Service/News

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New publications

NMBMMR

***Resource Map 12**—Satellite photomap of New Mexico, 1981. A black and white lithograph at 1:1,000,000 scale of the mosaic compiled by the Agricultural Stabilization and Conservation Service of the U.S. Department of Agriculture. $3.00

***Resource Map 13**—Precambrian rocks of the southwestern United States and adjacent areas of Mexico, by K. C. Condie, 1981, scale 1:1,500,000. Delineates Precambrian outcrops in all or part of eight states and Mexico; includes reference list. $4.00

***Geologic Map 50**—Precambrian rocks of Red River-Wheeler Peak area, New Mexico, by K. C. Condie, 1980, 1 sheet, text, map scale 1:48,000. This map covers an area bounded by Cabresto Creek drainage (north), Lucero Canyon (south), the escarpment of the Sangre de Cristo Mountains (west), and the Moreno Valley (east). $3.00

***Bulletin 108**—Supplemental bibliography of New Mexico geology and mineral technology through 1975, by D. M. Heljeson and C. L. Holts, 1981, 136 p. Contains over 1,800 references of New Mexico geoscience and mineral technology not included in earlier bibliographies as well as those included in a previous chronologically incorrect volume. $10.00

***Memoir 36**—Geology of Organ Mountains and southern San Andres Mountains, New Mexico, by W. R. Seager, 1981, 96 p., 8 tables, 88 figs., 3 oversize sheets (includes geologic map at scale 1: 31,250), 2 appendices. Integrates results of recent exploration activity, geophysical studies, and radiometric dating into the geologic framework of the Organ and southern San Andres Mountains. Previously unmapped portions of the area that contain features of structural significance were mapped on a greatly improved 7½-min topographic base map. $20.00

***Circular 173**—Statistical method for analysis of planispiral coiling in shelled invertebrates, by A. L. Gutjahr and S. C. Hook, 1981, 15 p., 8 tables, 6 figs. Discusses a statistical method for evaluating and comparing planispiral growth patterns among invertebrates predicated on simple logarithmic growth and employing simple and multiple linear regression combined with analysis of variance and covariance techniques. $2.50

***Circular 176**—Pennsylvanian stratigraphy, petrography, and petroleum geology of Big Hatchet Peak section, Hidalgo County, New Mexico, by S. Thompson III and A. D. Jacka, 1981, 126 p., 7 tables, 42 figs. Describes, analyzes, and evaluates an exposure of the best petroleum objective found to date in Hidalgo County, New Mexico. $10.00

***Circular 180**—Contributions to mid-Cretaceous paleontology and stratigraphy of New Mexico, compiled by S. C. Hook, 1981, 36 p., 2 tables, 12 figs. First in a planned series of short papers on the paleontology and stratigraphy of the mid-Cretaceous (Albian, Cenomanian, and Turonian) of New Mexico. $4.00

***Circular 181**—New Mexico's energy resources '80 —annual report of Bureau of Geology in the Mining and Minerals Division of New Mexico Energy and Minerals Department, by E. C. Arnold, J. M. Hill, and others, 1981, 60 p., 48 tables, 12 figs. Annual summary of energy developments in New Mexico; discusses coal, oil, and gas reserves, possible geothermal applications, and production of coal, crude oil, natural gas, and uranium. $3.00

***Annual Report**—Annual report for the fiscal year July 1, 1979, to June 30, 1980, by F. E. Kottlowski and staff, 70 p. Summarizes Bureau activities and services for the fiscal year. Includes articles on Cretaceous fossils, mineral production, Pleistocene horse, and paleocurrents of Bliss Sandstone. $2.00

***Pricelist 15**—Publications available from New Mexico Bureau of Mines and Mineral Resources, April 1981. FREE

USGS

MISCELLANEOUS INVESTIGATIONS SERIES

I-1221—Geologic map of the Cotton City quadrangle and the adjacent part of the Vanar quadrangle, Hidalgo County, New Mexico, by Harald Drewes and C. H. Thorman, 1980, scale 1:24,000, sheet 34 by 39 inches

MISCELLANEOUS FIELD STUDIES MAPS

MF-1248—Geologic map of the Star Lake quadrangle, McKinley County, New Mexico, by G. R. Scott, J. W. Mytton, and G. B. Schneider, 1980, scale 1:24,000, sheet 30 by 40 inches

MF-1249—Geologic map of the Ojo Encino Mesa quadrangle, McKinley and Sandoval Counties, New Mexico, by G. R. Scott, G. B. Schneider, and J. W. Mytton, 1980, scale 1:24,000, sheet 30 by 40 inches

MF-1253—Preliminary geologic map of the Waterflow quadrangle, San Juan County, New Mexico, by J. D. Strobell, Jr., P. T. Hayes, and R. B. O'Sullivan, 1980, scale 1:24,000, sheet 28 by 50 inches

MF-1263—Geologic map of the Redrock NW quadrangle, Grant County, New Mexico, by D. C. Hedlund, 1980 (1981), scale 1:24,000

MF-1264—Geologic map of the Redrock NE quadrangle, Grant County, New Mexico, by D. C. Hedlund, 1980 (1981), scale 1:24,000

MF-1265—Geologic map of the Redrock SE quadrangle, Grant and Hidalgo Counties, New Mexico, by D. C. Hedlund, 1980, scale 1:24,000, sheet 31 by 40 inches

NEW TOPOGRAPHIC MAPS

*Owl Tank Canyon West, 1975–1980, lat. 32° 7′ 30″, long. 105° 52′ 30″, scale 1:24,000, contour interval 20 ft

REVISED TOPOGRAPHIC MAPS

*Cotton City, 1964, revised 1978, lat. 32°, long. 108° 52′ 30″, scale 1:24,000, contour intervals 20 and 10 ft

*C Bar Ranch, 1963, revised 1978–1980, lat. 32° 22′ 30″, long. 108° 22′ 30″, scale 1:24,000, contour interval 20 ft

*Coyote Peak, 1964, revised 1978–1980, lat. 32°, long. 108° 30′, scale 1:24,000, contour interval 10 ft

*Gary, 1964, revised 1978–1980, lat 32° 15′, long. 108° 45′, scale 1:24,000, contour intervals 10 and 5 ft

*Separ, 1964, revised 1978–1980, lat. 32° 7′ 30″, long. 108° 22′ 30″, scale 1:24,000, contour interval 10 ft

*Separ NE, 1964, revised 1978–1980, lat. 32° 7′ 30″, long. 108° 15′, scale 1:24,000, contour interval 10 ft

*Turn, 1952, revised 1977–1979, lat. 34° 30′, long. 106° 37′ 30″, scale 1:24,000, contour interval 10 ft

Abstracts

DEPOSITIONAL PATTERNS IN THE POINT LOOKOUT SANDSTONE, NORTHWEST SAN JUAN BASIN, NEW MEXICO, by Paul Ellis Devine, University of Texas (Austin)

The Point Lookout formation, which is well exposed along the northwest margin of the San Juan Basin in northwestern New Mexico, includes nearshore sediments deposited during a regression of the Cretaceous epicontinental sea in earliest Montanan time. The unit is mainly composed of sandstone and siltstone with sand percentage increasing upward. Principal outcrop lithofacies include a lower portion of interbedded, highly bioturbated, very fine sandstone and shale. This grades upward into a massively bedded, fine sandstone. Wave-formed, hummocky cross bedding is the dominant primary sedimentary structure in these lower two facies. A medium-grained upward-fining sandstone caps the entire formation. This facies generally has an erosional base with lateral accretionary bedsets and a clayclast lag. The remainder of the facies contains medium-to-large-scale trough-fill cross lamination in herringbone fashion suggestive of tidal influence. Measured sections from the outcrop of the Point Lookout closely correspond with electric-log patterns from the subsurface data east of the outcrop belt. Within the formation, correlation of genetically related sand packages that cross time lines permits the evaluation of changing sedimentation patterns through time. Distinctive sand-body geometries are representative of specific phases of the depositional history. Periods of shoreline aggradation and early progradation present a strike-aligned series of dip-oriented net-sand thicks. These deposits probably represent balanced conditions of sedimentation rate and relative sea-level change when tidal influences are maximized. Strike-oriented, cuspate-to-linear patterns of sand thicks record deltaic-strandplain progradations that appear to be wave dominated. Periodic transgressions are mainly erosive but may include deposition of strike-oriented sands composed of coalesced shallow-shelf bars.

Geoscience Research Symposium, NMIMT, April 18, 1981

The Second Annual Geoscience Student Research Symposium was held on the campus of the New Mexico Institute of Mining and Technology at Socorro, New Mexico, on April 18, 1981. Abstracts of papers presented on geoscience in New Mexico are printed below. Other papers included: Rb–Sr geochronology of the Mayo-Darle Complex, Cameroon, by Francois Nguene; Rb–Sr geochronology of the Lady Mary Formation in the Tati Greenstone Belt, northeast Botswana, by Stephen White and Francois Nguene; Ore mineralogy and fluid inclusion study of the southern amethyst vein system, Creede mining district, Colorado, by Rick Robinson; Geology and mineralogy of the Callaham vanadium-uranium mine, Sage Plains, southeastern Utah, by Tim Post and David Norman; and A fluid inclusion study of selected drill core from the Bushman mine, Botswana, by Scott Long.

DISTRIBUTION AND STRATIGRAPHY OF THE DOG SPRINGS VOLCANIC COMPLEX, SOCORRO AND CATRON COUNTIES, NEW MEXICO, by Greg C. Coffin, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM ☞

The Dog Springs volcanic complex is a thick (3,000 ft, 915 m) sequence of intermediate-composition volcanic rocks, consisting primarily of volcanic breccias, which formed during the Early Oligocene. The complex is exposed along the northern margin of the Datil and Gallinas Mountains and covers approximately 100 sq mi (260 sq km). The complex is similar to, though smaller than, numerous other volcanic breccia fields scattered throughout the western United States. The Dog Springs volcanic complex is the basal portion of the Spears Formation which represents the earliest volcanism in the area and directly overlies the Baca Formation. In the western Gallinas Mountains, the complex has been divided into upper and lower members. The lower member is a thick (2,000 ft, 610 m) sequence of heterolithic, tuffaceous laharic breccias with minor exotic blocks and sedimentary partings. The upper member is a thinner (1,000 ft, 305 m) sequence of interbedded andesitic mudflows, monolithic volcanic breccias, minor mudstones, exotic blocks, fluviatile sedimentary rocks, and ash-flow tuffs.

STOCHASTIC MODELING OF SPATIAL AND TEMPORAL WATER-QUALITY VARIATIONS IN GROUND WATER, by Christopher J. Duffy, New Mexico Institute of Mining and Technology, Socorro, NM

The current controversy over problems of contamination of our ground-water environment has led to the development of new techniques for aquifer analysis and pollution control. The difficulties encountered in most studies of mass transport involve the complex spatial and temporal variations of field-measured hydrogeologic variables. A stochastic approach to the problem implies an element of uncertainty, in that variables are characterized in a probabilistic sense. This study is concerned with stochastic solutions to simple forms of mass transport encountered in a variety of ground-water pollution situations. The research can be divided into three categories: 1) analysis of continuous water-quality time series—pollution, subject to a time-variable source; 2) analysis of spatial variations in water quality—the influence of variable-flow properties of the geologic environment; and 3) the combined problem of spatial and temporal variability—interaction between spatial variations in the porous medium and temporal variability of the source of pollution. Application of the stochastic theory is illustrated with several examples of field data: 1) transport of salts in an agricultural watershed—Rio Grande valley, New Mexico; 2) river pollution affecting municipal wells—Rhine; 3) transport of environmental tritium—a karst region of Switzerland; and 4) the implication of spatial and temporal variability on the long-term fate of hazardous waste.

THE JONES CAMP MAGNETITE DEPOSIT, SOCORRO COUNTY, NEW MEXICO, by Tom Gibbons, New Mexico Institute of Mining and Technology, Socorro, NM

The podiform magnetite-hematite deposits of Jones Camp occur on the southern edge of Chupadera Mesa in western Socorro County, New Mexico. Upon casual inspection, these deposits bear a striking resemblance to contact-metasomatic skarn deposits. The lenticular, discontinuous pods of high-grade ore can be seen replacing sedimentary host rocks of the Yeso Formation (limestones, sandstones, and gypsum) where they come in contact with the Jones Camp monzonite dike and later associated diabase dikes. Several lines of evidence suggest that no genetic relationships exist between the magnetite-hematite mineralization and the intrusive episodes at Jones Camp. The iron appears to have been introduced, following the intrusion of the dike rocks, along channelways that developed at the monzonite-sedimentary rock interface. Two models are considered for the emplacement of the iron through these channelways: 1) Kiruna-type magmatic injection and 2) hydrothermal replacement by deeply circulating solutions.

TECTONIC SIGNIFICANCE OF MICROEARTHQUAKE ACTIVITY IN THE RIO GRANDE RIFT NEAR SOCORRO, NEW MEXICO, by Daniel P. Wieder, New Mexico Institute of Mining and Technology, Socorro, NM

An array of portable high-gain short-period seismographs centered near Socorro, New Mexico, detected 1,200 microearthquakes during 316 recording days from May 1975 through January 1978. The locations of 534 of these microearthquakes were obtained through the use of P and S arrival times from four or more recording stations. Characteristics of these earthquakes include occurrence in swarms and shallow depths of focus (generally less than 13 km). Most hypocenters cannot be directly correlated with the major mapped faults in the study area. Instead, the areal distribution of epicenters is diffuse, roughly centered on a large sill-like crustal magma body at a depth of 19 km. The major part of the seismicity occurs in the La Jencia Basin southwest of Socorro, where previous studies have suggested that the high level of seismic activity is related to the upward intrusion of small crustal magma bodies to a depth of about 7–10 km. Many microearthquakes also occur in the Rio Grande valley within the central portion of the Rio Grande rift. These events may be tectonic in nature rather than related to the intrusion of magma. The seismic source mechanisms for twelve regions in the study area were determined by compositing P-wave first-motion data using only the best located microearthquakes. These focal mechanisms indicate that the majority of the earthquakes are generated by dominantly dip-slip motion along east- or west-dipping normal faults. The faults trend north to north-northwest with dips ranging between 30 and 74 degrees. The focal mechanisms are in general agreement with the mapped faults in the area.

UPPER CRETACEOUS GEOLOGY OF THE SEVILLETA GRANT, SOCORRO COUNTY, NEW MEXICO, by Bruce W. Baker, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

More than 1,300 ft of Upper Cretaceous strata overlie the Dockum Formation (Upper Triassic) and are exposed on the Sevilleta Grant, near La Joya, Socorro County, New Mexico. The Upper Cretaceous sequence extends from the Dakota Sandstone to the Dilco Coal Member of the Crevasse Canyon Formation and consists largely of shales and sandstones. The included Tres Hermanos Sandstone consists of sandstones, shales, and two thin coal seams. The lowest section of the Tres Hermanos is a moderately sorted, calcareous sandstone that coarsens upwards with small- and medium-scale, wedge- and trough-shaped sets of crossbeds. The sandstone is about 11 ft thick and contains fossil-rich lenses of dark-brown-weathering sands that are friable to moderately indurated. Abundant turtle bone fragments, some crocodile teeth, and scute fragments amid vertebrae and teeth indicate a nearshore environment with a nearby source of fresh water. Abundant selachian teeth have been recognized including the following genera: *Hybedus, Lonchidion, Squadicoras,* and several others. Other Upper Cretaceous strata include the Twowells Tongue of the Dakota Sandstone and the lower Mancos Shale, Rio Salado Tongue, and D-Cross Shale Tongue of the Mancos Shale. The base of the D-Cross contains Juana Lopez equivalent beds with *Prionocyclus wyomingensis* and *Scaphites warreni*. The D-Cross is split by the E Sandstone of the Gallup Sandstone and contains *Lopha sannionis* and *Forresteria* sp. The Dilco Coal Member contains fine-grained sandstones with interbedded carbonaceous shales and two coal seams.

A TWO-DIMENSIONAL COMPUTER MODEL OF GROUND-WATER FLOW: ROSWELL BASIN, NEW MEXICO, by Kenneth R. Rehfeldt, New Mexico Institute of Mining and Technology, Socorro, NM

Recharge to the San Andres Limestone aquifer in the central portion of the Roswell basin in Chaves and Lincoln Counties, New Mexico, was estimated using a two-dimensional finite-difference computer model of ground-water flow. The modeled recharge distribution is only approximate because it was obtained by calibrating and verifying the computer model based on a limited amount of data for transmissivity, storage coefficient, and interaquifer leakage. Even as an order of magnitude estimate of the true recharge, however, the modeled recharge distribution leads one to conclude that the generally accepted belief that recharge to the San Andres aquifer is derived from only the infiltration of precipitation that falls on the outcrop area west of Roswell is incorrect. An alternate hypothesis is proposed that recharge to the San Andres aquifer comes largely from leakage of water vertically upward from the underlying formations. Based on tritium data, as much as 80 percent of the recharge is derived from upward leakage.

PRECAMBRIAN DEFORMATION AND METAMORPHISM OF THE TIJERAS GREENSTONE AND CIBOLA GNEISS, TIJERAS CANYON, BERNALILLO COUNTY, NEW MEXICO, by James R. Connolly, University of New Mexico, Albuquerque, NM

In Tijeras Canyon east of Albuquerque, two Precambrian metamorphic terranes are juxtaposed by the northeast-striking Tijeras fault. Tijeras Greenstone (on southeast) is a complex association of tholeiitic metabasalts, greenschists, metapelites, and minor metadacite. Small-scale folds, boudinage, and macroscopic analysis of foliation orientation suggest tight folding about moderately southeast-plunging axes. Greenstone metamorphism is amphibolite facies (andalusite + cordierite + biotite in phyllites, hornblende + An_{37} plagioclase in metabasalts), retrogressively altered to greenschist facies. Cibola Gneiss (on northwest) is primarily granitic paragneiss (meta-arkose) with a prominent ridge of quartzite plus minor aplite and pegmatite. Small- and large-scale structures in the quartzite indicate that the terrane has been isoclinally folded about gently northeast-plunging axes. Gneiss has been intruded by Sandia "Granite" (here granodiorite); auto-metamorphism and a potassic metasomatic halo around the intrusive have created an apparent gradational contact with the gneiss. Granitic intrusion is post-kinematic relative to folding in gneiss and quartzite. Schistose lenses in quartzite contain abundant andalusite and biotite suggesting amphibolite facies. Sillimanite is common in migmatite near the "granite" contact and present locally in quartzite. Synkinematic metamorphism in greenstone and gneiss took place at low pressure (<4 Kb); kyanite-andalusite equilibrium constrains geothermal gradients to more than 25°C/km. The Tijeras fault originated in mid-Proterozoic time as a sinistral strike-slip fault; subsequent activity has continued through Quaternary time and includes dip-slip and strike-slip movement.

THE GAS COMPOSITION OF SEVERAL THERMAL WATERS IN NEW MEXICO, by Carl Bernhardt and David Norman, New Mexico Institute of Mining and Technology, Socorro, NM

A survey is currently being made of the gas composition of several wells and springs in New Mexico. The gas chemistry of the thermal waters is being studied to determine the gases that characterize thermal waters derived from hot deep sources. The gas chemistry can be used to estimate the temperature and redox conditions of a geothermal reservoir. The use of a particular gas or gas ratio may be used to locate a geothermal reservoir, identify and estimate mixing in a reservoir, and differentiate between old and young waters. The gas composition of thermal waters may affect the other chemical geothermometers. Analysis of waters from the Las Cruces and Radium Springs areas have high helium and carbon-dioxide contents. Earlier work by Swanberg (1975) showed that these waters may be derived from thermal waters that have a temperature greater than 200°C. Analysis of a warm well in the Bosque Del Apache Game Refuge showed high helium and carbon dioxide, suggesting that these waters may be derived from a hotter source. Analysis of waters from the Socorro Hot Spring showed little excess helium and carbon dioxide. These waters are believed to be shallow young ground waters.

STEADY STATE MODELS OF THE THERMAL SOURCE OF THE SAN JUAN VOLCANIC FIELD, by Gerry Clarkson and Marshall Reiter, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

The increase in heat flow on approaching the San Juan volcanic field depicts a profile having a large half width, perhaps 50–100 km. As such, the profile may suggest thermal sources creating the observed anomaly at depths of the same order under, or in proximity to, the San Juan volcanic field. Cooling and solidification of the upper crustal batholith under the San Juan volcanic field may be shown to contribute only ~ 0.1–0.2 HFU to the present heat flow. The cooling and solidification of very deep magma bodies (to 75 km) also provide far less heat than required by the observed anomaly. Thus, replenishment of the thermal source causing the anomaly is postulated. This replenishment is approximated by several finite-difference, steady-state models having an isothermal lower boundary with a simple geometrical shape. The resulting best-fit models suggest a plume-type phenomenon rising from depths of at least 100 km to depths as shallow as 34 km with a lateral extent as far south as the Durango area.

STABILITY OF LEAD FLUORIDE COMPLEXES AT ELEVATED TEMPERATURES, by Robert W. Smith and Borden R. Putnam III, New Mexico Institute of Mining and Technology, Socorro, NM and AMAX Exploration Inc., Salem, MO

The Cave-in-Rock and Hansonburg mining districts are characterized by lead mineralization and associated fluorite. This association suggests that the transport of lead and fluorine in hydrothermal solutions is related. To test this hypothesis, numerical experiments were performed to evaluate the role of fluoride transport of lead. Lead-fluoride complexes have higher stability constants than do chloride complexes of lead. Numerical experiments to evaluate the effect of pH on fluoride-complex ion formation indicated that increased pH favors formation of fluoride complexes. Increasing temperature also favors the formation of lead-fluoride complexes. These experiments indicated that at 200°C, a neutral pH, and a Cl^-:F^- ratio of twenty, over 90 percent of the lead in the system is transported as fluoride complexes. Further numerical experiments were carried out to characterize the ore-forming solutions that were associated with the Hansonburg, New Mexico, deposits. These experiments indicated that enough lead, sulfur, and fluorine to form an ore deposit can be transported by a single solution. Mineral precipitation may have been brought about by the cooling and dilution of the ore fluids with ground water. In the Hansonburg ore fluids the Cl^-:F^- ratio was ~ 200, and fluoride complexes did not transport significant amounts of lead.

SURFACE-WAVE ANALYSIS USING TWO-DIMENSIONAL FINITE-ELEMENT TECHNIQUES, by Philip J. Carpenter, New Mexico Institute of Mining and Technology, Socorro, NM

Two-dimensional finite-element techniques are employed to model Love and Rayleigh waves propagating across structures with varying topography. Love- and Rayleigh-wave propagation through a model of the Magdalena Mountains is examined for periods from 1.0–6.0 seconds. For an incident-fundamental-mode Love wave, more than 80 percent of the energy is transmitted in the fundamental mode. For an incident Rayleigh wave, the energy in the transmitted fundamental mode increases from 85 percent to nearly 100 percent over this range of periods. Several Rio Grande rift models are examined for incident-fundamental Love- and Rayleigh-wave motion at periods of 1.0–8.0 seconds. For Rayleigh waves, lower periods (high frequencies) generally lose much of their energy to higher surface-wave modes (body waves). For Love waves, the same is true, except for an anomalous (40 percent) loss of energy near 3.7 seconds. In all cases tested, nearly all energies are transmitted with virtually no reflection. The conversion of energy into other modes suggests possible mechanisms for the existence or absence of features seen on local microearthquake seismograms (for example, low frequency codas or total lack of surface waves).

THE EVOLUTION OF THE SOCORRO CAULDRON, SOCORRO COUNTY, NEW MEXICO, by Ted L. Eggleston, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

The Socorro cauldron is a well-defined, probably resurgent, cauldron in the northeastern Datil–Mogollon volcanic field, southwest of Socorro, New Mexico. The cauldron is approximately 25 km in diameter and is the source of the Hells Mesa Tuff, a major regional ash-flow tuff in the Datil–Mogollon volcanic field. The cauldron is exposed in the Socorro, Chupadera, and Magdalena Mountains with the best exposures in the Chupadera Mountains where strong rotation of beds on normal faults has exposed at least 2,000 ft of Hells Mesa Tuff overlain by about 2,500 ft of moat-filling Luis Lopez Formation. The next regional tuff in the volcanic field, the A-L Peak tuff, overlies this sequence, indicating that the Luis Lopez is genetically related and restricted to the Socorro cauldron. Variations in the thickness of the A-L Peak suggest that the Luis Lopez Formation did not entirely fill the moat. The intracauldron Hells Mesa Tuff contains a large percentage of lithic fragments and many lenses of cauldron-collapse breccias. The uppermost Hells Mesa is a sequence of interbedded ash-flow and ash-fall tuffs suggesting episodic or pulsating events during the decline of the eruption. The overlying Luis Lopez Formation is a heterolithic sequence of lavas, tuffs, and sedimentary rocks similar to moat-fill sequences described elsewhere. The lowest of these units is a sedimentary rock interval whose lithologies suggest that they were derived from a resurgent dome to the north and the topographic wall of the cauldron to the south. The overlying units are basaltic lavas, ash-flow tuffs, and a major rhyolite dome complex exposed along Nogal Canyon.

PROCEDURES FOR EXPERIMENTATION, ANALYSIS, AND MODELING OF THERMALLY STIMULATED DISCHARGE CURRENTS FROM PURE ICE, by Bob Will, New Mexico Institute of Mining and Technology, Socorro, NM

Thermally stimulated discharge (TSD) currents have been used as a means of studying the dielectric properties of polymers since creation of the first 'Electret' by Eguchi in 1925. TSD, a method which employs time-temperature superposition in conventional isothermal dielectric theory, enables the researcher to determine characteristic trapping parameters for dielectric mechanisms with a single test. Application of TSD to studies of pure ice shows that 4-5 discrete storage/relaxation mechanisms exist. Three of these mechanisms seem to be intrinsic to ice while others may be due to extrinsic mechanisms associated with sample imperfections and boundary effects. Generalized least-squares inversion of TSD data yields activation energies of .31, .36, and .42 eV for the three most prominent mechanisms. Results agree well with previous studies conducted in this lab and correspond, to some extent, with results obtained by others studying TSD as well as luminescent mechanisms in ice.

STOCHASTIC ANALYSIS OF SPATIAL VARIABILITY IN UNSATURATED FLOW, by Tian-Chyi J. Yeh, New Mexico Institute of Mining and Technology, Socorro, NM

Effects of spatial variability of soil properties on unsaturated flow are analyzed by solving stochastic steady-state infiltration partial differential equations where the variability of saturated hydraulic conductivity (Lnk) and soil-water characteristic variable (α) are treated as homogeneous stochastic processes. Head variance and covariance functions for one- and three-dimensional flow are determined by using isotropic and anisotropic Lnk and α covariance functions as inputs. The results show that head variance derived from the three-dimensional case is less than that of one-dimensional flow. For large values of correlation length scale and soil-water characteristic variable, the one- and three-dimensional results become equivalent, indicating that the flow is predominantly one dimensional under this condition. The variance of soil moisture obtained from the theoretical analysis is found to be in a close agreement with that observed in the field. In addition, the results of the analysis demonstrate the importance of the correlation-length scale, variance of Lnk and α, mean capillary-pressure head, and mean soil-water characteristic variable in determining the effective unsaturated hydraulic conductivity.

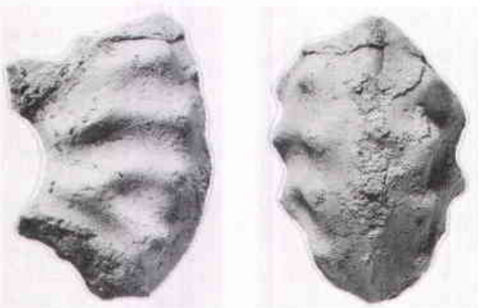
THE GEOLOGY AND PALEONTOLOGY OF A FRUITLAND FORMATION (LATE CRETACEOUS) "PETRIFIED FOREST" AND ADJACENT AREAS IN THE SAN JUAN BASIN OF NORTHWEST NEW MEXICO, by Adrian Hunt, New Mexico Bureau of Mines and Mineral Resources, Socorro, NM

In the Fruitland Formation (Late Cretaceous) of the San Juan Basin in northwest New Mexico is a rare association of fossils in an area known as the "Fossil Forest." Within four sections are found almost 200 in situ petrified stumps associated with a dozen petrified logs, a variety of dinosaurian and other reptilian skeletal elements, two mammal- and microvertebrate-bearing accumulations, and several mollusk beds. Twenty measured stratigraphic sections were taken in the study area where approximately 26 m of sediments are exposed, mainly shale, siltstones, and channel sandstones with coal in the lower part of the sequence. Sections were correlated using two carbonaceous shale horizons, the only continuous beds in the area. Various dinosaur remains have been collected for study. These are predominantly hadrosaurian and ceratopsian including three jaws, two femurs, an illium, an ischium, a pubis, a tibia, a sacrum, and several ribs and vertebrae. Large quantities of material from the two mammal-bearing quarries have been processed using bulk-sorting techniques developed by Hibbard and McKenna producing approximately 300 teeth, one third of which are mammal including multituberculates, metatherians, and eutherians, as well as leaf, shark, skate, gar, amphibian, crocodile, lizard, turtle, and dinosaur remains. All identified mollusks are fresh-water forms. The environment is interpreted as a warm-temperate to subtropical coastal plain. □

Upper Cretaceous ammonite *Hourcquia* in New Mexico and Texas

Hourcquia, a very rare Upper Cretaceous ammonite, was named in 1965 by Maurice Collignon, who described two species from the upper Turonian of Madagascar. A third species was described in 1970 from Sakhalin (USSR). Aside from these two localities, the genus is known only from nine specimens found at three localities in New Mexico and one in Trans-Pecos Texas by S. C. Hook (New Mexico Bureau of Mines and Mineral Resources) and W. A. Cobban (U.S. Geological Survey, Denver, Colorado).

The American specimens are all from a very narrow zone near the base of the upper Turonian. The New Mexico specimens are from the base of the Juana Lopez Member of the Carlile Shale near Taylor Springs in Colfax County (1978–79 Annual Report of NMBMMR, p. 43), from the base of the Juana Lopez Member of the Mancos Shale at its type locality (*New Mexico Geology,* v. 2, no. 2, p. 20), and from sandstone concretions at the top of the Tres Hermanos Sandstone Member of the Mancos Shale near Oscura in Lincoln County (USGS Prof. Paper 1192, p. 24). The Texas occurrence is from the base of a ridge-forming unit of Juana Lopez lithology in the Chispa Summit Formation near Chispa Summit in Jeff Davis County. Molluscan fossils associated with *Hourcquia* at these localities include *Lopha lugubris* (Conrad), *Inoceramus dimidius* White, and a late form of *Prionocyclus macombi* Meek.



Hourcquia cf. *H. mirabilis* Collignon, natural size, from the top of the Tres Hermanos Sandstone Member of the Mancos Shale, near Oscura, Lincoln County, New Mexico.

Western Mining Directory available

The fourth edition of the *Western Mining Directory* is now available for purchase. The current publication lists 681 active/hardrock mines, 159 coal mines, 222 uranium/vanadium mines, 1,313 mining companies, and the active oil-shale projects in the 13 western states. This 250-page publication is available from the Western Mining Directory office, 311 Steele St., Suite 208, Denver, CO 80206, for $20.00 plus tax or $23.00 by mail.

MINING REGISTRATIONS
(DECEMBER 29, 1980 TO MARCH 3, 1981)

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

Date and operation	Operators and owners	Location
12-29-80 uranium	Operator—Sec. 30 W., Teton Exploration Drilling Co., P.O. Drawer A-1, Casper, WY 82602; Gen. Mgr.: Victor Magnus, same address, phone: 307-265-4102; Person in charge: Charles Ernst, 1510 Berryhill, Milan, NM, phone: 287-4421; Gen. Supt.: Duane Roe, P.O. Drawer A-1, Casper, WY Owner—Kerr-McGee Nuclear Corp., P.O. Box 218, Grants, NM 87020	McKinley Co.; sec. 30, T. 14 N., R. 9 W.; Grants mineral belt mining district; NM-53 northeast from Milan to Jay's Corner then left to Ambrosia Lake; Type: underground; Works: vent shaft; private land
12-29-80 uranium	Operator—Sec. 36, Teton Exploration Drilling Co., P.O. Drawer A-1, Casper, WY 82602; Gen. Mgr.: Victor Magnus, same address, phone 307-265-4102; Gen. Supt.: Duane Roe, same address and phone; Person in charge: Norman Gamache Owner—Kerr-McGee Nuclear Corp., P.O. Box 218, Grants, NM 87020	McKinley Co.; sec. 36, T. 14 N., R. 9 W.; Grants mineral belt mining district; NM-53 northeast from Milan, NM to Jay's Corner then left to Ambrosia Lake; Type: underground; Works: vent shaft; private land.
1-26-81 uranium	Operator—Crownpoint mine, sec. 24, Grizzly Engr. Corp., P.O. Box 878, Crownpoint, NM 87313; Gen. Mgr.: Ronald B. Gabitzsch, no local address yet; Person in charge: same; Gen. Supt.: DeWitt Blanchard, Sierra Ave., Vista Grande Mobile Home Park, phone: 862-7210 Owner—WMC/Conoco	McKinley Co.; sec. 24, T. 17 N., R. 13 W.; .9 mi west of Crownpoint, NM; uranium; Type: 4G; private land
1-26-81 coal	Operator—San Juan Mine, San Juan Coal Co., P.O. Box 561, Waterflow, NM 87421; Gen. Mgr.: J. W. Mainard, 3607 Melrose Dr., Farmington, NM 87401, phone: 325-1603; Person in charge: J. W. Mainard; Gen. Supt.: Allen Barber, 705 Ocio St., Farmington, NM; Sen. Engr.: Bill Scheel, 3102 Municipal Dr., Farmington, NM; Safety Engr.: Warren Dixon, Box 1561, Kirkland, NM Owner—Utah International, Inc., 550 California St., San Francisco, CA 94104	San Juan Co.; secs. 2, 3, 4, 9, 10, 15, 16, 21, 22, 27, 28, 32, 33, 34, T. 30 N., R. 15 W.; secs. 4, 5, T. 29 N., R. 15 W.; Shiprock mining district; 11 mi west from Farmington, NM by US-550 to Public Service Co. of NM, turn off north 3 mi to San Juan Coal Co., turn off east ¼ mi to mine administration bldg.; coal; Type: S; private, state, and federal land
1-26-81 gypsum	Operator—Rosario Gyp, Hutchens Mining, 10526 4th NW, Albuquerque, NM 87114; Gen. Mgr.: Merle Hutchens, same address, phone: 898-4772 Owner—Western Gypsum, Santa Fe, NM	Santa Fe Co.; sec. 32, T. 15 N., R. 7 E.; 21 mi south of Santa Fe on I-25; gypsum; private land
1-26-81 mill	Operator—San Juan Coal Co. preparation plant, San Juan Coal Co., P.O. Box 561, Waterflow, NM; Gen. Mgr.: J. W. Mainard, 3607 Melrose Dr., Farmington, NM; Supt.: Allen P. Barber, 705 Ocio St., Farmington, NM; Sen. Engr.: Bill Scheel, 3102 Municipal Dr., Farmington, NM; Safety Engr.: Warren Dixon, P.O. Box 1561, Kirkland, NM 87417 Owner—Utah International, Inc., 550 California St., San Francisco, CA 94104	San Juan Co.; sec. 20, T. 30 N., R. 15 W.; Shiprock mining district; 11 mi west from Farmington, NM, by US-550 to Public Service Co. of NM, turn off north 3 mi to San Juan Coal Co., turn off east ¼ mi to administration bldg., north ½ mi by access road to preparation plant; coal; Custom milling: no; private, federal, and state land
1-26-81 mill	Operator—Phelps Dodge Tyrone Branch, Jack Whisler, Inc., 1001 Wall St., El Paso, Texas 79915; Gen. Mgr.: Joseph S. Hanawalt, same address; Job Supt.: Jesus Chavez or Isidro Perez, 7239 Alameda, Sp. 103, El Paso, TX 79915; Painting Div. Supt.: Armando Telles, 1001 Wall St., El Paso, TX Owner—Phelps Dodge Corp.	Grant Co.; sec. 22, T. 19 S., R. 15 W.; Burro Mountain mining district; 13½ mi southwest of Silver City, NM, on NM-90; Ores milled or refined: copper; Custom milling: no; private land
2-5-81 mine shafts	Operator—Molycorp #1 & 2, Harrison Western Corp., P.O. Box 648, Questa, NM 87556; Gen. Mgr.: Allan Provost; Pres: Harrison Western, 1208 Quail St., Lakewood, CO 80215; Person in charge: Larry White, Proj. Mgr., P.O. Box 648, Questa, NM, phone: 586-0100; Gen. Supt.: Chris Kennedy, same address and phone; Proj. Engr.: John Ducic, same address and phone Owner—Molycorp, Questa, NM	Taos Co.; sec. 2 (Unsey), T. 29 N., R. 13 E.; Red River mining district; 5 mi east of Questa, NM, on the Red River highway; molybdenum; private land
2-5-81 pit	Operator—Marinelli 1, Marinelli Construction, Inc., P.O. Box 967, Grants, NM 87020; Gen. Mgr.: Arthur Marinelli, NM-53 South, Grants, NM, phone: 287-2972; Other official: Doloris Marinelli, same address and phone Owner—George E. Drew, Tempe, AZ	Valencia Co.; sec. 11, T. 10 N., R. 8 W.; 4 mi north of McCartys, left off of forest road 400; Type-B/ Cours Cemt. Leach; Works: open pit; private land
2-5-81 gold	Operator—Encino Vivo, American International Mining Co., Inc., 610 N. Bullard, Silver City, NM 88061; Person in charge: E. E. Parrish, Pres., same address, phone: 388-2523; Gen. Supt.: L. L. Osmer, V.P. Field Super., same address and phone; Other official: Dr. Philip Myers, 22900 Ventura Blvd., Suite 340, Woodland Hills, CA 91436 Owners—L. L. Osmer, Bin R, Tyrone, NM 88065; David Garcia, P.O. Box 1441, Silver City, NM 88061	Grant Co.; sec. 17, T. 19 S., R. 16 W.; Burro Mountains mining district; from Silver City, south on US-90 approximately 11 mi, turn right on Mangas road, proceed approximately 7 mi, turn left on forest road 851, proceed approximately 8½ mi, turn left approximately 2,000 ft; gold; Lode: underground; federal land
2-5-81 coal	Operator—De-Na-Zin, Sunbelt Mining Co., Inc., P.O. Box 2106, Albuquerque, NM; Div. Mgr.: Robert Scott, Caller Service 101, Farmington, NM, phone: 327-4975; Oper. Mgr.: Jerry Tystad, same address and phone; Min. Supt.: Don Rose, same address and phone; Vice-president: C. E. Hunter, P.O. Box 2106, Albuquerque, NM Owner—State of New Mexico, State Land Office, Santa Fe, NM	San Juan Co.; sec. 16, T. 23 N., R. 13 W.; Shiprock mining district; approximately 35 mi south of Farmington, NM on NM-371; coal; surface; strip mine; state land

(continued on page 48)

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Geographic names

U.S. Board on Geographic Names

Mockingbird Gap—pass, elevation 1,631 m (5,350 ft), connects the Tularosa Valley and Jornada del Muerto between the Oscura and San Andres Mountains 54 km (34 mi) southeast of San Antonio, Socorro County, New Mexico; secs. 5, 8, 16, and 17, T. 9 S., R. 5 E.; New Mexico Principal Meridian 33° 34′ 00″ N., 106° 27′ 15″ W. (north end), 33° 32′ 10″ N., 106° 26′ 15″ W. (south end).

Ritas Draw—watercourse, 17.7 km (11 mi) long in Tularosa Valley, heads at 32° 58′ 25″ N., 105° 57′ 45″ W., trends southwest to join Malone Draw at the head of the Lost River 14.5 km (9 mi) west of Alamogordo, Otero County, New Mexico; sec. 27, T. 16 S., R. 9 E.; New Mexico Principal Meridian 32° 54′ 02″ N., 106° 06′ 48″ W.

by Stephen J. Frost,
NMBMMR Correspondent

Correction

In the May 1981 issue of *New Mexico Geology,* under the column on geographic names "Compana" should have read "Campana."

MINING REGISTRATIONS (continued)

Date and operation	Operators and owners	Location
2-5-81 barite	Operator—Holiday, G.L.G. Development Corp., P.O. Box 1036, Socorro, NM; Gen. Mgr.: Glen E. Stevenson, 3 mi east of Magdalena, NM, phone: 854-2512; Person in charge: Jim Haines, Los Lunas, NM Owner—Don Fingaldo, Truth or Consequences, NM	Sierra Co.; sec. 6, T. 15 S., R. 3 W.; Caballo mining district; 10 mi east and 10 mi south of Truth or Consequences, NM; barite; underground; state land
2-17-81 silver, gold	Operator—Margery mine, Trans-World Metals, P.O. Box 2003, Truth or Consequences, NM; Gen. Mgr.: Embree H. Hale, Jr., P.O. Box 445, Truth or Consequences, NM, ph: 895-5319 Property owner—Embree H. Hale, same address and phone	Sierra Co.; sec. 13, T. 15 S., R. 9 W.; Kingston mining district; type—underground; works—adit; go to north Percha Road, between Hillsboro and Kingston, go to Percha Cabin, turn north 1 mi; federal land
2-17-81 silver	Operator—Triple Cross exploration drift, Sunspot Minerals, Inc., Box 117, Winston, NM 87943; Gen. Mgr.: Caesar Fulton, 205 Gibson St., Truth or Consequences, NM, ph: 894-7128 Property owner—National Forest Service	Sierra Co.; sec. 22, T. 10 S., R. 9 W.; Winston (Grafton) mining district; 1 mi beyond the old townsite of Grafton which is on Turkey Creek, approximately 10 mi west-northwest of Winston; silver; type—exploration; federal land
2-17-81 uranium	Operator—H-1 mine, Anaconda Copper Co., Box 638, Grants, NM; Mgr.: R. D. Lynn, same address, ph: 876-2211; Mine Supt.: J. Anderson, same address and phone; Other official: Jack E. Sabo, Chief Safety Engr.; Rudy Garza, Assist. Safety Engr., same address	Valencia Co.; secs. 2 and 3, T. 10 N., R. 5 W.; Laguna mining district; type—underground; leave I-40 at Laguna exit; west on old US-66 to NM-279; north 2.9 mi then turn right on dirt road and proceed 4.8 mi to mine site; private land
3-3-81 copper, lead zinc	Operator—Royal John group, Ree-Co Minerals, Inc., 2527 Virginia NE, Suite H, Albuquerque, NM 87110; Gen. Mgr.: Hal McGarr, same address, ph: 293-1520; Person in charge: Bakke & Assoc., same address and phone; Gen. Supt.: Burt Bakke, same address and phone; Other official: Oliver C. Reese, same address and phone Property owner—Ree-Co Minerals, Inc., same address	Grant Co.; secs. 8, 9, 16, 17, T. 17 S., R. 9 W.; Swartz mining district; copper, lead, zinc; type—base metal; works—underground; 40 mi east of Silver City, NM; federal land
3-3-81 silver, copper	Operator—Silver Monument, FMC Minerals, 575 Union Blvd. #300; Lakewood, CO 80228; Gen. Mgr.: Cecil Alvarez, same address, ph: 303-989-5800; Person in charge: Lee Davis, same address and phone; Other officials: A. T. Bogen, V.P., First Mississippi Corp., P.O. Box 1249, Jackson, Miss. 39205 Property owner—FMC Minerals, same address	Sierra Co.; sec. 19, T. 11 S., R. 8 W.; Hot Springs mining district; silver, copper; type—underground; west on NM-52 to Chloride, then west 14 mi up Chloride Creek; private land
3-3-81 mill	Operator—Silver Bar Project-Chloride Mill, FMC Minerals, 575 Union Blvd. Suite 300; Lakewood, CO 80228; Gen. Mgr.: Cecil Alvarez, same address; Other officials: A. T. Bogen, V.P., First Mississippi Corp., P.O. Box 1249, Jackson, Miss. 39205 Property owner—FMC Minerals, same address	Sierra Co.; sec. 20, T. 11 S., R. 8 W.; Hot Springs mining district; silver, copper, gold; exploration only; NM-52 west from Truth or Consequences 40 mi to Chloride; 1 ton per hr capacity; private land
3-3-81 uranium	Operator—Piedra Triste, Todilto Exploration & Dev., 3810 Academy Parkway St. NE, Albuquerque, NM 87109; Gen. Mgr.: George Warnock, same address, ph: 345-8391 Property owner—Todilto Exploration & Development Corp., same address	McKinley Co.; sec. 30, T. 13 N., R. 9 W.; Grants mining district; uranium; NM-53 north from Milan, NM, 11 mi, left on dirt road leading to Hope and Reserve mines (1 mi NW of NM-53); private, federal land

(TO BE CONTINUED NEXT ISSUE)

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