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Arizona Geology

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ARIZONA GEOLOGICAL SURVEY
Information to Arizonans since 1889

MISSION

To provide unbiased information to the public to enhance understanding of Arizona's geologic framework and support prudent management and use of land, water, mineral, and energy resources.

FUNCTIONS

- *Provide information about Arizona geology*
- *Map and describe bedrock and surficial geology*
- *Map and characterize mineral and energy resources*
- *Investigate geologic hazards and limitations*
- *Prepare and publish geologic maps and reports*
- *Maintain databases and files*
- *Maintain geology library*
- *Maintain rock cuttings and core repository*
- *Provide administrative and staff support for the Oil and Gas Conservation Commission*

A.R.S. § 27-152

Mapping Arizona Geology

Jon E. Spencer
Research Geologist
Arizona Geological Survey

Geologic mapping is one of the most important tasks of the Arizona Geological Survey (AZGS). Since 1984 we've used more than $1 million from our General Fund appropriation and have been awarded an additional $1 million from the U.S. Geological Survey (USGS) to make geologic maps. During that time, AZGS geologists completed nearly 100 mapping projects and released the maps for use by the public.

The AZGS was awarded $151,036 from the STATEMAP component of the National Geological Mapping Program, administered by the USGS, to support our mapping projects this year. The AZGS will also spend an equal amount of State dollars on these projects. Priorities for new mapping are recommended by the Arizona Geologic Mapping Advisory Committee in accordance with STATEMAP guidelines. The 26-member Committee represents the environmental and engineering geology community, mineral explorationists, Arizona universities, and Federal and State land- and resource-management agencies.

The AZGS gives high priority to the preparation of detailed geologic maps in areas that are experiencing or have potential for urban development. The most obvious of these areas in Arizona is the Phoenix-Tucson corridor, which contains about 10 percent of Arizona's land but 80 percent of its population (Figure 1). Mapping this field season will be directed at bedrock northeast of Phoenix and surficial deposits near Casa Grande (Figure 2). Maps will be prepared at 1:24,000 scale and released to the public. In 1996, 13 geologic maps were completed. Because of increasing demand for digital geologic maps, the AZGS began production in 1996 and released four 1:100,000-scale digital geologic maps in 1997.

Basic geologic maps are important because they depict the geologic framework and can be used to identify potential water, mineral, and energy resources and geologic hazards. Land and resource managers use the maps to help them make *informed* decisions. The following types of important information can be obtained

see MAPPING ARIZONA, page 2

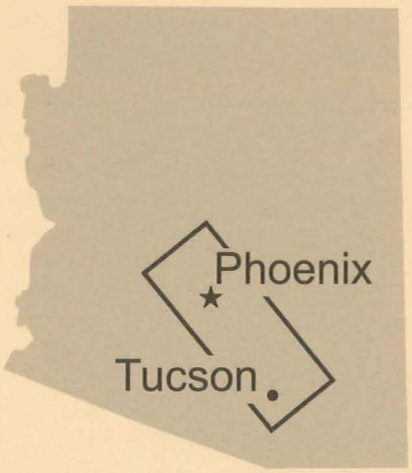

Figure 1. *The Arizona Geological Survey, with partial funding from the National Geologic Mapping Program, is preparing new geologic maps in the Phoenix-Tucson Corridor, shown above.*

Mapping Arizona *(continued from page 1)*

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JANE DEE HULL

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Arizona **Geology**

is published quarterly by the Arizona Geological Survey (AZGS) to provide information about geologic materials and processes and their impacts on the development and use of Arizona's land, water, mineral and energy resources. We encourage your comments and suggestions.

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Peter F. Corrao

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from geologic maps: 1. *Land subsidence and earth fissures.* When ground water is pumped faster than natural recharge occurs the land eventually subsides and large cracks (earth fissures) form. Subsidence may damage structures; earth fissures may provide a direct pathway for surface contaminants to reach groundwater aquifers. This has already happened in large portions of central and southeastern Arizona and continues to be a problem that must be considered. Some of the known subsidence and earth-fissure areas are currently used for agricultural purposes, but will be subdivided or otherwise developed within 5-20 years. Knowledge of where these areas are is essential for those who site, construct, or maintain subdivisions, waste disposal facilities, buildings, highways, canals (Figure 3), and other structures. 2. *Flood-prone areas.* In some parts of Arizona developers must address the potential for alluvial-fan flooding on piedmonts surrounding mountain ranges. The distribution of young surficial deposits on piedmonts, which is shown on detailed surficial geologic maps, may be used as a guide to delineate areas that may be prone to alluvial-fan flooding. 3. *Sand and gravel resources.* Construction of homes, commercial buildings, highways, city streets, and many other types of structures associated with urban development requires a supply of sand and gravel resources near the developing areas. Geologic maps can be used to help locate such resources. 4. *Potentially active faults.* Detailed mapping of young faults provides information about the length of the

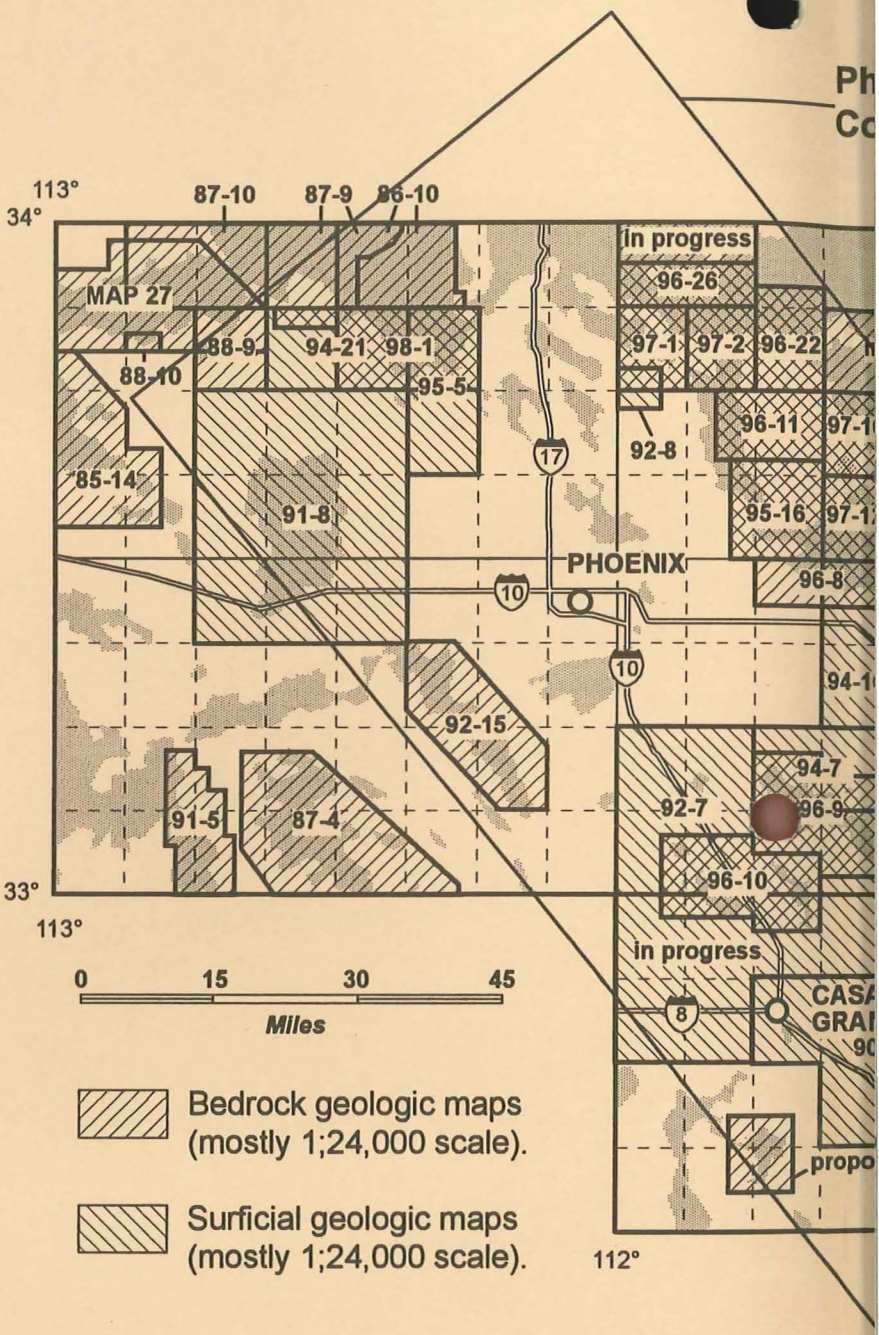
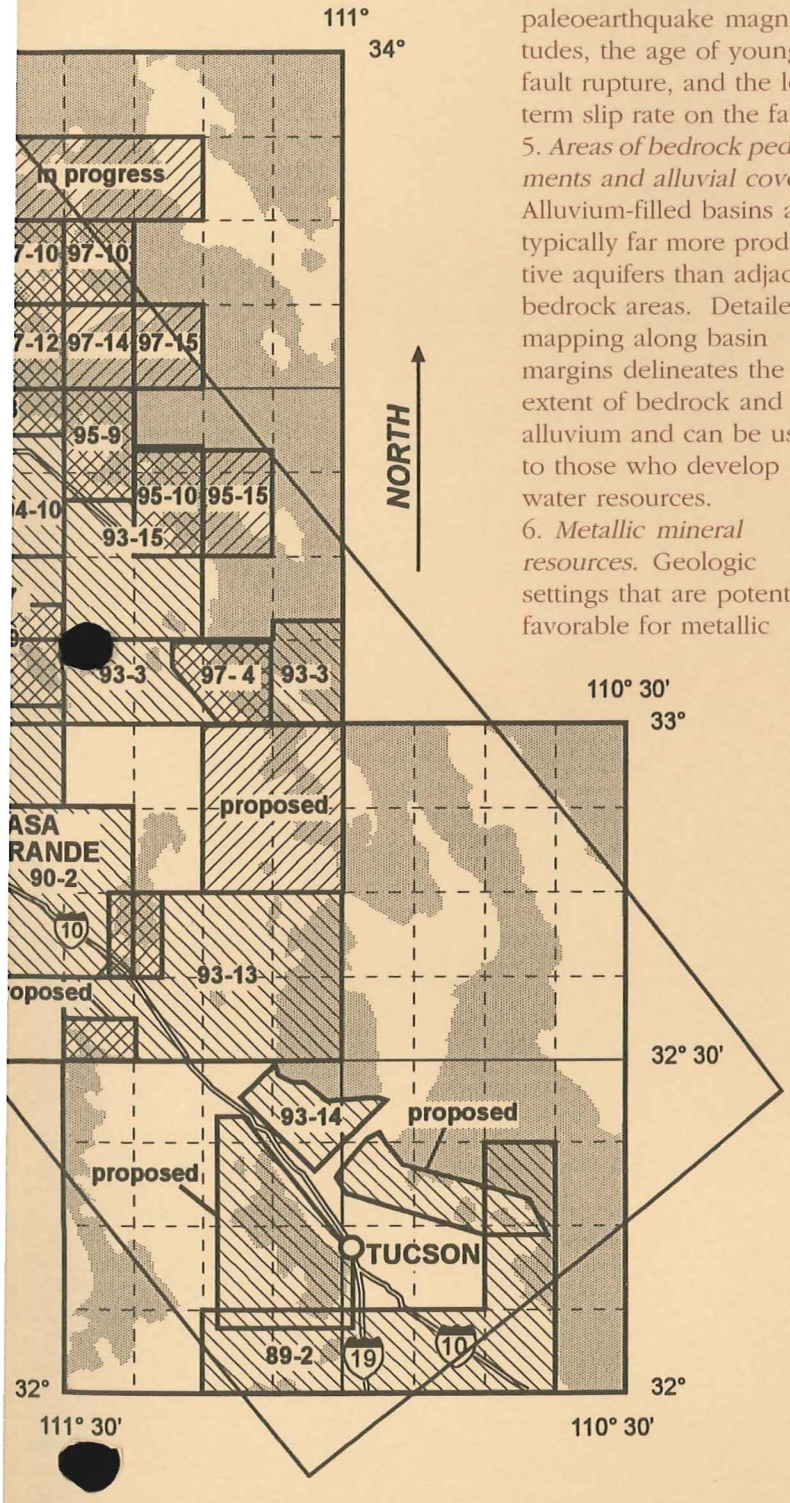


Figure 2. *Geologic maps recently completed by the Arizona Geological Survey. (The number 96-6 refers to Arizona Geological Survey Open-File Report 96-6.)*

Phoenix-Tucson Corridor



fault zone, which Quaternary units are faulted, and how much the faulted units have been displaced. These data are used to estimate paleoearthquake magnitudes, the age of youngest fault rupture, and the long-term slip rate on the fault.

5. *Areas of bedrock pediments and alluvial cover.* Alluvium-filled basins are typically far more productive aquifers than adjacent bedrock areas. Detailed mapping along basin margins delineates the extent of bedrock and alluvium and can be useful to those who develop water resources.

6. *Metallic mineral resources.* Geologic settings that are potentially favorable for metallic mineral resources can be interpreted from geologic maps. Exploration target areas can then be defined and, ultimately, exploration programs developed.

7. *Uranium in rock and soil.* Homes and other buildings built on rock or soil that has elevated concentrations of uranium have an increased potential for accumulation of indoor radon gas. Radon-resistant construction is far less expensive if incorporated into building design, rather than retrofitting after construction. Geologic maps show the distribution of rock formations present at the land surface. These units can be tested to determine their uranium content.

Detailed geologic maps have not been made in all parts of Arizona. Many maps have been completed, and are available for examination and interpretation. We can tell you which areas have been mapped and we have many of the maps in our library. Call us.

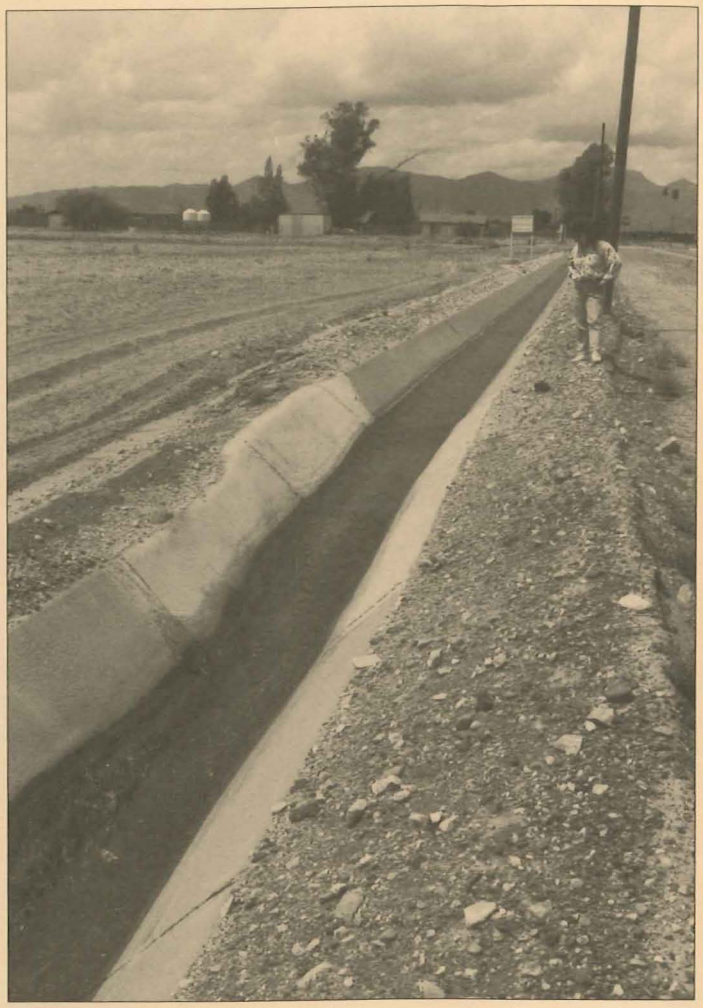


Figure 3. *Uneven land subsidence causes irrigation canals, such as the one shown above, to crack and become offset. New concrete used to repair the cracks is lighter in color than the original.*

New Publications

Geology of the Fortuna mine, Yuma County, Arizona: S. M. Richard, C. A. Ferguson, and S. J. Skotnicki, 1997, Arizona Geological Survey Open-File Report 97-16 (Pub. number OFR 97-16), 14 p. $3.00

The Fortuna mine is on the west side of the Gila Mountains within the Barry M. Goldwater Gunnery Range. The geology of the area is poorly known. About 125,000 ounces of gold have been produced from the mine, mostly from 1897-1904. Two types of gneiss crop out at the mine, but the age of the protolith and the timing of metamorphism are not well understood. The gneiss has been intruded by north- to northeast-trending pegmatite dikes. Previous workers reported that the dikes are intimately associated with gold-bearing quartz veins. The age and style of mineralization are not well understood.

Surficial geologic map of the Theodore Roosevelt Lake 30' x 60' Quadrangle, Arizona: P. A. Pearthree, S. J. Skotnicki, and K. A. Demsey, 1997, Arizona Geological Survey Open-File Report 97-17 (Pub. number OFR 97-17), 1:100,000 scale. $5.00

Compiled from 17 larger scale maps, this map includes the northeastern portion of the Phoenix metropolitan area. The quadrangle straddles the boundary between the Basin and Range physiographic province and the Transition Zone. The northern, central, and eastern parts of the map, within the Transition Zone, are rugged and have been deeply dissected. The southwestern part has low mountains and minimally dissected valleys. Alluvial deposits of the Salt and Verde rivers, which traverse the quadrangle, provide hints about the nature of regional landscape evolution. A substantial part of the map area is covered by Quaternary and Tertiary surficial deposits. Surficial deposits were differentiated on the basis of their position in the regional landscape and their ages.

Geologic map of the Santa Maria Mountains volcanic field, Yavapai County, Arizona: N. A. Ash, 1997, Arizona Geological Survey Contributed Map 97-B (Pub. number CM 97-B), scale 1:24,000. $3.50

Precambrian granitic rocks crop out extensively. Erosional remnants of Paleozoic sedimentary units and Tertiary trachyte, dacite, basalt, and related units are scattered throughout the map area.

The geology, leasing, and production history of the Sunnyside uranium-vanadium mine, Apache County, Arizona: W. L. Chenoweth, 1997, Arizona Geological Survey Contributed Report 97-C (Pub. number CR 97-C), 11 p. $2.00

This mine, located on the Navajo Indian Reservation, is on the east rim of Sunnyside mesa nine mi southeast of the settlement of Immanuel Mission in the western Carrizo Mountains. The ore body is in channel sandstone in the Salt Wash Member of the Morrison Formation (Jurassic). About 500 tons of uranium-vanadium ore were produced.

The geology, leasing, and production history of the Syracuse (R F and R) uranium-vanadium mine, Apache County, Arizona: W. L. Chenoweth, 1997, Arizona Geological Survey Contributed Report 97-D (Pub. number CR 97-D), 14 p. $2.25

Located on the Navajo Indian Reservation 1 1/4 mi north of the settlement of Oak Springs, this mine is in channel sandstones in the Salt Wash Member of the Morrison Formation (Jurassic). About 2,500 tons of uranium-vanadium ore were produced.

GEODAZE 1998

The 26th Annual GeoDaze Geoscience Symposium will be held at the University of Arizona March 26-27, 1998. This two-day event enables students to present original research and gain feedback from attendees. Information sources:
E-mail:
geodaze@geo.arizona.edu
web site:
http:/www.geo.arizona.edugeodaze/98/

How to Order Them

You may purchase publications at the AZGS office or by mail. Address mail orders to AZGS Publications, 416 W. Congress St., Suite 100, Tucson, AZ 85701. Orders are shipped by UPS, which requires a street address for delivery. All mail orders must be prepaid by a check or money order payable in U.S. dollars to the Arizona Geological Survey or by Master Card or VISA. Do not send cash. Add 7% sales tax to the publication cost for orders purchased or mailed in Arizona. Order by publication number and add these shipping and handling charges to your total order:

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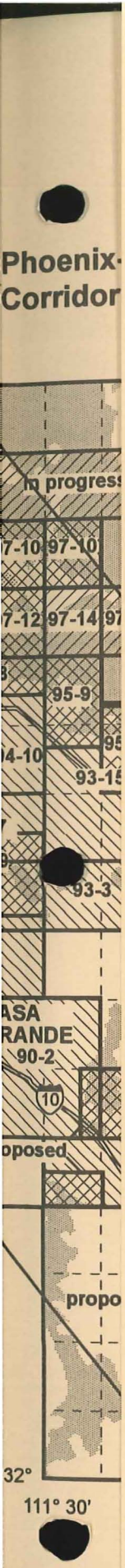
Over 100.00,	add 12%

Other countries, request price quotation.

Shipping and handling charges include insurance. For rolled maps, add $1.00 for a mailing tube.

If you purchase Open-File Reports, Contributed Maps, or Contributed Reports at the AZGS office, allow up to two days for photocopying.



Seismic Policy Recommendations

The Western States Seismic Policy Council (WSSPC) was established to provide a forum to advance earthquake-hazard-reduction programs throughout the Western Region and to develop, recommend, and present seismic policies and programs through information exchange, research, and education. WSSPC is managed by a 7-member Board of Directors composed of the directors of three state emergency-management agencies, three state geologists, and one at-large member who can be either. Steven Ganz is Executive Director of WSSPC, offices of which are in San Francisco.

At the WSSPC annual business meeting November 7, 1997, members adopted the following policy recommendations:

WSSSPC PR97-1: Active Fault Definition Categories for the Basin and Range Province
WSSPC recommends that the following guidelines be used in defining active faults in the Basin and Range physiographic province. Active faults can be categorized as follows, recognizing that all degrees of fault activity exist and that it is the prerogative of the user to decide the degree of anticipated risk and what degree of fault activity is considered "dangerous":

1. Holocene Active Fault - a fault that has moved within the last 10,000 years.
2. Late Quaternary Active Fault - a fault that has moved within the last 130,000 years.
3. Quaternary Active Fault - a fault that has moved within the last 1,600,000 years.

It should be emphasized that more than half of the historic magnitude 6.5 or greater earthquakes in the Basin and Range province have occurred on faults that did not have Holocene activity and, furthermore, that earthquakes in the province will occur on faults in all three categories.

WSSPC PR97-2: Developing Guidelines for Fault-Trace Setbacks
WSSPC encourages individual state workshops to develop guidelines for local jurisdictions to establish consistent criteria for setbacks from surface traces of one or more categories of active faults, such as those defined in WSSPC PR-1. In several western states, policy for the regulation of setbacks from active surface fault traces is established at the local level. WSSPC encourages individual jurisdictions that are traversed by the same active fault to have consistent setback requirements. Note that setbacks deal with surface fault ruptures from earthquakes, but do not address the broader, more significant hazards of ground shaking and other effects, such as ground-motion amplification, liquefaction, rockfalls, and landslides.

WSSPC PR97-3: Development of National Earthquake Hazard Risk Mitigation Priorities
WSSPC proposes to take the initiative to coordinate a process with the federal National Earthquake Hazard Reduction Program agencies and regional earthquake consortia to establish national earthquake-hazard-risk-mitigation priorities. This may be accomplished by WSSPC facilitating dialog among the states and presentation of consensus to the federal government.

WSSPC PR97-4: Seismic Monitoring Networks
Because seismic-monitoring networks are vital for earthquake-hazard characterization and because there is an insufficiency in available data, WSSPC advocates the continuation and expansion of seismic-monitoring networks, including strong-motion instrumentation, by support from state and federal agencies. WSSPC further recommends that existing networks be interconnected by compatible hardware and software.

For more information contact Larry D. Fellows at the Arizona Geological Survey. Fellows is the at-large member of the WSSPC Board.

1998 TUCSON GEM AND MINERAL SHOW

The 44th Annual Tucson Gem & Mineral Show will be held at the Convention Center in downtown Tucson February 12-15, 1998. The 1998 show features are Fluorite and Alpine minerals.

The Tucson Gem and Mineral Society sponsors this event, which has become the most prestigious mineral show in the world. Many of the prominent mineral museums in the world will be represented. Several major mineralogical groups hold their annual meetings in conjunction with the show. More than 200 dealers will be at the Convention Center. Many others will be at satellite shows in local hotels and motels. Each year 30-40,000 people attend the Show at the Convention Center. Richard A. Trapp, an Arizona Geological Survey geologist, is chairman of the show committee.

Please stop at the AZGS booth or visit our office on Congress Street, just a short walk northwest of the Convention Center.

1998 HIGHWAY GEOLOGY SYMPOSIUM

Call for papers. The 49th Annual Highway Geology Symposium will be held in Prescott September 10-14, 1998. The Arizona Department of Transportation, Arizona Geological Survey, and Geology Department at Northern Arizona University are the symposium cosponsors. Two all-day technical sessions and one all-day highway geology fieldtrip are scheduled. An optional trip to the Grand Canyon will be available September 14. A number of businesses will have booths or exhibits.

Papers are invited on subjects concerning highway-related geological problems and geotechnical solutions. Topics of interest include engineering geology, landslide remedial measures, slope stability, rock mechanics, karst, retaining walls, bridge foundations, and construction problems. If you are interested in presenting a paper at the meeting, please submit a 250-500 word abstract no later than January 30, 1998. Abstracts may be submitted by U.S.P.S. or by e-mail to:

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Those whose papers are accepted will be notified by March 15, 1998. A camera-ready copy of accepted papers must be received by June 1, 1998, to be included in the proceedings.

Symposium organization. The Highway Geology Symposium was organized in 1950 to foster a better understanding and closer cooperation between geologists and civil engineers in the highway industry. Since 1962 Symposia have been hosted in alternate years by western and eastern states. The Highway Geology Symposium has no central headquarters, annual dues, or formal membership requirements. The governing body is a steering committee composed of about 20 engineering geologists and geotechnical engineers from state and federal agencies, universities, private-sector companies and consulting firms throughout the country.

For more information about the 1998 Symposium, contact Nick Prizner at the Arizona Department of Transportation, Tel (602) 255-8089.

AIPG MEETING

The Arizona Section of the American Institute of Professional Geologists (AIPG) will meet at the AZGS office February 14 (Saturday) at 10 a.m. Steve Testa, National AIPG president for 1998, will be the featured speaker. Visitors are welcome.

February 12, the AIPG and the Tucson Gem and Mineral Society will co-sponsor a public talk by a NASA representative, who will bring a sample of the Allen Hills meteorite from Mars (84-001) that some scientists believe contains evidence of life. A prototype of the Rover, which many of us saw on live TV when it landed on Mars last July 4, will be on display. The Rover was constructed at the University of Arizona.

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