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THE STATE AGENCY FOR GEOLOGIC INFORMATION

MISSION

To inform and advise the public about the geologic character of Arizona in order to foster understanding and prudent development of the State's land, water, mineral, and energy resources.

ACTIVITIES

PUBLIC INFORMATION

Inform the public by answering inquiries, preparing and selling maps and reports, maintaining a library, databases, and a website, giving talks, and leading fieldtrips.

GEOLOGIC MAPPING

Map and describe the origin and character of rock units and their weathering products.

HAZARDS AND LIMITATIONS

Investigate geologic hazards and 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.

ENERGY AND MINERAL RESOURCES

Describe the origin, distribution, and character of metallic, non-metallic, and energy resources and identify areas that have potential for future discoveries.

OIL AND GAS CONSERVATION COMMISSION

Assist in carrying out the rules, orders, and policies established by the Commission, which regulates the drilling for and production of oil, gas, helium, carbon dioxide, and geothermal resources.

Buying or Building?

Have You Considered Geologic Hazards?

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Director and State Geologist

Geologic processes such as flooding (Figure 1), earthquakes, landslides, debris flows, and rockfall have potential to cause death or injury to Arizona residents. Other geologic processes and related features (land subsidence, earth fissures, problem soils, and sinks and other solution features) have caused construction and maintenance problems in parts of the State and have potential to cause similar problems. Many people are not aware of potential geologic hazards and limitations before they buy or build. By knowing what to expect beforehand, prospective property or home buyers may be able to save themselves substantial expense and grief.

Arizona Geological Survey (AZGS) geologists Raymond C. Harris and Philip A. Pearthree wrote *A Home Buyer's Guide to Geologic Hazards in Arizona* (AZGS Down-to-Earth 13) to summarize geologic conditions that are most likely to cause property or structural damage. If prospective buyers and builders know about potential hazards they

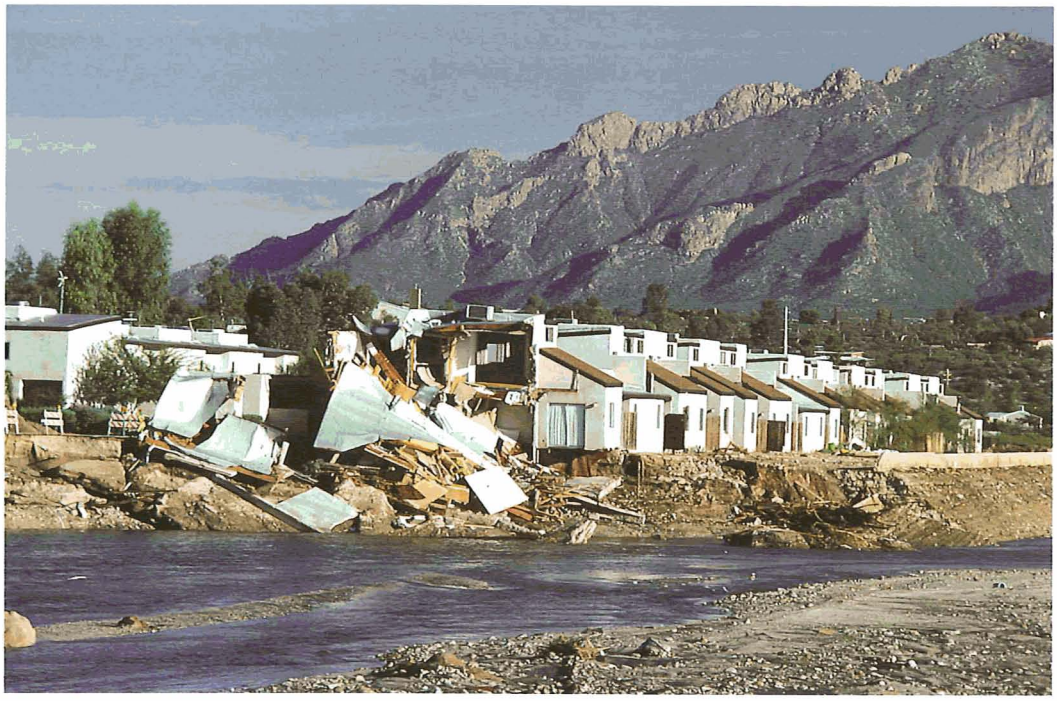

Figure 1. During the flood of October 1983, bank erosion along Rillito Creek in Tucson caused these housing units to be undermined and collapse. Photograph © Peter L. Kresan.

Figure 2. A forest fire south of Sierra Vista in the southern Huachuca Mountains in June 1988 consumed most of the vegetation on a portion of the mountain. The following month a rain storm triggered a debris flow along a tributary of Ash Creek, where there was little vegetation left to hold the soil. The debris flow, a viscous mixture of mud and rocks, moved downslope and damaged several homes. Photograph by Philip A. Pearthree.

can determine how to deal with them and decide what level of risk is acceptable. The authors tell what can be done to reduce damages from specific hazards and where to get additional information.

The 38-page book, printed in full color, is dedicated to the memory of Dr. Troy L. Péwé, a professor of geology at Arizona State University for 34 years. Dr. Péwé and his graduate students mapped and investigated geologic hazards in the metropolitan Phoenix area.

Ordering instructions for this and other new publications are given on page 5 of this issue. The home buyer's guide includes a chapter on each of the geologic hazards and limitations summarized below.

FLOODS

Even though most of Arizona is relatively dry, flooding is probably the most common and widespread geologic hazard in the State. Dry washes can quickly become raging torrents, and the volume of water flowing down rivers may increase a thousand fold.

Floods on smaller washes generally occur during the summer rainy season, when intense, localized thunderstorms may drop as much as 3-4 inches of rain in an hour. In areas with low topographic relief, channel positions may shift substantially during floods and floodwater may cover wide areas outside of existing channels.

Larger streams and rivers flood in response to regional storms that occur in Arizona during the fall and winter. Floods may erode unprotected channel banks (Figure 1) and inundate adjacent floodplains.

Cities and counties in Arizona regulate new building in flood-prone areas.

EARTHQUAKES

Arizona doesn't have nearly the earthquake hazard that its neighbors California, Nevada, and Utah do. Nevertheless, earthquakes do occur. Earthquake hazard is fairly high in the Yuma area. Quakes there are generated by movement along faults in the Imperial Valley, as well as other active faults that extend into northern Mexico.

The earthquake hazard in northwestern Arizona is significant, but less severe than in the Yuma area. More than 50 potentially active faults have been mapped in the Flagstaff-Williams-Grand Canyon area.

Earthquake hazard is much less in the rest of Arizona, although extensive damage occurred as a result of a large earthquake that occurred in northern Sonora, Mexico in 1887.

PROBLEM SOILS

Some soils have a high content of clay minerals that can absorb large quantities of water. When that happens, the soil expands. Expansive soils may cause damage to walls, foundations, highways, and other structures. The amount of soil expansion depends partly on the amount and type of clay mineral in the soil.

Other types of soils lose their strength and compact when wet. This is particularly true in soils that have a high content of silt. Collapsing soils may also cause damage to structures.

Figure 3. Earth fissures such as this one in the southeastern metropolitan Phoenix area southwest of Queen Creek are commonly used as illegal dump sites. Debris was subsequently removed from this fissure. Photograph by Larry D. Fellows.

MASS MOVEMENTS

Huge masses of rock fail occasionally and slide downslope, commonly after heavy rains or snowmelt saturate fractures in the rock. In some areas individual blocks of rock break loose, bounce downslope, and crash into a house, highway, or, with luck, an open field. When rain falls on a recently burned forest or grassland, debris flows may occur because nothing is left to hold the soil and rocks in place (Figure 2).

As urban development proceeds from flat valley floors into adjacent, steeply sloping mountainous areas, mass movements become more problematic. Some of the choicest building sites are in steeply sloping areas.

SUBSIDENCE AND FISSURES

In parts of southern Arizona groundwater has been, and is being, pumped faster than natural recharge can take place. This causes the sand and silt particles in the aquifer to become more compacted and the overlying land surface to subside. In at least two places the land surface is 15-20 feet lower now than it was in 1950.

Subsidence commonly has been accompanied by the development of cracks that may be 5-10 or more feet wide and 5-30 feet deep. A 4,500-foot-long fissure opened after Hurricane Nora dumped heavy rain on parts of west-central Arizona in September 1997. These cracks, called earth fissures, may extend downward to the water table. Subsidence and earth fissures may cause serious drainage and structural problems. Fissures are commonly used as illegal dumping grounds (Figure 3).

RADON

Radon is a gas produced by the natural radioactive decay of uranium. All rocks and soils contain minor amounts of uranium. In some rocks, including some types of granite and lake-bed sediment, uranium is present in above-normal concentrations. Houses and other buildings constructed on rock or soil that has elevated concentrations of uranium are more likely to have elevated concentrations of indoor radon. If the presence of rocks or soils with elevated uranium content is known in advance, special construction methods can be followed to vent radon gas and minimize the hazard potential.

KARST

"Karst" is the name given to topographic and related features that form in areas where comparatively soluble rocks such as limestone, gypsum, or halite (common table salt) are present at or near the land surface. The name is derived from the Karst region of Slovenia, part of the former Yugoslavia.

Soluble rocks are present at or near the land surface in parts of northern Arizona. As a result, an underground plumbing system consisting of land-surface depressions (sinks), caves, and springs have developed slowly over time (Figure 4).

Many karst features in Arizona formed when rainfall rates were greater than they are today. Collapse of sinks and caverns may cause structures, including waste disposal lagoons, to fail.

Figure 4. Salt dissolved in the subsurface west of Snowflake in southern Navajo County and caused overlying rock units to bend, crack, or even collapse. This sinkhole is one of hundreds of collapse features that formed in the area. Photograph by Larry D. Fellows.

ABANDONED MINES

Arizona is highly mineralized because of natural geologic processes. Over the years prospectors dug thousands of holes to determine whether traces of mineralization at the surface extended into the subsurface. Most exploration took place in mountainous areas where bedrock is exposed. A small percentage of the "prospects" contained ore and were eventually mined.

Many prospect pits and mines, long abandoned, have not been closed properly to prevent unauthorized persons from entering (Figure 5). In some instances individuals have forced their way into sealed mine entrances and have been injured. As urban development continues, homes and other structures are being built near or in the mountainous areas where abandoned prospect pits and mines are more common.

Figure 5. Abandoned mine near Tombstone. Photograph by Raymond C. Harris.

VOLCANIC HAZARDS

Volcanic eruptions in Arizona were common during the geologic past. The most recent eruptions took place in the vicinity of Sunset Crater near Flagstaff less than a thousand years ago. Other young eruptions occurred in the western Grand Canyon and in the Pinacate volcanic field in northernmost Sonora and southwestern Pima County.

These volcanic fields are dormant rather than extinct. There is no evidence to suggest, however, that molten rock (magma) is moving in the subsurface or that a volcanic eruption is imminent.