

New Mexico EARTH MATTERS



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Geology for Everyone: Outreach and Education at the New Mexico Bureau of Geology and Mineral Resources

NEW MEXICO, ALSO KNOWN AS THE LAND OF ENCHANTMENT, HAS A LANDSCAPE, CULTURE, AND HISTORY SHAPED BY THE STATE'S INCREDIBLE GEOLOGY. Whether it's the prominent mesas and badlands of the San Juan Basin, the trace of life-sustaining rivers flanked by rugged peaks, or the remote volcanic mountains of the Gila Wilderness, the rich culture and history of our state are intimately tied to a geologic story. Understanding New Mexico's geologic past, present, and future is a core mission of the state's geological survey, the New Mexico Bureau of Geology and Mineral Resources. Founded in 1927 and located in Socorro, the survey studies the geology and hydrology of our state and takes a multifaceted approach to communicating science to all of our stakeholders—from school children to the interested public to decision-makers to professional geologists. Most of our staff participate in the outreach and education programs highlighted in this article.

Interest in geology can start at a young age, and a great way to nurture that interest is to provide geological education to elementary, middle, and high school students. Several Bureau of Geology resources give teachers tools to engage students in geology. [Rockin' Around New Mexico](#) is a flagship educational program that has offered hands-on geological education experiences for New Mexico K–12 teachers for over 30 years. The three-day summer program includes both field and classroom education and provides supplies that teachers can use in their schools. To best serve teachers from around the state, our workshop can be used as part of a Master of Science Teaching degree program. Rockin' is held each year in



New Mexico teachers learn about the fascinating geology of the Silver Creek area in the Sevilleta National Wildlife Refuge. *Photo courtesy of Linda Brown*

different areas around New Mexico to highlight the state's varied geology. Past locations include Socorro, Albuquerque, Santa Fe, Carlsbad, Jemez Springs, Las Cruces, Grants, Los Alamos, Truth or Consequences, Silver City, and Farmington.

We also produce *Lite Geology*, a free, biannual online publication for teachers and their students. Published since 1992, *Lite Geology* includes articles and classroom activities, resources for teachers, web links, a geological crossword puzzle, and information about scientific events. Each issue focuses on a specific geological topic, such as dinosaurs, the Permian Basin, water resources, renewable energy, climate change, caves, or similar subjects. Guides for hands-on, geology-focused exercises are also [available on the Bureau of Geology's website](#).

Direct outreach to students in the classroom or the field is another effective way to reach young scholars and illustrate the importance of geology in their daily lives. By showing them what geologists do and how research in the earth sciences impacts their communities and state, we make geology more visible and encourage students to pursue geoscience careers. Bureau geologists interact with kindergarten through high school students in many ways, including classroom visits, but one of the most popular and effective ways to connect with students is on a field trip. In a field setting, students might see a landscape or rock outcrop and gain insight into the geologic processes responsible for New Mexico's enchanted landscapes. Bureau of Geology scientists also judge the Rocks and

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Minerals event for the New Mexico State Science Olympiad and give the Excellence in the Geosciences Award to student presenters at the New Mexico State Science and Engineering Fair.

Students can visit the Bureau of Geology building for tours to learn about our geology and hydrology programs and see how laboratory equipment works. In recent years, the bureau's analytical chemistry laboratory has led a water resource program for local high school students. Bureau staff and students work with the high schoolers to sample water from a well, which is then taken to the lab for analysis. Follow-up happens a few weeks later when the students visit the New Mexico Tech campus to learn how the analyses are done and how to determine if their well water is safe to use. Other activities on campus help them understand how water moves in the subsurface. For teachers and students with a keen interest specifically in minerals, our Mineral Museum has mineral-focused lesson plans and a teacher-focused guide that can be used during class field trips to the museum, where students can see a range of beautiful minerals from New Mexico and elsewhere, do a mineral scavenger hunt, or learn about minerals from museum and outreach staff.

Bureau staff have also been part of an exciting program called **Tech Trek**, organized by the American Association of University Women, which brings 7th-grade girls from all over New Mexico to New Mexico Tech to participate in a weeklong immersive summer camp focused on STEM—science, technology, engineering, and mathematics. Bureau of Geology scientists have been participating in Tech Trek for several years, leading the girls on geology field trips and laboratory exercises, giving talks about their career tracks, and participating in a networking dinner where professional women interact with and answer questions from Tech Trek campers.



2018 Tech Trek campers learn about missing geologic time and angular unconformities. Photo by Cynthia Connolly

The New Mexico Bureau of Geology building, located on the New Mexico Tech campus, is a great place to visit. Among the many attractions is a collection of art acquired in collaboration with the New Mexico Department of Cultural Affairs Art in Public Places program, which mandates that 1% of appropriated capital improvement costs of any public building be put toward art pieces. The art was commissioned specifically to reflect the geology and minerals of New Mexico, and this theme runs through all of the artwork in the building, as exemplified in the multicolored illuminated panels of *Moon Rocks*, an installation housed on the building's first floor. This eye-catching piece draws inspiration from the pressure, uplift, water, and weathering that create rocks and minerals.

Museums are gateways for exploring the sciences as much as they are for history and the arts. With 25,000 visitors annually, the New Mexico Bureau of Geology and Mineral Resources **Mineral Museum** is one of Socorro's most popular destinations. This world-class mineral collection—over 20,000 specimens, with over 4,000 on display— attracts the general public, educators, hobbyists, and professionals. The exhibits concentrate on New Mexico specimens but also show minerals from around the world.

Exhibits include not only minerals but also mining artifacts, gemstones and lapidary art, fossils, and meteorites. Museum staff offer educational programs, including tours, demonstrations, and scavenger hunts for visitors of all ages. Beautiful mineral specimens are available for purchase to start or enhance a collection. Museum staff can do in-person mineral identification for the general public by appointment.

The Mineral Museum hosts the **New Mexico Mineral Symposium**, one of the largest meetings of its kind in the United States. The symposium brings together hundreds of mineral enthusiasts from far and wide for a weekend of mineralogy presentations, field trips, auctions, and sharing a passion for minerals and earth science. The informal atmosphere allows both professionals and amateurs to learn and share knowledge about New Mexico and worldwide mineral occurrences. The symposium is held annually during the second full weekend in November.

Directly across the hall from the Mineral Museum is the bureau's bookstore, which offers a wide range of geologically focused products, including popular and technical geology publications, topographic maps for the entire state of New Mexico, and a variety of field guides. The bookstore also carries a selection of great gifts like jewelry, children's science kits, geological jigsaw puzzles, mugs, clothing, field notebooks, and more. Many Bureau of Geology products are available not just in our bookstore but in other bookstores across the country, including those at state and national parks and monuments. Many products are also available for purchase through the bookstore's [web page](#).

Among the publications available in the bookstore is a pair of books that present authoritative overviews of the geology of New Mexico's parks, monuments, and public lands, with information on the regional setting, the rock record, and the most prominent geologic features. The books, which focus on the northern and southern



Moon Rocks, a 6' x 30" x 5.5" multimedia art installation by Kenny Davis. Photo by Frank Sholedice



The bookstore and Mineral Museum are on opposite sides of the atrium on the ground floor of the Bureau of Geology building, located on the New Mexico Tech campus in Socorro.



An example display at the New Mexico Bureau of Geology and Mineral Resources Mineral Museum. Photo by Frank Sholedice

parts of New Mexico, include chapters on national parks and monuments, state parks, and many of the most popular Bureau of Land Management and U.S. Forest Service sites in the state. With full-color geologic maps, graphics, and photographs, the books are perfect introductions to some of New Mexico's most significant geologic landscapes. Two other books that contain great geological information for the general public are river rafting guides for the Rio Grande and the Rio Chama. These river guides explore the geologic history of the areas and include a mile-by-mile description of the geology viewed along the riverbanks. The guides have been described as “superb” and “engrossing” by readers, who highlight how the geological information is made accessible to the non-geologist. Along with the parks and monuments books, our river guides have won numerous awards for excellence in design and scholarly information.

Another publication of note is the one you're reading right now: *New Mexico Earth Matters*. First issued in 2001, *Earth Matters* delivers information on a wide variety of geological subjects. Some issues focus on popular topics like New Mexico dinosaurs, volcanoes, minerals, caves, and gemstones. Others provide information about the Bureau of Geology's history, research programs, resources, and analytical laboratories. And yet others are succinct and information-rich syntheses of societally weighty topics, such as water resources, climate change, critical minerals, earthquakes, geothermal energy, oil and gas, geologic mapping, and mining.

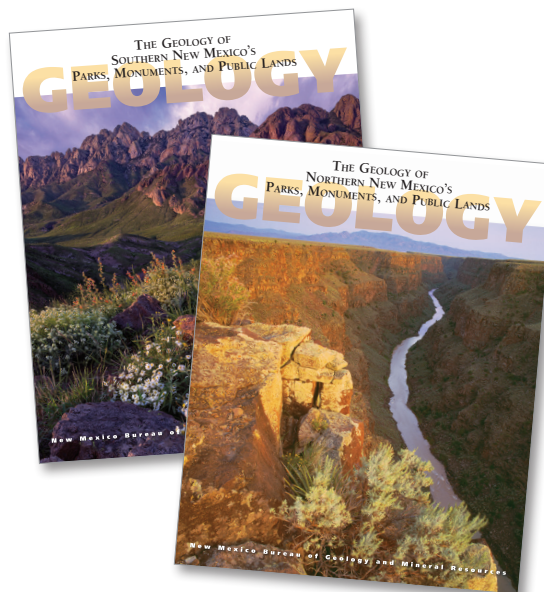
The **Bureau of Geology's website** is another rich source of geological information for the general public, professional geologists, and decision-makers. A News and Announcements

sidebar on the homepage gives quick snapshots of projects, awards, meetings, and other news. The sidebar also features **Postcards from the Field**, which describe and illustrate field projects being carried out by our researchers. Many of these items are also mirrored on our Facebook page, which is available to follow. Visitors to our website can listen to a series of **two-minute geology presentations** prepared for radio broadcasts.

Other information highlighted on our site includes a **virtual geological tour of New Mexico**, answers to **frequently asked questions** about New Mexico geology, a **searchable bibliography** of publications related to New Mexico geology, and a recently developed **photo and document library** where users can peruse and

download a wide range of historical and modern geologically focused materials, along with a large collection of other resources. We host a **data-rich interactive web-based mapping tool** that may be of interest to professional geologists and the general public alike. For instance, the web map tool can generate maps of different geologic features, such as volcanic vents. The many facets of the website are too numerous to list here—visit our site and explore! Individual geologic maps can be downloaded through our **geologic map page** as PDF files or geographic information system (GIS) datasets. These maps provide detailed geological information about many parts of New Mexico and are useful to a range of geologists in the public or private sector. Many other types of geological data and metrics can be accessed through our website, including oil and gas, mines and minerals, water, geothermal energy, geologic hazards, and the subsurface geology of our state. A technical periodical publication called *New Mexico Geology*, along with monographs, field guides, databases, atlases, and geological reports, can also be downloaded for free. These vast information archives are the first place where many geoscientists, whether in the private, public, or academic sectors, go when beginning a new geological project in New Mexico. During the last year, roughly half a million distinct visitors accessed our website and downloaded thousands of gigabytes of data.

Bureau scientists deliver direct geological information through numerous invited geology and hydrology presentations, from short talks to extended workshops. These are attended by a range of participants, including legislators and legislative committees, teachers, mineral and earth science enthusiasts, professional scientists, and the general public. Serving in this capacity, Bureau of Geology researchers are a valuable resource to all New Mexicans and



Our award-winning guidebooks focusing on the geology of the parks, monuments, and public lands of southern and northern New Mexico.

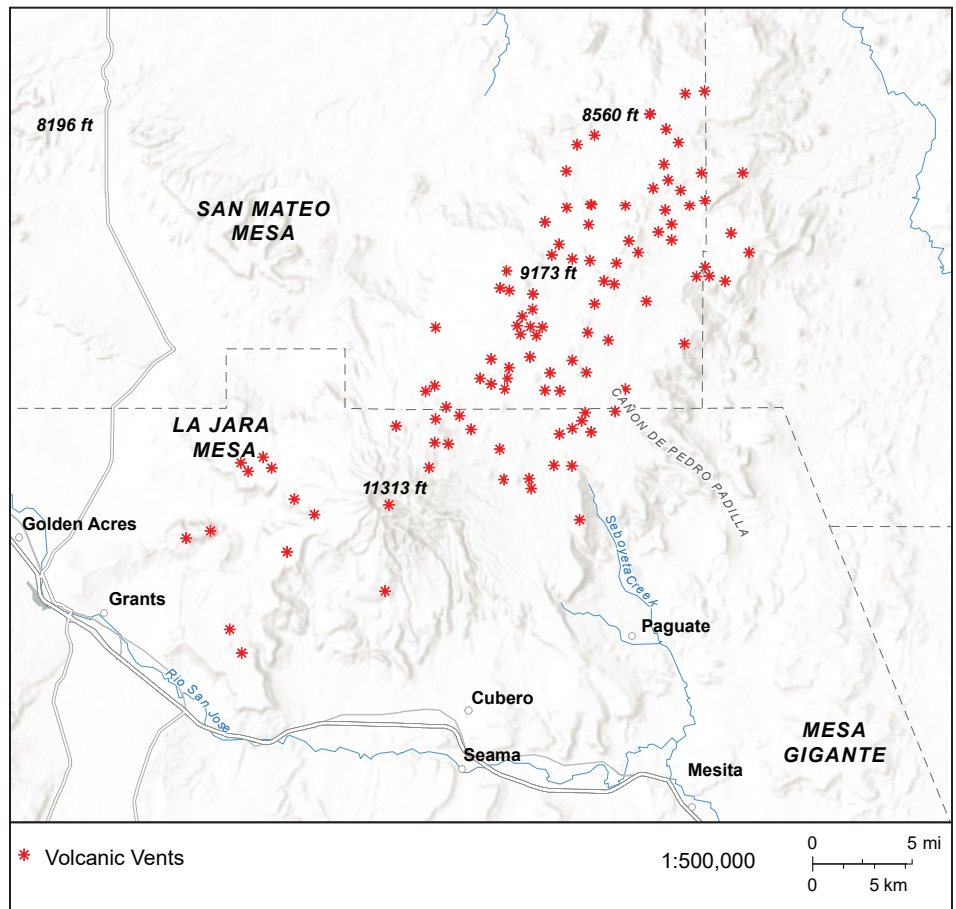
can be counted on to provide accurate and well-researched geological and hydrological information to all who are interested.

A unique way the Bureau of Geology communicates science to a broad audience is our annual Earth Science Day during the New Mexico legislative session each winter. The event is open to all and held in the New Mexico capital building—the Roundhouse—where legislators meet. During Earth Science Day, many state and federal agencies that have a geology or hydrology component to their mission set up informational tables where visitors can learn about each agency’s work. Agencies that typically participate include the U.S. Geological Survey, the New Mexico Environment Department, the New Mexico Museum of Natural History, the State Land Office, the New Mexico Mining Association, the Office of the State Engineer, and the New Mexico Energy, Minerals and Natural Resources Department. During Earth Science Day, an **Earth Science Achievement Award** is presented to a New Mexico citizen who has made notable contributions to earth science in the arenas of public service and public policy.

Scientific outreach to decision-makers, such as appointed and elected officials, government agency directors, educators, media leaders, citizen advocates, business leaders, and representatives from tribes, pueblos, and nations, is critical to our mission. The New Mexico Bureau of Geology and Mineral Resources offers a series of conferences focused on water issues called **New Mexico Water Leaders Workshops**. These interactive meetings are a forum for New Mexico leaders to learn firsthand about current opportunities, challenges, and solutions concerning vital earth science issues and to learn in an informal outdoor setting. To date, the Bureau of Geology has organized three workshops. The first conference was in Socorro in December 2022, followed by Las Cruces in December 2023 and Ghost Ranch in March 2024. Each workshop focused on locally relevant hydrogeologic issues.

The inaugural meeting provided opportunities and materials to help legislators and other state water leaders increase and improve their understanding of water issues in New Mexico. Participants visited the San Acacia Dam and Bosque del Apache, where water use and management topics were presented. The Las Cruces meeting considered pressing issues, such as climate change, water deliveries, water quality, stormwater capture, and ongoing water litigation, with field trips up and down the lower Rio Grande from Elephant Butte

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ArcGIS map showing the location of volcanic vents around the Mount Taylor area, generated by the Bureau of Geology's [interactive web map](#).



Conference participants float the Rio Chama as part of the 2024 Water Leaders Workshop at Ghost Ranch. Photo by Frank Sholedice

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to the Mesilla Valley. The 2024 workshop in Ghost Ranch brought together over 120 participants, including 21 legislators, two federal delegation representatives, 16 agency leaders and decision-makers, and 14 individuals from tribes, pueblos, and nations. Other attendees hailed from New Mexico state agencies, federal agencies, and non-governmental entities. During the workshop, attendees heard 40 talks from subject matter experts, participated in panel discussions, and visited several locations in the field to view water infrastructure, river and bosque restoration projects, and farmlands. The workshop's themes included wildfires and watershed health, climate change, tribal water rights settlements, the San Juan–Chama Project, and regional and local river restoration and management strategies. Attendees leave these workshops with a deeper understanding of the complexities, challenges, and opportunities facing water resources in New Mexico. They also leave with newly forged personal connections to water researchers and decision-makers from across New Mexico. The workshops will continue into the future; the 2025 meeting will be held in Silver City.

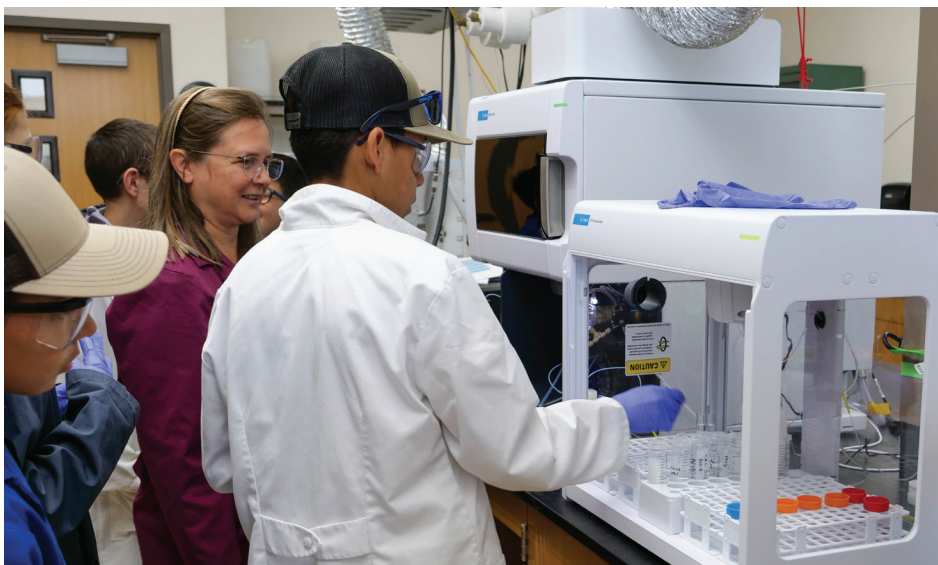
Physical collections, including several warehouses full of rock samples, rock cores, well cuttings (chips of rock recovered during well drilling), and technical and historical documents, are housed in the Bureau of Geology's buildings on the New Mexico Tech campus in Socorro. These collections are professionally curated and accessible to the public. Donations of rock samples, cores, and documents may be accepted and added to the collections if they are considered to be a valuable public resource. We also accept donations of geological artifacts, including antique mining equipment, a collection of

which is available for public viewing in the outdoor courtyard of our building.

The Bureau of Geology is a research and service division of New Mexico Tech and contributes greatly to the university's academic mission. Many of our staff members teach classes at the graduate and undergraduate levels and advise students at New Mexico Tech and other New Mexico universities who are carrying out geological research projects as part of their degree programs. Bureau of Geology staff also run cutting-edge geochemical and geochronological laboratory facilities that are available for professional and student use. Many of the laboratories provide training on their instruments, which is valuable for students when seeking employment. In addition to providing instruction and advising, the Bureau of Geology hires students to work in many parts of our organization. An **overview of student support** demonstrates our long-term commitment to education and cites the types of projects carried out by bureau-supported graduate students. Undergraduate students are also an essential part of our organization. Over the past few years, between 50 and 75 students have been supported annually using grant, philanthropic, or state funding. Through this effort, the New Mexico Bureau of Geology and Mineral Resources plays an integral part in training the next generation of geoscientists, many of whom may find professional homes in New Mexico and continue to contribute to the geological and hydrological understanding of our state.

Dr. Nelia Dunbar

Nelia Dunbar is the New Mexico Bureau of Geology and Mineral Resources emerita director and state geologist.



Bureau of Geology Associate Director of Laboratories Bonnie Frey shows a student from the Magdalena Teen Science Café how to load water samples on an autosampler. *Photo by Cynthia Connolly*

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Bureau News

Bureau to receive funding to purchase new analytical instrumentation

New analytical instruments are coming to the Bureau of Geology through two grants, one from the National Science Foundation and the other from the Department of Energy through the New Mexico Consortium. Dr. Nels Iverson, along with co-investigators Dr. Nicole Hurtig and Dr. Laura Waters of New Mexico Tech's Earth and Environmental Science Department, were awarded \$1,569,800 to purchase a new state-of-the-art electron microprobe. Electron probe microanalysis is an analytical technique that allows researchers across multiple disciplines to collect chemical information on a wide range of materials at the nanometer scale. The new instrument will meet the needs of a diverse research community and advance the training of the next generation of geoscientists in electron microscopy.

The second instrument is a single-crystal X-ray diffractometer that has been purchased with funding received by Dr. John Rakovan. This specialized instrument can determine the detailed crystal structure of tiny mineral samples. With this new diffractometer, Bureau of Geology scientists are studying the origin and distribution of critical minerals, which are essential to many advanced technologies. The instrument will also be used to develop mineral-based solutions to a range of environmental projects.

San Juan Basin carbon sequestration project supported by DOE

The Bureau of Geology has been awarded a \$1,180,850 grant from the Department of Energy to study the structural and thermal characteristics of the San Juan Basin. Luke Martin, senior petroleum geologist, will lead the project as the principal investigator along with other collaborators from across New Mexico Tech. The San Juan Basin—a source of oil and gas production for over 100 years—is increasingly the focus of research on carbon capture, utilization, and storage. The project will focus on understanding the margins of the basin and the subsurface geology to gain confidence that subsurface CO₂ storage can be done effectively. It will also involve thermal characterization of the basin to better understand how fluids may migrate during CO₂ injection.

Bureau staff members receive recognition and appointments

Each year, the New Mexico Geological Society (NMGS) awards an honorary membership to a member with a long record of productive research, impactful teaching and advising, or positive effects in the geoscience industries in New Mexico. This year's honoree, nominated by several NMGS members from across the state,

is Dr. Matthew Heizler, the Bureau of Geology's geochronologist emeritus. Over a 31-year geology career, Matt has contributed to geological research of nearly every stripe, in every corner of the state and beyond.

Dr. Virginia McLemore, principal senior economic geologist, has been selected as a Society for Mining, Metallurgy & Exploration (SME) Fellow, Class of 2025, by SME board proclamation. SME presents its fellow award to a small percentage of its membership who have made sustained and notable contributions to the society and industry. Dr. McLemore has provided outstanding service to SME through committee participation and editorial service and has been an excellent representative of SME and the industry to the public. She has published many technical papers, been strongly involved in educational activities, and been a leader in exploration, environment, basic sciences, education, and public relations.

Dr. Nelia Dunbar, emerita Bureau of Geology director and state geologist, has been appointed by U.S. Secretary of the Interior Deb Haaland to serve on a national committee to establish a Nationwide Volcano Early Warning System (NVEWS). The NVEWS advisory committee, convened by the U.S. Geological Survey, is tasked with ensuring that all active and potentially active volcanoes in the United States are monitored at levels that match the threats they pose.