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ARS 27-152

INSIDE

Land Subsidence in the Salt River Valley west of Phoenix

Larry D. Fellows
Arizona Geological Survey

When Arizona's population began to increase in the late 1940's, demand for ground water intensified. Since then, in many parts of southern Arizona, ground water has been pumped faster than natural recharge has occurred. As a consequence of excessive ground-water withdrawal followed by sediment compaction, the land surface has subsided and large cracks, called "earth fissures," have developed. This has happened within or near Apache Junction, Mesa, and north Phoenix, as well as in many less-populated areas, including Avra Valley northwest of Tucson, parts of Cochise County, western Pinal County, and the Salt River Valley west of Phoenix. Subsidence has also occurred in Tucson, but fissures have not been noted. In time, subsidence and fissuring will take place beneath other existing urban areas, and cities will expand into subsiding areas. It is important, therefore, to know where subsidence has occurred, fissures have developed, and potential exists for future subsidence and fissuring.

More than 15 feet of land subsidence was measured at one locality west of Phoenix, in an area bounded by Interstate Highway 10, the Agua Fria River, and the White Tank Mountains. Earth fissures have developed; differential subsidence has damaged buildings, roads, railroads, irrigation canals, flood-control structures, and water wells (Figure 1); land-surveying problems have occurred; and some agricultural fields have had to be releveled. In September 1992 flooding, exacerbated by land subsidence, caused problems on and near Luke Air Force Base (AFB), located within this area. Four inches of rain fell north of the AFB in just a few hours. Water overtopped the Dysart drain, which was designed to carry runoff water from the AFB eastward to the Agua

*see **SUBSIDENCE**, page 4*

***Figure 1.** Irrigation canal, located 5 1/2 miles northwest of Litchfield Park, that has cracked because of differential land subsidence.*

Help Wanted

In the past 2 years the Arizona Geological Survey (AZGS) has lost two full-time support-staff positions because of budget reductions. A drafter-illustrator position was eliminated in 1991 and, effective July 1, 1993, an editor position was abolished. A full-time drafter-illustrator and a half-time editorial assistant are now available to assist in preparing geologic maps and reports for publication.

To adjust to these staff decreases, we have made substantial changes in graphics and editorial procedures. One change was to reduce *Arizona Geology* from 12 to 4 pages per issue so the editorial assistant's time may be devoted to the formal publications such as bulletins, special papers, circulars, and maps.

We plan to continue to publish *Arizona Geology* quarterly, but are reevaluating distribution policies, the number of copies to print, the types of information to include, and printing costs. We will continue to inform *Arizona Geology* readers about AZGS projects and activities, newly released publications, and items of special interest to the geologic community and the public. General-interest articles, which were commonly included in past issues, will be published in the Down-to-Earth Series.

We request your help in making future issues of *Arizona Geology* most effective. Please tell us what types of information are most useful to you. We also welcome your suggestions and comments about *Arizona Geology*, in general, as well as how we can improve our methods of providing geologic information. Please address your suggestions and comments to Larry D. Fellows, Director and State Geologist, Arizona Geological Survey, 845 N. Park Ave., # 100, Tucson, AZ 85719-4816.

Pub List

The Arizona Geological Survey (AZGS) released a new list of publications available for purchase. The list contains 402 maps and reports that depict or describe Arizona's geology, geologic hazards and limitations, and mineral and energy resources. The list includes 75 reports on mineral resources, 44 on potential geothermal resources, 38 on oil and gas resources, 32 on geologic hazards and limitations, 179 geologic maps, and 33 bibliographies and indexes. (Some of these are identified in more than one category.) A free copy may be obtained from the AZGS.

Fact Book

The Association of American State Geologists has released the 1993 Fact Book, which provides information about the programs and program managers of each state geological survey. To obtain a copy, send $10 to T.M. Berg, Ohio Geological Survey, Dept. of Natural Resources, 4383 Fountain Square Drive, Bldg. B, Columbus, OH 43224-1362.

Just Released

The Arizona Geological Survey has released several new publications since June 1993. They may be purchased from the Arizona Geological Survey, 845 N. Park Ave., #100, Tucson, AZ 85719-4816. Orders are shipped by UPS; a street address is required for delivery. All orders must be prepaid by check or money order payable in U.S. dollars to the Arizona Geological Survey. Add these shipping charges to your total order:

Radon in Arizona, edited by J.E. Spencer, Bulletin 199, 96 p., 2 sheets, scale 1:32,000 and 1:1,000,000. $29.00

This bulletin was announced in the Summer issue of *Arizona Geology*, but we failed to include its publication number and the map scales.

Land Subsidence and Earth Fissures in Arizona, by Steven Slaff, Down-to-Earth 3, 24 p. $4.50

More than 3,000 square miles of land in Arizona have subsided during the 20th century, including parts of Cochise, La Paz, Maricopa, Pima, and Pinal Counties. Subsidence occurs after ground water has been pumped for a long time at a faster rate than that of natural recharge. In many subsided areas, earth fissures have formed. Some fissures are several miles long, tens of feet wide, and possibly hundreds of feet deep.

Causes and effects of subsidence and earth fissures are described in nontechnical terms. Maps and figures show the areas in Arizona where subsidence and fissures have occurred.

SHIPPING & HANDLING CHARGES

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$1.01 - $5.00, add $2.00
5.01 - 10.00, add 3.00
10.01 - 20.00, add 4.50
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30.01 - 40.00, add 6.50
40.01 - 50.00, add 8.00
50.01 - 100.00, add 10.25
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Other countries, request price quotation.

Geologic Map of the Painted Rock Mountains, Maricopa County, Arizona, by Steve Skotnicki, Open-File Report 93-7, 8 p., scale 1:24,000. $4.00

The Painted Rock Mountains consist of middle Tertiary volcanic rocks and less abundant granitic rocks that are flanked by low-lying, upper Cenozoic basalts of the Sentinel volcanic field. Volcanic rocks form the bedrock foundation for the Painted Rock Dam. The Painted Rock mineral district is within the map area and is characterized by veins along a fault zone that also hosts an andesitic dike.

Geologic Map of the Western Harcuvar Mountains, La Paz County, West-Central Arizona, by S.J. Reynolds and J.E. Spencer, Open-File Report 93-8, 9 p., scale 1:24,000. $3.50

The western Harcuvar Mountains consist of the Cretaceous Tank Pass Granite and several older granitic and gneissic rocks that have been severely deformed. These rocks host numerous northwest-trending mafic dikes that are commonly associated with alteration zones and locally with quartz veins. Mineral deposits in the Cunningham Pass and Harcuvar mineral districts have yielded significant amounts of copper and gold. This map and report outline the character, distribution, and structure of the bedrock.

Preliminary Geologic Map of the Southern Plomosa Mountains, La Paz County, Arizona, by S.M. Richard, J.E. Spencer, R.M. Tosdal, and Paul Stone, Open-File Report 93-9, 27 p., scale 1:24,000. $7.00

The southern Plomosa Mountains contain a great diversity of rock types and structures. These include Proterozoic granitic rocks, Paleozoic sedimentary rocks that resemble less deformed strata on the Colorado Plateau, Jurassic volcanic rocks, Jurassic(?) and Cretaceous strata that reflect sedimentation in an environment of early extension(?) and later thrust faulting, and Cenozoic volcanic and clastic rocks. Numerous thrust and high-angle faults disrupt these strata, which are locally overturned. The area has numerous quartz veins, mineralized shear zones, and placer gold deposits.

Geologic Map of Face Mountain and Oatman Mountain, South-Central Gila Bend Mountains, Maricopa County, Arizona, by Steve Skotnicki, Open-File Report 93-10, scale 1:50,000. $2.00

Face Mountain and Oatman Mountain largely consist of middle Miocene(?) basalt or basaltic andesite flows that form deeply eroded mesas and hogbacks. In the northwestern part of Face Mountain, moderately tilted, lower Miocene(?) conglomerate and tuff underlie the gently dipping mafic flows.

Geologic Map of the Western Eagletail Mountains, La Paz County, Arizona, by J.E. Spencer, S.M. Richard, and M.H. Ort, Open-File Report 93-12, 11 p., scale 1:24,000. $5.00

The Eagletail Mountains consist of middle Tertiary dacitic and rhyolitic flows, domes, volcanogenic breccias, dikes, plugs, and pyroclastic rocks, as well as less abundant andesitic and basaltic flows, sedimentary rocks, and underlying pre-Tertiary crystalline rocks. Near the eastern edge of the map area, abundant intermediate to felsic dikes intrude pre-Tertiary crystalline rocks and are locally associated with mineralized veins and alteration zones.

Geologic Map of Volcanic Rocks along the East Side of Central Chino Valley, Yavapai County, Arizona, by W.L. Stefanov, Contributed Map CM-93-E, 9 p., scale 1:12,000. $3.00

This geologic map covers an area of approximately 6-square-miles that is located about 5 miles east of the community of Chino Valley. The map area is primarily underlain by the Sullivan Buttes Latite. This volcanic rock, which is of intermediate composition, is high in potassium. The unit includes flows, pyroclastics, and shallow intrusions. It has been dated as upper Oligocene to lower Miocene. The latite is known for its petrologically diverse xenolith suite, which includes peridotite and eclogite.

New DMMR Director

H. Mason Coggin became the new Director of the Arizona Department of Mines and Mineral Resources (DMMR) August 23, 1993. Mr. Coggin has a B.S. degree in mining engineering from the University of Arizona, is a Registered Professional Engineer and Land Surveyor, and has 32 years of experience in the mining industry in Arizona. He replaced Leroy Kissinger, who has retired.

New OGCC Commissioner

Governor Fife Symington appointed Lisa C. Worthington to a 5-year term on the Arizona Oil and Gas Conservation Commission (OGCC). Ms. Worthington is a graduate of the University of Southern California and Pepperdine University, has 9 years of experience in petroleum exploration, and is a Certified Professional Geologist and a Certified Professional Petroleum Geologist. She replaced Barbara H. Murphy, whose term on the OGCC expired in January 1993.

Geothermal Test Hole

Tonto Drilling Services, based in Salt Lake City, completed a geothermal test hole, the Alpine-Federal #1, at a total depth of 4,505 feet on August 29, 1993. The hole is about 6 miles north of Alpine, Arizona, in T. 6 N., R. 30 E., sec. 23, Apache County. It was drilled to determine the hot-dry-rock geothermal potential of the granitic basement rocks in east-central Arizona. The U.S. Department of Energy and Arizona Department of Commerce funded the project.

The Datil Formation (Tertiary) is at the surface at the drill site. The hole was cored from 500 feet to total depth. The operator reported the following formation tops: Baca Formation (Eocene), 1,093 feet; early Tertiary red beds, 3,139 feet; Cretaceous rocks, 3,260 feet; San Andres Limestone (Permian), 3,369 feet; Glorieta Sandstone (Permian), 3,436 feet; basaltic dike, 3,639 feet; and Yeso Formation (Permian), 3,751 feet. The Yeso Formation included two basaltic units, probably dikes. The drilled thickness of the upper one was slightly more that 100 feet, and the drilled thickness of the lower one was about 60 feet. The hole was in the lower dike when drilling stopped.

Mark Your Calendar

Fossil Symposium. The first annual Fossils of Arizona Symposium will be held Saturday, November 13, 1993, at the Mesa Southwest Museum, 53 N. Macdonald, Mesa, AZ 85201-7325. For additional information, contact Brian McClelland or Rob Price at (602) 644-2230.

SUBSIDENCE, from page 1

Fria River, and inundated parts of the AFB and approximately 100 homes adjacent to it. Flood-related damage and cleanup efforts cost more than $3 million. Plans have been made to modify the Dysart drain to take into account past and anticipated land subsidence and prevent future flood damage.

In 1987 five agencies cooperatively prepared a 1:1,000,000-scale map that shows areas where groundwater levels have been lowered, the amount of lowering that has occurred, and earth-fissure areas. The map was published by the AZGS as Map 23. A 1:500,000-scale version of the same map was released as AZGS Open-File Report 86-14. Both may be purchased from the AZGS: Map 23 is $4.00, plus shipping; Open-File Report 86-14 is $5.00, plus shipping. (See the list of shipping charges on page 2 of this issue.)

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Gas Well

A gas well was drilled in July 1993 in the Black Rock gas field in northeastern Apache County, Arizona. The Black Rock #12 well was completed at about 1.5 million cubic feet of gas per day from the Paradox Formation (Pennsylvanian).

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