

### **Soil**

- Most of the Earth's land surface is covered by **regolith** - the layers of rock and mineral fragments produced by weathering.
- SOIL - is a combination of regolith, organic material, water, air and organisms. It can actually be considered an ecosystem.
- There are at least 10,000 soil types in the United States - grouped into 12 basic orders and many thousands more worldwide.

### **Soil Development**

- Good topsoil accumulates at a rate of approximately 1mm per year in “good conditions” and can take up to thousands of years to develop under “poor conditions.”

### **Soil Organisms**

- Fertile soil contains a wide range of organisms: algae, bacteria (nitrogen fixing etc.), fungi (decomposers), worms and nematodes (soil processors), plus a wide variety of bugs, slugs, and microscopic organisms.
- We have very little understanding of this complex ecosystem  
See figure 7-11 in book

Soil is composed roughly of 50% solid material (rock and mineral fragments, and organic material) and roughly 50% air and water filling the pore spaces.

### **SOIL HORIZONS** - See figure 7 – 12 in book

#### **O-Horizon**

- consists largely of organic material such as plant litter, fecal matter, and other organic debris
- The upper portion is mostly undecomposed and the lower portion is composed of **humus** partly/fully decomposed organic material.
- Most of the living organisms are in this layer

#### **A-Horizon**

- A largely mineral layer, with high biologic activity and some significant percentage of humus (up to 30%)
- the O and A horizons = TOPSOIL

#### **E - Horizon**

- a light colored layer that contains little organic material
- Water percolates through this layer **leaching** away minerals/nutrients and washing away finer particles = **eluviation**

## **B-Horizon**

- also called the **subsoil**
- a zone of accumulation - the material carried away from the E-horizon is typically deposited here.
- if this layer turns completely into hard clay it is called **hardpan**
- Soil horizons O, A, E and B together comprise the **solum** or “true soil”
- This is where soil forming processes are active and that living roots, animals and microorganisms are confined

## **C-Horizon**

- below the solum, this layer is composed of partially altered parent (i.e. rock) material
- Beneath this is unaltered bedrock

## **Soil Types**

- There are twelve soil orders
- Geology books use 3 “soil series” which is actually a really old system
- classified based on the organic content, climate conditions, percentage of each horizon, etc.

### **PEDALFER**

Rich in Aluminum and Iron.

Form in humid environments like the south-eastern US

### *Mollisols*

- soils of grassland ecosystems. They are characterized by a thick, dark surface horizon.
- Mollisols are among some of the most important and productive agricultural soils in the world.

### *Alfisols*

- Alfisols are forest soils that have relatively high native fertility. These soils are well developed and contain a subsurface horizon in which clays have accumulated. Alfisols are mostly found in temperate humid and subhumid regions of the world. Alfisols to be very productive soils for agriculture and silviculture.

### **PEDOAL**

Rich in calcium

Form in arid environments like the southwest

### **LATERITE**

Depleted of nearly everything but Fe and Al (bright red color – looks like a brick)

Form in tropical environments with very high rainfall

- Lots of clearing in the Amazon; turning into a desert; the forest will not come back.
  - Hardpan (laterite) forms
  - Plow Agriculture – clearing and plowing is a disaster.
  - Cattle Ranching - exposes soil to rapid erosion
  - Thin humus layer destroyed

**Renewable or Nonrenewable ?**

- Every year 3 million hectares (~7.5 million acres) of crop land is ruined by erosion
- 4 million hectares are lost to desert
- 8 million hectares are converted to nonagricultural use
- 1.9 billion hectares of soil has been degraded to some extent
  - 300 million hectares strongly degraded (gulleys, nutrient poor, poor crop growth)
  - 910 million ha moderately degraded
  - 9 million ha can no longer support crops

See Figure 7.14 and 7.15 in the book

### **Erosion**

- transport of material by some agent (wind, water, ice...)
- The thin topsoil layer of soil is transported away often much faster than it is replaced by soil production (only a couple of millimeters has to be transported away to outpace production)

### **Water Erosion**

Farming Methods !

### **Wind Erosion**

Dust Bowl

- In 1931 the rains stopped and the "black blizzards" began. Powerful dust storms carrying millions of tons of stinging, blinding black dirt swept across the Southern Plains--the panhandles of Texas and Oklahoma, western Kansas, and the eastern portions of Colorado and New Mexico. Topsoil that had taken a thousand years per inch to build suddenly blew away in only minutes. One journalist traveling through the devastated region dubbed it the "Dust Bowl." Finally, in the fall of 1939, the skies opened.

### **Runoff**

- loading of rivers with sediment
- silting of dams and reservoirs
- smothering wetland and coral reefs
- Fertilizer can make soil productive but the increased nutrients in the runoff cause problems ... red tides, algal bloom

### **Chemical Degradation**