

Annual Report

Arizona Geological Survey

1995



Annual Report

of the

Arizona Geological Survey

for

FY 1994-95
(July 1, 1994 to June 30, 1995)

by

Larry D. Fellows
Director and State Geologist

**ARIZONA GEOLOGICAL SURVEY
OPEN-FILE REPORT**

95 - 19

This report is preliminary and has not been edited or reviewed for conformity with Arizona Geological Survey standards

October 2, 1995

The Honorable Fife Symington
Governor of Arizona
Arizona State Capitol
1700 West Washington Street
Phoenix, AZ 85007

Dear Governor Symington:

It is a pleasure to submit this Annual Report to highlight accomplishments of the Arizona Geological Survey during Fiscal Year 1994-95.

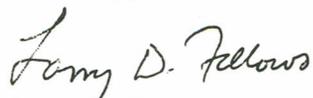
Arizona Geological Survey staff provided geologic information and assistance to more than 8,400 individuals and groups, including Arizona citizens and residents of other states and countries. Staff geologists added to the understanding of Arizona's geologic framework by completing original investigations and detailed geologic maps. The agency released 52 reports and maps, most of which were completed by staff geologists, that describe or depict Arizona's geology, potential hazards and limitations to land and resource management, and non-renewable natural resources. Reports and maps that were completed and data that were compiled are used by the public, businesses, and government agencies to make *informed* land- and resource-management decisions.

The need to better understand Arizona's geologic character, hazards and limitations, and water, mineral, and energy resources increases as the population grows and demand for land and resources accelerates. Because of this, the Arizona Geological Survey gives high priority to providing the unbiased geologic information that land- and resource-management agencies use to make prudent decisions. During the year we contracted with seven such agencies on matched-cost studies and generated additional funding to supplement our General Revenue appropriation. Results of investigations that were completed were released to the public.

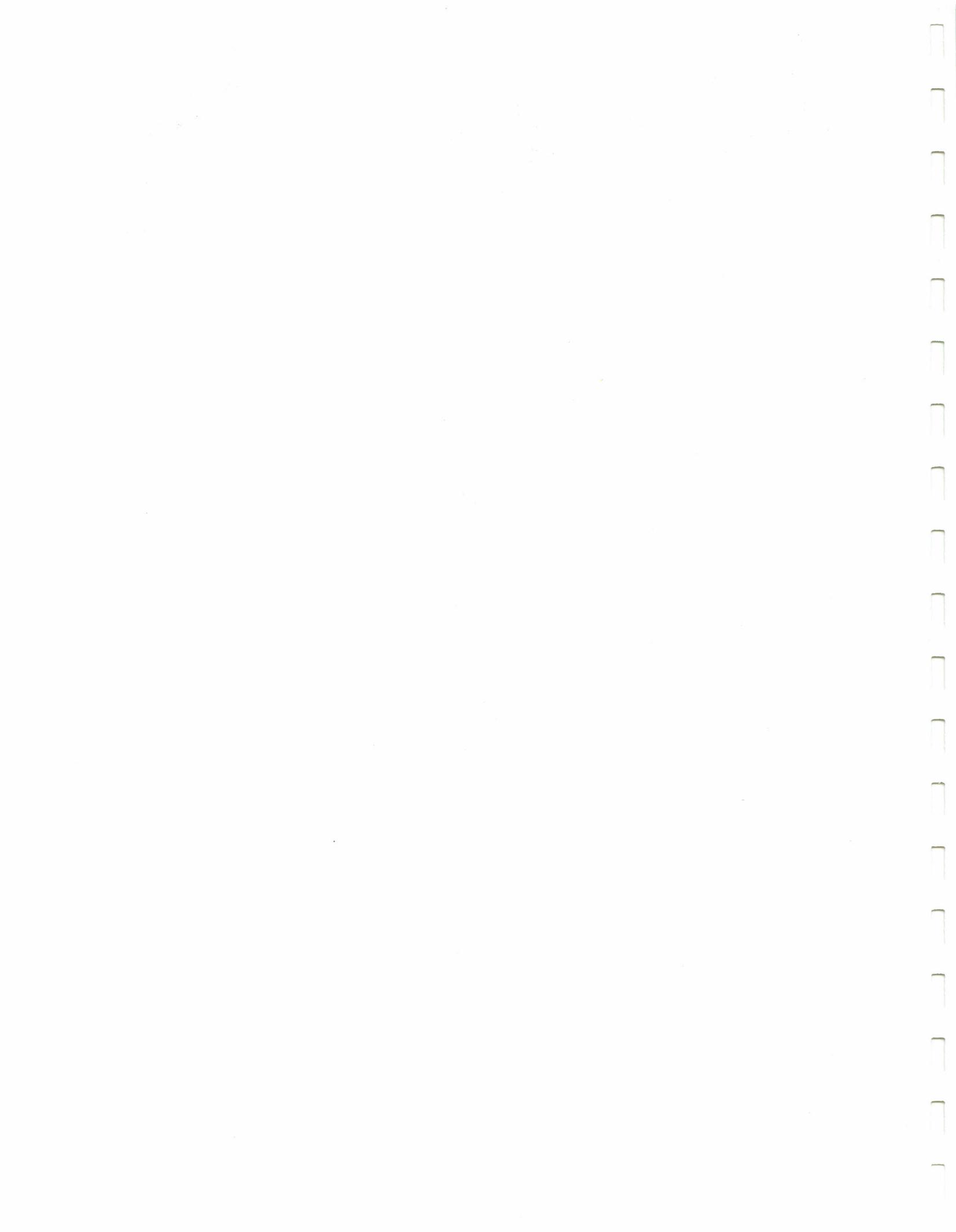
In June the headquarters office of the Arizona Geological Survey was moved to the State of Arizona Regional Complex in downtown Tucson. Photographs throughout this report depict the new offices.

It was a pleasure to work with you and your staff during the year. We always welcome your questions about the geologic framework and character of Arizona.

Sincerely yours,



Larry D. Fellows
Director and State Geologist



Executive Summary

Information

Arizona Geological Survey (AZGS) staff responded to more than 8,400 requests for information and assistance from persons who wrote, telephoned, or visited AZGS offices. Publication sales, including geologic reports, maps, and related information, totalled \$45,318. Staff provided information from the Headquarters office and the Earth Science Information Center (ESIC). The latter is operated cooperatively with the U.S. Geological Survey. In addition, AZGS geologists traveled to various areas to give talks and lead fieldtrips to inform the public about the geology of Arizona.

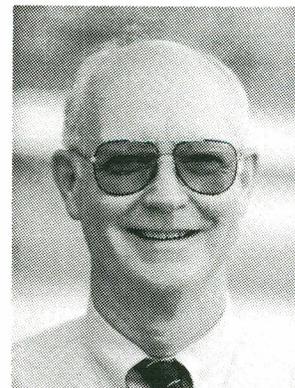
In June 1995 the headquarters office, which had been located on Park Avenue along the west side of the University of Arizona campus since 1975, was moved to 416 West Congress Street in downtown Tucson. The cover photograph and photographs throughout this report feature our new offices.

Investigations

AZGS staff completed 39 geologic maps and reports that were released for the public and a number of others that are in advanced stages of completion. These studies dealt with characterization and mapping of bedrock and surficial materials, subsurface geology, and potential geologic hazards and limitations to land and resource management, such as earthquakes, land subsidence and earth fissures caused by overpumping ground water, and flooding. Staff geologists also made continued progress on the bibliography of Arizona geology, which now contains more than 11,000 citations.

AZGS geologists worked cooperatively on projects with other agencies and groups, including the Arizona Departments of Emergency and Military Affairs, Environmental Quality, Transportation, and Water Resources; Arizona Radiation Regulatory Agency; Arizona Geological Society; Federal Emergency Management Agency; U. S. Army, U. S. Environmental Protection Agency; and the U. S. Geological Survey. Partial funding for these projects was provided under contract. Expenditure of contract funds totalled \$148,273. Results of these studies were released or will be released for the public.

The Land Subsidence and Earth Fissure Information Center, established in cooperation with the Arizona Department of Water Resources, completed its first full year of operation. Representatives from 9 governmental agencies met to discuss data needs and priorities relative to Center activities. This group meets periodically to provide guidance and oversight.



Dr. Larry D. Fellows
Director and State Geologist
Arizona Geological Survey

Oil and Gas

The AZGS provides administrative and staff support for the Arizona Oil and Gas Conservation Commission, a 5-member board appointed by the Governor. The Commission held four regular meetings. Staff issued eight permits to drill oil test wells. Five wells were drilled. One was completed as a producing oil well in the Four Corners area. One was completed as a potential carbon dioxide well near St. Johns, pending further drilling and testing. Three were dry and abandoned and three had not been started before the end of the fiscal year.

Staff inspected 34 wells to ensure that equipment was functioning safely. At year end Arizona had 20 producing oil wells, 6 producing gas wells, one refinery, and two underground LPG-storage facilities.

Personnel and Budget

The AZGS' General Revenue appropriation was \$625,900, from which a team of 13.25 full-time-equivalent geologists and support staff was employed. Sixteen temporary employees, mostly part time, were paid from contracted or other funds.



Contents

Mission and Milestones	2
Programs and Functions	3
Constituents	4
Geologic Information and Investigations	5
Oil and Gas Conservation Commission	10
Personnel	12
Budget	14
Appendices	16
Location Map	28



Mission

The mission of the Arizona Geological Survey is to provide unbiased earth-science information to the public, businesses, and governmental agencies to facilitate development of relevant policies and courses of action for prudently managing and using Arizona's land, water, mineral, and energy resources.

Milestones

- 1863 Arizona Territory organized; Prescott became capitol
- 1881 Office of the Territorial Geologist created
- 1889 First Territorial Geologist appointed
- 1891 University of Arizona opened in Tucson; Territorial Geologists subsequently held appointments as faculty members
- 1912 Arizona became the 48th state in Nation
- 1915 Arizona Bureau of Mines established, continuing functions of Territorial Geologist and University's mineral testing laboratory; administered by University of Arizona
- 1977 Bureau of Geology and Mineral Technology created by modernizing enabling act of Arizona Bureau of Mines, adding responsibility for geologic hazards and limitations, and defining Geological Survey and Mineral Technology Branches; administered as a division of University of Arizona
- 1988 Arizona Geological Survey established as a stand-alone State agency by redirecting Geological Survey Branch of the Bureau of Geology and Mineral Technology
- 1991 Oil and Gas Conservation Commission attached administratively to Arizona Geological Survey
- 1992 Arizona Geological Survey completed Sunset Review; continued for 10-year period

Programs and Functions

Geologic Information and Investigation Program

- Answer requests for information and assistance
- Sell and distribute publications on Arizona geology
- Operate Center for Land-Subsidence and Earth-Fissure Information
- Give talks, lead fieldtrips, serve on committees, etc.

Maintain, for public access:

- Library of published and unpublished geologic reports, maps, and data files
- Oil, gas, geothermal, and helium well files, maps, and production records
- Rock cuttings and core repository

- Map the distribution of bedrock- and surficial-material units
- Describe the character of bedrock and surficial materials
- Study known and potential geologic hazards and limitations
- Investigate and describe oil, gas, and mineral resources

- Compile geologic data and enter it into the Arizona Geologic Information System
- Publish geologic maps and technical reports that summarize results of investigations
- Publish general-interest, nontechnical reports about the geology of Arizona
- Publish *Arizona Geology* to inform constituents about agency activities

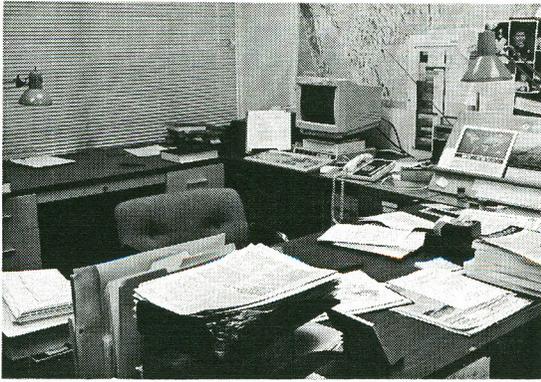
Oil and Gas Conservation Commission Program

- Provide administrative and staff support for the Oil and Gas Conservation Commission
- Conduct regular Commission meetings and special hearings

- Review applications for permits to drill, and approve if properly completed
- Inspect wells for compliance, both during drilling and after completion

- Monitor oil, gas, geothermal, and helium drilling activities
- Compile oil, gas, geothermal, and helium production statistics

- Provide information to the exploration and development communities and the public



Constituents

Public

- Citizens and groups
- Elementary and secondary schools
- Colleges and universities
- Professional groups
- Libraries



Businesses

- Environmental and engineering geology
- Mineral exploration and mining
- Oil and gas exploration and development
- Other businesses



Governmental Agencies

- State of Arizona
- Arizona county, city, and town
- Federal
- Indian
- Other states and countries

Examples of public groups, businesses, and governmental agencies that requested information or assistance from the Arizona Geological Survey during Fiscal Year 1994-95 are listed on pages 16-20.

Geologic Information and Investigations

Geologic Information

Headquarters Office

In June 1995 the Arizona Geological Survey (AZGS) Headquarters was moved to the State Office Complex in downtown Tucson at 416 West Congress Street. This office houses AZGS staff, library, computerized databases, data files, oil and gas records, and rock cuttings and cores. Maps and reports are prepared for publication and mail orders are processed here. The agency headquarters was at 845 North Park Avenue since 1975.

Earth Science Information Center (ESIC)

This office is co-located with the U.S. Geological Survey (USGS) Mineral Information Office and the Center for Inter-American Mineral Resources Information (CIMRI) at 340 North Sixth Avenue. Visitors can purchase USGS topographic maps and reports, including selected USGS publications dealing with Latin America to support the CIMRI office. Diane Murray, an AZGS employee, manages the ESIC, with coordination and support from USGS employees Frances Pierce and Karen Bolm.

The ESIC, a cooperative venture between the AZGS and the USGS, was established in 1992 to improve service to the public by providing earth-science and mineral- resource information from both agencies. Coordination with the AZGS Headquarters Office ensures complete access to current research on Arizona's geology and nonrenewable resources. Those who need more detailed information about those topics are referred to appropriate AZGS or USGS geologists or the library at the AZGS headquarters office.

Information Requests

More than 5,900 requests for information were made to the AZGS Headquarters and 2,500 to the ESIC office. Most of these were routine requests to determine what types of information are available, purchase publications, use the library, and confer with geologists. AZGS geologists are commonly asked to give talks, conduct workshops, lead fieldtrips, and serve on committees. They do so as time and budget allows.

Publications

During the fiscal year the AZGS released 34 publications that were prepared by AZGS geologists and 13 that were contributed by other geologists. In addition, AZGS geologists authored 5 maps, ab-



stracts, or reports that were released by professional societies or other agencies. One of the AZGS releases was a formal publication, Down-to-Earth Series No. 4, How Geologists Tell Time; the remainder were in the open-file report, contributed map, or contributed report series. A complete list of the maps and reports that were released is given on pages 21-24.

Publication sales from the Headquarters Office totalled \$32,276, down from \$36,544 in FY 1994. Revenue from the sale of AZGS publications is, by statute, deposited in the Geological Survey Printing Revolving Fund to be used for expenses incurred to print other AZGS publications. Sales from the ESIC office totalled \$17,175. Revenue from these sales is used to purchase other publications for resale and for ESIC operating expenses.

ARIZONA GEOLOGY

Arizona Geology is published quarterly to summarize current events related to geology, announce and describe new geologic maps and reports that have been completed, and to publicize other activities or events that pertain to "things geologic" in Arizona. The intended audience for *Arizona geology* is geologists who are practicing in Arizona or who have a special interest in Arizona geology. Four 4-page issues were published and distributed during the year.

Arizona Geologic Information System (AGIS)

The AGIS is a computer database that was developed to store and provide access to data on Arizona geology. Data are compiled from geological investigations and maps completed by AZGS staff and other professionals. Major components of the AGIS include GENLIB, a database of AZGS library holdings; AZGEOBIB, a bibliography of Arizona geology; AZMIN, a database for metallic mineral districts and production, mine names, including primary and secondary references; and AZAGE, a compilation of radiometric age determinations. R. A. Trapp is the AGIS manager.

During FY 1994-95 emphasis was placed on AZGEOBIB, which now has more than 11,100 citations. Each citation has been key-worded by subject, stratigraphic name, and geographic area. A map showing the 555 geographic areas used in key wording was released as Open-File Report 95-2. An

unindexed, alphabetical list, by author, of all citations in the database was released as Open-File Report 95-4.

Bibliographic subsets can be constructed using combinations of subject and location key words, as was done to produce bibliographies of land subsidence and earth fissures throughout the State (Open-File Report 95-8) and just in the metropolitan Phoenix area (Open-File Report 95-11). New citations are added to AZGEOBIB on a continuing basis.

Geology Library

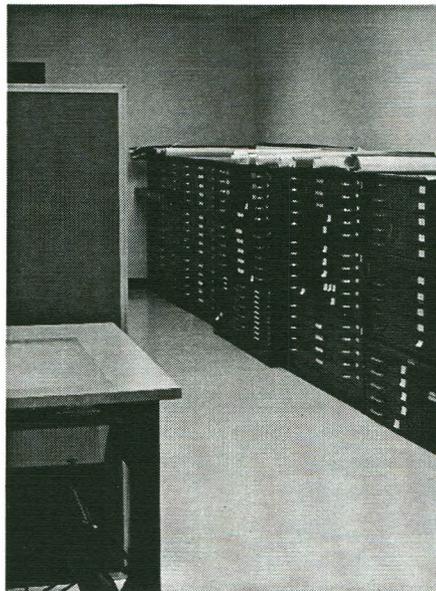
The AZGS library contains more than 25,000 volumes, including all publications of the AZGS and its predecessors, the Arizona Oil and Gas Conservation Commission, and selected publications of other governmental agencies. The library also contains theses and dissertations on Arizona geology, selected technical journal and bulletin series, textbooks, environmental impact statements and reviews, and unpublished maps and reports on the geology, water, energy, and mineral resources of Arizona. The library, supervised by T. G. McGarvin, is open to the public.

Rock Cuttings and Core Repository

The AZGS has statutory responsibility to maintain a central repository for rock cuttings and cores and associated supplemental data. Companies that drill for oil, gas, helium, or geothermal resources are required by Oil and Gas Conservation statutes to save rock cuttings during drilling and submit them to the AZGS, together with logs and other pertinent information. Rock cores, primarily taken during mineral exploration, are commonly donated to the AZGS. Because of space limitations, only representative samples of cores are usually saved. Cuttings from approximately 4,000 oil and water wells and cores from many mineral tests are in the repository, which is open for use by the public.

Subsurface Data

The Oil and Gas Conservation Commission requires that subsurface data, including rock samples, logs, and testing results, be submitted for filing and archiving at the AZGS. These data add to the general understanding of Arizona's geologic framework and



subsurface mineral and energy resources. Well files, organized by Oil and Gas Conservation Commission drilling permit number, include information about drilling depth, rock formations penetrated, casing records, and completion procedures. Subsurface samples from two oil and gas test wells were added to the AZGS sample repository.

Well locations and other information are plotted on a series of county and regional maps. During FY 1994-95 ten county and regional subsurface maps that show the locations of oil and gas wells were updated by S. L. Rauzi, Oil and Gas Program Administrator. They are listed in Appendix II, pages 21-24.

In order to increase the general understanding of the geologic framework of Arizona, the AZGS loaned some of the samples from the geothermal test hole drilled near Alpine in Fiscal Year 1993-94 to the New Mexico Bureau of Mines and Mineral Resources. The New Mexico Bureau is actively investigating the Tertiary geology of western New Mexico.

Geologic Investigations

A brief summary is given of each major Arizona Geological Survey (AZGS) project that was undertaken. A number of projects were done under contract with other agencies. A complete list of the reports and maps that were completed is given on pages 21-25.

Geologic Mapping

The National Geologic Mapping Act of 1992 was passed to expedite the production of a geologic-map database for the Nation, which can be applied to land-use management, assessment, and utilization, conservation of natural resources, groundwater management, and environmental protection. The U.S. Geological Survey is the lead Federal agency. The Statemap component of the Act enables State Geological Surveys to receive Federal funds, to be matched equally with State General Revenue funds, for geologic mapping. Priorities for areas to be mapped within a state are determined by State Geologic Mapping Advisory Committees that are established by the state geological survey. A Peer Review Panel selects mapping projects to be funded.

The Arizona Geological Survey received Statemap funds for FY 1994-95. Many of the projects described

below were partially funded by the Statemap component.

Bedrock geology. Bedrock geologic mapping of the Phoenix (1° x 2°) Quadrangle was completed and work began on the Mesa (1° x 2°) Quadrangle. The following maps were released during FY 1994-95: Big Horn and Belmont Mountains [Open-File Report (OFR) 94-15], scale 1:50,000), Salome Quadrangle (OFR 94-17, scale 1:100,000), central Gila Bend Mountains (OFR 94-18, scale 1:50,000), and Little Horn Mountains (OFR 95-1, scale 1:100,000).

AZGS geologists mapped approximately 234 square miles in the Mesa Quadrangle, specifically in the western Superstition Mountains, Whitlow Canyon, Mineral Mountain, and Superior areas. Field maps were submitted for drafting and will be released in FY 1995-96.

Bedrock geologic mapping projects were supervised by J. E. Spencer and carried out by Spencer, S. M. Richard, C. A. Ferguson, and S. J. Skotnicki.



Surficial geology. Surficial geologic maps of the following areas were released: Wittmann and Hieroglyphic Mountains (OFR 94-21, scale 1:24,000); Table Top Mountain (OFR 94-22, scale 1:24,000); Lower Agua Fria River, Lake Pleasant to Sun City (OFR 95-5, scale 1:24,000); southern Verde Valley, Yavapai County (OFR 94-23); and Mesa (30' x 60') Quadrangle (OFR 94-24). Approximately 1,320 square miles were covered.

Surficial geologic mapping projects were supervised by P. A. Pearthree and carried out by Pearthree, P. K. House, G. Huckleberry, and E. G. Pendall.

Relocation of Highway 88, Globe area. Field work was initiated on a cooperative project with the Arizona Department of Transportation (ADOT) to provide a detailed geologic map along approximately 7 miles of the planned new highway between Globe and Roosevelt Lake. A geologic map (1:12,000 scale) was completed and copies were submitted to ADOT for review. Detailed mapping adjacent to the new highway will be completed during FY 1995-96. S. J. Skotnicki is the project geologist.

Garden Canyon. AZGS geologists are mapping surficial geology and studying landforms in the Garden Canyon area on Ft. Huachuca in Cochise County. Work being done is part of a Legacy Grant to study the natural environment in the area. Funding is provided by the U.S. Department of Defense. G. Huckleberry was the project geologist.

Highway geology map. The AZGS and the Arizona Geological Society agreed to cooperate on a highway geology map of Arizona. The AZGS' Geologic Map of Arizona will be used. J. E. Spencer and S. M. Richard will be the primary contacts at the AZGS. Information about Arizona's geology and mineral resources will be added to the back side of the map by Arizona Geological Society members. The map will be published at a scale of 1:1,000,000.

Earthquakes

Earthquake Program. The Earthquake Program in the Division of Emergency Management, Arizona Department of Emergency and Military Affairs, has a cooperative program with the Federal Emergency Management Agency (FEMA). AZGS staff work closely with the Division (M. P. Austin, Director) and the Earthquake Program (L. D. Mason, Program Manager). L. D. Fellows is a member of the Arizona Council on Earthquake Safety (ACES), the advisory group to the Earthquake Program, and serves on the Executive Committee. P. A. Pearthree, an Associate Member of ACES, serves on the Geotechnical Committee. ACES meets quarterly.

Sugarloaf Fault. The Arizona Department of Transportation (ADOT) is widening State Route 87 to four lanes northeast of Phoenix and will be constructing several new bridges. The highway crosses Sugarloaf Fault near two bridge sites. ADOT contracted with the AZGS to assess when the most recent fault movement occurred and to assess the earthquake risk. Under the direction of AZGS geologist P. A. Pearthree, and with assistance of project geologist K. R. Vincent, two trenches were dug across the fault. The study indicated that the hazard posed by the fault is low. A preliminary report was

submitted to ADOT and will be released after final computations have been submitted and the report has been approved.

Quaternary faults. The U.S. Geological Survey (USGS) and the Russian Geological Institute are cooperatively preparing a world map of major active faults. Fault locations will be compiled from existing maps and digitized. Key information will be added to the database about each fault. The USGS has responsibility for the Western Hemisphere. AZGS geologist P. A. Pearthree is compiling data for faults in Arizona. No products have yet been submitted.

Bellemont Fault. The Bellemont fault, a relatively young feature with more than 30 feet of displacement, crosses Camp Navajo, an Arizona National Guard facility west of Flagstaff in Coconino County. The escarpment is the product of more than one faulting event. P. A. Pearthree is directing a project, with the assistance of project geologist K. R. Vincent, to determine the amount of displacement and the age of the youngest movement along the fault.

The project is funded by the Federal Emergency Management Agency in cooperation with the Division of Emergency Management, Arizona Department of Emergency and Military Affairs. Trenches will be dug across the fault to enable geologists to carefully study exposures along the trench walls. Ultimate objective of the project is to assess the seismic hazard at the Camp. The project will be completed during FY 1995-96.

Subsidence and Earth Fissures

Center for Land-Subsidence and Earth-Fissure Information (CLASEFI). The AZGS and the Arizona Department of Water Resources (ADWR) established and are jointly funding CLASEFI through an Intergovernmental Agreement prepared by Greg Wallace (ADWR) and L. D. Fellows (AZGS). The purpose of the Center is to answer requests for information, refer the public to appropriate agencies for assistance, assemble existing information at a single location, map and monitor the extent of subsidence and fissuring, and investigate subsidence areas and individual fissures. The ultimate objective is to identify areas that may have potential for subsidence and related problems in the future. A number of governmental agencies have responsibilities that require them to know the location of subsiding areas and the character of the subsidence and fissures.

Geologist Robin Frisch-Gleason began serving as coordinator of CLASEFI activities in April 1995. She completed a bibliography of land subsidence and earth fissures in Arizona, released as OFR 95-8, and a



bibliography for just the Metropolitan Phoenix area, OFR 95-11. A steering committee composed of representatives of 9 governmental agencies met in April 1995 to discuss current developments and to determine priorities for activities and investigations during FY 1995-96.

Earth-fissure mapping. Subsidence is known to have occurred and earth fissures have developed in the Stanfield area west of Casa Grande in Pinal County. The extent of subsidence has not been determined, however, and exact locations of earth fissures had not recently been field checked and mapped. AZGS geologist R. C. Harris examined detailed aerial photographs provided by Pinal County, identified anomalous linear features, field checked them, and plotted locations of the earth fissures on topographic maps. His study was summarized in a report that was released as OFR 95-6.

Other Projects

River Navigability. The Arizona State Land Department (ASLD) has been directed by the Legislature to determine which rivers were navigable at the time of Statehood (1912). The ASLD contracted with George V. Sabol (GVS), Consulting Engineers, to obtain this information. The AZGS is working with GVS to review the geomorphology and historic changes of the Santa Cruz and Bill Williams rivers. P. A. Pearthree is responsible for the AZGS portion of the project, with assistance from P. K. House.

Geologic data. AZGEOBIB, the AZGS' computerized bibliographic database on Arizona geology, currently contains 11,170 citations, each of which has been key-worded by subject and location. About 300 subject, 2,000 stratigraphic names, and 555 location key words are used. Bibliographic subsets are constructed by using combinations of subject and

location key words. The 555 geographic areas were plotted on a map that was released as OFR 95-2. A complete list of citations in the database was released as OFR 95-4. New citations are regularly added to the database. AZGS geologist R. A. Trapp is the database manager.

Digital databases now on line at the AZGS allow access to U. S. Geological Survey Mineral Resource Data System (MRDS) records for Arizona, to the base- and precious-metal production data compiled for AZGS Bulletin 193 (data through 1981), and to U. S. Bureau of Mines Mineral Industry Location System data sites in Arizona. In addition, Arc/Info

coverage derived from the geologic map of Arizona (Map 26) is accessible using ArcView or Arc/Info. Integration and updating of these data sets is ongoing as time allows.

Mine Remediation. The Arizona Department of Environmental Quality (ADEQ) contracted with the AZGS to review literature and provide an overview of pollution-abatement methods that have been used to control and remediate surface- and ground-water pollution from inactive and abandoned mines. R. Frisch-Gleason completed the project and submitted a draft report to the ADEQ for review and approval.

Uranium and Radon. Radon is a colorless, odorless gas produced by the natural radioactive decay of uranium. Indoor-radon levels generally correlate with uranium concentration in underlying rocks and soil. In some parts of Arizona uranium levels are elevated. This study is part of a multi-year project, done in cooperation with the Arizona Radiation Regulatory Agency, with funding by the U.S. Environmental Protection Agency. R.C. Harris studied the distribution of uranium in late-Cenozoic basin-fill sediment in the upper San Pedro Valley. He measured uranium concentrations using a portable gamma-ray spectrometer. Results of the study, done under the direction of J. E. Spencer, were released as OFR 95-3. Harris and R. A. Trapp produced a comprehensive bibliography of radon and uranium in Arizona (OFR 94-25).

Geologic Field Trips in Tucson Area. A guidebook for a series of one-day geologic field trips in the Tucson area is being prepared by staff from the Arizona Geological Survey, Arizona- Sonora Desert Museum, U. S. Forest Service, and U. S. Geological Survey. The book will be published by the Arizona Geological Survey.

Oil and Gas Conservation Commission

The Oil and Gas Conservation Commission (agency) was eliminated in 1991 to reduce expenditure from the General Fund. The governing board, also known as the Oil and Gas Conservation Commission (OGCC), was retained and transferred to the Arizona Geological Survey, which provides administrative and staff support. The OGCC regulates the drilling for and production of oil, gas, helium, and geothermal resources.

Commission

The OGCC is composed of five members appointed by the Governor. In addition, the State Land Commissioner is an ex-officio member. Members are J. Dale Nations, Flagstaff, Chairman; Donald W. Clay, Yuma; James C. Lanshe, Paradise Valley; Zed Veale, Flagstaff; Lisa C. Worthington, Phoenix; and M.J. Hassell, ex-officio. The OGCC held four regular meetings.

Production, Refining, and Storage

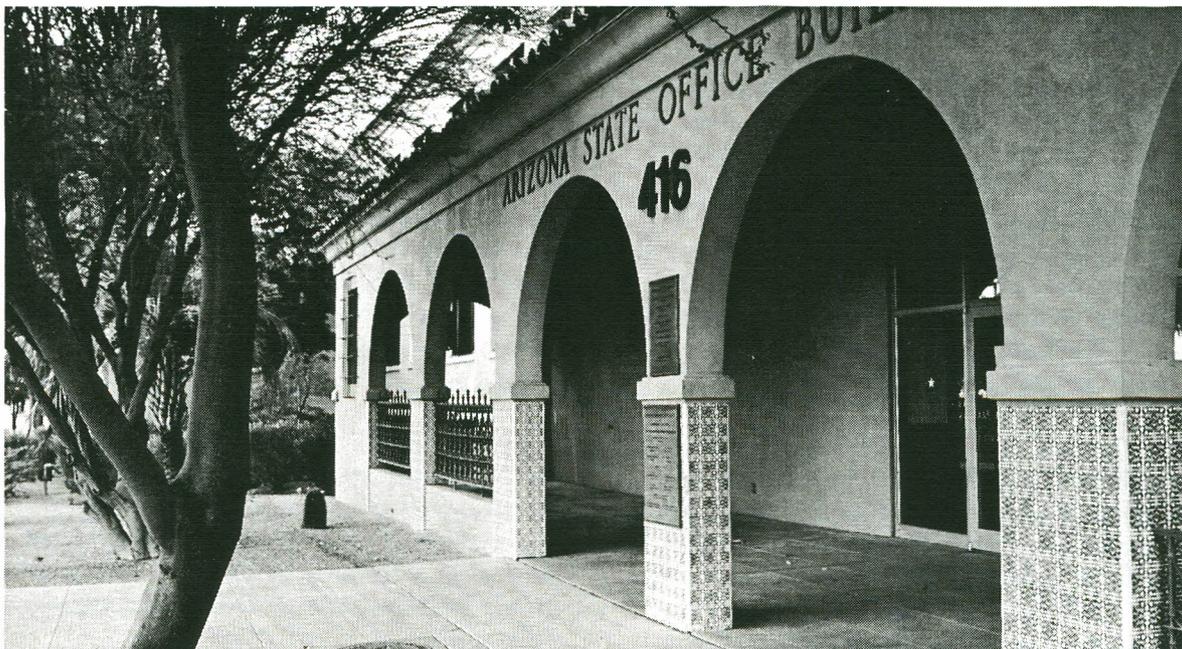
Oil production in Arizona in 1994 totaled 64,748 barrels from 20 producing wells, down from 73,141 barrels in 1993. Gas production in 1994 totaled 759 million cubic feet from six producing wells, up from 618 million cubic feet in 1993.

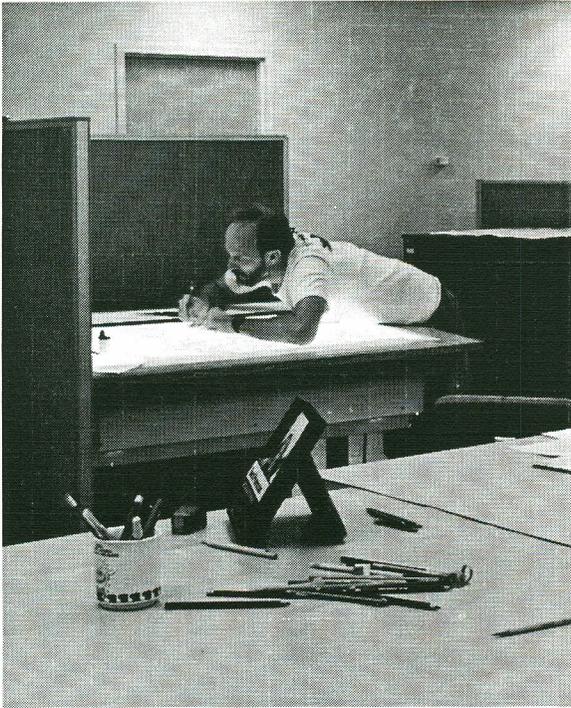
One refinery in Arizona produced 1,200 barrels of product in 1994, down from 1.1 million barrels of product produced from two refineries in 1993. This drop in output is the result of the closure of the Sunbelt Refinery near Coolidge in August 1993. Asphalt and naphtha, a blending stock, were the two products produced at the remaining refinery near Fredonia.

Products transferred in 1994 through the 14 hydrocarbon storage wells near Luke Air Force Base and Adamana included about 58 million gallons in receipts and 56 million gallons in deliveries. About 43 million gallons were in storage at the end of the year. Propane and iso-, normal, and mixed butane are stored in storage wells constructed in large deposits of subsurface salt.

Leasing

Oil and gas leasing increased on both State Trust and public land. State Trust land under lease on June 30, 1995 totaled 132,000 acres, up from 70,000 acres in June 1994. Public land under lease in June 1995 totaled 152,000 acres, up from 116,000 acres in June 1994. The State Land Department administers leasing on State Trust Land. The U.S. Bureau of Land Management administers leasing on public lands.





Drilling

Eight drilling permits were issued, compared with one that was issued in fiscal year 1993-94. One was completed as a producing oil well in the Four Corners, one was completed as a potential carbon dioxide well near St. Johns, one was abandoned because of drilling problems, one was temporarily abandoned pending additional work, one was a dry hole and converted to a water well, and three had not started drilling by the end of the fiscal year, June 30, 1995.

The carbon dioxide encountered in the well near St. Johns may prove to be a significant contribution to the economy of east-central Arizona. The operator, Ridgeway Arizona Oil Company, estimates reserves in the St. Johns area, based on the initial well, at 260 billion cubic feet of carbon dioxide and two billion cubic feet of helium (Petroleum Information Rocky Mountain Region Report, 8-23-95, p. 1 and 2). Additional drilling is planned to verify the initial reserve estimates. More than nine billion cubic feet of helium-bearing gas were produced from fields near Pinta and Navajo, Arizona, in the 1960's and 1970's.

Inspection and Enforcement

Thirty-four wells were inspected in fiscal year 1994-95. Inspections included semiannual safety inspections of 14 hydrocarbon-storage wells near Luke Air Base and Adamana, circulation of cement and testing of blowout-control equipment on two drilling wells near St. Johns and Winslow, and the plugging and abandonment of three dry, nonproductive holes near Chandler and Winslow.

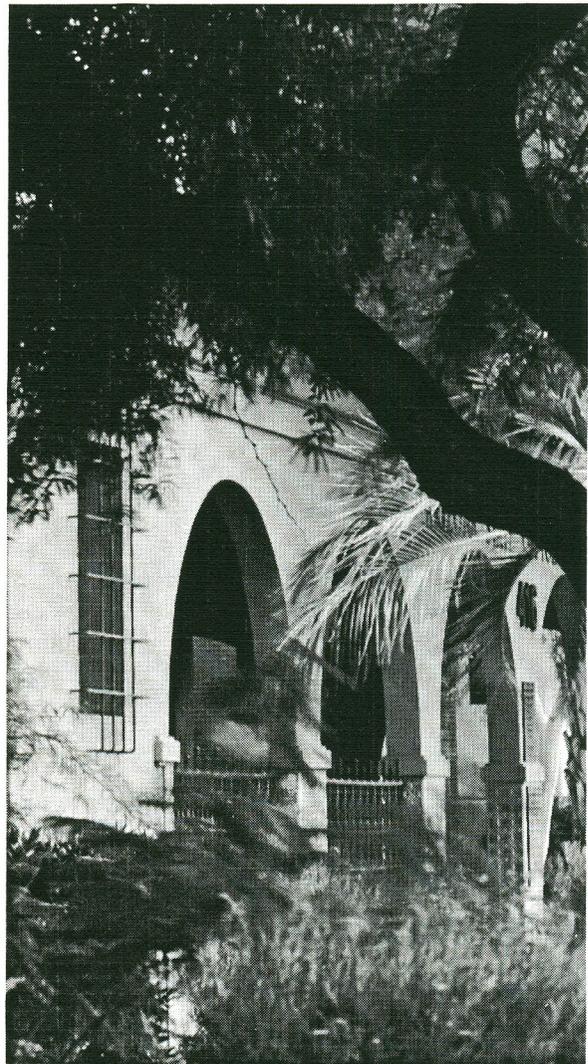
Legislation

The OGCC improved its enforcement authority by amending A.R.S. §§ 27-524 and 27-654 during the 1995 Legislative session. House Bill 2013 clarified an operator's or owner's responsibility relative to plugging abandoned wells and improved the OGCC's ability to prosecute certain types of noncompliance.

Service to other Agencies

The Oil and Gas Program Administrator met with staff at the Arizona Department of Environmental Quality to advise them about the OGCC's rules on class-II storage wells, including enhanced recovery, produced-water-disposal, and hydrocarbon-storage wells.

The Oil and Gas Program Administrator consulted with State Land Department staff about plugging requirements in A.A.C. R12-7-232 in anticipation of the Gila Valley Irrigation District's grant application to the Arizona Water Protection Fund to plug an abandoned geothermal well in Graham County.



Personnel

LARRY D. FELLOWS, Director and State Geologist
B.S., Iowa State Univ.; M.A., Univ. of Michigan;
Ph.D., Univ. of Wisconsin

Geologists

ROBIN FRISCH-GLEASON,* Geologist II
B.A., Oberlin College
M.S., Vanderbilt Univ.

JON E. SPENCER, Research Geologist
B.S., Univ. of California, Santa Cruz
Ph.D., Massachusetts Inst. of Technology

THOMAS G. McGARVIN, Geologist I
B.A., California Lutheran College

RICHARD A. TRAPP, Geologist II
B.S., Univ. of Nebraska, Omaha
M.S., Univ. of Arizona

PHILIP A. PEARTHREE, Research Geologist
B.A., Oberlin College
M.S. and Ph.D., Univ. of Arizona

PROJECT GEOLOGISTS:
(not funded with General Revenue)
Charles A. Ferguson

STEVEN L. RAUZI, Oil and Gas Program Admin.
B.S. and M.S., Utah State Univ.

Raymond C. Harris
P. Kyle House

STEPHEN M. RICHARD, Research Geologist
B.S. and M.S., Univ. of Arizona
Ph.D., Univ. of California, Santa Barbara

Gary Huckleberry
Elise G. Pendall
Stephen J. Skotnicki
Kirk R. Vincent

*Position partly funded by Arizona Department of Water Resources

ROSE ELLEN McDONNELL, Admin. Services Officer II
B.S., Univ. of Arizona

Support Staff

PETER F. CORRAO, Graphic Designer II
B.S., Arizona State Univ.

OTHERS EMPLOYED:

Joaquin B. Bermudez, Student Aide
Jason D. Boulanger, Student Aide
Laurette E. Colton, Admin. Sup. Supervisor I
Martin J. Hartney, Student Aide
Pamela J. Lott, Secretary
Alfredo Mesa, Student Aide
Derek M. Van Pelt, Student Aide
Debra Wilkie, Student Aide

DIANE MURRAY,** Librarian I
B.S., New Mexico Inst. of Mining and Tech.
M.L.S., Univ. of Arizona

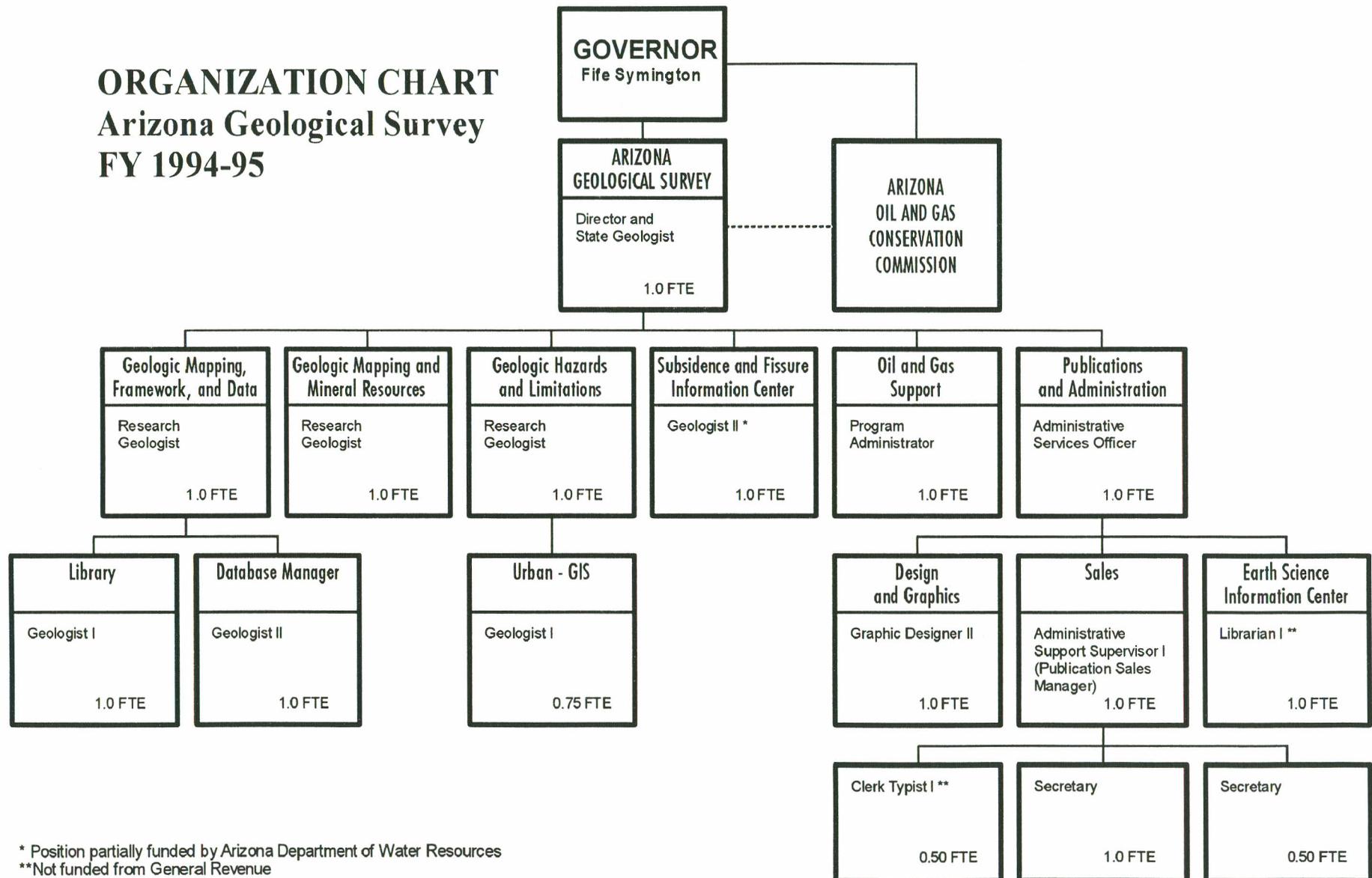
MARY E. PASBORG,** Clerk-Typist I

MARY E. REDMON, Accounting Technician II

** Not paid from General Revenue

Persons employed June 30, 1995. The agency is authorized to employ 13.25 full-time-equivalent staff members, using appropriated General Revenue funds.

ORGANIZATION CHART Arizona Geological Survey FY 1994-95



* Position partially funded by Arizona Department of Water Resources
**Not funded from General Revenue

Budget

General Fund

Category	FY 1993-94 Expended	FY 1994-95 Expended	FY 1995-96 Budgeted
Personal Services	\$390,398	398,883	410,000
Benefits	89,609	81,973	84,200
Operations	117,867	127,032	168,600
In-State Travel	8,820	9,271	27,700
Out-of-State Travel	3,201	1,720	2,000
Capital Equipment	3,100	6,553	58,100
TOTAL	612,995	625,432	750,600

Printing Revolving Fund

Revenue	
Received during FY 1994-95	\$45,318
Expenditures	
Salaries	9,202
Benefits	2,236
Operations	32,796
Equipment	10,502
TOTAL EXPENDITURES	54,736

Persons Employed: J.B. Bermudez, J.D. Boulanger, R. Frisch-Gleason,
M.J. Hartney, A. Mesa, M.E. Pasborg, D.M. Vanpelt, D.P. Wilkie

Contracted Projects

Project (Funding Source)	Principal Investigator	Personal Services	Benefits	Operations	In-State Travel	TOTAL
Geologic Mapping - Bedrock Phoenix Quadrangle (U.S. Geological Survey)	Spencer	\$3,944	405	275	1,620	6,244
Geologic Mapping - Surficial Materials (U.S. Geological Survey)	Pearthree	4,839	482	2,847	845	9,013
Uranium Levels in Rocks (U.S. Environmental Protection Agency)	Spencer	14,864	2,137	0	0	17,001
Earth Science Information Center (U.S. Geological Survey)	McDonnell	21,702	4,819	0	0	26,521
Geologic Mapping Phoenix Quadrangle (U.S. Geological Survey)	Spencer	49,915	5,113	2,725	4,131	61,884
Garden Canyon Surficial Geology (U.S. Army)	Pearthree	3,283	338	0	117	3,738
Printing and Distribution (Arizona Geological Society)	McDonnell	0	0	565	0	565
Channel Changes (CH2M Hill, Salt River)	Pearthree	1,529	14	21	0	1,564
Land Subsidence/Fissures (AZ Dept of Water Resources)	Fellows	8,947	1,150	12	78	10,187
Pollution Abatement (AZ Dept of Environmental Quality)	Fellows	6,337	652	320	121	7,430
Sugar Loaf Fault (AZ Dept of Transportation)	Pearthree	2,302	237	1,008	168	3,715
Belmont Fault (AZ Dept of Emergency Management)	Pearthree	267	28	116	0	411
TOTAL EXPENDITURES		117,929	15,375	7,889	7,080	148,273

Persons Employed: C.A. Ferguson, R.Frisch-Gleason, R.C. Harris, P.K. House, G.A. Huckleberry, D. Murray, E.C. Pendall, S.J. Skotnicki, K.R. Vincent

Appendix I

Constituents - Public

Citizens and groups

KIWANIS CLUB OF RINCON, Tucson
TOHONO CHUL PARK DOCENTS, Tucson
TUCSON GEM AND MINERAL SOCIETY, Tucson

Elementary and Secondary Schools

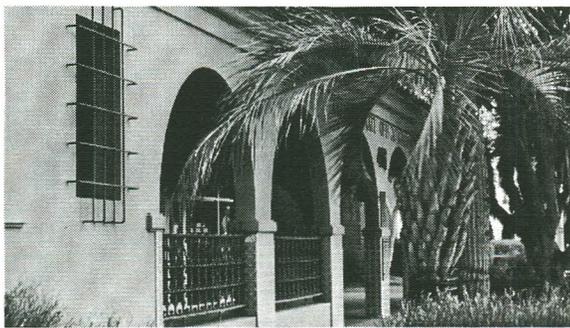
ACADIA SCH, Vail
AM INDIAN CHRISTIAN MISSION, Show Low
AMPHITHEATER SCH DIST, Tucson
APACHE JUNCTION UNIFIED SCH,
Apache Junction
BISBEE UNIFIED SCH DIST, Bisbee
CUMBERLAND VALLEY HIGH SCH,
Mechanicsburg, PA
DESERT HORIZONS ELEM SCH, Phoenix
DOOLEN MIDDLE SCH, Tucson
EMILY GRAY JR HIGH, Tucson
HOLIDAY ELEM SCH, Tucson
LIBERTY ELEM SCH, Tucson
LINEWEAVER ELEM SCH, Tucson
MOUNTAIN SKY JR HIGH, Phoenix
MOUNTAIN VIEW HIGH SCH, Tucson
NEELY ELEM SCH, Gilbert
RED MESA ELEM SCH, Teec Nos Pos
RICHARDSON ELEM SCH, Tucson
SAN MANUEL HIGH SCH, San Manuel
SIERRA MIDDLE SCH, Tucson
SUNRISE MIDDLE SCH, Scottsdale
TUCSON HEBREW ACAD, Tucson
TUCSON UNIFIED SCH DIST
SCIENCE RESOURCE CENTER
VAIL MIDDLE SCH, Vail
WAKEFIELD MIDDLE SCH, Tucson
WALKER ELEM SCH, Tucson
WARREN ELEM SCH, Tucson
WASHINGTON ELEM SCH, Phoenix

Colleges and Universities

AM RIVER JR COLL, Sacramento, CA
AZ ST UNIV, Tempe
DEPT OF GEOLOGY
ARCHITECTURE AND DESIGN SCHOOL

AUBURN UNIV, Auburn, AL
RALPH BROWN DRAUGHON LIB
CA INST OF TECH, Pasadena, CA
CA STATE UNIV LIB, Fullerton, CA
CENTRAL MO ST UNIV, Warrensburg, MO
CHAFFEY JR COLL, Alta Loma, CA
COLL OF WOOSTER, Wooster, OH
CORNELL UNIV, OLIN LIB, Ithaca, NY
EASTERN AZ COLL, Thatcher
FORT LEWIS COLL BOOKSTORE, Durango, CO
GRAND CANYON UNIV, Glendale
GUSTAVUS ADOLPHUS COLL, St. Peter, MN
THE BOOK MARK
HARVARD UNIV, KUMMEL LIB, Cambridge, MA
ID ST UNIV, OBOLER LIB, Pocatello, ID
IA ST UNIV, PARKS LIB, Ames, IA
MARICOPA COMM COLL DIST, Phoenix
NAVAJO COMM COLL, Shiprock, NM
NM HIGHLANDS UNIV, Las Vegas, NM
N AZ UNIV, Flagstaff
PASADENA AREA COMM COLL DIST,
Pasadena, CA
PA ST UNIV, PATTEE LIB, University Park, PA
PIMA COMM COLL, Tucson
PRESCOTT COLL, Prescott
PRINCETON UNIV LIB, Princeton, NJ
PURDUE UNIV, DEPT OF EARTH & ATMOS SCI,
W Lafayette, IN
SAM HOUSTON ST UNIV, COLL OF ARTS & SCI,
Huntsville, TX
SOUTHERN METHODIST UNIV, FONDREN
LIB, Dallas, TX
SOUTHWESTERN COLL, Phoenix
STANFORD UNIV, BRANNER LIB, Stanford, CA
TX CHRISTIAN UNIV, Fort Worth, TX
TULSA UNIV, GEOSCIENCES, Tulsa, OK
UNIVERSITA DI SIENA, ISTITUTO DI
MINERALOGIA, Siena, ITALY
UNIVERSITAT ERLANGEN-NURNBERG,
Kochstrasse, GERMANY
INSTITUT FUR GEOGRAPHIE
UNIV OF AZ, Tucson
DEPT OF GEOSCIENCES
LIBRARY
LUNAR & PLANETARY LAB
NAVAJO COUNTY EXTENSION
OFFICE OF ARID LAND STUDIES
OFFICE OF ECONOMIC DEVELOPMENT
UNIV OF AZ PRESS
UNIV OF CA LIB, Davis, CA
UNIV OF CHICAGO LIB, Chicago, IL
UNIV OF CO AT BOULDER, DEPT OF GEOL SCI,
Boulder, CO

UNIV OF IL LIB, Urbana, IL
 UNIV OF IA, DEPT OF GEOLOGY, Iowa City, IA
 UNIV OF KS, DEPT OF GEOG, Lawrence, KS
 UNIV OF NV AT LAS VEGAS, Las Vegas, NV
 UNIV OF OR, Eugene, OR
 UNIV OF PHOENIX, Phoenix
 UNIV OF S FL, MARINE SCI DEPT,
 St. Petersburg, FL
 UNIV OF TX AT AUSTIN, GENERAL LIB,
 Austin, TX
 UNIV OF TX AT EL PASO, DEPT OF GEOL SCI,
 El Paso, TX
 UNIV OF SW LA, Lafayette, LA
 VA POLYTECH INST, UNIV LIB, Blacksburg, VA
 WA UNIV LIB, St. Louis, MO
 YALE UNIV, GEOL LIB, New Haven, CT
 YAVAPAI COLL LIB, Prescott



Professional Groups

AM GEOPHS UNION
 AM INST OF MINING, MET, &
 PETROLEUM ENGRS
 AM INST OF PROF GEOLOGISTS
 AZ ASSOC FOR LEARNING IN AND ABOUT
 THE ENVIRON
 AZ FLOODPLAIN MGT ASSOC
 AZ GEOL SOC
 AZ SCIENCE TEACHERS ASSOC
 ASSOC OF AM STATE GEOLOGISTS
 GEOL SOC OF AMERICA
 SOC OF LANDSCAPE ARCHITECTS
 SOC OF MINING ENGRS
 SOUTHWEST MINERALS EXPLOR ASSOC
 SOUTHWEST PALEONTOLOGICAL SOC
 THE ACAD OF NATURAL SCIENCES,
 Philadelphia, PA
 WESTERN STATES SEISMIC POLICY COUNCIL

Libraries

MAYER PUBLIC LIB, Mayer
 MIDWEST LIB SERVICE, Bridgeton, MO

PATAGONIA PUBLIC LIB, Patagonia
 PHOENIX PUBLIC LIB, BIBLIOGRAPHIC
 SERVICES, Phoenix
 YAVAPAI CO LIB DIST, Prescott
 YUMA CO LIB DIST, Yuma Constituents-Busines

Constituents- Businesses

Environmental and Engineering Geology

AGRA EARTH & ENVIRON, Phoenix
 AJAY ENVIRON CONSULTANTS, Tucson
 ASL HYDROLOGIC & ENVIRON, Phoenix
 ATC ENVIRONMENTAL, Omaha, NE
 BARR ENGR CO, Minneapolis, MN
 BASIN AND RANGE HYDROGEOLOGISTS,
 Phoenix
 BBL ENVIRON, Solana Beach, CA
 BDM OKLAHOMA, INC, Bartlesville, OK
 BECHTEL ENVIRON, INC, San Francisco, CA
 BLACK & VEATCH ENGRS, Phoenix
 BROWN AND CALDWELL, Phoenix
 CHAPARRAL CONSULTANTS, Scottsdale
 COBB RESOURCES CORP, Albuquerque, NM
 CONVERSE CONSULTANTS SW, Las Vegas, NV
 CRUSON & PANSZE, GEOLOGISTS, Golden, CO
 DAMES & MOORE, Phoenix
 DAVID J NEWTON ASSOC, Portland, OR
 DAVID JENSEN ASSOC, INC., Denver, CO
 DAVIS2 CONSULTING EARTH SCIENTISTS,
 Georgetown, CA
 EARTH RESOURCE TECH, Tempe
 EBERHART & STONE, INC, Orange, CA
 ENVIRON DATA RESOURCES, Southport, CT
 ENVIRON ENG CONSULTANTS, Phoenix
 ERROL L MONTGOMERY & ASSOC, Tucson
 FOREE & VANN, INC, Phoenix
 FOUR CORNERS ENVIRON, Phoenix
 FUGRO, Sacramento, CA
 GERAGHTY & MILLER, INC, Phoenix
 GERVASIO & ASSOC, INC, Phoenix
 GILES ENGR ASSOC, Anaheim, CA
 GROUNDWATER TECHNOLOGY, INC, Tempe
 HARGIS & ASSOC, Tucson
 HYDRO-SEARCH, INC, Phoenix
 KLEINFELDER, INC, Las Vegas, NV; Phoenix
 LAW ENVIRON, Kennesaw, GA
 LEXICON ENVIRON ASSOC, W Chester, PA
 B A LIESCH ASSOC, INC, Minneapolis, MN
 MALCOLM PIRNIE, INC., Phoenix
 NOVA ENGR SERVICES, Chicago, IL

PARSONS ENGR SCIENCE, Tempe
 QUANTERA ENVIRON, Davis, CA
 RESOURCE APPLICATIONS, INC, Lakewood, CO
 RICKER, ATKINSON, McBEE & ASSOC, Tempe
 RIVERSIDE TECH, INC, Fort Collins, CO
 SARGENT-LUNDY ENGR, Chicago, IL
 KENNETH D SCHMIDT & ASSOC, Phoenix
 SCOTT, ALLARD, & BOHANNON ENGRS,
 Phoenix
 SCS ENGRS, Phoenix
 SEA, INC, Sparks, NV
 SHB AGRA, INC, Phoenix
 SIMONS LI & ASSOC, INC, Tempe
 SOUTHWEST GROUND-WATER CONSULTANTS
 Phoenix and Prescott
 SOUTHWESTERN ENGR GEOLOGISTS,
 Fillmore, CA
 STANLEY CONSULTANTS, Phoenix
 STETSON ENGRS, San Rafael, CA
 TAIT ENVIRON MANAGEMENT, Orange, CA
 TERRANE ENGR CORP, Tempe
 VECTOR ENGRS, INC, Grass Valley, CA
 WATER & ENVIRON SYSTEMS, Denver, CO
 WOODWARD CLYDE CONSULTANTS,
 San Diego, CA; Midvale, UT

Mineral Exploration and Mining

AM PRESCOTT GEOSURVEY, Prescott
 AZ MINING ASSOC, Phoenix
 BASIN RANGE EXPLOR, Ely, NV
 CAL-GOLD ENTERPRISES, Pasadena, CA
 CHEMICAL LIME CO, Fort Worth, TX
 COMBINED METALS, Collbran, CO
 CRA EXPLOR PTY LTD, Fyshwick, AUSTRALIA
 CYPRUS AMAX MINERALS CO, Englewood, CO
 CYPRUS METALS EXPLOR, Sparks, NV
 DOHERTY NELLMAPIUS PARTNERSHIP,
 Wickenburg
 GEORGIA MARBLE CO, Atlanta, GA
 HEMAL EXPLORATION, Vancouver, BC, CANADA
 HOMESTAKE MINING, Reno, NV
 JABA, INC, Tucson
 MINERA CUICUILCO,
 Guadalajara, Jalisco, MEXICO
 MINING & ENVIRON CONSULTANTS, Phoenix
 NEW DAWN MINERALS & EXPLOR,
 Bridgewater, NJ
 NM & AZ LAND CO, Albuquerque, NM
 NORTH MINING INC, Denver, CO
 PHELPS DODGE MORENCI, INC, Morenci
 PITTSTON NEVADA GOLD CO, Reno, NV
 PNC EXPLOR CO, LTD, Vancouver, BC, CANADA
 SOUTH PASS RESOURCES, INC, Scottsdale

STERLING EXPLOR, Albuquerque, NM
 THE WINTERS CO, Tucson
 U S BORAX, Tucson
 URANERZ USA, INC, Reno, NV
 GARY WILLIAMS & ASSOC, INC, Glendale

Oil and Gas Exploration and Development

AMERIGAS, Waddell
 ANDERSON REPORTS, Casper, WY
 ARZON CORP, Phoenix
 BDM OKLAHOMA, Bartlesville, OK
 BECSUL ENERGY, Oklahoma City, OK
 BIRD SEISMIC, Phoenix
 BURNETT OIL CO, INC, Fort Worth, TX
 CHEVRON COMPANIES, Houston, TX
 CO INTERSTATE GAS COMPANY,
 CO Springs, CO
 DMS HOLDING CO, Scottsdale
 DRY MESA CORP, Wichita, KS
 DUGAN PRODUCTION CORP, Farmington, NM
 EDWARD OIL CO, Youngsville, PA
 ENERGY STRATEGIES, INC, Salt Lake City, UT
 FERRELLGAS, Holbrook
 FISCHER PETROLOGIC, Denver, CO
 GIANT REFINING CO, Scottsdale
 GRAYHAWK OIL, Phoenix
 HALLIBURTON ENERGY SERVICES, Denver, CO
 HARKEN SOUTHWEST CORP, Dallas, TX
 HIGH PLAINS PETROLEUM, Boulder, CO
 HUMBLE INSTRUMENTS & SERVICES,
 Humble, TX
 HUMPHREY OIL CORP, Dallas, TX
 HUNT OIL CO, Dallas, TX
 JAMAR ENERGY CO, Sun Lakes
 KERR-McGEE, Tulsa, OK
 LeGRANDE CONCORD, INC, Phoenix
 MAGELLAN PETROLEUM, Brisbane, AUSTRALIA
 MASON RESEARCH CONSULTANTS, Austin, TX
 MERIDIAN OIL INC, Englewood, CO
 MERRION OIL & GAS, Farmington, NM
 MOORE ENERGY, Denver, CO
 MOUNTAIN STATES PETROLEUM CO,
 Roswell, NM
 MUNGER OIL INFO SERVICES, Los Angeles, CA
 J W MULLOY ASSOCIATES, Midland, TX
 NORTON DRILLING CO, Lubbock, TX
 OIL INC, Okmulgee, OK
 OILTON, INC, St. Paul, MN
 PERMIAN BRINE SALES, INC, Odessa, TX
 PETROLEUM INFO, Farmington, NM
 PHILLIPS PETROLEUM, Bartlesville, OK
 PREMCO WESTERN, Garland, TX
 QUESTAR ENERGY CO, Denver, CO

REGULATORY COMPLIANCE SPECIALISTS,
Kerrville, TX
RICHARDSON PETROLEUM, INC, Denver, CO
RIDGWAY PETROLEUM CO, Calgary,
Alberta, CANADA
SALOMON BROTHERS, New York, NY
TOWER ENERGY, Denver, CO
THE TOWNSEND CO, Abilene, TX
TRINITY PETROLEUM EXPLOR, Denver, CO
VECTOR ASSOC, Houston, TX
WALSH ENGR, Farmington, NM

Other Businesses

ARCHEOLOGICAL RESEARCH SERVICES,
Tempe
AZ DAILY STAR, Tucson
ARIZONA-SONORA DESERT MUSEUM, Tucson
BAKER & TAYLOR BOOKS, Momence, IL
BANK OF AMERICA, Phoenix
BUILDERS HOME WARRANTY, Englewood, CO
COLOSSAL CAVE MOUNTAIN PARK, Tucson
COUNTY PRINTERS, Winslow
DATAMAP, Eden Prairie, MN
D B A COCHISE CARTOGRAPHICS, Bisbee
ELECTRONIC DATA SYSTEMS, Herndon, VA
ESCUJILLA CATTLE CO, Mesa
FENNEMORE CRAIG, PC, Phoenix
GUIDON BOOKS, Scottsdale
HIGH-GRADE PUBLICATIONS, Aptos, CA
JOANN HINZ BOOKS, Mesa
HOMESTEAD GEOL APPRAISAL SERVICES,
Westlake Village, CA
HOVEN & CO REPROGRAPHICS, Bakersfield, CA
KCS INVESTMENTS, INC, San Francisco, CA
KVMR-FM, Nevada City, CA
KVOA-TV, Tucson
LOUISIANA LAPIDARY, Lake Charles, LA
MANY FEATHERS, Phoenix
MAP WORLD, Encinitas, CA
MARTIN-McINTOSH CIVIL ENGR &
LAND SURV, Tucson
MASON MAP SERVICE, INC, Austin, TX
NATIONAL GEOG SOC, Washington, DC
CARTOGRAPHIC DIV
NAVAJO TIMES, Window Rock
DOUGLAS C NELSON, PC, Phoenix
OMNI RESOURCES, Burlington, NC
PHOENIX HOME & GARDEN, Phoenix
PLUESS-STAUFER INDUSTRIES, INC,
Proctor, VT
QUALITY WESTERN CONTRACTORS, INC,
Tempe
R & R TECHNICAL BOOKFINDERS, Littleton, CO
RESOURCE APPLICATIONS, INC, Lakewood, CO

ROYBAL CORP, Denver, CO
SALT RIVER PROJECT, GROUNDWATER SEC,
Phoenix
SOUTHWEST RES INST, San Antonio, TX
STATISTICAL RESEARCH, Tucson
TET PROSPECTING EQUIP, Sierra Vista
TUCSON MAP & FLAG CENTER, Tucson
TUCSON WEEKLY, Tucson
UNIVERSITY TEXT AND TOOLS, Flagstaff
VERDE INDEPENDENT, Cottonwood
WORLD GEOSCIENCE CORP,
Floreat, AUSTRALIA
WORLD GEOSCIENCE, INC, Houston, TX
YANKEE BOOK PEDDLER, Contoocook, NH

Constituents- Government

State of Arizona

AZ RADIATION REGULATORY AGENCY
ATTORNEY GENERAL, LIBRARY & RESEARCH
DEPT OF COMMERCE, ENERGY OFFICE
DEPT OF EDUCATION
DEPT OF EMERGENCY & MILITARY AFFAIRS
EARTHQUAKE PROGRAM
DEPT OF ENVIRONMENTAL QUALITY,
WQD/APP/IDU
DEPT OF LIB, ARCHIVES, AND PUBLIC
RECORDS
GEOGRAPHIC NAMES
DEPT OF MINES & MINERAL RESOURCES
DEPT OF REAL ESTATE
DEPT OF TRANSPORTATION, MATERIALS
DEPT OF WATER RESOURCES
BASIC DATA SECTION
HYDROLOGY
NOGALES AMA
GAME AND FISH DEPT
STATE LAND DEPARTMENT, MINERALS

Arizona County, City, and Town

CITY OF MESA, MESA SOUTHWEST
MUSEUM, Mesa
COCHISE CO, ED SERVICES COORD
HIGHWAY/FLOODPLAIN, Bisbee
NAVAJO CO, CO ENGR, Holbrook
PIMA CO FLOOD CONTROL DIST, Tucson
PUEBLO GRANDE MUSEUM, Phoenix

CITY OF TEMPE, CITY ATTORNEY, Tempe
CITY OF TUCSON, TRANSPORTATION
DEPT, Tucson
YAVAPAI CO SEARCH & RESCUE, Prescott

SERVICE
AZ STATE OFFICE, Phoenix

Indian Nations

GILA RIVER INDIAN COMMUNITY, Sacaton
MINERAL & WATER RESOURCES SEC
NAVAJO NATION MINERALS DEPT,
Window Rock

Federal

BUREAU OF LAND MANAGEMENT
ARIZONA STATE OFFICE, Phoenix
NATIONAL TRAINING CENTER, Phoenix
BUREAU OF MINES, FINANCE, Denver, CO
BUREAU OF RECLAMATION, Phoenix
FOREST SERVICE
APACHE-SITGREAVES NATIONAL FOREST
ALPINE RANGER DISTRICT, Alpine;
SPRINGERVILLE OFFICE
ARIZONA ZONE OFFICE, Phoenix
REGIONAL OFFICE, Albuquerque, NM
TONTON NATIONAL FOREST, Phoenix
GEOLOGICAL SURVEY
GEOLOGIC DIV, Flagstaff;
TUCSON FIELD OFFICE
LIBRARY, NATIONAL CENTER, Reston, VA
WATER RESOURCES DIV, Tempe
LOS ALAMOS NATIONAL LABORATORY,
Los Alamos, NM
NATIONAL PARK SERVICE-SOAR, Phoenix
NATIONAL RESEARCH COUNCIL,
Washington, DC
NATIONAL SCIENCE FOUNDATION,
Washington, DC
NATURAL RESOURCE CONSERVATION

Other States

AK DEPT OF NATURAL RESOURCES,
Fairbanks, AK
DIV OF GEOL & GEOPHYS SURVEYS
CT DEPT OF ENVIRON PROTECTION,
Hartford, CT
CENTRAL SERVICES DIV
KY GEOL SURVEY, Lexington, KY
NM BUR OF MINES & MINERAL RESOURCES,
Socorro, NM
NV BUREAU OF MINES AND GEOL, Reno, NV
PA GEOL SURVEY, Harriaburg, PA
UT GEOL SURVEY, Salt Lake City, UT

Other Countries

GEOLOGICAL SURVEY OF CANADA,
Ottawa, Ontario



Appendix II

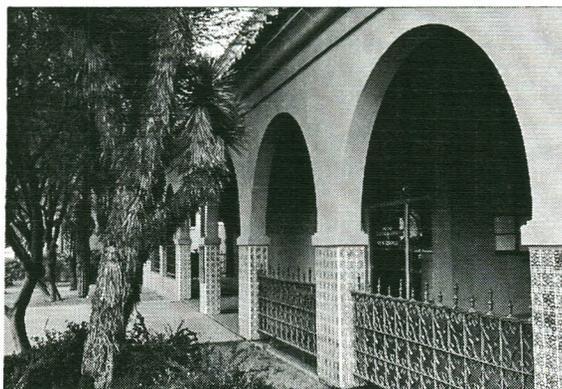
Reports and Maps Completed

Reports and maps that were completed during FY 1994-95 are listed in two categories: a) published and b) in drafting, review, or in press. Those that were published are indexed by subject and publication series on pages 24-25.

Most of the reports and maps were prepared by AZGS geologists. Authors that were not AZGS employees are designated by an asterisk. Geologists whose names are in bold were employed by the AZGS during FY 1994-95. Those whose names are not in bold and not designated by an asterisk were employed by the AZGS prior to FY 1994-95, when work on the project took place.

A. Published

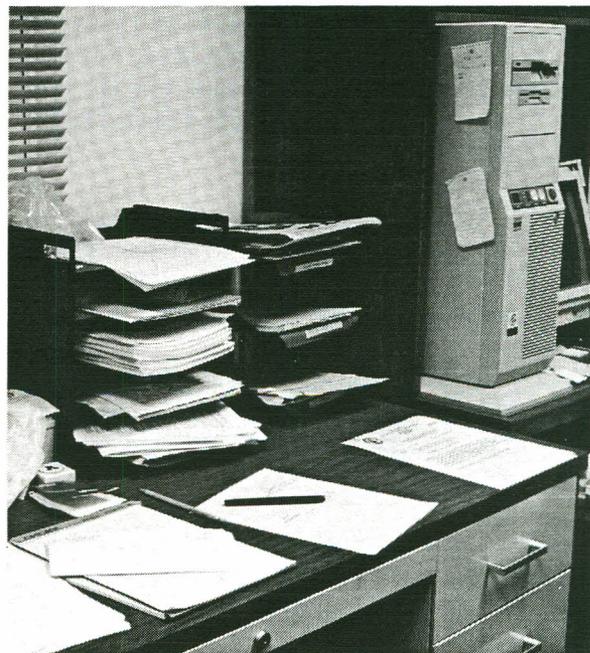
1. *Chenoweth, W. L., 1994a, Geology and production history of the Big Four No. 2 uranium mine, Navajo County, Arizona: Arizona Geological Survey Contributed Report 94-G, 5 p.
2. _____, 1994b, Geology and production history of the Fern No. 1 uranium mine, Navajo County, Arizona: Arizona Geological Survey Contributed Report 94-H, 11 p.
3. _____, 1995a, Geology and production history of the Golden Crown (George Harrison No. 1) uranium mine, Navajo County, Arizona: Arizona Geological Survey Contributed Report 95-F, 6 p.
4. _____, 1995b, Geology and production history of the Mitchell Butte Uranium-Vanadium mine, Navajo County, Arizona: Arizona Geological Survey Contributed Report 95-B, 10 p.
5. _____, 1995c, Geology and production history of the Moonlight uranium-vanadium mine, Navajo County, Arizona: Arizona Geological Survey Contributed Report 95-D, 11 p.
6. _____, 1995d, Location, geology, and mining, Sam Charlie No. 1 uranium-vanadium prospect, Navajo County, Arizona: Arizona Geological Survey Contributed Report 95-C, 8 p.
7. _____, 1995e, The geology, exploration, and production history of the Capitan Benally No. 4A uranium-vanadium mine, Apache County, Arizona: Arizona Geological Survey Contributed Report 95-E, 6 p.
8. _____, 1995f, The geology, leasing, and production history of the Oak Springs uranium-vanadium mines, Apache County, Arizona: Arizona Geological Survey Contributed Report 95-G, 15 p.
9. *Conley, J. N., *Koester, E. A. and Rauzi, S. L., 1995, Well location map, Maricopa County, Arizona: Arizona Geological Survey Oil and Gas Publication 3, 2 sheets, scale 1:500,000 (OGCC County Series Map 1).
10. _____, 1995, Well location map, Yuma and LaPaz Counties, Arizona: Arizona Geological Survey Oil and Gas Publication 4, scale 1:500,000 (OGCC County Series Map 2).
11. _____, 1995, Well location map, Pima and Santa Cruz Counties, Arizona: Arizona Geological Survey Oil and Gas Publication 9, scale 1:500,000 (OGCC County Series Map 7).
12. _____, 1995, Well location map, Graham and Greenlee Counties, Arizona: Arizona Geological Survey Oil and Gas Publication 10, scale 1:500,000 (OGCC County Series Map 8).
13. _____, 1995, Well location map, Colorado Plateau Province, Arizona; Apache, Coconino, Navajo, and portions of adjacent counties: Arizona Geological Survey Oil and Gas Publication 11, 48 p., 4 p. addendum, scale 1:500,000 (OGCC County Series Map 9).





14. *Dickinson, W. R., 1994, Trace of main displacement surface (bedrock/basin-fill contact) of Pirate fault zone, west flank of Santa Catalina Mountains, Pima and Pinal Counties, Arizona: Arizona Geological Survey Contributed Map 94-G, 9 p., 1 sheet, scale 1:24,000.
15. Fellows, L. D., 1994, Annual report of the Arizona Geological Survey for Fiscal Year 1993-94: Arizona Geological Survey Open-File Report 94-26, 24 p.
16. Frisch-Gleason, R., Slaff, S., and Trapp, R. A., 1995, Bibliography of subsidence and earth fissures within Arizona: Arizona Geological Survey Open-File Report 95-8, 24 p.
17. Grubensky, M. J., *Haxel, G. B., and Demsey, K. A., 1995, Geologic map of the southeastern Kofa Mountains and western Tank Mountains, southwestern Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-2454, 1 plate, scale 1:62,500.
18. Harris, R. C., 1995, A reconnaissance of earth fissures near Stanfield, Maricopa, and Casa Grande, western Pinal County, Arizona: Arizona Geological Survey Open-File Report 95-6, 6 p., one plate, scale 1:24,000.
19. _____, 1995, Uranium distribution in sediments of the upper San Pedro basin, southeast Arizona, and implications for indoor radon: Open-File Report 95-3, 9 p., scale 1:62,500.

20. Harris, R. C. and Trapp, R. A., 1994, Comprehensive bibliography of uranium and radon in Arizona: Arizona Geological Survey Open-File Report 94-25, 50 p.
21. *Hollocher, K., Spencer, J. E., and Ruiz, J., 1994, Composition changes in an ash-flow cooling unit during K-metasomatism, west-central Arizona: Economic Geology, v. 89, p. 877-888.
22. House, P. K., 1994, Surficial geology of the southern Verde Valley, Yavapai County, Arizona: Arizona Geological Survey Open-File Report 94-23, 20 p., scale 1:24,000.
23. House, P. K. and Pearthree, P. A., 1994, A geomorphologic and hydraulic evaluation of an extraordinary flood discharge estimate: Bronco Creek, Arizona: Arizona Geological Survey Open-File Report 94-19, 21 p.
24. _____, 1994, Hydraulic and geomorphic re-evaluation of an extraordinary flood discharge estimate: Bronco Creek, Arizona: Geological Society of America Abstracts with Programs, v. 26, n. 7, p. A235.
25. Huckleberry, G., 1994a, Archeological implications of late Holocene channel changes on the middle Gila River, Arizona: Geoarcheology, v. 10, p. 159-182.
26. _____, 1994b, Contrasting channel response to floods on the middle Gila River, Arizona: Geology, v. 22, p. 1083-1086.



27. _____, 1994c, Surficial geology of the Wittmann and Hieroglyphic Mountains Southwest 7.5' Quadrangles, northern Maricopa County, Arizona: Arizona Geological Survey Open-File Report 94-21, 20 p., 2 sheets, scale 1:24,000.
28. _____, 1994d, The 1983 and 1993 floods in southern Arizona: Implications for high frequency climate change and channel dynamics: Geological Society of America Abstracts with Programs, v. 26, n. 7, p. A236.
29. _____, 1995, Surficial geology of the lower Agua Fria River, Lake Pleasant to Sun City, Maricopa County, Arizona: Arizona Geological Survey Open-File Report 95-5, 35 p., scale 1:24,000.
30. *Humble Geochemical Services, Humble, Texas, 1994, Geochemical analysis of the 1-Alpine Federal well, Apache County, Arizona: Arizona Geological Survey Contributed Report 95-A, 48 p.
31. *Koester, E. A., *Conley, J. N. and **Rauzi, S. L.**, 1995a, Well location map, Cochise County, Arizona: Arizona Geological Survey Oil and Gas Publication 6, scale 1:500,000 (OGCC County Series Map 4).
32. _____, 1995b, Well location map, Mohave County, Arizona: Arizona Geological Survey Oil and Gas Publication 8, scale 1:500,000 (OGCC County Series Map 6).
33. _____, 1995c, Well location map, Pinal County, Arizona: Arizona Geological Survey Oil and Gas Publication 5, scale 1:500,000 (OGCC County Series Map 3).
34. _____, 1995d, Well location map, Yavapai County, Arizona: Arizona Geological Survey Oil and Gas Publication 7, scale 1:500,000 (OGCC County Series Map 5).
35. **Pearthree, P. A. and Huckleberry, G.**, 1994, Surficial geologic map of the Mesa 30' x 60' Quadrangle, Arizona: Arizona Geological Survey Open-File Report 94-24, scale 1:100,000.
36. **Pendall, E. G.**, 1994, Surficial geology, soils, and vegetation patterns of the Table Top Mountain area, Pinal and Maricopa Counties, Arizona: Arizona Geological Survey Open-File Report 94-22, 37 p., scale 1:24,000.
37. *Pewe, T. L., *Bales, J., and *Montz, M., 1983, Reconnaissance environmental geology of northern Scottsdale, Maricopa County, Arizona: Arizona Geological Survey Contributed Map 94-E, 3 sheets, scale 1:24,000. Plate 1, geology; Plate 2, geologic hazards; and Plate 3, waste disposal.
38. *Pewe, T. L., *Kenny, R., and *Bales, J., 1985, Reconnaissance environmental geology of the Tonto foothills, Scottsdale, Maricopa County, Arizona: Arizona Geological Survey Contributed Map 94-F, 4 sheets, scale 1:24,000. Plate 1, geology; Plate 2, geologic hazards; Plate 3, waste disposal; and Plate 4, flooding.
39. **Rauzi, S. L.**, 1995a, Annual oil, gas, and helium production in Arizona 1954-1994: Arizona Geological Survey Oil and Gas Publication 2, 16 p. (published annually).
40. _____, 1995b, Arizona well location map and report: Arizona Geological Survey Oil and Gas Publication 12, 27 p., 1 p. addendum, 2 sheets, scale 1:675,000 (OGCC State Series Map).
41. _____, 1995c, Monthly oil, gas, and helium production report: Arizona Geological Survey Oil and Gas Publication 1, 5 p. (published monthly).
42. _____, 1995d, Oil and natural gas occurrence in Arizona: Arizona Geological Survey Oil and Gas Publication 35 (OGCC Chart C-1).
43. **Richard, S. M., Spencer, J. E., and Reynolds, S. J.**, 1994, Geologic map of the Salome 30' x 60' Quadrangle, west-central Arizona: Arizona Geological Survey Open-File Report 94-17, 33 p., scale 1:100,000.
44. *Shank, D. C. and *Pewe, T. L., 1973, Geology of the Phoenix Mountains, Maricopa County, Arizona: Arizona Geological Survey Contributed Map 94-D, 1 sheet, scale 1:15,000.
45. **Skotnicki, S. J.**, 1994, Compilation geologic map of the central Gila Bend Mountains, Maricopa County, Arizona: Arizona Geological Survey Open-File Report 94-18, 17 p., scale 1:50,000.
46. **Spencer, J. E.**, compiler, 1995, Geologic map of the Little Horn Mountains 30' x 60' Quadrangle, southwestern Arizona: Arizona Geological Survey Open-File Report 95-1, 10 p., scale 1:100,000.

47. **Spencer, J. E., Richard, S. M., Reynolds, S. J., *Miller, R. J., *Shafiqullah, M., Grubensky, M. J., and Gilbert, W. G., 1995, Spatial and temporal relationships between mid-Tertiary magmatism and extension in southwestern Arizona: Journal of Geophysical Research, v. 100, p. 10,321-10,351.**
48. **Stimac, J. A., Richard, S. M., and others, 1994, Geologic map and cross sections of the Big Horn and Belmont Mountains, west-central Arizona: Arizona Geological Survey Open-File Report 94-15, 16 p., scale 1:50,000, 3 sheets.**
49. **Trapp, R. A., 1994, Bibliography of geologic reports and maps for Apache County, Arizona, south of Interstate 40: Arizona Geological Survey Open-File Report 94-20, 22 p.**
50. **Trapp, R. A. and Frisch-Gleason, R., 1995, OFR 95-11 Bibliography on subsidence and earth fissures in the Metropolitan Phoenix area: Arizona Geological Survey Open-File Report 95-11, 6 p.**
51. **Trapp, R. A. and Reynolds, S. J., 1995, Map showing names and outlines of physiographic areas in Arizona used by the Arizona Geological Survey: Arizona Geological Survey Open-File Report 95-2a and b, scale 1:1,000,000. (94-2a is on highway base map; 2b is on township and range base map)**
52. **Trapp, R. A., Schmidt, N., Reynolds, S. J., and Horstman, K. C., 1995, AZGEOBIB, Version 2.0: A list of references on the geology of Arizona: Arizona Geological Survey Open-File Report 95-4, 326 p.**
53. **VandenDolder, E. M., 1995, How geologists tell time: Arizona Geological Survey Down-to-Earth 4, 33 p.**

Subject Index of Reports and Maps Published

(Numbers refer to citations that are listed alphabetically on pages 21-24.)

DISTRIBUTION AND CHARACTER OF BEDROCK AND SURFICIAL MATERIALS
14, 17, 21, 22, 27, 29, 35, 36, 37, 38, 43, 44, 45, 46, 47, 48

POTENTIAL GEOLOGIC HAZARDS AND LIMITATIONS TO LAND AND RESOURCE MANAGEMENT

16, 18, 19, 20, 23, 24, 26, 28, 37, 38, 50

OIL, GAS, AND MINERAL RESOURCES

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 30, 31, 32, 33, 34, 39, 40, 41, 42

GEOLOGIC DATA

16, 20, 49, 50, 51, 52

OTHER SUBJECTS

15, 25, 53

Publication Series of Reports and Maps Published

Series	Number in list (pages 21-24)
--------	------------------------------

ABSTRACTS

24, 28

CONTRIBUTED MAP

CM 94-D	44
CM 94-E	37
CM 94-F	38
CM 94-G	14

CONTRIBUTED REPORT

CR 94-G	1
CR 94-H	2
CR 95-A	30
CR 95-B	4
CR 95-C	6
CR 95-D	5
CR 95-E	7
CR 95-F	3
CR 95-G	8

DOWN-TO-EARTH

No. 4	53
-------	----

JOURNAL ARTICLES

21, 25, 26, 47

OIL AND GAS

OG-1	41
OG-2	39
OG-3	9
OG-4	10
OG-5	33

OG-6	31
OG-7	34
OG-8	32
OG-9	11
OG-10	12
OG-11	13
OG-12	40
OG-35	42

OPEN-FILE REPORT

OFR 94-15	48
OFR 94-17	43
OFR 94-18	45
OFR 94-19	23
OFR 94-20	49
OFR 94-21	27
OFR 94-22	36
OFR 94-23	22
OFR 94-24	35
OFR 94-25	20
OFR 94-26	15
OFR 95-1	46
OFR 95-2	51
OFR 95-3	19
ORF 95-4	52
OFR 95-5	29
OFR 95-6	18
OFR 95-8	16
OFR 95-11	50

OTHER AGENCIES

17

B. In Drafting, Review, or in Press

Projects listed below are in advanced stages of completion. Most of them will be released during Fiscal Year 1995-96.

Ferguson, C. A. and Skotnicki, S. J., Geologic map of the Florence Junction and southern portion of the Weavers Needle 7.5' Quadrangles, Pinal County, Arizona: Map submitted to Arizona Geological Survey for drafting, scale 1:24,000.

Frisch-Gleason, R., Controlling and remediating surface- and ground-water contamination from inactive and abandoned mines: A survey of management practices: Draft report submitted to Arizona Department of Environmental Quality for review.

House, P. K. and Pearthree, P. A., Geomorphologic and hydrologic evaluation of an extraordinary flood discharge estimate: Bronco Creek, Arizona: Submitted to Water Resources Research.

Huckleberry, G., Geomorphology and surficial geology of Garden Canyon, Huachuca Mountains, Arizona: Draft report submitted U.S. Department of Defense, Ft. Huachuca, for review.

Pearthree, P. A., Vincent, K. R., and Fellows, L. D., Seismic hazard posed by the Sugarloaf fault, central Arizona: Draft report submitted to Arizona Department of Transportation for review.

Skotnicki, S. J. and Ferguson, C. A., Geologic map of the Goldfield and northern portion of the Superstition Mountains SW 7.5' Quadrangles, Pinal and Maricopa Counties, Arizona: Map submitted to Arizona Geological Survey for drafting, scale 1:100,000.

Spencer, J. E. and *Patchet, P. J., Sr isotope evidence for a lacustrine origin for the upper Miocene to Pliocene Bouse Formation, lower Colorado River trough, and implications for timing of Colorado Plateau uplift: Submitted to Geological Society of America for publication.

Spencer, J. E. and Richard, S. M., Compilation geologic map of the east half of the Mesa 30' x 60' Quadrangle, Gila, Maricopa, and Pinal Counties: Submitted to the Arizona Geological Survey for drafting, scale 1:100,000.

Spencer, J. E., Richard, S. M., and *Peterson, D. W., Geologic map of the Picketpost Mountain and southern portion of the Iron Mountain 7.5' Quadrangles, Pinal County, Arizona: Map submitted to the Arizona Geological Survey for drafting, scale 1:24,000.

Stewart, J. H., and 16 authors, including **S. M. Richard**, Map showing Cenozoic tilt domains and associated structural features in western North America: Submitted to the Geological Society of America for publication as a Special Paper.

Appendix III

Service to the Public and Profession

FELLOWS, L. D.

- American Institute of Mining Engineering,
Arizona Conference
At-large Director
- American Institute of Professional Geologists
member of Steering Committee for 31st Annual
Meeting, held in Flagstaff
- Annual Meeting activities: chairman of Field
Trip Committee
prepared geology guidebook from
Phoenix to Flagstaff
gave Keynote address to open
General Session
citationist for John T. Galey, Sr.,
Memorial Public Service Award
- Arizona Council on Earthquake Safety
member of Council and Chairman of
Executive Committee
- Arizona Geological Society, Tucson
gave talk on geologic mapping in Arizona
- Association of American State Geologists
member of Earth Science Education Committee
- Grand Canyon University, Phoenix
gave talk to geology class on geology of Arizona
- Kiwanis Club of Rincon, Tucson
gave talk on geology of Tucson area
- Society of Mining Engineers, Phoenix
gave talk on changes in government programs
- Verde Independent -- Verde River Day,
Cottonwood
led field trip in Cottonwood area

HOUSE, P. K.

- Geological Society of America, Cordilleran
Section Meeting, Seattle
presented paper on re-evaluation of an
extraordinary flood discharge estimate

HUCKLEBERRY, GARY

- Geological Society of America, Cordilleran Section
Meeting, Seattle
presented paper on 1983 and 1993 floods in
southern Arizona

McGARVIN, T. G.

- Arizona Association for Learning in and about
the Environment
gave two talks at annual meeting in Payson:

one about earthquakes in Arizona and one
on geologic highlights between Tucson,
Phoenix, and Heber

- Arizona Science Teachers Association
gave talk at annual meeting in Mesa on geology
of Tucson region
- Natural Resource Conservation Workshop
for Arizona Youth
gave talk on geology of Sierra Ancha
Mountains
- Science and Mathematics Conference, Tucson
gave talk on geology of Tucson area
- Society of Landscape Architects, Tucson
gave talk on the geology of Picacho Peak
- Stimulating, Motivating, Innovative Learning for
Educators Conference, Sierra Vista
gave talk on earthquakes
- Tohono Chul Park Docents, Tucson
gave talk on geologic processes and the
"geology wall" at the Park

MURRAY, DIANE

- SME Minerals Education Coalition
Booth Volunteer,
National Science Teachers Association
Regional Conference, Las Vegas
- Tucson Section AIME,
member of Government, Education, and
Mining Committee

PEARTHREE, P. A.

- Arizona Council on Earthquake Safety
Associate member and member of
Geotechnical Committee
- Arizona Floodplain Management Association
member of Technical Review Committee
- National Research Council, Committee on
Alluvial-fan Flooding
gave talk summarizing geologic research into
alluvial-fan flooding in Arizona
- Pima County Flood Control District
Chairman of Advisory Committee
- U.S. Geological Survey, National Earthquake
Hazard Reduction Program
reviewed three proposals that were submitted
for funding
_____, seismic hazard mapping team
gave talk on Quaternary faulting in Arizona
- University of Arizona, Department
of Geosciences

gave lecture on paleoseismology and earthquake hazards in Arizona to class
helped lead field trip that focused on flood hazards in Pima County
served on thesis committee of one graduate student

RICHARD, S. M.

Economic Geology (Journal)

reviewed manuscript that was submitted for publication

Geological Society of America

reviewed manuscript that was submitted for publication

U. S. Bureau of Reclamation

reviewed geology and mineral resource potential in Lake Pleasant area

U.S. Geological Survey

worked with assessment team for porphyry gold and epithermal gold deposits

reviewed Arizona section of National Mineral Resource Assessment

University of Arizona, Department of Geosciences

member of panel to review proposals for H.

W. Peirce scholarship

served on doctoral advisory committee of one student

SPENCER, J. E.

American Geophysical Union

reviewed manuscript that was submitted for publication

Arizona Geological Society, Tucson

Councilor, 1994; Secretary 1995

Economic Geology (Journal)

reviewed manuscript that was submitted for publication

Geological Society of America

reviewed manuscript that was submitted for publication as a Special Paper

National Science Foundation

reviewed two proposals that were submitted for funding

Nevada Bureau of Mines and Geology

reviewed map that was being prepared for publication

Petroleum Research Fund

reviewed a proposal that was submitted for funding

University of Arizona, Department of Geosciences

gave talk on radon gas to a class

served on thesis committee of one graduate student

TRAPP, R. A.

Tucson Gem and Mineral Society

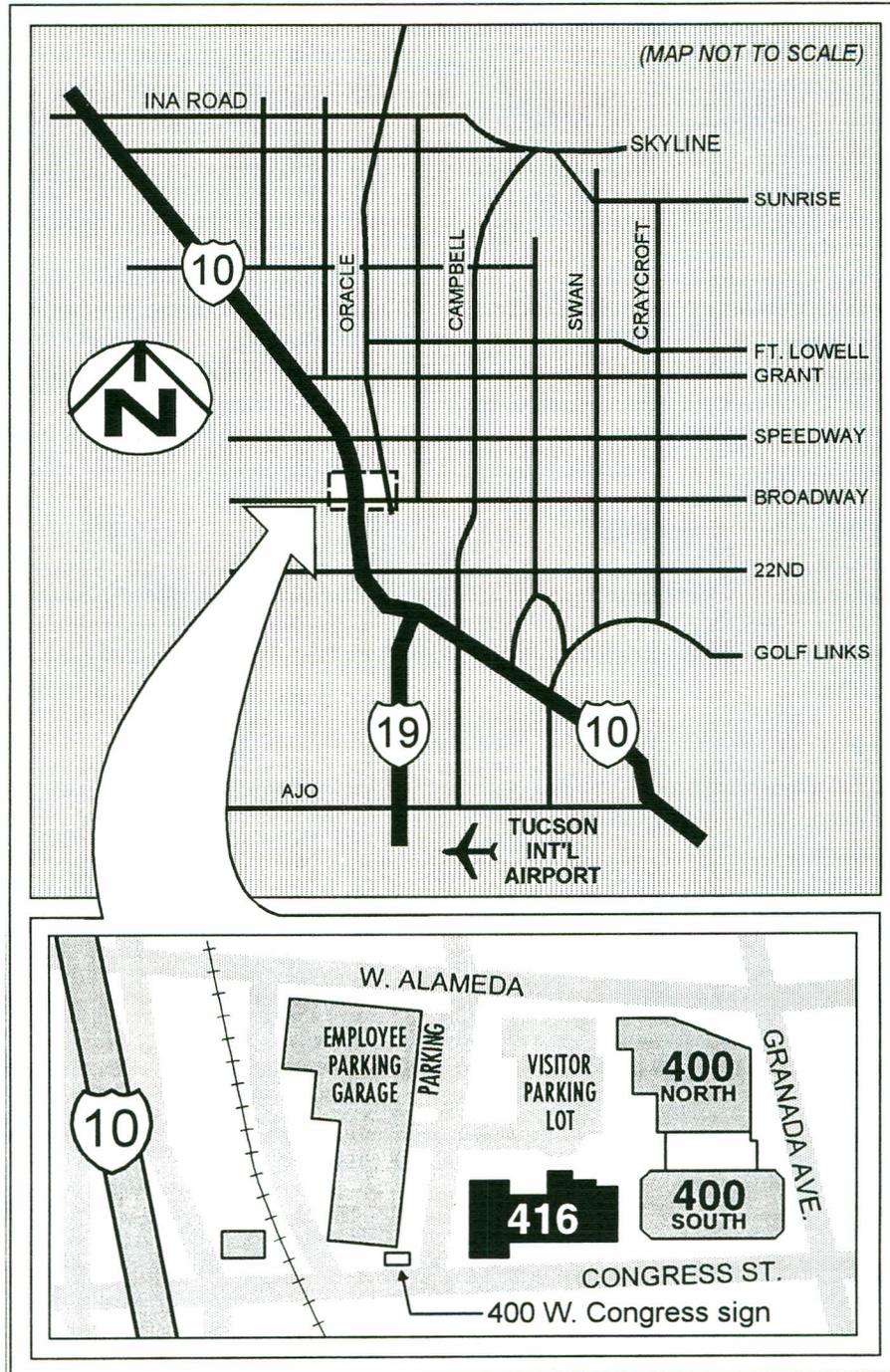
member of Board of Directors

Treasurer, Tucson Gem and Mineral Show

led mineral collecting field trips



Location Map



Arizona Geological Survey
416 W. Congress, Suite 100
Tucson, AZ 85701
(520) 770-3500