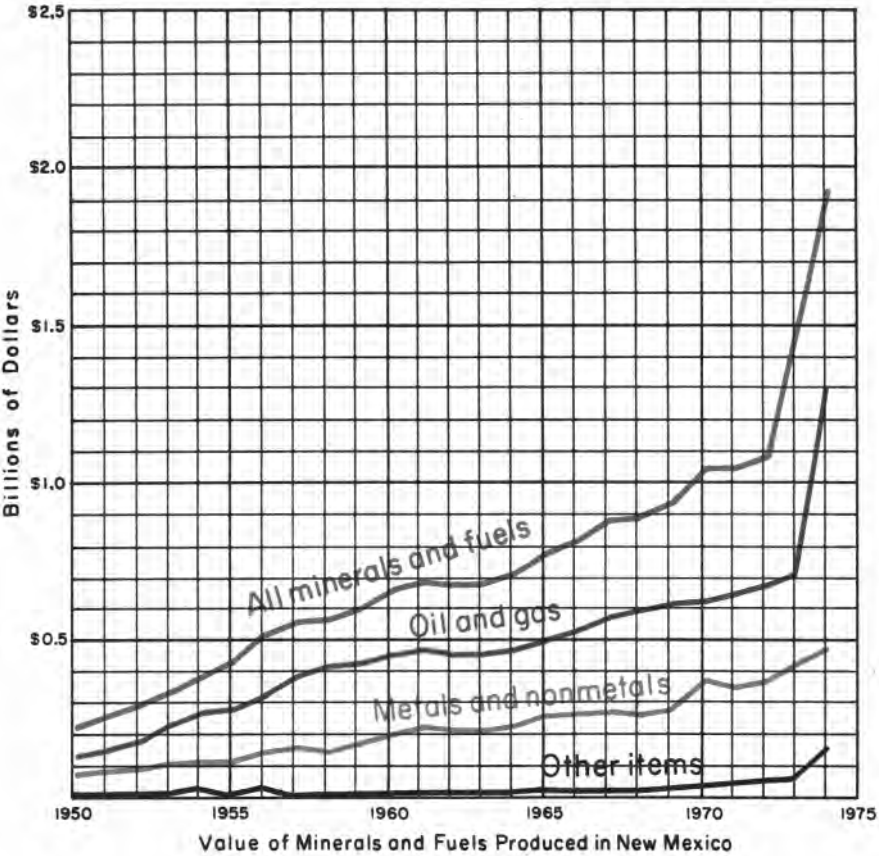
Annual Report

July 1, 1974 to June 30, 1975

APPENDIX



New Mexico Bureau of Mines & Mineral Resources

A DIVISION OF
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

New Mexico Bureau of Mines & Mineral Resources
Socorro, NM 87801

A DIVISION OF
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

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Albuquerque 505/835-5011

October 1, 1975

To: Board of Regents and President of
New Mexico Institute of Mining & Technology
Governor of New Mexico

I have the honor of transmitting to you the Annual Report of the New Mexico Bureau of Mines & Mineral Resources for the fiscal year July 1, 1974 to June 30, 1975, as required by Section 3, Chapter 115, of the Eighth New Mexico Legislature sessions laws, approved March 4, 1927.

During the fiscal year 21 new technical reports were published by the Bureau, 12 talks were presented at scientific meetings, and 35 papers by Bureau staff and consultants were published in scientific and mineral resources journals. Information concerning exploration, development, and conservation of New Mexico's mineral resources was provided in 6955 letters, in 4560 telephone calls, and in 3520 visitor conferences in Bureau offices. Sales of publications, priced at about cost of printing, totaled $32,550. More than 8,500 publications were distributed to state officials, libraries, and scientific agencies.

Resignations and deaths had reduced professional staff by 35 percent during the previous fiscal year; addition of 7 new members during 1974-75, however, restored professional staff to full strength. The Board of Educational Finance and the New Mexico Legislature closely followed the Regents' recommendations for a 6-percent increase in the Bureau's budget for the 1975-76 fiscal year, and allowed salary adjustments to keep competitive with State agencies.

During May 1975, most of the Bureau staff moved into the newly constructed southwest wing of Workman Research Center. Total space in the new facility is more than 10,000 square feet, a net gain of 3,500 square feet as the Bureau gave up 6,500 square feet of its previous floor space.

Respectfully submitted,

Frank E. Kottlowski

Frank E. Kottlowski
Director

New Mexico Bureau of Mines & Mineral Resources

A DIVISION OF
NEW MEXICO INSTITUTE OF MINING & TECHNOLOGY

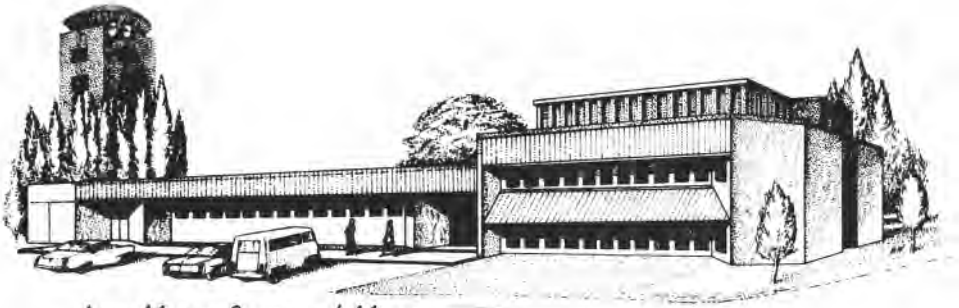
ANNUAL REPORT

for the Fiscal Year
July 1, 1974 to June 30, 1975

by

Frank E. Kottlowski
and Staff

1975



New Mexico Bureau of Mines and Mineral Resources

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Introduction

Where can New Mexico turn for reliable knowledge of the mineral resources critically needed by the nation?

By law, the New Mexico Bureau of Mines & Mineral Resources is the official State organization charged with investigating and reporting on the geology and mineral resources of New Mexico, including the energy resources. The Bureau is required to give technical and scientific assistance in the exploration, development, production, and conservation of New Mexico's mineral wealth. That is the basis of our program. In 1974 the value of minerals extracted in New Mexico totaled more than $2.0 billion—about 2000 times the Bureau's appropriation for that year.

New Mexico's mineral industry contributes mightily to the State's economy. In addition to the $2.0 billion value of the raw products taken from the earth are the many jobs for mineral industry employees in the cities shown in the mineral map on the outside of the back cover. Furthermore, the industry paid to the State and its subdivisions more than $155 million in taxes, rentals, royalties, and bonuses. No other industry even approaches this kind of direct fiscal support. These tax monies comprise a major part of the current surplus in the general fund.

The mineral industry needs answers to economic and technical problems. Scientific evaluation is increasingly important in assessing New Mexico's mineral potential. Geologic, mining, and metallurgical studies insure a stable mineral economy. New Mexico must make sure that when presently producing deposits are used up others, to be discovered, are ready to take their place.

Most of the talents and funds for finding and developing New Mexico's mineral resources comes from private industry. The Bureau contributes actively to these programs by taking the lead in applied research that insures industry's prudent growth. Serving as a clearinghouse of the best possible scientific and technical information, the Bureau shares impartially its files of basic data with all companies, individuals, agencies, and institutions. An outstanding example is the New Mexico Library of Subsurface Data established in the Bureau. Oil well samples and records, secured by companies and individuals at a cost of several billion dollars, are freely available; their value increases with the passing of time.

Relation of Geology to Resources

Geological knowledge is indispensable in the exploration and development of mineral resources. Field investigations of mineral deposits, regional geologic reports, structure contour maps, detailed and reconnaissance geologic maps, and stratigraphic studies aid in finding and, eventually, in extracting minerals. Many geologists, mining engineers, prospectors, and landowners visit the Bureau to confer on geologic data and interpretations.

Much of the Bureau's work is in technical services, but pure and applied geologic research are also important. Prior to 1960, Schilling's study of low-grade molybdenum deposits near Questa was in the realm of pure research; today, a mill extracts this ore. Prior to 1962, studies of late Paleozoic reefs in the San Andres, Sacramento, and Guadalupe Mountains were mostly stratigraphic research; today, similar Abo reefs in southeastern New Mexico yield oil and gas.

Outcrop and subsurface stratigraphic studies of the 24 counties not now producing oil and gas may be considered pure geologic research today, but, tomorrow could lead to the discovery of petroleum in these areas.

Geologic investigations that may help exploration for metals and industrial rocks range from tabulation of county-by-county mineral production to detailed work on the gold deposits at White Oaks. Evaluation of ground-water supplies is aided by hydrogeologic reports setting forth basic geologic and engineering data for counties or other areas. Areal geologic mapping, fundamental to all geologic and mineral resources investigations, has been completed for many quadrangle areas.

Many of the Bureau's technical publications are designed to aid in the search for fuels and minerals. These publications range from reconnaissance maps in the *Geologic Map* series to detailed studies contained in the *Bulletins, Memoirs,* and *Circulars.* Is the scientific and technical information generated by the Bureau useful to the mineral exploration industry? Sales of Bureau publications totaled more than $32,550 this fiscal year; about 8,500 copies of the new publications were issued free to state officials, libraries, and scientific organizations. Nor do the sales figures or a particular publication necessarily reflect its ultimate worth to New Mexico; a single report or map may contain the clue that leads to the discovery of a huge orebody or a million-barrel oil pool.

Many New Mexicans, and most of the tourists visiting the state, are not concerned directly with technical geologic investigations but do have a true interest in our enchanting landscapes. They want to know how the canyons and mountains, arroyos and mesas, and volcanoes and desert playas were formed. The popular guides *Scenic Trips to the Geologic Past* explain the geology of local areas, and point out scenic and geologic wonders. These booklets also are designed to keep tourists in the state "that extra day"—so important to New Mexico's economy. Tens of thousands of copies have been distributed already, and the demand continues.

Basic Services

Citizens of New Mexico (and elsewhere) including geologists, engineers, landowners, prospectors, legislators, students, industry personnel, and tourists asked for technical advice from Bureau staff. Our records show that 6,955 letters and 4,560 telephone inquiries were answered, and 3,520 office visitors counseled.

More than 15,000 adults and school children toured the Bureau's mineral museum. Bureau laboratories prepared 2,227 analytic reports on 1,002 samples (mineral, ore, water, and metallurgical). Staff mineralogists identified hundreds of hand specimens brought or mailed to the Bureau.

Direct services to petroleum exploration included making available records of many of the more than 65,000 test wells drilled in New Mexico, including cuttings from selected wells and a variety of borehole logs such as electric, radioactive, and sonic. Up-to-date petroleum exploration maps for most counties are maintained and available.

The business office sold publications and maps for total sales of $32,550. In

addition, about $26,000 of New Mexico Geological Society guidebooks were sold; the Bureau handles these special publications as a public service. The business office also furnished secretarial and stenographic services, assisted in the selection of vendors for specialized materials, and prepared requisitions and purchase orders.

The Mineralmobile was exhibited in various parts of the state for 19 days, as well as at the State Fair.

The Director of the New Mexico Bureau of Mines & Mineral Resources is *ex officio* Director-Secretary of the New Mexico Coal Surfacemining Commission. Surfacemining permits were issued to Navajo Mine of Utah International, Inc. and Sundance Mine of Sundance Mining Co. Inspections were made of York Canyon mine of Kaiser Steel Co., McKinley mine of Pittsburg & Midway Coal Co., and the San Juan mine of Western Coal Co.

The Director of the New Mexico Bureau of Mines & Mineral Resources is also *ex officio* member of the State Water Quality Control Commission which conducts regular bimonthly meetings as well as additional special meetings and public hearings.

A number of cooperative projects were continued with state and federal agencies. Staff members served on various government committees and commissions, served as officers of professional organizations, presented papers at scientific meetings, and served New Mexico Tech by teaching, directing graduate studies, and participating in the work of various campus committees.

Table of Organization

Administration & information
Kottlowski
Deputy Director vacancy
Drake
Peralta

Business office & pub. sales
Devlin
Whyte
Meeks

Drafting & illustrating
Arnold
Wooldridge
Pearson

Editing & publishing
Kelley
Burlbaw
Merillat

Environmental geology
Tabet
Hunt
Hawley

Geophysics
Reiter
Mansure

Hydrogeology & geothermal
Stone
Reiter

Industrial minerals & coal
Austin
Weber
Chapin
Foster
Tabet
Economic Geologist vacancy

Metallic ores
Chapin
Renault
Robertson
Weber

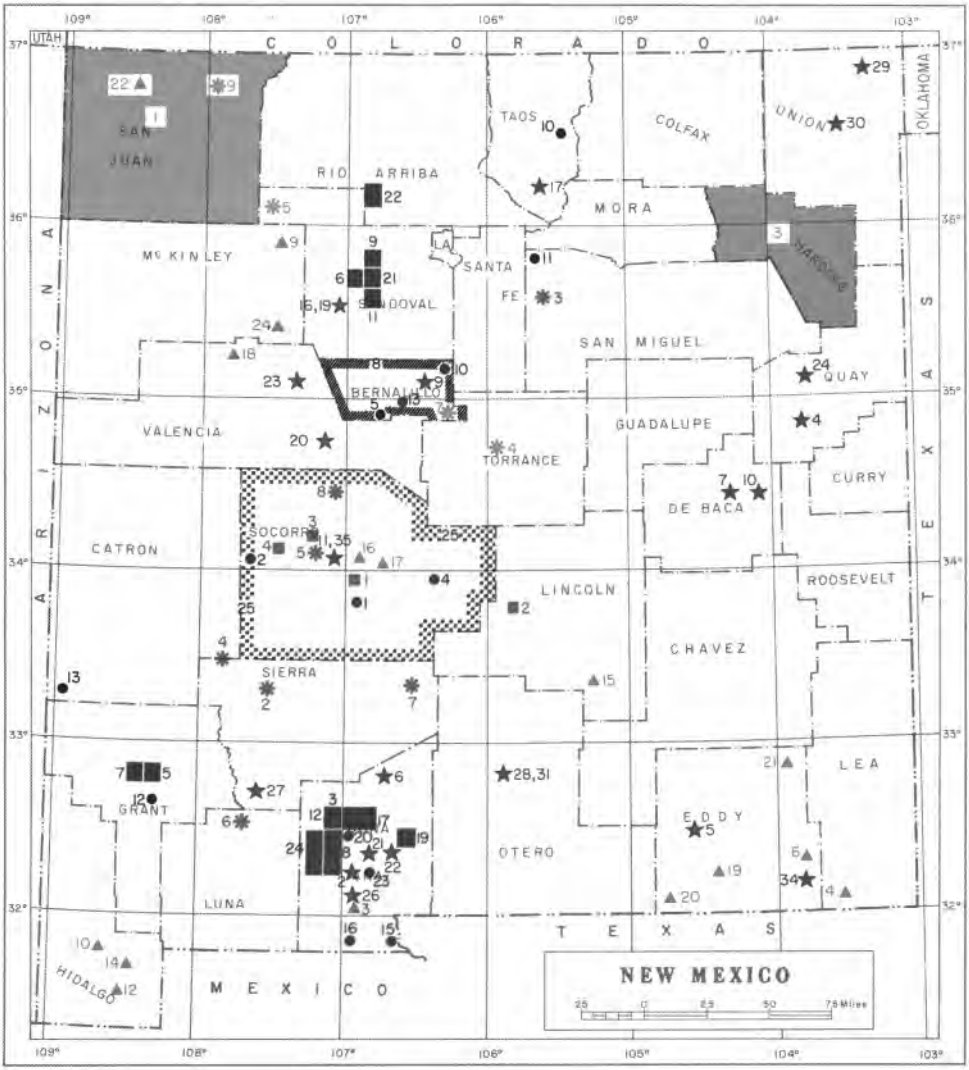
Metallurgy & chemistry
Roman
Brandvold
Brierley
Shantz
Smith
Crespin

Mineralogy & x-ray
Taggart
Renault
Davidson

Oil & gas
Bieberman
Foster
Thompson
Chavez
Candelaria

Paleontology
Flower
Hook

Bureau Field Projects



Geologic and Resource Investigations

Emphasis in the Bureau's program is to provide statewide evaluations of resources and reserves, to study key areas in detail, and to recommend guides for exploration, development, production, and conservation of our mineral and fuel resources.

Energy Resources

1. Foster and Grant–Future of New Mexico's oil and gas resources (Resource Map 3)
2. Bieberman–Oil and gas fields and exploration map of New Mexico
3. Thompson and Bieberman–Oil and gas exploration wells in Doña Ana County, New Mexico (New Mexico Geological Society 26th guidebook, in press)
4. Foster–Petroleum geology of the Bone Springs Formation
5. Bieberman–Up-date catalog of samples available in New Mexico Library of Subsurface Data
6. Foster–Oil and gas potential of central Delaware basin, New Mexico
7. Bieberman–New Mexico part of "Oil and Gas Field Data Bank and Map of North America" by American Association of Petroleum Geologists
8. Foster–Petroleum developments, 1973 (1973-74 Annual Report)
9. Shomaker–Deep coal deposits of Mesaverde Group in San Juan basin (cooperative with U.S. Bureau of Mines)
10. Thompson–Petroleum potential of southwest New Mexico
11. Foster–Estimate of oil and gas reserves in New Mexico
12. Greenwood, Thompson and Kottlowski–Petroleum potential of Pedregosa basin
13. Foster–Petroleum developments, 1974 (1974-75 Annual Report)
14. Zeller and Thompson–Structural geology of the Big Hatchet Peak quadrangle (Circular 146, in press)
15. Milner–Glorieta-San Andres facies in east-central New Mexico
16. Chamberlin and Chapin–Geology and geothermal potential of Socorro Peak volcanic field
17. Tabet–Jornada del Muerto coal field
18. Schilling, F.–Annotated bibliography of Grants uranium region (Bulletin 105, in press)
19. Yurewicz–Capitan Formation in Guadalupe Mountains
20. Wheeler–Goat Seep reef in Guadalupe Mountains
21. Kumar and Foster–Tertiary recovery of oil in Loco Hills field, Eddy County
22. Roman and Shomaker–Spacial distribution of rock strata in coal spoil banks (in cooperation with U.S. Forest Service)
23. Christiansen–History of oil and gas exploration and production in New Mexico
24. Renault and Hayslip–Thermoluminescence of quartz as a guide to exploration for uranium in sandstone deposits

Geology and Mineral Resources

1. Renault–Geology of Chupadera Mountains
2. Weber–Geology of Plains of San Agustin
3. Seager, Clemons, and Hawley–Geology of Sierra Alta quadrangle (Bulletin 102)
4. Weber–Geology of Mockingbird Gap site
5. Cunningham–Geologic map of Silver City quadrangle (Geologic Map 30)
6. Woodward and Martinez–Geologic map of Holy Ghost Spring quadrangle (Geologic Map 33)
7. Cunningham–Circle Mesa quadrangle
8. Clemons–Geologic map of east half of Corralitos Ranch quadrangle (Geologic Map 36, in press)
9. Woodward, DuChene, and Reed–Geologic map of San Miguel Mountain quandrangle (Geologic Map 34)
10. Kelley and Northrop–Geology of Sandia Mountains and vicinity (Memoir 29)
11. Woodward–Geologic map of San Ysidro quadrangle (Geologic Map 37, in press)
12. Seager and Clemons–Geology of Cedar Hills-Selden Hills area, Doña Ana County (Circular 133, in press)
13. Kelley, V.–Structure of Albuquerque basin
14. Hunt–Surficial geology of New Mexico
15. Lovejoy–Geology of Cristo Rey (Memoir 31, being edited)
16. Hoffer–Geology of Potrillo basalt field, south-central New Mexico

17. Seager—Geologic map and sections of south half San Diego Mountain quadrangle (Geologic Map 35, in press)
18. Hunt—Physiographic map and description of New Mexico
19. Seager and Dulas—Geology and ore deposits of the Organ quadrangle
20. Seager and Kottlowski—Geology of Doña Ana Mountains (Circular 147, in press)
21. Woodward—Geologic map of Gilman quadrangle
22. Woodward—Geologic map of Gallina quadrangle
23. Seager, Kottlowski, and Hawley—Geology of Robledo Mountains
24. Clemons—Geologic map of west half of Corralitos Ranch quadrangle
25. Chapin—Geology and mineral resources of Socorro County
26. Robertson—Annotated bibliography and index to mapping of Precambrian geology of New Mexico

Water Resources

1. Stone—Geology and ground-water resources of San Juan County (in cooperation with U.S. Geological Survey)
2. Stone—Question-and-answer pamphlet on ground-water resources
3. Trauger—Ground-water resources of Harding County (in cooperation with U.S. Geological Survey)
4. Titus—Ground-water resources and geology of Estancia Basin (Bulletin 103, being edited)
5. Shomaker—Deep aquifers in the San Juan basin (in cooperation with companies in area)
6. Summers—Catalog of thermal waters in New Mexico (Hydrologic Report 4, in press)
7. Titus—Ground-water resources of Sandia and Manzano Mountains (in cooperation with U.S. Geological Survey)
8. Brandvold, L.—Mercury content of natural waters in New Mexico
9. Brown—Hydrogeology of Aztec quadrangle
10. Stone—New Mexico water resources information
11. Brandvold, L. and Dauchy—Analysis of heavy metals in Rio Grande basin
12. Brandvold, L.—Represents the New Mexico Bureau of Mines & Mineral Resources on the State Water Quality Control Commission

Industrial Minerals

1. Austin—Shale and clay resources in New Mexico
2. Austin—Potash deposits in New Mexico
3. Austin and Weber—Perlite deposits in New Mexico
4. McAnulty—Fluorspar deposits in New Mexico
5. Weber—Zeolites in New Mexico
6. Taggart—Mineralogy of Hansonburg mining district

Metallic Ores

1. Chapin, Clemons, Seager, Weber, and Kottlowski—Age dating of igneous rocks and metallic mineralization in central and southwestern New Mexico
2. MacMillan—Structure, petrology, and ore deposits of southern part of Sierra Cuchillo
3. Robertson—Precambrian geology and ore deposits of southern Sangre de Cristo Mountains
4. Lufkin—Tin mineralization within rhyolite flow-domes, Black Range (Open-file report 57)
5. Iovenitti—Origin of silification in Kelly mining district
6. Proctor—Trace base metals in Cooke's Peak stock
7. Condie and Budding—Precambrian rocks in San Andres Mountains
8. Condie—Precambrian rocks of the Ladron Mountains, Socorro County (Geologic Map 38, in press)

Mining Districts

1. Jahns and Willard—Manganese deposits of Luis Lopez district
2. Jahns and Willard—Gold deposits of White Oaks mining district
3. Chapin—Geology and mineral resources of the Magdalena area
4. Wilkinson—Cat Mountain mining district
5. Christiansen—History of mining in New Mexico (Scenic Trips 12)

Stratigraphy and Paleontology

1. Hawley, Bachman, and Manley—Quaternary stratigraphy of the Basin and Range and Great Plains Provinces, New Mexico and western Texas

2. Hawley—Quaternary geology of Las Cruces region
3. Flower—Mollusca of the Devonian of New Mexico
4. Frye, Leonard, and Glass—Ogallala Formation of northeast New Mexico
5. Sarg—Carbonate-evaporite transition facies of Seven Rivers Formation
6. Kottlowski—Mississippian strata of San Andres Mountains
7. Leonard and Frye—Pliocene and Pleistocene deposits and molluscan fauna, east-central New Mexico (Memoir 30)
8. Flower—Ordovician actinoceroids and endoceroids (Memoir 28, in press)
9. Zidek—Some fishes of the Wild Cow Formation (Pennsylvanian) Manzanita Mountains, New Mexico (Circular 135, in press)
10. Frye, Glass, Leonard, and Coleman—Caliche and clay mineral zonation of Ogallala Formation, central-eastern New Mexico (Circular 144)
11. Siemers, T.—Stratigraphy and petrology of Mississippian, Pennsylvanian, and Permian rocks in the Magdalena area, Socorro County (Open-file report 54)
12. Hook and Flower—Cephalopod faunas of latest Canadian age from southwestern United States
13. Flower—Ordovician correlation chart (Circular 138, in press)
14. Siemers, T.—Pennsylvanian stratigraphy of Socorro County
15. Flower and LeMone—Faunal and petrologic studies of Bliss Sandstone, El Paso Group, and Montoya Group
16. Sheely—Petrography of sandstones in Dakota Formation on southeast fringe of San Juan basin
17. Pfefferkorn—Pennsylvanian compression floras in northern New Mexico
18. Balk—Stratigraphic nomenclature for New Mexico
19. Grant and Owen—Dakota Formation of southern Chama basin
20. Kues—Fauna of Red Tanks Member of Madera Limestone in Lucero Mesa area
21. LeMone—Permian carbonate petrology for Doña Ana and Robledo Mountains
22. Simpson—Abo-Hueco megafaunas from Doña Ana and Robledo Mountains
23. Owen and Siemers, C.—Dakota units in southeast San Juan basin between Laguna and La Ventana
24. Gage—Mesa Rica sandstone in Tucumcari area
25. LeMone, Simpson, and Klement—Paleoecology of transition beds of Abo and upper members of Hueco
26. King, Krause, and Dixon—Fusulinids of Hueco Formation in Las Cruces area
27. Macurda—Mississippian crinoids in Lake Valley Formation
28. Van Wagoner and Wilson—Gobbler Formation facies in the Sacramento Mountains, Otero County
29. Smith, R.—Petrogenesis of clastic plugs in Union County
30. Gilbert—Sedimentology of braided alluvial interval of Dakota Sandstone in northeastern New Mexico
31. Benne—Lower Gobbler Formation in Sacramento Mountains, Otero County
32. Hook—Statistical analysis of planispiral coiling in cephalopods, gastropods, and fusulinids
33. Flower—Cephalopod studies: 1) Orders Endoceratida and Tarphyceratida, 2) Piloceratida of Newfoundland, 3) cephalopods of Durness Limestone of Scotland, Platteville Limestone of upper Mississippi valley, Tyrone Limestone of Kentucky, and Smithville Formation of Arkansas and Missouri, and 4) Ordovician of Spitzbergen
34. Foster and Riese—Stratigraphy of the Castile Formation
35. Chapin—Cenozoic stratigraphy of Socorro-Magdalena area

Environment, Remote Sensing, and Geologic Hazards

1. Tabet, Feldman, and Inglis—"Landsat" (formerly Earth Resources Technology Satellite) evaluation of mineral resources, geological structures, land use and landforms in New Mexico
2. Tabet, Inglis, Feldman, and Page—Land use and remote sensing resources evaluation (in cooperation with Federation of Rocky Mountain States, Technology Application Center (University of New Mexico) and State Planning Office)
3. Feldman, Inglis, Vonder Linden, Chapin, Rhodes, and Kottlowski—Geologic analysis of ERTS-1 (Earth Resources Technology Satellite 1) imagery for New Mexico (Open-file report 53)

Geophysical Surveys

1. Reiter, Mansure, Edwards, and Shearer—Deep temperature logging and crustal radioactivity measurements in New Mexico and adjacent areas (funded by National Science Foundation

and the Energy Research and Development program of State of New Mexico in cooperation with New Mexico Institute of Mining & Technology)

2. U.S. Geological Survey–Aeromagnetic mapping of area from Socorro to north of Santa Fe (in cooperation with New Mexico Bureau of Mines & Mineral Resources)
3. Reiter, Edwards, and Shearer–Shallow temperature logging (4000 feet or less) in New Mexico and adjacent areas (funded by National Science Foundation in cooperation with New Mexico Institute of Mining & Technology)
4. Sanford–Survey of earthquakes in New Mexico (continuing)
5. Sanford–Gravity survey in central New Mexico
6. Barrie–Gravity survey of southwest Doña Ana County

Special Projects

1. Chapin–Origin of the Rio Grande rift
2. Schilling, J.–"Isochron/West," a periodic bulletin of isotopic geochronology (in cooperation with Nevada Bureau of Mines and Geology)
3. Chapin–Mechanics of transport and deposition of ash-flow tuffs
4. Weber–Petrographic and chemical characteristics of 4 new meteorites from New Mexico
5. Renault–Petrology and geochemistry of basalts in the Isleta area, Socorro and Valencia Counties
6. Chapin–New Mexico in the Cenozoic tectono-magmatic framework
7. Renault–Spinel composition of basalts of Rio Grande valley
8. U.S. Geological Survey–Topographic map (1:50,000 scale) of Bernalillo County (in cooperation with Bernalillo County, City of Albuquerque, Four Corners Regional Commission, and New Mexico Bureau of Mines & Mineral Resources)
9. Brandvold–Atomic absorption methods for analysis of some elements in ores and concentrates (Circular 142)
10. Schilling, J.–Revision of Scenic Trips No. 2, Taos-Red River-Eagle Nest
11. Sutherland–Revision of Scenic Trips No. 6, Trail Guide to the Upper Pecos
12. James and Schilling, J.–Revision of Scenic Trips No. 10, Southwestern New Mexico (by incorporating Scenic Trips No. 5, Silver City-Santa Rita-Hurley into Scenic Trips No. 10)
13. Bikerman–Age-dating of volcanic rocks in Glenwood area
14. Taggart–Rb-Sr whole rock age determinations for Sandia Granite and Cibola Gneiss

Metallurgy

The primary functions of the Bureau's program in metallurgy are: 1) to provide assistance to any individual or group seeking help in developing a technical process for a mineral deposit in the state, 2) to improve the processes for testing ores and the procedures for operating mineral-processing plants, and 3) to assist in the technical education of individuals interested in the mineral industry in this state.

Formal courses were taught, guest lectures given, and graduate theses directed for the College Division; papers were presented at technical meetings, and current research results published.

Current metallurgical projects:

Brierley–1) Biogenic extraction of copper and molybdenum at high temperatures, 2) effect of an oxidant on leach dump bacteria, 3) biogenic uranium extraction from Anaconda ores, and 4) properties of thermophilic bacteria.

Plouf–1) Environmental equilibrium study with water and substrata samples from the Red River, upstream and downstream from Questa, 2) a feasible chloridization system for removing aluminum from clay, 3) a small-scale pilot plant for the solvent extraction of metal ions from leached ores, 4) small-scale characterization of leachability of copper oxide ores.

Roman–1) Heap leaching evaluation of Cerrillos copper ore, 2) heap leaching evaluation of Miami copper ore, 3) coal mine reclamation, 4) open-pit mining sequence, and 5) in-situ hydrogenation of coal.

Analytical and X-Ray Laboratories

The Bureau's laboratories are equipped to perform extensive chemical, mineralogical, and petrologic investigations. Chemical analyses, both qualitative and quantitative, are performed by classic wet-chemical and optical-spectrographic procedures, as well as by atomic absorption, X-ray, and electron-microprobe spectrometry.

The laboratories serve the public and all divisions of New Mexico Tech. Capabilities include analyzing water, ores, concentrates, geological samples, and leach liquids for the common elements or parameters.

During the year analytic assays were made of mineral samples, ore samples, water samples, metallurgical solutions, heads, concentrates, and tails on a total of 750 samples (1,670 assays). A data system has been established to reproduce the many water analyses run in our laboratory during the past 10 years; the file contains 400 entries and is about 65 percent complete.

X-ray analyses were performed on a large variety of rock materials. Machine time for X-ray diffraction totaled 920 hours; for X-ray fluorescence, 2,070 hours. The electron-microprobe facility was used mainly for microanalysis of spinel inclusions in olivine phenocrysts of basalts; more than 1,000 analyses were obtained.

The thin-section laboratory produced more than 500 thin sections for various Bureau projects; facilities were also used extensively by the Geoscience Department. Over 2,500 thin sections have now been cataloged for the Henry Birdseye Laboratory, including rocks from all areas of New Mexico.

New Mexico Library of Subsurface Data

During the year 210 sets of drilling samples were added, bringing the total number of sets on hand to more than 9,200. Also acquired were electric and other types of mechanical logs from 1,392 wells, in addition to 1,375 well records from drilling operations.

Publications

The Bureau issued 20 new publications in the form of memoirs, bulletins, circulars, scenic trips, journal of geochronology, geologic maps, resource map, publication catalogs, brochures, geologic postcard, and annual report. Another 3 publications were re-issued, while 10 manuscripts were released as open-file reports. Six publication announcement cards were prepared and released. Seven large-scale full-color geologic map sheets were published (3 sheets in 3 Geologic Maps, 2 sheets in Memoir, and 2 in Bulletin). The brochures were in conjunction with the mining symposium convened in Silver City in May, and the State Fair.

Editing and Publishing

A total of 621 pages were edited and printed in new publications (scientific, 412; popular, 113; publication catalogs, 64; annual report, 32). A total of 349 pages were printed in re-issued publications (all scientific).

Funds allocated to printing totaled $51,835, or about 6 percent of the total budget for operating the Bureau.

At the close of the fiscal year, 53 manuscripts were either in review or planning (up 15 percent); another 21 were being edited or were in press (up 16 percent).

Man-years devoted to publishing activities were estimated as follows: editing, 0.7 internal plus 0.1 external; pasteup and copyreading, 1.0; proofreading (student), 0.3; secretarial, 0.13. The cutback in editing staff amounted to a decrease of 0.82 man-years.

About 21 percent of the camera-ready copy for new publications was prepared in Bureau; about 18 percent of printing was done at Tech.

Drafting and Illustrating

Three full-time employees do most of the Bureau's cartographic and illustrating work. As time permits, occasional small jobs are done for the other divisions of Tech.

Running duplicate copies of U.S. Geological Survey aeromagnetic maps and other open-file maps continues at high volume.

Skills developed with the color-proofing equipment acquired previously, along with use of a new color selection chart, have contributed importantly to the increased quality of our multicolor maps.

Twelve large geologic maps were in production or awaiting preparation at the close of the fiscal year.

New Publications

Memoir 29—GEOLOGY OF SANDIA MOUNTAINS AND VICINITY, NEW MEXICO, 1975, by V. C. Kelley and S. A. Northrop, 136 p., 4 tables, 92 figures, 4 maps, 2 appendices. $12.50.

Comprehensive coverage of rocks and formations, structure, paleontology, stratigraphy, geologic history, and mineral resources. Discusses caves and artifacts, historical geologic surveys and early mining operations; also includes such environmental problems as landslides and earthquakes. Contains a topographic map, structure map, structure sections, and color geologic map.

Memoir 30—PLIOCENE AND PLEISTOCENE DEPOSITS AND MOLLUSCAN FAUNA, EAST-CENTRAL NEW MEXICO, 1975, by A. B. Leonard and J. C. Frye, 44 p., 3 tables, 6 figures, 3 plates. $5.00.

Molluscan faunal assemblages (dated 18,000 to 5,000 B.P.) from 45 localities produce a composite fauna of 47 species. Describes paleoclimates and geology of the Cenozoic.

Bulletin 102—GEOLOGY OF SIERRA ALTA QUADRANGLE, DOÑA ANA COUNTY, NEW MEXICO, 1975, by W. R. Seager, R. E. Clemons, and J. W. Hawley, 56 p., 2 tables, 13 figures, 1 map, 2 appendices. $4.50.

Describes stratigraphy of Permian to Holocene rocks. Structure includes a volcano-tectonic depression which appears to be a precursor to Rio Grande rift in this area. Miocene to Pliocene faults superimpose across the depression. Also characterizes Quaternary evolution of landscape.

Bulletin 105—ANNOTATED BIBLIOGRAPHY OF GRANTS URANIUM REGION, NEW MEXICO, 1975, by F. A. Schilling, Jr., 69 p. $4.00.

Circular 142—ATOMIC ABSORPTION METHODS FOR ANALYSIS OF SOME ELEMENTS IN ORES AND CONCENTRATES, 1974, by L. A. Brandvold, 22 p., 1 table. $1.00.

Laboratory manual of procedures for application of atomic absorption and dissolution methods to rocks and minerals.

Circular 144—CALICHE AND CLAY MINERAL ZONATION OF OGALLALA FORMATION, CENTRAL-EASTERN NEW MEXICO, 1974, by J. C. Frye, H. D. Glass, A. B. Leonard, and D. D. Coleman, 16 p., 2 tables, 7 figures, 1 appendix. $1.50.

Clay mineral zones, lithology of rocks and physiographic setting determine climatic influences and correct age of zones. Top 4 to 6 ft of the capping caliche was developed by events of the Pleistocene and Holocene.

Scenic Trip 12—THE STORY OF MINING IN NEW MEXICO, 1974, by P. W. Christiansen, 112 p., 29 photographs, 3 maps, 7 drawings. $2.50.

History of mining from the Indians and Spanish, through the gold and silver rushes of the 1800's to the turn of the century. Includes a chapter on mining potpourri and an annotated bibliography. Unique collection of rare photographs and attractive illustrations.

Isochron/West–Nos. 10, 11, 12 edited by John H. Schilling, 25 p., 43 p., and 14 p. Available by subscription (4 issues for $6.00).

A serial journal of isotopic geochronology.

Geologic Map 30–GEOLOGIC MAP OF SILVER CITY QUADRANGLE, NEW MEXICO, 1974, by J. E. Cunningham. $1.50.

Text on map.

Geologic Map 33–GEOLOGIC MAP OF HOLY GHOST SPRING QUADRANGLE, NEW MEXICO, 1974, by L. A. Woodward and R. Martinez. $1.50.

Text on map.

Geologic Map 34–GEOLOGIC MAP OF SAN MIGUEL MOUNTAIN QUADRANGLE, NEW MEXICO, 1974, by L. A. Woodward, H. R. DuChene, and R. K. Reed. $1.50.

Text on map.

Resource Map 3–THE FUTURE OF NEW MEXICO'S OIL AND GAS RESOURCES, 1974, by R. W. Foster and P. R. Grant, Jr., text and 2 figures. $1.00.

Map classifies exploration potential of nonproducing areas. Recommends reevaluation of New Mexico's present regulations governing exploration and development of resources.

Price List 6 and 7–PUBLICATIONS AVAILABLE FROM NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES. October 1974 and June 1975. Free.

Comprehensive listing of geologic and mineral reports and maps, with subject and author index and colored index map.

Geologic Postcard–SKETCH OF NEW MEXICO FROM SATELLITE PHOTOGRAPHS, 1974, 4½" x 6" postcard. $0.10.

Annual Report–NEW MEXICO BUREAU OF MINES & MINERAL RESOURCES JULY 1, 1973 TO JUNE 30, 1974, by F. E. Kottlowski and staff, 32 p. Free.

Brochure–BASE METAL AND PRECIOUS METAL DISTRICTS OF NEW MEXICO AND ARIZONA.

Abstracts of papers presented at symposium in Silver City, New Mexico, May 1975.

Re-issued Publications

Memoir 15–GEOLOGY AND TECHNOLOGY OF THE GRANTS URANIUM REGION, 1963. Prepared by the Society of Economic Geologists, 277 p. $5.00.

ISOCHRON/WEST–Nos. 6 and 10 (available to subscribers)

Open-file Reports

Open-file Report 48–OIL AND GAS POTENTIAL SITE FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTE, 1974, by R. W. Foster, 296 p., 46 tables, 54 figures.

Open-file Report 49–STRATIGRAPHY AND SEDIMENTARY PETROLOGY OF JURASSIC AND PRE-GRANEROS CRETACEOUS ROCKS, NORTHEASTERN NEW MEXICO, 1958, by C. J. Mankin, 208 p., 11 tables, 17 figures, 23 plates.

Open-file Report 50–AN EQUILIBRIUM DISTRIBUTION OF TRACE ELEMENTS IN A NATURAL STREAM ENVIRONMENT, THE RED RIVER NEAR QUESTA, NEW MEXICO, 1974, by S. E. Faith, 54 p., 9 tables, 4 figures, 3 appendices.

Open-file Report 51–HYDROGEOLOGY OF THE SAN AUGUSTIN PLAINS, NEW MEXICO, 1973, by D. D. Blodgett and F. B. Titus, 54 p., 6 tables, 10 figures, 2 appendices.

Open-file Report 52–GEOLOGIC MAP OF THE CEDAR HILLS–SELDEN HILLS AREA, DOÑA ANA COUNTY, NEW MEXICO, 1974, by W. R. Seager and R. E. Clemons, scale 1:24,000.

Open-file Report 53–GEOLOGIC ANALYSIS OF ERTS-1 IMAGERY FOR THE STATE OF NEW MEXICO, 1974, by S. Feldman, M. Inglis, K. Vonder Linden, C. E. Chapin, R. C. Rhodes, and F. E. Kottlowski, 108 p., 5 tables, 19 figures, 2 appendices.

Open-file Report 54–STRATIGRAPHY AND PETROLOGY OF MISSISSIPPIAN, PENNSYLVANIAN, AND PERMIAN ROCKS IN THE MAGDALENA AREA, SOCORRO COUNTY, NEW MEXICO, 1974, by W. T. Siemers, 133 p., 7 tables, 38 figures, 1 plate.

Open-file Report 55–REGIONAL HYDROLOGY AND EVAPORATIVE DISCHARGE AS A PRESENT-DAY SOURCE OF GYPSUM AT WHITE SANDS NATIONAL MONUMENT, NEW MEXICO, 1973, by R. J. Allmendinger and F. B. Titus, 53 p., 15 figures, 1 plate.

Open-file Report 56–TECTONIC MAP OF RIO GRANDE RIFT, NEW MEXICO, 1975, compiled by L. A. Woodward, J. F. Callender, and R. E. Zilinski.

Open-file Report 57—TIN MINERALIZATION WITHIN RHYOLITE FLOW-DOMES, BLACK RANGE, NEW MEXICO, 1972, by J. L. Lufkin. 148 p., 8 tables, 48 figures, 5 plates.

Outside Papers Sponsored in Part by Bureau

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Articles in Bureau Publications

Bieberman, R. A., Weber, R. H., Summers, W. K., Shomaker, J. W., and Kottlowski, F. E., 1975, Energy reserves and resources of New Mexico, Appendix to Annual Report 1973-1974, p. 22-26.

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Foster, R. W., 1975, Petroleum developments for 1973, Appendix to Annual Report 1973-1974, p. 28-30.

Kelley, R. W., 1975, Foreword to Memoir 29, Geology of Sandia Mountains and vicinity, p. 5.

Additional Professional Activities

Participation in Scientific and Professional Conferences

American Association of Petroleum Geologists: Annual Meeting, April; Circum-Pacific Energy and Minerals Conference, August; Rocky Mountain Section, June

American Chemical Society: Pacific Conference on Chemistry and Spectroscopy, October (Society for Applied Spectroscopy, cosponsor); Regional Meeting, July

American Institute of Chemical Engineers: August

American Institute of Mining Engineers: September

American Institute of Mining, Metallurgical and Petroleum Engineers: Intermountain Section Conference, August

American Mining Congress: October

Association of American State Geologists: May; Coal Conference, February (U.S. Geological Survey, cosponsor)

Association of Earth Science Editors: October

Clay Minerals Society: October

Energy Research and Development Institute, New Mexico State University: Coal Symposium, April

Federal Energy Administration: Symposium on Subsurface Geoscience Records and Materials, April

Geological Society of America: Annual Meeting, November; Penrose Conference, August; Rocky Mountain Section, May; South Central Section, March

Institute of Electrical and Electronics Engineers, Inc.: April

Institute on Lake Superior Geology: Twenty-First Annual Meeting, April

Mackay School of Mines, University of Nevada at Reno: Water, Energy, and People for Future Western Mineral Production, November and February

Montana States Engineers: First Gaudin Memorial Idea Conference on Fragmentation and Leaching, May

NASA: Earth Resources Survey Symposium, June

National Science Foundation: RANN (Reseach Applied to National Needs) Geothermal Conference, September; RANN Symposium, June; Symposium on Molybdenum in the Environment, June (Environmental Protection Agency and University of Colorado, cosponsors)

New Mexico Geological Society: Twenty-Fifth Field Conference, October: Symposium on Base and Precious Metal Districts of New Mexico and Arizona, May (Arizona Geological Society, cosponsor)

New Mexico Water Conference: Twentieth Annual Meeting, April

Palaeontological Association: Ordovician System Symposium, September

Rocky Mountain Federation State Coordinating Meeting: February

Roswell Geological Society: March

Soil Conservation Society of America: New Mexico Section, December

United Nations: Geothermal Symposium, May

U.S. Geological Survey: Central Region Planning, September (American Association of State Geologists, cosponsor); Petroleum Research Symposium, December

Participation in Committees and Commissions

GOVERNMENTAL

Bieberman–Federal Energy Administration (Ad Hoc Committee on Preservation of Subsurface Geoscience Records and Materials).

Brandvold–New Mexico Water Resources Research Institute, New Mexico State University (Water Conference Advisory Committee); New Mexico Water Quality Control Commission (Bureau representative).

Foster–Interstate Oil Compact Commission (Tar Sands Committee); Governor's Committee on Technical Excellence (Subcommittee on Radioactive Waste).

Kottlowski–New Mexico Coal Surfacemining Commission (Director-Secretary); New Mexico Mining Safety Advisory Board (chairman); Interstate Oil Compact Commission (member).

Reiter–National Academy of Science (Continental Drilling Committee); Governor's Energy Task Force, State of New Mexico (Committee for Geothermal Energy Position Paper, chairman).

PROFESSIONAL

Bieberman–American Association of Petroleum Geologists (House of Delegates; Committee on Preservation of Samples and Cores; Membership Committee); New Mexico Geological Society (Publications Committee).

Chapin–New Mexico Geological Society (Publications Committee, chairman; Annual Meeting Committee, chairman; Executive Committee).

Flower–International Commission on the Cambrian-Ordovician Boundary (corresponding member).

Foster–American Association of Petroleum Geologists (Stratigraphic Correlations Committee).

Kelley–Association of Earth Sciences Editors (Board of Directors); New Mexico Geological Society (Publications Committee).

Kottlowski–American Association of Petroleum Geologists (Executive Committee; Publications Committee; Stratigraphic Correlations Committee; Academic Advisory Committee; Editorial Board, chairman; Committee on Preservation of Samples and Cores); American Commission on Stratigraphic Nomenclature (representative from Association of American State Geologists).

Weber–New Mexico Mapping Advisory Committee (Bureau representative); Archeological Society of New Mexico (Board of Trustees).

NEW MEXICO TECH

Arnold–Affirmative Action Task Force.

Chapin–Presidential Search Committee.

Kelley–Group Insurance Committee.

Kottlowski–Executive Committee.

Renault–Library Committee; Graduate Council.

Roman–Graduate Council; Council of Chairmen.

Weber–Financial Aids Committee.

Off-Campus Talks by Bureau Staff

Brierley, C., "Biological methods for copper and molybdenum extraction" at Intermountain Minerals Conference, Vail, CO, August.

Chapin, C., "Onset of rifting and evolution of rift structures in the Socorro-Magdalena area" at Penrose Conference on Rio Grande Rift, Geological Society of America, Santa Fe, NM, August.

Field trip speaker, New Mexico Geological Society, 25th Field Conference, Ghost Ranch, NM, October.

Foster, R., "Oil and gas potential of central Delaware basin" at Roswell Geological Society, Roswell, NM, March.

"Oil and gas potential of waste disposal site" at Sandia Laboratories, Albuquerque, NM, April.

Hawley, J., "Geomorphology of the Rio Grande valley in southern New Mexico" at Penrose Conference on Rio Grande Rift, Geological Society of America, Santa Fe, NM, August.

"Geologic relationships in New Mexico" at Albuquerque Geological Society, Albuquerque, NM, January.

Kottlowski, F., "Stratigraphy of the Santa Fe Group south of Albuquerque" at Penrose Conference on Rio Grande Rift, Geological Society of America, Santa Fe, NM, August.

Reiter, M., "Heat flow along the Rio Grande rift" at Penrose Conference on Rio Grande Rift, Geological Society of America, Santa Fe, NM, August.

"Heat flow studies in New Mexico by New Mexico Tech" at Institute of Electrical and Electronics Engineers, Inc., Albuquerque, NM, April.

Renault, J., "Basalt volcanism and rift tectonics" at Penrose Conference on Rio Grande Rift, Geological Society of America, Santa Fe, NM, August.

Roman, R., "Heap design with the aid of computer simulation" at Annual Meeting AIChE, Salt Lake City, UT, August.

Bureau Personnel

STAFF CHANGES

New employees joining the Bureau were: George S. Austin, *Industrial Minerals Geologist,* September 1, 1974; Ruben A. Crespin, *Technician,* February 24, 1975; John W. Hawley (one year assignment), *Geologist,* September 1, 1974; Emily Mathieu, *Clerk-Typist,* February 6, 1975; Norma J. Meeks, *Clerk-Typist,* April 21, 1975; Candace H. Merillat, *Editorial Secretary,* May 9, 1975; Leslie S. Mott, *Clerk-Typist,* September 23, 1974; Marshall A. Reiter, *Geophysicist,* April 1, 1975; James M. Robertson, *Mining Geologist,* November 4, 1974; William J. Stone, *Hydrogeologist,* September 1, 1974; David E. Tabet, *Assistant Field Geologist,* March 10, 1975; Joseph E. Taggart, Jr., *Assistant Mineralogist,* August 1, 1974; Samuel Thompson III, *Petroleum Geologist,* November 4, 1974.

Resignations during the fiscal year were: Diane Allmendinger, September 1974; Jill Collis, January 1975; Emily Mathieu, May 1975; and Thomas M. Plouf, January 1975.

STAFF PORTRAITS

Frank E. Kottlowski
Director,
Senior Geologist 7/2/51

Diane Allmendinger
Clerk-Typist 8/10/72

William E. Arnold
Scientific Illustrator 1/4/54

George S. Austin
Industrial Minerals Geologist
9/1/74

Robert A. Bieberman
Petroleum Geologist 6/1/50

Lynn A. Brandvold
Chemist 11/10/65

Corale Brierley
Chemical Microbiologist 9/1/71

Judy R. Burlbaw
Editorial Assistant 9/4/73

Charles E. Chapin
Geologist 6/1/70

Richard R. Chavez
Technician 2/21/57

Jill Collis
Secretary 6/28/71

Ruben A. Crespin
Technician 2/24/75

Lois M. Devlin
Office Manager 1/24/62

Jo Drake
Administrative Assistant, Director's Secretary 9/10/68

Rousseau H. Flower
Senior Paleontologist 9/1/51

Roy W. Foster
Petroleum Geologist 11/19/53

John W. Hawley
Geologist 9/1/74

Robert W. Kelley
Editor, Geologist 5/15/71

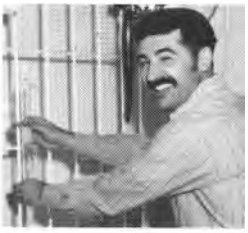
Norma J. Meeks
Clerk-Typist 4/21/75

Candace H. Merillat
Editorial Secretary 5/9/75

Leslie S. Mott
Clerk-Typist 9/23/74

Neila M. Pearson
Draftswoman 8/15/73

Judy Peralta
Secretary 2/25/74



Thomas M. Plouf
Research Extractive Metallurg
8/14/72

Marshall A. Reiter
Geophysicist 4/1/75

Jacques R. Renault
Geologist 9/1/64

James M. Robertson
Mining Geologist 11/4/74

Ronald J. Roman
Chief Research Metallurgist
5/5/69

Jackie H. Smith
Laboratory Asstistant 12/16/63

William J. Stone
Hydrogeologist 9/1/74

David E. Tabet
Assistant Field Geologist
3/10/75

Joseph E. Taggart, Jr.
Assistant Mineralogist 8/1/7

Samuel Thompson III
Petroleum Geologist 11/4/74

Robert H. Weber
Senior Geologist 5/15/50

Shirley Whyte
Stenographer 4/26/72

Michael W. Wooldridge
Scientific Illustrator 1/25/71

Appendix

follows

PETROLEUM DEVELOPMENTS FOR 1974

by Roy W. Foster

Production and Reserves—Production of crude oil declined from almost 101 million barrels in 1973 to 98.7 million barrels in 1974 (calendar years). As in the preceding year, most of the decrease was in Lea County. Declines in production also occurred in Chaves, Roosevelt, McKinley, and Rio Arriba Counties. Partially offsetting these declines were the marked increases in production in Eddy and San Juan Counties. Production at Empire-Abo accounted for the gain in production in Eddy County. Almost 14 percent of the total oil produced in the state came from this field. The gain in production in San Juan County resulted from almost a million-barrel increase at the Tocito Dome-Pennsylvanian field. Reserves of crude oil estimated by the American Petroleum Institute show a decline of some 18 million barrels by the end of 1974. The northwest area of the state recorded a slight gain in crude produced; the southeastern area, a sharp decline. Estimated proved reserves for the state total 625 million barrels.

Production of natural gas increased about 30 billion cubic ft over 1973. Most of this increase occurred in Eddy and Lea Counties where development of Pennsylvanian-age pay zones continued. Increases in production also were recorded in McKinley, San Juan, and Sandoval Counties. The largest decline was in Rio Arriba County, but active in-fill drilling in 1974 should improve this trend. The American Gas Association's estimated reserves declined 543 billion cubic ft. As of the first of the year reserves totaled 12 trillion cubic ft.

Natural gas liquid production amounted to almost 36 million barrels, an increase of about 110 thousand barrels over 1973. Reserves declined slightly to 397 million barrels.

Drilling Summary—The number of wells drilled for oil and gas increased from 981 in 1973 to 1141 in 1974. The number of completions in the northwest area of the state declined slightly. This was more than offset by drilling activity in the southeast area of the state. Exploratory drilling was about the same with 228 completions in 1974, compared with 226 in 1973. Exploratory completions numbered 12 oil wells, 40 gas wells, 1 dual gas well, 146 dry holes and 29 temporarily abandoned wells. Twenty-seven percent of the wells were completed successfully. Eddy County again led in the number of wildcat tests with 100 completions. The total exploratory footage drilled in the state amounted to 1.5 million ft, an increase of 100,000 ft over 1973. The average depth of wildcat wells increased from 6,050 ft in 1973 to 6,416 in 1974. Independent operators accounted for 81 percent of the exploratory wells drilled.

Development drilling increased to 913 wells in 1974, compared with 755 wells in 1973. Development footage increased by over one million ft; the average depth, from 5,516 ft in 1973 to 5,737 ft in 1974. Almost one million ft more were drilled in Eddy County, offsetting a drilling decline in San Juan County. Independent operators drilled 530 development wells, compared with 382 completions for the major oil companies.

Twenty-eight oil and gas tests were completed in the nonproducing counties. Four of these wells, two in De Baca County, one in Mora County and one in Otero County were either listed as shut-in gas wells or had significant shows of gas. Exploratory wells were drilled in Colfax, Curry, De Baca, Guadalupe, Harding, Lincoln, Mora, Otero, Quay, San Miguel, Santa Fe, Sierra, and Valenica Counties.

The total footage drilled in 1974 was 6,700,408 ft. Not included are data from 18 wells drilled for carbon dioxide, 36 previously completed wells that were drilled deeper, 18 wells that were junked, and 19 wells drilled for water injection. This data would bring total operations to 1,232 wells and footage drilled to 6,850,148 ft.

Oil and Gas production, 1974

(Annual Report of New Mexico Oil and Gas Engineering Committee)

County and area	Crude oil (barrels) Production	Crude oil (barrels) Gain (+) or decline (–) from 1973	Natural gas (thousands cu ft) Production	Natural gas (thousands cu ft) Gain (+) or decline (–) from 1973
Chaves	1,787,622	–133,491	10,293,711	–14,401
Eddy	21,504,533	+3,464,235	229,214,339	+17,958,713
Lea	66,028,464	–5,806,427	436,930,336	+16,777,410
Roosevelt	1,372,927	–246,907	5,842,166	–1,862,112
Southeast area	90,693,546 (92%)	–2,722,590	682,280,552 (55%)	+32,859,610
McKinley	1,263,069	–410,382	2,668,041	+ 312,739
Rio Arriba	1,475,669	–140,066	174,869,865	–3,776,838
Sandoval	264,131	+ 63,723	1,288,661	+ 249,462
San Juan	4,998,550	+918,594	368,565,817	+ 488,533
Northwest area	8,001,419 (8%)	+431,869	547,392,384 (45%)	–2,726,104
State totals	98,694,965	–2,290,721	1,229,672,936	30,133,506

Oil and gas reserves, 1974

(American Petroleum Institute and Annual Report of American Gas Association)

Area	Crude oil (barrels) Reserves	Crude oil (barrels) Gain (+) or decline (–) from 1973	Natural gas (thousands cu ft) Reserves	Natural gas (thousands cu ft) Gain (+) or decline (–) from 1973
Southeast area	597,761,000 (96%)	–21,373,000	4,327,505,000 (36%)	–175,472,000
Northwest area	27,207,000 (4%)	+ 3,347,000	7,617,397,000 (64%)	–367,989,000
State totals	624,968,000	–18,026,000	11,944,902,000	–543,461,000

Drilling statistics, 1974

County and area	Wildcats No. of wells	Wildcats Total footage	Wildcats Average depth (ft)	Development No. of wells	Development Total footage	Development Average depth (ft)	Totals No. of wells	Totals Total footage	Totals Average depth (ft)
Chaves	24	108,279	4,512	38	112,901	2,971	62	221,180	3,567
Eddy	100	705,601	7,056	256	1,869,266	7,302	356	2,574,867	7,233
Lea	31	313,636	10,117	248	1,616,953	6,520	279	1,930,589	6,920
Roosevelt	3	24,937	8,312	6	34,148	5,691	9	59,085	6,565
Southeast area	158	1,152,453	7,294	548	3,633,268	6,630	706	4,785,721	6,779
McKinley	6	12,028	2,005	21	34,179	1,628	27	46,207	1,711
Rio Arriba	6	24,904	4,151	190	914,617	4,814	196	939,521	4,793
Sandoval	16	41,941	2,621	3	7,952	2,651	19	49,893	2,626
San Juan	14	54,634	3,902	151	647,499	4,288	165	702,133	4,255
Northwest area	42	133,507	3,179	365	1,604,247	4,395	407	1,737,754	4,270
All other counties	28	176,933	6,319	–	–	–	28	176,933	6,319
State totals	228	1,462,893	6,416	913	5,237,515	5,737	1,141	6,700,408	5,872

MINERAL PRODUCTION IN NEW MEXICO[1]

Released by U.S. Bureau of Mines, December 30, 1974

Mineral		1973 Quantity	1973 Value (thousands $)	1974 p/ Quantity	1974 p/ Value (thousands $)
Clays[2]	thousand short tons	88	169	W	W
Coal (bituminous)	do	9,069	31,862	9,392	41,619
Copper (recoverable content of ores, etc.)	short tons	204,742	243,643	196,585	303,920
Gem stones		NA	70	NA	200
Gold (recoverable content of ores, etc.)	troy ounces	13,864	1,356	15,427	2,464
Gypsum	thousand short tons	255	1,220	157	532
Iron ore (usable)	thousand long tons, gross weight	5	114	W	W
Lead (recoverable content of ores, etc.)	short tons	2,556	833	2,364	1,064
Lime	thousand short tons	44	793	58	1,697
Manganiferous ore (5 to 35 percent Mn)	short tons	32,084	W	W	W
Mica, scrap	thousand short tons	10	82	12	60
Natural gas	million cubic feet	1,218,749	287,889	1,223,208	391,534
Natural gas liquids:					
Natural gasoline and cycle products	thousand 42-gallon barrels	9,848	32,449	30,118	162,636
LP gases	do	29,652	74,427	17,911	96,721
Peat	thousand short tons	3	50	W	W
Perlite	do	478	5,024	480	6,306
Petroleum (crude)—thousand 42-gallon barrels		100,986	414,041	96,416	696,334
Potassium salts	thousand short tons	2,168	91,996	2,102	128,589
Pumice	do	339	1,001	471	1,466
Sand and gravel	do	10,641	15,753	7,413	10,605
Silver (recoverable content of ores, etc.)	thousand troy ounces	1,111	2,843	1,195	5,628
Stone	thousand short tons	2,830	5,894	3,539	8,359
Uranium (recoverable content U_3O_8)	thousand pounds	9,268	60,356	9,971	104,693
Zinc (recoverable content of ores, etc.)	short tons	12,327	5,094	13,784	9,897
Value of items that cannot be disclosed: Cement, clay, iron, sulfur, fluorspar (1974), molybdenum, salt, tin, vanadium and values indicated by symbol W		XX	29,631	XX	37,500
Total		XX	1,306,590	XX	2,011,824

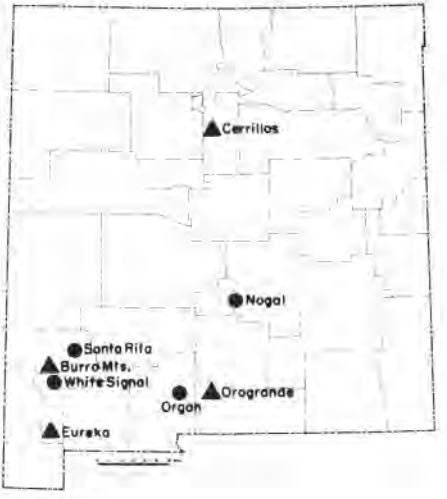
p/ Preliminary. NA Not available. W Withheld to avoid disclosing individual company confidential data; included with "Value of items that cannot be disclosed." XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

[2]Excludes fire clay: included with "Value of items that cannot be disclosed."

TURQUOISE IN NEW MEXICO

Robert H. Weber



PRINCIPAL DEPOSITS AND MINOR OCCURRENCES OF TURQUOISE IN New Mexico

▲ Deposit

● Occurrence

Deposits of turquoise are widely distributed in New Mexico in a triangular-shaped region extending from Santa Fe County at the northern apex to Otero, Doña Ana, and Grant Counties in the south. The principal deposits that have been sources of significant production are distributed in 4 districts: The Cerrillos district near Los Cerrillos in Santa Fe County; the Burro Mountains district in the vicinity of Tyrone, Grant County; the Eureka (Hachita) district near Hachita, Grant County; and the Orogrande (Jarilla) district near Orogrande, Otero County.

Minor occurrences have been recognized in the White Signal and Santa Rita districts in Grant County, the Organ district in Doña Ana County, and the Nogal district in Lincoln County. Other reported occurrences remain unverified; probably the mineral is more widely distributed in minor amounts than has been recognized.

Inasmuch as all known deposits are on patented or unpatented mining claims, and leaseholds on State lands, the express permission of the claim owner or lessee must be obtained prior to entering the property for purposes of collecting or prospecting for turquoise.

The significance of turquoise to prehistoric inhabitants of the region is widely manifested by the ancient workings (with associated primitive mining tools) that led to the rediscovery of major deposits in the late 1800's. Although the beginnings of this industry are obscure, archeological evidence extends to circa 200 B.C. During the interval of approximately 900 to 1650 A.D., turquoise was intensively exploited and became a commodity of widespread trade throughout the Southwest and Mexico, having been fabricated into beads, pendants, inlay, and mosaic work. The recovery of more than 65,000 pieces during excavations at Pueblo Bonito in Chaco Canyon indicates the magnitude of trade with regions lacking local sources.

Cerrillos District. Deposits in the Cerrillos district are particularly well known from both archeological and historical records spanning a period from 1150 A.D. through the Spanish Colonial and American occupations of the region. In terms of its historic significance and production, the Cerrillos turquoise is pre-eminent among the deposits of the United States, as testified by numerous technical reports dating from 1858.

The major deposits are localized in two separate clusters 3 miles apart, on Mount Chalchihuitl and Turquoise Hill, a few miles north of Los Cerrillos. Extensive prehistoric workings are noteworthy at both localities. Turquoise occurs as narrow veinlets and nodules ranging in color from pale to bright blue through bluish green to dark green set in a matrix of altered monzonite and latite. Brown limonite staining of the matrix is common; occasional inclusions of pyrite in the turquoise have been noted.

Modern production by non-Indian miners began in the 1880's, reached a peak during the 1890's, and declined rapidly during the early years of the present century, although intermittent production in the district continued at the Blue Bell mine until 1925. Estimates of the value of production range widely, reportedly exceeding $2 million from operations of the American Turquoise Co. The major part of this production was from the Tiffany (Castilian) mine at Turquoise Hill, reputed to have yielded a higher proportion of high-grade gem material than any other mine in the United States. Some estimates place the total production of the district at as much as $9 million. Renewed interest in the Cerrillos district in the last few years has stimulated exploration for copper and turquoise, but data on any turquoise production are lacking. Turquoise mining operations in the Cerrillos district currently registered with the State Inspector of Mines consist of the Laura mine of the Laura Mining Co. with F. Rod Blankley of Albuquerque in charge.

Burro Mountains District. In the Burro Mountains district, turquoise has been recovered from a number of mines and prospects in an area about 6 miles southwest of the new townsite of Tyrone. Turquoise is widely distributed as veinlets and nodules in fractured zones in granite and quartz monzonite porphyry highly altered to kaolinite and sericite accompanied by secondary silica. The turquoise exhibits a wide range of color in various shades of blue and green and includes some of the finest gem-quality material obtained anywhere in the world. Pure nuggets to 1500 carats were recovered.

The "original" discovery was made in 1875 by John E. Coleman at the site of prehistoric mine workings. Major mining activity occurred during the period from 1890 to 1910 at several properties, among which were the Azure, Parker, and Porterfield (Maroney) mines. The Azure mine was particulary noteworthy for both the quantity and quality of the turquoise produced. Mine development extended across a fractured zone 40 to 60 ft wide on four adit levels, with a large open pit later excavated from the second level to the surface. The best turquoise was recovered within 100 ft of the surface, with a remarkable concentration in the "Elizabeth pocket" extending 150 ft along the vein, across a width of up to 40 ft, and over a vertical distance of 40 to 60 ft. Production estimates for this period range from $2 million to $4 million for the Azure mine alone, and up to $5 million for the entire district. The former turquoise-producing properties now are controlled by Phelps Dodge Corporation, whose Tyrone open-pit copper mine has in recent years exposed significant turquoise concentrations in the walls of the pit. Currently this deposit is being mined and marketed under contract with Phelps Dodge by James Hamilton of Silver City, doing business as Tyrone Turquoise. The turquoise mining operation is registered as the Tiffany mine

(subject to confusion with the old Tiffany mine in the Cerrillos district). Both raw and cut turquoise in considerable quantity are being marketed by Tyrone Turquoise.

Eureka District. Turquoise deposits of the Eureka district, on the eastern side of the Little Hatchet Mountains about 6 miles west of Hachita, were rediscovered in 1885 by Sterling Burwell and Con Ryan while exploring ancient diggings for the gold they believed had been mined there by Aztecs or early Spaniards. Mining for turquoise continued intermittently in the district for the ensuing 25 years. Mines developed during this period included the Azure, Cameo, Galilee, Aztec, and the American Turquoise Company. The turquoise occurred in irregular seams up to half an inch thick in altered, fractured, and limonite-stained monzonite; also to a lesser extent in andesitic to basaltic volcanic rocks, sandstone, and diorite. Clay minerals and jarosite commonly were associated with the turquoise. Fine gem-quality stones were recovered in colors that ranged from pale blue through dark sky blue to greenish blue, the paler varieties tending to be relatively soft. Many of the stones were finished in attractive yellow and brown iron-stained matrix pieces; cameos were cut from some of the seams in which a tightly bonded brown matrix served as the base for the carving. Registered mining operations include the Old American mine of the Cameo Turquoise Mining Co., Bowie, AZ, Joseph C. Cooke in charge; and U. V. Industries, Inc. of Salt Lake City, W. H. Ott in charge. No production data are available either for past or current operations in the area, but evidently the total yield has been small as compared with the Cerrillos and Burro Mountains districts.

Orogrande District. In common with the previously described districts, prehistoric workings in the Jarilla Mountains, a few miles north of Orogrande, provided guideposts to turquoise for early prospectors. Although poorly documented, historic mining of turquoise apparently began circa 1891 when 50 kilos of marketable stones were shipped. The turquoise occurred at shallow depths as thin seams along fractures and as reniform, semiglobular, and irregular nodules associated with kaolin, limonite, pyrite, gypsum, and jarosite. Colors ranged from blue to green, some deep-blue stones tending to fade markedly following removal from the mine. Specimens at hand, probably representative of poor quality material from waste dumps, consist of soft, chalky, pale-blue seams with brown webbing and pale-blue to deep-green, irregular nodules in highly bleached and altered rock of monzonitic aspect. Iron oxide staining is conspicuous; the altered wallrock locally is replaced by secondary silica. The Jarilla Mt. Turquoise Co. (James Koons, Jr., El Paso, TX) has developed the Laura Claim No. 1 for production in the district during the past year.

Miscellaneous Occurrences. Minor amounts of turquoise have been recognized in 4 other districts that apparently have yielded relatively little or no commercial production. At the Chapman turquoise mine in the White Signal district, high-grade turquoise was mined (between 1890 and 1900) from a shaft and glory hole in kaolinized and sericitized rhyolite. At the Red Hill prospect, also in the White Signal district, turquoise occurs in narrow veinlets in a wide shattered zone in altered granite. Although most of the turquoise was soft and green in color, a few nodules of hard, blue stones were recovered. In the Santa Rita district, turquoise has been encountered in the Chino open-pit copper mine of the Kennecott Copper Corporation at Santa Rita. Some may have reached the market via miners working in the pit. Two specimens seen by the writer consist of aggregates of small spheroids of turquoise, one of which is bright blue and contains lesser amounts of quartz, sericite, and sparse pyrite; the other exhibits a

fine-textured spiderweb pattern of smaller (1 to 3 mm) bluish-green to dark-green spheroids in a brown to reddish-brown matrix. Small amounts of turquoise were found in kaolinized monzonite in underground workings of the Torpedo mine in the Organ district, near the town of Organ. Possibly from the Organ district is a specimen (in the Bureau Mineralogical Museum) for which the locality is given only as Doña Ana County. This specimen consists of a polished 1- to 2-mm-thick seam of mottled medium-blue and bluish-green turquoise with limonitic matrix inclusions; this seam coats a fracture surface on a fine-grained silicified rock. Turquoise has been reported to occur in the oxidized capping of a breccia pipe at the Parsons mine in the Nogal district (a few miles southwest of Nogal) but does not extend into the underground workings.

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The Bureau's Financial Statements

BOARD OF EDUCATIONAL FINANCE–LEGISLATIVE

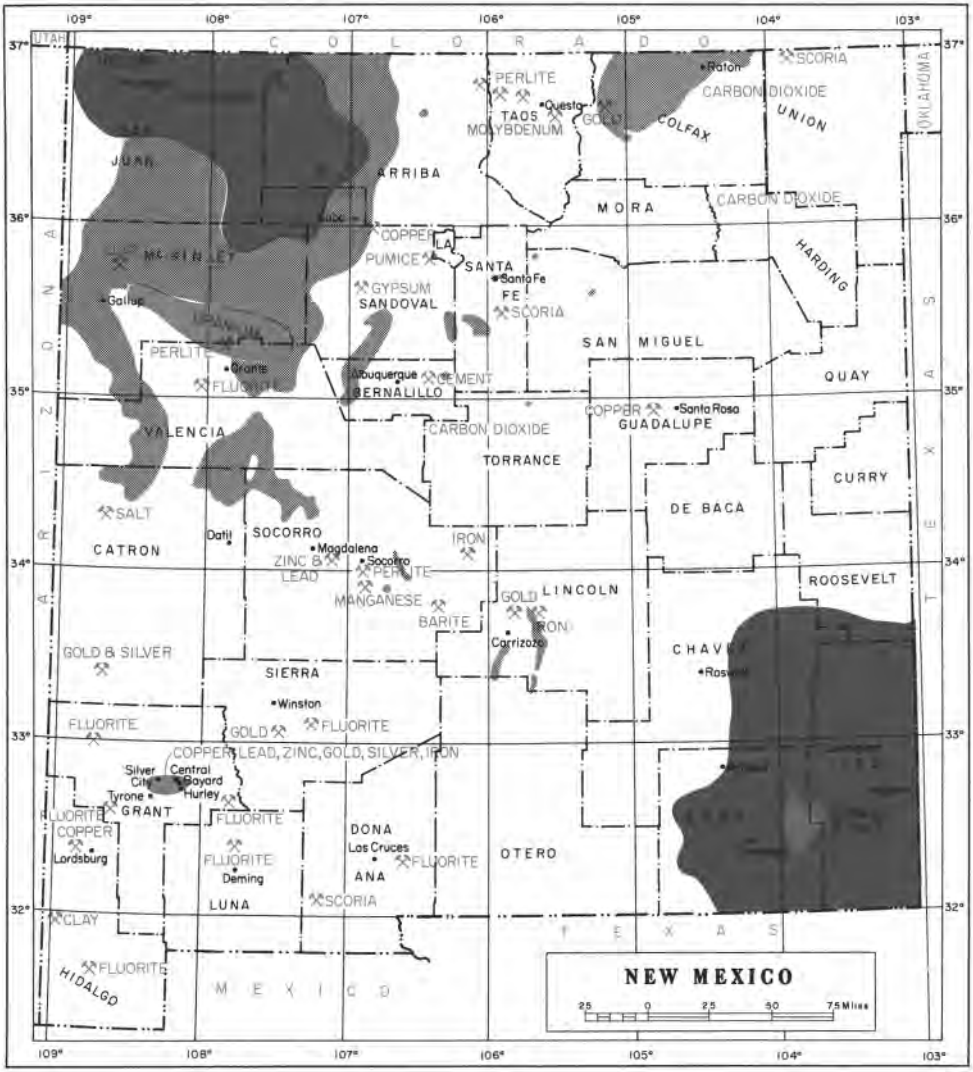
Funds Available			
Beginning balance		$ 27,565	
State appropriation		750,000	
Publication sales		32,550	$810,115
Expenditures			
Salaries:			
Full-time staff	$417,737		
Part-time staff (mostly students)	89,344	507,081	
Employee benefits		49,424	
Project contracts		36,887	
Travel & automotive		27,033	
Scientific laboratories:			
Maintenance	6,725		
Materials & supplies	18,271	24,996	
Office supplies		9,527	
Postage		4,703	
Printing		51,835	
Equipment		28,611	
General expenses:			
Telephone	14,959		
Subscriptions & dues	2,152		
Computer service	4,190		
Overhead and audit	22,200		
Professional services	15,219	58,720	798,817
Balance			$ 11,298

GRANTS AND CONTRACTS

Funds available		
Beginning balance	4,109	
State grants	136,180	
Federal and company grants	71,722	212,011
Expenditures		
Salaries	41,874	
Benefits	4,281	
Travel	28,713	
Equipment & supplies	84,984	
Overhead	14,237	174,089
Balance		$ 37,922

NEW MEXICO COAL SURFACEMINING COMMISSION

Funds available		
Beginning balance	12,563	
Fees collected	12,031	24,594
Expenditures		
Salaries & fees	12,879	
Benefits	317	
Travel	1,526	
Supplies	765	15,487
Balance		$ 9,107


NEW MEXICO
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COLORADO
UTAH
OKLAHOMA
TEXAS
ARIZONA
MEXICO
SCORIA
CARBON DIOXIDE
UNION
COLFAX
Raton
PERLITE
TAOS
MOLYBDENUM
Questa
GOLD
JUAN
ARRIBA
MORA
CARBON DIOXIDE
HARDING
MC KINLEY
Gallup
COPPER
PUMICE
LA
SANTA
FE
Santa Fe
GYPSUM
SANDOVAL
SCORIA
SAN MIGUEL
QUAY
PERLITE
Grants
FLUORITE
Albuquerque
CEMENT
BERNALILLO
COPPER
GUADALUPE
Santa Rosa
VALENCIA
CARBON DIOXIDE
TORRANCE
CURRY
DE BACA
SALT
CATRON
Datil
SOCORRO
Magdalena
Socorro
ZINC & LEAD
PERLITE
IRON
MANGANESE
BARITE
GOLD
LINCOLN
IRON
Carrizozo
ROOSEVELT
GOLD & SILVER
SIERRA
Winston
FLUORITE
GOLD
FLUORITE
COPPER, LEAD, ZINC, GOLD, SILVER, IRON
Silver City
Central
Bayard
Hurley
Tyrone
GRANT
FLUORITE
COPPER
Lordsburg
FLUORITE
FLUORITE
Deming
DONA
ANA
Las Cruces
FLUORITE
OTERO
LUNA
SCORIA
CLAY
FLUORITE
HIDALGO
OIL AND GAS BASINS
METALLIC ORES
INDUSTRIAL MINERALS
COAL FIELDS