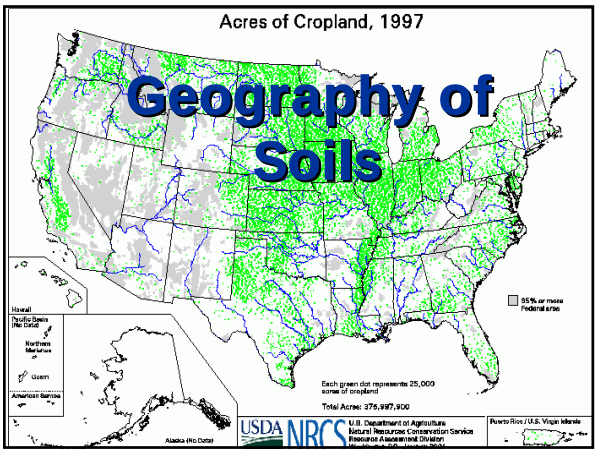
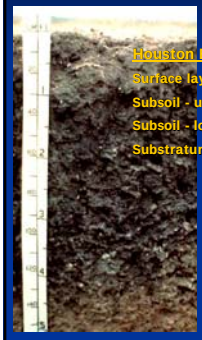
Physical Geography

GEOGRAPHY 1300

DAVID R. SALLEE



Soil as a Resource



The central concept of Vertisols is that of soils that have a high content of expending clay. They shrink when drying and swell when they become wetter.

Houston Black Soil Profile

Surface layer: black clay

Subsoil - upper: black clay with slickensides

Subsoil - lower: black clay with slickensides and calcium carbonate

Substratum: light olive brown clay

The Houston Black series occurs on about 1.5 million acres in the Blackland Prairie, which extends from north of Dallas south to San Antonio. Because of their highly expansive clays, Houston Black soils are recognized throughout the world as the classic Vertisols, which shrink and swell markedly with changes in moisture content. These soils formed under prairie vegetation and in calcareous clays and marls. Water enters the soils rapidly when they are dry and cracked and very slowly when they are moist.

Overview

- Soil Formation
- Chemical and Physical Properties of Soils
- Soils and Human Activities

What is Soil and How Does it Form?

- Soil is a mixture of weathered rock material, water, air, and organic matter
  - Sand, silt, and clay - weathered rock fragments
  - Humus - carbon rich decayed organic material
  - Residual soils - develop on parent rock
  - Transported soils - eroded and transported to another location where soil develops

Soil Formation

- Soil-Forming Processes: Weathering
- Soil Profiles, Soil Horizons

Soil

- Controls of soil formation
  - Parent material
    - Residual soil – parent material is the bedrock
    - Transported soil – parent material has been carried from elsewhere and deposited
  - Time
    - Important in all geologic processes
    - Amount of time to evolve varies for different soils

Soil

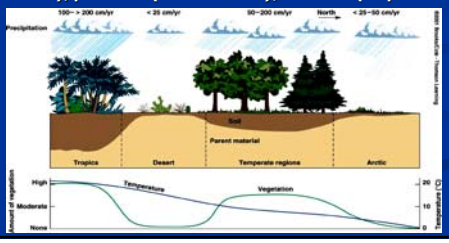
- Controls of soil formation
  - Climate
  - Plants and animals
    - Organisms influence the soil's physical and chemical properties
    - Furnish organic matter to soil

Soil

- Controls of soil formation
  - Slope
    - Angle
      - Steep slopes often have poorly developed soils
      - Optimum is a flat-to-undulating upland surface
    - Orientation (direction the slope is facing) influences
      - Soil temperature
      - Moisture

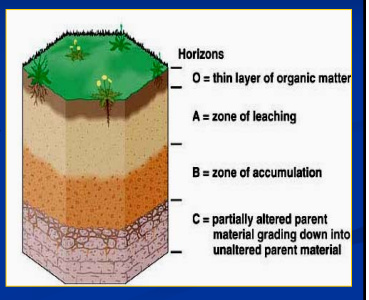
What is Soil and How Does it Form?

- Factors Controlling Soil Formation
  - Climate, relief, slope angle
  - Three major soil types are recognized: pedalfers (humid climates), pedocals (arid climates), laterites (tropical climates)



What is Soil and How Does it Form?

- The Soil Profile
  - O horizon
    - organic matter
  - A horizon
    - top soil, intense biological activity
  - B horizon
    - subsoil, zone of accumulation
  - C horizon
    - little organic matter, partially altered parent rock



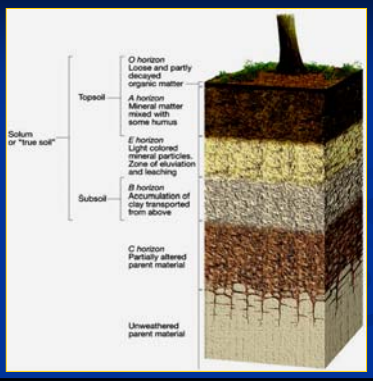
Soil

- Soil Profile
  - Soil forming processes operate from the surface downward
  - Horizons – zones or layers of soil
  - Horizons in temperate regions
    - O – organic matter
    - A – organic and mineral matter
    - E – little organic matter

Soil

- Soil Profile
  - Horizons in temperate regions
    - B – zone of accumulation
    - C – partially altered parent material
  - O and A together called topsoil
  - O, A, E, and B together called solum, or "true soil"

An idealized soil profile



A soil profile showing different horizons

What is Soil and How Does it Form?

- Soil degradation is a decrease in soil productivity or loss of soil.

Chemical and Physical Properties of Soils

- Color, Texture, and Structure of Soils
- Soil Classification

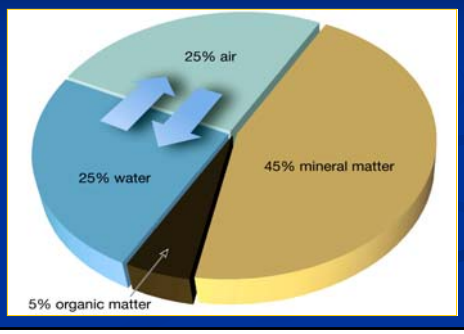
SOIL ORDER:

A group of soils in the broadest category of the the USDA "Soil Taxonomy." The Soil Taxonomy is a basic system of soil classification for making and interpreting soil surveys. There are 12 orders, differentiated by the presence or absence of diagnostic horizons: Alfisols, Andisols, Aridisols, Entisols, Gelisols, Histosols, Inceptisols, Mollisols, Oxisols, Spodosols, Ultisols, and Vertisols. Orders are divided into Suborders and the Suborders are farther divided into Great Groups.

Soil

- An interface in the Earth system
- Soil is a combination of mineral matter, water, and air – that portion of the regolith (rock and mineral fragments) that supports the growth of plants

Typical components in a soil that yields good plant growth



Soil

- Soil texture and structure
  - Texture refers to the proportions of different particle sizes
    - Sand (large size)
    - Silt
    - Clay (small size)
  - Loam (a mixture of all three sizes) is best suited for plant life

Soil Texture Triangle

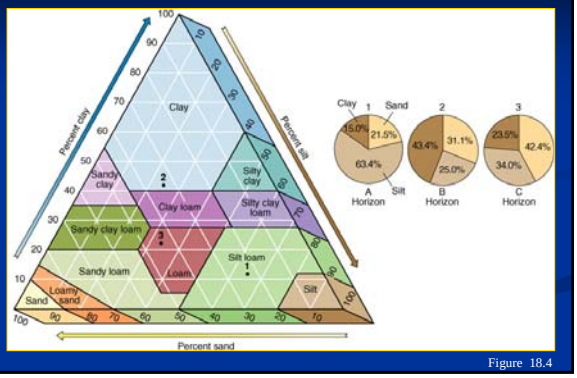
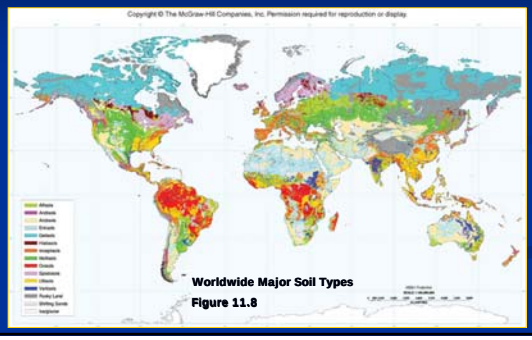


Figure 18.4

Chemical and Physical Properties of Soils



Worldwide Major Soil Types

Figure 11.8

Types of Soil Structure

Figure 18.5

Properties of Soils

Munsell Color Book

Soils and Human Activities

- Lateritic Soil
- Wetland Soils
- Soil Erosion
- Soil Erosion versus Soil Formation
- Strategies for Reducing Erosion
- Irrigation and Soil Chemistry
- The Soil Resource–The Global View

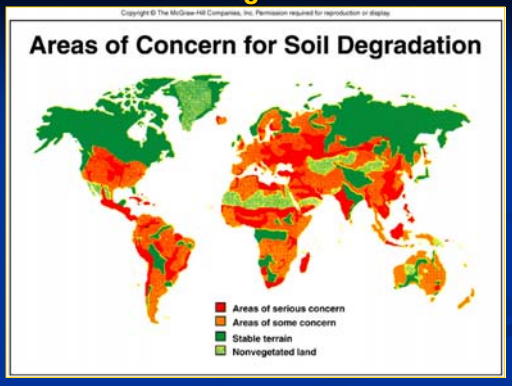
Soil

- Soil erosion
  - Recycling of Earth materials
  - Natural rates of erosion depend on
    - Soil characteristics
    - Climate
    - Slope
    - Type of vegetation

Soil

- Soil erosion
  - Soil erosion and sedimentation can cause
    - Reservoirs to fill with sediment
    - Contamination by pesticides and fertilizers

Concern for Soil Degradation Worldwide

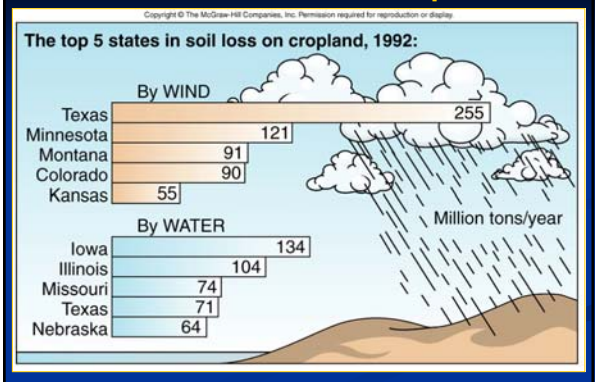


Source: *Data from Global Resource Information Database of U.N. Environment Programme.*

Location of Soil Erosion by Wind or Water

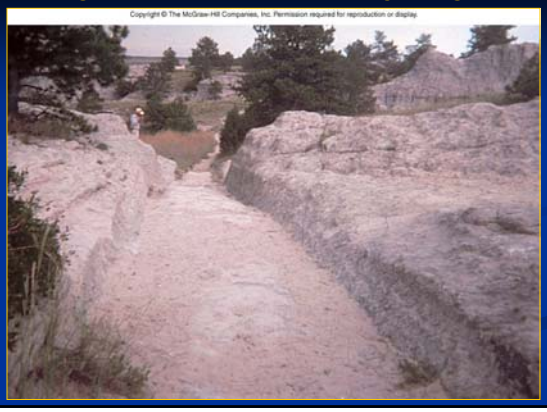
Source: *Data from Global Resource Information Database of U.N. Environment Programme.*

Soil Loss Per State on Cropland

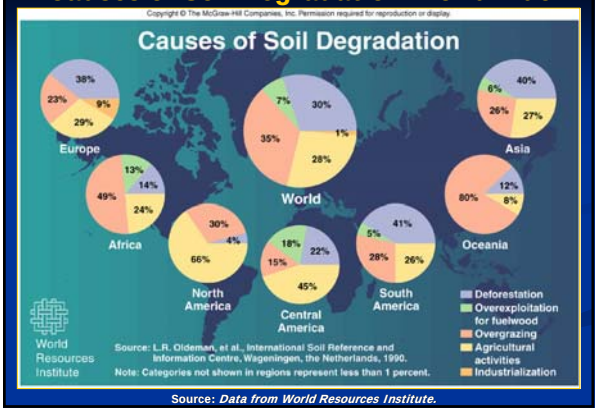


Source: National Resources Inventory April 1995, *USDA Natural Resources Conservation Service.*

Oregon Trail Ruts Carved by Wagons



Causes of Soil Degradation Worldwide



Source: *Data from World Resources Institute.*

EROSION CONTROL

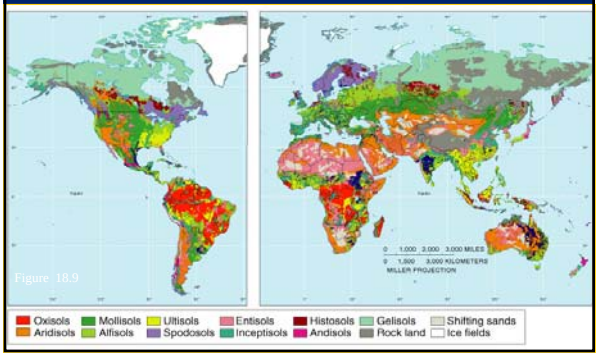
RURAL
- Contour plowing
- Terracing
- Wind Breaks
- Riparian buffers
- Silt ponds

URBAN
- Silt fences
- Storm drain filters
- Detention ponds
- Retention ponds

Soil Classification

- Soil Taxonomy
- Diagnostic Soil Horizons
- The 12 Soil Orders of the Soil Taxonomy

Soil Taxonomy



Soil

- Soil texture and structure
  - Structure
    - Soil particles clump together to give a soil its structure
    - Four basic soil structures
      - Platy
      - Prismatic
      - Blocky
      - Spheroidal

Soil

- Soil types
  - Hundreds of soil types worldwide
  - Three very generic types
    - Pedalfer
      - Accumulation of iron oxides and Al-rich clays in the B-horizon
      - Best developed under forest vegetation

Soil

- Soil types
  - Three very generic types
    - Pedocal
      - Accumulate calcium carbonate
      - Associated with drier grasslands
    - Laterite
      - Hot, wet, tropical climates
      - Intense chemical weathering

Soil

TABLE 5.2 **Summary of Soil Types**

Climate	Temperate humid (>63 cm rainfall)	Temperate dry (<63 cm rainfall)	Tropical (heavy rainfall)	Extreme arctic or desert
Vegetation	Forest	Grass and brush	Grass and trees	Almost none, so no humus develops
Typical Area	Eastern U.S.	Western U.S.		
Soil Type	Pedalfer	Pedocal		Laterite
Topsoil	Sandy, light-colored; acid	Commonly enriched in calcite; whitish color	Enriched in iron (and aluminium) brick-red color	No real soil forms, because there is no organic material. Chemical weathering is very slow.
Subsoil	Enriched in aluminum, iron and clay; brown color	Enriched in calcite; whitish color	All other elements removed by leaching	
Remarks	Extreme development in conifer forests, because abundant humus makes groundwater very acidic. Produces light gray soil because of removal of iron.	Caliche is name applied to the accumulation of calcite.	Apparently bacteria destroy humus, so no acid is available to remove iron.	

Zones not developed