References

Broadhead, R. F., 1987, Carbon dioxide in Union and Harding Counties: New Mexico Geological Society, Guidebook to 38th Field Conference, pp. 339–349.

Frye, J. C., Leonard, A. B., and Glass, H. D., 1978, Late Cenozoic sediments, molluscan faunas, and clay minerals in northeastern New Mexico: New Mexico Bureau of Mines and Mineral Resources, Circular 160, 32 pp.

Haley, J. E., 1949, Charles Goodnight, cowman and plainsman: University of Oklahoma Press, Norman, 485 pp.

Hawley, J. W., 1984, The Ogallala Formation in eastern New Mexico; **in** Whetsone, G. A. (ed.), Proceedings of the Ogallala Aquifer Symposium II: Texas Tech University, Water Resources Division, pp. 157–176.

Hawley, J. W., 1986, Physiographic provinces; **in** Williams, J. L. (ed.), New Mexico in maps, 2nd edition: University of New Mexico Press, Albuquerque, pp. 23–27.

Lucas, S. G., Hart, A. P., Kues, B. S., Trauger, F. D., and Holbrook, J., 1987, Second-day road log, from Clayton to Clapham, Miera, Bueyeros, Mosquero, Roy, Yates, and back to Clayton: New Mexico Geological Society, Guidebook to 38th Field Conference, pp. 23–40.

McGrath, D. B., and Hawley, J. W., 1987, Geomorphic evolution and soil-geomorphic relationships in the Socorro area, central New Mexico; **in** McLemore, V. T., and Bowie, M. R. (compilers), Guidebook to the Socorro area, New Mexico: New Mexico Bureau of Mines and Mineral Resources, pp. 55–67.

Osterkamp, W. R., and Wood, W. W., 1987, Playa-lake basins on the southern High Plains of Texas and New Mexico—Part I, hydrologic, geomorphic, and geologic evidence for their development: Geological Society of America Bulletin, v. 99, pp. 215–223.

Reeves, C. C., Jr., 1971, Relations of caliche to small natural depressions, southern High Plains, Texas and New Mexico: Geological Society of America Bulletin, v. 82, pp. 1983–1988.

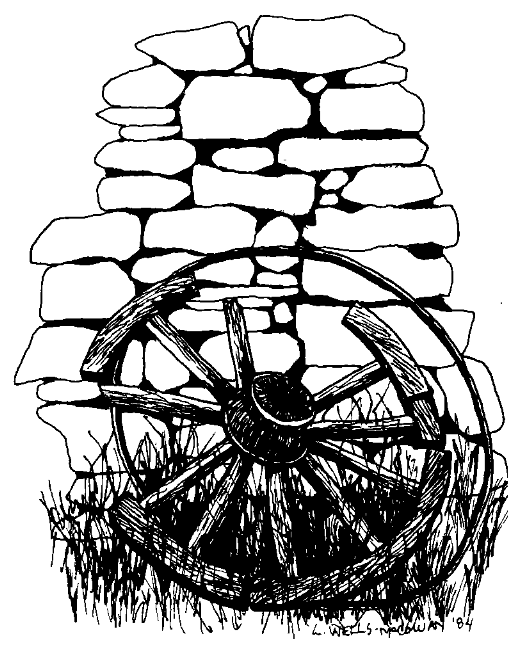
Reeves, C. C., Jr., 1972, Tertiary–Quaternary stratigraphy and geomorphology of west Texas and southeastern New Mexico: New Mexico Geological Society, Guidebook to the 23rd Field Conference, pp. 108–117.

Scott, G. R., 1986, Geologic and structure contour map of the Springer 30′ × 60′ quadrangle, Colfax, Harding, Mora, and Union Counties, New Mexico: U.S. Geological Survey, Map I-1705, 2 sheets, scale 1:100,000.

Smith, L. R., 1984, "Old" area setting for new technology: Drill Bit, v. 33, no. 6, pp. 15–18.

Wanek, A. A., 1962, Reconnaissance geologic map of parts of Harding, San Miguel, and Mora Counties, New Mexico: U.S. Geological Survey, Oil and Gas Investigations Map OM-208, scale 1:96,000.

Wood, W. W., and Osterkamp, W. R., 1987, Playa-lake basins in the southern High Plains of Texas and New Mexico—Part II, a hydrologic model and mass-balance arguments for their development: Geological Society of America Bulletin, v. 99, pp. 224–230. ☐



Abstracts

New Mexico Geological Society

The New Mexico Geological Society annual spring meeting was held at New Mexico Institute of Mining and Technology (Socorro) on April 15, 1988. Following are abstracts from sessions given at that meeting. Abstracts from the other session will appear in future issues of *New Mexico Geology.*

Poster session

REVISION OF THE NEW MEXICO STATE GEOLOGIC MAP: COMPILATION METHOD, STYLE, NOMENCLATURE CHANGES, AND STRATIGRAPHIC REASSIGNMENTS, by *O. J. Anderson,* and *Darrell Daude,* New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

In 1985, a decision to revise and publish an updated version of the 1965 New Mexico State Geologic Map was made. The project is being carried out jointly with the U.S.G.S. Justification for the revision derives from 1) much detailed geologic mapping during the last 22 years, 2) new radiometric dating methods (Ar40/Ar39) that have permitted a better understanding of the sequence of mid-Tertiary volcanics, 3) a keener understanding of Precambrian events, and 4) refinements to our biostratigraphic knowledge. The recompilation is currently underway at the NMBMMR using a computerized digitizing system. The computer-assisted approach to the project was found to be superior to a more conventional approach such as graphical-data transfer instrument, e.g. a Bausch and Lomb zoom transfer scope. Stylistic changes will include 1) color selections and contrasts, 2) more attention to portrayal and definition of structure, and 3) legend format. Nomenclature changes have been most apparent in, but not limited to, the Precambrian, Jurassic, Cretaceous, and the mid-Tertiary. The Precambrian rocks will be assigned to one of five age or genetic groups: a) sedimentary, b) plutonic, or c) one of three suites of early Proterozoic metamorphic rocks. Changes in the Jurassic include proposals by the U.S.G.S. to replace the middle part of the San Rafael Group with the name Wanakah Fm. The change reduces the rank of the Todilto and Summerville Fms. to Members of the Wanakah. The Zuni Sandstone will be redefined and restricted geographically. Changes to the Cretaceous will include restricting the stratigraphic range of the Mesaverde Group in the west-central part of the state, and elevation of the Dakota Sandstone to Group status with both upper and lower Cretaceous components in the east-central part of the state. Extensive revisions of the Tertiary volcanics are largely the result of accurate dating of ignimbrites which permit correlations across the Datil–Mogollon volcanic field.

Stratigraphy, sedimentation, and paleontology session

TRIASSIC STRATIGRAPHY NEAR LAMY, SANTA FE COUNTY, NEW MEXICO, by *Bruce D. Allen,* and *Spencer G. Lucas,* Department of Geology, University of New Mexico, Albuquerque, New Mexico 87131

The Triassic section exposed near Lamy is approximately 410 m thick and can be divided into three distinct units that correspond to the Middle Triassic Anton Chico Formation and the Upper Triassic Santa Rosa and Chinle Formations. The Anton Chico Formation is up to 37 m thick and composed of reddish-gray, trough-crossbedded litharenite and conglomerate. It lies unconformably on the Permian Bernal Formation and is unconformably overlain by the Santa Rosa Formation in sec. 7, T12N, R11E, and has yielded fragments of capitosauroid labyrinthodont dermal armor indicative of an Early–Middle Triassic age. The Santa Rosa Formation is about 140 m thick and dominated by yellowish-brown, trough-crossbedded quartz-arenite. It is overlain by the Chinle Formation in sec. 28, T15N, R11E. Outcrops in secs. 9 and 11, T12N, R10E and in sec. 29, T12N, R11E expose about 230 m of redbeds of the Chinle Formation, which consists of mudstone-dominated and sandstone-dominated intervals. It is unconformably overlain by the Entrada Sandstone in sec. 9, T12N, R10E. Fossil bone fragments from the Chinle Formation include phytosaur and metoposaurid labyrinthodont remains and are of Late Triassic age. The vertical succession of Triassic strata near Lamy is similar to the stratigraphic succession in east-central New Mexico, suggesting that the two areas existed within the same Triassic depositional basin and experienced similar depositional cycles or events.

TRIASSIC MOENKOPI FORMATION OF THE LUCERO UPLIFT, VALENCIA COUNTY, NEW MEXICO, by *Steven N. Hayden,* and *Spencer G. Lucas,* Department of Geology, University of New Mexico, Albuquerque, NM 87131

The oldest Triassic strata in west-central New Mexico have previously been assigned to various formations. Originally classified as Shinarump Conglomerate or Dockum Group, Stewart et al. (U.S.G.S. Prof. Paper #691, 1972) designated them as Moenkopi(?) Formation. These strata are best exposed in the SE$^1/_4$SE$^1/_4$NE$^1/_4$, sec. 10, T5N, R4W on Mesa Gallina in the Lucero uplift, where they consist of as much as 70 m of conglomerate, sandstone, siltstone and mudstone, in three to four repetitive sedimentary packages. The conglomerates range from clast to matrix supported, with predominantly limestone clasts in a matrix of gray, to grayish-red sandstone which resembles the nonconglomeratic sandstones. These sandstones show abundant trough and planar crossbedding. The siltstones range from medium reddish-brown to dusky red, yellowish, and gray, and from coarsely laminated with current ripples to massive. The mudstones are mostly dark red to dusky red-purple with green mottling. The sedimentary packages tend to thicken toward the top of the sequence, and the sands also become more laterally continuous and show higher energy sedimentary structures in the upper units. These strata overlie limestone of the San Andres Formation and underlie mottled strata of the Chinle Formation. Fragments of fossil bone collected from the basal conglomerate of the uppermost unit include three partial vertebrae and most of a scapula of a non-parasuchian thecodont reptile, and one partial interclavical armor plate from a capitosauroid amphibian, indicating an Early to Middle Triassic age. Ostracodes from these strata suggest an Early Triassic age. These fossils preclude assignment of these strata to the Shinarump Conglomerate or the Dockum Group, and together with lithologic and paleocurrent data suggest that these strata are correlative with the Holbrook Member of the Moenkopi Formation of northeastern Arizona.

THE CALCAREOUS MICROFAUNA OF THE MOENKOPI FORMATION (TRIASSIC, SCYTHIAN OR ANISIAN) OF CENTRAL NEW MEXICO, by *Kenneth K. Kietzke,* Department of Geology, University of New Mexico, Albuquerque, NM 87131

Lacustrine and fluvial sediments thought to be outliers of the Moenkopi Formation in the Lucero Mesa area of Valencia County, New Mexico were sampled for microfossils. These samples yielded charophytes and ostracodes. The charophytes are represented by two species of *Porochara* and one of (?) *Altochara*. The ostracodes are represented by two species of *Darwinula*, one species of *Darwinuloides*, and one species of (?) *Gerdalia*. The fauna and flora are most abundant in the middle and upper parts of the basal lacustrine unit. The red overbank mudstones overlying this yellowish laminated shale contain rare, poorly preserved specimens of (?) *Darwinula*. *Darwinuloides* is apparently restricted to Lower Triassic units in the Soviet Union and the Lower Triassic Bundsandstein of Germany. The presence of this genus in the basal Moenkopi samples suggests an Early Triassic age for the basal Moenkopi in the Lucero Mesa region. The charophytes and ostracodes further suggest a clear, highly mineralized lacustrine environment of less than nine meters depth in the section sampled.

TRIASSIC STRATA IN THE HUBBELL SPRINGS FAULT ZONE, VALENCIA COUNTY, NEW MEXICO, by *Spencer G. Lucas, Kenneth K. Kietzke, Steven N. Hayden*, and *Bruce Allen*, Department of Geology, University of New Mexico, Albuquerque, NM 87131

Triassic strata exposed in the Hubbell Springs fault zone pertain to the Moenkopi (?) and Chinle Formations. At least 10 m of pale-brown, brownish-gray and pale-red, fine-grained, micaceous, crossbedded sandstone 1.4 km south of Ojo Huelos lithologically resemble Moenkopi strata in the Lucero uplift and may be assigned tentatively to that unit. Just south of Ojo Huelos (34° 43′ 46″ N; 106° 46′ 42″ W) the approximately 13 m of Triassic strata exposed are assigned to the Chinle Formation. The lower 5.6 m of these strata consist of red, gray and yellowish-orange jasper and chert pebbles (maximum diameter = 5 cm) in a matrix of sandy siltstone that is mottled red, gray, yellowish orange and reddish purple. On a lithologic basis, we correlate these strata with the "mottled strata" and Shinarump Member of the Chinle Formation. Above these strata are 7.4 m of interbedded pisolitic and fenestrate, ostracodal limestone and yellowish-gray sandy mudstone. These lacustrine strata may correlate with part of the Monitor Butte Member of the Chinle Formation. They contain Late Triassic fossils that include the skull of a metoposaurid labyrinthodont, phytosaur teeth, a microfauna of fish teeth, including the freshwater shark *Lissodua* cf. *L. humblei*, and ostracodes assignable to two species of *Darwinula* and to *Gerdalia* cf. *G. triassica*.

PALEONTOLOGY OF THE PETRIFIED FOREST MEMBER OF THE CHINLE FORMATION (LATE TRIASSIC), CENTRAL SANDOVAL COUNTY, NORTH-CENTRAL NEW MEXICO, by *Adrian P. Hunt, Paul L. Sealey*, and *L. Kim Martini*, Department of Geology, University of New Mexico, Albuquerque, NM 87131

Fossil vertebrates, invertebrates and plants are locally abundant in the Petrified Forest Member (PFM) of the Chinle Formation in central Sandoval County, New Mexico. Fossils from the lower third of the PFM have been recovered from the S1/2sec. 3, T15N, R1E. The majority of these fossils represent phytosaurs, including a disarticulated partial vertebral column, a toothplate of the lungfish *Ceratodus dorotheae*, jaw fragments, scutes and teeth. Other vertebrates include two partial interclavicles of the labyrinthodont *Metoposaurus*, fragmentary paramedian scutes of an aetosaur and coprolites. An isolated ungual phalanx is assigned to cf. *Placerias*, the first indication of this genus in New Mexico. The bennettitalean *Zamites* occurs with these vertebrates. Three localities yield fossils from the upper third of the PFM: NW1/4sec. 13, T16N, R1W; SE1/4sec. 20, T16N, R1E; and NW1/4sec. 6, T16N, R1E. The majority of fossils from these localities also represent phytosaurs, including teeth, caudal vertebrae, scutes and other fragments. An aetosaur is represented by fragments of paramedian scutes. A partial caudal vertebrae of a dinosaur is tentatively assigned to the Ceratosauria. Freshwater bivalves are locally abundant and represent *Unio arizonensis* and *Unio* sp. The occurrence of cf. *Placerias* with common metoposaur remains in the lower PFM of Sandoval County suggests correlation with the lower PFM (below Sonsela) of northeastern Arizona. The absence of metoposaurs and the presence of a small primitive theropod in the upper PFM of Sandoval County suggests correlation with the upper PFM (above Sonsela) of northeastern Arizona and the siltstone member/PFM of north-central New Mexico.

UPPER TRIASSIC CORREO SANDSTONE BED, PETRIFIED FOREST MEMBER, CHINLE FORMATION, HAGAN BASIN, SANDOVAL COUNTY, NEW MEXICO, by *Spencer G. Lucas, Kim Martini*, and *Terry Martini*, Department of Geology, University of New Mexico, Albuquerque, NM 87131

The youngest Triassic strata in the Hagan Basin of north-central New Mexico pertain to the Correo Sandstone Bed of the Petrified Forest Member of the Chinle Formation. The Correo Sandstone Bed is 5.5 to 24 m crossbedded, quartzose sandstone and lithic- and limestone-cobble conglomerate exposed along an arcuate outcrop belt that extends from sec. 12, T13N, R5E on the north to the vicinity of Puertecito (sec. 15, T12N, R6E) on the south. Across this outcrop belt, the Correo forms a prominent cliff above reddish-brown mudstone of the Petrified Forest Member of the Chinle Formation and below the medial silty member of the Jurassic Entrada Sandstone. Fossil vertebrates from the Correo Sandstone Bed are fragmentary remains of phytosaurs and metoposaurid labyrinthodonts as well as coprolites, some of which contain ganoid fish scales. These fossils indicate a Late Triassic age and occur primarily in conglomerates, especially in the NE1/4NW1/4, sec. 13, T13N, R5E and the SW1/4NW1/4, sec. 10, T12N, R6E. Recognition of the Correo Sandstone Bed in the Hagan Basin extends its distribution about 80 km to the northeast of its type locality (and supposed easternmost outcrop) at Mesa Gigante (T9N, R3W), Valencia County. This extension is based on similarities in lithology, stratigraphic position and fossils of the type Correo Sandstone Bed and the outcrops in the Hagan Basin.

THE OLDEST PROSAUROPOD DINOSAUR IN NORTH AMERICA FROM THE UPPER SHALE MEMBER OF THE CHINLE FORMATION (LATE TRIASSIC) IN EAST-CENTRAL NEW MEXICO, by *Adrian P. Hunt*, Department of Geology, University of New Mexico, Albuquerque, NM 87131

Isolated teeth from the lower third of the upper shale member of the Chinle Formation in east-central New Mexico represent at least one taxon of anchisaurid prosauropod. Two distinct tooth morphologies are present. The first type consists of laterally compressed teeth up to 13 mm in height, 6 mm in width, and 9 mm in length. Both anterior and posterior margins of the teeth bear up to 15 coarse serrations, which are at angles from 90 degrees to 45 degrees to the tooth margin. Above the root the teeth broaden before tapering to a point. Some teeth are poorly recurved and some bear faint longitudinal striations. Terminal and lateral wear facets are apparent on some teeth. These teeth undoubtedly represent prosauropod dinosaurs because of their shape, size, and morphology of serrations and are most similar to maxillary and dentary teeth of the anchisaurid *Plateosaurus*. A second type is represented by triangular laterally compressed teeth, which are up to 9 mm in height, 4 mm in width, and 6 mm in length. Up to 10 coarse serrations, angled at about 45 degrees, are present on the anterior and posterior margins of the teeth. A distinct median ridge is evident on the lateral aspect of these teeth. Some specimens show terminal and lateral wear facets. The roots are narrower than the bases of the crowns. The tooth shape, serration morphology, and presence of median ridges indicate that these teeth represent herbivorous dinosaurs. In size these teeth resemble prosauropods, but in morphology they are most similar to smaller fabrosaurids and some later stegosaurs, such as *Huangosaurus*. At least the first of these two types of tooth morphology represents an anchisaurid prosauropod. Prosauropods are unknown in the Late Triassic of North America but are common in some rock units of that age in South America, Europe, China, and Africa.

GEOMETRY OF HIGH-FREQUENCY SHORELINE CYCLES: POINT LOOKOUT SANDSTONE, SAN JUAN BASIN, NEW MEXICO, by *Steven N. Hayden, Robyn Wright*, and *Jean Miossec–Luc*, Department of Geology, University of New Mexico, Albuquerque, NM 87131

High frequency (<100,000) transgressive (T–R) shoreline couplets form the building units of the Point Lookout Sandstone. Following cycle hierarchy, these couplets are of fifth order, while the entire Point Lookout forms the regressive half of a larger third order couplet. Third and fourth order transgressions are commonly accompanied by development of associated transgressive deposits. Most observations suggest, however, that fifth order cycles are asymmetric, and that a transgressive surface of erosion of nondeposition is followed vertically by a coarsening-upward progradational package. This study demonstrates greater symmetry may exist within these cycles than previously observed. Eight sections were measured at a laminae scale on a transect roughly perpendicular to paleoshoreline in the transition from Mancos Shale to the base of the Point Lookout Sandstone. All sections were lateral equivalents within the same fifth order couplet (selected for its continuous exposure), and all display the same general geometry: fining upward mudrock base, clay-rich "condensed" section, and coarsening upward mudrock to sandstone top. Symmetry is best displayed in distal sections, while coarse shoreface sandstones directly overlie the "condensed" section in proximal localities. Similar detailed measurements must be made for many other fifth order cycles before a depositional model can be constructed; but this study demonstrates that mud deposition accompanied transgression within one high-frequency T–R couplet. This observation is significant because transgressive mudrocks may play an important role in fluid migration within shoreline sandstones and because their blanket geometry is very different from their regressive counterparts.

JEMEZ-DERIVED PUMICE NEAR SAN ANTONIO, NEW MEXICO: DEPOSITIONAL PROCESSES AND IMPLICATIONS, by *Steven M. Cather*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

Pumiceous sedimentary deposits containing cobble-sized clasts are exposed in bluffs located about 5 km east of San Antonio, NM. These deposits attain a maximum thickness of about 5 m and consist of, in order of ascending stratigraphic position: 1) basal ash-rich fluvial and hyperconcentrated flood-flow deposits; 2) coarse debris-flow deposits (at least two flows are represented); 3) sandy hyperconcentrated flood-flow deposits; and 4) local, rafted blocks of pumice at the top. Due to effects of nondeposition, erosion, and recent mining activities, component facies are rarely all exposed together in a solitary outcrop. Stratigra- ☞

phy and styles of soft-sediment deformation suggest deposition occurred during a single flood event. Debris flows were presumably initiated by rhyolitic eruptive events in the Jemez area (1.1 to 1.5 Ma) although more precise correlations remain controversial. Probably because of their low density, debris flows represented by the pumice deposit near San Antonio are extraordinarily far-traveled; they are about 220 km downstream from their source. Deposition and preservation of pumice and underlying axial floodplain mudstones in the study area may be related to down-valley constriction of flow by the juxtaposed Pleistocene fans of San Pedro Arroyo and Walnut Creek. If these pumiceous deposits are temporally related to a Jemez eruption, then their inset nature indicates an age of 1.1 Ma or older for the Tio Bartolo surface of Sanford et al. (1972).

TAPHONOMY OF TWO MENISCOTHERIUM ASSEMBLAGES FROM THE EOCENE SAN JOSE FORMATION, SAN JUAN BASIN, NEW MEXICO, by *Thomas E. Williamson*, Department of Geology, University of New Mexico, Albuquerque, NM 87131, and *Steven McCarroll*, Department of Geological Sciences, University of Illinois, Chicago IL 60680

Two localities within the lower Eocene San Jose Formation yield numerous fossils of the early Eocene mammal *Meniscotherium chamense*. The AMNH 150 locality (NE¹/₄, SW¹/₄, SW¹/₄, sec. 31, T25N, R1W) in the Tapicitos Member produced at least 43 individuals of *M. chamense*. Fossil bones are complete but disarticulated in patches within a 7–13-cm-thick interval of poorly sorted, muddy to fine sandy siltstone with 1-cm-thick vertical burrows and calcium carbonate concretions. The bone bed lies about 7 m below a trough-crossbedded sandstone. Sixty-eight long-bone orientations plot as two perpendicular modes in a nearly horizontal plane, and the bone assemblage is depleted of bones of Voorhies Group I, implying slight movement by shallow running water. UNM locality JIC–E147 (NE¹/₄, SE¹/₄, NW¹/₄, sec 22, T23N, R2W) in the Regina Member yielded at least 46 individuals of *M. chamense*. The relatively narrow bone-producing interval is about 50 m from a laterally adjacent trough-crossbedded channel sandstone. The remains of *M. chamense* are found as complete and incomplete articulated skeletons and disarticulated complete bones and bone fragments. The main bone-containing interval, filling a paleodepression, is about 80 cm thick and is a poorly sorted muddy to fine sandy siltstone almost completely devoid of burrows. Both articulated and disarticulated bone was found as much as 1.2 m above the main bone-producing layer suggesting reworking and repeating burials. The two localities share several associated taxa which include *Coryphodon sp.*, *Hyracotherium sp.*, *Saniwa ensidens*, and *Crocodilia*. Both represent little transported, catastrophic death assemblages, buried in overbank deposits of proximal floodplain environments.

Hydrogeology and geophysics session

USE OF SLUG AND BAILER TESTS AS GUIDES TO AQUIFER PARAMETERS, by *Clay L. Kilmer*, and *T. E. Kelly*, Geohydrology Associates, Inc, 4015–A Carlisle, N.E., Albuquerque, NM, 884–0580

Testing techniques have been described in the literature which allow for the acquisition of hydrologic data from wells where the installation of a test pump is impossible or not feasible. The techniques involve rapid introduction (slug) or withdrawal (bail) of water in a well bore. Wells completed in confined aquifers may be "bailed" or "slugged"; wells completed in water-table aquifers must be bailed. Field testing has shown good correlation between aquifer parameters measured with bail and slug tests and aquifer parameters determined by sustained yield tests in the same wells and/or in wells completed in similar lithologic units. These tests are particularly useful in environmental applications where abundant small-diameter wells are typically drilled for sampling purposes. Slug and bailer tests provide a "window" of the hydraulic properties in a small portion of the aquifer. When used with proper considerations, these tests can provide hydrologic information where no data would otherwise be available, or as invaluable additions to more expensive and less abundant conventional test data.

HYDROGEOLOGIC EFFECTS OF DEWATERING AN OPEN-PIT COPPER MINE NEAR TYRONE, NEW MEXICO, by *Deborah L. Hathaway*, State Engineer Office, Bataan Memorial Building, Santa Fe, New Mexico

A finite-difference ground-water flow model has been developed for the area surrounding Tyrone, New Mexico, to determine the effects of dewatering an open-pit copper mine and pumping adjacent wells on regional water levels and stream flows. The open-pit mine straddles the Continental Divide at the eastern edge of the Big Burro Mountains in southwestern New Mexico. The model area includes a portion of the Big Burro Mountains which are composed primarily of granite and associated rocks along with the Tyrone quartz monzonite stock, the Little Burro Mountains, and intervening valley areas which are underlain by the Gila Conglomerate. The model includes a portion of two groundwater basins managed by the state engineer: the Mimbres and the Gila–San Francisco basins. Initial estimates of hydraulic parameters for the flow model were developed on the basis of the hydrogeologic characteristics of the formations and aquifer tests. The parameters were refined within the empirically estimated range through two transient calibration simulations. The simulations were performed over the period April 1952 to June 1953, during which time four wells were pumped and water levels were monitored in nearby wells, and the period January 1971 to February 1985, during which time the mine was in operation and for which pumping, tailings pond seepage, and water level records were available. The model was then used to calculate the drawdown at nearby existing wells and the depletion in the flow of Mangas Creek which would result from proposed pumping at the mine.

HYDROGEOLOGIC INVESTIGATION AT WHITE SANDS TEST FACILITY (WSTF), LAS CRUCES, NEW MEXICO, by *Victoria Sutton*, Lockheed, P.O. Drawer MM, Las Cruces, NM 88004, *Earl L. Morse*, Geoscience Consultants, Ltd., 500 Copper Ave., NW, St. 200, Albuquerque, NM 87102, and *Robert E. Mitchell*, White Sands Test Facility, P.O. Drawer MM, Las Cruces, NM 88004

U.S. Environmental Protection Agency regulations, developed under the Resource Conservation and Recovery Act (RCRA), require a facility which treats, stores, and/or disposes of hazardous waste to obtain an operating permit. A thorough characterization of the site hydrogeology is required under RCRA to understand the environmental impact of facility operations. Controls on fluid movement in both the vadose zone and the uppermost aquifer must be determined prior to predicting the flow of potential contaminants released to the environment. WSTF began a detailed site hydrogeologic characterization in 1986 with geophysical and geologic surveys, a shallow soil boring project, and the installation of groundwater monitoring wells. The presence of locally variable geomorphic features complicate fluid migration in the vadose zone. These surface variations and the presence of a shallow caliche zone reduce infiltration and aquifer rates and increase surface runoff. Groundwater is located between 120 and 180 feet below WSTF in an unconfined aquifer. The aquifer transects three distinct geologic units: 1) The Camp Rice Formation (uppermost Santa Fe Group), 2) The Oligocene Orejon Andesite, and 3) Paleozoic Limestones of the Hueco Formation. The Oregon Andesite and Paleozoic carbonates typically have low matrix hydraulic conductivity and transmit water primarily through open fractures. Camp Rice sediments are believed to be highly variable in both lithology and hydraulic properties. Small-displacement, high-angle faults act as primary structural control on groundwater movement as a result of higher fluid transmitting capabilities. The direction of groundwater movement is west–southwest from WSTF into the Jornada del Muerto Basin. Further hydrogeologic characterization will continue at WSTF with the information gathered during monitor well installation, seismic reflection surveys, aquifer testing, and groundwater modeling.

PRELIMINARY WORK ON THE DETERMINATION OF GROUNDWATER FLOW USING CHEMICAL ANALYSIS, JORNADA DEL MUERTO BASIN, DOÑA ANA COUNTY, NEW MEXICO, by *Roseann Stickel*, Geology Dept., Box 3AB NMSU, Las Cruces, New Mexico 88003

The Jornada del Muerto, located in southern New Mexico, is an intermontane synclinal basin that is bounded by several north–south trending faults that define block ranges—mainly the Sierra Oscura and the San Andres Mountains to the east and the Fra Cristobal and the Caballo Mountains to the west. The north-trending depression is approximately 120 mi in length and ranges from 10 to 30 mi in width. Quaternary and Tertiary sedimentary rocks of the Santa Fe Group are covered by a thin veneer of alluvial sand and pediment gravel. The Santa Fe Group is divided into four formations which are from base to top: 1) an unnamed transitional unit between the basin-fill surface and the Santa Fe Group; 2) the Hayner Ranch Formation; 3) the Rincon Valley Formation; and 4) the Camp Rice Formation. Because of a variety of depositional environments, the Miocene to middle Pleistocene Santa Fe Group consists of two principal hydraulic units. The hydraulic units are composed of alluvial-fan and fluvial facies that are interbedded with a less permeable clay facies that retards the flow of water. Preliminary contour maps and piper trilinear diagrams of chemical (cations—Na^+, K^+, Ca^{+2}, Mg^{+2}, and anions—HCO_3^-, CO_3^{-2}, Cl^-, SO_4^{-2}) concentrations, pH, conductivity, and temperature data from 68 wells indicates that groundwater flow in the southern portion of the Jornada del Muerto is generally to the northwest, while flow in the northern end of the basin typically moves southwestward.

STREAM–AQUIFER RELATIONS IN THE MESILLA GROUNDWATER BASIN, DOÑA ANA COUNTY, NEW MEXICO, AND EL PASO COUNTY, TEXAS, by *Robert G. Myers*, and *Edward L. Nickerson*, U.S. Geological Survey, Box 30001, Dept. 3167, New Mexico State University, Las Cruces, New Mexico 88003–0001

Hydrologic sections consisting of observation-well groups and a river-stage gage were established along the Rio Grande near Las Cruces, Mesquite, and Canutillo as part of a study to better define the hydrologic system of the Mesilla groundwater basin. The wells were completed in the Quaternary flood-plain alluvium and in the Quaternary and Tertiary Santa Fe Group at depths ranging from 35 to 801 feet. Downward, vertical hydraulic gradients exist at all observation-well groups. Water levels in wells near the Rio Grande correspond to changes in river stage. Hydraulic gradients indicate the Rio Grande is recharging the aquifer at each section. Seasonal water-level trends in wells less than 60 feet deep generally correspond to recharge during the irrigation season; water levels in deeper wells (60 to 350 feet) generally indicate similar trends. Water-quality analyses indicate that freshwater zones are overlain by zones of slightly saline to saline water. Near the Rio Grande and irrigation canals, the shallow, slightly saline to saline water is flushed from the aquifer by surface-water recharge.

GROUND-WATER-LEVEL DATA FOR THE ALBUQUERQUE–BELEN BASIN, NEW MEXICO, THROUGH WATER YEAR 1985, by *Georgianna E. Kues*, United States Geological Survey, 4501 Indian School Rd. N.E., Albuquerque, NM 87110

Ground-water levels in the central part of the basin are approximately at the altitude of the Rio Grande. Water levels near the northeast basin boundary showed a vertical difference of approximately 620 ft over a horizontal distance of about 1 mi. In continuously monitored wells on the outskirts of the city of Albuquerque, ground-water levels generally rise each year from October through February and decline from March through September. The decline in highest recorded annual water levels was greater from water year 1983 to 1984 than from water year 1984 to 1985. Such declines increased with increasing distance from the Rio Grande. Monitoring wells that have multiple completion depths showed water levels up to approximately 20 ft higher in the uppermost screened interval than in the lowest screened intervals. Water levels in wells outside the city of Albuquerque, generally declined less than 6 ft from water year 1982 to water year 1985.

HYDROGEOLOGY OF THE SAN AGUSTIN BASIN, THE ALAMOSA CREEK BASIN UPSTREAM FROM MONTICELLO BOX, AND THE UPPER GILA BASIN, WEST-CENTRAL NEW MEXICO, by *Robert G. Myers*, U.S. Geological Survey, Box 30002, Dept. 3167, New Mexico State University, Las Cruces, New Mexico 88003–0001

The San Agustin Basin, Alamosa Creek Basin upstream from Monticello Box, and the upper Gila Basin are located in parts of Catron, Socorro, and Sierra Counties in west-central New Mexico. There are four major aquifers within the study area: the San Agustin bolson-fill aquifer; the Alamosa Creek shallow aquifer; and the Datil and the shallow upland aquifers, which are present in all basins. Three minor aquifers, the Baca Formation at the northern edge of the San Agustin Basin, a basalt to basaltic andesite unit overlying the Datil Group in the San Agustin and Gila Basins, and the Gila Conglomerate in all basins, produce some water. Potentiometric-surface maps were constructed to determine the hydraulic gradients of the San Agustin bolson-fill aquifer, the Datil aquifer, and the Alamosa Creek shallow aquifer. Dissolved-solids concentrations of water samples from all aquifers ranged from 74 to 23,500 milligrams per liter. The dominant cations varied; the dominant anion of freshwater generally was bicarbonate. Vertical electrical-resistivity soundings were used to estimate the thickness of bolson-fill and the depth of the saline-water/freshwater interface in the San Agustin bolson-fill aquifer. Point-of-discharge temperatures of well or spring water that are greater than 21°Celsius are associated with faults in the areas of shallow or exposed bedrock. The dissolved-solids concentration of warm water ranged from 120 to 1,200 milligrams per liter.

CORRELATIONS BETWEEN HEAT-FLOW AND HYDROLOGIC DATA FROM THE SAN JUAN BASIN, NEW MEXICO, by *M. Reiter*, New Mexico Bureau of Mines and Mineral Resources and Geoscience Department, New Mexico Institute of Mining and Technology, Socorro, NM 87801, and *F. M. Phillips*, Geoscience Department and Geophysical Research Center, New Mexico Institute of Mining and Technology, Socorro, NM 87801

Geophysicists have recognized the potential for ground-water movement to disturb the conductive geothermal gradient and therefore to perturb measurements of terrestrial heat flow. Conversely, one may examine deep precision temperature logs not only to evaluate heat-flow data, but also to study the hydrologic regime of an area. By plotting Q (heat flow) vs T (temperature) the direction and magnitude of vertical ground-water movement may be estimated. The slope of the Q– T plot is given by $m = \nu/\rho c$, where ν is specific discharge, ρ is density, and c is specific heat. Using both heat-flow data, and data on hydraulic head differences between formations, estimates of specific discharge have been compared at 8 locations in the San Juan Basin. Estimates of the direction of vertical ground-water movement (up or down) using the two techniques were compatible at many of the sites, and the rates of specific discharge also agreed to an order of magnitude. At some locations the different estimates of vertical specific discharge were incompatible, probably because of poor thermal conductivity data (needed to calculate heat flow) and incomplete hydrologic data. The deeper heat-flow data in the San Juan Basin demonstrate smaller Q–T slopes; and therefore indicate lower rates of specific discharge. Q–T plots may have the potential to provide valuable estimates of the magnitude and direction of vertical ground-water movement in many areas.

INTERPRETATION OF HEAT-FLOW AND COAL-MATURATION DATA IN WEST-CENTRAL NEW MEXICO, *J. Minier**, and *M. Reiter*, New Mexico Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, NM 87801

Two general hypotheses have been proposed to describe the tectonic evolution of the southeastern boundary of the Colorado Plateau. One hypothesis suggests that the geophysical boundary of the Plateau is migrating toward the Plateau interior as a result of crustal/lithospheric thinning, for example as is thought to be occurring along the northwestern Plateau boundary. Another hypothesis, however, suggests that much of the volcanic activity along the southwestern Plateau boundary reflects the presence of a pre-existing zone of weakness in the lithosphere, the Jemez lineament, which has leaked magma to the surface. Several observations derived from this study tend to favor the latter hypothesis. First, profound regional trends in heat flow are not observed in the study area (although deeper heat-flow data are surely needed). The data present a heat-flow pattern consisting of local anomalies of relatively high heat flow superimposed on a regional low to intermediate heat-flow setting, rather than a gradual increase of heat flow from the Plateau interior across the transition zone to the Rio Grande rift/Basin and Range Province. Sites with relatively high heat flow located towards the Plateau interior and away from recent volcanic activity may reflect magma intrusion and/or ground-water movement along crustal zones of weakness associated with Laramide deformation (monoclines). Second, the lack of profound regional trends in coal maturation across the study area suggests that any post-Cretaceous thermal events which may be associated with the southern Plateau boundary of Jemez lineament have been initiated relatively recently and/or are occurring at relatively great depths; or the thermal events are in the form of relatively small, widely spaced intrusions.

*Now at Daniel B. Stephens & Assoc., P.O. Box 740, Socorro, NM 87801

A PRELIMINARY REPORT ON THE HYDROGEOTHERMICS OF THE SOCORRO AREA, NEW MEXICO, by *Margaret W. Barroll*, and *Marshall Reiter*, New Mexico Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro, NM 87801

The Socorro area has been tectonically, volcanically and geothermally active since early Oligocene times; the area continues to be geothermally active today. This study is based on geothermal resource exploration data and samples that have been released by industry sources (e.g. temperature logs, lithologic logs, drill cuttings). Heat flows determined from this data indicate that the near surface geothermal regime in the Socorro area is profoundly influenced by subsurface hydrology, and possibly by subsurface magmatic heat sources as well. Very low heat flows are present west of the Socorro mountain block in La Jencia Basin. These values are far lower than typical values for a geothermally active area, even lower than values measured in geologically stable areas. The low heat flows in La Jencia Basin suggest downward groundwater flow at depth. Heat flows in the Socorro mountain block are often very high and data from deep wells in the mountain block show great variation of heat flow with depth. Curvature in the temperature depth profiles of deep wells suggests upward ground-water leakage in an aquitard above a Tertiary volcanic aquifer. Very high heat flows and warm water at shallow depth are found where the Tertiary volcanic rocks have been upfaulted close to the surface. The Tertiary volcanics may be a reservoir for warm water such as is found at Socorro Springs and the Blue Canyon well. The hydrologic conditions of this aquifer and its geometry probably have a great influence on the geothermal regime of the Socorro mountain block. Cooling crustal magma may contribute to the reservoir's heat.

Economic geology session

TIJERAS FAULT SYSTEM, INTRUSIONS, AND AU MINERALIZATION ON THE ORTIZ MINE GRANT, SANTA FE COUNTY, NEW MEXICO, by *Stephen R. Maynard*, LAC Minerals (U.S.A.), Inc., 10,000 Trumbull, S.E., Albuquerque, NM 87123

Investigations on the Ortiz Mine Grant have revealed the relationship of igneous activity and gold mineralization to the Tijeras fault system. The northeast-trending Tijeras fault system passes through the southeastern part of Ortiz Graben Mountains and is characterized by the asymmetric Ortiz Graben. Several fault blocks, containing up to 1,000 ft of Eocene Galisteo Formation, comprise the graben, which has up to 4,000 ft and 2,000 ft of stratigraphic separation on its southeast and northwest sides, respectively. Development of the Ortiz Graben is postdated by a late Oligocene(?) augite monzonite stock. It is postulated that the Ortiz Graben began forming in the late Eocene or early Oligocene. Intrusions on the Ortiz Mine Grant occurred in four stages: 1) quartz-bearing latite-andesite sills, laccoliths, and dikes intruded Triassic to Tertiary strata at about 40 m.y. (Bachman and Mehnert, 1978). Recurrent fault movement makes the timing of latite-andesite intrusion relative to development of the Ortiz Graben obscure. 2) A Late Oligocene(?) augite monzonite stock with an extensive contact metamorphic aureole intruded the sill- and laccolith-intruded section. 3) Quartz monzonite and syenite-latite stocks and plugs intruded and pipe-like breccia bodies developed near or along the northwest margin of the ☞

Ortiz Graben. 4) Trachytic latite dikes intruded parallel to the northwest boundary of the Ortiz Graben and radial to intrusive plugs and breccia pipes. Gold mineralization occurs in five distinct environments on the Ortiz Mine Grant: 1) breccia pipes, 2) skarns, 3) veins and shear zones, 4) magnetite–chalcopyrite stockworks, and 5) placers. Lode mineralization postdates stage 3) intrusions and predates state 4).

STRUCTURAL AND STRATIGRAPHIC CONTROLS OF DEPOSITION AND MICROSTRATIGRAPHY OF FLUORITE–BARITE DEPOSITS IN THE SOUTHERN RIO GRANDE RIFT, NEW MEXICO, by *Timothy P. McMahon* and *Thomas H. Giordano*, Department of Earth Sciences, New Mexico State University, Las Cruces, NM 88003

Areas within the southern Rio Grande rift in which fluorite–barite deposits occur include the Bishop Cap Hills, Tortugas Mountain, the Organ Mountains, San Diego Mountain, and the southern Caballo Mountains. These deposits usually occur as fracture-fill in structures related to the development of the Rio Grande rift. Most of the deposits are hosted by Paleozoic sedimentary rocks, but a few occur in Precambrian crystalline rocks. Replacement of carbonate rocks during mineralization was usually minor, but large-scale replacement has been observed in the southern Caballo Mountains. Preliminary thin section analysis suggests the following paragenetic sequence for the dominant minerals found in most of the deposits studied: fluorite, barite, quartz, calcite. Galena occurs in some deposits, usually in small, local concentrations. Pyrite has also been observed, but it is less common than galena. Cathodoluminescent microscopy reveals features in quartz which may be useful in correlating phases of mineralization among deposits in the study area. A model for fluorite–barite mineralization in the Rio Grande rift is proposed. Deep basin fluids, heated by a high geothermal gradient, were driven upward along rift-related structures by forced convection. Deposition of the minerals took place as these fluids mixed with shallower formation waters. There were at least two phases of hydrothermal activity within this system. The first phase resulted in the deposition of fluorite and barite, while quartz and calcite were deposited during the second phase. These deposits appear to have formed during the middle to late Miocene.

GEOLOGY AND GEOCHEMISTRY OF CARBONATITES IN NEW MEXICO, by *Virginia T. McLemore*, New Mexico Bureau of Mines and Mineral Resources, Socorro, New Mexico 87801

Carbonatite dikes occur at five localities in New Mexico: Lemitar and Chupadera Mountains in Socorro County, Monte Largo area in Bernalillo County, Lobo Hill in Torrance County, and Chico Hills in Colfax County. They are carbonate-rich rocks of apparent magmatic descent and are characterized by a distinct but variable mineralogy, geochemistry, and associated alteration. These unusual rocks consist of greater than 50% carbonate minerals and varying amounts of apatite, magnetite, mica, and other accessory minerals. Two geochemical groups can be differentiated: 1) low iron (4–11% FeO + Fe_2O_3), high phosphate (greater than 1.4% P_2O_5) and 2) high iron (8–16% FeO + Fe_2O_3), low phosphate (trace–1.5% P_2O_5). Both groups are high in CaO (17–41%), CO_2 (14–41%), and numerous minor and trace elements and low in SiO_2 (less than 20%) and Al_2O_3 (less than 6%), relative to other igneous rock types. The carbonatites are enriched in light REE relative to heavy REE and display steep, light REE-enriched chondrite-normalized patterns. Fenitization, a metasomatic alteration associated with carbonatite and alkalic rocks, is locally present adjacent to some carbonatites. The Lemitar, Chupadera, Monte Largo, and Lobo Hill carbonatites intrude Precambrian terrains and appear to be Cambrian–Ordovician, although only the Lemitar carbonatites have a reported K–Ar biotite age of 449 ± 16 m.y. The Lobo Hill carbonatite intrudes a syenite with a reported Rb–Sr whole-rock age of 640 m.y. Carbonatites in southern Colorado are Cambrian–Ordovician. The Chico Hills carbonatite intrudes a phonotephrite with a reported K–Ar hornblende age of 25.3 ± 0.9 m.y. The similarity in emplacement, mineralogy, geochemistry, alteration, and age suggest that the Lemitar, Chupadera, Monte Largo, and Lobo Hill carbonatites and the carbonatites in southern Colorado are part of a regional carbonatite and alkalic magmatic event which affected New Mexico and southern Colorado during Cambrian–Ordovician times. The Chico Hills carbonatite is related to the Raton–Clayton volcanic field of Tertiary age.

INVESTIGATION OF A RARE-EARTH ELEMENT OCCURRENCE, by *M. Willis*, P.O. Box 2466 C/S, Socorro, NM 87801

The prospect is located in the Capitan Mountains several miles northeast of the town of Capitan. The veins are hosted by a igneous stock (laccolith?) of alaskaite composition (50% feldspars, 40% quartz, 3% hornblende, 7% accessory minerals) and contains: allanite, titanite (sphere), quartz, plagioclase, chlorite and clay minerals. Allanite exhibits a similar crystal habit as epidote and contains the rare-earth Cerium (Ce). Some quartz at the prospect exhibits Japanese twining. The paragenetic sequence of minerals in the vein is obscured by poor exposure and the presence of clays. The general area is characterized by few outcrops and thick cover. Through microscopic textural relationships, a tentative paragenesis has been constructed. Fluid inclusions have been found in the sphere and quartz at the deposit. These inclusions have several characteristics that make them very interesting. 1) The salinities are very high, averaging 65 eq. wt. % NaCl. 2) Homogenization temperature ranging from 480–580°C. 3) Homogenization by halite disappearance (i.e., vapor homogenizes before halite). This may be explained by the fluid being saturated with halite at the time of deposition. Further evidence for this is solid inclusions of halite found in quartz. 4) The inclusions contain an average of 8 daughter minerals. Positive identification of the daughter minerals is complicated by their small size, but tentative identification of halite, sylvite, hematite and anhydrite has been made based on optical properties and behavior upon heating. The rest are unidentified. Allanite is commonly associated with felsic igneous rocks and pegmatites. The high salinities and homogenization temperatures along with the close proximity to a igneous body point to a magmatic source for the mineralizing fluid.

GEOLOGY OF BRAVO DOME CARBON DIOXIDE GAS FIELD, NORTHEAST NEW MEXICO, by *Ronald F. Broadhead*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

The Bravo dome carbon dioxide gas field is located in Union and Harding Counties of northeast New Mexico. The Bravo dome field covers approximately 800,000 acres, but areal boundaries of the field have not been fully defined by drilling. Production in 1986 was 127 billion ft^3 gas from 271 wells. Cumulative production at the end of 1986 was 244 billion ft^3. Estimated recoverable reserves are 10 trillion ft^3 gas. The gas is 98–99% CO_2. Most CO_2 produced from the Bravo dome field is used for enhanced oil recovery in the Permian Basin. The Bravo dome is a faulted, southeast-plunging, basement-cored anticlinal nose. It is bordered on the east and south by large high-angle faults of Pennsylvanian and Wolfcampian (Early Permian) age. The principle reservoir in the Bravo dome field is the Tubb sandstone (Leonardian–Permian) at depths of 1,900 to 2,950 ft. The Tubb consists of 0–400 ft of fine- to medium-grained, well-sorted, orange feldspathic sandstone. It rests unconformably on Precambrian basement on the highest parts of the Bravo dome and is not offset by late Paleozoic faults that form the dome. The Cimarron Anhydrite (Leonardian–Permian) conformably overlies the Tubb and is a vertical seal. The trap at Bravo dome has structural and stratigraphic aspects. Drape of Tubb sandstone over the dome created structural closure on the northeast, southeast, and southwest flanks of the field. Trapping on the northwest flank of the field is associated with regional northwest thinning of the Tubb.

TRAVERTINE QUARRIES AND DEPOSITS IN NEW MEXICO, by *James M. Barker*, New Mexico Bureau of Mines and Mineral Resources, Campus Station, Socorro, NM 87801

Travertine, produced at two quarries in New Mexico, is a banded limestone deposited at or near the surface by ground water. Bedded limestone is the primary source rock for the carbonate-charged waters that form most travertine deposits. Travertine distribution in New Mexico therefore is typically related to the presence of limestone at or near the surface. Travertine is currently quarried in New Mexico by New Mexico Travertine near Belen and by Apache Springs Company near Radium Springs. Several other deposits have drawn attention during the 1980's but none have been developed for travertine. The quarry operated by New Mexico Travertine is in Valencia County about 20 miles west of Belen at Mesa Aparejo. The mill is about two miles west of Belen. The quarry is in sec. 12–13, T5N, R3W and is operated continuously at a rated capacity of 4,800 tons per year. Reserves underlie about 1,140 acres and total about 200 million tons. A wiresaw cuts 15–18 ton blocks of travertine which are then tipped out of the face and hauled to the mill. All smaller blocks are crushed for use in pre-cast exposed-aggregate panels, rock veneers, and landscaping. The travertine mill features Italian-made equipment including a 55-blade gangsaw (Gaspari), bridgesaw (Gregori), and a polishing line (Gregori). This equipment can produce 2000–3000 sq ft of polished slabs (4'x 8') or tiles (1'x 2', 2'x 2') daily. All sawing, finishing, coping, and polishing of the stone is done here with a large custom business in place. The quarry operated by Apache Springs Co. is in Doña Ana County, about eight miles southwest of Radium Springs. It is in sec. 23, T21S, R2W and is operated intermittently at a rated capacity of 96 cubic feet per day. Travertine deposits are widespread in New Mexico but few have dimension stone quality. A more likely end use for some of these is as high-calcium limestone or in cement manufacture.

RECONNAISSANCE GEOCHEMISTRY, INFERRED FLUVIAL SYSTEMS, AND ECONOMIC POTENTIAL OF THE EOCENE SAN JOSE FORMATION, SAN JUAN BASIN, NEW MEXICO, *Richard M. Chamberlin*, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM 87801

The Eocene San Jose Formation is generally considered to consist of widespread arkosic sandstones and interbedded mudstones of fluvial origin. As part of the National Uranium Resource Evaluation (NURE), stream-sediment samples were collected from 439 first-order catchments within the San Jose Formation. Fine-grained fractions (−100 mesh) were analyzed for all major elements, except Si, and a broad spectrum of 25 trace elements. Element distribution maps, prepared from the NURE data, provide a new perception of primary sediment distribution which differs significantly from published geologic maps. Petrographic identification of sandstone mineralogy, element correlation diagrams, and element distribution maps have been used to delineate four compositionally distinct fluvial systems. The generally south-flowing fluvial systems are informally named after features near where they entered the basin. The arkosic Carracas Mesa system is distinguished by relatively high concentrations of Al, Ti, Zr, Y, P, Mg and K. Erratic highs of Ti, Zr, and Y reflect placer concentrations of ilmenite, zircon and monazite along the stream axis. High Al and K, with uniformly low Ti define illitic floodplain deposits. High Mg reflects entrapment of biotite by waning currents in a fluvial-fan subfacies. The Llaves system is distinguished by unusually low Al, which reflects an average estimated SiO_2 content of 89 percent. Kaolinitic floodplain deposits are indicated by locally high variability of Al and very high ratios of Al to alkalis. The Riverside–Cuba Mesa system is characterized by intermediate concentrations of Al and estimated SiO_2 (84%) in association with relatively thorium-rich zircons (Th/Zr greater than 0.2). The Piedra Peak system is locally defined by slightly elevated boron, suggesting traces of tourmaline. Groundwater uranium anomalies, radiometric anomalies, and weathered uranium occurrences (associated with jarosite) collectively indicate significant potential for leachable Gulf Coast-type uranium deposits at the margins of the 150-m-thick Llaves sandstone system. In the future, superconductivity technology utilizing yttrium could make monazite placers in the Carracas system economically attractive. Recognition of a northeast-trending basement structure, defined by an aeromagnetic lineament and the apex of the Carracas fluvial fan, may help focus exploration for oil and gas in underlying Cretaceous strata.

Upcoming geologic meetings

Conference title	Dates	Location	Contact for more information
Western States Geographic Names Conference	Sept. 7–10	Holiday Inn, Crown Plaza, Seattle, WA	Bonnie Bunning (206) 459–6372
Denver Gem & Mineral Show	Sept. 16–18	Exposition Hall, Merchandise Mart, Denver, CO	Denver Council, Box 621444, Littleton, CO 80162
Geographic Information Systems Symposium	Sept. 26–30	Sheraton Denver Tech Center, Denver, CO	Dr. Thomas M. Usselman, Bd. of Earth Sciences, NAS, 2101 Constitution Ave. NW, Washington, DC 20418 (202) 334–3349
Denver Geotech 88	Oct. 1–4	Denver, CO	Doug Peters, US Bureau of Mines, P.O. Box 25086, BLDG20–DFC, Denver, CO 80225 (303) 236–0772
Association of Earth Science Editors	Oct. 2–5	Sheraton Old Town, Albuquerque, NM	Jon Callender, Museum of Natural History, Albuquerque, NM (505) 841–8842
New Mexico Geological Society, fall field conference	Oct. 5–8	Deming, NM area	Robert Myers, Dept. of Earth Sciences, Box 3AB, New Mexico State Univ., Las Cruces, NM 88003 (505) 646–1335
West Texas Geological Society, fall field seminar	Oct. 13–16	Guadalupe Mts.	Jim W. Adams, Exxon Co., P.O. Box 3116, Midland, TX 79702 (915) 688–6292, OR WTGS Office, P.O. Box 1595, Midland, TX 79702 (915) 683–1573
1988 GSA Centennial Celebration	Oct. 31–Nov. 3	Denver, CO	GSA Meeting Dept., P.O. Box 9140, Boulder, CO 80301 (303) 447–2020
New Mexico Mineral Symposium	Nov. 12–13	Macey Center, Socorro, NM	Judy Vaiza, NMBMMR, Socorro, NM 87801 (505) 835–5203

WTGS Fall Field Trip

The 1988 West Texas Geological Society fall field seminar will be held in the Guadalupe Mountains area of southeastern New Mexico October 13–16, 1988. All three roadlogs will begin and end in Carlsbad; buses will carry participants to trailheads, and hiking boots, canteens, hard hats, and flashlights are recommended equipment for off-road trips into canyons and a travertine cave. Stops will include the west face of the Guadalupes (Shumard and Bone Spring Canyons) or Bell Canyon sandstone, Rader limestone, and reef-facies transitions (McKittrick Canyon, and Pratt's cabin or the geology rim trail); backreef facies (Dark Canyon), cave pearls, and an evaporite–dolomite transition (Rocky Arroyo); and backreef facies, pisolites, and teepee structures (Walnut Canyon). Participants may independently tour Carlsbad Caverns. Two stops to study the Castile anhydrite will highlight the return trip to Midland. General chairman for the field seminar is Jim Adams, Exxon Company, USA, Box 3116, Midland, Texas 79702. Bill Purves is in charge of roadlogs that interweave human history with geology. For more information, contact Jim Adams (915/688-6292) or Marie Bellomy (915/683-1573) in Midland.

NMGS Fall Field Trip

The 1988 New Mexico Geological Society fall field conference will be held in the Deming–Lordsburg area of southwest New Mexico October 5–8, 1988. All three roadlogs will begin and end in Deming, and four-wheel-drive vehicles will be required for the three days of driving into the Florida, Little Hatchet, and Animas Mountains. The theme of the trip is Cretaceous and Laramide tectonic evolution of southwestern New Mexico. Stops will include Precambrian and Paleozoic rocks, Laramide deformation, Cretaceous and lower Tertiary stratigraphy, and Tertiary volcanics. General chairman for the field conference is Jerry Mueller, Department of Earth Sciences, New Mexico State University, Las Cruces, New Mexico 88003 (505/646-2708). Russ Clemons (505/646-1033) and Greg Mack (505/646-1343) are field trip co-chairmen; guidebook editors are Greg Mack and Tim Lawton. Registration information is available from Robert Myers, Department of Earth Sciences, Box 3AB, New Mexico State University, Las Cruces, New Mexico 88003 (505/646-1335).