

## Geology of Texas

Six Distinct Geologic Provinces (pp. 549-551)

- High Plains
- North-Central Province
- Edwards Plateau
- Llano Uplift
- Trans-Pecos Texas
- Gulf Coast Plain

## Precambrian

- Edge of the North American continent along line B
- North and west of line B, basement rocks are of Precambrian age and composed of continental crust of granitic composition.
- To the east, under the Gulf Coastal Plain, the character of the basement is not well known as it lies buried beneath a thick sequence of sedimentary rocks. The basement is composed at least partly of basaltic oceanic crust.
- Llano Uplift: Precambrian igneous and metamorphic basement
- Deformation and metamorphism occurred between 1.2 and 1.3 billion years (b.y.) ago.
- Intrusion of granitic batholiths occurred 1.1 b.y. ago.

## Paleozoic Era

- Early to middle Paleozoic Era
  - Much of Texas was occasionally flooded by shallow seas and at other times the land lay barely above sea level.
- Late Paleozoic Era
  - Collision of North American tectonic plate with another land mass formed the Ouachita Mountains.
  - During the Pennsylvanian and Permian Periods, rivers drained westward from the Ouachita barrier, in a direction opposite to the present drainage direction.

## Mesozoic Era

- Early Mesozoic Era
  - Early formation of the Gulf of Mexico
  - Thick salt deposition under the coastal plain
- Late Mesozoic Era
  - Marine transgression resulting in deposition of a sheet of limestone unconformably over older rocks
  - Edwards Plateau in West Texas

## Cenozoic Era

- Early Cenozoic Era (Tertiary Period)
  - The sea retreated, and the current drainage system (toward the southeast) became established.
  - Thick sediment, chiefly of delta origin, was deposited in the Coastal Plain.
  - Depression of the earth's crust resulted from the load of sediment, initiating the Balcones Fault System.
  - Widespread volcanism and faulting occurred in Trans-Pecos region where the crust was thinned and stretched.
- Late Cenozoic Era (Tertiary/Quaternary Period)
  - Ogallala Formation in the High Plains - alluvium shed off mountains to the west in New Mexico

## Hydrogeology

- Aquifer: a rock body that has the capacity to transmit "usable" quantities of water to a well
  - Rock types that are good aquifers: sandstone (if weakly cemented), conglomerate, fractured limestone
- Aquitard: A rock body that does NOT transmit "usable" quantities of water over a reasonably short period of time
  - Example of aquitard: shale
- Water table: a level below which the ground is saturated with water, and above which it is not saturated (although moisture may be present)

## Porosity and Permeability

- Porosity: fraction of a rock body consisting of void spaces (example: 20% porosity)
  - Primary porosity - present initially in a rock body when created
  - Secondary porosity - created later by processes such as fracturing or dissolution
- Permeability: a measure of how well interconnected the pores are, hence how easily the material can transmit fluids

## Types of Aquifers

- Alluvial aquifer: sandstone, conglomerate
  - High primary porosity and permeability
  - Diffuse flow (SLOW), providing time for breakdown of contaminants
  - Serves as a natural filter for contaminants.
- Karst aquifer: fractured limestone
  - Limestone may have LOW primary porosity/permeability
  - BUT, fracturing/dissolution can create secondary porosity/permeability.
  - Discrete (RAPID) flow: little/no filtering or breakdown of contaminants

- Recharge: the process of surface water entering an aquifer
  - Infiltration: water soaks into the ground over a large area, how alluvial aquifers recharge
  - Focused recharge: along narrow zones of interconnected fractures exposed at the surface, how karst aquifers recharge
- Discharge: the process by which groundwater exits an aquifer and enters a body of surface water
- Problems with increased impervious cover (material such as asphalt and concrete):
  - concentrates pollutants on top of the cover.
  - increases rate of runoff and worsens floods.
  - inhibits recharge.

## Important Texas Aquifers

- Tertiary Ogallala Aquifer - alluvial aquifer
  - Semi-arid region with low rate of recharge
  - Overpumping, resulting in lowering of the water table
- Cretaceous Edwards Aquifer - karst aquifer
  - vulnerable to contamination
  - focused recharge, hence methods of construction must be regulated stringently along fault zone.