EARTH SCIENCES AND MINERAL RESOURCES OF OKLAHOMA
Figure 35. The generalized stratigraphic column shows selected rock units of Oklahoma. Ages of geologic-time periods are approximate. Rock units separated by commas show the youngest first; rock units with hyphens are indistinguishable or interchangeable. Shaded areas represent unconformities. Rows or column height does not indicate thickness of rock units. The reader may refer to Figure 1 that illustrates the major geologic provinces of Oklahoma. Sources used to compile the stratigraphic column are Huffman (1956), Zeller (1968), Sutherland and Manger (1979), Bingham and Berg- man (1980), Hills and Kottkowski (1983), Lucas and others (1987), Markis (1987), and Arzenv (1989).

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Glass Mountains
Sprinkler irrigation
Granite in Witchita
Solar-salt pans
Lake Altus
Limestone in Arbuckle
Glass sands
Tombstone topography
Turner Falls
Hennessey Shale
EARTH SCIENCES AND MINERAL RESOURCES OF OKLAHOMA

INTRODUCTION
Kenneth S. Johnson, Oklahoma Geological Survey

Oklahoma is a region of complex and fascinating geology with a multitude of natural resources that originated from geologic processes acting over millions of years of Earth history (see Table 1). Several major sedimentary basins, set among mountain ranges and uplifts, lie beneath the State’s surface (Fig. 1). Historically, classic studies of many areas in Oklahoma helped to develop fundamental scientific and engineering principles, including those involved in geology, petroleum exploration, and mineral production. The State has advanced research programs in hydrology, soil science, and climatology, as well as a comprehensive network for monitoring earthquakes.

The topographic map of Oklahoma on page 2 shows mountains, plains, streams, and lakes, as well as spot elevations above sea level of different parts of the State. Hundreds of millions of years ago, geologic forces within the Earth’s crust caused parts of Oklahoma to subside forming major sedimentary basins, while adjacent areas were folded and thrust upward forming major mountain uplifts. Most outcrops in Oklahoma are sedimentary rocks, consisting mainly of shale, sandstone, and limestone; outcrops of igneous and metamorphic rocks, such as granite, rhyolite, gabbro, and gneiss, occur mostly in the Wichita and Arbuckle Mountains. The geologic history of Oklahoma is discussed on pages 3–5, and its present-day geologic map and cross sections are on pages 6 and 7. Oklahoma’s land surface has 27 geomorphic provinces. Each has a similar geologic character, with rocks that underwent a similar geologic history. Weathering and erosion have shaped rocks in these geomorphic provinces into landforms that are described on page 8.

Oklahoma is not known for its earthquake activity, as are California and other western states. However, about 50 earthquakes were detected in Oklahoma every year since 1977, when seismograph stations were installed to monitor low-intensity tremors. Commonly, only one or two earthquakes are strong enough to be felt locally by citizens; the others are detected by Oklahoma’s network of 10 seismograph stations. The earthquake history of Oklahoma is told on page 9.

Oklahoma has abundant mineral resources that include petroleum (crude oil and natural gas), coal, and nonfuel minerals (such as limestone, crushed stone, sand and gravel, iodine, glass sand, gypsum, and shale). The value of petroleum, coal, and nonfuel minerals production reached $11.99 billion in 2004 (latest available data), making the mineral industry the State’s largest source of revenue in recent years. Oklahoma’s nonfuel resources and coal are discussed on page 10, and its petroleum resources are discussed on page 11.

Water resources in Oklahoma consist of surface water and ground water. Surface waters, shown on page 12, are streams and lakes supplied primarily by precipitation and, locally by springs and seeps. In most parts of Oklahoma, surface water and precipitation percolate down into the ground recharging major aquifers, and saturating other sediments and rock units. Page 13 describes the ground-water resources of Oklahoma. Outlines of stream systems or drainage basins, used for improving the management of Oklahoma surface-water resources, are shown on page 14.

Natural and man-made geologic hazards in Oklahoma are discussed on page 15. In Oklahoma, natural geologic processes or conditions that can cause hazardous conditions or environmental problems include earthquakes, landslides, radon, expansive soils, floods, karst features, and salt dissolution/salt springs; some human activities that may create geologic hazards include underground mining, strip mining, and disposal of industrial wastes.

The soils and vegetation of Oklahoma depend on local geology and climate; soils develop as parent material (that is, underlying rocks or sediments) is altered by climate, plants and animals, topographic relief, and time. Weathering of parent material helps develop soils shown on page 16. Soil characteristics and climate largely control the types of native vegetation that grow in various parts of Oklahoma (page 17).

Climate conditions in Oklahoma—including temperature and precipitation—and some other Oklahoma weather facts are shown on pages 18 and 19. Violent storms and tornadoes are common in Oklahoma, especially in the spring. Information about Oklahoma tornadoes is presented on page 19.

Finally, a glossary of selected terms and a list of references are given on pages 20 and 21, and a generalized stratigraphic column (Fig. 35) of outcropping rocks is represented on page 21.
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Page 28, References

Glossary of Selected Terms

Acro-foot—The volume of liquid and/or soil required to cover 1 acre to a depth of 1 foot.

Alluvium—Flat-surfaced deposits of sand, silt, clay, and gravel in stream beds and on flood plains of present-day rivers and streams. Also includes deposits formed by alluviation of eroded material, including loess, and alluvial fan deposits. Usually deposited at the base of a slope.

Aquifer—A permeable rock or deposit that is water bearing.

Basin—A large area that sank faster than surrounding areas during much of geologic time. These areas eventually become the sites of sedimentary basins, which are filled with sediments.

Bentonite—An absorbent clay formed by decomposition of volcanic ash.

Cave—A mineral, calcium carbonate, CaCO₃, the principal component of limestone and a common cement of sandstone.

Cavern—A porous sedimentary rock consisting of sand or gravel cemented by calcium carbonate.

Clinoptilolite—The crushed chert, limestone, and dolomite that is left as a by-product of mining and milling limestone and sandstone.

Coal—A combustible black sedimentary rock consisting mostly of decomposed and carbonized plant matter.

Colluvium—Low and incoherent mass of soil material and/or rock fragments usually transported both downslope and horizontally.

Conglomerate—A sedimentary rock consisting largely of rounded gravel or pebbles cemented together in a fine matrix.

Crude oil—Unrefined hydrocarbons that exist as a liquid in a subsurface reservoir.

Cubic foot (gallon) (gfg)—Amount of gas that will occupy a cubic foot at atmospheric pressure (14.73 pounds per square inch at sea level) and 60° Fahrenheit.

Cuesto—A long, gentle slope capped by a hard layer of rock and terminated by a steep slope.

Cumulonimbus—Exceptionally dense and vertically developed cloud type occurring both as isolated clouds and as a line or wall of clouds; generally accompanied by heavy rain, lightning, and flash floods; this type of cloud is frequently associated with thunderstorms.

Dimension stone—Any stone suitable for cutting and shaping into blocks and slabs for building or ornamental purposes.

Dolomite—A sedimentary rock consisting mostly of the mineral dolomite, CaMg(CO₃)₂ formed from dolomite muds and fossil fragments or, more commonly, by alteration of limestone.

Earthquake—A sudden motion or trembling in the earth caused by the abrupt release of slowly-accumulating stored energy.

Earthquake intensity—A measure of the effects of an earthquake at a particular site. Intensity depends not only on the earthquake magnitude, but also on the distance from the origin of the earthquake and on local geology.

Earthquake magnitude—a measure of the strength of an earthquake determined by seismographic observations; determined by taking the common logarithm (base 10) of the largest ground motion recorded during the arrival of a seismic wave and applying a standard correction for distance to the epicenter. Three magnitude scales, MLQ, m, and MsQ, are used to report magnitude for Oklahoma earthquakes. Each magnitude scale was established to accommodate specific criteria, such as the distance from the epicenter, the size of the event, or the depth of certain seismic data (see Lawson and Luna, 1995, for detailed explanation).

Entisol—Soil order identified by the properties of the parent material (rock

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