1984-85
ANNUAL REPORT

Arizona Geological Survey
Open-File Report 85-20

Arizona Geological Survey
416 W. Congress, Suite #100, Tucson, Arizona 85701

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

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The University of Arizona

Arizona
Bureau of Geology and Mineral Technology
Geological Survey Branch
845 N. Park Ave., Tucson Arizona 85719
(602) 621-7906

1885

1985

A Proud Beginning

INTRODUCTION

This report summarizes activities of the Arizona Geological Survey for Fiscal Year 1984-85, which ended June 30, 1985. The Arizona Geological Survey is the Geological Survey Branch of the Bureau of Geology and Mineral Technology.

The report begins with a statement of purpose, objectives, and responsibilities excerpted from the enabling act of the Bureau of Geology and Mineral Technology (Title 27, Chapter 1, Article 4, Arizona Revised Statutes). Two major responsibilities are mandated: to do research and to provide information. Research and data collection projects, together with information, education, and service activities completed, are listed. Fiscal data, including estimated costs to perform each of the major responsibilities, are provided.

We welcome questions about any aspect of our program and invite your comments.

STATE OF ARIZONA
BUREAU OF GEOLOGY
AND MINERAL TECHNOLOGY
OPEN-FILE REPORT

85-20

Larry D. Fellows
State Geologist and
Assistant Director

This report is preliminary and has not been edited or reviewed for conformity with Arizona Bureau of Geology and Mineral Technology standards.

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CONTENTS

PAGE

FY 1984-85 SUMMARY 1

ENABLING LEGISLATION 3
- Mission and Objectives 4
- Responsibilities 5
- History 6

ACCOMPLISHMENTS 7
- Research and Data Collection 8
- Information, Education, and Service. 14

PERSONNEL 21
- Employees. 22
- Geological Staff and Specialty Areas 23

BUDGET 25
- State Appropriation and Expenditures 26
- Estimated Cost Per Responsibility. 27
- Contracted Projects. 28

LOCATION MAP 30

FY 1984-85 SUMMARY

The 21st Forum on Geology of Industrial Minerals, organized by Dr. H. Wesley Peirce, was hosted in Tucson by the Bureau in April. The meeting, which included five field trips and 23 technical papers, was attended by nearly 150 registrants from 28 states and Canada.

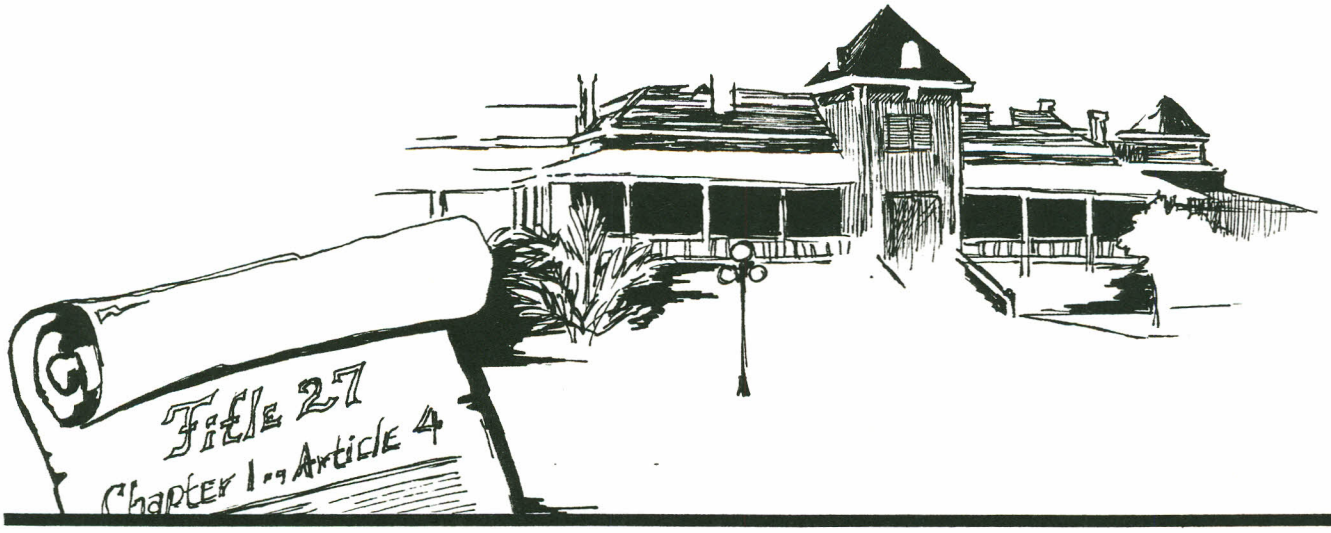
Arizona was one of 17 states chosen to participate in the U. S. Geological Survey's Cooperative Geologic Mapping Program (COGEOMAP). Five geologists prepared geologic maps and studied mineral resources in the Harquahala, Big Horn, and Belmont Mountains and the Bouse Hills. Dr. Stephen J. Reynolds is the project leader.

The Arizona Geologic Information System, a computerized geologic data base, was expanded by addition of theses on Arizona geology and published K-Ar age dates. This work is coordinated by Dr. Reynolds.

Additional data about the State's metallic mineral resources were compiled, under the direction of Dr. Jon E. Spencer, to supplement Bulletin 194, "Metallic Mineral Districts and Production in Arizona", which was published by the Bureau in 1983. Open-file report 85-1 describes the geologic age and origin of those districts of mid-Tertiary age. Bibliographies for each mineral district were completed for 12 counties and await publication.

This was the final year of a project to screen the Basin and Range Province to identify large areas (several hundred to thousands of square miles) that meet criteria for further study relative to disposal of high level radioactive waste. At the request of Governor Babbitt, Dr. Larry D. Fellows served as Arizona's representative on the Province Working Group and coordinated the work done on the project by the Arizona Geological Survey. Interpretations and conclusions resulting from the study, directed by the U. S. Geological Survey, were based entirely on existing geologic and hydrologic data.

More than 3900 persons visited our office or telephoned to obtain information or assistance. Publication sales totalled $15,125. Geology of the South Mountains, Bulletin 195, was published; Bulletin 187, "Index of mining properties in Cochise County", was reprinted; and maps (1:1,000,000 scale) showing outcrops of Laramide-age rocks and post-15-million-year-old volcanic rocks were published. Nine reports and maps were placed on open file. A number of other maps and reports by Arizona Geological Survey geologists were published by other agencies or groups. Four 12-page issues of Fieldnotes were published; and many talks were given to professional, business, and school groups.



Arizona Geological Survey

MISSION · OBJECTIVES · RESPONSIBILITIES

MISSION

The legislature declares that the wise use of the lands and mineral resources of the state can be assisted by the establishment of a scientific, investigative and information agency whose purpose is to conduct research and provide information for use by the legislature, governmental agencies, industry and the public. (House Bill 2060, Thirty-third legislature, 1977, Section 1.)

OBJECTIVES

1. To inform the public in matters concerning the geological environment and the development and use of the mineral resources of this state.

2. To encourage the wise use of the lands and mineral resources of this state toward its development.

3. To provide technical advice and assistance in geology and mineral technology to other state and local governmental agencies engaged in projects in which the geologic setting or the mineral resources of the state are involved.

4. To provide technical advice and assistance in geology and mineral technology to industry and other members of the public toward the wise development and use of the mineral and land resources of this state.

(Section 27-152, Arizona Revised Statutes)

RESPONSIBILITIES

I. Research and Data Collection

Investigate, describe, and interpret the geological setting of this state, including its natural hazards and limitations, its natural attributes and its mineral resources. (Section 27-152.01, item 1, ARS)

Publish in the form of bulletins, circulars, maps and other related series or otherwise make available to state agencies, government officials, industry, and the public the results of all geological, mineral technology and related research and investigation undertaken by the Bureau. (Section 27-152.01, item 3, ARS)

II. Information, Education, and Service

Provide lectures, talks, displays, and exhibits for the general education of the public toward a better understanding of this state and the wise use of this state's land and its mineral resources. (Section 27-152.01, item 4, ARS)

Operate and maintain a central repository for reports, books, maps, and other publications regarding the geology, mineral resources, and associated technologies present or practiced in this state. Such repository shall be available for the use of the public. (Section 27-152.01, item 5, ARS)

Operate and maintain a central repository for rock cores, well cuttings, and related subsurface samples and all associated supplemental data consistent with the laws of this state requiring the deposit of such material and information. Such repository shall be available for the use of the public. (Section 27-152.01, item 6, ARS)

Research and data collection projects and information, education, and service activities completed are summarized in p. 8-20. Estimated costs to perform each of these major responsibilities are outlined on p. 23.

HISTORY

Arizona Bureau of Mines

Arizona Bureau of Geology and Mineral Technology

1888 - U. S. Congress established the post of "Territorial Geologist", requested by Governor Tritle in 1883. John F. Blandy (1889-1891), Dr. Theodore B. Comstock (1891-1895), Dr. William P. Blake (1898-1910), and Dr. Cyrus F. Tolman (1911-1912), filled the position. All but Blandy were faculty members at the University of Arizona.

1891 - Dr. Theodore B. Comstock, Director of the School of Mines and Territorial Geologist, established a metallurgical testing laboratory know informally as the University of Arizona "Bureau of Mines."

1912 - Arizona became the 48th state in the Union.

1915 - Arizona Bureau of Mines established by legislature as a Department of the University of Arizona, continuing functions of the Territorial Geologist and the University "Bureau of Mines." Charles F. Willis, and instructor in geology and mining engineering, was the Bureau's first director.

1918 - College of Mining and Engineering was established. The Dean, Dr. Gurdon M. Bulter, was also named director of the Arizona Bureau of Mines.

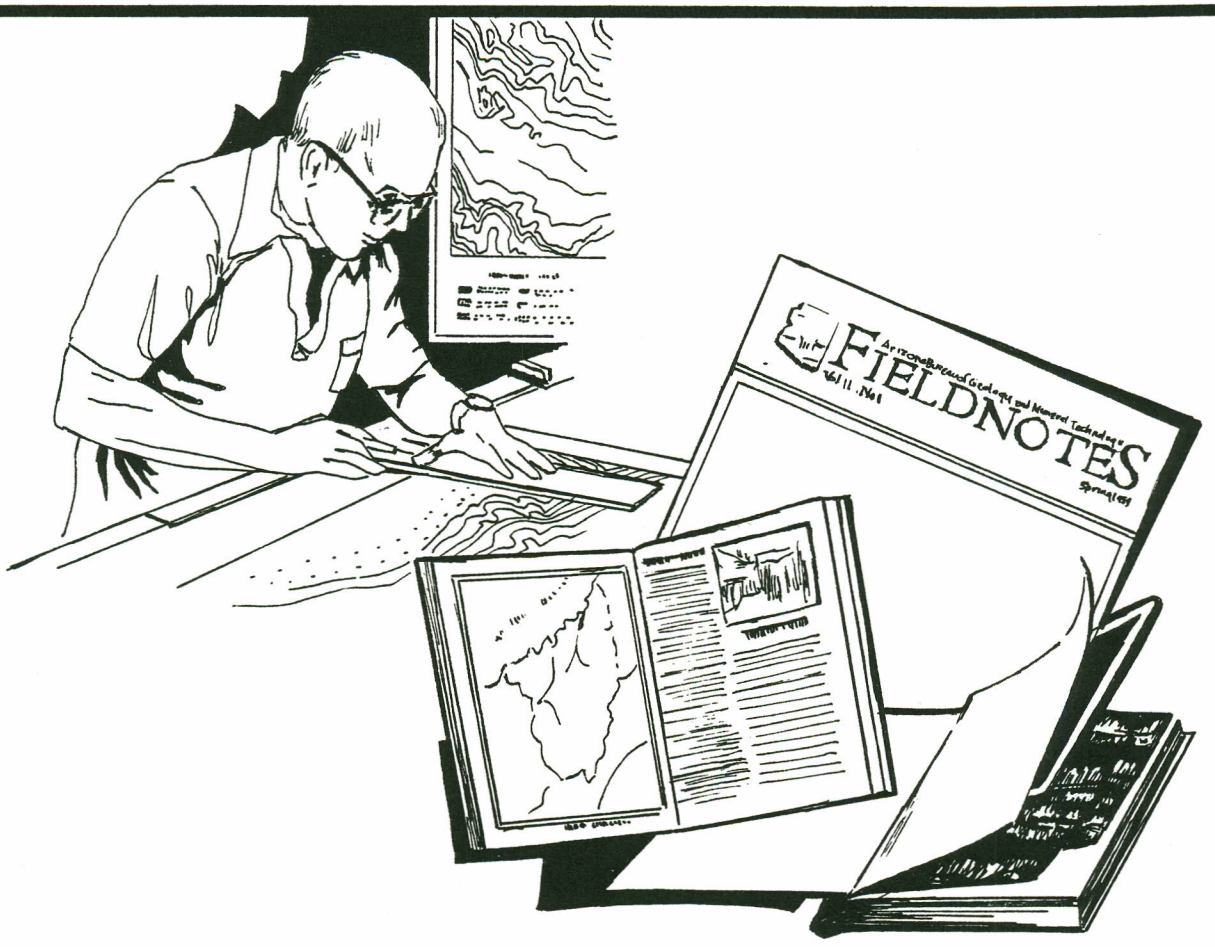
1940 - College of Mining andd Engineering was divided into two Colleges. Responsibility for the Bureau of Mines was assigned to the Dean of the College of Mines, Dr. Thomas G. Chapman.

1977 - Name of the Bureau of Mines was changed to Bureau of Geology and Mineral Technology. The Geological Survey Branch, which is the Arizona Geological Survey, and the Mineral Technology Branch, which continued the Bureau of Mines function, were established. Responsibility for geologic hazards and limitations was added. Bureau was identified as a Division of the University of Arizona to be administered by the Board of Regents and supervised by the President or his designate. Dr. William H. Dresher, Dean of the College of Mines, continued to serve as Director of the Bureau.

1985 - Colleges of Mines and Engineering merged to form the College of Engineering and Mines. Dr. R. A. Swalin, Dean of the college, is Director of the Bureau.

Arizona Geological Survey

ACCOMPLISHMENTS



I. RESEARCH AND DATA COLLECTION *

PUBLISHED:

Map showing outcrops of granitic rocks: Johnson, W. D., Jr., and **R. B. SCARBOROUGH**, 1984, U.S. Geological Survey Water-Resources Investigations Report 83-4114-D, 33 p. text, 1:500,000 scale maps, 2 sheets. Completed under contract with U. S. Geological Survey.

Map showing outcrops of pre-Quaternary basaltic rocks: W. D. Johnson, Jr. and **R. B. SCARBOROUGH**, 1984, U.S. Geological Survey Water-Resources Investigations Report 84-4114-G, 19 p. text, 1:500,000 scale maps, 2 sheets. Completed under contract with U. S. Geological Survey.

Map of outcrops of Laramide (Cretaceous-Tertiary) rocks in Arizona and adjacent regions: Stanley B. Keith, 1984, Arizona Bureau of Geology and Mineral Technology Map 19, 1:1,000,000 scale.

Index of mining properties in Cochise County, Arizona: Stanton B. Keith, 1973, reprinted 1985, Arizona Bureau of Geology and Mineral Technology Bulletin 187, 98 p.

Windows to the past: Fossils of the San Pedro Valley: E. H. Lindsay, Arizona Bureau of Geology and Mineral Technology, Fieldnotes, v. 14, no. 4, p. 1-4.

Reconnaissance analysis of possible Quaternary faulting in central Arizona: **P. A. PEARTHREE** and **R. B. SCARBOROUGH**, 1984, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-4, 27 p., 26 illus., 1:250,000 scale map. Completed under contract with U. S. Bureau of Reclamation.

Some Late Cenozoic basins and basin deposits of southern and western Arizona: **H. W. PEIRCE**, 1984, in Landscapes of Arizona, Lantham, MD, University Press of America, p. 207-227.

Geologic history of the South Mountains: **S. J. REYNOLDS**, Arizona Bureau of Geology and Mineral Technology, Fieldnotes, v. 15, no. 1, p. 1-3.

Geology of the South Mountains, central Arizona: **S. J. REYNOLDS**, Arizona Bureau of Geology and Mineral Technology Bulletin 195, 61 p.; geologic map, 1:24,000 scale.

A fluorite-bearing granite, Belmont Mountains, central Arizona: **S. J. REYNOLDS**, E. A. Scott, and R. T. O'Haire, 1985, Arizona Bureau of Geology and Mineral Technology, Fieldnotes, v. 15, no. 2, p. 3-5.

*Authors whose names are in bold print were employees of the Arizona Geological Survey during the fiscal year.

Preliminary geologic map of the Aguila Ridge - Bullard Peak area, eastern Harcuvar Mountains, west-central Arizona: **S. J. REYNOLDS** and **J. E. SPENCER**, 1984, Arizona Bureau of Geology and Mineral Technology Open-File Report 84-4, 1:24,000 scale, 2 sheets.

Evidence for large-scale transport on the Bullard detachment fault, west-central Arizona: **S. J. REYNOLDS**, and **J. E. SPENCER**, Geology, 1985, v. 13, no. 5, p. 353-356.

Reconnaissance geologic map of the Merritt Hills, southwestern Yavapai County, Arizona: **S. J. REYNOLDS**, and **J. E. SPENCER**, 1985, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-5, 1:24,000 scale.

Map of post-15-million-year volcanic outcrops in Arizona: **R. B. SCARBOROUGH**, 1985, Arizona Bureau of Geology and Mineral Technology Map 21, 1:1,000,000 scale.

Geologic cross sections of western Arizona Basin and Range: **R. B. SCARBOROUGH**, 1985, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-2, 10 p. text and 35 maps and cross sections, 1:250,000 scale. Completed under contract with U. S. Geological Survey.

Cenozoic erosion and sedimentation in Arizona: **R. B. SCARBOROUGH**, 1984, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-3, 61 p., 11 illus.

Index of published geologic maps of Arizona, November 1982--June 1984: **R. B. SCARBOROUGH**, and **T. G. McGARVIN**, Arizona Bureau of Geology and Mineral Technology Open-File Report 84-5, 1:1,000,000 scale.

Geometry of low-angle normal faults in west-central Arizona: **J. E. SPENCER**, 1984, Arizona Bureau of Geology and Mineral Technology, Fieldnotes, v. 14, no. 3, p. 6-8.

Geologic map of the Little Harquahala Mountains, west-central Arizona: **J. E. SPENCER**, S. M. Richard, and **S. J. REYNOLDS**; being prepared for release as open-file report by Arizona Bureau of Geology and Mineral Technology; 1:24,000 scale.

Reconnaissance geology of mineralized areas in parts of the Buckskin, Rawhide, McCracken, and northeast Harcuvar Mountains, western Arizona: **J. E. SPENCER** and **J. W. WELTY**, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-6, 31 p.

Geology and production of middle Tertiary mineral districts in Arizona: **J. W. WELTY**, **J. E. SPENCER**, **G. B. ALLEN**, **S. J. REYNOLDS**, and **R. A. TRAPP**, 1985, Arizona Bureau of Geology and Mineral Technology Open-File Report 85-1, 88 p.

A view of subsidence: C. C. Winikka, 1984, Arizona Bureau of Geology and Mineral Technology, Fieldnotes, 14, no. 3, p. 1-5.

RESEARCH SUMMARIZED IN TALKS TO PROFESSIONAL GROUPS:

Polyphase deformation history of Mesozoic metasedimentary rocks in western Arizona: S. E. Laubach, **S. J. REYNOLDS**, **J. E. SPENCER**, and S. Marshak; talk given at Annual Meeting of the Geological Society of America, Reno, Nevada, November 1984; abstract published in Geological Society of America Abstracts with Programs, v. 16, p. 570.

Industrial minerals and rocks of Arizona: **H. W. PEIRCE**; talk given at 21st Forum on Geology of Industrial Minerals, Tucson, April 1985.

Geologic evolution of Arizona - controls on the distribution of mineral deposits: **S. J. REYNOLDS**, and **H. W. PEIRCE**; talk presented at 21st Forum on Geology of Industrial Minerals, Tucson, April 1985.

Mesozoic thrust sheets of the Harquahala and Little Harquahala Mountains, western Arizona: S. M. Richard, **S. J. REYNOLDS**, and **J. E. SPENCER**; talk presented at Cordilleran Section of the Geological Society of America, Vancouver, British Columbia, April 1985; abstract published in Geological Society of America Abstracts with Programs, v. 17, p. 404.

Mid-Tertiary crustal extension in Arizona: **J. E. SPENCER**, and **S. J. REYNOLDS**; talk presented at Annual Meeting of Geological Society of America in Reno, Nevada, November 1984; abstract published in Geological Society of America Abstracts with Programs, v. 16, p. 664.

Extensional tectonics of the Kingman - Lake Mead area: **J. E. SPENCER**; talk presented on Arizona Geological Society field trip, Kingman, Arizona, November 1984.

Geology and industrial uses of Arizona's volcanic rocks: **J. W. WELTY** and **J. E. SPENCER**; talk given at 21st Forum on Geology of Industrial Minerals, Tucson, April 1985.

SUBMITTED FOR PUBLICATION:

Mineral and energy resources, in Studies of geology and hydrology in the Basin and Range Province, southwestern United States, for isolation of high-level radioactive waste; characterization of the Sonoran region, Arizona: B. T. Brady and **R. B. SCARBOROUGH**, in preparation, U. S. Geological Survey Open-File Report 84-741. Completed under contract with U. S. Geological Survey.

An ancestral Colorado Plateau edge - Fossil Creek Canyon: **H. W. PEIRCE**; submitted to Geological Society of America for inclusion in Centennial Field Guide, Rocky Mountain Section.

Geologic hazards in Arizona: T. L. Pewe, Geology Department, Arizona State University; being prepared for publication by Arizona Bureau of Geology and Mineral Technology as Special Paper 4.

Continental extension and magmatism in Arizona: **S. J. REYNOLDS** and **J. E. SPENCER**; abstract submitted to conveners of conference on heat and detachment in crustal extension on continents and planets; conference to be held in Sedona, Arizona, October 1985.

Structural evolution of the shear zones of the South Mountains (central Arizona) and Whipple Mountains (southwestern California): **S. J. REYNOLDS**, G. Davis, and G. Lister; submitted for publication in GEOLOGY.

Quaternary tectonism, in Studies of geology and hydrology in the Basin and Range Province, southwestern United States, for the isolation of high-level radioactive waste; characterization of the Sonoran region, Arizona: K. A. Sargent and **R. B. SCARBOROUGH**; in preparation, U. S. Geological Survey Open-File Report 84-741. Completed under contract with U. S. Geological Survey.

Geology, in Studies of geology and hydrology in the Basin and Range Province, southwestern United States, for the isolation of high-level radioactive waste; characterization of the Sonoran region, Arizona: **R. B. SCARBOROUGH**; in preparation, U. S. Geological Survey Open-File Report 84-741. Completed under contract with U. S. Geological Survey.

Map of mid-Tertiary (40-15 m.y.) volcanic, plutonic, and sedimentary rock outcrops in Arizona: **R. B. SCARBOROUGH**; in preparation, Arizona Bureau of Geology and Mineral Technology, 1:1,000,000 scale.

Map of Late Pliocene - Quaternary (post - 4 m.y.) faults, folds, and volcanism in Arizona: **R. B. SCARBOROUGH**, Christopher M. Menges, and **PHILIP A. PEARTHREE**; in preparation, Arizona Bureau of Geology and Mineral Technology, 1:1,000,000 scale.

Possible role of crustal flexure in the initial detachment of extensional allochthons: **J. E. SPENCER**; submitted to conveners of conference on heat and detachment in crustal extension on continents and planets; conference to be held in Sedona, Arizona, October 1985.

Mid-Tertiary ore deposits of Arizona: **J. E. SPENCER**, **J. W. WELTY**, and **G. B. ALLEN**; submitted to Arizona Geological Society for publication.

Mine index for metallic mineral districts in Arizona: **J. W. WELTY**, **S. J. REYNOLDS**, S. B. Keith, D. E. Gest, and E. DeWitt; being prepared for publication by the Arizona Bureau of Geology and Mineral Technology as Bulletin 196.

Ore grades for metallic mineral districts in Arizona: **J. W. WELTY**, **S. J. REYNOLDS**, **R. A. TRAPP**; being prepared for release as open-file report by Arizona Bureau of Geology and Mineral Technology.

Bibliography of geologic literature on metallic mineral districts in Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, Yavapai, and Yuma Counties, Arizona: **J. W. WELTY**, and L. Schnabel; being prepared for publication by the Arizona Bureau of Geology and Mineral Technology.

Theses and dissertations on Ariona geology, 1891-1978: P. S. Wright, **R. A. TRAPP**, **S. J. REYNOLDS**, **S. M. RICHARD**, AND **H. W. PEIRCE**.

IN ADVANCED STAGE OF COMPLETION:

Map of outcrops and ages of granitic rocks in Arizona: W. D. Johnson, **R. B. SCARBOROUGH**, and **S. J. REYNOLDS.** Project partially funded by U. S. Geological Survey.

Map of outcrops and ages of basaltic rocks in Arizona: W. D. Johnson, **R. B. SCARBOROUGH**, and **S. J. REYNOLDS.** Project partially funded by U. S. Geological Survey.

Application of Quaternary geology and geomorphology to seismic hazard evaluation, southeastern Arizona and adjacent portions of New Mexico and Sonora, Mexico: **P. A. PEARTHREE.** Alluvial processes in the arid Southwest: M. S. Pearthree and V. Baker.

Landslides in Arizona: **V. REALMUTO.** Project funded by U. S. Geological Survey.

Preliminary assessment of Quaternary faulting between Salt and Gila Rivers, Maricopa and Pinal Counties, Arizona: **R. B. SCARBOROUGH** and **P. A. PEARTHREE.** Project funded by U. S. Bureau of Reclamation.

Preliminary geologic map of the Mesa (1° X 2°) Quadrangle: **S. J. REYNOLDS**, 1:250,000 scale.

Preliminary geologic map of the Tucson (1° X 2°) Quadrangle: **S. J. REYNOLDS** and others, 1:250,000 scale. Project being done in cooperation with U. S. Geological Survey.

Oxygen and hydrogen isotopic study of mylonitization and detachment faulting, South Mountains: **S. J. REYNOLDS** and others.

Timing of mylonitization and detachment faulting in the South Mountains, central Arizona: **S. J. REYNOLDS** and E. DeWitt.

Compilation of K-Ar age determinations in Arizona: **S. J. REYNOLDS** and others.

Ductile-to-brittle evolution of the South Mountains shear zone, central Arizona: **S. J. REYNOLDS** and G. Lister.

Preliminary geologic map of Big Horn and Belmont Mountains, western Arizona: **S. J. REYNOLDS** and others, 1:24,000 scale.

Preliminary geologic map of the Granite Wash Mountains: **S. J. REYNOLDS, J. E. SPENCER**, and others, 1:24,000 scale

Reconnaissance geology of the crest of the Sierra Estrella: **J. E. SPENCER, S. J. REYNOLDS**, and others. Project completed in cooperation with the Gila River Indian Community.

II. INFORMATION, EDUCATION, AND SERVICE

INFORMATION PROVIDED

More than 3900 persons visited our office, telephoned, or wrote to ask questions, buy publications, use the library and rock sample repository, or talk with geologists. Sale of Bureau publications and open-file reports totalled $15,125.

Information was provided to representatives of industry, state and federal government agencies, earth science teachers and students, and to other members of the public. Much information was made available in Fieldnotes, the quarterly publication of the Bureau. Articles in Fieldnotes, in turn, triggered follow-up stories in newspapers, magazines, and on radio and television. In addition, talks on various aspects of Arizona's geology and mineral resources were given to interested groups upon request.

Some of the groups to whom we provided geologic data or assistance during the fiscal year are listed below.

State agencies and organizations:
Arizona Highways Magazine
Arizona State Parks Department
Arizona State University
Department of Education
Department of Health Services
Department of Mines and Mineral Resources
Department of Transportation
Department of Water Resources
Division of Emergency Services
Energy Office
Game and Fish Department
Governor's Office
Governor's Commission on Arizona Environment
Land Department, Minerals Section
Northern Arizona University
Oil and Gas Conservation Commission
Office of Arid-Lands Studies
Office of Economic Planning and Development
Radiation Regulatory Agency
Registrar of Contractors
Salt River Project

Federal Agencies:
Bureau of Indian Affairs
Bureau of Land Management
Bureau of Mines
Bureau of Reclamation
Forest Service
Geological Survey
Securities and Exchange Commission
Soil Conservation Service

News Media:

Arizona Daily Wildcat	KZKZ, Flagstaff
Arizona Republic	KAET, Phoenix
Tempe Daily News	KJZZ, Phoenix
Tucson Citizen	KOLD, Tucson
U. S. Water News	KUAT, Tucson

TALKS GIVEN (NON-TECHNICAL):

L. D. Fellows - Assessing Arizona's mineral potential: Arizona Propectors and Small-Mine Operators, Tucson; October 1984.

- State perspective on cooperative project with the U. S. Geological Survey (Geology and hydrology of the Basin and Range Province): U. S. Geological Survey - State Geological Surveys Western Region cluster Meeting, Fort Worden, Washington; November 1984.

- Assessing Arizona's mineral potential: Pinal Mountain Section American Institute of Mining Engineers, Miami, Az; January 1985.

- Assessing Arizona's mineral potential: Annual meeting of Arizona Prospectors and Small-Mine Operators, Congress Junction, Az; January 1985.

- Arizona's surficial environment: Knowing what's there: Panel member, Governor's Commission on Arizona Environment, Phoenix; February 1985.

- Assessing Arizona's mineral potential: Mesa Golddiggers, Mesa; March 1985.

- Application of Side-Looking Airborne Radar (SLAR) in Arizona: talk presented at a briefing organized by Senator Dennis DeConcini to announce the availability of SLAR in the Phoenix and Prescott Quadrangles, Phoenix; March 1985.

- The Arizona Geological Survey, an update: American Institute of Professional Geologists, Tucson; April 1985.

- Geologic mapping in the future: Panel member at annual meeting of Association of American State Geologists, June 1985.

H. W. Peirce - Floods of October 1983: Kiwanis Club, Tucson, September 1984.

- Arizona industrial minerals: Arizona Prospectors and Small-Mine Operators, Tucson; August 1984.

- Floods of October 1983: University of Michigan Alumni Club, Tucson; October 1984.

- Geologic framework of southern Arizona: talk to group of visiting mining industry officials from South Africa, Tucson; May 1985.

S. J. Reynolds- Geologic framework of Arizona: Arizona Prospectors and Small-Mine Operators, Tucson; July 1984.

J. E. Spencer - Geologic evolution of Arizona's metallic mineral resources: Arizona Prospectors and Small-Mine Operators, Tucson; September 1984.

T. G. McGarvin- Field trip on geology of Tucson area: Arizona Small-Mine Operators Association, December 1984.

FIELDNOTES

Fieldnotes is the quarterly news and information publication of the Bureau. Its purpose is to describe geology and mineral-technology items pertinent to Arizona, to announce new publications released by the Bureau and other groups, to announce meetings and fieldtrips, and to present other information of general interest.

Fall 1984 - Volume 14, Number 3 12 pages

A view of subsidence, Carl C. Winikka (Arizona Department of Transportation)
Geometry of low-angle normal faults in west-central Arizona, Jon E. Spencer.
What's in a name (Department of Mines and Mineral Resources and Bureau of Geology and Mineral Technology)
Mineral resources: an introductory guide.
Recent publications on the geology of Arizona
Bureau welcomes new Director

Winter 1984 - Volume 14, Number 4, 12 pages

Windows to the past: Fossils of the San Pedro Valley Everett H. Lindsay (Department of Geosciences, University of Arizona)
Arizona's metallic mineral districts: a wealth of information, John W. Welty
USGS Director visits Tucson

Spring 1985 - Volume 15, Number 1, 12 pages

Geologic history of the South Mountains, Stephen J. Reynolds
Cooperative geologic mapping, Larry D. Fellows
Mineral Technology Branch receives new Assistant Director
Recent publications on the geology of Arizona
Registration of geologists
Open-file reports published by Bureau in 1984
Computerzing Arizona geology, Stephen J. Reynolds
Theses and dissertations on Arizona geology, 1980-1984.

Summer 1984 - Volume 15, Number 2, 12 pages

The nonfuel mineral industry of the Southwest
A fluorite - bearing granite in the Belmont Mountains, central Arizona, Stephen J. Reynolds
Study of the Basin and Range Province completed, Larry D. Fellows
Wilderness Act update, Larry D. Fellows
Recent publication on the geology of Arizona
Bureau publications (new)

EDUCATIONAL ACTIVITIES

University students. Arizona Geological Survey geologists have regular opportunities to contribute to the educational experience of undergraduate and graduate students, primarily in the Department of Geosciences at the University of Arizona, but also at Arizona State University, Northern Arizona University, and at out-of-state universities.

During FY1984-85 Arizona Geological Survey geologists served on thesis committees of 12 graduate students and assisted 12 others by visiting their thesis field areas.

S. J. Reynolds was a co-leader of a raft trip through the Grand Canyon to observe geology exposed in the Canyon walls and side canyons accessible only by boat. The trip was sponsored by a geology graduate student group in the University of Arizona Department of Geosciences. Reynolds also served as advisor to the Society of Earth Science Students, University of Arizona, on a project that involved preparation of a set of Kodachome slides of metamorphic core complexes in Arizona and other western states. The club is selling the set as a fund-raising project.

Elementary and secondary school talks:

Indian Oasis 6th grade (Sells)
Tanque Verde 6th grade (Tucson)
Elvira 4th grade (2) "
St. Cyrls 7th-8th grade "
Smith 6th grade "
Fructhendler 6th grade "
Mesa Verde 6th grade "
Hughes 2nd grade "
Richardson 4th grade "
Miles 7th-8th grade (Tucson)
Vesey 3rd-4th grade (2) "
Henry 3rd-4th grade "
Harelson 6th grade "
Kino 4th-8th grade "
My Lords and Ladies Day Care K-6th "

All school talks were on Arizona's geology and rocks and were given by T. G. McGarvin

Workshops and field trips:

Geology session at Teacher workshop organized by Arizona Game and Fish Department, Aravaipa Canyon, July 1984; H. W. Peirce.

Geology session at Teacher's Outdoor Education Workshop sponsored by U. S. Forest Service, Tonto Creek area, June 1985; H. W. Peirce

Engineering workshop for women, minorities, and disadvantaged (high school), Tucson, July 1984; T. G. McGarvin

Engineering workshop for women, minorites, and disadvantaged (8th-9th grade), Tucson, June 1985; T. G. McGarvin. 2 sessions.

Fructhendler 6th grade, Camp Cooper, Tucson, October 1984; T. G. McGarvin

Corbett 6th grade (Tucson) at Camp Cooper, Tucson, October 1984; T. G. McGarvin.

Mission View 6th grade (Tucson) at Camp Cooper, Tucson, October 1984; T. G. McGarvin

Drexel 6th grade (Tucson) at Chiricahua Mountains, March 1985; T. G. McGarvin

Kellond 6th grade (Tucson) at Peppersauce Campground near Oracle, May 1985; T. G. McGarvin

Tanque Verde 6th grade (Tucson) at Triangle Y Camp near Oracle, May 1985; T. G. McGarvin

Nanini Library - "Great Escapes," summer program of the Tucson Public Libraries, June 1985; T. G. McGarvin

Other Activities

H. W. Peirce prepared chapter entitled "Things Geologic" in Arizona State Department of Education Teacher's Guide to Environmental Education.

SERVICE ACTIVITIES

L. D. Fellows

- American Institute of Professional Geologists (National): external appointments committee member
- American Institute of Mining Engineers, Arizona Section: board member at large
- Arizona Mapping Advisory Committee: member
- Association of American State Geologists: statistician; COGEOMAP committee; cluster meeting committee
- Forum on Geology of Industrial Minerals, Tucson, April 1985: chaired 1/2-day technical session
- Governor's Commission on Arizona Environment: land committee
- National Strategic Materials and Minerals Policy Advisory Committee, subcommittee to evaluate effectiveness of mineral assessments made by the U. S. Geological Survey and the U. S. Bureau of Mines: Reno, April 1985.

H. W. Peirce

- Arizona State Parks Department: Natural Areas Advisory Committee
- Hosted 21st Annual Forum on Geology of Industrial Minerals in Tucson, April 9-12, 1985; Forum was attended by 150 registrants from 28 states and Canada; 23 papers on geology and industrial minerals in Arizona and adjacent states were presented and 5 field trips were organized. Also prepared "abstracts with program."

S. J. Reynolds

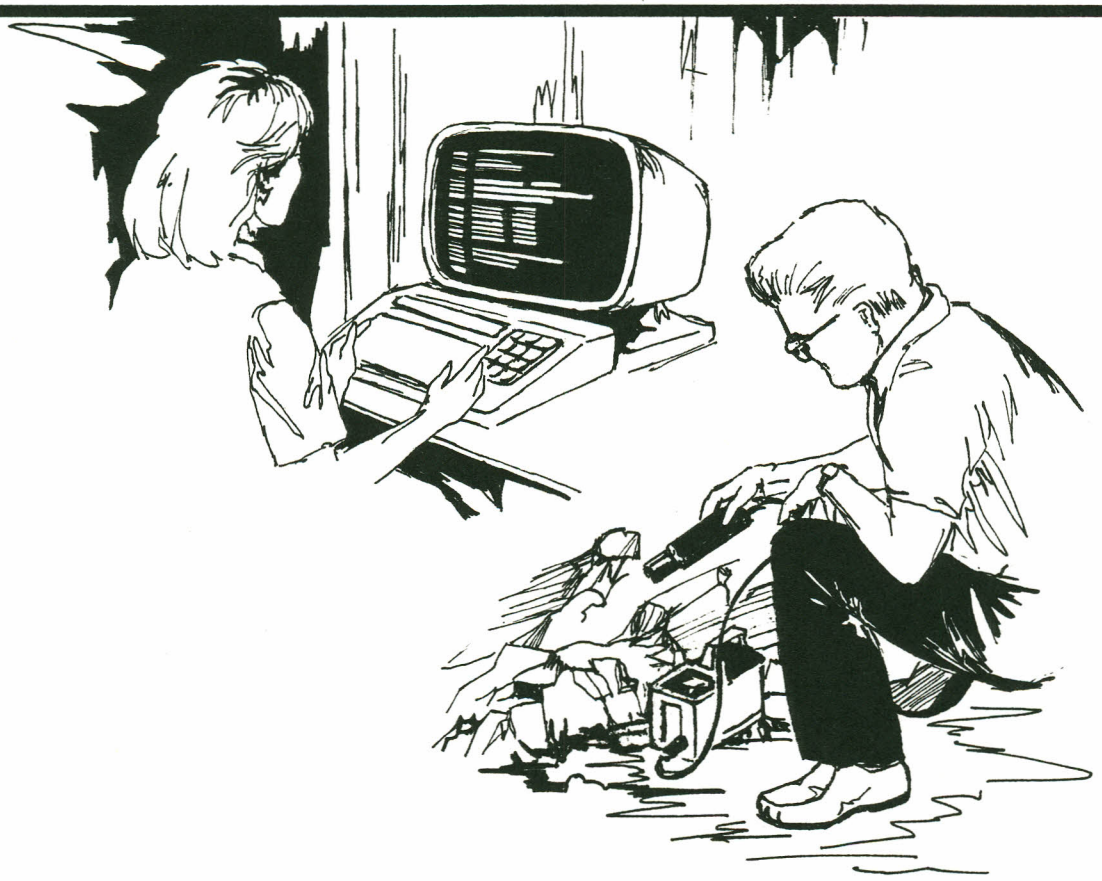
- Arizona Geological Society: publications committee; program committee member for March 1986 symposium on "Frontiers of the geology and ore deposits of Arizona and the Southwest"; co-editor of book (in preparation) on geology of Arizona.
- Geological Society of America: reviewer of articles for Geology.

J. E. Spencer

- Arizona Geological Society: field trip committee for March 1986 symposium on "Frontiers of the geology and ore deposits of Arizona and the Southwest."

Arizona Geological Survey

PERSONNEL



GEOLOGICAL SURVEY BRANCH EMPLOYEES

FY1984-85

FULL-TIME, STATE-FUNDED EMPLOYEES, JUNE 30, 1985

Professional Staff:

Larry D. Fellows, State Geologist and Assistant Director
H. Wesley Peirce, Principal Geologist
Stephen J. Reynolds, Assistant Research Geologist
Jon E. Spencer, Assistant Research Geologist

Support Staff:

Joseph R. LaVoie, Research Equipment Technician
Thomas G. McGarvin, Research Assistant - Librarian
Joy E. Mehulka, Graphic Artist III
Michael Settle, Administrative Assistant I
Evelyn M. VandenDolder, Associate Editor
Vacant, Secretary II

PART-TIME, TEMPORARY, STUDENT, AND OTHER EMPLOYEES, FY1984-85

Arlene V. Anderson, Graduate Research Assistant (F)
George B. Allen, Graduate Research Assistant (F)
Richard C. Capps, Research Assistant II (F)
Elaine M. Falls, Secretary II
Martin D. Favero, Student Laboratory Assistant
Frank P. Florence, Student Laboratory Assistant
Karen A. Hohe, Student Clerical Assistant
Curtis P. Kortemeier, Research Assistant II (F)
Kenneth Matesich, Graphic Artist III
Philip A. Pearthree, Graduate Research Assistant (F)
Jeffrey W. Prellberg, Student Laboratory Assistant
Vincent J. Realmuto, Graduate Research Assistant (F)
Amy S. Ruf, Student Clerical Assistant
Robert B. Scarborough, Assistant Geologist (F)
Jonathan D. Shenk, Student Library Assistant
James A. Stimac, Research Assistant II (F)
Richard A. Trapp, Graduate Research Assistant (F)
John W. Welty, Graduate Research Assistant (F)

(F) Funded at least partially by federal contracts

GEOLOGICAL STAFF AND SPECIALTY AREAS

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

- general geology of Arizona
- geologic hazards and limitations

THOMAS G. MCGARVIN, Research Assistant - Librarian; B.A., California Lutheran College.

- general geology of Arizona
- availability of maps and reports on Arizona geology
- assistance to earth science teachers
- talks to earth science classes
- assistance in use of library
- assistance in use of cuttings and core repository

H. WESLEY PEIRCE, Principal Geologist; B.S., University of Montana; M.S., Indiana University; Ph.D., University of Arizona.

- general geology of Arizona
- impact of "things geologic"
- industrial minerals: salt, gypsum, limestones, etc.
- energy materials: petroleum and coal
- subsurface geology: Plateau and Cenozoic basins
- physiography: development, subdivision; Mogollon Escarpment
- Pennsylvanian-Permian stratigraphy: Plateau and Transition Zone

STEPHEN J. REYNOLDS, Research Geologist; B.S., University of Texas at El Paso; M.S., University of Arizona; Ph.D., University of Arizona.

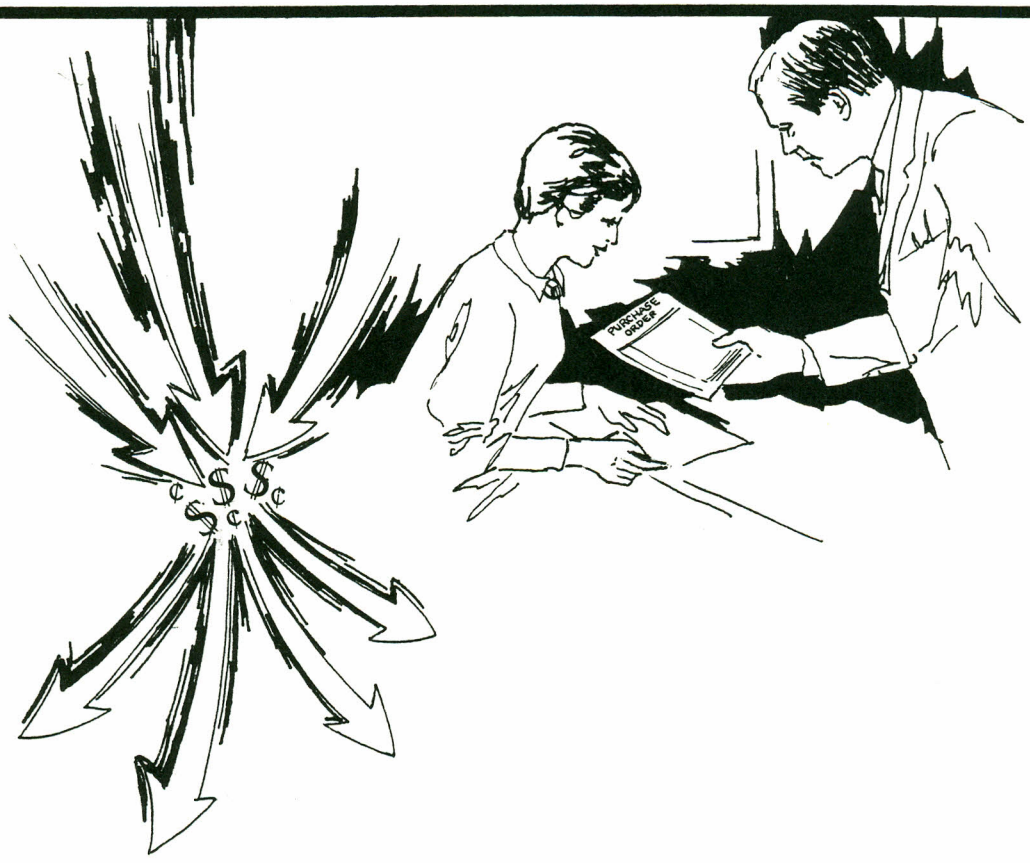
- general geology of Arizona
- state geologic mapping project
- structural geology; analysis of rock fabric and fault movement Basin and Range province
- base metals (copper, molybdeum, lead, zinc, etc.)
- geochemistry of granites
- computer applications

JON E. SPENCER, Research Geologist; B.S., University of California, Santa Cruz; Ph.D., Massachusetts Institute of Technology.

- general geology of Arizona
- Basin and Range province
- structural geology
- geologic mapping
- geology of Tertiary rocks
- precious metals (gold, silver)
- geochronology
- geophysics
- mathematical modeling

Arizona Geological Survey

BUDGET



STATE APPROPRIATION AND EXPENDITURES

ARIZONA BUREAU OF GEOLOGY AND MINERAL TECHNOLOGY (1)

UNIT	FY1983-84		FY1984-85		FY1985-86
	Budgeted	Spent(3)	Budgeted	Spent(4)	Budgeted(5)
ADMINISTRATION	$ 42,860	$ 41,860	$ 37,245	$ 30,554	$ 60,492
FTE(2)	1.390		1.190		1.183
GEOLOGICAL SURVEY					
Personal Service	241,528	242,528	245,702	266,780	262,775
Operations	25,000	29,000	25,000	26,846	25,000
In-state travel	7,200	7,400	5,400	6,241	5,900
Out-of-state travel	1,150	1,150	750	663	750
Equipment	11,200	11,200	7,900	6,508	0
TOTAL	286,078	291,278	284,752	307,038	294,425
FTE	9.094		9.094		9.114
MINERAL TECHNOLOGY	164,992	160,792	175,799	175,133	181,953
FTE	4.000		4.000		4.000
TOTAL	$493,930	$493,930	$497,796	$513,915	$536,870
FTE	14.484		14.284		14.297

(1) Bureau of Geology and Mineral Technology is included in "Organized Research" appropriation to the University of Arizona.

(2) Full-time equivalent employees

(3) Estimated - specified amounts were not given to each branch

(4) Reflects salary increases awarded January 1, 1985.

(5) Capital equipment included in ADMINISTRATION

ESTIMATED COST PER RESPONSIBILITY

I. RESEARCH AND DATA COLLECTION TASKS:

- geologic field work
- library research
- map preparation
- report writing
- develop data base
- talks to professional groups
- drafting, editing, layout, etc.
- bidding process
- contract administration
- review technical manuscripts

II. INFORMATION, EDUCATION, AND SERVICE TASKS:

- answer inquiries
- assist office visitors
- provide information to other agencies
- talks to public groups, schools, etc.
- publish Fieldnotes
- assist graduate students
- review environmental statements
- review manuscripts
- serve on committees
- write, edit, draft non-technical reports

ESTIMATED COSTS - FY 1984-85

CATEGORY	I. Research and Data Collection		II. Information, Education, Service		BUDGET
	Est. Time Spent	Est. Expen-diture	Est. Time Spent	Est. Expen-diture	
Personal Service	66.6%	$177,702	33.4%	$89,078	$266,780
Operations	66.6	17,879	33.4%	8,967	26,846
In-state travel	80	4,993	20	1,243	6,241
Out-of-state travel	100	663	0	0	663
Equipment	100	6,508	0	0	6,508
TOTAL		$207,745		$99,293	$307,038

CONTRACTED PROJECTS
FY1984-85

Geologic mapping in Phoenix Quadrangle (1° x 2°). Project funded on a cost-sharing basis with the U. S. Geological Survey as part of their Cooperative Geologic Map Program (COGEOMAP) with state geological surveys. U. S. Bureau of Land Management provided 1,100 color air photographs, valued at $5,500, to assist in the project.

Principal Investigator: S. J. Reynolds and L. D. Fellows

Amount (from U.S.G.S.): $45,685

Review maps showing availability of Federal land for mineral exploration. Project done under contract with U. S. Bureau of Mines. Unpublished information on uranium mineral occurrences provided.

Principal Investigator: L. D. Fellows

Amount: $3,000

Locations and timing of late Quaternary faulting in central Arizona. Photo analysis, field examination, and mapping of faults between Salt and Gila Rivers in Maricopa and Pinal Counties. Done under contract with U. S. Bureau of Reclamation.

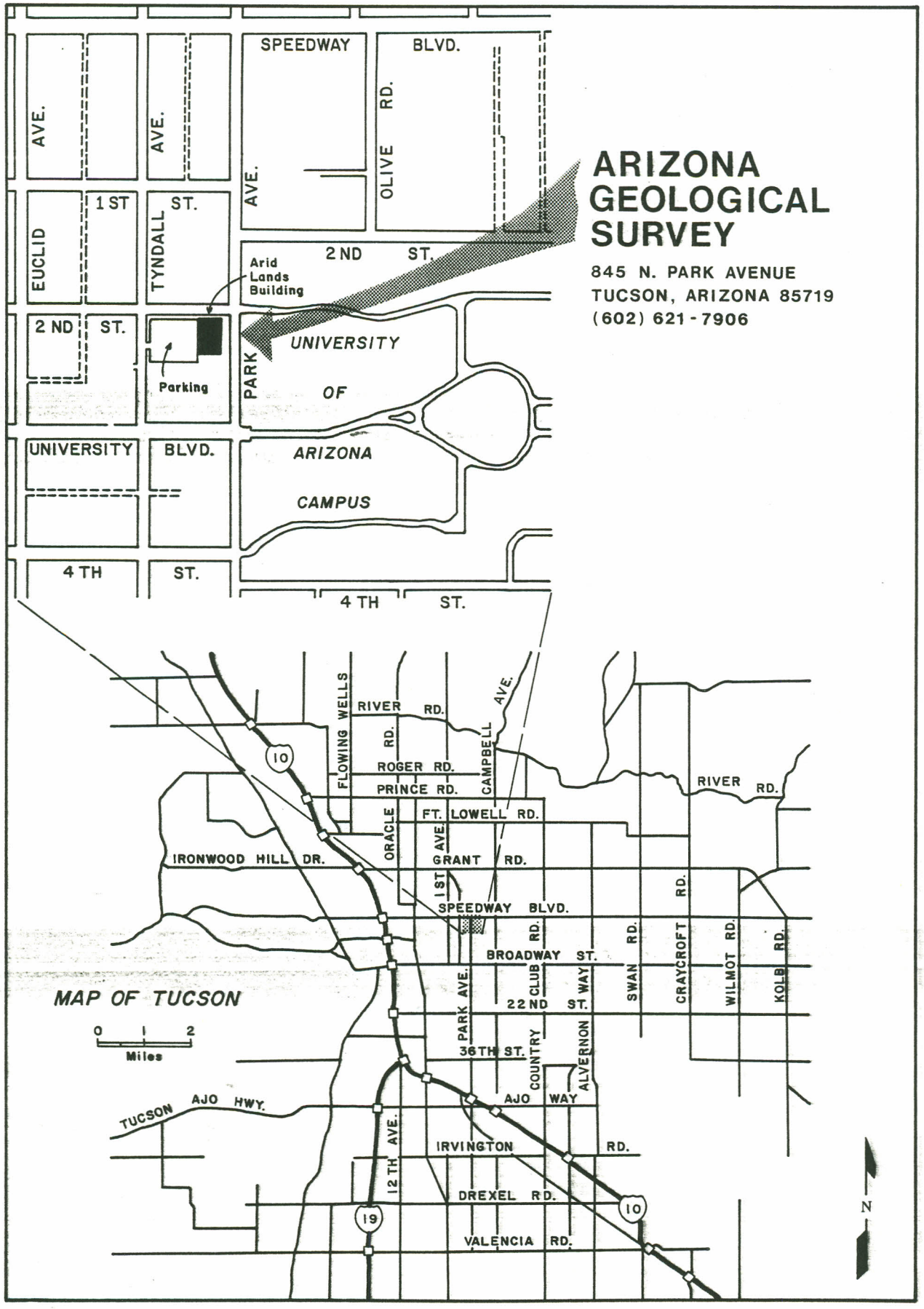
Principal Investigator: L. D. Fellows and R. B. Scarborough

Amount: $4,695

Landslides in Arizona. Statewide compilation of historic landslide and rockfall events, with specific information about each event. Funded by U. S. Geological Survey with substantial assistance provided by Arizona Department of Transportation.

Principal Investigator: L. D. Fellows and V. H. Realmuto

Amount: $4,628


ARIZONA GEOLOGICAL SURVEY
845 N. PARK AVENUE
TUCSON, ARIZONA 85719
(602) 621-7906
SPEEDWAY BLVD.
OLIVE RD.
AVE.
EUCLID AVE.
1 ST ST.
TYNDALL AVE.
2 ND ST.
Arid Lands Building
2 ND ST.
Parking
PARK
UNIVERSITY OF ARIZONA CAMPUS
UNIVERSITY BLVD.
4 TH ST.
4 TH ST.
MAP OF TUCSON
0 1 2
Miles
FLOWING WELLS RD.
RIVER RD.
ROGER RD.
PRINCE RD.
CAMPBELL AVE.
ORACLE
FT. LOWELL RD.
1 ST AVE.
IRONWOOD HILL DR.
GRANT RD.
SPEEDWAY BLVD.
BROADWAY ST.
PARK AVE.
CLUB RD.
22 ND ST.
36TH ST.
COUNTRY CLUB RD.
ALVERNON WAY
SWAN RD.
CRAYCROFT RD.
WILMOT RD.
KOLB RD.
RIVER RD.
TUCSON AJO HWY.
AJO WAY
12 TH AVE.
IRVINGTON RD.
DREXEL RD.
VALENCIA RD.
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