV calcic-soil horizon. Paleocurrent orientations measured in alluvial unit 1 indicate transport directions to the southwest, parallel to the modern drainage. This unit is interpreted to have been deposited during mid-Pleistocene(?) time on a broad southwest-sloping erosional surface that was bounded on the north by Moncisco Mesa. The S1 surface graded to an ancestral Chaco River drainage that was approximately 110 m above the modern Chaco River. The ancestral Chaco River apparently ran parallel to the modern course of the Chaco River in the study area by S1 time. Alluvial unit 2 exists on strath terraces and alluvial slopes that grade toward and along the modern axes of the Chaco tributary drainage basins in the study area. Alluvial unit 2 graded to approximately 32 m above the modern Chaco River during late Pleistocene(?). Alluvial unit 3 is similar to, but lower than, alluvial unit 2 and grades to a level approximately 12 m above the Chaco River. Alluvial unit 4 makes up fill terraces and alluvium along the modern washes. The topographic positions and lithologic properties of alluvium on Moncisco Mesa and S1-surface remnants suggest that the ancestral Chaco tributary drainage basins in the study area headed in sandstone outcrops of the San Jose Formation, along and northeast of the present Chaco River drainage divide. The inset relationships of the S2 and S3 surfaces indicate that incision of the S1 surface occurred near the axes of the modern drainage basins in the study area. The north-flowing Gallegos Wash has captured the headwater region of the study area, separating the San Jose Formation from the Chaco River drainage basin in the study area.

SOILS ON LATE QUATERNARY EOLIAN DEPOSITS IN THE CHACO DUNE FIELD, NEW MEXICO—INFLUENCE OF AEROSOLIC DUST ON PEDOGENESIS, by *Leslie D. McFadden, Stephen G. Wells,* and *Jerald D. Schultz*, Department of Geology, University of New Mexico, Albuquerque, NM

Field studies and textural, mineralogical, and chemical analyses of soils formed in eolian deposits of the Chaco dune field in the semiarid San Juan Basin, New Mexico, demonstrate that the influx of aerosolic dust has strongly influenced rates and processes of pedogenesis. The soils, formed on parabolic dunes and extensive dune sheets, have parent materials that consist of moderately to moderately well sorted, subangular to subrounded fine sand, and they are composed of quartz (53–67%), feldspar (13–30%), and lithic fragments (13–35%). Soils on middle Holocene (2,800–5,900 yrs B.P.) deposits (Qe2) typically possess a 25–50-cm-thick cambic or weak argillic horizons (maximum clay percent increase = 4.7%; maximum reddish color = 8.75 YR 5/6) that have weak, very coarse, subangular, blocky structure and, in many instances, very thin argillans on skeletal grains. Soils on older, early Holocene to late Pleistocene deposits (Qe1) have a 15–40-cm-thick argillic horizon (maximum clay percent increase = 11.9%; maximum reddish color = 6.25 YR 5/6) that have moderate, coarse, subangular, blocky structure and continuous, thin to very thin argillans on skeletal grains and in tubular pores. In the Qe1 and Qe2 soils, secondary carbonate ranges from few to locally common, small and medium nodules (stage II) over a depth that exceeds 3 m in thick, eolian sands. Occasionally, secondary carbonate may impregnate the argillic B horizon or buried B horizons and interstratified fluvial deposits. X-ray diffraction studies show that secondary pedogenic clay in the Bw–Bt horizon is composed of smectite, kaolinite, and illite/mica. Secondary clay in the lower part of the Bk (calcic) horizon, however, is composed chiefly of smectite. Thus, both carbonate and easily dispersible, fine-grained smectite are translocated to great depths in the highly permeable parent materials. The lack of weathering or etching of parent material grains and rapid rate of clay and carbonate accumulation indicate that the rapid formation of Holocene soils in the study area is due to high aerosolic-dust influx. Locally extensive badland terranes that formed in terrestrial and marine sediments during late Quaternary may provide a source for much of this dust. In situ weathering may be limited largely to ☞

minimal alteration of lithic grains and formation to authigenetic Fe oxyhydroxides, suggested by increases in soil rubification in the Qe1–Bt horizon that are associated with 1) marked increases in the total secondary Fe oxyhydroxide content (maximum increase, $Fe_2O_3d = 0.7\%$); and 2) increase in the ferrihydrite Fe_2O_3o: Fe_2O_3d ratio (ratio increase = 0.02–0.06).

LATE QUATERNARY SMALL VERTEBRATES FROM CHACO CANYON, NORTHWEST NEW MEXICO, by *William B. Gillespie*, Albuquerque, NM

Recent excavations in conjunction with archaeological investigations of small rockshelters in Chaco Canyon, northwest New Mexico, have led to the recovery of skeletal remains of a large number of vertebrate taxa. This material provides new evidence of late Wisconsinan and Holocene environmental conditions in the San Juan Basin. Late Wisconsinan small vertebrates from Sheep Camp shelter include a preponderance of extra-local taxa indicative of considerably more mesic conditions. Present are species now found in more montane locations in the southwest U.S. and abundant remains of taxa characteristic of the Great Basin, including Pygmy Rabbit (*Brachylagus idahoensis*), Sagebrush Vole (*Lagurus curtatus*), and Sagebrush Grouse (*Centrocercus urophasianus*). Among other extra-limital species is the first prehistoric record of Heather Vole (*Phenacomys intermedius*) from New Mexico. Habitat preferences of identified species and macro-plant remains suggest that montane conifers, including spruce (*Picea* sp.) and limber pine (*Pinus flexilis*), grew on rockier terrain, while deeper soils supported extensive sagebrush (*Artemisia*) communities. Analogy to the present Great Basin suggests that a more winter-dominant precipitation regime and cooler temperatures were in effect. Vertebrates from middle Holocene (about 5,000 B.P.) sediments in a second rockshelter, Atlatl Cave, are more similar to modern fauna, but still include extra-limital forms. These suggest conditions as warm or warmer than at present, but not necessarily more arid. Cotton Rat (*Sigmodon hispidus*) and Prairie Vole (*Microtus ochrogaster*) have modern ranges to the south and east where greater summer precipitation allows better developed grassland to occur. The geographical location of the San Juan Basin suggests that increased summer rainfall can be expected during periods of climatic warming due to the increased effectiveness of the monsoonal circulation pattern in the southwest U.S.

AAPG, BULLETIN, V. 67, NO. 2, AUGUST 1983

RELATION OF NATURAL GAS COMPOSITION TO THERMAL MATURITY AND SOURCE-ROCK TYPE IN SAN JUAN BASIN, NORTHWESTERN NEW MEXICO AND SOUTHWESTERN COLORADO, by *D. D. Rice*, U.S. Geological Survey, pp. 1,199–1,218.

San Juan Basin is a roughly circular, asymmetric structural depression located in northwestern New Mexico and southwestern Colorado. Ultimate recoverable reserves of predominantly nonassociated gas (23 tcf, 0.65×10^{12} m^3) are present in the structurally low part of the central basin. The major producing intervals are low-permeability sandstone reservoirs in the Upper Cretaceous Dakota Sandstone, Mesaverde Group, and Pictured Cliffs Sandstone. Lesser amounts of oil and/or gas are produced from Pennsylvanian, Jurassic, and Cretaceous rocks along the southern and western flanks of the basin. The gases display a trend of becoming isotopically heavier ($\delta^{13}C_1$ values range from −48.7 to −31.4‰) and chemically drier (c_1/C_{1-5} values range from 0.75 to 0.99) with increasing depth. These changes are assumed to be the result of thermal cracking processes, and the gases are interpreted to have been generated during the mature and post-mature stages of hydrocarbon generation. However, there is considerable scatter in the data which is interpreted to result from a difference in source-rock type. Gases generated from nonmarine (humic) source rocks are isotopically heavier and chemically drier than those generated from marine (sapropelic) source rocks at equivalent levels of maturity. The gases also become isotopically heavier and chemically drier to the northeast, following the trend of increasing maturity of all units in that direction. The increase in maturity is attributed to a combination of greater burial depth and a higher geothermal gradient resulting from batholiths to the north in the San Juan Mountains area. Maximum burial and heat flow occurred during Oligocene time, which probably coincided with peak hydrocarbon generation. Lack of oil in the central basin is believed to be the result of two factors. First, gas in reservoirs such as the Dakota Sandstone may have resulted from thermal cracking of oil generated from marine source rocks during late mature (wet-gas condensate) and post-mature (dry gas) stages of hydrocarbon generation. Second, gas in reservoirs such as Mesaverde Group and Pictured Cliffs Sandstone is nonassociated and probably was generated from nonmarine (coaly) organic matter during the mature and post-mature stages. Minor amounts of condensate, instead of oil, may have been generated from nonmarine source rocks during the mature stage.

AAPG, ROCKY MTNS. SECTION MEETINGS, SEPTEMBER 18–21, 1983, BILLINGS, MT

PALEOTECTONIC CONTROL OF PENNSYLVANIAN SEDIMENTATION IN PARADOX BASIN, by *D. L. Baars* and *G. M. Stevenson.*

EOCENE PALEOTECTONICS AND SEDIMENTATION IN THE ROCKY MOUNTAIN–COLORADO PLATEAU REGION, by *C. E. Chapin* and *S. M. Cather.*

AAPG, BULLETIN, V. 67, NO. 10, OCTOBER 1983

DEVELOPMENTS IN URANIUM IN 1982, by *W. L. Chenoweth*, U.S. Department of Energy, Grand Junction, CO

Slippage in demand, increasing costs, and low spot-market prices continued to influence the uranium industry during 1982. The supply of uranium exceeds the current demand and, as a result, exploration for uranium declined in the United States for the fourth straight year. During 1982, 92 companies spent $73.86 million on uranium exploration, including 6.1 million ft of surface drilling. This drilling was done mainly in the producing areas and in the areas of recent discoveries. During the year, a significant discovery was announced in south-central Virginia, the first major discovery in the eastern United States. Production of uranium concentrate declined in 1982, when 1,343 short tons of uranium oxide (U_3O_8) were produced. In response to a soft market, numerous mines and 4 mills were closed during the year. Domestic uranium reserves, as calculated by the Department of Energy, decreased during 1982, mainly because of increasing production costs and the lack of exploration to find new reserves. Exploration for uranium in foreign countries also declined during 1982. Canada and Australia continue to dominate the long-term supply.

DEVELOPMENTS IN GEOTHERMAL RESOURCES IN 1982, by *Jim Combs*, Geothermal Resources International, Inc., Menlo Park, CA, *C. W. Berge*, Grace Geothermal Corp., Salt Lake City, UT, *J. W. Lund*, Geo-heat Center, Oregon Institute of Technology, Klamath Falls, OR, *D. N. Anderson*, Geothermal Resources Council, Davis, CA, and *P. P. Parmentier*, Republic Geothermal, Inc., Santa Fe Springs, CA

The total number of geothermal wells drilled in 1982 decreased to 79 from 99 wells in 1981. Total footage drilled in 1982 decreased to 559,326 ft from 676,127 ft in 1981. An increase in average well depth from 6,830 ft in 1981 to 7,080 ft in 1982 indicates that operators are having to drill deeper in their efforts to extend the productive limits of proven geothermal reservoirs. Of the 79 geothermal wells completed in 1982, about 80% (i.e., 63 wells, which accounted for 90% of the total footage) were drilled in California. Two major acquisitions occurred during 1982 in The Geysers geothermal field in northern California. Geothermal Resources International, Inc. (GRI) purchased Thermogenics, Inc. (TGI), including the steam-producing property from which TGI sells steam to the Pacific Gas and Electric Co. (PG&E) Unit 15 geothermal power plant. Additionally, GRI purchased the 50% interest of Aminoil USA, Inc. in about 60,000 acres within and around The Geysers for $26.25 million in the largest transaction negotiated in the geothermal industry during 1982. GRI then entered into agreements for the exploration and development of the acreage with the Central California Power Agency. Geothermal power generation was highlighted at The Geysers by an increase of 110 MWe of electricity. With the start-up of PG&E Unit 17, the total capacity of The Geysers at year end was 1,019 MWe. In the Salton Sea KGRA in the Imperial Valley in southern California, the Southern California Edison Co. 10 MWe single-flash demonstration plant became operational in 1982, bringing the total geothermal-electricity-generation capacity in the Imperial Valley to about 31 MWe. By mid-year, 5 development wells were completed by California Energy Co., Inc. at the Coso Hot Springs KGRA on the China Lake Naval Weapons Center in south-central California. These wells confirmed the dry steam discovery of late 1981 and established the Coso area as another important geothermal resource for electrical-power generation. Other achievements included the accelerated federal geothermal leasing program reaching its goal of offering about 600,000 acres in 14 sales held by the U.S. Bureau of Land Management. Five other geothermal lease sales were conducted by 3 state agencies. Private industry paid more than $18.7 million in bonus bids in 1982 for geothermal leases at these competitive federal and state lease sales, an average of $113.20 per acre. In 1982, two significant technical developments, the Crystallizer Clarifier Processor and the EFP System, were successfully demonstrated and will accelerate the commercial utilization of liquid-dominated geothermal resources in the United States and elsewhere. Finally, the dedication of several district heating projects highlighted the direct-use application of geothermal resources in 1982.

DEVELOPMENTS IN COAL IN 1982, by *S. A. Friedman*, Oklahoma Geological Survey, Norman, OK, *R. W. Jones*, Wyoming Geological Survey, Laramie, WY, and *M. L. W. Jackson*, Texas Bureau of Economic Geology, Austin, TX

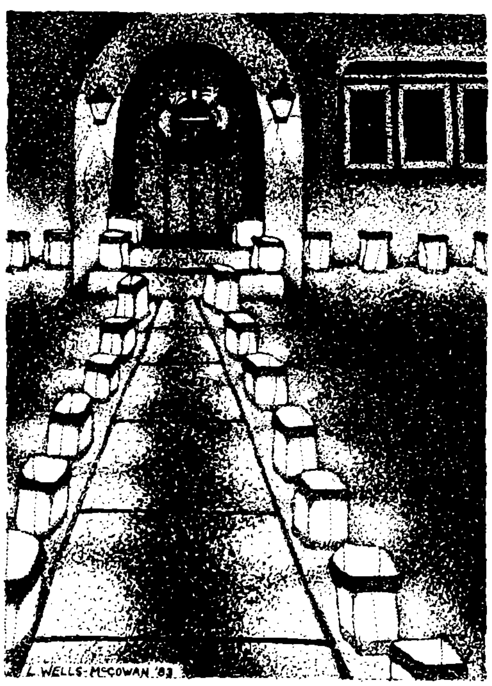
In 1982, United States mines produced a record high 833 million short tons of coal (about 1% more than in 1981), indicating that a production plateau has been reached. West Virginia's 1982 production increased 16 million tons from that of 1981, Illinois production increased by 12 million tons, and Wyoming production increased by 5 million tons. Although Kentucky decreased in coal production, it remained the United States leader by producing 150 million tons, followed by West Virginia's 129 million tons, and Wyoming's 108 million tons. One-half of the 26 coal-producing states increased production in 1982; the other half decreased production. Illinois showed the greatest rate of increase (19%), Montana the greatest rate of decrease (17%). Regionally, production increased in 5 areas and decreased in 4 areas. In the Eastern Interior it increased 9%, and 5% increases were recorded in both the Rocky Mountain and Gulf provinces. Ranking first in 1982 was the Appalachian region at 428 million tons of bituminous coal, followed by the Rocky Mountain province at 175 million tons of bituminous and subbituminous coal, and the Northern Great Plains at 155 million tons of subbituminous and lignitic coal. In 1982, the second highest quantity of coal exported from the United States (106 million tons) was a 6% decline from 1981 exports. This was 13% of the 1982 United States coal production; 61% of it was coking coal for use in iron and steel manufacture, and 39% was "steam" coal used for electric-power generation. The European Economic Community, Japan, and Canada received 74.5 million short tons or 70% of these exports in 1982. Coal exploration and issuing of mine permits in most producing regions continued at a high level, and federal coal-lease sales increased greatly in the Northern Great Plains province.

OIL AND GAS DEVELOPMENTS IN FOUR CORNERS–INTERMOUNTAIN AREA IN 1982, by *G. M. Stevenson*, Stevenson Petroleum Consultants, Inc., Denver, CO, and *L. S. Hayte*, Denver, CO

Exploratory drilling in the Four Corners–Intermountain area remained essentially unchanged in 1982, with 343 wells drilled compared with 335 wells drilled in 1981. Ninety-nine successful wells were completed for a success rate of 28.86%, down from 38.5% in 1981. Total exploratory footage drilled was down 5% from 1981, with 1,881,494 ft drilled in all exploratory categories. With 1,124 holes drilled, development drilling decreased 20.5% from 1981. Most of the decrease is due to a depressed gas market affecting San Juan Basin infill drilling. There were no significant discoveries in the region for 1982. Exploratory drilling in the Paradox basin remains high, with numerous discoveries reported at year end.

OIL AND GAS DEVELOPMENTS IN WEST TEXAS AND EASTERN NEW MEXICO IN 1982, by *W. W. Collier*, Exxon Co., Midland, TX, *D. R. Adams*, Midland, TX, *R. B. Gaines*, Nortex Gas and Oil Co., Midland, TX, *W. R. Gibson*, Earle M. Craig, Jr., Corp., Midland, TX, *H. A. Miller*, Midland, TX, *P. H. Pause*, Midland, TX, and *L. D. Robbins*, Hanley Petroleum, Midland, TX

During 1982, 8,495 wells were drilled in eastern New Mexico and west Texas, 17.1% more than 1981. The success rate for all wells was 78.7%, down 2.9% from 1981. The number of exploratory wells drilled was 17.8% higher than 1981, and the total exploratory footage drilled was up 16.0%. Significantly, the exploratory success rate decreased from 31.2% to 26.4%. Seismic activity decreased 6.2% from 1981, continuing a downward trend which began in 1981. The anticipated decline in exploratory drilling for 1982 based on the 1981 seismic decline did not materialize. This was due primarily to the peak in drilling-rig activity in late 1981 and the carry over to early 1982 of subsequent completion activity. During 1982, 17.0% more development wells were drilled, and development footage set a record for the second consecutive year with 38,965,649 ft, an increase of 15.3%. Development success decreased by 2.5% to 89.1%. Oil production for 1982 was 559,991,956 bbl, down 3.2% from 1981, and gas production was 2,173,835,539 mcf, down 10.8% from 1981. Leasing activity decreased sharply in 1982. This was not reflected in prices paid and acreage purchased at the University of Texas land sale as well as the New Mexico state sales.



MINING REGISTRATIONS
(JUNE 27, 1983 THROUGH SEPT. 15, 1983)

State Mine Inspector 2340 Menaul N.E. Albuquerque, NM 87107

Date and operation	Operators and owners	Location
6–27–83 gold, silver	Operator—Comet Flotation Mill, Comet, Inc., Rt. 1, Box 47–A, Deming, NM 88030; Gen. Mgr.—Jim Cooper, same address, phone: 546–4974; Property owner—Comet, Inc., Rt. 1, Box 47–A, Deming, NM 88030	Luna Co.; sec. 18, T. 23 S., R. 9 W.; type—quartz; works—flotation only; directions to mill: follow 2nd St. to first right hand paved road approximately 0.5 mi; turn right, proceed past AS&R mill, at end of pavement, turn left into mill yard
6–27–83 coal	Operator—Museum, Mine Shaft Corp., Star Route, Madrid, NM 87010; Gen. Mgr.—Jack D. Day, House #232, Madrid, NM 87010, phone: 473–0743; Person in charge—Preston Malott, General Delivery, Cerrillos, NM 87010, phone: 473–0743; Property owner—Harry D. Salkeld, Star Route, Madrid, NM 87010	Santa Fe Co.; private land; dummy shaft; directions to museum: Madrid, NM, old coal mine museum. Check at mine shaft tavern for admission
8–4–83 leonardite	Operator—Black Diamond, LaPlata Construction Co., Box 125, La Plata, NM 87418; Gen. Mgr.—Anthony Montoya, same address, phone: 325–3047	San Juan Co.; sec. 28, T. 32 N., R. 13 W.; private land; directions to mine: NM–17, north of Farmington, turn left at 16 mi marker and go approximately 2.5 mi to site
8–4–83 gold, silver	Operator—Last Chance, TLC Unlimited, Inc., P.O. Box 373, Lordsburg, NM 88045; Gen. Mgr.—M. T. Cochran, 419 Campbell Ct., Richardson, TX, phone: (214) 644–7922; Gen. Supt.—Michael Lipstate, 11896 W. 13th Ave., Golden, CO, phone: (303) 278–0252; Property owner—Alhumbru Resources, 413 Placita del Oro, Lordsburg, NM 88045	Hidalgo Co.; sec. 1, T. 24 S., R. 19 W.; Pyramid mining district; private land; dump—surface; directions to mine: 6 mi south of Lordsburg, on Animas Road (old) to gate and 1.5 mi to mine site
8–4–83 base metal	Operator—Jones Hill, Santa Fe Mining Inc., 4775 Indian School Road NE, Albuquerque, NM 87190; Gen. Mgr.—Paul Ebbe, same address, phone: 262–2211; Gen. Supt. (contractor)—T. E. McNeely, Pecos, NM	Santa Fe Co., sec. 1, T. 17 N., R. 11 E.; Willow Creek mining district; private land; underground; directions to mine: north of Pecos, NM, on NM–63 to Indian Creek, then west across a locked gate at the Conoco service station
8–16–83 silicon, silver, gold	Operator—Hanover, Bob Rogers Mining Co., Box 1058, Silver City, NM 88062; Gen. Mgr.—Bob Rogers, same address, phone: 546–4505; Other official—Carl Rogers, same address and phone; Property owner—Stephen McTaggart, P.O. Box 1058, Silver City, NM 88062	Grant Co.; secs. 1, 2, 3, 6, 31, 34, 35, 36, T. 16, 17 S., R. 11, 12 W.; Fierro–Central mining districts; private, state, and federal land; open pit; directions to mine: Hanover to Fierro, down Shingle Canyon about 2 mi, turn right, go through Forest Gate, about 1 mi to workings
8–16–83 gold	Operator—c/o Bob Christy, Box 215, Sandia Park, NM 87047; Gen. Mgr.—Bob Christy, same address, phone: 281–1752; Property owner—W. R. Christy	Santa Fe Co.; sec. 21, T. 12 N., R. 7 E.; San Pedro mining district; federal land; placer; directions to mine: 1 mi south of Golden, NM
9–1–83 gold	Operator—Arrowhead, Stear Mining Co., P.O. Box 191, Hillsboro, NM 88042; Person in charge—Arvil Higginbotham, Main St., Hillsboro, NM, phone: 895–5683; Property owner—Stear Mining Co., 555 E. Ocean Blvd., Suite 818, Long Beach, CA 90802	Sierra Co.; sec. 24, T. 15 S., R. 7 W.; state and federal land; directions to mine: 0.5 mi east of Quintana, NM
9–15–83 gold, silver	Operator—Washington Load, Bland Mining, 5800 Harper NE, #701, Albuquerque, NM 87109; Gen. Mgr.—Larry Serna, same address, phone: 821–0731	Sandoval Co.; sec. 36, T. 18 N., R. 4 E.; Cochiti mining district; private land; hard rock–open pit; directions to pit: take I–25 north from Albuquerque to the Cochiti Lake turnoff (left-hand turn), take NM–22 west through Peña Blanca, continue west through Cochiti to Bland Canyon road 268
9–15–83 mill	Operator—Ginney Mining Co., Golden Gulch Mining Co., Inc., 910 Juniper, Truth or Consequences, NM 87901; Official—Glen Schwab, same address; Property owner—Diamond A Cattle Co., Roswell, NM	Sierra Co.; sec. 20, T. 27, R. 17; Sierra mining district; private land; ores milled—gold, silver; capacity of mill—300 tons per hour; directions to mill: Latter Ranch
9–15–83 gold, silver	Operator—Center Shafts, Royal Minerals, Box W, Duncan, AZ 85534; Gen. Mgr.—Fred Dollarhide, same address, phone: (602) 359–2239; Person in charge—Douglas E. Hanson, same address, phone: (602) 359–2835; Property owner—Douglas Hanson, same as above	Grant Co.; sec. 1, T. 16 S., R. 21 W.; Steeple Rock mining district; private land; underground–stopes; directions to mine: 12 mi north of Duncan, down Carlisle road
9–15–83 mill	Operator—Allied American Gypsum Co., P.O. Box 6345, Albuquerque, NM 87197; Gen. Supt.—Delfinio Gonzales, same address, phone: 898–4811; Gen. Mgr.—Angus Pomeroy, same address and phone; Property owner—E. M. McDowell Sr. and Jr., Allied Bank–A. Pomeroy	Bernalillo Co.; private land; ores milled—gypsum; custom milling; directions to mill: 8001 Jefferson NE, Albuquerque, NM
9–15–83 gold, silver	Operator—Little Granite mine, Bob Rogers, P.O. Box 1058, Silver City, NM; Gen. Mgr.—Bob Rogers, phone: 538–5376, unit 2442; Person in charge—Tony Pence, same address; Property owner—Steve McTaggert, same address	Sierra Co.; sec. 16, T. 10 S., R. 9 W.; Black Range (Grafton) mining district; federal land; underground; directions to mine: take forest road 524 NW from Winston approximately 10 mi up Turkey Creek, road leads directly to mine

USGS

TOPOGRAPHIC MAPS—NEW (scale 1:24,000)

	yr	lat	long	contour (ft)	
*Beclabito (AZ–NM)	78–82	36° 45′	109°	40	
*Buell Park (AZ–NM)	78–82	35° 52′ 30″	109°	20	10
*Cerro de la Campana	75–82	33° 45′	106° 37′ 30″	10	
*Chuska Peak	77–82	35° 52′ 30″	108° 45′	20	
*Crevasse Canyon	78–82	35° 45′	108° 52′ 30″	20	
*Fort Defiance (AZ–NM)	78–82	35° 45′	109°	20	10
*Hatchita	77–82	31° 52′ 30″	108° 15′	10	
*Indian Peak	77–82	31° 45′	108° 52′ 30″	40	
*Playas Peak	77–82	31° 52′ 30″	108° 22′ 30″	20	
*Red Valley (AZ–NM)	78–82	36° 30′	109°	20	
*Roof Butte (AZ–NM)	78–82	36° 22′ 30″	109°	40	
*San Luis Pass	77–82	31° 22′ 30″	108° 37′ 30″	20	
*Sonsela Butte (AZ–NM)	77–83	36°	109°	40	20
*Todilto Park	78–82	31° 52′ 30″	108° 52′ 30″	20	
*Tohatchi	78–82	35° 45′	108° 45′	20	10

TOPOGRAPHIC MAPS—REVISED (scale 1:24,000)

	yr	yr (rev)	lat	long	contour (ft)	
*Angus	63	79–82	33° 22′ 30″	105° 37′ 30″	40	
*Bancos Mesa	63	81–82	36° 52′ 30″	107° 15′	20	
*Bancos Mesa NW	54	81–82	36° 52′ 30″	107° 22′ 30″	20	
*Bixler Ranch	63	81–82	36° 45′	107° 7′ 30″	20	
*Carbacas Canyon	63	81–82	36° 52′ 30″	107° 7′ 30″	40	
*Devils Well	67	79–82	34°	104° 37′ 30″	10	
*Espinosa Ranch	63	81–82	36° 45′	107° 15′	20	
*Gibbons Ranch	66	79–82	34° 37′ 30″	104° 22′ 30″	20	10
*Gobernador	63	81–82	36° 37′ 30″	107° 15′	20	
*Gomez Ranch	54	81–82	36° 45′	107° 22′ 30″	20	
*Haystack Mountain	67	79–82	33° 37′ 30″	104° 7′ 30″	10	
*Leandro Canyon	63	81–82	36° 37′ 30″	107° 7′ 30″	20	
*North Lake	67	79–82	33° 45′	104° 52′ 30″	20	
*Panther Hill	62	79–82	33° 30′	104° 30′	10	5
*Puerto de Luna	63	79–82	34° 45′	104° 30′	20	10
*Ramon	67	79–82	34° 7′ 30″	104° 52′ 30″	10	
*Ramon SW	67	79–82	34°	104° 52′ 30″	10	
*Ricardo	66	79–82	34° 22′ 30″	104° 22′ 30″	10	
*Rock House Canyon	62	79–82	33° 37′ 30″	104° 37′ 30″	10	
*Ruidoso	63	79–82	33° 15′	105° 37′ 30″	40	
*Santos Peak	63	81–82	36° 30′	107° 22′ 30″	20	
*Sardine Lake	67	79–82	33° 30′	104°	10	
*Shannon Draw	67	79–82	33° 45′	104° 22′ 30″	10	
*Sumner Dam	66	79–82	34° 30′	104° 22′ 30″	20	10
*Swallow Nest Canyon	67	79–82	33° 52′ 30″	104° 22′ 30″	10	
*Taiban	68	79–82	34° 22′ 30″	104°	10	
*Watts Hill	67	79–82	34° 7′ 30″	104°	10	
*West Camp	66	79–82	34° 15′	104° 22′ 30″	10	
*Whitehorse	61	79–82	34° 45′	107° 37′ 30″	20	
*Windmill Draw	65	79–82	34° 30′	104° 15′	10	
*Wire Lake	67	79–82	34°	104° 45′	10	
*Wright Ranch	67	79–82	34° 7′ 30″	104° 45′	10	

1:100,000-SCALE INTERMEDIATE TOPOGRAPHIC MAPS (METRIC)

	yr	lat	long	contour (m)	
Capulin Mountain	1982	36° 30′	103°	20	
Chama (NM–CO)	1981	36° 30′	106°	50	
Conchas Lake	1982	35°	104°	20	
*Hatch	1982	32° 30′	107°	50	
Kim (CO–NM–OK)	1982	37°	103°	20	
Las Cruces	1982	32°	106°	20	
*Wheeler Peak (NM–CO)	1982	36° 30′	105°	50	25

1:100,000-SCALE INTERMEDIATE BLM MAPS

	yr	lat	long	contour (m)
Animas	1980	31° 30′	108°	—
*Artesia	1982	32° 30′	104°	10
Chama (NM–CO)	1981	36° 30′	106°	50
Clovis	1978	34°	103°	5

Desert Soil–Geomorphology Project 1984 field study tour

A field-study tour of the Desert Soil–Geomorphology Project in southern New Mexico will be held May 28–June 1, 1984. The Desert Project is a study of landscape evolution and soil development originally conducted by the U.S. Soil Conservation Service from 1957 to 1972 in the Rio Grande valley and adjacent intermontane basins near Las Cruces. Current soil–geomorphic research and study tours in the Project area are part of the environmental geology program of the New Mexico Bureau of Mines and Mineral Resources. Tour leaders are Leland H. Gile, Soil Scientist, and John W. Hawley, Environmental Geologist.

The four-day session, for 40 participants, will start with registration and orientation discussions on Monday, May 28, from 6:00 to 10:00 p.m. at Howard Johnson's Motor Lodge in Las Cruces. Field tours of approximately 20 Desert Project study sites will be conducted from 8:00 a.m. to 5:00 p.m., Tuesday through Thursday, and from 8:00 a.m. to noon on Friday, June 1. Concluding discussions will be on Friday afternoon.

Emphasis will be on classification, morphology, and genesis of soils in arid and semiarid environments; geomorphology and Quaternary stratigraphy; and soil–geomorphic relationships. The 1981 Desert Project Guidebook—*Soils and geomorphology in the Basin and Range area of southern New Mexico* (New Mexico Bureau of Mines and Mineral Resources, Memoir 39)—will serve as a comprehensive field guide to Project and regional soil–geomorphic relationships. Authors L. H. Gile, J. W. Hawley, and R. B. Grossman received the 1983 Kirk Bryan Award of the Geological Society of America for preparing this volume.

The registration fee of $150.00 per professional and $75.00 per student includes tour-bus transportation, lunches, drinks, and a copy of the guidebook. Preregistration by May 1, 1984 is required. Information on motel and camping accommodations will be furnished to participants so that they can make their own housing arrangements. Please note that a block of rooms has been reserved at the tour headquarters, Howard Johnson's Motor Lodge, 1200 South Valley Drive, Las Cruces, New Mexico, 88001; phone (505) 526-4441. The rate for a single room is $27.00 plus tax. Please use *Desert Geomorphology Project Tour* on correspondence and on checks sent to cover registration fees. Tour coordinators are John W. Hawley and David W. Love, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico, 87801; phone (505) 835-5420.

New Mexico Bureau of Mines and Mineral Resources Staff Notes

Following is a new feature about staff activities at the New Mexico Bureau of Mines and Mineral Resources, Socorro, NM.

John Hawley, Senior Environmental Geologist, was a co-recipient of the Kirk Bryan Award at the national meeting of the Geological Society of America in Indianapolis, Indiana on November 2, 1983. The award was shared with Lee Gile and Robert Grossman for the publication of *Soils and geomorphology in the Basin and Range area of southern New Mexico—guidebook to the Desert Project* (NMBMMR Memoir 39). This is GSA's highest award for excellence in Quaternary geology and geomorphology. (Much of Kirk Bryan's pioneering geomorphic work was done in the Rio Grande area of New Mexico.)

The 1983 New Mexico Geological Society field conference, held near Socorro, October 13–15, was the culmination of much geologic work by many members of the Bureau staff, particularly by general co-chairmen Charles Chapin, Senior Geologist, and Robert Osburn, Economic Geologist. Chapin was also a co-editor of the guidebook. Both contributed their geologic expertise of the Socorro region, wrote part of the roadlogs, and wrote several of the guidebook articles. Almost the entire NMBMMR staff was involved in this field conference; Richard Chamberlin was registration chairman. He also contributed to the roadlogs and wrote a paper on structural evolution of the Lemitar Mountains. Other papers and roadlog entries (see *New Mexico Geology,* August 1983, p. 51) were contributed by staff members: John Hawley, JoAnne Osburn, Orin Anderson, James Barker, Robert Bieberman, Robert Eveleth, Ron Broadhead, Virginia McLemore, Gary Johnpeer, Robert North, David Love; Bureau-supported graduate students: John Young, Doug Heath, Steve Johansen, Julie D'Andrea-Dinkelman, Ione Lindley, Sam Bowring, Sue Kent, Ward Sumner, Steve Rosen, Ted Eggleston, Steve Cather, Adrian Hunt, Bill McIntosh, and Danny Bobrow; and NMBMMR alumni: Terry Siemers and Steve Hook. The roadlogs and articles are an up-to-date summary of the geology of central New Mexico.

James Robertson, Mining Geologist, was awarded honorary membership in the New Mexico Geological Society during the beginning session of the NMGS field conference on October 12. The award was given in recognition of Robertson's help in managing the Society's financial affairs, overseeing guidebook publication, and participation in field conferences.

Lynn Brandvold, Senior Chemist, (with Don Brandvold, Carl Popp, and others) presented two posters at the International Symposium on Environmental Biogeochemistry in late October, entitled "Acid precipitation in arid regions—New Mexico" and "Priority pollutant contamination and transport in a large southwestern river–reservoir ecosystem."

The theme of the Geoscience Department–NMBMMR seminars this fall was the geologic history of New Mexico. Talks included "Precambrian geology in New Mexico," by James Robertson and "Quaternary geology of New Mexico," by John Hawley. David Love, Environmental Geologist, was the co-chairman of the seminar programs.

Robert North, Mineralogist, chaired the fourth annual New Mexico Mineral Symposium that was held at New Mexico Tech on November 12 and 13, 1983. North also wrote a paper with Virginia McLemore, Geologist, for the symposium, entitled *Mineralogy of the carbonatites and barite-fluorite-sulfide veins in the eastern Lemitar Mountains.* Robert Eveleth, Mining Engineer, gave the keynote presentation at the symposium dinner, "Of bridal chamber, jewelry shops, and crystal caverns—a glimpse of New Mexico's mining camps, characters, and their mineral treasures."

Samuel Thompson III, Senior Petroleum Geologist, sends memoranda to people interested in the petroleum geology of southwest New Mexico, including notes on drilling activities, recent publications, and other current items. Industry or research geologists may be placed on the mailing list, free of charge, by writing to Thompson at the New Mexico Bureau of Mines and Mineral Resources (please use letterhead paper with a business address).

William Stone, Hydrogeologist, and Lynn Brandvold, Senior Chemist, represent NMBMMR on the state Water Conference Advisory Board of the Water Resources Research Institute. The next water conference meeting will take place in April 1984.

New NMBMMR staff (or people in new positions) are: Nanette Dynan, Secretary of Information, Research, and Service Center; Michael J. Harris, Metallurgist; Zana Harvey, Clerk-Typist; David Menzie, Manager-Geologist of Information, Research, and Service Center; Kathryn Parker, Drafter; Deborah Shaw, Assistant Editor; Linda Wells-McCowan, Drafter; Lisa Zangara, receptionist; and Diane Murray, CRIB Geologist. Steve Blodgett was promoted to Associate Editor, and Teresa Mueller was promoted to Scientific Illustrator I. Marla Adkins–Heljeson, Associate Editor and *New Mexico Geology* Editor, joined the Kansas Geological Survey. Deborah Shaw is now handling *New Mexico Geology.*

James Barker, Industrial Minerals Geologist, Gary Johnpeer, Engineering Geologist, and Robert Bieberman, Senior Petroleum Geologist, represented NMBMMR on the New Mexico Energy and Minerals Department task force to evaluate the mineral resources of the Waste Isolation Pilot Plant (WIPP) site.

Bieberman reports that requests to the Petroleum Section for oil and gas information are up 15% and orders for Petroleum Exploration Maps have increased 20% in the past year.

Recent visitors to the Bureau include geologists from Terrell Drilling Center, Geoscience Consultants, Florida Exploration, Cibola Energy, U.S. Bureau of Reclamation, Scholl Drilling Co., U.S. Bureau of Land Management, Armstrong Energy, Texas Bureau of Economic Geology, Amoco, Chevron, Phelps Dodge Corp., and Champlin Petroleum.

John Hawley testified on hazardous-waste-disposal sites and geologic studies necessary to assure waste stability in arid climates at the U.S. Senate Environmental and Public Works Committee hearing in early July. The Albuquerque meeting was chaired by William Ruckelshaus and Senator Pete Domenici.

NMBMMR participated in the New Mexico Mining Association exhibit at Coronado Center, October 12–15, during the Association's annual meeting in Albuquerque. Robert Eveleth, Robert North, George Austin, David Menzie, and Gretchen Roybal put together the exhibit and answered questions during the sessions. Featured were everyday products that are manufactured and obtained from the state's mineral resources and ore and mineral specimens; photographs of mines and mills in the state, including historic photos and photographs illustrating coal surface-mining reclamation in northwest New Mexico also were part of the exhibit.

James Robertson has been appointed series editor for the Society of Economic Geologists to oversee a new annual publication of the SEG called *Reviews in Economic Geology.*

At the November meeting of the Society of Vertebrate Paleontologists, Donald Wolberg, Vertebrate Paleontologist, was appointed to the Government Liaison Committee of SVP.

Robert Weber, Senior Geologist, aided Deuel and Associates in a geologic assessment of the upper Gila region in conjunction with an archaeological survey of that area.

David Love was a co-author of the Chaco Canyon country guidebook of the American Geomorphological Field Group for their October field conference. In addition to writing parts of the road logs, Dave wrote the following articles: "Summary of the hydrology, sedimentology, and stratigraphy of the Rio Puerco valley" (co-written with John Hawley and Steve Wells), "Summary of late Cenozoic geomorphic and depositional history of Chaco Canyon," and "Quaternary facies in Chaco Canyon and their implications for geomorphic-sedimentologic models."

Robert Eveleth's article entitled "Heap leaching for gold—a case history of new

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methods for working in old mines" was published in the Association of Geoscientists for International Development's Guide to Mineral Resources Development, published by the United Nations.

Frank Campbell and Gretchen Roybal, Coal Geologists, are the Bureau's chief participants in New Mexico Energy Research and Development Institute's Assessment of Quality of New Mexico's Strippable Coals project.

Frank Kottlowski, Senior Geologist and Bureau Director, was elected chairman of the New Mexico Coal Surface Mining Commission. The CSMC's duties are: 1) to prepare regulations governing coal surface mining and reclamation (with aid from the New Mexico Energy and Minerals Department's Division of Mining and Minerals); and 2) to consider appeals from rulings by the Director of the Mining and Minerals Division concerning coal surface mining.

George Austin, Industrial Minerals Geologist and Deputy Director, is program chairman for the Society of Mining Engineers–American Institute of Mining and Metallurgical Engineers Industrial Minerals Division for 1984 and 1985. He presented a paper entitled "Adobe as an insulating building material" at the October AIME meeting. James Barker, Industrial Minerals Geologist, will co-chair a symposium on borates at the 1984 autumn meeting in Denver, Colorado.

At the October meeting of the New Mexico Academy of Science, John Hawley discussed "The post-Miocene history of New Mexico—an overview," Wayne Wentworth gave a paper, co-written with Don Wolberg and Adrian Hunt, entitled "Plio-Pleistocene vertebrates from the Socorro area," and David Love gave a paper on "Types of Quaternary sequences of fluvial aggradation in New Mexico" *see* abstracts, this volume).

Pergamon Press' *Encyclopedia of Materials, Science, and Engineering* contains two articles by George Austin entitled "Soil additives" and "Soil additives: phosphate, potash, and sulfur."

Marshall Reiter, Senior Geophysicist, and Gerry Clarkson, Bureau-supported graduate student, published three papers in autumn, 1983: "Geothermal studies in the San Juan Basin and the Four Corners area of the Colorado Plateau: Terrestrial heat-flow measurements (part I) and Steady-state models of the thermal source of the San Juan volcanic field (part II)," both published in *Tectonophysics* (v. 91, pp. 223–269) by Elsevier Scientific Publishing Company; and "A note on terrestrial heat flow in the Colorado Plateau," published in *Geophysical Research Letters* (v. 10, no. 10, pp. 929–932).

Charles Chapin and Steve Cather presented a paper on "Eocene paleotectonics and sedimentation in the Rocky Mountain–Colorado Plateau region" at the American Association of Petroleum Geologists' Rocky Mountain Section meeting in Billings, Montana, in September. Chapin also contributed a paper entitled "An overview of Laramide wrench faulting in the southern Rocky Mountains with emphasis on petroleum exploration" in the Rocky Mountain Association of Geologists' volume, *Rocky Mountain foreland basins and uplifts*. A 1981 paper by Chapin and Cather on Eocene tectonics and sedimentation was reprinted in this volume.

Frank Kottlowski is a member of the National Academy of Sciences' Committee on Highwalls and Approximate Original Contour (COHAOC). The group is considering the Office of Surface Mining's regulations concerning highwalls and returning coal surface-mined land to the approximate original contour; a report is due in early 1984.

The mining, minerals, and geologic exhibits for the New Mexico State Fair were prepared mainly by Robert North and Robert Eveleth, with help from David Menzie, Orin Anderson, Gretchen Roybal, Nan Dynan, Judy Vaiza, Shorty Vaiza, Robert Osburn, JoAnne Osburn, James Barker, Adrian Hunt, Kathy Garret, David Love, Jeff Lambert, and Roger Leaf. We shared the space with the other three divisions of New Mexico Tech: Research and Development Division, College Division, and Petroleum Research and Recovery Center.

George Austin attended a November session concerning the complex land ownership in the Alamo region as the Bureau's representative on the Alamo Indian Reservation's Private Industry Advisory Board.

Ron Broadhead, Petroleum Geologist, represented NMBMMR at the Oklahoma Geological Survey's Seventy-fifth Anniversary Symposium in December.

Samuel Thompson III, Senior Petroleum Geologist, attended the Penrose field conference on Sea Level Changes in Late Paleozoic time that was held in El Paso, Texas, in mid-October; the main emphasis of the conference was to examine the evidence for changes of sea level in Late Paleozoic sedimentary rocks exposed in the Sacramento and Guadalupe Mountains of New Mexico.

Robert Weber, Senior Geologist, and Donald Wolberg, Vertebrate Paleontologist, are participating with other state agencies in possible archaeological–paleontological salvage operations of the U–Bar cave in Hidalgo County, New Mexico.

Gary Johnpeer presented a paper on a survey of geologic hazards in New Mexico at the Association of Engineering Geologists' meeting in October. Johnpeer also described earthquake preparedness (or lack thereof) in New Mexico at the Western States Seismic Policy meeting.

Donald Wolberg is the Bureau's representative on the Governor's Task Force that is reviewing the Bureau of Land Management's San Juan Basin coal-leasing documents and especially the recent Environmental Impact Statement.

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