



Vol. 28, No. 1
Spring 1998

Arizona Geology

Published Quarterly by the Arizona Geological Survey

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 to 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

Nora's Tears Cause Landowner Fears

E. F. Corkhill,
Maurice A. Tatlow,
Kim R. Mitchell, and
L. A. Ramsey
*Arizona Department of
Water Resources*

Hurricane Nora breezed through Yuma and western Arizona in September 1997 dropping 2½ inches of rain in 4 to 5 hours. An unexpected result was that a 4,400-foot-long earth fissure opened in the Harquahala Plain about 70 miles west of Phoenix. After the storm, Al Rogers, a long-time area resident, discovered a 5-foot-deep, 10-foot-wide gully crossing the dirt road over which he drove several times every week before the storm.

Earth fissures of this type develop in areas where pumping has caused ground-water levels to be lowered, dewatered layers to compact, and, commonly, the land surface to subside.

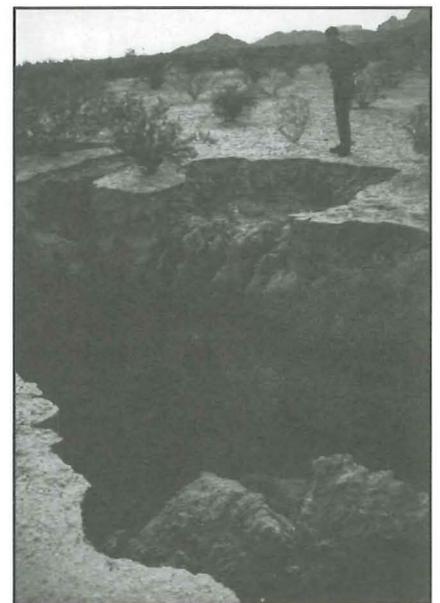
The Harquahala Plain overlies a broad, elongated alluvium-filled

ground-water basin. The alluvium is more than 5,000 feet thick. Ground water has been pumped to irrigate crops there since the 1940's. Water levels dropped 200 to 300 feet in some wells in the southeastern portion of the basin. Since 1985, when pumping began to be significantly reduced, water levels have risen by as much as 50 feet in some wells. Water levels have continued to decline slightly, however, in other parts of the basin.

The earth fissure is located near the juncture of the shallow bedrock pediment on the southwest and the deep ground-water basin on the northeast. No other fissures have been reported in this immediate area. The width of the fissure ranges from less than half an inch at its ends to 20 to 30 feet. The typical width is 5 to 20 feet. In

most places the fissure is 5 to 15 feet deep, but it exceeds 30 feet in depth locally.

Rains associated with Hurricane Nora caused an unseen earth crack to develop into a major fissure in only a few hours. Similar unseen cracks could develop in other areas where pumping has caused substantial lowering of ground-water levels.



View toward the upslope side of the fissure, showing erosion caused by water flowing into the fissure. Photograph by L.A. Ramsey.

AIPG Reviews AZGS

**GOVERNOR
JANE DEE HULL**

ARIZONA GEOLOGICAL SURVEY

Director and State Geologist
Larry D. Fellows, Ph.D.

Information and Publications

Rose Ellen McDonnell, B.S.
Peter F. Corrao, B.A.
Georgeanna L. Meeke
Cathy L. Moore, M.S.
Mary E. Pasborg
Mary E. Redmon

Mapping and Investigations

Jon E. Spencer, Ph.D.
Sean M. Kneale, B.A.
Thomas G. McGarvin, B.S.
Philip A. Pearthree, Ph.D.
Stephen M. Richard, Ph.D.
Richard A. Trapp, M.S.

Oil and Gas

Steven L. Rauzi, M.S.

Contracted Projects

Charles A. Ferguson, Ph.D.
Wyatt G. Gilbert, Ph.D.
Raymond C. Harris, M.S.
Jeanne E. Klawon, M.S.
Robert S. Leighty, Ph.D.
Steven J. Skotnicki, M.S.

LOCATION

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

Web Address:

<http://www.azgs.state.az.us>

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.

Design and layout:
Peter F. Corrao

Copyright © 1998
by the Arizona Geological Survey
Printed on recycled paper

Arizona Geology
Spring 1998

The Arizona Geological Survey (AZGS) was established by State statute to provide geologic information to the public. Practicing geologists are one of the major groups that use information and services that the AZGS provides. It behooves the AZGS, therefore, to ask practicing geologists what types of information and services they need.

With that in mind, Dr. Larry D. Fellows, Director of the AZGS, asked Dawn H. Garcia, 1996 President of the Arizona Section of the American Institute of Professional Geologists (AIPG), if she would consider appointing a committee to review the performance of the AZGS.

Garcia agreed and selected J. Alan Coope, Walter E. Heinrichs, Jr., and Eric F. Weiland to serve with her on the committee. The committee, with Garcia as chair, began working on the review in February 1997 and submitted its final report to Fellows in December 1997.

The committee interviewed the AZGS Director and geological and support staff, the AZGS liaison in the Office of the Governor, fiscal analysts in the Governor's Office of Strategic Planning and Budgeting and in the Joint Legislative Budget Committee, and groups that regularly use geologic information and services provided by the AZGS.

The committee's report,

which was thorough and carefully thought out, included 29 conclusions, 26 recommendations, and the supporting information on which they were based. The AZGS released the document as Open-File Report 97-20. Refer to the list of new releases on page 3.

During 1998 the AZGS plans to begin implementing the AIPG recommendations. *L.D. Fellows*



AIPG Review Committee members (standing, left to right) J. Alan Coope, Eric F. Weiland, Dawn H. Garcia (chair), and Walter E. Heinrichs, Jr. Photograph by K.J. Garcia.

Surprised?

When you heard about the magnitude-3.9 earthquake that occurred in Navajo County on January 6, were you surprised? People in Winslow and Holbrook were SHOCKED! The epicenter of the quake was about 15 mi south-east of Winslow.

Many people do not realize that Arizona has

an earthquake hazard, albeit not as great as that in some adjacent states. At least one earthquake has been recorded in every Arizona county since 1875. Since 1960 at least one earthquake has occurred in 12 of the 15 counties in the State.

The Arizona Division of Emergency Management has a free brochure entitled

Arizona Earthquakes: Are We at Risk? This brochure and related information may be obtained from Al Franco, Earthquake Program Manager, Arizona Division of Emergency Management, 5636 East McDowell Road, Phoenix, AZ 85008-3495; tel: (602) 392-7510.

A. Franco

Whole Lava Love

That's what Charles Ferguson, Arizona Geological Survey (AZGS) geologist, called the three-day field course he led in January. The course focused on volcanic rocks exposed along the north-west side of the Superstition Mountains east of Phoenix. Twenty-two geologists from Arizona, New Mexico, Colorado, Oklahoma, Massachusetts, and Alberta, Canada participated. They represented industry, academia, and State and Federal agencies.

Geologists must be able to recognize and distinguish among the remains of lava flows, explosive eruptions of tuff, hot rock avalanches, shallow intrusions, and other volcanic rock types. This can be a difficult task because the rocks, commonly many millions of years old, may have been deeply eroded, broken by faults, and altered by hot water and steam.

AZGS geologists Ferguson, Steven Skotnicki, and Wyatt Gilbert mapped most of the Superstitions during the past four years as part of the National Geologic Mapping Program and released the maps as AZGS open-file reports. They built on, and in many areas reinterpreted, maps that were prepared by geologists from Arizona State University and the U.S. Geological Survey. Many discussions during the course centered on reconciling conflicting interpretations by different geologists. *J.E. Spencer*



Above: From a strategically located vantage point, field-course participants can observe structural and stratigraphic relationships of various volcanic rock units in the study area. Left: Dr. Ferguson describes the geology of the western Superstition Mountains as based on the detailed geologic maps that he, Gilbert, and Skotnicki prepared. Photograph by J.E. Spencer.

How to Order

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:

Shipping & Handling CHARGES

In the United States:

Less than \$1.01, add \$1.00
1.01- 10.00, add 3.00
10.01- 20.00, add 4.50
20.01- 30.00, add 5.75
30.01- 40.00, add 6.50
40.01- 50.00, add 8.00
50.01- 100.00, add 10.25
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.

Arizona Geology
Spring 1998

Just Released

Land use in the San Carlos-Safford-Duncan nonpoint-source management zone:

R. C. Harris, 1997, Arizona Geological Survey Open-File Report 97-18 (Pub. number OFR 97-18), 7 p., 3 sheets, scale 1:100,000 and 1:250,000. \$7.00

Earth fissures in the Bowie-San Simon area, Cochise County, Arizona:

R. C. Harris, 1997, Arizona Geological Survey Open-File Report 97-19 (Pub. number OFR 97-19), 10 p., 1 sheet, scale 1:24,000. \$7.00

Report of the Arizona Geological Survey Review Committee:

American Institute of Professional Geologists, Arizona Section, 1997,

Arizona Geological Survey Open-File Report 97-20 (Pub. number OFR 97-20), 67 p. \$11.00

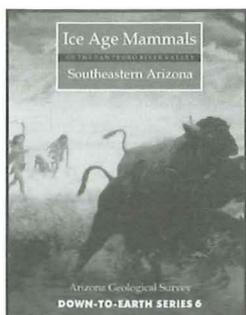
Historical channel changes along the lower San Pedro River, southeastern Arizona:

M. L. Wood, 1997, Arizona Geological Survey Open-File Report 97-21 (Pub. number OFR 97-21), 44 p., 3 sheets, scale 1:24,000. \$22.00

Facies map of post-mid-Miocene Quiburis Formation, San Pedro trough, Pinal, Pima, Graham, and Cochise Counties, Arizona:

W. R. Dickinson, 1998, Arizona Geological Survey Contributed Map 98-A (Pub. number CM 98-A), 6 p., 10 sheets, scale 1:24,000. \$20.00

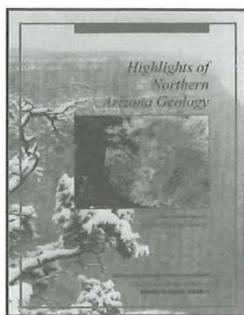
NEW GENERAL INTEREST PUBLICATIONS



ICE AGE MAMMALS OF THE SAN PEDRO RIVER VALLEY, SOUTHEASTERN ARIZONA

Mastodons, ground sloths, and lions roamed southeastern Arizona about 10,000 years ago. This book includes sketches of those animals, a description of the environmental conditions at that time, and speculation about the causes of extinction.

W. A. Amman, Jr., J. V. Bezy, Ron Ratkevich, and W. M. Witkind
Arizona Geological Survey
Down-To-Earth 6
19 p. \$6.95



HIGHLIGHTS OF NORTHERN ARIZONA GEOLOGY

This book includes a summary of the geologic history of northern Arizona and photographs and descriptions of scenic features, including the Grand Canyon, Monument Valley, Canyon de Chelly, Black Mesa, Painted Desert, Petrified Forest, Meteor Crater, San Francisco Mountains, and Sunset Crater.

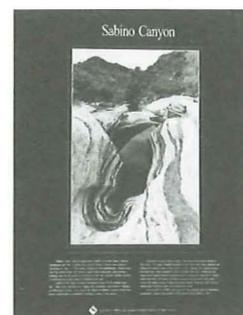
Compiled and edited by Robin Frisch-Gleason.
Arizona Geological Survey
Down-To-Earth 7
44 p. \$7.95



3D STEREO TOPOGRAPHIC MAP OF ARIZONA

Using glasses with red and blue lenses (provided), one can observe Arizona's land surface in three dimensions. Landforms throughout the Colorado Plateau, Basin and Range, and Transition Zone provinces stand out distinctly, illustrating the impact the geologic framework has had on topography in Arizona.

Arizona Geological Survey
Map 32
Scale 1:750,000
33 x 38.5 inches
\$9.95



SABINO CANYON POSTER

This poster features the geology of Sabino Canyon, probably the most popular natural area with easy public access in the Tucson area. Sabino Creek has eroded its channel into solid gneiss, which is clearly exposed along the creek and in the canyon walls. A nontechnical description of the geologic setting is given.

Arizona Geological Survey
Poster 1
18 x 24 inches
color
\$6.95



Arizona Geological Survey

416 West Congress, Suite 100
Tucson, AZ 85701
(520) 770-3500

Return Service Requested

NON PROFIT ORG.
U.S. POSTAGE
PAID
TUCSON, ARIZONA
PERMIT NO. 3088