Vol. 26, No. 4
Winter 1996

Arizona Geology

Published Quarterly by the Arizona Geological Survey

ARIZONA GEOLOGICAL SURVEY
INFORMATION TO ARIZONANS SINCE 1889

MISSION

To provide unbiased information to the public to enhance understanding of geologic processes, materials, and resources and support prudent management and use of Arizona's land, water, mineral, and energy resources.

FUNCTIONS

- *Provide information about Arizona geology*
- *Map and describe bedrock and surficial geology*
- *Map and characterize mineral and energy resources*
- *Investigate geologic hazards and limitations*
- *Prepare and publish geologic maps and reports*
- *Maintain databases and files*
- *Maintain geology library*
- *Maintain rock cuttings and core repository*
- *Provide administrative and staff support for Oil and Gas Conservation Commission*

A.R.S. § 27-152

Seismic Hazard in the Flagstaff Area

Philip A. Pearthree
Arizona Geological Survey

Geologic investigations of young faults (paleo-seismology) provide information about large prehistoric earthquakes that can be used with the historical seismic record to evaluate potential for damaging earthquakes. Historical seismic activity and the geologic record of young faulting suggest that there is significant seismic hazard in the Flagstaff area. Flagstaff has been shaken by moderate earthquakes in the past century, the largest of which was around magnitude 6. Many faults in the area have been active in the past several million years and may have potential to generate large quakes. To evaluate the seismic hazard, we conducted a detailed paleoseismologic study of the Bellemont fault, 10 miles west of downtown Flagstaff and gathered information on other young faults in the area.

The Bellemont fault, probably representative of many of the potentially active faults in the area, has experienced repeated ruptures throughout the past few million years. About 12 m of slip has occurred along it during the past 500,000 years. Based on interpretation of a trench excavated across the fault, we concluded that about 2 m of slip occurred in the youngest fault rupture. This rupture, which occurred about 10,000 to 100,000 years ago, likely generated a magnitude 6.6 to 7.0 earthquake. On average, a large quake occurs on the Bellemont fault every 50,000 to 100,000 years. Even though the probability that a large earthquake will occur during a time frame as short as the next 50 years is very low, a large earthquake could occur on the fault at any time.

High concentrations of faults that have been active in the past 5 million years exist south of Flagstaff and north of the San Francisco Mountains. During the past 500,000 years or so, 17 faults

*see **SEISMIC HAZARD**, page 3*

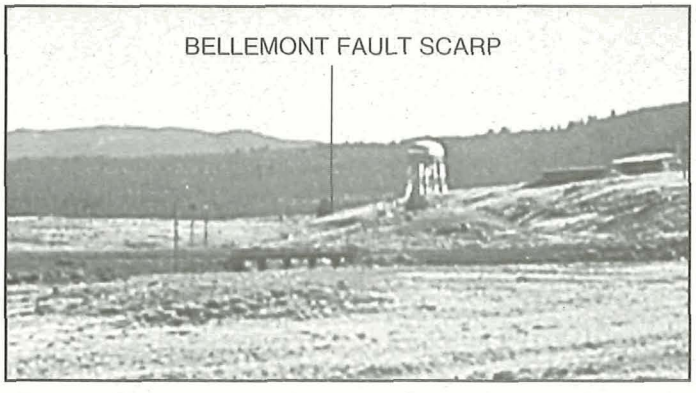

Figure 1. *View looking north along the Bellemont fault on Camp Navajo. In the foreground two strands of the fault drop the land surface on the left (west) side of the photo down relative to the right side. The prominent fault scarp formed on the middle Pleistocene Headquarters basalt flow is evident just to the left of the water tower (arrow). The Bellemont fault extends to the north, where it forms a high, gentle scarp on the horizon on the right side of the photo.*

New Publications

Seismic Hazard

(continued from page 1)

have likely ruptured at least once and about 20 more faults may have ruptured. Typical intervals between surface ruptures on individual faults are probably at least 100,000 years. Using this information, we infer that a large earthquake occurs *on average* every 2,000 to 5,000 years in the Flagstaff area.

A new seismic hazard assessment of the area was developed. We used several alternative assumptions about fault behavior and background seismicity to develop probabilistic hazard scenarios. Results of these analyses imply that seismic hazard in Flagstaff is moderate. Large earthquakes occur in this region, but not frequently enough to result in high probabilistic accelerations over short exposure periods.

These investigations and analyses are summarized in Arizona Geological Survey (AZGS) **Bulletin 200**, which is announced in the next column. This work was supported cooperatively by the AZGS, the Federal Emergency Management Agency, and the Arizona Department of Emergency and Military Affairs.

The Arizona Geological Survey released the following reports and maps since September 1996:

Plio-Quaternary faulting and seismic hazard in the Flagstaff area, northern Arizona: P. A. Pearthree, K. R. Vincent, R. Brazier, and D. M. Hendricks, 1996, Arizona Geological Survey Bulletin 200 (Pub. number B-200), 31 p., 2 plates, scale 1:50,000 and 1:100,000. $20.00

The content of this report is described in detail on page 1.

Geology and geophysics of the Cienega basin area, Pima and Cochise Counties, Arizona: S. M. Richard and R. C. Harris, 1996, Open-File Report 96-21 (Pub. number OFR 96-21), 37 p., 4 plates, scale 1:100,000. $9.00

Geologic data for the lower Cienega basin area were compiled at 1:100,000 scale. Gravity and magnetic data were used in conjunction with the geologic data to construct four cross sections. A generalized isopachous map for low-density (inferred high porosity) basin fill was constructed from the cross sections.

Geologic map of the Bartlett Dam Quadrangle and southern part of the Horseshoe Dam Quadrangle, Maricopa County, Arizona: S. J. Skotnicki, 1996, Open-File Report 96-22 (Pub. number OFR 96-22), 21 p., 1 map, scale 1:24,000. $6.00

The center of the study area includes the volcanic hills of Brushy Mountain and dissected basin-fill deposits, which are well exposed in the southeastern corner of the area. Most of the northern part of the area is underlain by coarse-grained K-feldspar porphyritic granite, which has been eroded into a well developed pediment south of the drainage divide.

Geologic map of the Mesa 30' x 60' Quadrangle, east-central Arizona: J. E. Spencer, S. M. Richard, and P. A. Pearthree, compilers, 1996, Open-File Report 96-23 (Pub. number OFR 96-23), scale 1:100,000. $3.00

This 34 x 57 mile quadrangle in Maricopa and Pinal Counties includes much of Mesa, Tempe, and Chandler, as well as the Santan Mountains, portions of the Sacaton and Superstition Mountains, and a large mountainous area between Superior, Florence, and the Ray Mine. New 1:24,000-scale geologic maps produced under the STATEMAP program, and older U.S. Geological Survey geologic quadrangle maps, are the primary sources of geologic map data. Bedrock and surficial units, earth fissure zones, and radiometric ages of rocks are shown.

Geology of the Cholla Tank and northern third of the Hoodoo Well quadrangles, northern Kofa Mountains, Yuma and La Paz Counties, Arizona: S. J. Skotnicki and C. A. Ferguson, 1996, Open-File Report 96-24 (Pub. number OFR 96-24), 14 p., 1 plate, scale 1:24,000. $5.00

Lower Miocene volcanic rocks rest unconformably on Mesozoic granitoids, metavolcanics, and conglomerates, which crop out locally.

Oil and gas potential of pre-Permian strata, eastern Holbrook basin, Arizona: S. L. Rauzi, 1996, Open-File Report 96-25 (Pub. number OFR 96-25), 15 p. $3.00

The author describes the source-rock potential and thickness of Devonian, Mississippian, and Pennsylvanian strata along the southwestern margin of the Defiance-Zuni positive area. Two cross sections through the eastern Holbrook basin are included.

Surficial geologic map of the southern parts of the New River Mesa and Humboldt Mountain Quadrangles, Maricopa County, Arizona: P. A. Pearthree and K. A. Demsey, 1996, Open-File Report 96-26 (Pub. number OFR 96-26), 13 p., 1 plate, scale 1:24,000. $4.50

This map depicts the distribution of stream deposits and hillslope colluvium on the northeastern fringe of the Phoenix metropolitan area. The map area, which is just north of Carefree and Cave Creek, consists of rugged mountainous terrane, the valley of Cave Creek, and the northern part of a dissected bedrock pediment. Most of the bedrock at the surface in the mountains