Vol. 27, No. 2
Summer 1997

Arizona Geology

Published Quarterly by the Arizona Geological Survey

Asarco Opens Mineral Discovery Center

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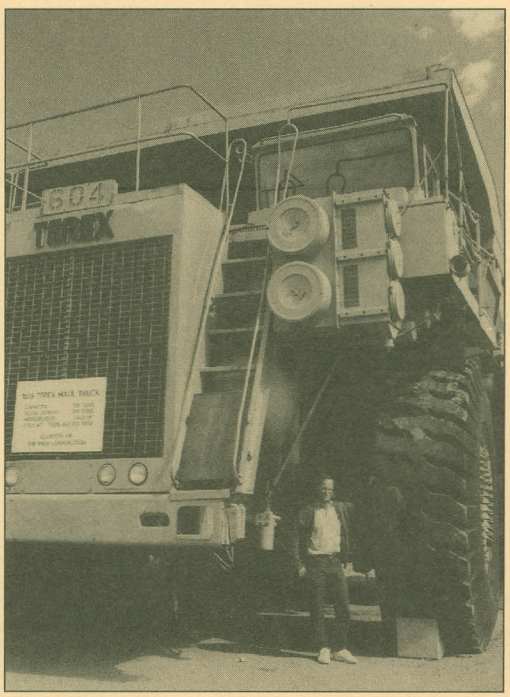
Almost two-thirds of the copper produced in the U.S. comes from Arizona mines. One can see, therefore, why Arizona's copper is important to the Nation, as well as to the economies of the State of Arizona and Pima County.

Modern society requires copper and many other metallic and nonmetallic resources. All of us, without exception, are consumers. The average single-family home has more than 400 lbs of copper tubing, wire, and hardware. Clothes washers and dryers, refrigerators, stoves, air conditioners, televisions, VCRs, computers, and other electrical appliances use even more copper. A typical U.S.-built automobile has more than 50 lbs of copper. A Boeing 747-400 aircraft contains 9,000 lbs of copper, including 640,000 ft (121 mi) of copper wire.

Exhibits at the Asarco Mineral Discovery Center, which opened in February, explain how copper is extracted from rock and how the metal is used. Two 20-minute movies are shown in the theater. One focuses on metallic and nonmetallic resources and the other features copper mining, milling, and smelting. Admission to the Center is free. For a small fee visitors may take a 1-hour bus tour of the Mission Complex, four miles to the west, and view the open-pit mine, one of the two mills, and reclamation areas. (Special tours can be arranged for educational institutions.) Mining equipment is displayed at the Center.

Minerals must be sufficiently concentrated in rocks to be mined profitably. Such deposits, formed by geologic processes millions or even billions of years ago, depending on the specific deposit, are rare and increasingly difficult to discover. Geologists and other scientists who understand the character of mineral deposits and how they form play a key role in their discovery. All businesses, including mineral producers, are dependent on economics. To survive, a company must conduct exploration programs, discover ore, mine, mill, process, and distribute its product at a profit. Operating costs are substantial. For example, one cubic ft of ore at the Mission mine contains only about a pound of copper, but three cubic ft of rock must be removed to get to it. The price of copper, which has fluctuated significantly in the past, is now (early May) about $1.05-1.10 per lb. Nearly 1,000 people work at the Mission Complex. Asarco is one of four major copper mining companies that operate in Arizona.

Information such as that given above, and much more, is available at the Center. To get there, drive south on Interstate 19 about 15 miles from downtown Tucson (Congress Street exit), get off at Pima Mine Road (Exit 80), and follow the signs. For more information call (520) 625-7513.



Haul truck used in 1975 dwarfs man. Trucks used today are even larger!

Search for Carbon Dioxide Accelerates

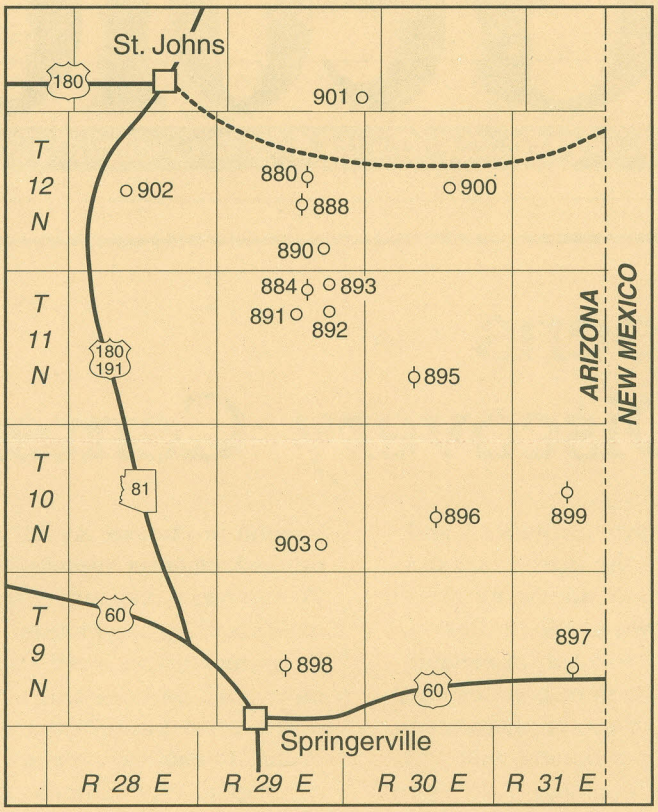
An oil show in a geothermal test hole drilled near Alpine in 1993 caught the attention of Walter B. Ruck, president of Ridgeway Petroleum Corporation in Calgary, Alberta, Canada. Ruck formed the Ridgeway Arizona Oil Corporation and, in 1994, drilled an oil test near St. Johns, 37 miles north of the Alpine hole in southern Apache County. The well encountered carbon dioxide (CO_2) and helium. The second well, drilled in 1995, also found CO_2. Both wells are shut in.

Six wells have been drilled in 1997 to date and four permitted locations (numbers 900-903) await drilling. State law requires that a permit from the Arizona Oil and Gas Conservation Commission be obtained prior to drilling.

The CO_2 is in the Ft. Apache Member of the Supai Formation, less than 2,000 feet below the surface. Most land in the area is State Trust or privately owned.

When the wells referred to above have been drilled and cased, Ridgeway will begin testing to find out whether there's enough CO_2 to produce commercially. Drilling will take place on permits 890-893 after this testing program has been completed.

For more information, contact Steven L. Rauzi, Oil and Gas Program Administrator, at the AZGS.



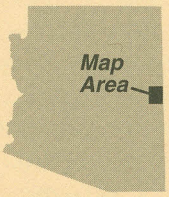
880 Arizona Oil & Gas Conservation Commission (OGCC) permit no.

○ Permitted location for new well

ϕ Well drilled and shut-in

0 5 10

Miles



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

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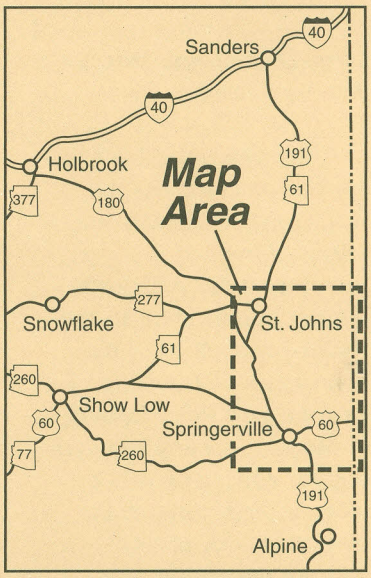

OGCC Permit No.	Well Name	Location Sec-Twp-Rge	Total Depth	Comments
880	1 Plateau Cattle	15-12N-29E	2431 ft	Shut-in 8/94
884	3-1 State	3-11N-29E	1813 ft	Shut-in 9/95
888	22-1X State	22-12N-29E	2149 ft	Shut-in 2/97
890	35-1 State	35-12N-29E		(drilling not scheduled)
891	10-1 State	10-11N-29E		(drilling not scheduled)
892	11-1 State	11-11N-29E		(drilling not scheduled)
893	2-1 State	2-11N-29E		(drilling not scheduled)
895	11-21 State	21-11N-30E	2410 ft	Shut-in 3/97
896	10-22 State	22-10N-30E	2265 ft	Shut-in 3/97
897	9-21 State	21-9N-31E	2686 ft	Shut-in 3/97
898	9-22-29 State	22-9N-29E	3180 ft	Shut-in 4/97
899	10-16-31 State	16-10N-31E		Drilling 4/97
900	12-15-30 State	15-12N-30E		(drilling has not started yet)
901	13-36-29 State	36-13N-29E		(drilling has not started yet)
902	12-16-28 State	16-12N-28E		(drilling has not started yet)
903	10-26-29 State	26-10N-29E		(drilling has not started yet)

New Publications

The Arizona Geological Survey (AZGS) released the following reports and maps since February 1997:

Geologic map of the North Butte area, central Arizona: S. M. Richard and J. E. Spencer, 1997, Open-File Report 97-4 (Pub. number OFR 97-4), 18 p., 1 sheet, scale 1:24,000. $5.00

An east-tilted block of Proterozoic granite overlain by an east-dipping section of Tertiary volcanic and sedimentary rocks is bounded on the west by a steep range-bounding fault with very gently dipping or untilted Tertiary strata in the hanging wall. The eastern boundary of the tilt block is a low-angle normal fault that may record about 10 km of slip. Laramide Teacup Granodiorite forms the footwall of this fault. North-trending Proterozoic diabase dikes and an east-northeast-trending swarm of Laramide dikes intrude the Proterozoic granite. Pre-Tertiary rocks are overlain by strata correlated with the Tertiary Whitetail conglomerate (tilted 30-50°) and Miocene sedimentary and volcanic rocks (tilted 10-40°). Two major areas of mineralization are present in the map area. The principal mineralized structures are quartz-hematite veins and mineralized joints, apparently coeval with the Laramide dike swarm. Secondary copper minerals are widespread but not abundant.

Data structure for Arizona Geological Survey digital geologic maps: S. M. Richard and J. P. Thieme, 1997, Open-File Report 97-5, ver. 1.1, (Pub. number OFR 97-5), 11 p. $2.00

This report is a list of the codes and a description of the data structure used in the Arizona Geological Survey's digital geologic map series.

Uranium distribution in the Cave Creek-Carefree area, central Arizona, and implications for indoor radon: R. C. Harris, 1997, Open-File Report 97-6 (Pub. number OFR 97-6), 12 p., 1 sheet, scale 1:100,000. $3.00

Uranium levels in rock reported in this report were compared with radon levels in homes and water wells to see if there is correlation. Although some water wells in the area have elevated radon levels, the radon levels do not correlate well with the uranium content of the rocks. The average indoor radon level in the study area is slightly higher than the State average.

Rates of Holocene soil formation in south-central Arizona: Gary Huckleberry, 1997, Open-File Report 97-7 (Pub. number OFR 97-7), 27 p. $5.00

Geological and geoarchaeological studies of Holocene soils in south-central Arizona have yielded tow important insights. First, Holocene pedogenesis is more variable in the upper Sonoran Desert than one might expect and, consequently, a single soil chronosequence is inadequate for the Phoenix basin and vicinity. Second, the most rapid soil formation is occurring on the western slopes of mountains at the transition from the Basin and Range to the Central Highlands provinces, particularly in the foothills of the Mazatzal Mountains. Soil patterns summarized can help guide geologists in estimating ages of Holocene deposits and landforms in south-central Arizona.

Digital representation of the geological map of the Phoenix North 30' x 60' Quadrangle, central Arizona: S. J. Reynolds and M. J. Grubensky, digitized by J. P. Thieme and edited by S. M. Richard, 1997, Digital Information Series 4 (Pub. number DI-4), 2 HD disks, 2 p. $30.00

This publication includes several PC Arc/Info export files (compatible with ArcView, PC Arc/Info, and Arc/Info), standard metadata text files, and a description of the data structure. Separate coverages of the contacts and faults, all other lines, structural data, and degenerate areas make up the complete digital map. Detailed information about the projection, coordinate system, attribute accuracy, process description, tolerances, geological units, and distribution of the digital maps is given in the

see NEW PUBLICATIONS, page 4

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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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.

Coconino Shakes

Seven earthquakes have already been felt in Coconino County in 1997. The largest, which occurred in late March, had a magnitude of 3.7 and was centered near Red Mountain, 26 mi northwest of Flagstaff. Epicenters of the magnitude 4.9 and 5.4 quakes that occurred in April 1993 were about 20 mi northwest of Red Mountain.

Contact Doug Bausch at the Arizona Earthquake Information Center in Flagstaff [tel. (520) 523-7196] for more information.

Geology of Arizona Revised

The second edition of *Geology of Arizona* was recently released. The book, written by Dale Nations (Northern Arizona University) and Edmund Stump (Arizona State University), includes a discussion of basic geologic principles and their application to the interpretation of rocks and landscapes of Arizona. The book includes stratigraphic correlation diagrams, tectonic maps, isopachous maps, paleogeographic maps, and a folded copy of the *Geologic Map of Arizona*, published by the Arizona Geological Survey as Map 26. The 260-page soft-cover book may be purchased from Kendall/Hunt Publishing Company, 4040 Westmark Drive, Dubuque, IA 52002 for $36.95 plus postage. Include the ISBN number (0-7872-2525-8) with your order.

NEW PUBLICATIONS, from page 3

metadata text files. A copy of Open-File Report 97-5, which outlines the database structure of the digital maps and lists all of the codes used in the digital map database, is included with this publication.

Digital representation of the geological map of the Phoenix South 30' x 60' Quadrangle, central Arizona: S. J. Reynolds and S. J. Skotnicki, digitized by K. M. Korroch and edited by S. M. Richard, 1997, Digital Information Series 5 (Pub. number DI-5), 2 HD disks, 2 p. $30.00

The description for DI-4, above, also applies to DI-5.

The geology and production history of the Sunlight and South Sunlight uranium mines, Navajo County, Arizona: W. L. Chenoweth, 1997, Contributed Report 97-A (Pub. number CR 97-A), 12 p. $2.00

These mines are in the El Capitan Flat area of Monument Valley, 17 mi north of Kayenta. Ore is in the basal Shinarump Member of the Chinle Formation. The mines, which were in operation from 1957-1964, produced nearly 84,000 tons of ore that averaged 0.26-0.30 percent U_3O_8.

The geology and production history of the Starlight and Starlight East uranium mines, Navajo County, Arizona: W. L. Chenoweth, 1997, Contributed Report 97-B (Pub. number CR 97-B), 12 p.$2.00

The geologic setting and production of these mines are almost identical to those of the Sunlight and South Sunlight mines, described above. More than 86,000 tons of ore averaging 0.30 percent U_3O_8 were produced from the Starlight and Starlight East mines.

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