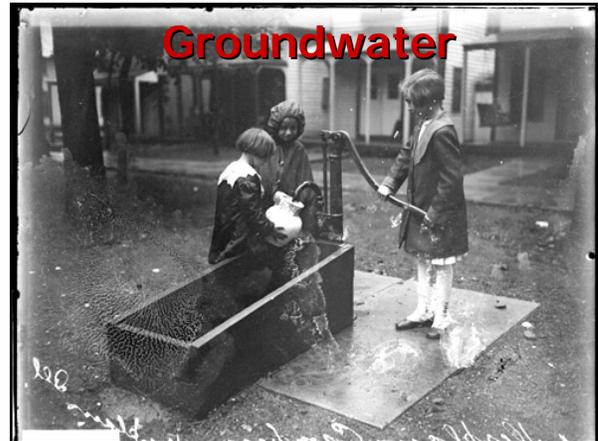


Essentials of Geology

David Sallee

Chapter 10

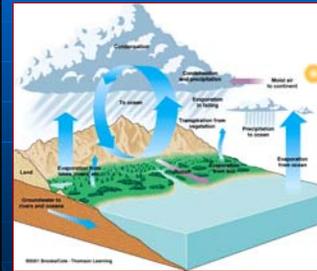


Introduction

- Groundwater fills the open spaces in rocks, sediment, and soil beneath the surface
- Groundwater is an important source for domestic, industrial, and agricultural use, but is also an important erosional agent and important energy source in some areas



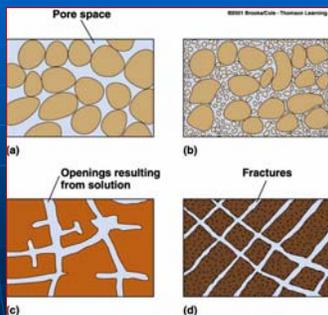
Groundwater and the Hydrologic Cycle



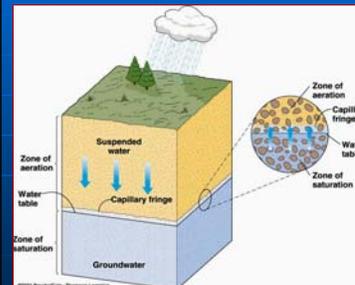
- Groundwater is about 22% of the world's fresh water
 - comes from precipitation percolating through soils and sediment
 - streams, lakes, and snowmelt also contribute

What Properties of Earth's Materials Allow Them to Absorb Water?

- Porosity**
 - the percentage of a material's volume that is pore space
- Permeability**
 - the measure of the interconnectedness of pore spaces
- Aquifer**
 - permeable layer that transports water

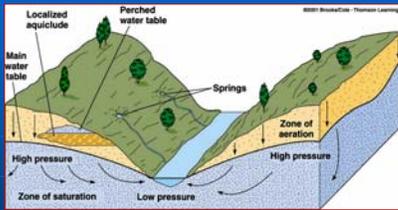


What is the Water Table?



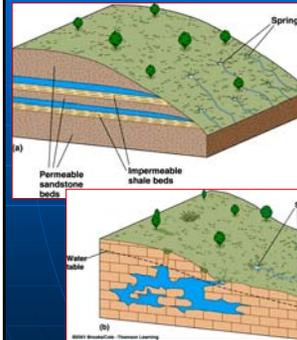
- Zone of aeration**
 - pore spaces contain mostly air
- Zone of saturation**
 - pore spaces contain mostly water
- Water table**
 - the top of the zone of saturation

How Does Groundwater Move?



- Gravity moves groundwater, just as it does water in channels
 - moves from areas of high pressure to areas of low pressure
 - may move up to 250 m per day, or less than a few cm/day

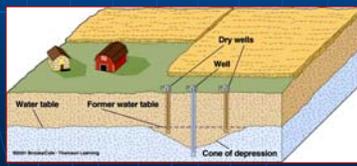
What Are Springs?



- Places where groundwater flows or seeps out of the ground
 - when percolating water reaches the water table or impermeable layer, it flows laterally and may intersect the surface

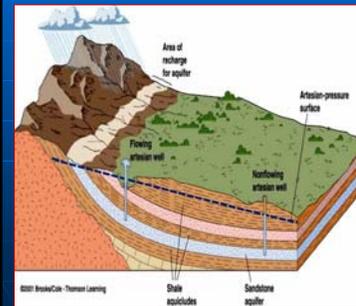
What Are Water Wells?

- Water percolates into a drilled or dug hole when the zone of saturation is penetrated
 - pumping can create a cone of depression
 - lowering of the water table is a major problem in some areas



What Are Artesian Systems?

- Confined groundwater that flows at the surface under hydrostatic pressure
 - confined above and below
 - rocks are exposed at the surface
 - sufficient precipitation to recharge the aquifer

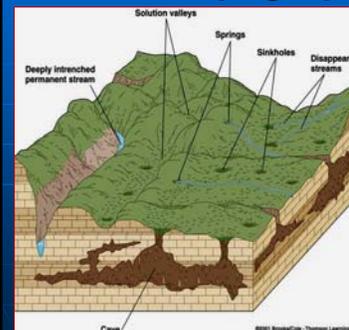


How does Groundwater Erode and Deposit Material?

- When soluble rock is exposed at the surface, water can attack minerals chemically and become a significant erosional agent



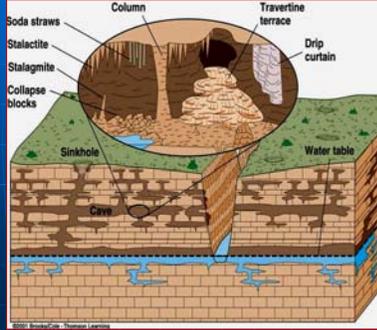
Sinkholes and Karst Topography



- Sinkholes form when
 - soluble rock is dissolved leaving shallow depressions
 - cavern roof collapse
- Karst topography
 - numerous caves, springs, solution valleys, sinkholes, and disappearing streams

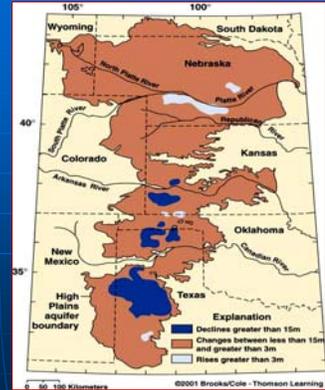
Caves and Cave Deposits

- Caves form as a result of dissolution of carbonate rocks
- They may have a complex history reflecting changes in the water table
- Depositional features include:
 - dripstone, stalagmites, and stalactites

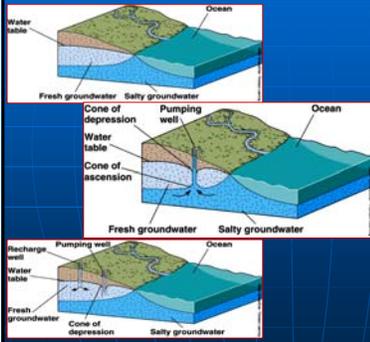


Lowering the Water Table

- Occurs primarily when more groundwater is used than is replaced by natural processes
 - the High Plains aquifer is used for agriculture
 - water is being used at up to 100 times its recharge rate in some areas



Saltwater Incursion



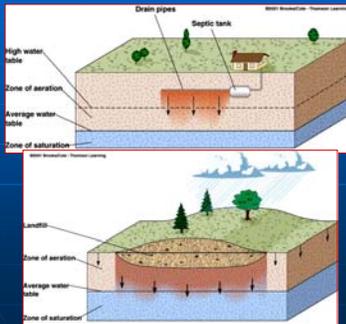
- Excessive pumping in coastal areas can result in salt water being drawn into wells
 - major problem in rapidly growing coastal communities
 - recharge wells are often used to pump water back into the system

Subsidence

- Loose grains of the aquifer are packed tighter after groundwater withdrawal
 - subsidence of the land has lowered Mexico City more than 3m in some places



Groundwater Contamination



- Most common sources:
 - sewage, landfills, toxic waste disposal sites, and agriculture
 - serious problem due to indiscriminate practices by industry and citizens

Hydrothermal Activity-What Is It and Where Does it Occur?



- Hot Springs
 - water is circulated deep, where it is heated by magma or cooling igneous rocks
 - runs freely at the surface
- Geysers
 - forcefully eject water and steam because of constrictions in the plumbing system

Geothermal Energy

- About 1 - 2% of the world's energy is generated from geothermal sources
- It is limited to locations with plentiful water and where hot rocks are near the surface
 - Iceland, United States, Mexico, Italy, New Zealand, Japan, Philippines, and Indonesia



The Pearl, a rotating restaurant built on the top of Reykjavik's geothermal water tanks