



New Mexico EARTH MATTERS

Volume 2, Number 1, January 2002

NOTES FROM THE STATE GEOLOGIST

In previous issues I've recounted some of the work that we do in fulfillment of our mission. In this issue, I'd like to highlight some of the work we do in partnership with other agencies, and I want to tell you of the recognition we've recently received for our efforts. We collaborate annually with a wide range of partners — state, federal, local, and Native American — on our decision-makers field conferences. We also conduct ongoing research in conjunction with an equally broad range of partners. Over the past few years we've received grants from the National Science Foundation (NSF), the U.S. Department of Energy, the Defense Department, and other federal agencies to carry out a variety of projects, both within New Mexico and outside its borders. Just a few weeks ago, two of our employees received a two-year NSF grant to study discrepancies between radiometric ages yielded by two minerals (biotite and sanidine). Both minerals have been dated using $^{40}\text{Ar}/^{39}\text{Ar}$ techniques at the New Mexico Geochronology Research Laboratory, a state-of-the-art facility here at the bureau, co-directed by Matt Heizler and Bill McIntosh (the grant recipients). This work, accomplished in our Geochronology Research Laboratory, complements all of the research we do, and this work has applications that extend well beyond the bureau, as well. Resolution of the age-discrepancy problem will greatly improve reliability of age determinations that are applied to geologic mapping, volcanology, volcanic risk assessment, minerals exploration, and other tasks.

(Continued on page 4)

ENERGY RESOURCES IN NEW MEXICO

New Mexico is a land truly blessed with a bounty of energy-related natural resources. Large reserves of oil, natural gas, coal, uranium, and geothermal energy lie below the surface. Above ground, our sunny southwestern landscape, wind-swept vistas, and abundant forests provide incredible potential for development of solar, wind, and biomass (plant- or animal-derived) energy. Above all, we have the good fortune of employing a talented, high-tech, and forward-looking energy

workforce, dedicated to producing energy efficiently and safely. Today we reap this bounty in the form of abundant, cheap, and reliable fossil energy resources. The major fossil energy resources extracted in New Mexico today are petroleum (oil and natural gas) and coal. In the future, other energy resources will likely play an important role in the mix of energy resources that enrich us.

Petroleum

We are a state, nation, and world hungry for petroleum. Although we often see short-term fluctuations in demand, this need is ever-growing over the long term (Fig. 1). Fueling our consumption requires both continual replacement of consumed petroleum and expanded capability to provide additional volumes to meet growing demands. The United States is a net importer of fossil energy, primarily in the form of crude oil to be refined into products like gasoline. Since 1989 we have imported more than half of our supply from overseas countries. We import crude oil because we cannot produce much of our remaining domestic reserves in the volumes that we want, at a price that is acceptable to us. A truly global effort on the part of oil companies and governments is required to meet this demand. Today we face major challenges in meeting current demand efficiently, providing stable supplies and prices, and finding replacement reserves. In the future we face the eventual depletion of "cheap" reserves, for fossil fuels are indeed a finite resource, and they are ever more difficult to find in the quantities we require.



Driller Tom Cumpston on Bearcat Drilling's rig north of Aztec, NM. One of New Mexico's most promising renewable energy resources, the sun, is also visible. Photo by Marc F. Henning.

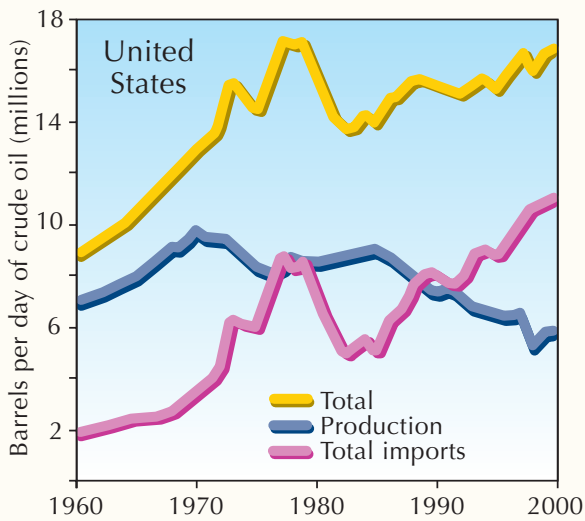


Figure 1 Crude oil production/imports vs. time

New Mexico is a major producer of competitively priced petroleum to the regional energy market, making us a net exporter of this energy form. In the U.S., excluding offshore production, New Mexico ranks sixth in oil and third in natural gas production (Table 1). In 2000 oil and gas were produced primarily from San Juan Basin and Permian Basin fields (Fig. 2). New Mexico enjoys major economic benefits from participating in a larger marketplace. Because there is great demand for New Mexico's oil and gas, we have a thriving sub-economy based on production. The petroleum industry provides jobs (nearly 12,000 in 2000) and supports strong local economies in some counties, while bringing higher income statewide through royalties and taxes (Table 2).

Source	Revenue
State general fund taxes	\$138 million
Severance tax	\$106 million
Rents and royalties	\$138 million
Earnings on permanent funds	\$314 million
State land office revenue	\$102 million
Total:	\$798 million

Table 2 2000 state revenues from oil and gas production

Unfortunately, being a major producer does not mean that we always realize price advantages as consumers. For the most part, crude oil and natural gas leave the state through interstate transportation systems for use throughout the Southwest. Although we are a major regional source of crude oil, much of the supply leaves the state in this raw form to be refined elsewhere. We import much of the gasoline we

use, and our prices reflect the cost of transportation. As for natural gas, we do have some price advantages in that the transportation costs for us are lower than for more distant end users like California. However, our nation's natural gas supply and distribution system is so well connected through the interstate pipeline system that local utilities compete directly with major gas buyers all over the country. Consequently, we either benefit or suffer locally from price fluctuations, depending upon the pricing demands of a larger marketplace.

Coal

Coal is an important domestic energy resource, and we have very large national reserves upon which to rely in the future. Among states with coal reserves, New Mexico is an important producer, ranking thirteenth nationwide

Product	New Mexico 2000 production	NM ranking in lower 48 onshore production	New Mexico 2000 reserves	U.S. rank
Crude oil	68 million barrels	6	718 million barrels	4
Natural gas	1,673 billion feet ³	3	15,449 billion feet ³	2
Coal	27 million tons	13	1385 million tons	3

Table 1 New Mexico ranking and reserves for fossil fuel reserves

(Table 1). In 2000, 27 million tons of coal were mined in New Mexico. Coal mining operations are found in two areas of the state, around the flanks of the San Juan Basin and in the Raton Basin (Fig. 2).

Energy from coal takes two distinctly different forms. Methane, the major component of natural gas, naturally resides in most coals and can be extracted from wells drilled in coal-bearing rock units in a manner similar to the extraction of natural gas from other geologic formations. Coalbed methane production in New Mexico comprises more than one third of our total natural gas production. It is a fairly new resource; production of coalbed methane barely existed in New Mexico before 1990 (Fig. 3).

Coal itself, of course, is combustible and was used historically as a heating and transportation fuel. The fact that coal is abundant and cheap to produce today makes it an ideal boiler fuel, burned to boil water to make steam,

which is then put to work to turn turbines that generate electricity. Currently, coal provides most of the electric power generated in New Mexico (Fig. 4). Generating large amounts of electricity requires literally mountains of mined coal. Transportation costs are onerous for shipping large volumes of New Mexico coal long distances, thus we tend to use the coal at "mine-mouth" electric generating stations. Because of this, as well as the lack of transportation infrastructure (i.e., railroads), most of New Mexico's coal energy is exported as electricity through the regional power grid.

Coal is considered to be a "dirty" fuel. Strict environmental standards have been imposed on the coal-fired electric-generating industry, and the industry has a good record of meeting the ever-evolving standards imposed upon it. Decades of time and large investments of money are required to plan and construct mine and power

plant operations. Plant designers must anticipate the regulatory environment that will apply to a plant during its lifetime. As any plant matures, however, new pollution standards are usually imposed that could not have been

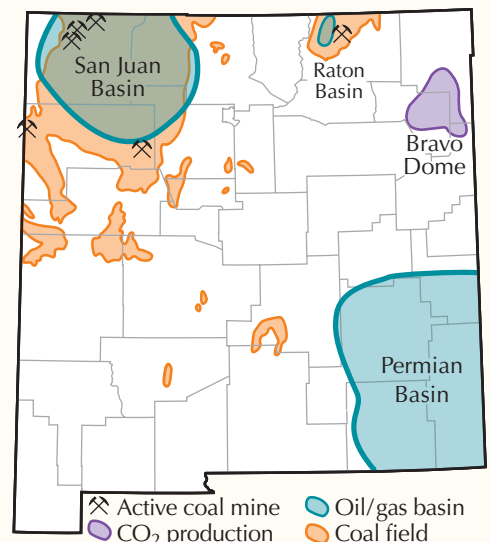


Figure 2 New Mexico fossil energy resources

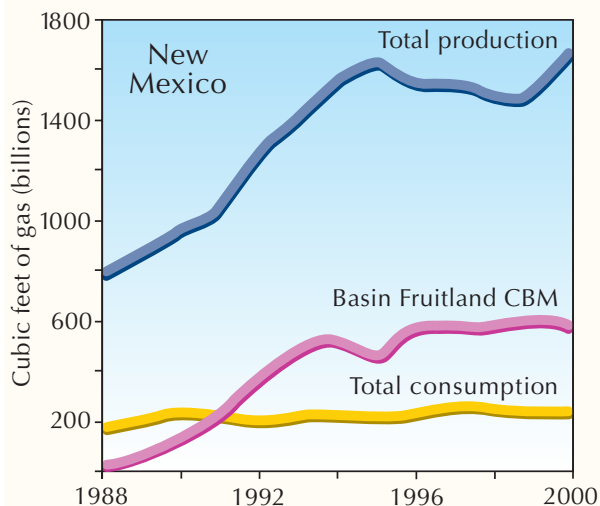


Figure 3 Gas production and consumption

anticipated. As time passes, old plants will be shut down or retrofitted with new technology in order to comply with newer standards. Research is currently underway that holds the promise of development of lower-emission coal combustion processes to further reduce pollution from power plants in the future. How we convert to this and other technologies, and how we distribute the costs to retrofit or construct new plants, will affect the New Mexican consumer. If we are to continue to enjoy the benefits of cheap and abundant electricity, government, industry, and the public need to work together to set reasonable long-range goals for higher standards, accomplished in a way that rewards industry compliance. From a resource-development standpoint, new technologies and long-range planning allow us to better manage development of our coal reserves.

Other Energy Types

Although fossil fuels dominate the New Mexico energy landscape, there is a significant resource base of other energy forms, including nuclear-generated energy and renewable energy. These energy types are underdeveloped in the state but have potential to help us extend our fossil-fuel resource base.

Although it is generally not cited by government as a major source of New Mexico's electricity supply, we are in fact connected to a grid system that includes nuclear-generated electricity, but it is all generated out-of-state. A fourth of the electricity used by customers of Public Service Company of New Mexico (PNM) is nuclear-generated

power from the Palo Verde plant in Arizona. Nuclear power generation depends upon a supply of uranium, and in terms of uranium reserves, New Mexico ranks second in the U.S. after Wyoming. The nuclear power industry currently enjoys a market glut of uranium-based fuel, caused by the decommissioning of nuclear weapons; the only uranium extraction operations in the state today are based on mine-water recovery from old mines. But in the future, New Mexico may once again become a supplier to the nuclear power-generation market.

Renewable energy resources in New Mexico fall into two categories: those that produce electricity and those used directly for space or water heating. Hydroelectric power generation currently goes on at nine sites in the state and is currently our most productive renewable energy resource (Fig. 4).

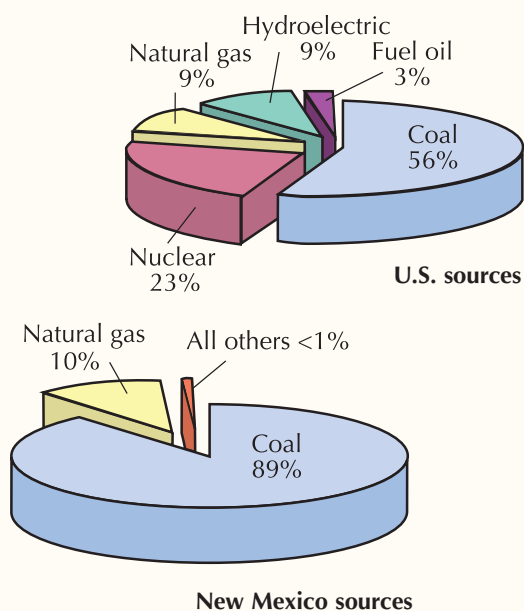


Figure 4 Electric generation sources

There is, however, little potential for expansion, given New Mexico's limited surface water resources. Solar photovoltaic technology and wind-powered turbines have the potential to make significant contributions to our future electric power supply, particularly over the long term. But we are in the early part of the learning curve in harnessing them to produce the needed amounts of electricity at prices competitive with

conventional energy sources. Wind farms (clusters of wind-powered turbines) appear to hold particular promise in the near-term as centralized, high-output energy "plants," whereas solar photovoltaic technology today appears to be best suited to smaller, building-specific electric power sources. A problem with both of these technologies is that they produce power intermittently: the sun doesn't shine, nor does the wind blow, twenty-four hours a day or seven days a week. Still, these energy sources may help meet peak demand for electricity, easing the strain on conventional generation methods.

Renewable energy resources used for space or water heating include geothermal, solar, and biomass energy. Temperatures below the surface of the earth in New Mexico are high enough to allow for the generation of geothermal energy; this is accomplished by circulating water at depth and retrieving the geothermally-heated water to heat buildings above ground. There are several active commercial geothermal energy projects today in New Mexico, including greenhouse and fish farming. Every New Mexican is familiar with the state's abundant sunshine, and many new homes are being built using passive solar design principles. Solar space and water heating are excellent ways for individuals, families, and companies to curtail consumption of our finite fossil-fuel resources. Also familiar to New Mexicans is biomass energy use, in the form of burning wood, but there are air quality issues associated with the use of wood as fuel. Wood burning itself, although common today, is a major contributor to poor air quality in some communities. There are ways to burn wood more efficiently; high-efficiency pelletized-wood stoves are an example. Also, scrap wood can be buried in landfills to generate methane gas for heating purposes. Many of our state's forests are overgrown; large-scale culling of forest growth may generate a new home-grown energy industry. Other currently utilized biomass energy sources include methane gas generated from sewage, and alcohol fuel produced from agricultural projects. Given New Mexico's growing dairy industry, feedlot animal waste fermentation is an obvious possible future resource of methane.

Challenges

Although New Mexicans enjoy the economic benefits of producing more energy than we consume today, we must be aware that our reliance on finite fossil resources, growth in consumption, and increasingly more stringent limitations on resource development will impact our ability to provide for ourselves in the future. Our continued prosperity depends upon our ability to address these challenges:

- Maintain replacement of mined energy reserves through development of new reserves.
- Lessen environmental impacts through new technologies in conventional energy generation and consumption.
- Improve overall production and consumption efficiency to extend the life of finite natural resources.
- Encourage and reward industry for innovation, performance, and compliance through reasonable expectation of profit and regulatory stability.

- Expand production of energy from the entire mix of energy resources to accommodate future growth.
- Find ways to advance research and encourage utilization of renewable energy through economic incentives rather than penalties.
- Manage energy production and consumption through long-range planning that can outlive short-term political goals.

Energy Research and Outreach

Our energy resources and consumption are topics important to all New Mexicans. Our energy resources are earth-based; the most important resources mined today are fossil fuels such as petroleum and coal. An understanding of the nature of these resources and the ability to quantify their size and economic life are critical to planning for their use. Long-term planning requires that we have a full understanding of the options available to us.

The New Mexico Bureau of Geology and Mineral Resources employs several earth-resource scien-

tists who are focused on research of energy minerals such as oil and natural gas, coal, and uranium. Databases and maps related to energy resources can be found on the bureau's Web site at <http://geoinfo.nmt.edu>. We also have an active outreach program designed to educate the public about all types of energy resources. We support the concept of responsible energy management and strive to help to improve communication and understanding among research scientists, lawmakers and law enforcers, industry, and the consuming public.

—Brian S. Brister
New Mexico Bureau of Geology
and Mineral Resources

Each issue of Earth Matters features an invited article on a subject of interest to New Mexicans. These articles represent the author's informed opinion on important geoscience issues in New Mexico. The New Mexico Bureau of Geology and Mineral Resources is a non-regulatory agency.

—Ed.

NOTES FROM THE STATE GEOLOGIST

(Continued from page 1)

We've recently embarked upon other collaborative efforts as well, including a project with the State Land Office involving sand and gravel, oil and gas, and hard-rock minerals assessments on state lands. We have undertaken hydrologic projects with the Interstate Stream Commission and the State Engineers Office and have conducted detailed geohydrologic studies with county and local governments in several parts of the state. We are currently working with the U.S. Forest Service and Los Alamos National Laboratory to produce a geologic map for the newly established Valles Caldera National Preserve. Indeed, our entire geologic mapping program is directed by an advisory panel of partner organizations that meets once a year to set state priorities. We are embarking upon a collaboration with the

National Park Service, the New Mexico State Parks Department, and the U.S. Bureau of Land Management to produce two volumes on the geology of the parks, monuments, and public lands of New Mexico, a project that may soon be extended to include national forest lands as well.

We also work with several state and federal agencies on hazards assessment and education programs. One of our teacher education programs, "Rockin' Around New Mexico," recently received the Western States Seismic Policy Council's 2001 Award for Excellence in Outreach to Schools. Susie Welch, David Love, Richard Chamberlin, and several other of our staff were instrumental in developing this program, which we've conducted for the past five years in conjunction with many partners.

We greatly value these collaborations (and the many others that I do not have space to mention here). They keep us in touch with the real geologic needs of the state and, in many cases, they provide financial support, helping to stretch state dollars to meet these needs. The fact that we have no regulatory responsibilities makes the bureau an excellent partner for organizations looking for an independent and unbiased look at geoscience problems. We value that role and plan to increase such collaborations in the future.

—Peter Scholle
Director and State Geologist
New Mexico Bureau of Geology
and Mineral Resources

BUREAU NEWS

The STATEMAP Project

We are in the tenth year of the New Mexico Bureau of Geology and Mineral Resources geologic mapping program (the STATEMAP project). Once again, we've received generous support from the U.S. Geological Survey for this cooperative program. This year's grant of \$317,333 was the second largest awarded to any state. New Mexico to date has received the highest total dollar support for this important program. The 2002 effort will continue to focus on the Rio Grande watershed from Taos to Elephant Butte reservoir, but will expand its geographic coverage to include projects in the Carlsbad, Farmington, and the Las Vegas areas. We will also produce a geologic/geomorphic map of the Rio Grande floodplain from the San Acacia diversion structure to Elephant Butte reservoir, for use by a variety of local, state, and federal agencies working on water and habitat-related issues in the Rio Grande valley.

Annual Mineral Symposium

The 22nd Annual New Mexico Mineral Symposium was held in Socorro in November, with over 170 people in attendance. The featured speaker at this year's symposium was well-known photographer

Jeff Scovil. This event, sponsored by the bureau and hosted by the staff of the Mineral Museum, has been a popular event for many years. Next year's Mineral Symposium is scheduled for November 9-10, 2002 on the campus of New Mexico Tech. The Mineral Museum continues to be a popular attraction throughout the year; visitors last year approached 15,000. For more information on the symposium or the museum, contact Virgil Lueth, the museum's director, at vwlueth@nmt.edu.

Our Newest Hires

The bureau's newest geologist is Bill Raatz, a carbonate stratigrapher and petroleum geologist. Bill received his B.S. and M.S. in geology from the University of Iowa, and his Ph.D. from the University of Wisconsin in Madison. He joins the bureau with six years of petroleum industry experience in both exploration and development. Bill's research interests include Paleozoic carbonates from central and southern New Mexico, rocks that are important hydrocarbon reservoirs for the state. In addition to research, he looks forward to teaching courses and advising students at New Mexico Tech.

We also welcome Theresa Lopez and Susie Kyle to our front-office staff. Those of you ordering publications or visiting the bureau will likely have occasion to speak to both of them.

OUR MISSION

The New Mexico Bureau of Geology and Mineral Resources, established by legislation in 1927, is a service and research division of the New Mexico Institute of Mining and Technology. It acts as the geological survey of New Mexico with these main goals:

- CONDUCT research and interact with state and federal agencies and industry to facilitate prudent exploitation of the state's geological resources.
- DISTRIBUTE accurate information to scientists, decision makers, and the New Mexico public regarding the state's geologic infrastructure, mineral and energy resources, and geohydrology (including water quantity and quality).
- CREATE accurate, up-to-date (digital and GIS-based) maps of the state's geology and resource potential.
- PROVIDE timely information on potential geologic hazards, including earthquakes, volcanic events, soils- and subsidence-related problems, and flooding.
- ACT as a repository for cores, well cuttings and a wide variety of geological data. Provide convenient physical and internet access for New Mexicans to such resources.
- PROVIDE public education and outreach through college teaching and advising, the Mineral Museum, and teacher- and student-training programs.



New Mexico EARTH MATTERS

Published twice annually by the
NEW MEXICO BUREAU OF GEOLOGY
AND MINERAL RESOURCES

Peter A. Scholle

Director and State Geologist
a division of

NEW MEXICO INSTITUTE OF
MINING AND TECHNOLOGY

Daniel H. López

President

801 Leroy Place
Socorro, New Mexico 87801-4796
(505) 835-5420

Albuquerque Office
2808 Central SE Albuquerque
New Mexico 87106
(505) 366-2530

Visit our main Web site
<http://geoinfo.nmt.edu>

Board of Regents
Ex Officio

Gary E. Johnson

Governor of New Mexico

Michael J. Davis

Superintendent of Public Instruction
Appointed

Sidney M. Gutierrez

President

2001-2007, Albuquerque

Anthony L. Montoya, Jr.

Secretary/Treasurer

2001-2003, Socorro

Ann Murphy Daily

1999-2004, Santa Fe

Randall E. Horn

1997-2003, Albuquerque

Robert E. Taylor

1997-2003, Silver City

Editors

L. Greer Price

Jane C. Love

Layout

Thomas Kaus

Graphics

Kathryn Glesener

Earth Matters is a free publication.
For subscription information please call
(505) 835-5420, or e-mail us at
pubsofc@gis.nmt.edu

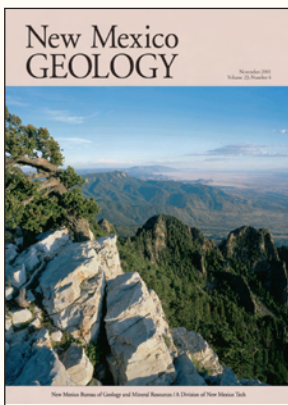
Cover photo of Ship Rock, New Mexico
by

Paul G. Logsdon

copyright © **Marcia L. Logsdon.**

Reproduced with permission.

NEW PUBLICATIONS



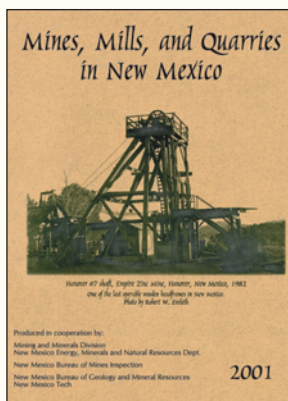
New Mexico Geology, a quarterly journal for regional research and service directed to the New Mexico geoscience community. 1-year subscription, \$10; 2-year subscription, \$18; single issues, \$2.50.

*This year **New Mexico Geology** begins its 24th season with more dazzling full-color covers that show off the wonderful landscape where geologists work. We continue to publish peer-reviewed research papers, shorter contributions, abstracts, book*

reviews, descriptions of new publications, and upcoming meetings.

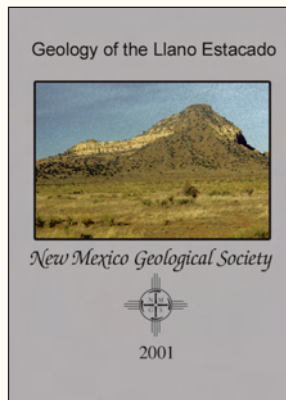
Coming articles include:

- Lake Jornada, an early-middle Pleistocene lake in the Jornada del Muerto Basin, southern New Mexico
- Invertebrate fossil assemblage from Galisteo Dam and the correlation of the Cretaceous Dakota–Mancos succession in north-central New Mexico
- Geomorphic development of the Giants of the Mimbres, Grant County, New Mexico
- Minerals industry in New Mexico 1998–2000
- Morphy Lake State Park



Mines, Mills, and Quarries in New Mexico is a cooperative publication of the New Mexico Bureau of Geology and Mineral Resources, the Mining and Minerals Division of the New Mexico Energy, Minerals and Natural Resources Department, and the New Mexico Bureau of Mine Inspection, 2001, 46 pp., 1 map, scale 1:1,000,000 free. *Data on active mining operations are collected by the Mining and*

Minerals Division of the NMEMNRD and organized by the type of commodity and thereafter alphabetically by county. Commodity codes are used to key individual mining operations to the map. The text has seven major divisions: 1) Aggregate and stone mining, 2) Coal mining, 3) Industrial minerals mining and milling, 4) Metals, 5) Potash, 6) Smelters, converters, and refineries, and 7) Uranium mining and milling. Specific data listed for each entry include the name of the operation, the commodity mined or milled, ownership, address, current status, location (USGS quadrangle and section, township, and range), and mineral and surface estate owner. This report is also available as a downloadable pdf file on the bureau's Web site.



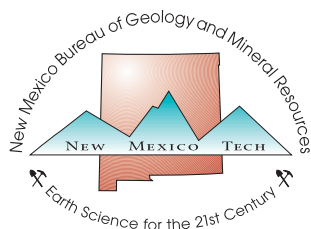
Geology of the Llano Estacado, Spencer G. Lucas and Dana S. Ulmer-Scholle, editors, 2001, 352 pp., \$50 plus \$5 shipping and handling. *This guidebook, published by the New Mexico Geological Society, was developed to accompany their 52nd annual fall field conference, held in late September 2001. Stops included Palo Duro Canyon in west Texas and Pyramid Mountain in eastern New Mexico. Articles in this volume cover a broad spectrum of topics*

including geophysics and volcanology, stratigraphy, paleontology, sedimentology, hydrogeology, and economic geology.

For more information about these and other bureau publications:

- Visit our Web site at <http://geoinfo.nmt.edu>
- Write or visit our Publications Office on the campus of New Mexico Tech 801 Leroy Pl, Socorro, NM 87801
- Call (505) 835-5420
- E-mail us at pubsofc@gjs.nmt.edu

Payment by check or money order payable to NMBGMR must be enclosed with mailed orders. Telephone orders may be paid with VISA, Discover, or MasterCard.



New Mexico Bureau of Geology
and Mineral Resources
801 Leroy Place
Socorro, New Mexico 87801-4796
Return service requested

NONPROFIT ORGANIZATION
U.S. Postage
PAID
PERMIT NO. 388
ALBUQUERQUE, NM