



# Arizona House of Representatives House Majority Research REPORT

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**To:** JOINT LEGISLATIVE AUDIT COMMITTEE  
Senator Blendu, Chairman  
Representative Knaperek, Vice Chairman

**Date:** December 16, 2005

**Subject:** Sunset Review of the Arizona Oil and Gas Conservation Commission

Attached is the final report of the sunset review of the Arizona Oil and Gas Conservation Commission, which was conducted by the Senate Natural Resources and Rural Affairs and the House of Representatives Environment Committee of Reference.

This report has been distributed to the following individuals and agencies:

Governor of the State of Arizona  
The Honorable Janet Napolitano

President of the Senate  
Senator Ken Bennett

Speaker of the House  
Representative Jim Weiers

Senate Members  
Senator Marilyn Jarrett, Cochair  
Senator Marsh Arzberger  
Senator Timothy S. Bee  
Senator Robert Blendu  
Senator Robert Cannell

House Members  
Representative Michele Reagan, Cochair  
Representative Ray Barnes  
Representative Steve Huffman  
Representative Leah Landrum Taylor  
Representative Kyrsten Sinema

Arizona Oil and Gas Conservation Commission  
Arizona State Library, Archives & Public Records  
Office of the Auditor General

Senate Majority Staff  
Senate Research Staff  
Senate Minority Staff  
Senate Resource Center

House Majority Staff  
House Research Staff  
House Minority Staff  
Chief Clerk

## COMMITTEE OF REFERENCE REPORT

Senate Natural Resources and Rural Affairs and House of Representatives Environment  
Committee of Reference

### ARIZONA OIL AND GAS CONSERVATION COMMISSION

#### *Background*

Pursuant to A.R.S. § 41-2953, the Joint Legislative Audit Committee (JLAC) assigned the sunset review of the Arizona Oil and Gas Conservation Commission (OGCC) to the Senate Natural Resources and Rural Affairs and House of Representatives Environment Committee of Reference for review.

The Office of Oil and Gas Conservation, before 1959, was an office within the State Land Department. The OGCC became a stand-alone agency in July 1959. In July 1991, however, in an effort to reduce General Fund expenditures, the Legislature eliminated the OGCC and attached the Commission and one FTE to the Arizona Geological Survey (AZGS). The AZGS provides administrative and staff support needed to fulfill the mission and regulatory responsibilities of the OGCC.

Pursuant to A.R.S. § 27-515, the Arizona Oil and Gas Conservation Commission administers and enforces state laws relating to the conservation of oil, gas and geothermal resources. The OGCC fulfills its mission by issuing permits for oil, gas and geothermal wells; monitoring and inspecting wells and facilities for compliance with rules; maintaining rules; compiling and maintaining drilling, production, and subsurface data for public use; and preparing and publishing geologic studies to encourage and assist the exploration for and development of Arizona's oil, gas and geothermal resources.

#### *Committee of Reference Sunset Review Procedures*

The Committee of Reference held one public hearing on Wednesday, November 16, 2005 to review the Agency responses, as required by A.R.S. § 41-2954, subsections D and F, and to hear and accept public testimony. Testimony was received from J. Dale Nations, Chairman, Arizona Oil and Gas Conservation Commission and Paul Buff, Bureau of Land Management.

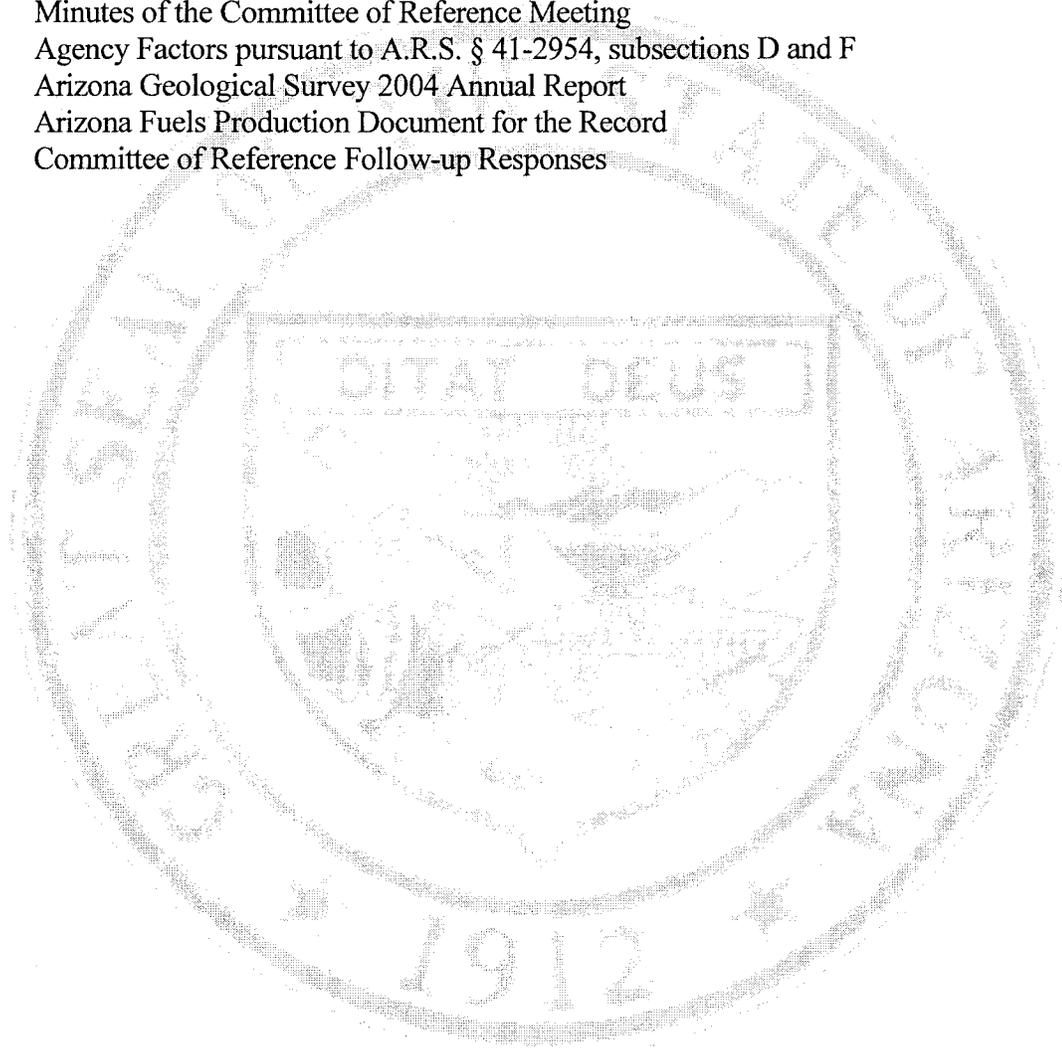
December 16, 2005

***Committee of Reference Recommendations***

The Committee of Reference recommended that the Arizona Oil and Gas Conservation Commission be continued for ten years.

***Attachments***

- 1) Meeting Notice
- 2) Minutes of the Committee of Reference Meeting
- 3) Agency Factors pursuant to A.R.S. § 41-2954, subsections D and F
- 4) Arizona Geological Survey 2004 Annual Report
- 5) Arizona Fuels Production Document for the Record
- 6) Committee of Reference Follow-up Responses



## ARIZONA STATE LEGISLATURE

### INTERIM MEETING NOTICE OPEN TO THE PUBLIC

#### SENATE NATURAL RESOURCES AND RURAL AFFAIRS AND HOUSE OF REPRESENTATIVES ENVIRONMENT COMMITTEE OF REFERENCE FOR THE SUNSET HEARING OF THE ARIZONA OIL AND GAS CONSERVATION COMMISSION

**Date:** Wednesday, November 16, 2005

**Time:** 10:00 a.m.

**Place:** House Hearing Room 5

#### AGENDA

1. Call to Order – Opening Remarks
2. Presentation of the Sunset Review on the Arizona Oil and Gas Conservation Commission
3. Public Testimony
4. Discussion and Recommendations by Committee of Reference
5. Adjourn

#### Members:

Senator Marilyn Jarrett, Co-Chair  
Senator Marsha Arzberger  
Senator Tim Bee  
Senator Robert Blendu  
Senator Robert Cannell

Representative Michele Reagan, Co-Chair  
Representative Ray Barnes  
Representative Steve Huffman  
Representative Leah Landrum Taylor  
Representative Kyrsten Sinema

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ARIZONA STATE LEGISLATURE  
Forty-seventh Legislature – First Regular Session

SENATE NATURAL RESOURCES AND RURAL AFFAIRS AND  
HOUSE OF REPRESENTATIVES ENVIRONMENT  
COMMITTEE OF REFERENCE FOR THE SUNSET HEARING OF THE  
ARIZONA OIL AND GAS CONSERVATION COMMISSION

Minutes of Meeting  
Wednesday, November 16, 2005  
House Hearing Room 5 -- 10:00 a.m.

Chairman Reagan called the meeting to order at 10:18 a.m. and the Members present were recognized by the CoChairs.

**Members Present**

Senator Arzberger  
Senator Bee  
Senator Blendu  
Senator Cannell  
Senator Jarrett, Cochair

Representative Barnes  
Representative Landrum Taylor  
Representative Sinema  
Representative Reagan, Cochair

**Members Absent**

Representative Huffman

**Speakers Present**

Dale Nations, Chairman, Arizona Oil and Gas Conservation Commission  
Paul Buff, Bureau of Land Management

**PRESENTATION**

Dale Nations, Chairman, Arizona Oil and Gas Conservation Commission (OGCC), gave a slide presentation relating that the OGCC administers and enforces state laws relating to the conservation of oil, gas and geothermal resources. The OGCC consists of six members, five of which are appointed from the general public by the Governor, and the State Land Commissioner serves as the sixth ex-officio member. The Arizona Geological Survey (AGS) provides administrative and staff support. Even though Arizona is not a major oil-producing state, the revenue generated by oil and gas production greatly exceeds the cost of regulation by the OGCC. Compared to an annual General Fund budget for the OGCC of approximately \$60,000, the

SENATE NATURAL RESOURCES AND RURAL  
AFFAIRS AND HOUSE OF REPRESENTATIVES  
ENVIRONMENT COMMITTEE OF REFERENCE  
FOR THE SUNSET HEARING OF THE AZ  
OIL AND GAS CONSERVATION COMMISSION  
November 16, 2005

revenue from lease rentals recently averaged \$441,000 per year (which goes to the General Fund), and taxes recently averaged \$53,000 per year.

Mr. Barnes asked how compensation is provided for educational seminars. Mr. Nations responded that there is no budget for seminars. The commissioners meet four times per year and are compensated \$30 per day. There is only one employee, an oil and gas specialist who goes out and inspects wells that are drilled and makes sure safety precautions are followed. He does not have a travel budget and the AGS has a very limited travel budget. It would be better to have a travel budget for the employee to attend a few professional meetings per year.

Chairman Reagan noted that the OGCC was eliminated in 1991 and made into a division of the AGS, which has been a perfect fit and saves about \$130,000 per year. Mr. Nations assured Mr. Barnes that the OGCC is perfectly satisfied staying with AGS.

Mr. Nations advised Senator Jarrett that active oil wells are located on the Navajo reservation in the extreme northeastern part of Arizona in Apache County. Portions of Arizona with oil and gas potential are in the northeastern corner, the southeastern corner, the northwestern corner and possibly the Gulf of California region near Yuma.

Senator Jarrett said she understands there has been some study and experimentation in converting coal into oil in the Four Corners area and wondered if that would be under the OGCC's purview. Mr. Nations responded that coal is found on Navajo and Hopi reservation land, so that would be under federal purview, in addition to the Native American governments, but natural gas could possibly be produced from those coal beds. The gas is generally within the coal, although that has not been proven for Arizona coal. There is currently a tremendous amount of production of natural gas from coal beds in the Powder River Basin in Wyoming and the San Juan Basin in New Mexico.

Senator Jarrett recalled that when she was a child her father talked about the possibility of natural gas above the Rim. Mr. Nations said that would be in the extreme northeastern part of the state, probably the Holbrook area, where lots of wells have been drilled in the Holbrook Basin. Nothing has been developed commercially, but there is still an interest. He added that another type of gas, carbon dioxide, is being tested and produced in the St. John's area. Very few wells have been drilled over a very large area, so additional drilling will be necessary. How much would actually be productive has not yet been determined, and whether or not it is good enough to justify building a pipeline to the West Coast to deliver the carbon dioxide is currently in question.

Senator Cannell asked if there is any use for the carbon dioxide in dry ice. Mr. Nations replied that the main use is enhanced recovery in oil fields where it is pumped down into the reservoir. For example, it is being used in the Permian Basin in West Texas. Carbon dioxide is produced in Colorado and New Mexico and piped down to the oil fields in the Permian Basin. A real interest for the Arizona potential would be the West Coast where the oil fields in the Los Angeles area are being depleted. If they had a large supply of carbon dioxide, it could be pumped into the reservoirs, which would selectively move more of the oil out of the reservoir.

Mr. Nations advised Senator Cannell that geothermal is being tested in the White Mountains volcanic region and the San Francisco Peak.

Senator Cannell asked if OGCC was involved in the proposal to store gas near Luke Air Force Base, which was very controversial. Mr. Nations answered that the OGCC regulates the maintenance of the wells, which have to be drilled to create caverns in the salt to store the gas, either liquefied or natural. The OGCC is responsible for determining that the wells are done safely, maintained properly, and monitoring production. He indicated that storage would be safe in the area as long as the wells are maintained, but he understands the public concern. There are other salt basins in Arizona where it could be done farther away from urban areas.

Senator Blendu asked why some storage facilities have blown up if they are so safe, such as in Kansas, New Mexico and Arkansas. Mr. Nations said he does not know, but the OGCC is concerned about making sure projects are done in a safe manner.

Senator Blendu remarked that he is concerned when these plans are proposed and people from the OGCC testify before a Committee that it is completely safe when the reality is it is only as safe as it is maintained and the OGCC checks it. Mr. Nations pointed out that checking involves conducting pressure tests to determine if there is any leakage, which is done regularly.

Senator Blendu noted that the storage facility that blew up in New Mexico killed 14 people including people as far away as one-quarter mile, so he believes it is unacceptable to put these storage facilities in neighborhoods. Mr. Nations reiterated the fact that there are other basins with thick sequences of salt that could be used for that kind of development without conflict with an urban area.

Senator Blendu replied that was his argument and he hopes that in the future OGCC will point that out and say there is a danger, and according to inspections, specification, and testing that danger may be minimized, but it is up to the OGCC to quantify how it affects other things when it could be done somewhere else. Mr. Nations answered that it is flammable matter and these considerations should be taken into account. Luke Air Force Base already exists and all that can be done is to monitor and make sure storage facilities are done properly, which is done by people who know what they are doing.

Senator Blendu wondered why Mr. Nations did not know about the storage facilities that blew up, noting that it would be good to find out why and factor that into OGCC's work. Mr. Nations said he will pursue the matter and prepare a review for the Members.

Chairman Reagan asked if OGCC would be involved in pursuing an oil refinery in Arizona. Mr. Nations answered that OGCC would not have anything to do with that and assumed that it would fall under the Arizona Corporation Commission.

Mr. Nations advised that Arizona is not a major oil or gas producing region, but does have a history of production since about 1957. He reviewed a chart showing the annual production

from 1954 to 1996 (Attachment 1). He said Arizona currently has 29 active oil wells in the extreme northeastern part of the state, 14 active gas wells and 14 hydrocarbon storage wells. The hydrocarbon storage wells are south of Interstate 40 near Sanders and the Luke AFB. Other companies are interested in other basins, such as the Picacho Peak area where there is not a lot of population, and Red Lake in the extreme northwestern part of the state near Kingman.

Mr. Nations concluded the presentation by stating that with the increase in oil and gas prices, it is likely there will be more interest and investment in development of oil and gas resources in Arizona. The OGCC is prepared to encourage and regulate Arizona's oil, gas and geothermal development in the future.

He advised Senator Bee that some test drilling has been done in the Picacho Peak area to determine if the salt reservoir is adequate. Senator Bee asked if that type of project is done in conjunction with county supervisors and land planners. He is aware that Diamond Ventures is going to be putting in a huge project near Picacho Peak, so there will probably be more and more development in Pinal County.

Mr. Nations said there was some communication relative to Luke AFB with the county government, but he does not know about Picacho Peak. Senator Bee encouraged communication with the county board of supervisors.

Chairman Reagan asked Mr. Nations to send the results of the research on Senator Blendu's concerns to Tami Stowe, House Majority Research Analyst, for distribution to the Members.

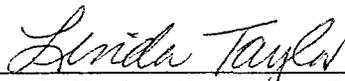
### **PUBLIC TESTIMONY**

Paul Buff, Bureau of Land Management, in favor of continuation of OGCC, testified that he works closely with the OGCC on leasing and drilling issues on federal lands.

### **RECOMMENDATION**

**Senator Jarrett moved that the Committee of Reference recommend to the Legislature that the Arizona Oil and Gas Conservation Commission be continued for 10 years. The motion carried by a roll call vote of 9-0-0-1 (Attachment 2).**

Without objection, the meeting adjourned at 10:48 a.m.

  
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Linda Taylor, Committee Secretary  
November 21, 2005

(Original minutes, attachments, and tape are on file in the Office of the Chief Clerk.)

REPORT TO THE COMMITTEE OF REFERENCE

On the

2006 SUNSET REVIEW

Of the

**ARIZONA OIL AND GAS CONSERVATION COMMISSION**

Submitted by

J. Dale nations

Chairman Arizona Oil and Gas Conservation Commission

And

Steven L. Rauzi

Oil and Gas Program Administrator

August 19, 2005

## EXECUTIVE SUMMARY

The Oil and Gas Conservation Commission (OGCC), pursuant to A.R.S. § 27-515, administers and enforces state laws relating to the conservation of oil, gas, and geothermal resources. The statutory definition of gas, A.R.S. § 27-501(9), includes helium and carbon dioxide.

Before 1959, the Office of Oil and Gas Conservation at the State Land Department administered state laws relating to oil and gas. The OGCC became a stand-alone agency in July 1959. In July 1991, in order to reduce General Fund expenditures, the Legislature eliminated the agency and attached the OGCC (governing board) and one FTE to the Arizona Geological Survey (AZGS). The OGCC retained statutory authority to set policy, promulgate rules, and issue orders on matters within its jurisdiction. Under this arrangement, the AZGS provides administrative and staff support needed to fulfill the mission of the OGCC. This has reduced expenditure of General Revenue funds on behalf of the OGCC from about \$190,000/year to about \$60,000/year, a savings of \$130,000/year.

The OGCC fulfills its mission by issuing permits for oil, gas, and geothermal wells; monitoring and inspecting wells and facilities for compliance with rules; maintaining rules in Title 12, Chapter 7 of the *Arizona Administrative Code*; collecting, compiling, and maintaining drilling, production, and subsurface data for public use; coordinating enforcement with the Attorney General; and preparing and publishing geologic studies to encourage and assist the exploration for and development of Arizona's oil, gas, and geothermal resources.

Arizona currently has 29 active oil wells, 14 active gas wells, and 14 hydrocarbon-storage wells. During the Sunset Review period (July 1996 through June 2005) the OGCC permitted 36 wells. All drilling, producing, and storage wells were inspected and monitored. All safety, environmental, or communication problems were resolved.

## CONCLUSION

It is important that a commission of public members should set oil and gas regulatory policy and promulgate and maintain rules that govern the drilling and production of oil, gas, and geothermal resources in Arizona. The regulated community has access to the OGCC if disputes or special needs require resolution. **The OGCC, the only governmental unit with appropriate statutory authority and technical expertise to perform these functions, should be continued.**

Affiliation with the AZGS facilitates sharing of geologic data, maintaining subsurface and well information, and accessing expertise relative to the overall geologic character of Arizona's subsurface and potential for oil and gas resources.

## **Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission**

### **REPORT TO THE COMMITTEE OF REFERENCE**

The following information about the Arizona Oil and Gas Conservation Commission (OGCC) was compiled in response to a request from representative Michele Reagan, Co-Chair of the Committee of Reference. The sunset review period is from July 1, 1996 to June 30, 2006.

#### **1. The objective and purpose in establishing the agency.**

The OGCC was established to administer and enforce state laws relating to the conservation of oil, gas, and geothermal resources. The Arizona Geological Survey (AZGS) provides administrative and staff support needed to carry out this charge.

The OGCC conserves and prevents waste of oil, gas, and geothermal resources; provides for protection of owners of land wherein these resources lie; encourages responsible exploration and development of these resources; and safeguards the health, property, environment, and public welfare of the citizens of the State.

The above objectives are accomplished by issuing permits for oil, gas, and geothermal wells; monitoring and inspecting wells and facilities for compliance with rules; maintaining effective rules in Title 12, Chapter 7 of the *Arizona Administrative Code*; collecting, compiling, and maintaining drilling, production, and subsurface data for public use; coordinating enforcement with the Attorney General; and completing geologic studies to encourage exploration for and development of Arizona's oil, gas, and geothermal resources.

#### **2. The effectiveness with which the agency has met its objective and purpose and the efficiency with which it has operated.**

During the Sunset Review period (July 1996 to June 2005) 36 drilling permits were issued, 29 wells were drilled, and all OGCC rules were reviewed in conjunction with the Governor's Regulatory Review Council and amended as necessary. In addition, there are currently 29 active oil wells, 14 active gas wells, and 14 hydrocarbon-storage wells in Arizona. All drilling, producing, and hydrocarbon-storage wells were inspected and monitored. All safety, environmental, or communication problems were resolved.

The OGCC has effectively met its objective and purpose through close interaction with the regulated community and the Departments of Water Resources and Environmental Quality; timely inspections during drilling; periodic inspections of hydrocarbon-storage wells, and by keeping its rules consistent with current technology and environmental practices. This regulatory activity is carried out with expenditure of about \$60,000 of General Revenue funds. Examples of major activities completed are:

- a. Enforced abandonment of two non-productive exploratory wells near Meteor Crater and Concho.

## Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission

- b. Completed two 5-year reviews of oil and gas rules in Title 12, Chapter 7, *Arizona Administrative Code* in cooperation with the Governor's Regulatory Review Council (GRRC).
  - c. Amended 7 rules in Title 12, Chapter 7, *Arizona Administrative Code*. The GRRC approved all amended rules.
  - d. Completed an assessment of potential geologic carbon sequestration sites in Arizona for the U.S. Department of Energy.
  - e. Microfilmed all oil and gas files to provide for disaster recovery.
  - f. Prepared and published 12 geologic studies related to subsurface geology for the purpose of encouraging and assisting exploration for and development of Arizona's oil, gas, and geothermal resources.
  - g. Digitized oil and gas well information on a CD that is available to the public.
- 3. The extent to which the agency has operated within the public interest.**

The OGCC's rules, orders, and substantive policy statements are adopted to conserve oil, gas, and geothermal resources, and safeguard the health, property, environment, and public welfare of the citizens of the State. Ensuring proper drilling, completion, and production practices conserves resources and prevents pollution of ground water.

All meetings and hearings of the OGCC are open to the public. An agenda is posted two weeks before the meeting or hearing to advise the public on all matters to be considered. This ensures input and participation by all interested parties in any matter being considered.

The composition of the OGCC further ensures its operation in the public interest. The OGCC consists of six members, five of which are appointed from the general public by the Governor. The State Land Commissioner serves as the sixth, ex-officio member. Only the appointed, public members have voting rights, and no more than three members may be of the same political party.

**4. The extent to which rules and regulations promulgated by the agency are consistent with the legislative mandate.**

A.R.S. § 41-1054 requires an agency to conduct a review of its rules in cooperation with the GRRC every five years. This ensures that rules are up-to-date with respect to current technology in the regulated industry and the latest environmental protection practices. The review process ensures that each rule is:

- a. Authorized by existing statutes;

## Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission

- b. Effective in meeting its intended objective;
- c. Consistent with legislative mandate, other rules, and current enforcement policy; and
- d. Clear, concise, and understandable by the regulated industry and general public.

The OGCC cooperated with the GRRC in these reviews of its rules. Four rules were amended, and all were shown to be consistent with legislative mandate.

### **5. The extent to which the agency has encouraged input from the public before promulgating its rules and regulations and the extent to which it has informed the public as to its actions and their expected impact on the public.**

All rulemaking activities of the OGCC are carried out in full compliance with the Arizona Administrative Procedures Act, reviewed by the GRRC, and adopted subject to certification by the Attorney General. GRRC meetings are open to the public and all rules sent to the GRRC must be accompanied by an economic, small business, and consumer impact statement.

All OGCC rulemaking activity is initiated in public meetings, published in the *Arizona Administrative Register*, and adopted after a public hearing on the proposed rulemaking. This process facilitates input and participation from the regulated industry and general public in the promulgation of all OGCC rules.

### **6. The extent to which the agency has been able to investigate and resolve complaints that are within its jurisdiction.**

Few complaints have been received, and they have been resolved with input from the public. This is due to the right of any interested person to appear at any OGCC meeting and be heard on any matter within the jurisdiction of the OGCC. The OGCC encourages and welcomes public input, which is carefully considered before regulatory and policy decisions are made.

### **7. The extent to which the attorney general or any other applicable agency of state government has the authority to prosecute actions under the enabling legislation.**

Pursuant to A.R.S. § 27-521, the Attorney General shall be attorney for the OGCC, and has full authority to prosecute actions under the enabling legislation. Enforcement options include prohibitory or mandatory injunctions, temporary restraining orders, and preliminary injunctions in addition to civil penalties of not more than one thousand dollars for each violation and for each day the violation continues.

Within the sunset review period, the OGCC successfully resolved two ongoing cases of noncompliance by closely coordinating enforcement with the Attorney General. Forfeiture of bond money and threat of prosecution by the Attorney General resulted in compliance before the cases were brought to suit.

## **Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission**

### **8. The extent to which agencies have addressed deficiencies in their enabling statutes which prevent them from fulfilling their statutory mandate.**

In late 1998 discussions with the state land department, regulated community, legislators, and the Attorney General resulted in HB 2332, which amended A.R.S. §§ 27-501, 27-516, 27-522, 27-653, and 27-661 in the 1999 legislative session. This bill clarified the definition of a gas well and extended the time frame for holding well information confidential from six months to one year from the completion of drilling.

In late 1999 an independent operator had some concern with the existing time frame for holding well information confidential. Discussions with the operator, legislators, and the Attorney General resulted in HB 2492, which amended A.R.S. §§ 27-501, 27-515, and 27-522 in the 2000 legislative session. This bill clarified the definition of a completed well and extended the time frame for holding well information confidential from one year to not more than two years from the completion of drilling upon a showing of cause by an operator.

### **9. The extent to which changes are necessary in the laws of the agency to adequately comply with the factors listed in this subsection.**

No changes are necessary at this time.

### **10. The extent to which the termination of the agency would significantly harm the public health, safety, or welfare.**

The OGCC safeguards the health, property, environment, and public welfare of the citizens of the State as it relates to oil, gas and geothermal drilling and production activities. Termination of the OGCC would result in a vacuum because no other agency has statutory authority to address these needs. Not only is statutory authority required, the agency must also have properly qualified staff. Persons with such qualifications are not employed by any other agency.

Errors in judgement concerning blow-out-control equipment and tests; depth and integrity of casing strings; and construction, maintenance, and operation of hydrocarbon storage wells could result in pollution of groundwater or blow outs and major fire resulting in possible injuries or fatalities. Termination of the OGCC would clearly result in a serious risk to the health, property, safety, and public welfare of the citizens of the State.

### **11. The extent to which the level of regulation exercised by the agency is appropriate and whether less or more stringent levels of regulation would be appropriate.**

The OGCC recently strengthened its performance bonding requirements. The current level of regulation exercised by the AZGS on behalf of the OGCC is appropriate with the current level of industry exploration and drilling activity.

## Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission

### **12. The extent to which the agency has used private contractors in the performance of its duties and how effective use of private contractors could be accomplished.**

The OGCC does not use private contractors in the performance of its regulatory duties. It would not be cost effective or efficient to use private contractors to handle the day-to-day collection and filing of production, drilling, and injection records maintained by this office. A full-time employee of the State most efficiently provides collection and filing of records, public relations, correspondence, and assistance to the regulated industry. All well data, samples, and files are available to the public. We encourage the use of these data in developing exploration programs.

### ADDITIONAL WRITTEN RESPONSES

#### **1. An identification of the problem or the needs that the agency is intended to address.**

The OGCC was established to administer and enforce state laws relating to the conservation of oil, gas, and geothermal resources

#### **2. A statement, to the extent practicable, in quantitative and qualitative terms, of the objectives of such agency and its anticipated accomplishments.**

The objectives of the OGCC are to conserve and prevent the waste of oil, gas, and geothermal resources; provide for the protection of owners of land wherein these resources lie; and safeguard the health, property, environment and public welfare of the citizens of the state by encouraging responsible exploration for and development of oil, gas, and geothermal resources. The OGCC plans to continue close interaction with the regulated community and the Departments of Water Resources and Environmental Quality, the Arizona State Land Department and appropriate federal agencies. It will perform timely inspections during drilling, periodic inspections of hydrocarbon-storage wells, and maintain rules that are consistent with current technology and environmental practices.

#### **3. An identification of any other agencies having similar, conflicting or duplicate objectives, and an explanation of the manner in which the agency avoids duplication or conflict with other such agencies.**

The responsibilities of the OGCC do not overlap with any other agency or commission.

#### **4. An assessment of the consequences of eliminating the agency or consolidating it with another agency.**

Elimination of the OGCC would result in a void because no other agency has the statutory authority to administer and enforce laws relating to the conservation of oil, gas, and geothermal resources. The consequences of eliminating the OGCC would be a lack of regulation and supervision of drilling activities including: blowout control equipment and tests, depth and

## Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission

integrity of casing strings, and construction, maintenance and operation of hydrocarbon storage wells that could result in pollution of groundwater, blowouts, or fires. Termination of the OGCC may also result in serious injuries or fatalities.

### ADDITIONAL RESPONSES AND MOST RECENT ANNUAL REPORT

#### 1. Describe any major activities/projects, accomplishments, or obstacles to success.

The major activities of the OGCC, pursuant to A.R.S. § 27-515, are administering and enforcing state laws relating to the conservation of oil, gas, and geothermal resources. These activities include issuing permits to drill oil, gas, and geothermal wells; monitoring and inspecting wells and facilities for compliance with rules; maintaining effective rules in Title 12, Chapter 7, of the *Arizona Administrative Code*; collecting, compiling, and maintaining drilling, production, and subsurface data for public use; coordinating enforcement with the Attorney General; and completing studies encouraging exploration for and development of Arizona's oil, gas, and geothermal resources.

The AZGS provides staff support. Affiliation with the AZGS facilitates sharing of geologic data and library, maintaining subsurface and well information, and accessing expertise relative to the overall geologic character of Arizona's subsurface and potential oil and gas resources.

Recent accomplishments of the OGCC include:

- a. Enforced abandonment of two non-productive exploratory wells. One well was near Meteor Crater, and the other was near Concho.
- b. Amended 7 rules in Title 12, Chapter 7, *Arizona Administrative Code*, which were approved by the Governor's Regulatory Review Council.
- c. Issued permits for 36 wells during the review period (July 1996 through June 2005). (34 wells were permitted in the previous review period from July 1984 through June 1994)
- d. Provided expertise on subsurface salt in Arizona as related to natural gas storage in a meeting with Speaker Flake, Representatives Nelson and Gray, and constituents.
- e. Provided expertise on subsurface salt in Arizona as related to natural gas storage in a meeting with Senator Binder and constituents.
- f. Completed an assessment of potential geologic carbon sequestration sites in Arizona for the U.S. Department of Energy.
- g. Microfilmed all oil and gas files to provide for disaster recovery.
- h. Digitized oil and gas well information on a CD that is available to the public.

## Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission

- i. Prepared and published 12 geologic studies related to subsurface geology for the purpose of encouraging and assisting exploration for and development of Arizona's oil, gas, and geothermal resources.

### **2. Provide the committee of reference with the most recent annual report (attached), including financial data that outlines the fee structure, expenditures and revenues, and number of FTEs.**

- a. The OGCC was attached administratively to the AZGS in July 1991 to reduce expenditure of General Revenue funds. One FTE at the AZGS, the Oil and Gas Program Administrator, handles day-to-day oil and gas functions and conducts regulatory activities on behalf of the OGCC.
- b. Expenditures on behalf of the OGCC were reduced from about \$190,000 a year as a stand-alone agency to about \$60,000 a year after the OGCC was attached to the AZGS. The current funding level reflects the current level of drilling and storage-well activity.
- c. There are no direct revenues to the OGCC. Related, non-direct revenues, which currently go to the General and State Reclamation Funds, include application fees, oil and gas lease rentals, and severance and property taxes on oil and gas production and equipment. Application fees are a function of the number of drilling permits issued and have recently averaged \$130 a year. Lease rentals are a function of the amount of acreage under lease and have recently averaged \$441,000 a year. Taxes are a function of production levels and have recently averaged \$53,000 a year. The Arizona State Land Department administers leasing on State Trust Land. The U.S. Bureau of Land Management administers leasing on Federal and Indian Lands.
- d. Application fees are structured to balance the need to cover the cost of processing drilling applications and encouraging exploration in Arizona, which, in turn, increases the probability for a discovery. A discovery of oil or gas will create jobs and increase general fund revenue for the state.
- e. The OGCC collects a \$10,000 to \$20,000 performance bond, depending on depth of hole, for each well permitted. These funds include surety, certificates of deposit, or cash; are custodial in nature and are owed to individuals. They are returned upon completion of a drilling project or may be forfeited by the OGCC for noncompliance with rules.

### **3. The composition and manner of appointment of the commission including number of members, number of public members and method of appointment.**

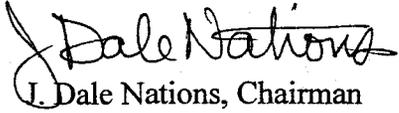
- a. The OGCC consists of six members. The Governor appoints five members from the general public. The State Land Commissioner serves as the sixth, ex-officio member. Only

**Sunset Review Report, 2006: Arizona Oil and Gas Conservation Commission**

the appointed, public members have voting rights, and no more than three members may be of the same political party.

- b. Current appointed members from the general public include Mr. Robert Jones, a retired petroleum geologist in Sun City West; Mr. Joseph Lane, a retired legislator in Phoenix; Dr. Dale Nations, a retired geology professor at Northern Arizona University in Flagstaff now living in Tucson; Ms. Michele Negley, a business management consultant in Phoenix; and Mr. Robert Wagner, a retired city manager in Yuma now living in Mesa. The sixth, ex-officio member is Mr. Mark Winkleman, State Land Commissioner.

Respectfully submitted by:



J. Dale Nations, Chairman  
Oil and Gas Conservation Commission

8/19/05

Date



Steven L. Rauzi  
Oil and Gas Program Administrator  
Arizona Geological Survey

8-19-05

Date

ANNUAL REPORT  
OF THE  
ARIZONA GEOLOGICAL SURVEY  
FY 2004



Pegmatite dikes intruded into the Leatherwood granodiorite.  
Arizona Geological Survey, Down-to-Earth 17

Larry D. Fellows  
Director and State Geologist

Arizona Geological Survey  
416 W. Congress Street, Suite 100  
Tucson, AZ 85701

(520) 770-3500

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Janet Napolitano  
Governor

State of Arizona  
**Arizona Geological Survey**

416 W. Congress, Suite 100  
Tucson, Arizona 85701  
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Larry D. Fellows  
Director and State Geologist

27 August 2004

The Honorable Janet Napolitano  
Governor  
1700 W. Washington  
Phoenix, AZ 85007

Dear Governor Napolitano:

The Annual Report of the Arizona Geological Survey (AZGS) for FY 2004 describes how staff carried out the AZGS mission by informing and assisting the public about the character of rock formations, geologic hazards, and mineral and energy resources. The report also summarizes geologic maps and studies that AZGS staff completed, including those that focused on the following topics:

- Distribution and character of rocks and sediment between Benson and Sierra Vista in Cochise County and near Green Valley in Pima County
- Alluvial-fan flooding on desert piedmonts in western Maricopa County
- Potential helium resources in the Holbrook basin in Navajo and Apache Counties
- Polygonal ground cracks in southern Arizona caused by prolonged drought

The report also describes special projects that were done under contract to provide information other agencies needed to carry out their missions. Funding for these projects supplemented the AZGS General Fund appropriation and expanded agency productivity.

The purpose of AZGS projects and activities is to produce and disseminate information that is used to make informed decisions and prudently manage Arizona's land, water, energy, and mineral resources.

I'll gladly answer any questions you or your staff might have about the report, the Arizona Geological Survey, or the geology of Arizona.

Respectfully submitted,

A handwritten signature in black ink that reads "Larry D. Fellows".

Larry D. Fellows  
Director and State Geologist

# EXECUTIVE SUMMARY

Arizona Geological Survey (AZGS) employees informed and assisted the public during Fiscal Year 2004 as follows:

- Responded to thousands of requests for information and assistance.
- Sold 9,076 reports and maps, an increase of 8.9 percent from last year. Revenue from sale of publications totaled \$70,567, an increase of 11.8 percent from last year. Almost 97 percent of mail orders were filled and mailed not more than one day after they were received.
- Released 24 new reports and maps on Arizona geology, including:
  - Four digital geologic quadrangle maps in the Santa Cruz River Valley south of Tucson in Pima County, and three in Cochise County along the San Pedro River Valley between Benson and Sierra Vista., including Kartchner Caverns State Park. (These maps are available in both paper and digital form.)
  - Three down-to-earth (non-technical) books (Wupatki and Sunset Crater Volcano National Monuments, White Mountains and the Springerville Volcanic Field, and Sabino Canyon and the Catalina Highway) done in cooperation with the National Park Service and the U.S. Forest Service
  - Two open-file reports that characterized rock units
  - Five open-file reports on applied geology subjects such as helium, asbestos, desiccation cracks, and alluvial-fan flooding
  - Seven articles published outside of the AZGS
- Participated in eleven cooperative projects under contract with governmental agencies including Arizona State Land Department, Flood Control District of Maricopa County, National Park Service, U.S. Department of Energy, U.S. Forest Service, and U.S. Geological Survey. Project expenditures totaled \$437,265. AZGS staff supervised the work of 15 temporary and part-time employees who were paid with contract funds to work on the projects.
- Gave 12 talks and led 18 field trips as requested by representatives of governmental agencies, professional societies, universities, and citizen groups.
- Updated five Digital Geologic Maps and three oil and gas maps.
- Submitted three manuscripts for publication outside of the AZGS.
- Published four 6-page issues of *Arizona Geology*, the AZGS newsletter.

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# MISSION AND DESCRIPTION

## 2 MISSION

To inform and advise the public about the geologic character of Arizona to help meet societal needs for water, energy, and mineral resources and assist in prudently managing the State's land and natural resources.

## DESCRIPTION

AZGS staff, who prepare geologic maps, complete field studies, compile data, and disseminate information, perform the following functions:

- Geology for Societal Needs.** Map and characterize rock formations and their weathering products; investigate geologic hazards and land-use 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; describe the origin, distribution, and character of metallic, non-metallic, and energy resources; and identify areas that may have potential for discovery of mineral and energy discoveries.
- Information and Service.** Inform and assist the public by answering inquiries, preparing and selling maps and reports, giving talks, leading field trips, and maintaining a library, databases, and a website.
- Oil and Gas.** Provide administrative and staff support to the Arizona Oil and Gas Conservation Commission. The Commission regulates the drilling for and production of oil, natural gas, geothermal, helium, and carbon dioxide, to ensure that sound engineering, environmental, and conservation practices are followed.
- Geologic Data Users**  
Citizens and citizen groups; elected officials and their staff, land- and resource-management agencies (e.g. State Land Department, Department of Water Resources, Department of Environmental Quality, Department of Transportation, State Parks, Office of Tourism, Attorney General), environmental and engineering geology companies, hydrologists, energy- and mineral-exploration companies, consultants, planners, attorneys, realtors, insurance companies, teachers, students, libraries, book dealers, and others.

## GEOLOGY FOR SOCIETAL NEEDS

3

**GOAL 1.** To characterize rocks, surficial materials, mineral and energy resources, and geologic hazards, with emphasis on areas that have potential for urban and resource development, and provide this information to the public.

Objective 1. Increase the distribution of technical maps/reports by 2 percent. Result: Did not meet objective – sale of technical maps/reports increased 0.5 percent.

## INFORMATION AND SERVICE

**GOAL 2.** To inform those not trained in geology about geologic processes and resources in Arizona.

Objective 1. Increase the distribution of non-technical reports by 15 percent. Result: Exceeded objective – sale of non-technical reports increased 39 percent.

Objective 2. Inform the public by giving 20 talks or field trips Result: Exceeded objective – gave 30 talks and field trips

**GOAL 3.** To disseminate more information while maintaining efficient service and high customer satisfaction.

## OIL AND GAS CONSERVATION COMMISSION

**GOAL 4.** To effectively assist the Arizona Oil and Gas Conservation Commission

Objective 1. Respond to requests for drilling permits within 5 working days.  
Result: Exceeded objective – issued 6 permits to drill with an average turn-around time of 4 business days from when the completed application was received

Objective 2. Inspect gas-storage wells twice and other wells as drilling takes place.  
Result: Met objective – conducted safety inspections of 14 wells in November and April and two wells during drilling.

# ACTIVITIES

## 4 GEOLOGY FOR SOCIETAL NEEDS

**National Cooperative Geologic Mapping Program.** Arizona Geological Survey (AZGS) geologists have participated in this cooperative program since its inception in 1993. They have completed mapping in most of the Phoenix-Tucson corridor and are expanding into other population-growth areas. During FY 2004 the AZGS released maps of four 7.5-minute quadrangles along and west of the upper Santa Cruz River valley south of Tucson in Pima County (Digital Geologic Maps 30-33). Citations for these and other publications released in FY 2004 are listed on pages 15-18. The agency also released maps of three 7.5-minute quadrangles along the upper San Pedro River between Benson and Sierra Vista in Cochise County (Digital Geologic Maps 34-36). Mapping is in progress on the southeast margin of Tucson, west of the White Tank Mountains in western Maricopa County, and in the Bullhead City area along the Colorado River.

The following AZGS geologists served on the mapping team: Jon E. Spencer, Stephen M. Richard, Charles A. Ferguson, and Bradford J. Johnson, bedrock geology; Philip A. Pearthree, Ann M. Youberg, and Todd C. Shipman, surficial geology; and Erin M. Moore and Stephen M. Richard, digital map preparation.

In addition to mapping the distribution of rock and surficial material units, AZGS geologists characterize the map units. In one project, released as Open-File Report 03-08, ages of 23 igneous rock samples from central and southeastern Arizona were determined. Geologists also described the mineralogy of granitic rocks that underlie much of northeastern Maricopa and northern Gila counties and released the results as Open-File Report 03-09.

The Statemap component of the National Cooperative Geologic Mapping Program, administered by the U.S. Geological Survey, provided half of the funding for geologic mapping in FY 2004. In accordance with the mapping act, the AZGS matched the federal funds received with an equal amount of state support. AZGS geologists provided in-kind service by doing geologic mapping and related activities. Requests for funding were judged competitively with proposals from the other state geological surveys. The AZGS was awarded \$217,439 for FY 2004; the total value of the mapping project, including the AZGS match, was \$434,878.

Priority of areas to be mapped was determined by the Arizona Geologic Mapping Advisory Committee, which is composed of representatives of state land- and resource-management agencies and the private sector. Committee members are:

Al Burch (U.S. Bureau of Land Management)  
Charles D. Graf (Arizona Department of Environmental Quality)  
William M. Greenslade (Southwest Ground-water Consultants, Inc.)  
Barbara H. Murphy, Chair (Clear Creek Associates)  
Nicholas M. Priznar (Arizona Department of Transportation)  
Frank Putman (Arizona Department of Water Resources)  
Michael J. Rice (Arizona State Land Department)  
Ralph E. Weeks (AMEC Earth & Environmental).

**National Geologic Map Database project.** Stephen M. Richard is a member of the North American Data Model Steering Committee. The purpose of the committee is to coordinate and review efforts to develop a data model, science language, and interchange mechanisms for exchange of geologic map data between state and federal geological survey data providers and data consumers in the public and private sector.

Richard is also a member of the workgroup established to develop a standard digital geologic map data model. Version 1.0 of the model was published on the world wide web ([http://geology.usgs.gov/dm/steering/teams/design/NADM-C1.0/NADMC1\\_0.pdf](http://geology.usgs.gov/dm/steering/teams/design/NADM-C1.0/NADMC1_0.pdf)). The workgroup took the lead in final editing and document preparation. The document was submitted for a joint USGS-GSC open-file report.

Richard adapted and expanded the science language terms that were developed by working groups of North American Data Model Steering Committee. The terms will be used as the science vocabulary in the National Geologic Map database. He also developed the relational database implementation of NADM-C1 model for the National Geologic Map database. These activities support ongoing development of a 1:24,000-scale geologic map database for the Phoenix metropolitan area.

Richard was the author of one article and co-author of another that described geologic databases and terminology. These articles were included in U.S. Geological Survey Open-File Report 03-471.

**Piedmont flood hazards in Maricopa County.** The AZGS has cooperated with floodplain management agencies to use geologic mapping to help define flood-prone areas on desert piedmonts for the past 15 years. Active alluvial fans, where runoff spreads widely and may form new channels during floods, are areas of primary concern. AZGS geologists Philip A. Pearthree, Ann M. Youberg, and Todd C. Shipman mapped the surficial geology of the Waterman Wash watershed and are working with the Flood Control District of Maricopa County to delineate piedmont flood hazards there. They also released a report (Open-File Report 04-02) on alluvial-fan flooding along Tiger Wash in western Maricopa and eastern La Paz counties.

**Giant desiccation cracks.** The prolonged drought has caused the soil and subsoil to dry out and form giant polygonal cracks similar to mud cracks, but on a much larger scale. AZGS geologist Raymond C. Harris studied the cracks near Wintersburg in Maricopa County and released a report that describes them (Open-File Report 03-07). He also completed a study of the distribution of these cracks throughout Arizona. The results of that study were summarized in Open-File Report 04-01. Ray found that the distribution of these giant cracks is much more extensive than was originally known.

**Asbestos in Arizona.** The AZGS learned that a resident of the Sun City area had publicly alleged that a sand and gravel operator was releasing dust that contained asbestos fibers into the atmosphere. Because AZGS staff were unaware of any asbestos deposits in that drainage basin, Raymond C. Harris did a literature search to determine whether any asbestos minerals had been described there. He also reviewed publications that dealt with asbestos deposits and occurrences throughout the state. Harris found no scientific reports of asbestos minerals in the Agua Fria drainage and no geologic indicators of asbestos (Open-File Report 03-06). Asbestos was produced commercially for many years in the Globe area in the Salt River drainage. Minor occurrences are known in several other areas as well.

**Miscellaneous basin studies.** AZGS staff began compiling information on the geologic character of selected deep alluvial basins, including structural history, stratigraphy, geologic controls on ground-water quality, and potential geologic hazards. Raymond C. Harris is the principal investigator of this project, which will continue if funding is available. William R. Drake, Stevan Gyetvai, Lizbeth C. Green, and Kevin C. Horstman also worked on the project.

**Advanced volcanology field course.** During the past decade, AZGS geologist Charles Ferguson has mapped and described many of Arizona's complex volcanic fields as part of the National Cooperative Geologic Mapping Program. Based on experience gained from this work, he developed a field course ("Whole Lava Love") that is focused on teaching practical aspects of field volcanology. The course, which has been associated with formal courses taught at the University of Arizona and Arizona State University, has been offered during the Christmas holiday season. Participants representing industry, academia, and government have come from every inhabited continent. Because of Charles' experience and expertise in field volcanology, spectacular exposures of varied volcanic rocks, and Arizona's mild climate, the course has been highly successful.

**Relationships among fires, soil geochemistry, and geomorphology in Cochise County.** The AZGS has cooperated with the U.S. Forest Service on several projects to provide geologic mapping and other data to support sustainable range management practices in southeastern Arizona. During the past year, Thomas H. Biggs, a faculty member at the University of Virginia, and Philip A. Pearthree mapped the surficial geology of portions of Fort Huachuca that include burned and unburned areas. Geochemical analyses of soil samples from the burned and unburned areas were made. Results of this research were presented as a poster at a professional meeting in Tucson. The final report will be submitted to the U.S. Forest Service and Fort Huachuca staff early in fiscal year 2005. The report will be released by the AZGS after the Forest Service has reviewed it.

## 6 INFORMATION AND SERVICE

**Geology Information Center.** Staff, primarily Thomas G. McGarvin and Richard A. Trapp, answered requests for information about Arizona geology. Rachel A. Aragon and Maricella M. Moreno, who sold reports and maps, filled and mailed ninety-four percent of mail orders the same day the orders were received. The Arizona Geological Survey (AZGS) has formal cooperative agreements to distribute publications of the Arizona Geological Society and U.S. Geological Survey.

Publication sales totaled \$70,567, an increase of \$7,442 (11.8 percent) from FY 2003. The increase in sales is attributed to the improved economy and the release of new non-technical reports. Revenue from publication sales is used to purchase books and maps for resale and to print and distribute publications.

**Geology library and databases.** The AZGS maintains a non-circulating library that is open to the public. The library, managed by Thomas G. McGarvin, contains all AZGS publications, as well as the following items: theses and dissertations on Arizona geology; reports by Arizona state agencies; publications of state geological surveys in adjacent states; U.S. Geological Survey publications, maps, and open-file reports; and numerous publications by other governmental agencies and professional societies.

AZGEOBIB is a database that contains more than 13,200 bibliographic citations on Arizona geology. The database is key-worded by subject and geographic area. AZGS staff members provide lists of citations for specific requests. This is a popular service for those who are starting new projects and need to know what geologic maps and reports are available in the project area. Richard A. Trapp, Information Technology Manager, maintains the databases.

**Website.** The AZGS web site ([www.azgs.az.gov](http://www.azgs.az.gov)) includes information about the agency, geology of Arizona, and publications for sale. Links to other geology-related agencies and groups are provided. Rose Ellen McDonnell is the webmaster.

**Arizona Geology.** The AZGS published four six-page issues of *Arizona Geology* to describe geologic processes, resources, and features that impact land management and the economy of Arizona, publicize new geologic maps and reports, and highlight other activities that pertain to the geology of Arizona. Feature articles described potential helium resources, distribution of asbestos minerals in Arizona, giant desiccation polygons caused by drying of the soil, and geology of the Sedona area. The latter was written because *USA WEEK-END*, the magazine that comes in your Sunday newspaper, named the Sedona area ("Red Rock Country") as "the most beautiful place in America."

**Down-to-Earth (DTE) publications.** These publications are written for those who have had no formal education or training in geology, but have a strong interest in and curiosity about geologic processes and features. Many state and national parks were created to preserve spectacular geologic features. The AZGS released three books in this series:

DTE 15, *Roadside geology: Wupatki and Sunset Crater Volcano National Monument.* This book includes descriptions and color photographs of 14 geologic features formed by volcanic action, including cinder cones, lava domes, aa flows, squeeze-ups, hornitos, and xenoliths. Sara L. Hanson, Professor of Geology at Adrian College in Adrian, Michigan, wrote the book. She was assisted by staff at Sunset Crater and Wupatki National Monuments. Sarah was a participant in the Geologist-in-the Park Program sponsored by the Geological Society of America (GSA) and the National Park Service (NPS). She was also supported by the GeoCorps America Program sponsored by the GSA and the NPS.

DTE 16, *A guide to the geology of the White Mountains and the Springerville volcanic field, Arizona.* This book includes descriptions of 26 geologic features that were formed by volcanic eruptions or glaciers. Several rock formations that were present before volcanic activity began are also described. This project was done cooperatively with John V. Bezy, a retired geologist. Staff at the Apache-Sitgreaves National Forest provided assistance.

DTE 17, *A guide to the geology of Sabino Canyon and the Catalina Highway.* John V. Bezy, author, described 11 geologic features in Sabino Canyon and 14 that can be observed along the Catalina Highway, which ends on top of Mt. Lemmon. Eileen J. Hill, Store Manager of the Sabino Canyon and Palisades Visitor Centers,

Public Lands Interpretive Association, provided assistance and support. Staff of the Coronado National Forest also assisted.

**Earth science education.** Thomas G. McGarvin, the AZGS' primary contact with science and earth science teachers, assisted teacher groups in incorporating local geology into their courses. He conducted a workshop at the Fall 2003 Conference of the Arizona Science Teachers Association in which he described publications available from the AZGS, primarily the Down-to-Earth series, which could be applied to the classroom by earth-science educators. Tom also led several field trips tailored for educators to see basic geologic features and discuss them in context within their geologic setting.

**Service to community and professional groups.** AZGS geologists are asked occasionally to provide special assistance to governmental agencies, professional societies, universities, and public groups. This assistance included giving talks, leading field trips and workshops, serving on panels, reviewing technical aspects of applications or proposals for funding, reviewing the geologic content of manuscripts submitted for publication, and other assistance.

AZGS staff gave 12 talks and led 18 field trips during the year. A list of the talks given, field trips led, and other assistance provided is attached as Appendix I, page 13 (A paper copy of the text and map is available for \$15.00 plus shipping and handling.).

### OIL AND GAS CONSERVATION COMMISSION

**The Commission.** The Arizona Oil and Gas Conservation Commission (OGCC), which regulates the drilling for and production of oil, gas, helium, carbon dioxide, and geothermal resources, is attached to the Arizona Geological Survey (AZGS). The AZGS provides administrative and staff support. The Governor appoints five members of the commission; the sixth, the State Land Commissioner, is *ex officio*. Commissioners are J. Dale Nations, Tucson, chairman; Robert L. Jones, Sun City West, vice chairman; Joseph J. Lane, Phoenix; Michele P. Negley, Phoenix; Robert L. Wagner, Yuma; and Mark Winkleman, State Land Commissioner.

Steven L. Rauzi, the Oil and Gas Administrator, issues permits to drill, monitors drilling, inspects completed wells, compiles drilling and production data, maintains well files, and does other duties on behalf of the OGCC. The Commission met three times.

**Production, refining, and storage.** Oil production in calendar year (CY) 2003 totaled 47,289 barrels from 16 producing wells, down from 63,417 barrels from 20 wells in 2002. Gas production in CY 2003 increased to 443 million cubic feet from nine producing wells. CY 2002 production was 304 million cubic feet from seven wells. CO<sub>2</sub> production totaled 159 million cubic feet from one producing well in 2003, down from 217 million cubic feet in 2002. Commercial production of CO<sub>2</sub> started in July 2002.

Both of Arizona's refineries remained closed. The refineries, near Fredonia and Coolidge, have been shut down since January 1997 and August 1993, respectively. The refinery near Fredonia is used as a storage and transfer site for asphalt products

Liquefied petroleum gas (LPG) transferred through storage wells west of Phoenix and at Adamana in CY 2003 included 85 million gallons in receipts and 80 million gallons in deliveries. In CY 2002, 90 million gallons were received and 122 million gallons were delivered. About 35 million gallons of LPG were in storage at yearend, up from the 29 million gallons the year before. Fourteen storage wells in subsurface salt are in use.

**Leasing.** In CY 2003, 481,000 acres were under lease for oil and gas exploration, up from 438,000 acres in 2002.

State Trust Land under lease in December 2003 totaled 376,000 acres, up from 324,000 acres in December 2002. Public land under lease in December 2003 totaled 105,000 acres, down from 114,000 acres in December 2002. The State Land Department administers leasing on State Trust Land. The U.S. Bureau of Land Management administers leasing on public lands.

## Activities—continued

- 8 Drilling.** Six permits to drill were issued and two holes were drilled in FY 2004. Clayton Williams Energy drilled a hole in search of gas north of Flagstaff. No gas was discovered and the well was transferred to the landowner for use as a water well.

Ridgeway Arizona Oil Corporation drilled in search of carbon dioxide between St. Johns and Springerville. The company was evaluating the hole as of July 1, 2004.

**Inspection and enforcement.** Staff made semiannual inspections of 14 hydrocarbon-storage wells west of Phoenix and at Adamana and witnessed the cementing of surface casing on the wells drilled by Clayton Williams and Ridgeway. Inspections are conducted to ensure that wellhead valves, safety alarms, and emergency shutdown systems are working properly and that cement is circulated back to the surface.

**Subsurface data.** The OGCC requires drilling operators to submit subsurface data, including rock samples, logs, and all test results, to the AZGS to be filed and archived. These drilling data add to the general understanding of Arizona's geologic framework and subsurface mineral and energy resources. The AZGS maintains a series of maps that show the location of oil, gas, and geothermal wells and the types of subsurface data that are available for examination. Subsurface samples from the Clayton Williams well north of Flagstaff were added to the AZGS sample repository.

**Carbon dioxide update.** Ridgeway Arizona Oil Corporation announced discovery of carbon dioxide (CO<sub>2</sub>) in a well in the St. Johns and Springerville areas in southern Apache County in August 1994. The company drilled 15 wells before the end of May 1997. At a meeting of the House of Representatives Natural Resources Committee in Springerville in August 1999, Ridgeway representatives estimated that initial development to supply CO<sub>2</sub> for enhanced oil recovery would require two to three years and about 200 wells. The company informed meeting attendees that as many as 1,195 wells would eventually be drilled over the 25-40 year life of the project.

Ridgeway produced CO<sub>2</sub> from one well in 2002-03. Production was piped to a liquids plant near Tucson Electric Power Company's Springerville Generating Station. At the end of FY 2004 (June 30, 2004) a total of 16 wells had been drilled. Three were completed as gas wells and are shut in, four were temporarily abandoned, and eight were plugged and abandoned. The most recently drilled well is being evaluated.

**Southwest Regional Partnership on Carbon Sequestration.** The AZGS was awarded \$87,797 by the U.S. Department of Energy to investigate potential sites in Arizona where carbon dioxide could be safely sequestered or stored in subsurface rock formations. The New Mexico Bureau of Geology and Mineral Resources, the state geological survey, is the project coordinator. The state geological surveys of Colorado, Oklahoma, Utah, and Arizona, as well as other organizations, are also participants.

**Subsurface investigations.** S.L. Rauzi prepared a report on helium production and potential in Arizona, which was released as AZGS Open-File Report 03-05. The report was summarized in the Winter 2003 issue of *Arizona Geology*, the AZGS newsletter. Similar reports on oil and gas potential and salt were completed in previous years.

Office of the Director

9

**Larry D. Fellows**, Director and State Geologist  
B.S., Iowa State University; M.A., University of Michigan;  
Ph.D., University of Wisconsin

**Rose Ellen McDonnell**, Assistant Director of Administration  
B.S., University of Arizona

Geologists

**Jon E. Spencer**, Senior Geologist  
B.S., University of California, Santa Cruz;  
Ph.D., Massachusetts Institute of Technology

**Thomas G. McGarvin**, Geologist II  
B.A., California Lutheran College

**Erin M. Moore**<sup>(2)</sup>, Geologist I  
B.S., University of Arizona  
M.S., University of California at Davis

**Philip A. Pearthree**, Research Geologist  
B.A., Oberlin College; M.S., University of Arizona;  
Ph.D., University of Arizona

**Steven L. Rauzi**, Oil and Gas Administrator  
B.S. and M.S., Utah State University

**Richard A. Trapp**, Information Technology Manager  
B.S., University of Nebraska, Omaha; M.S., University of Arizona

Support Staff

**Mary E. Redmon**<sup>(3)</sup>, Administrative Assistant III  
**Mary N. Andrade**<sup>(4)</sup>, Administrative Assistant III  
**Rachel A. Aragon**<sup>(5)</sup>, Administrative Assistant I  
**Maricella M. Moreno**<sup>(6)</sup>, Secretary

**10 Contracted Geologists and Student Assistants<sup>(7)</sup>**

Monisha J. Banerjee, Laboratory Technician  
Thomas H. Biggs, Research Geologist  
Stephen B. DeLong, Project Geologist  
William R. Drake, Project Geologist  
Charles A. Ferguson, Research Geologist  
Lizbeth C. Greene, Project Geologist  
Stevan Gyetvai, Project Geologist  
Raymond C. Harris, Research Geologist  
Kevin C. Horstman, Research Geologist  
Bradford J. Johnson, Research Geologist  
Michael K. Mahan, Project Geologist  
Erin M. Moore, Geologist II  
Stephen M. Richard, Research Geologist  
Todd C. Shipman, Geologist II  
Ann M. Youberg, Geologist II

- <sup>(1)</sup> Geologists and support staff who were paid from the General Fund appropriation and were on the payroll on June 30, 2004, except as otherwise noted. The Arizona Geological Survey is authorized to employ 12.25 full-time-equivalent staff members from the General Fund appropriation.
- <sup>(2)</sup> Promoted to Geologist II October 13, 2003 (State funded half time and contract funded half time)
- <sup>(3)</sup> Resigned September 12, 2003
- <sup>(4)</sup> Promoted to Administrative Assistant III, July 1, 2003
- <sup>(5)</sup> Promoted to Administrative Assistant I, July 1, 2003
- <sup>(6)</sup> Hired August 4, 2003
- <sup>(7)</sup> Paid from contracted projects funded by other agencies or groups during Fiscal Year 2004 to complete a specific product or service within a specified period of time.

# EXPENDITURES

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GENERAL FUND EXPENDITURES			
Category	FY 2003 Expended	FY 2004 Expended	FY 2005 Budgeted
Personal Services	430,559	427,646	431,800
Benefits	89,419	97,698	104,700
Operations	213,607	214,493	219,600
In-State Travel	39,329	36,624	40,600
Out-of-State Travel	1,081		
Capital Equipment	775	3,123	
<b>TOTAL</b>	<b>774,770</b>	<b>779,584</b>	<b>796,700</b>

PRINTING REVOLVING FUND	
PUBLICATIONS	FY 2004 Expended
Arizona Geological Survey	46,941
Arizona Geological Society	1,728
U.S. Geological Survey	24,877
Other Publications	1,589
<b>TOTAL</b>	<b>75,135</b>

## CONTRACTED PROJECTS

Project Fund Source	Principal Investigator	Personal Services	Benefits	Professional Services	In State Travel	Out State Travel	Operations	Equipment	Other Costs	TOTAL
<i>Geologic Mapping</i> USGS	Spencer	136,578	32,967		2,819		13,820		20,835	207,019
<i>Fort Huachuca Fire on Soil</i> USFS	Pearthree	4,103	424				12,159			16,686
<i>Carbon Sequestration</i> DOE	Rauzi	12,492	3,460			1,260	6,211	1,157		24,580
<i>National Geologic Database</i> USGS	Richard	27,870	8,827							36,697
<i>Gila Oil Well</i> Gila Valley NRC	Harris	3,621	975							4,596
<i>Marsh Station</i> Statistical Research, Inc.	Pearthree	493	51							544
<i>Waterman Wash</i> Engineering and Environmental Consultants, Inc.	Pearthree	23,314	4,666		633					28,613
<i>Land Resources</i> Arizona State Land Department	Harris	71,821	11,049	2,250	1,741		3,945	4,381	22,591	117,778
<i>Gamma-ray Spectrometer Survey</i> Environmental & Earth Science Consultants	Harris	457	141		154					752
<b>TOTAL</b>		<b>280,749</b>	<b>62,560</b>	<b>2,250</b>	<b>5,347</b>	<b>1,260</b>	<b>36,135</b>	<b>5,538</b>	<b>43,426</b>	<b>437,265</b>

## Service to Constituents

13

**American Geophysical Union:** Reviewed a manuscript submitted for publication in *Tectonics*

**American Institute of Professional Geologists, Arizona Section:** Co-leader of a field trip to observe the influence of the Luke salt on urban development

\_\_\_\_\_: Co-leader of a field trip along the Catalina Highway to Mt. Lemmon, Santa Catalina Mountains, to observe structural geology and related features

**Arizona Department of Environmental Quality:** Reviewed a report on ambient water quality in Detrital Valley, northwest Arizona

**Arizona Department of Transportation:** Co-leader of a field trip that was given to attendees of the 2003 meeting of the Interstate Technical Group on Abandoned Underground Mines

**Arizona Floodplain Management Association:** Gave a talk on the geologic development of the lower Colorado River

**Arizona Geological Society:** Served as a member of the steering committee to plan a 2007 symposium

\_\_\_\_\_: Gave a talk on the geologic development of the lower Colorado River

**Arizona Rock Products Association:** Gave a talk on the AZGS geologic mapping program

**Arizona Science Teachers Association:** Gave a talk at the annual meeting of the Association on information available from the AZGS

**Arizona State Parks:** Led a field trip to review the newly released geologic map of the Kartchner Caverns area

\_\_\_\_\_: Prepared an inventory of digital geologic data available for State Parks

**Computers and Geosciences:** Reviewed a manuscript that was submitted for publication in this journal.

**Geological Society of America:** Reviewed a manuscript being prepared for publication in *Geology*

\_\_\_\_\_: Reviewed three manuscripts being prepared for publication in a Special Paper

**Graham County Engineer, Safford:** Reviewed reports and participated in a field review of a project that was done in cooperation with Graham County

**Melbourne University, Victoria, Australia:** Led a field trip for a professor and graduate student who were collecting Arizona rock samples for analysis.

**National Aeronautics and Space Administration :** Led a field trip for personnel to observe earth fissures and giant desiccation cracks near Wintersburg and in the Harquahala basin.

**National Science Foundation:** Reviewed three project proposals that were submitted for funding

**Pima County Flood Control District:** Served as vice-chair of the advisory committee

**Pueblo Optimists Club, Tucson:** Gave a talk on the purpose and activities of the Arizona Geological Survey

**Structural Engineers Association of Arizona:** Gave a talk on seismic hazard in Arizona

- 14**     **Sun City Rockhounds Club, Sun City:** Gave a talk on the geology of Arizona
- Sunsites Gem and Mineral Club, Sunsites:** Gave a talk on the geologic history of Cochise County
- Tohono Chul Park, Tucson:** Gave a talk about the geology of the Tucson area to docents-in-training
- Tucson Gem and Mineral Society:** Served on the show committee for the 2004 Gem and Mineral Show
- \_\_\_\_\_: Gave a talk on geologic information for rock and mineral collectors
- Tucson Unified School District, D.T. Smith Science Center:** Led a field trip for a group of teachers to observe the geology of the Tucson area
- U.S. Department of Energy:** Reviewed two manuscripts being prepared for publication
- U.S. Forest Service:** Provided information about post-fire flood damage in Romero Canyon in the Santa Catalina Mountains
- University of Arizona, Department of Geosciences:** Led a field trip at the 2004 GEODAZE event to observe the Pirate fault and debris-flow deposits in the Santa Catalina Mountains
- \_\_\_\_\_: Led 3 field trips for a volcanology class
- \_\_\_\_\_: Served on Ph.D. and M.S. advisory committees
- University of Texas at Austin:** Led a field trip to the Santa Catalina and Rincon Mountains for a graduate student who was starting a M.S. thesis project.
- U.S. Geological Survey:** Served on the advisory panel for the Earth Surface Processes Research Institute
- \_\_\_\_\_: Served as a review panel member for the Earthquake Hazards Reduction Program
- Western National Parks Association, Tucson:** Gave two talks on the geology of Catalina State Park
- Wings Over Willcox, Willcox:** Led field trips (three) to Fort Bowie, Chiricahua Mountains, and the Willcox Playa
- Verde River Day, Cottonwood:** Led two field trips to observe the geology of the Verde River as viewed from Dead Horse Ranch State Park

## MAPS AND REPORTS COMPLETED

15

ARIZONA GEOLOGICAL SURVEY (AZGS) - FY 2004

## ARIZONA GEOLOGY

What makes "Red Rock Country" beautiful?: L.D. Fellows, v. 33, n. 3, p. 1-4.

Arizona has helium: S.L. Rauzi and L.D. Fellows, v. 33, n. 4, p. 1-4

Asbestos in Arizona: R.C. Harris, v. 34, n. 1, p. 1-4

Giant desiccation cracks in Arizona: R.C. Harris, v. 34, n. 2, p. 1-4.

## DIGITAL GEOLOGIC MAPS

**DGM 30.** Geologic map of the Samaniego Peak 7.5' Quadrangle, Pima County, Arizona: Johnson, B.J., Ferguson, C.A., Pearthree, P.A., and Stavast, W.A., 2002, AZGS Digital Geologic Map 30, CD-ROM that includes one 1:24,000-scale geologic map and 21-p. text.

**DGM 31.** Geologic map of the Twin Buttes 7.5' Quadrangle, Pima County, Arizona: Richard, S.M., Spencer, J.E., Youberg, Ann, and Johnson, B.J., 2003, AZGS Digital Geologic Map 31, CD-ROM that includes one 1:24,000-scale geologic map.

**DGM 32.** Geologic map of the Batamote Hills 7.5' Quadrangle, Pima County, Arizona: Ferguson, C.A., Johnson, B.J., and Shipman, T.C., 2003, AZGS Digital Geologic Map 32, CD-ROM that includes one 1:24,000-scale geologic map and 31-p. text.

**DGM 33.** Geologic map of the Esperanza Mill 7.5' Quadrangle, Pima County, Arizona: Spencer, J.E., Ferguson, C.A., Richard, S.M., and Youberg, Ann, 2003, AZGS Digital Geologic Map 33, CD-ROM that includes one 1:24,000-scale geologic map and 10-p. text.

**DGM 34.** Geologic map of the Benson 7.5' Quadrangle, Cochise County, Arizona: Youberg, Ann, Skotnicki, S.J., Shipman, T.C., and Ferguson, C.A., 2004, AZGS Digital Geologic Map 34, CD-ROM that includes one 1:24,000-scale geologic map.

**DGM 35.** Geologic map of the McGrew Spring 7.5' Quadrangle, Cochise County, Arizona: Shipman, T.C. and Ferguson, C.A., 2003, AZGS Digital Geologic Map 35, CD-ROM that includes one 1:24,000-scale geologic map.

**DGM 36.** Geologic map of the Huachuca City 7.5' Quadrangle, Cochise County, Arizona: Pearthree, P.A., 2003, AZGS Digital Geologic Map 36, CD-ROM that includes one 1:24,000-scale geologic map.

## DOWN-TO-EARTH

**DTE 15.** Roadside geology: Wupatki and Sunset Crater Volcano National Monuments: Hanson, S.L., 2003, AZGS Down-to-Earth 15, 32 p.

**DTE 16.** A guide to the geology of the White Mountains and the Springerville Volcanic Field, Arizona: Bezy, J.V. and Trevena, A.S., 2003, AZGS Down-to-Earth 16, 56 p.

**DTE 17.** A guide to the geology of Sabino Canyon and the Catalina Highway: Bezy, J.V., 2004, AZGS Down-to-Earth 17, 45 p.

**16 OPEN-FILE REPORTS**

**OFR 03-05.** Review of helium production and potential in Arizona: Rauzi, S.L., 2003, AZGS Open-File Report 03-05, 29 p.

**OFR 03-06.** Is asbestos present in Agua Fria River sand and gravel?: Harris, R.C., 2003, AZGS Open-File Report 03-06, 15 p.

**OFR 03-07.** Additional desiccation cracks near Wintersburg, Maricopa County, Arizona: Harris, R.C., 2003, AZGS Open-File Report 03-07, 17 p.

**OFR 03-08.** U-Pb isotope geochronologic data from 23 igneous rock units in central and southeastern Arizona: Spencer, J.E., Isachsen, C.E., Ferguson, C.A., Richard, S.M., Skotnicki, S.J., Wooden, J., and Riggs, N.R., 2003, AZGS Open-File Report 03-08, 40 p.

**OFR 03-09.** Modal mineralogy of some granitic rocks from eastern Maricopa and northern Gila counties, Arizona: Spencer, J.E., Skotnicki, S.J. and Richard, S.M., 2003, AZGS Open-File Report 03-09, 18 p.

**OFR 04-01.** Giant desiccation cracks in Arizona: Harris, R.C., 2004, AZGS Open-File Report 04-01, 93 p.

**OFR 04-02.** Geomorphology and hydrology of an alluvial fan flood on Tiger Wash, Maricopa and La Paz Counties, west-central Arizona: Pearthree, P.A., Klawon, J.E., and Lehman, T.W., 2004, AZGS Open-File Report 04-02, 40 p.

**CONTRIBUTED MAPS AND REPORTS**

(These maps and reports, prepared by geologists not employed by the AZGS, were released by the AZGS.)

**CONTRIBUTED MAPS**

**CM 04-C.** Geologic map of the northern Hualapai Mountains, Mohave County, Arizona: Siwec, B.R., 2004, AZGS Contributed Map 04-C, scale 1:24,000.

**CM 04-D.** Geologic maps and cross sections of selected areas in the Rawhide and Buckskin Mountains, La Paz and Mohave Counties, Arizona: Scott, R.J., 2004, AZGS Contributed Map 04-D, several map scales.

**CONTRIBUTED REPORTS**

**CR 03-C.** The geology, leasing, and production history of the uranium-vanadium mines on Eurida Mesa, Apache County, Arizona: Chenoweth, W.L., 2003, AZGS Contributed Report 03-C, 24 p.

**CR 03-D.** The geology, leasing, and production history of the Rattlesnake No. 1/Shorty No. 1 uranium-vanadium mine, Apache County, Arizona: Chenoweth, W.L., 2003, AZGS Contributed Report 03-D, 14 p.

**CR 03-E.** Geology and production history of the Moonlight uranium-vanadium mine, Navajo County, Arizona: Chenoweth, W.L., 2003, AZGS Contributed Report 03-E, 18 p. (This report supersedes CR 95-D.)

**PUBLISHED OUTSIDE OF THE AZGS**

Damon, P.E., and Spencer, J.E., 2001, K-Ar geochronologic survey of the Hopi Buttes volcanic field, *in* Young, R.A. and Spamer, E.E., eds., Colorado River origin and evolution: Grand Canyon, AZ, Grand Canyon Association, p. 53-56.\*

Fenton, C.R., Webb, R.H., Pearthree, P.A., Cerling, T.E., Poreda, R.J., Nash, B.P., 2001, Cosmogenic <sup>3</sup>He dating of western Grand Canyon basalts: Implications for Quaternary incision of the Colorado River, *in*

Young, R.A. and Spamer, E.E., eds., Colorado River origin and evolution: Grand Canyon, AZ, Grand Canyon Association, p. 147-152.\*

Patchett, P.J., and Spencer, J.E., 2001, Application of Sr isotopes to the hydrology of the Colorado River system waters and potentially related Neogene sedimentary formations, *in* Young, R.A. and Spamer, E.E., eds., Colorado River origin and evolution: Grand Canyon, AZ, Grand Canyon Association, p. 167-171.\*

Richard, S. M., 2003, Geologic Map Database Implementation in the ESRI Geodatabase Environment, *in* Soller, D.R., ed., Digital mapping techniques - 2003 Workshop proceedings: U.S. Geological Survey Open-File Report 03-471.

Richard, S. M., Matti, J.C., and Soller, D.R., 2003, Geoscience terminology development for the National Geologic Map Database, *in* Soller, D.R., ed., Digital mapping techniques - 2003 Workshop proceedings: U.S. Geological Survey Open-File Report 03-471.

Spencer, J.E., and Pearthree, P.A., 2001, Headward erosion vs. closed-basin spillover as alternative causes for the integration of the lower Colorado River, *in* Young, R.A. and Spamer, E.E., eds., Colorado River origin and evolution: Grand Canyon, AZ, Grand Canyon Association, p. 215-219.\*

Spencer, J.E., Peters, Lisa, McIntosh, W.C., and Patchett, P.J., 2001,  $^{40}\text{Ar}/^{39}\text{Ar}$  geochronology of the Hualapai Limestone and Bouse Formation and implications for the age of the Lower Colorado River, *in* Young, R.A. and Spamer, E.E., eds., Colorado River origin and evolution: Grand Canyon, AZ, Grand Canyon Association, p. 89-91.\*

\*This book, which carries a 2001 copyright date, was released in June 2004.

## TALKS AND POSTERS PRESENTED AT MEETINGS

Biggs, T.H., Pearthree, P.A., Florkowski, L.N., and Lee, P.J., 2004, The effects of fire events on soil geochemistry in semi-arid grasslands, *in* Connecting mountain islands and desert seas: Biodiversity and management of the Madrean Archipelago II, p. 20.

Boisvert, Eric, Brodaric, Boyan, Hastings, J.T., Johnson, Bruce, McDonald, James, Richard, S.M., presenter, Schweitzer, Peter, and Weisenfluh, G.A., 2003, NORTON: A proposed North American Geologic Map data conceptual model: Geological Society of America *Abstracts with Programs*, v. 35, no. 6, p.368. This paper was presented at the annual meeting of the Geological Society of America in Seattle, November 2003.

Harris, R.C., 2004, Desiccation polygons in southern Arizona. This was a poster presentation at the Shlemon Specialty Conference on Earth Fissures, El Paso, Texas, April 2004. The Engineering Geology Foundation and the Association of Engineering Geologists sponsored the conference. Conference materials were published on a CD.

Richard, S.M., presenter, Spencer, J.E., Orr, T., Ferguson, C.A., and Dickinson, W.R., 2003, Evidence for 35-50 km displacement on the Cloudburst-Suizo detachment fault system north of Tucson, Arizona, and restoration of a Mesozoic high-angle fault system: Geological Society of America *Abstracts with Programs*, v. 35, no. 6, p. 27. This was a poster presentation at the annual meeting of the Geological Society of America in Seattle, November 2003.

Richard, S.M., presenter, Soller, D.R., Matti, J.C., 2003, Geoscience terminology development for the National Geologic Map Database: Geological Society of America *Abstracts with Programs*, v. 35, no. 6, p. 278. This was a poster presentation at the annual meeting of the Geological Society of America in Seattle, November 2003.

Richard, S.M., presenter, Soller, D.R., Craigue, Jon, and Hastings, J.T., 2003, Data entry tool for the National Geologic Map Database. This paper was presented at the Digital Mapping Techniques Conference hosted by the Oregon Department of Geology and Mineral Industries in Portland in May 2004.

**18 MAPS UPDATED**

**DIGITAL GEOLOGIC MAPS**

Geologists occasionally add detail to parts of the map, re-configure formation contacts, or reinterpret rock relationships. Whenever a map is modified the version number is changed correspondingly. The following changes were made to digital geologic maps:

**DGM 18.** Fortified Peak Quadrangle, version 2.0: a cross section and new geochronologic information were added; the area covered by the inset map (1:12,000 scale) was extended.

**DGM 19.** Durham Hills Quadrangle, version 1.1: a cross section was added and minor changes were made; no new mapping.

**DGM 21.** Oro Valley Quadrangle, version 2.0: additional new mapping at Pusch Peak and Pima Canyon, one cross section, and 3 radiometric age dates were added; one age for biotite granite of Alamo Canyon was revised.

**DGM 22.** Chief Butte Quadrangle, version 1.1: a cross section and new geochronological information were added; no new mapping.

**DGM 23.** North of Oracle Quadrangle, version 2.0: additional mapping of the porphyritic granite near the town of Oracle was added.

**OIL AND GAS MAPS**

**OG 02.** Annual oil, gas, and helium production in Arizona 1954-2003: Rauzi, S.L., 2004, Arizona Geological Survey Oil and Gas Publication 02, 18 p.

**OG 15.** Dineh-Bi-Keyah oil field, Apache County, Arizona: Rauzi, S.L., 2004, Arizona Geological Survey Oil and Gas Publication OG 15, scale 1:63,360. (OGCC Pool Series Map P 2)

**OG 35.** Oil and natural gas occurrence in Arizona: Rauzi, S.L., 2004, Arizona Geological Survey Oil and Gas Publication OG 35, chart. (OGCC Chart C 1) [published annually]

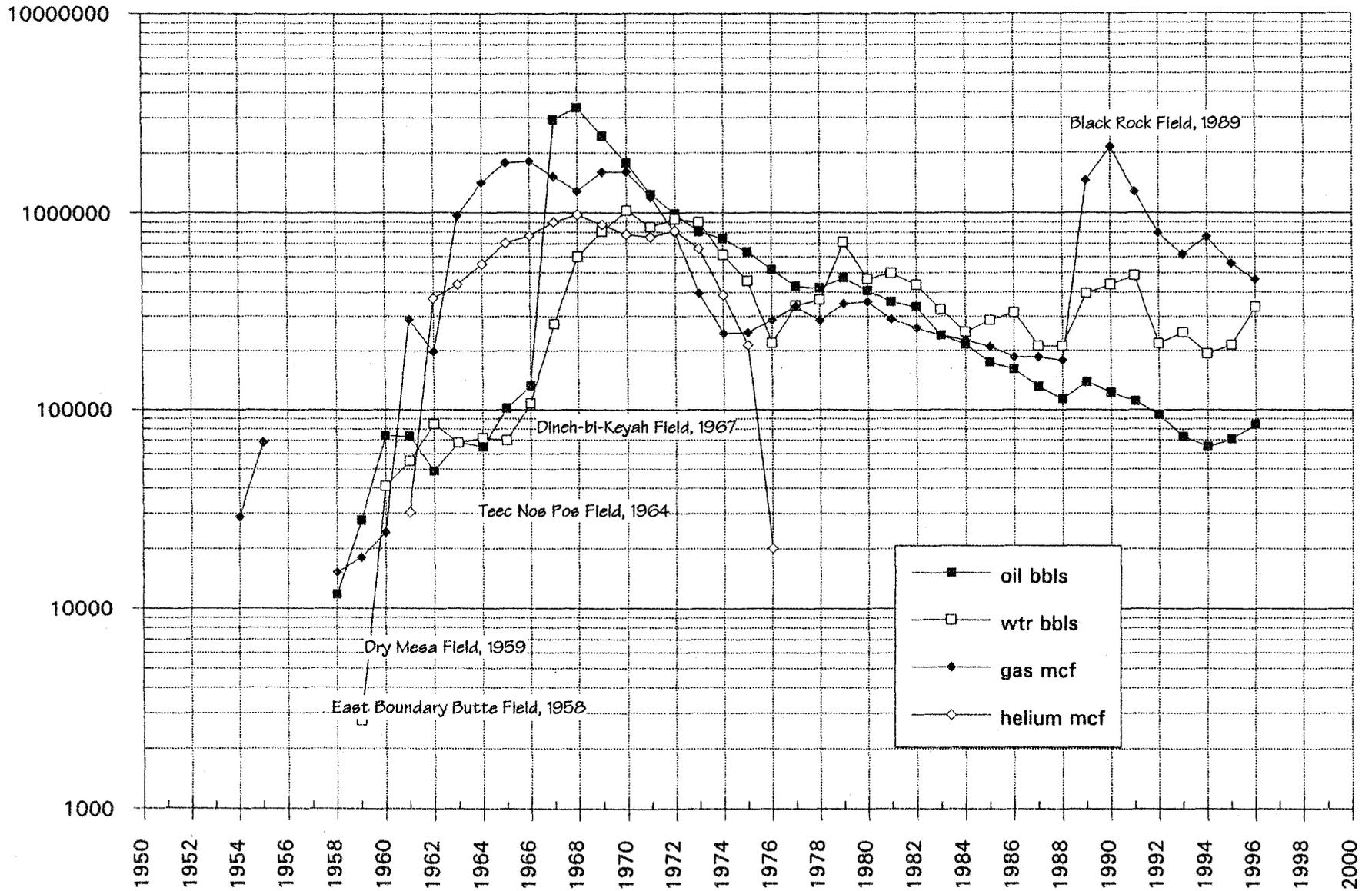
**MANUSCRIPTS SUBMITTED FOR EXTERNAL PUBLICATION**

Moore, J., Adams, M., Allis, R., Lutz, S., and Rauzi, S., Mineralogical and geochemical consequences of the long-term presence of CO<sub>2</sub> in natural reservoirs: An example from the Springerville-St. Johns field, Arizona and New Mexico, U.S.A.: submitted for publication by the U.S. Department of Energy.

Pelletier, J.D., Mayer, Larry, Pearthree, P.A., House, P.K., Demsey, K.A., Klawon, J.E., and Vincent, K.R., An integrated approach to alluvial-fan flood-hazard assessment with numerical modeling, field mapping, and remote sensing: Application to the southern Tortolita and Harquahala piedmonts, Arizona: Geological Society of America Bulletin.

White, S.P., Allis, R.G., Bergfeld, D., Moore, J.N., Chidsey, T.C., Morgan, C., McClure, K., and Rauzi, S.L., Evaluating the seal integrity of natural CO<sub>2</sub> reservoirs of the Colorado Plateau: submitted for publication by the U.S. Department of Energy.

# ANNUAL PRODUCTION IN ARIZONA : 1954 - 1996



**Arizona Oil and Gas Conservation Commission**  
**416 West Congress, Suite 100**  
**Tucson, Arizona 85701**  
**(520) 770-3500**

December 13, 2005

Committee of Reference for  
Sunset Review of the Arizona  
Oil and Gas Conservation Commission  
1700 W Washington Ste H  
Phoenix AZ 85007-2844

Re: Follow-up to Hearing of November 16, 2005

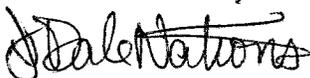
Dear Chairman Reagan:

I have enclosed five pages of information about the storage safety track record of underground natural gas storage facilities. The information describes nine storage incidents including two serious accidents and seven minor storage failures or mishaps.

I could find no record of an explosion at a storage facility in New Mexico. There was an explosion in New Mexico from a gas pipeline. I have enclosed a web page from the Federal Office of Pipeline Safety that describes that explosion.

The Commission established a policy in 1994 to provide a copy of an approved application for permit to drill to the County Manager in which the well will be drilled. The Commission continues to follow this policy in order to keep county government informed about proposed exploration and drilling activity. Applications for storage wells require a public hearing and all affected parties and governmental agencies would be notified and have an opportunity to appear and be heard in accordance with statute.

Sincerely,



J Dale Nations  
Chairman  
Arizona Oil and Gas Conservation Commission

Enclosures

## **Safety**

A major concern for a community in discussing the siting of a natural gas storage field is the safety track record. There are measures that can be taken to mitigate the risks associated with natural gas storage facilities.

### **Storage Safety Track Record**

Underground natural gas storage facilities are designed and constructed to meet stringent industry and regulatory specifications and codes. These facilities have one of the best safety records of all industries, both with respect to employee safety and to the welfare of the general public. The FERC noted the impressive safety record of the storage industry in a recent ruling:

There are more than 200 jurisdictional underground storage fields generally operating successfully and safely without major operational problems, despite the variety of difficulties inherent in storage operation...Field operators have achieved broad success through a system of sound engineering practices using appropriate monitoring and testing of storage field performance throughout the entire active operating life of each storage field. The early detection of problems such practices allow has proven effective in assuring the initiation of remedies to minimize adverse effects to the environment and the preservation of the stored natural gas.<sup>34</sup>

There have been relatively few problems associated with the underground storage of natural gas in the almost 90 year history of gas storage. During the last thirty years, only two serious accidents have occurred and seven minor storage failures or mishaps have been reported in the public record. These nine storage incidents are described below.

#### **Six Lakes, Mecosta County, Michigan**

In August 1974, a blowout and fire occurred during a remedial operation on a plugged storage well at the Six Lakes gas storage facility, located in Mecosta County, Michigan. After two deviated control wells were drilled and water and mud injected, the well was

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<sup>34</sup> 99 FERC ¶ 61,385 (2002). Docket CP01-427-001, Dominion Transmission, Inc.

brought under control. All surface equipment was destroyed. No third party damage was recorded.

#### **Eaton Rapids, Eaton County, Michigan**

In January 1993, at the Eaton Rapids field, storage gas was found to be migrating from shut-in production wells. Upon investigation, it was discovered that there was a leak in the production casing string, but it did not impact the water supply. The only outcome was that some of the gas was produced in neighboring fields. The leak was repaired, and the facility is still in operation.

#### **McDonald Island, San Joaquin County, California**

In October 1993, an explosion and fire occurred at the McDonald Island depleted reservoir facility, owned by Pacific Gas and Electric. The accident was reportedly caused by an observation port being left off an in-line heater's firebox which, coupled with an unexplained trip-out of the system's flame, allowed the accumulation of a combustible mixture of gas and air in the box which then ignited. There were no injuries associated with the explosion and fire, although approximately \$2 million of damage occurred to the heater and surrounding equipment.

#### **Aliso Canyon, Los Angeles County, California**

Subsidence resulting from the Northridge Earthquake damaged surface piping in January 1994 at the Aliso Canyon facility in Los Angeles County, California. Although neither fire nor injuries were reported at the storage site, the field was immediately shut-in to determine the full extent of the damage and to make appropriate repairs.

#### **Egan Storage, Acadia Parish, Louisiana**

In March 1994, Saltwater injections during debrining operations at the Egan salt cavern storage facility exceeded the normal pressure gradient, resulting in fluids and gas bubbles seeping to the surface in several nearby abandoned oil wells. The company was ordered to drill off dome disposal wells in order to reduce injection pressure and abandon the shallow salt-water disposal wells on the dome. Some minor third party damage occurred.

### **South Romeo Storage, Macomb County, Michigan**

An explosion and fire blew out two safety walls of the compressor station building at the South Romeo storage facility, the Washington 28 field in Macomb County, Michigan, in October 1997. The emergency shutdown device ("ESD") immediately closed the station, controlled the loss of gas, and prevented further damage. The failure was determined to be a design flaw in the compressor engine, which released gas into the compressor building, which subsequently exploded when a vent fan switched on. The damage was limited to the compressor building.

### **Yaggy Salt, Hutchinson, Kansas**

The one and only facility failure involving human fatality at a natural gas storage field occurred in January 2001 at the Yaggy salt cavern storage facility, located seven miles northeast of Hutchinson, Kansas. Originally developed to store liquid hydrocarbons, the facility was converted to natural gas storage service in 1993 and purchased by a subsidiary of Kansas Power and Light (KPL).

An explosion and fire occurred at several locations in Hutchinson. One at a mobile home trailer park critically injured two people and destroyed a mobile home. The two people later died at a Wichita, Kansas hospital. The other occurrence, several blocks from the trailer park in the center of town, demolished a building and started several fires, which were extinguished. Relief wells were drilled at other locations around the city to locate and vent the gas and relieve the pressure on remaining trapped gas. It appears that the failure of the casing in a storage cavern well allowed storage gas to migrate away from the storage facility, travel up to seven miles southwest, and rise to the surface through old improperly plugged salt solution mining wells under and around the town.

The Kansas Department of Health and Environment halted injection of gas into the storage cavern. This facility is not currently in operation and is unlikely to return to storage service.

The fundamental issue at Yaggy was the age of the casing string employed in a cavern originally designed for storage of natural gas liquids. The construction of a new cavern with appropriately designed casing strings is not likely to incur the same problems.

#### **Magnolia Gas Storage, Assumption Parish, Louisiana**

A leak developed in the casing of a storage well at the Magnolia Gas Storage Facility in December 2003, releasing natural gas to an adjacent aquifer and to the atmosphere.

Although there was no fire or explosion, residents were evacuated and a portion of State Highway 70 adjacent to the facility was closed. The storage well is owned by Dow Chemical Company and is leased to and operated by Gulf South Pipeline Company.

Downhole video shows three or four of the 13-3/8-inch casing connections have separated, causing the gas to leak behind the casing and subsequently to the surface. Several relief wells were drilled, and all of the gas from the shallow aquifer into which the gas migrated was vented. The Louisiana Department of Natural Resources requested sonar tests of each cavern; the results of these tests show that neither cavern experienced salt wall damage. Gulf South is in the process of evaluating whether the wells can be repaired and the caverns used once again for natural gas storage service.

#### **Moss Bluff Gas Storage, Liberty County, Texas**

Shortly after 4 A.M. of the morning of Thursday, August 19, 2004, an unscheduled event occurred with an explosion and resulting fire at the wellhead of the #1 cavern at Moss Bluff. According to the Moss Bluff Hub Partners *Incident Report Cavern #1 Well Control*, published in August 2004, the incident was caused by the separation of the 8-5/8" well string. Natural gas entered the well string, reached the surface, and flowed into above-ground piping. The Emergency Shut Down (ESD) system operated properly and shut in the piping. However, water hammer caused the piping between the wellhead and the ESD to breach. This breach caught fire, which was extinguished briefly. However, the wellhead assembly separated from the casing, causing gas to escape, which burned for five days. All operating procedures were reviewed and found to be adequate.

The one facility operator on site at the time of the event escaped unharmed. Local emergency officials responded quickly and residents within a one-mile radius were asked to evacuate the area as a safety precaution. This safety corridor was extended to a three-mile radius on the second day after part of the wellhead structure melted from the heat of the fire and allowed a higher volume gas stream to escape, which resulted in a larger vented flame.

Although this incident was visually spectacular and sensationalized by the media, it must be noted that there were no deaths, or even injuries, associated with this incident. The only losses associated with this incident are the considerable financial loss due to the escape of the gas from the storage cavern and the temporary disruption for those living in the close vicinity of this facility. Moreover, the quantity of gas that was released was about six billion cubic feet, a function of the cavern's size. By comparison, caverns built in bedded salt formations would typically only hold about one billion cubic feet of natural gas.



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- [Southwest Region](#)
- [Western Region](#)
- [Links to State Partners](#)
  
- [Carlsbad, New Mexico Pipeline Rupture Update](#)

**What Happened?**

2000

At 5:26 a.m. on August 19, an explosion occurred on one of three adjacent large natural gas pipelines near Carlsbad, New Mexico. El Paso Natural Gas Company operates the pipeline system. The pipelines supply consumers and electric utilities in Arizona and Southern California. Twelve people, including five children, died as a result of the explosion. The explosion left an 86 feet long crater.

Last Update 09/07/2000

**What is the federal government doing about it?**

The National Transportation Safety Board (NTSB) has sent investigators to the site. The NTSB is actively investigating the accident and is focused on finding its causes. The NTSB is examining the section of pipe that failed and will conduct laboratory test to identify flaws or corrosion in the metal walls of the pipe. They will also examine the company's record and maintenance procedures, and interview EL Paso employees.

The Office of Pipeline Safety (OPS) sent pipeline safety inspectors to ensure that no additional safety risk exist and to assist the NTSB. The OPS has ordered the section of pipeline that failed to be shut down. On August 23, 2000, OPS also issued an administrative order which required the two EL Paso Natural Gas pipelines adjacent to the failed line to be shut down until OPS determines that they can be operated safely.

The OPS is separately determining whether the Federal pipeline safety regulations it established were violated and take additional enforcement actions against the operator if there is probable cause to believe they were.

The Administrator of PHMSA and the Chairman of the NTSB visited the accident site August 24 and 25.

Last Update 09/22/2000

**How long will the investigation take?**