

Arizona Geology

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THE STATE AGENCY FOR GEOLOGIC INFORMATION

MISSION

To inform and advise the public about the geologic character of Arizona in order to foster understanding and prudent development of the State's land, water, mineral, and energy resources.

ACTIVITIES

PUBLIC INFORMATION

Inform the public by answering inquiries, preparing and selling maps and reports, maintaining a library, databases, and a website, giving talks, and leading fieldtrips.

GEOLOGIC MAPPING

Map and describe the origin and character of rock units and their weathering products.

HAZARDS AND LIMITATIONS

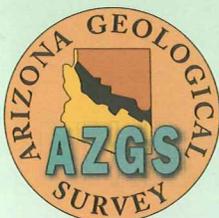
Investigate geologic hazards and limitations such as earthquakes, land subsidence, flooding, and rock solution that may affect the health and welfare of the public or impact land-and resource management.

ENERGY AND MINERAL RESOURCES

Describe the origin, distribution, and character of metallic, non-metallic, and energy resources and identify areas that have potential for future discoveries.

OIL AND GAS CONSERVATION COMMISSION

Assist in carrying out the rules, orders, and policies established by the Commission, which regulates the drilling for and production of oil, gas, helium, carbon dioxide, and geothermal resources.



Exploring Arizona

J. Dale Nations, Chairman
Arizona Oil and Gas Conservation Commission

The Arizona Oil and Gas Conservation Commission (AOGCC) regulates the drilling for and production of oil, gas, helium, carbon dioxide, and geothermal resources in Arizona. Arizona oil and gas statutes require those who drill for oil and gas to obtain a permit from and provide specific information about the drilling history of the well to the AOGCC. To date, about 1,000 permits to drill have been issued. Well files are maintained at the Arizona Geological Survey (AZGS). The Arizona legislature appropriated funds for this fiscal year to microfilm these invaluable records for disaster recovery. Microfilming will be completed in May and a copy of the microfilm will be stored at the State Records Center in Phoenix.

The AOGCC has six members: five are appointed by the Governor and the sixth, the State Land Commissioner, is *ex officio* (Figure 1a). AZGS provides administrative and staff support for the AOGCC (Figure 1b).

The AOGCC has jurisdiction over State Trust and private land. The Arizona State Land Department issues oil and gas leases for State Trust land. The AOGCC issues permits to drill on these leases. The U.S. Bureau of Land Management administers leasing, drilling, and production on federal and Indian lands.



Figure 1a. Members of the Arizona Oil and Gas Conservation Commission (left to right): Michele P. Negley, J. Dale Nations, Chairman (standing), Robert L. Wagner, and Robert L. Jones, Vice Chairman. Michael E. Anable, State Land Commissioner, and Joseph J. Lane were unable to be present for the photograph.

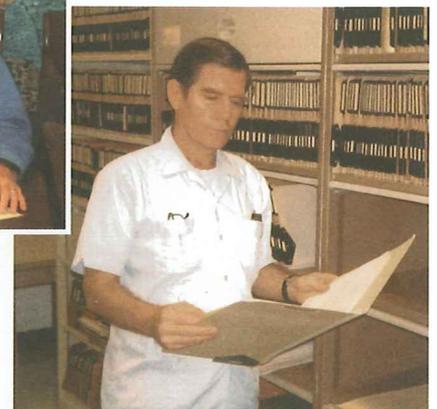


Figure 1b. Steven L. Rauzi, Oil and Gas Administrator, is the AZGS employee who assists the AOGCC.

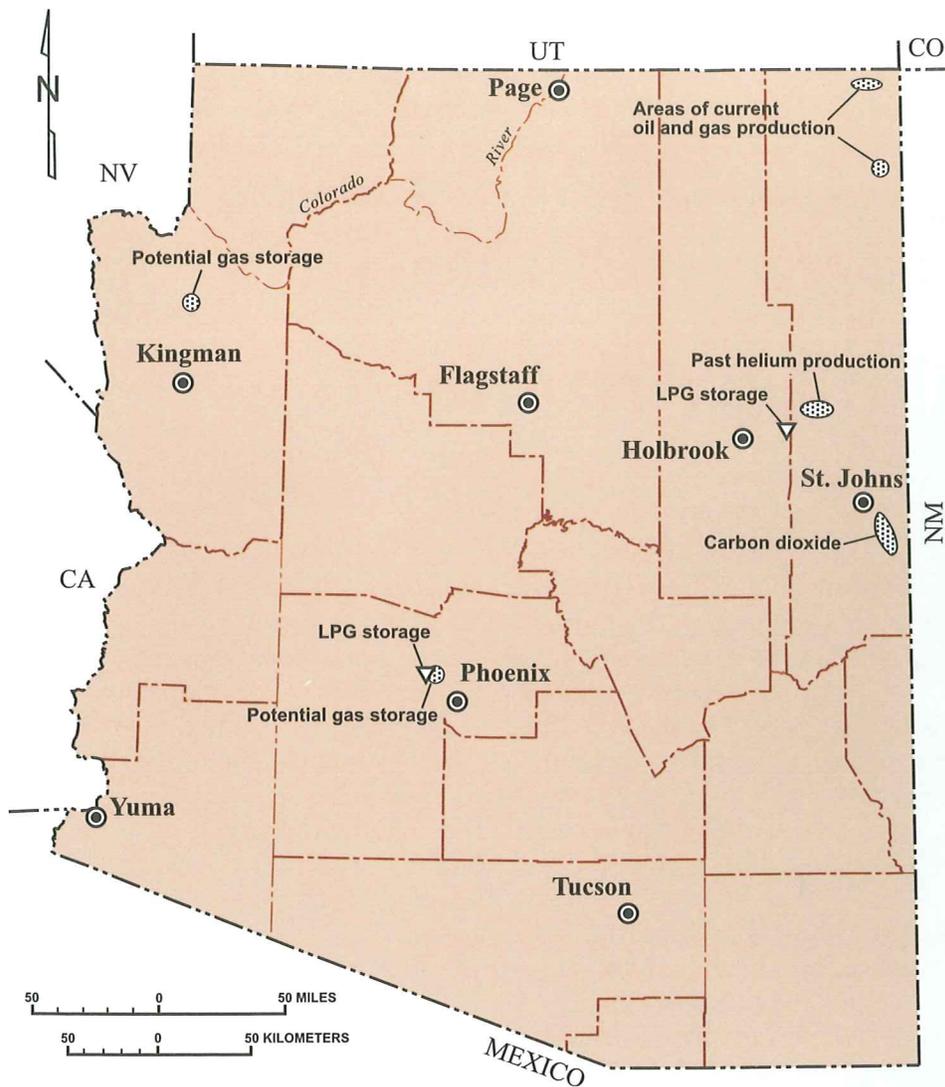


Figure 2. Oil and gas production, storage, and exploration.

Oil and gas production and potential

Small quantities of oil and natural gas are produced from wells in Arizona. More than 20 million barrels of oil and 29 billion cubic feet of gas were produced from wells in the Navajo Nation in northeasternmost Arizona since 1959 (Figure 2). About 700 million cubic feet of helium were produced from wells in Apache County between 1961 and 1976. Oil seeps have been observed at the land surface in numerous places and oil shows have been recorded in wells. Current and past production of oil and gas, oil seeps, and oil shows, suggest that parts of the State have potential for future discoveries (Figure 3). Rocks in Arizona's subsurface have not been adequately explored.

Exploration activities

Oil and gas leasing and exploration in Arizona fluctuate generally with the price of crude oil, which is influenced by events in the national and international

scene (Figure 4). The price of crude oil changes continuously in response to supply variations, and is commonly affected by political instability, particularly in the Middle East. Shortages, whether actual or threatened, result in price increases. Higher market prices cause increased interest in exploration activity and increased leasing activity.

Since 1998 the Arizona Corporation Commission has approved applications for 15 electrical power-generating facilities. Most of them will be gas fired and will require gas-storage facilities. Two liquefied-petroleum-gas (LPG) storage facilities have been developed in caverns constructed in subsurface salt deposits (Figure 2). Three companies have announced their intention to develop other such facilities for storing natural gas. One of the companies is investigating the Luke salt west of Phoenix; two are looking at the undeveloped Red Lake salt deposit north of Kingman (Figure 2).

A project is currently under way north of Flagstaff to test for potential oil and gas accumulations derived from the Precambrian Chuar Group. Studies of Chuar

outcrops in the Grand Canyon indicate the presence of both hydrocarbon source and reservoir rocks. Drilling in other parts of northern Arizona has not yet been adequate to test these rocks.

State land northeast of Holbrook near Pinta Dome has been leased and plans are being made to drill a helium test well. Gas from wells near Pinta Dome averaged 8.2 percent helium, which is exceptionally high. Some anticlines in this area have never been tested for helium. The current price of helium is about \$65 per thousand cubic feet.

Coal deposits in the Black Mesa basin (Figure 3) are potential sources of coalbed methane, a flammable natural gas of considerable value. Several companies have shown an interest in exploration in that area.

Carbon dioxide was discovered southeast of St. Johns in 1994. The company is now nearing completion of a plant that is estimated to produce about 200 tons of liquid carbon dioxide per day from three wells, two in Arizona and one in New Mexico.

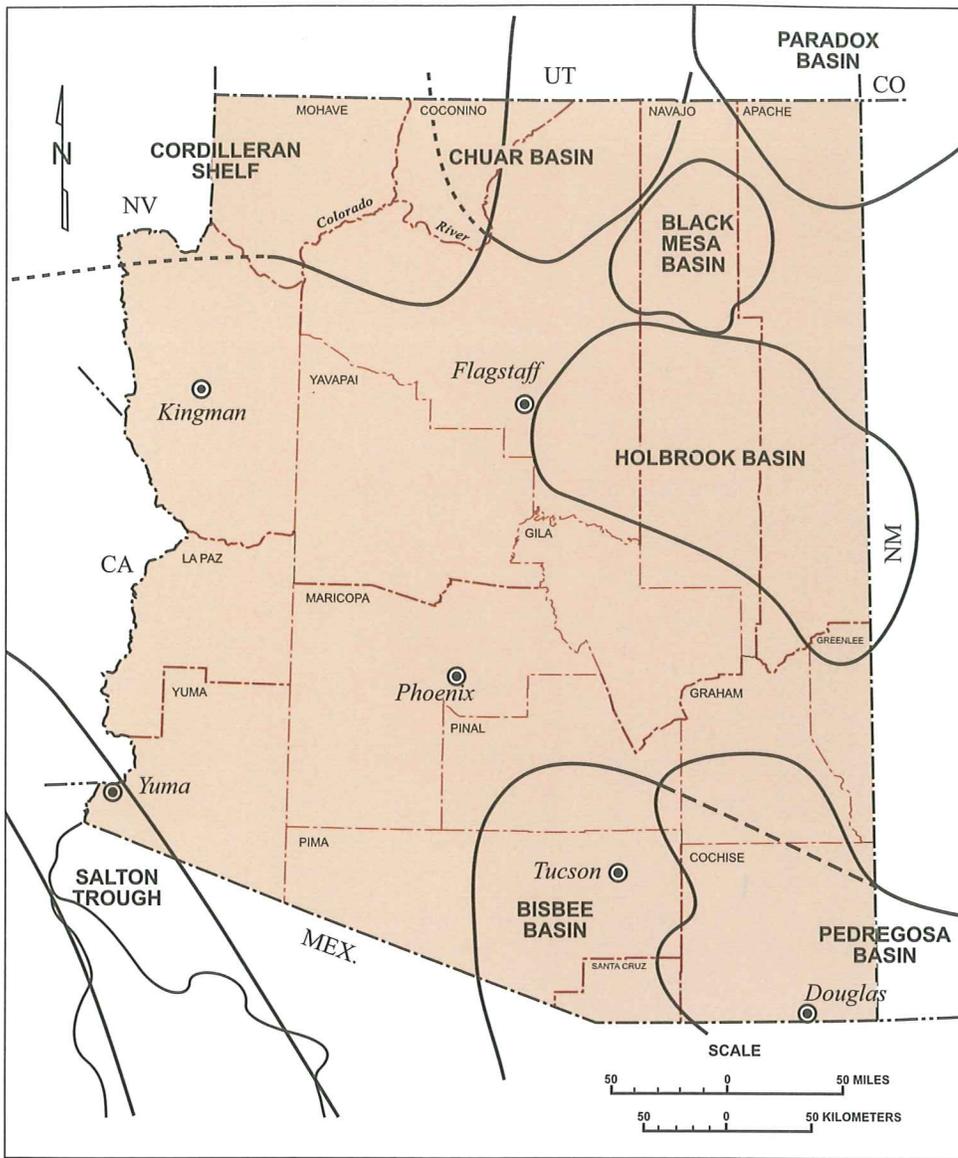


Figure 3. Areas with oil and gas potential in Arizona (from AZGS Circular 29).

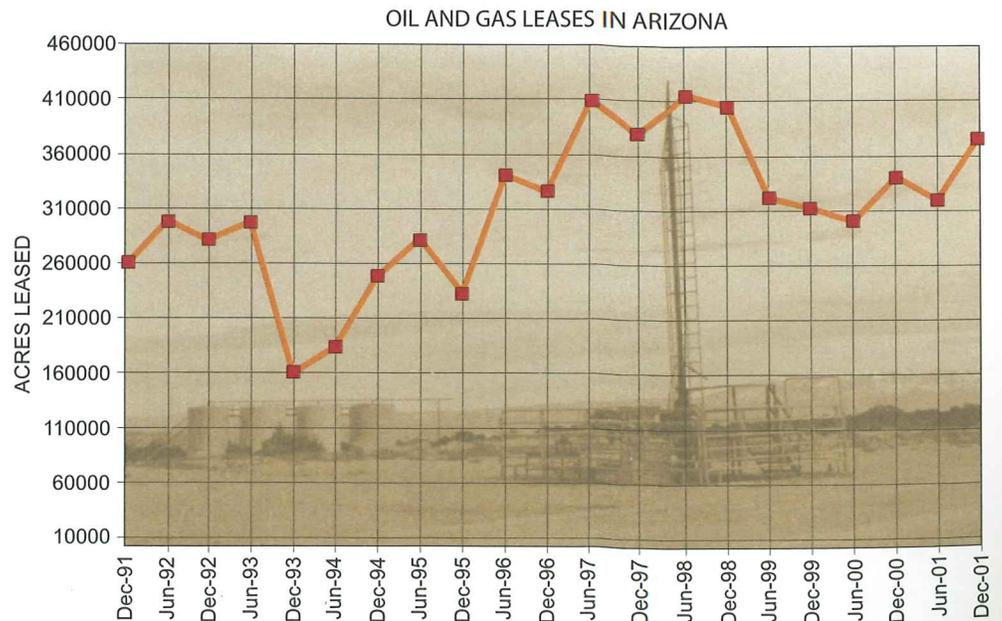


Figure 4. Total acres under lease December 1991 through December 2001. Increase from December 1995 to June 1999 is the result of interest in carbon dioxide in east-central Arizona.

New Publications

During the past three years the Arizona Geological Survey, in cooperation with the Arizona Oil and Gas Conservation Commission, released reports on the following subjects in order to better define Arizona's energy and related resources and encourage additional exploration:

Carbon dioxide in the St. Johns-Springerville area (Open-File Report 99-02)

Permian salt in the Holbrook basin (Open-File Report 00-03)

Petroleum source-rock potential of the Chuar Group in northern Arizona (Open-File Report 02-01)

Oil and gas potential in Arizona (Circular 29)
Salt in Arizona (Circular 30 and Arizona Geology, Spring 2002)

Energy resources in Arizona (Arizona Geology, Summer 2001)

Crude oil supply and demand: long-term trends (Arizona Geology, Winter 2001)

Need more information?

If you have any questions about oil and gas activities in Arizona or Arizona's oil and gas statutes, click on the AZGS website (www.azgs.az.gov) or telephone Steve Rauzi (520-770-3500).

JUST RELEASED

A guide to the geology of Catalina State Park and the western Santa Catalina Mountains: Bezy, J.V., 2002, Arizona Geological Survey Down-to-Earth 12 (DTE 12), 56 p. \$7.95 plus shipping and handling (page 6)

The content of this book is summarized on page 5 of this issue.

Giant desiccation cracks in the southwestern part of the Tohono O'odham Nation, Pima County, Arizona: R.C. Harris, 2002, Arizona Geological Survey Open-File Report 02-04 (OFR 02-04), 46 p. \$7.75 plus shipping and handling (page 6)

Giant desiccation cracks form when thick layers of clay-rich sediments dry out. The cracks, which form polygons 50 to 300 meters across, are common in playas in the southwestern United States.

Paleoseismology and neotectonics of the Shivwitz section of the Hurricane Fault, Mohave County, northwestern Arizona: Lee Amoroso, P.A. Pearthree, and J.R. Arrowsmith, 2002, Arizona Geological Survey Open-File Report 02-05 (OFR 02-05), 93 p., 1 sheet, scale 1:24,000 \$16.00 plus shipping and handling (page 6)

Diverse methods were used to estimate the slip rate along this fault and the age of the most recent earthquake. This section of the Hurricane fault presents a seismic hazard to the rapidly growing population of southwestern Utah. The Arizona Geological Survey, Arizona State University, and the U.S. Geological Survey supported the research.

Structural reconnaissance of lower-plate rocks along the Catalina-Rincon range front, Pima County, Arizona: E. R. Force, 2002, Arizona Geological Survey Contributed Map 02-A (CM 02-

A), 11 p., 2 sheets, scale 1:24,000 and 1:48,000 \$5.00 plus shipping and handling (page 6)

Geologic map of the Grasshopper Junction SE 7.5' quadrangle, Mohave County, Arizona: R.J. Varga, 2001, Arizona Geological Survey Digital Geologic Map 7 (DGM 7), 1 sheet, scale 1:24,000, 1 CD ROM \$15.00 plus shipping and handling (page 6)

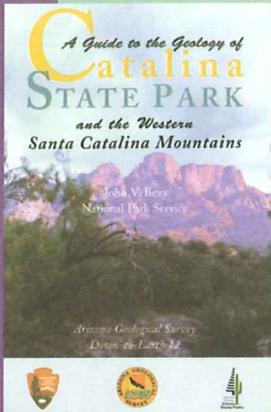
Geologic map of the Mount Fagan 7.5' quadrangle, eastern Pima County, Arizona: C.A. Ferguson, Ann Youberg, W.G. Gilbert, T.R. Orr, S.M. Richard, and J.E. Spencer, 2001, Arizona Geological Survey Digital Geologic Map 11 (DGM 11), 33 p., 1 sheet, scale 1:24,000, 1 CD ROM \$15.00 plus shipping and handling (page 6)

Geologic map of the White Tank Mountains, central Arizona: S.J. Reynolds, S.E. Wood, P.A. Pearthree, and J.J. Field, 2002, Arizona Geological Survey Digital Geologic Map 14 (DGM 14), 2 sheets, scale 1:24,000, 1 CD ROM \$15.00 plus shipping and handling (page 6)

Database for mineral districts in the State of Arizona: S.M. Richard, editor, 2002, Arizona Geological Survey Digital Information 23 (DI 23), 1 CD ROM \$30.00 plus shipping and handling (page 6)

This is a digital version of Map 18 (1983). Boundaries of metallic mineral districts have been revised for consistency with the bedrock geology and locations of prospects. The database includes production data from Bulletin 194. The project was done in cooperation with the U.S. Bureau of Land Management.

GEOLOGY GUIDE TO CATALINA STATE PARK



Arizona State Parks, the National Park Service (NPS), and the Arizona Geological Survey (AZGS) collaborated to produce *A Guide to the Geology of Catalina State Park and the Western Santa Catalina Mountains*. The 56-page book, *Down-to-Earth 12*, is available for purchase at the Catalina State Park Visitor Center and the Arizona

Geological Survey. Ordering information is provided on page 5 under "Just Released."

John V. Bezy, a NPS geologist, wrote the book. Larry D. Fellows (AZGS) took most of the photographs. John A. Birmingham (AZGS) prepared illustrations and did the design and layout. Rose Ellen McDonnell (AZGS) edited the book. Julie Allbrooks was the project coordinator for State Parks, which paid for the printing of the book. Neil Donkersley, Catalina

State Park Manager, discussed, reviewed, and patiently monitored progress on the project.

The book includes descriptions and photographs of 22 geologic features that can be observed along the western margin of the Santa Catalina Mountains north of Tucson, including within Catalina State Park, along the Charouleau Gap road near SaddleBrooke, near Biosphere 2, and just south of the town of Oracle.

The western Santa Catalina Mountains are on the upthrown (east) side of a major fault named the Pirate fault. The west side of the fault may have moved downward as many 16,000 ft relative to the east side. The Cañada del Oro flows southward and generally parallels the front of the mountains, not far west of the fault zone. Fragments of granite and other rock types, eroded from the rugged mountains east of the fault, were deposited as alluvial fans adjacent to the mountains and as alluvium by the Cañada del Oro and its tributaries. Erosional and depositional features that developed in this setting are described in the geology guide.

AZGS COMPLETES REVIEW

State agencies in Arizona are reviewed periodically, usually every 10 years, by the legislature. The purpose of the review is to determine (a) what the agency accomplished during the review period, (b) whether the accomplishments were authorized by the enabling statutes, (c) whether there are problems that need to be corrected, (d) whether the enabling statutes need to be modified, and finally, (e) whether the State is justified to continue funding the agency with tax dollars.

The review process began with a performance audit by a legislative committee of reference composed of five members of the Natural Resources and Agriculture Committee of the House of Representatives and five members of the Senate Natural Resources, Agriculture, and Environment Committee.

The AZGS and a number of its constituents were asked to respond to questions

about the operation of the agency. A public hearing was held in November 2001, after which a bill to continue the agency was drafted for introduction in the legislature in January 2002. Committee hearings were held on the bill (House Bill 2046), first in the House and then the Senate. The bill passed both houses and was forwarded to Governor Jane Dee Hull, who signed it April 16, 2002.

We thank Governor Hull for signing the bill, the many legislators and staff for successfully moving the bill through the legislature, and AZGS constituents for participating in the process. The Arizona Geological Survey and its predecessors have proudly served and informed Arizonans since 1889. We look forward to effectively informing and advising the public about the geologic character of Arizona during the next 10 years.

PUBLICATION ORDERING INFORMATION

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 pre-paid 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 7.6% 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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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, please allow up to two days for photocopying.

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