CHAPTER 3
GEOLOGY

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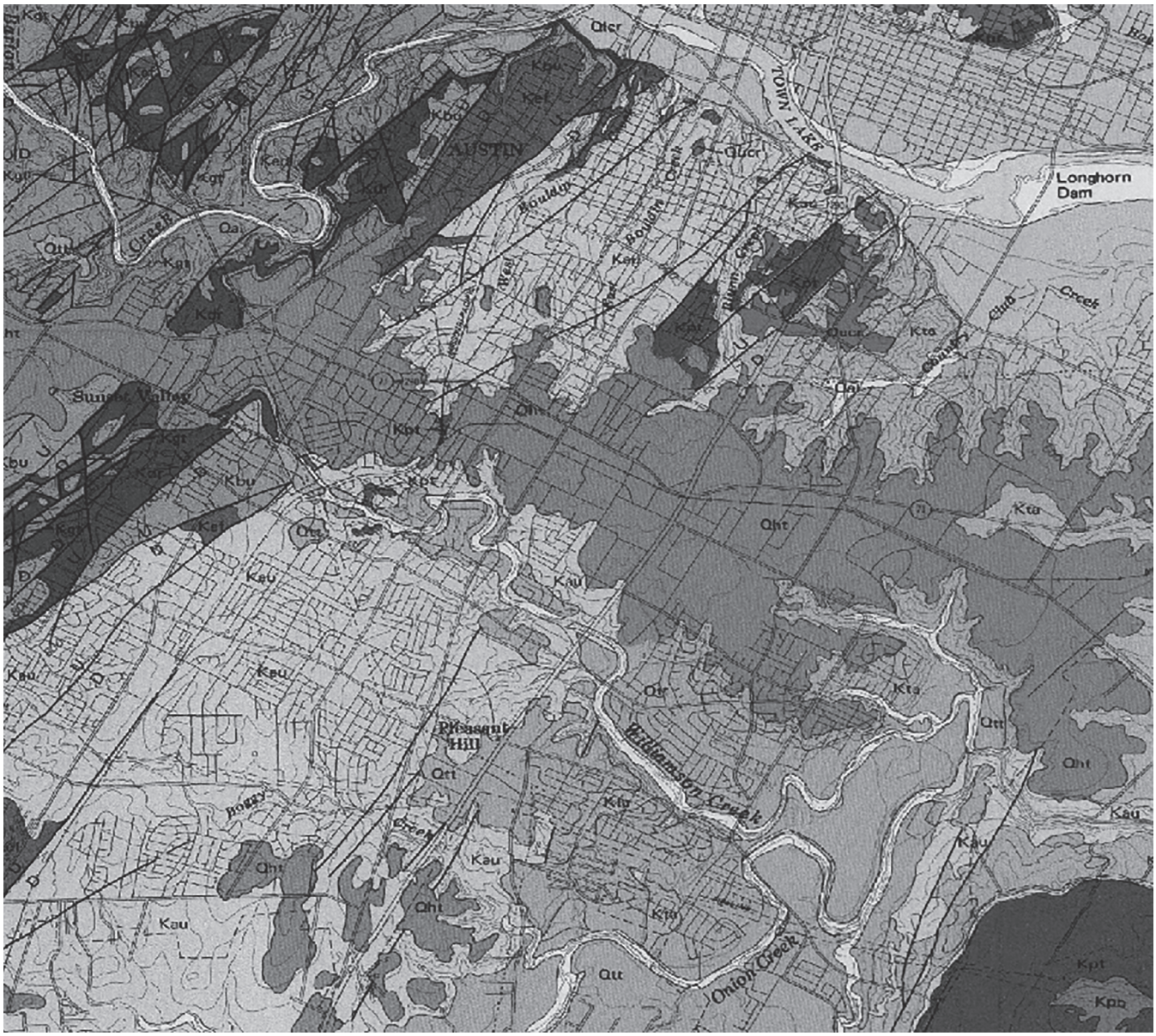


Geologic Outcrop Map of Austin, Texas

Chapter 3

Geology

3.1 Geology

Geology is the science of the origin, formation, and description of materials of the earth. Geologists have separated various formations and rock units into time periods ranging back to nearly the origin of the earth up to the present time. Table 3.1 is a representative time scale of geologic units.

Table 3.1
GENERALIZED GEOLOGICAL SEQUENCE
(oldest at bottom)

GROUP	SYSTEM		APPROXIMATE AGE (YEARS)
Recent	Quaternary	Present Day	Present – 10,000
Cenozoic		Pleistocene	10,000 – 1.6 Million
	Tertiary	Pliocene Miocene Oligocene Eocene	1.6 – 65 Million
Mesozoic	Cretaceous Jurassic Triassic		65 – 250 Million
Paleozoic	Permian Carboniferous Devonian Silurian Ordovician Cambrian		250 – 570 Million
Precambrian			Origins of Earth to Cambrian

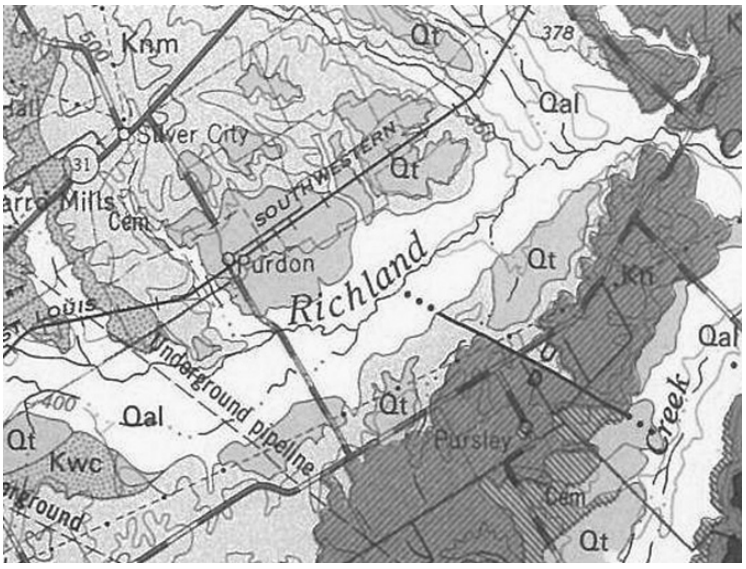
Any of the earth units shown on the time scale could be exposed near the ground surface at any particular locality depending on the erosional or faulting history of the area. Frequently, regardless of what ancient formation exists at a fairly shallow depth, there are recent deposits overlying the material. Recent deposits could be as old as 10,000 years or as young as yesterday. These are typically deposits due to water action. Deposition of soil derived from erosion sources often includes river or creek alluvium (alluvium means water-deposited); side bank deposits or deltas, such as the Mississippi River Delta; or wide areas of waterborne deposits called terrace or sheet deposits. Sometimes colluvium, which is material that has fallen from a slope or bluff by gravity, may be found covering older deposits.

Geotechnical engineering is mainly concerned with the engineering properties (strength, compressibility, shrink-swell, permeability) of the upper layers of the Earth's crust ranging from a few feet to perhaps several hundred feet, depending on the type of deposit and the nature of the proposed foundation.

3.2 Formations

Formations are geologic units that have been mapped by geologists using field work, aerial photography, soil borings, and other sources. Formations are generally identified by their geologic age. Knowing and understanding the geologic formations in a local area can be useful in the design and construction of foundations. Some formations can have a fairly consistent set of attributes in a local area, while others can be highly variable. Published geologic maps are available for a large percentage of the country.

Figure 3.1 shows a geologic outcrop map with older formations (Knm and Kwc) overlain by more recent terrace and alluvium deposits (Qt and Qal).



Courtesy of Bureau of Economic Geology, The University of Texas at Austin

FIGURE 3.1
GEOLOGIC OUTCROP MAP WITH RECENT DEPOSITS (Qt AND Qal) OVER CRETACEOUS AGE MATERIAL (Knm and Kwc)

3.3 Faults

Faults are fractures in formations caused by relative movements of the Earth's crust. Some faults are famous, such as the San Andreas Fault in California, because their movements result in frequent earthquakes. An earthquake occurs when stresses build up, and the stresses are suddenly relieved by slippage, creating a large acceleration and movement of the surrounding area. The stress build-up results from large plate movements of the Earth's crust, deep molten rock movements, or area subsidence. Faults can be of various types. They can be "strike-slip" movement from side to side or "thrusting" faults in which a sloping layer is forced under or over an adjacent layer. Active faults that tend to move with a sudden acceleration from time to time are of great interest to foundation and structural designers since they produce earthquakes, which can destroy or severely damage structures. If earthquakes occur within the ocean, tsunamis may result, which can be more damaging than earthquakes alone and result in greater loss of life.

In many areas there are numerous faults that are not active, meaning that they have not moved or caused earthquake-type accelerations for very long periods of time. Sometimes, for foundation design, even these "dormant" faults can cause problems because there may be a rock formation outcropping near the surface immediately adjacent to a clay formation. This will result in two different support conditions, which could cause the reaction of a foundation to be very different in different parts.

Faults can be clean breaks, which are very narrow, or they can have a wide zone of ground-up and mixed-up material. Often faults are sources of springs, and many major springs around the world are located at a fault zone. Figure 3.2 illustrates various kinds of faults.

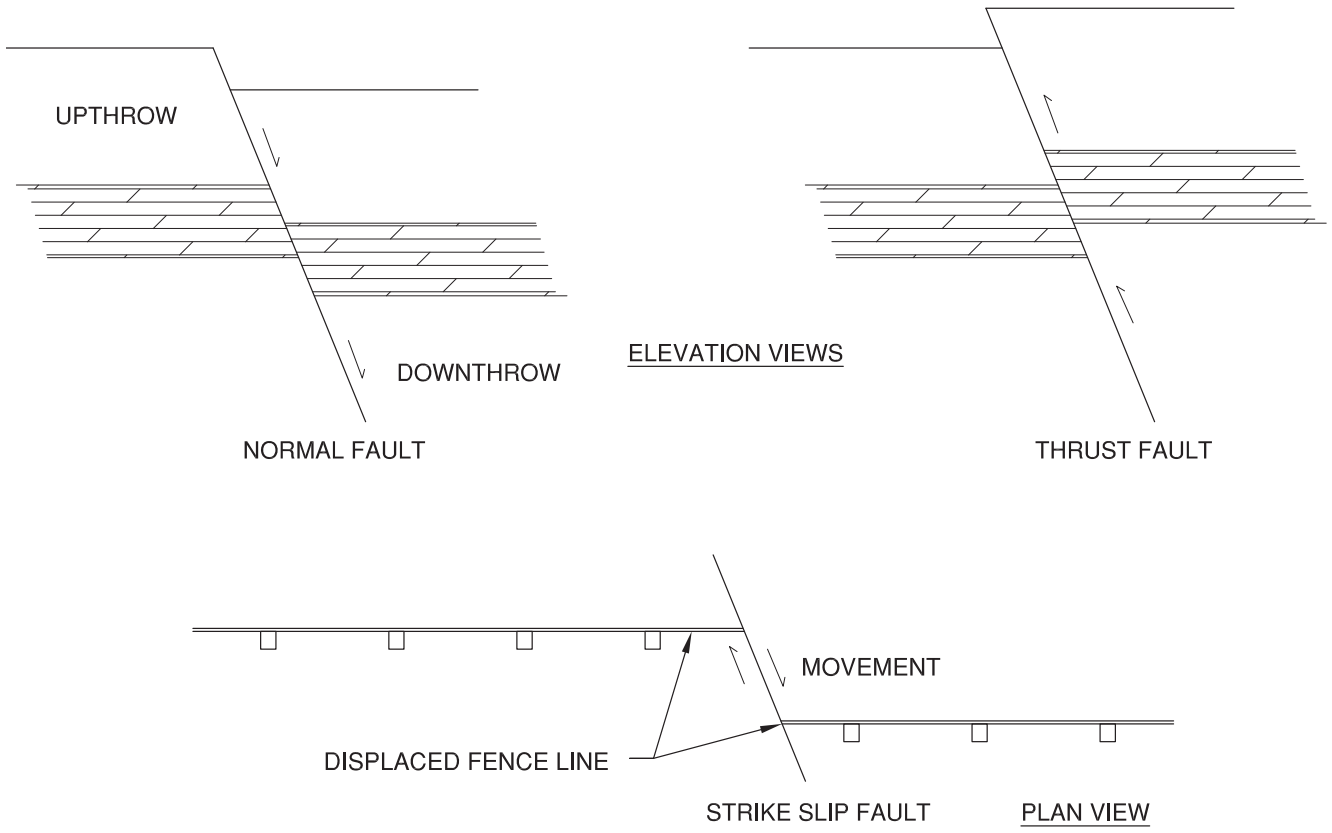


FIGURE 3.2
TYPES OF FAULTS

3.4 TEST QUESTIONS

MULTIPLE CHOICE

1. Geology is the science of (select one):
    a. mapping streets and towns in a locality
    b. finding the best highway route
    c. the origin, formation, and description of materials of the Earth
    d. evolution

2. Select the correct statements (select two):
    a. The Jurrassic Age is older than the Crestaceous Age
    b. In normal geologic sequence, the youngest formations are at the top of the soil profile
    c. The Paleozoic Period ranges from 65 to 250 millions years

3. Sudden movements of faults (select two):
    a. may result in earthquakes
    b. may cause tsunamis
    c. are the result of tornados

4. Faults which have not been active for very long periods of time (select one):
    a. never pose problems with regard to foundation design
    b. may spontaneously collapse
    c. could cause two different soil materials to be present at the ground surface

5. Formations are generally identified by (select one):
    a. age
    b. color
    c. the presence of springs

6. Colluvium is material that is deposited by (select one):
    a. volcanic ash
    b. falling from a slope or cliff
    c. airborne dust

7. Knowing and understanding the geologic formations in a local area can be useful in the design and construction of foundations:
    a. true
    b. false