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Arizona Geology

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ARIZONA
GEOLOGICAL
SURVEY

The State agency
for geologic information

MISSION

To provide impartial information to assist those responsible for prudently managing Arizona's land, water, mineral, and energy resources and to enhance understanding of the State's geologic heritage.

GOALS

- Inform the public about geologic processes, materials, and resources in a timely, courteous manner.
- Map and describe the bedrock and surficial geology of Arizona.
- Investigate and document geologic processes and materials that might be hazardous to the public or have adverse impact on land use and resource management.
- Administer the rules, regulations, and policies established by the Arizona Oil and Gas Conservation Commission.

CHIRICAHUA MONUMENT

75th
Celebrates
ANNIVERSARY



Figure 1. Pinnacles formed by weathering along joints in volcanic rock in the Chiricahua National Monument.

Larry D. Fellows,
Director and State Geologist

President Calvin Coolidge established Chiricahua National Monument (CNM) April 18, 1924. To celebrate its 75th anniversary, CNM hosted a series of activities and programs, including a rededication at Massai Point, the site of the original dedication. Like many parks, CNM was created to protect its geologic heritage. President Coolidge concluded that because "...certain natural formations known as 'the Pinnacles' are of

scientific interest, ...the public interests will be promoted by reserving as much land as may be necessary for the proper protection thereof, as a National Monument." Trails in the Monument lead the hiker among these spectacular pinnacles (Fig. 1).

About 27 million years ago what is now the CNM was the site of violent volcanic eruptions. The volcanic vent, not visible today, was just a few miles south. The volcano spewed red-hot pumice and ash over a 1,200-square-mile area. Pumice

and ash particles were compacted while hot, became "welded" together, and cooled to form tuff with the composition of rhyolite. As cooling took place the tuff contracted and intersecting vertical cracks (joints) formed. The Rhyolite Canyon Tuff, the most extensive rock unit within the CNM, is about 800 feet thick. Based on thickness and areal extent of the volcanic deposits, those eruptions were substantially larger than the Mt. St. Helens eruption in 1980.

From 25 to 5 million

Chiricahua Celebrates 75th (continued)

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years ago the Earth's crust beneath much of what is now the southwestern United States and northern Mexico stretched and broke into hundreds of large fault-bounded blocks. Some uplifted blocks now form mountain ranges. Down-dropped blocks became basins. This area of basins and ranges, defined by geologists as the Basin and Range province, extends from Mexico northward through parts of Texas, New Mexico, Arizona, California, Utah, Nevada, and into southeastern Oregon and southern Idaho.

Weathering and erosion of one of the mountain blocks formed the Chiricahua Mountains, including the pinnacles in CNM. Weathering and erosion processes cut into the volcanic rock along joints, leaving pinnacles in between. Although many pinnacles appear to be precariously balanced, they were sufficiently stable to withstand the 1887 earthquake, which shook southeastern Arizona. The epicenter of that magnitude-7.2 quake was about 60 mi

south in northern Sonora.

The Arizona Geological Survey (AZGS) published *Fieldguide to the Geology of Chiricahua National Monument, Southeastern Arizona*. John V. Bezy, National Park Service, wrote the book to explain how geologic processes have shaped the CNM. Although he wrote it for those who've had no training in geology, the book will also be helpful to those who have. Features he described can best be observed from the Sugarloaf Mountain and Echo Canyon trails. The book describes

and illustrates features such as case hardening, "chicken heads," exfoliation shingles, fiamme, fossil fumaroles, horizontal ribs, solution pans, spherulites, surge beds, and tafoni (Fig. 2). Distant features that can be viewed from the trails are also discussed.

The 32-page book, Down-to-Earth 8, may be purchased from the AZGS for \$6.95, plus \$3.50 for shipping and handling if ordered by mail. See page 3 for ordering information. It is also available for purchase at the CNM Visitor Center.



Figure 2. Tafoni, exposed near the Echo Canyon Trail, formed by differential weathering of volcanic rock.

Arizona Geology

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Geology Resource Guide for Arizona

This book lists sources of information about the geology and mineral resources of Arizona. A. J. Lombard, Mesa Community College, compiled it primarily for geologists and geology instructors. The book lists museums, parks with geologic exhibits, active mines and quarries, mine

overlooks and tours, college and university faculty, continuing education courses, sources for educational materials, selected books, web sites, rock and mineral clubs, rock and mineral shops, gem and mineral shows, and government agencies that have statutory authority for

geology and mineral resources.

The Resource Guide can be purchased from the Arizona Mineral and Mining Museum Foundation, P.O. Box 41834, Mesa, AZ 85274. It costs \$12.95 plus \$3.50 for shipping and handling. For orders of five or more the cost is \$8.00 per book.

Just Released

The Arizona Geological Survey released eight maps and reports since the Spring 1999 issue of *Arizona Geology* was published:

Carbon dioxide in the St. Johns-Springerville area, Apache County, Arizona: S.L.Rauzi, 1999, Arizona Geological Survey Open-File Report 99-02 (Pub. number OFR 99-02), 22 p., 3 sheets \$10.25 plus shipping and handling

A 1:100,000-scale structure contour map and cross sections are used to depict the geology, drilling, and carbon dioxide occurrences.

Feasibility of using isotopes as tracers of the sources of dissolved solids in the upper Gila River, Arizona: R.C.Harris, 1999, Arizona Geological Survey Open-File Report 99-03 (Pub. number OFR 99-03), 89 p., 1 sheet, scale 1:250,000 \$15.00 plus shipping and handling

Isotopic compositions of suspected sources of dissolved solids entering the Gila River are different from the background Gila River composition. These differences enable one to use isotopic compositions as tracers for each source. Sulfur, chlorine, and probably boron isotopes appear to be useful tracers. Because of the limited number of samples taken in this study, basin-fill sediment, ground water, and river water have not been fully characterized. Further sampling will be required to determine the actual amount of dissolved solids from various sources.

U-Pb geochronologic data from zircons from eleven granitic rocks in central and western Arizona: C.E.Isachsen, G.E.Gehrels, N.R.Riggs, J.E.Spencer, C.A.Ferguson, S.J.Skotnicki, and S.M.Richard, 1999, Arizona Geological Survey Open-File Report 99-05 (Pub. number OFR 99-05), 27 p. \$5.00 plus shipping and handling

Age dates are from the Phoenix area, McMullen Valley area (eastern La Paz and western Maricopa Counties), and the Tank Mountains (northeastern Yuma County).

Geologic map and report for the Theodore Roosevelt Dam area, Gila and Maricopa Counties, Arizona: J.E.Spencer and S.M.Richard, 1999, Arizona Geological Survey Open-File Report 99-06 (Pub. number OFR 99-06), 28 p., 1 sheet, scale 1:24,000 \$8.00 plus shipping and handling

East- or northeast-dipping Apache group strata, diabase sills, Troy Quartzite, and Paleozoic strata are exposed in the area mapped. The Apache Group rests on a mixed assemblage of Proterozoic granitic and gneissic rocks. Miocene sedimentary rocks in the Tonto basin are faulted and slightly tilted.

Subsurface information from three wells in the Tonto basin, Gila County, Arizona: S.M.Richard, 1999, Arizona Geological Survey Open-File Report 99-07 (Pub. number OFR 99-07), 8 p. \$2.00 plus shipping and handling

Paleoseismologic investigations of the Hurricane fault in northwestern Arizona and southwestern Utah: H.D.Stenner, W.R.Lund, P.A.Pearthree, and B.L.Everitt, 1999, Arizona Geological Survey Open-File Report 99-08 (Pub. number OFR 99-08), 130 p. \$15.00 plus shipping and handling

This project was done in cooperation with the Utah Geological Survey to enhance understanding of seismic hazard so information can be incorporated in design standards and building practices. The youngest paleoearthquake near the Utah-Arizona border occurred 5,000 to 10,000 years ago and had a magnitude of about 6.6.

Map of the volcanic geology of the Wood Chop Mesa area, Hopi Buttes (Tsézhin Bii'), Navajo Nation, Arizona: J.A.Vazquez, 1999, Arizona Geological Survey Contributed Map 99-A (Pub. number CM 99-A), 1 sheet, scale 1:12,000. \$3.00 plus shipping and handling

Flows, tuffs, and related rocks, all about 6 to 8 million years old, crop out in the area mapped, which is part of the Hopi Buttes volcanic field.

The geology, leasing, and production history of the Martin uranium-vanadium mine, Apache County, Arizona: W.L.Chenoweth, 1999, Arizona Geological Survey Contributed Report 99-B (Pub. number CR 99-B), 34 p. \$6.00 plus shipping and handling

Ordering Information

You may purchase publications at the AZGS office or by mail. Address mail orders to AZGS Publications, 416 W. Congress St., Suite 100, Tucson, AZ 85701. Orders are shipped by UPS, which requires a street address for delivery. All mail orders must be prepaid by a check or money order payable in U.S. dollars to the Arizona Geological Survey or by Master Card or VISA. Do not send cash. Add 7% sales tax to the publication cost for orders purchased or mailed in Arizona. Order by publication number and add these shipping and handling charges to your total order:

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Other countries, request price quotation.

Shipping and handling charges include insurance. For rolled maps, add \$1.00 for a mailing tube.

If you purchase Open-File Reports, Contributed Maps, or Contributed Reports at the AZGS office, allow up to two days for photocopying.

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Mark Your Calendar

Mining and Reclamation for the Next Millennium; August 13-19, 1999; the Radisson Resort, Scottsdale, AZ. This will be the 16th Annual National Conference of the American Society for Surface Mining and Reclamation (ASSMR). Technical sessions will be held on ecology, forestry and wildlife, geotechnical engineering, hydrology, landscape architecture, soils and overburden, tailings, and wetlands. Special presentations by the Western Region Ash Group will run concurrently with the ASSMR sessions. Pre-conference technical workshops and post-conference tours are planned.

For specifics contact the Arizona Mining Association by phone at (602) 266-4416 or e-mail ctchavez@state.nm.us.

4th Geological Meeting on Northwestern Mexico and Adjacent Areas; March 6-8, 2000; Hermosillo, Sonora, Mexico.

Symposia being planned include stratigraphy, paleogeography, and tectonics of the southwest margin of cratonic North America; magmatism and Tertiary tectonics; mineral deposits; neotectonics; geology of the Gulf of California; hydrogeology and environmental geology; Quaternary geology; Mesozoic arc-related rocks; paleontology, and general sessions. Field trips are also being planned as part of the meeting.

For more information contact Dr. Rogelio Monreal S., Departamento de Geologia, University of Sonora, Hermosillo, Sonora, Mexico. Tel: (62) 592110; Fax: (62) 592111; e-mail: monreal@geologia.uson.mx

Geology and Ore Deposits 2000: The Great Basin and Beyond; May 15-18, 2000; Reno, NV.

Technical sessions will be held on these topics: the geology of Nevada in the context of the Great Basin and the Cordillera, ore deposit models for frontier exploration, environmental geology from exploration to remediation, world-class gold systems, exploration technology for the 21st Century, tectonics and ore deposits, ore deposits in volcanic terranes, and descriptive geology of new deposits.

For details contact the Geological Society of Nevada, P.O. Box 12021, Reno, NV 89510, e-mail: gsnsymp@nbnmg.unr.edu, web site: www.seismo.unr.edu/GSN

Bisbee

The Story of Mining in Bisbee

George F. Leaming describes the geologic history of the Bisbee area, years of discovery of the ore, consolidation of mining claims, growth and expansion of mining companies, mergers and acquisitions, industry leaders, economic and political events that impacted mining, copper production and price, and Bisbee today.

Freeman G. Leaming illustrated this 32-page book, which can be purchased from Free Geos Library, P.O. Box 637, Marana, AZ 85653 for \$11.00, plus 65 cents tax if you live in Arizona.

For information, telephone (520) 903-1840 or e-mail leaming@theriver.com



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