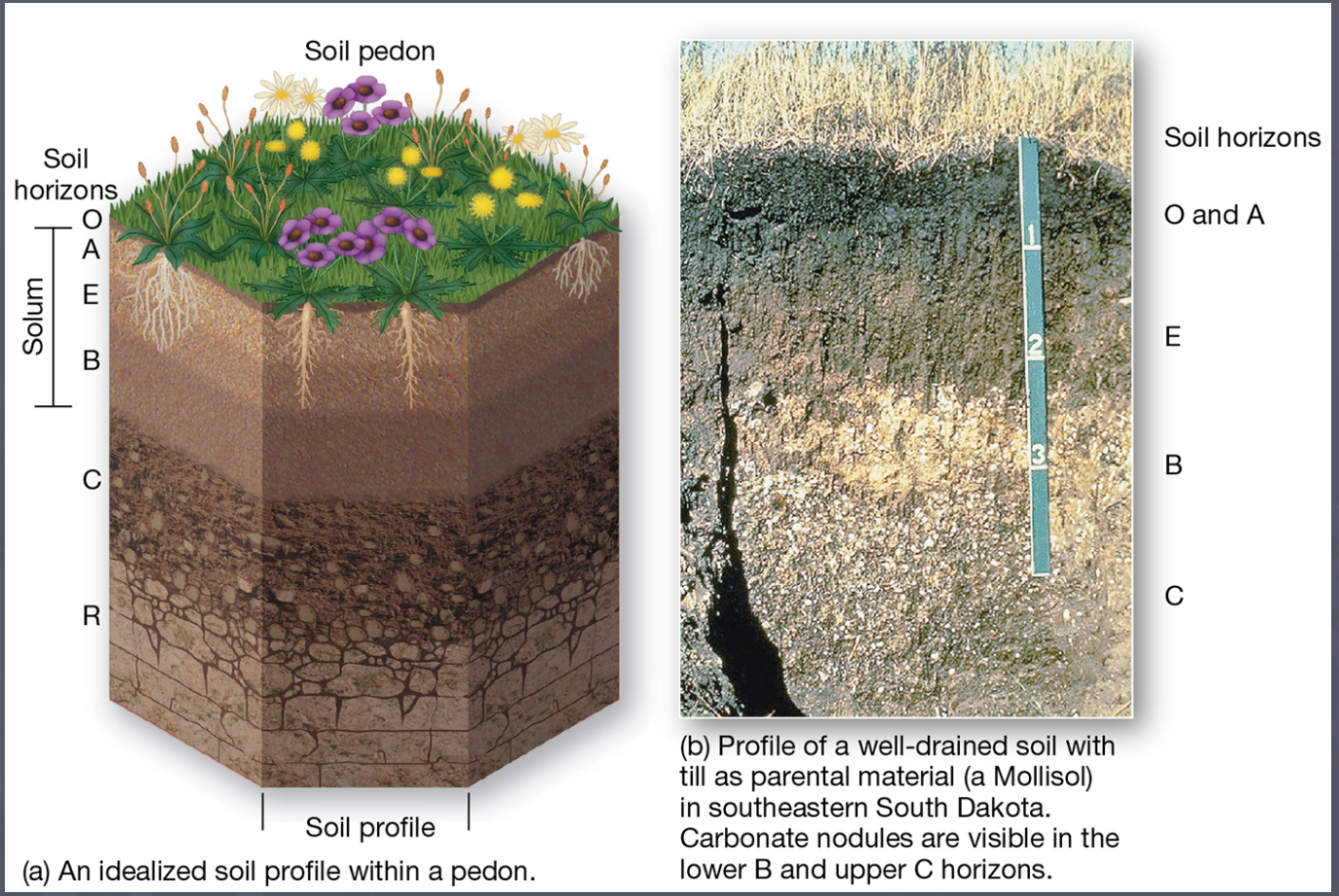
Introduction to Pedology

Chapter 18: The Geography of Soils

Pedology as a field of Science

- Pedology studies the origin, classification, distribution, and description of soil.
- A pedon is a hexagonal column measuring 1 to 10 m2 in top surface area. A pedon is the basic soil sampling unit in soil surveys.

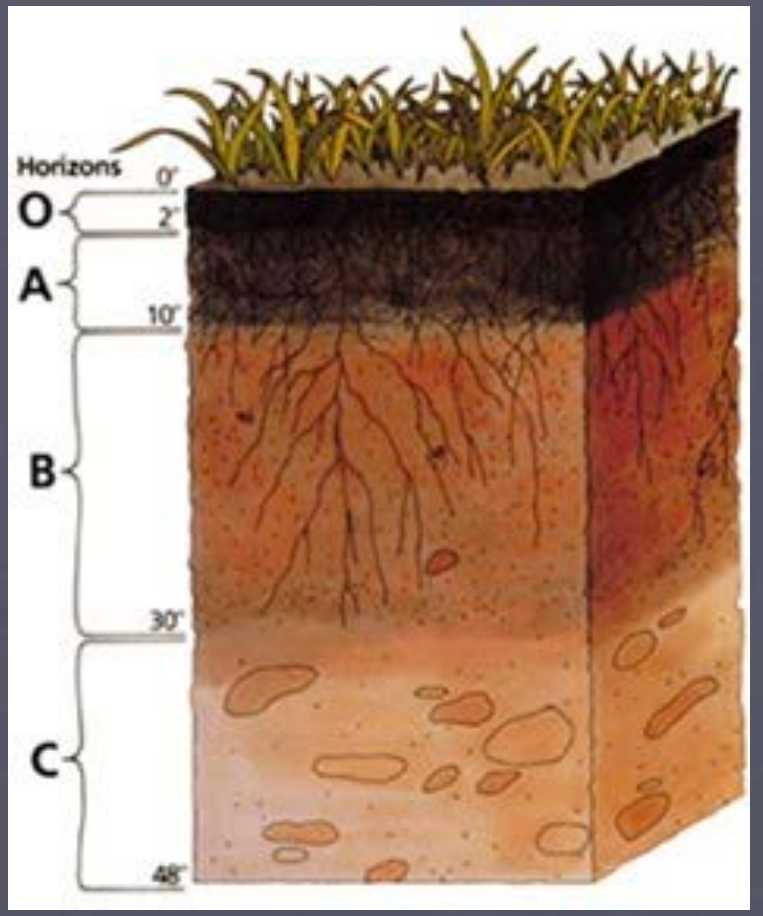
Pedology as a Field Science



Glacier Creek Prairie Reserve

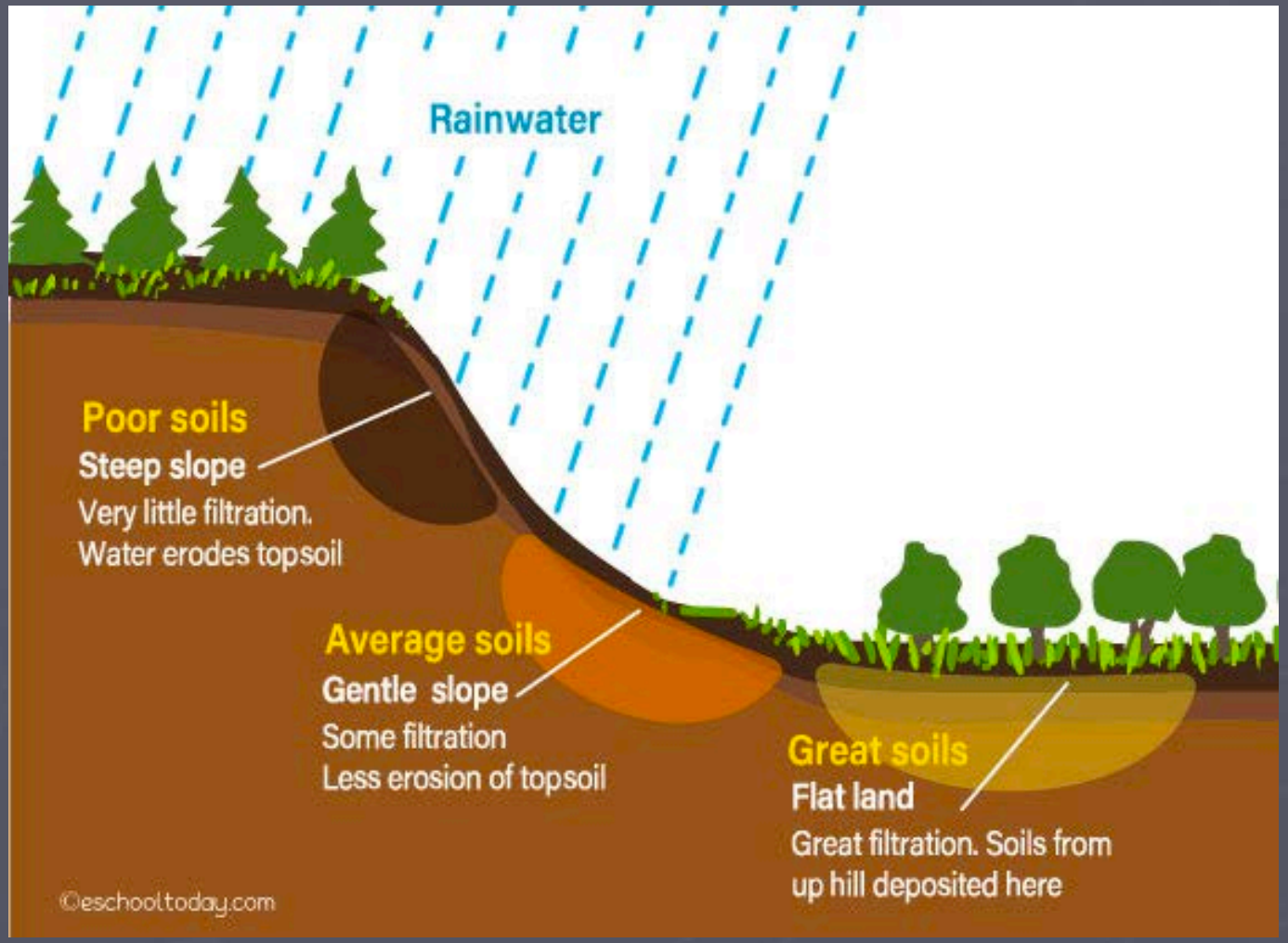
Soil Horizons

- **O** (humus or organic): Mostly organic matter such as decomposing leaves.
- **A** (topsoil): Mostly minerals from parent material with organic matter incorporated.
- **E** (eluviated): Leached of clay, minerals, and organic matter, leaving a concentration of sand and silt particles of quartz or other resistant materials – missing in some soils but often found in older soils and forest soils.
- **B** (subsoil): Rich in minerals that leached (moved down) from the A or E horizons and accumulated here.
- **C** (parent material): The deposit at Earth's surface from which the soil developed.
- **R** (bedrock): A mass of rock such as granite, basalt, quartzite, limestone or sandstone that forms the parent material for some soils



Factors that Determine Soil Composition

- Parent Material
- Climate
- Biological Material
- Topography



Classifying Soil

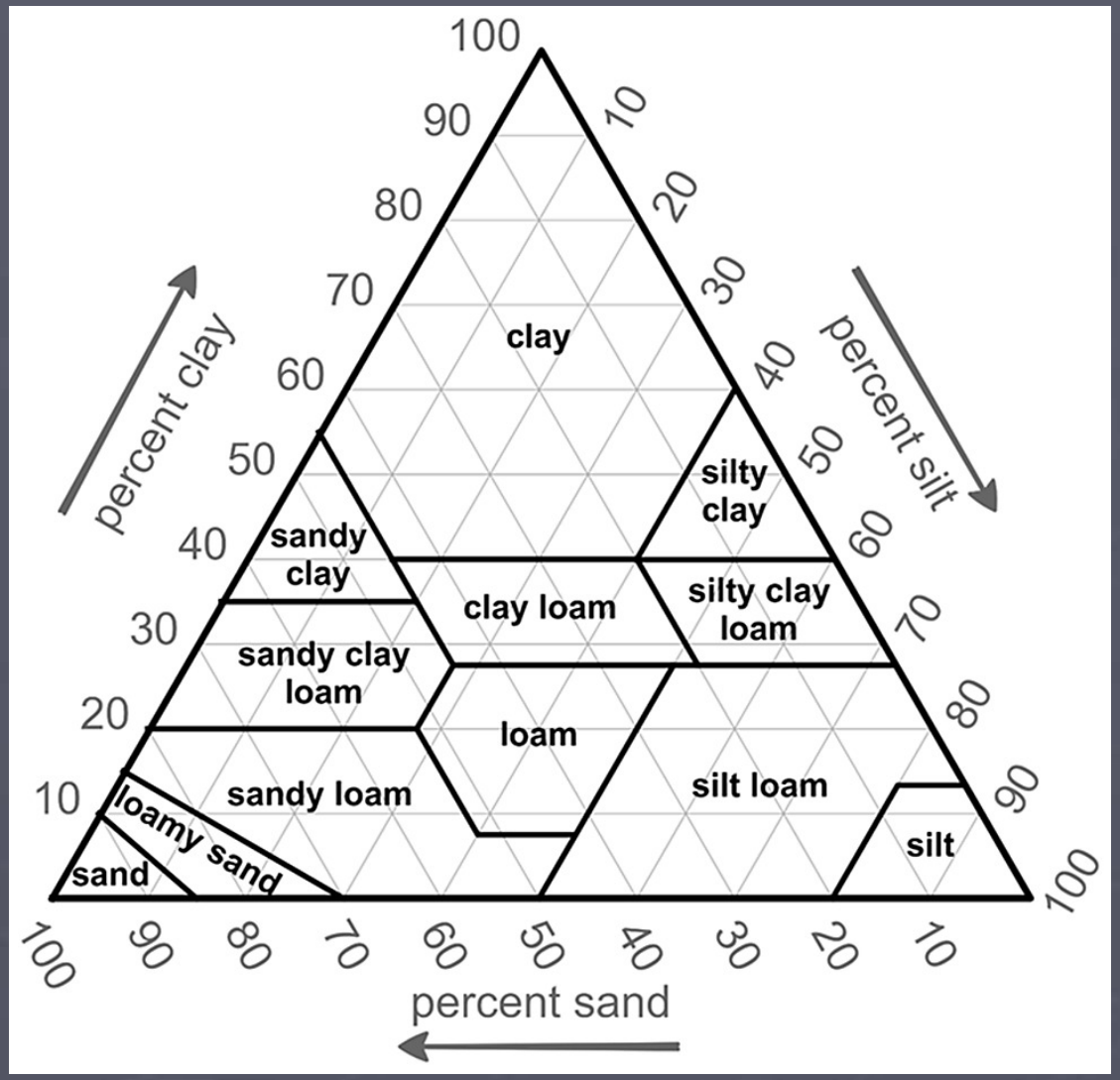
- Soil texture
- Soil color
- Soil structure
- Soil chemistry
- Soil acidity and alkalinity

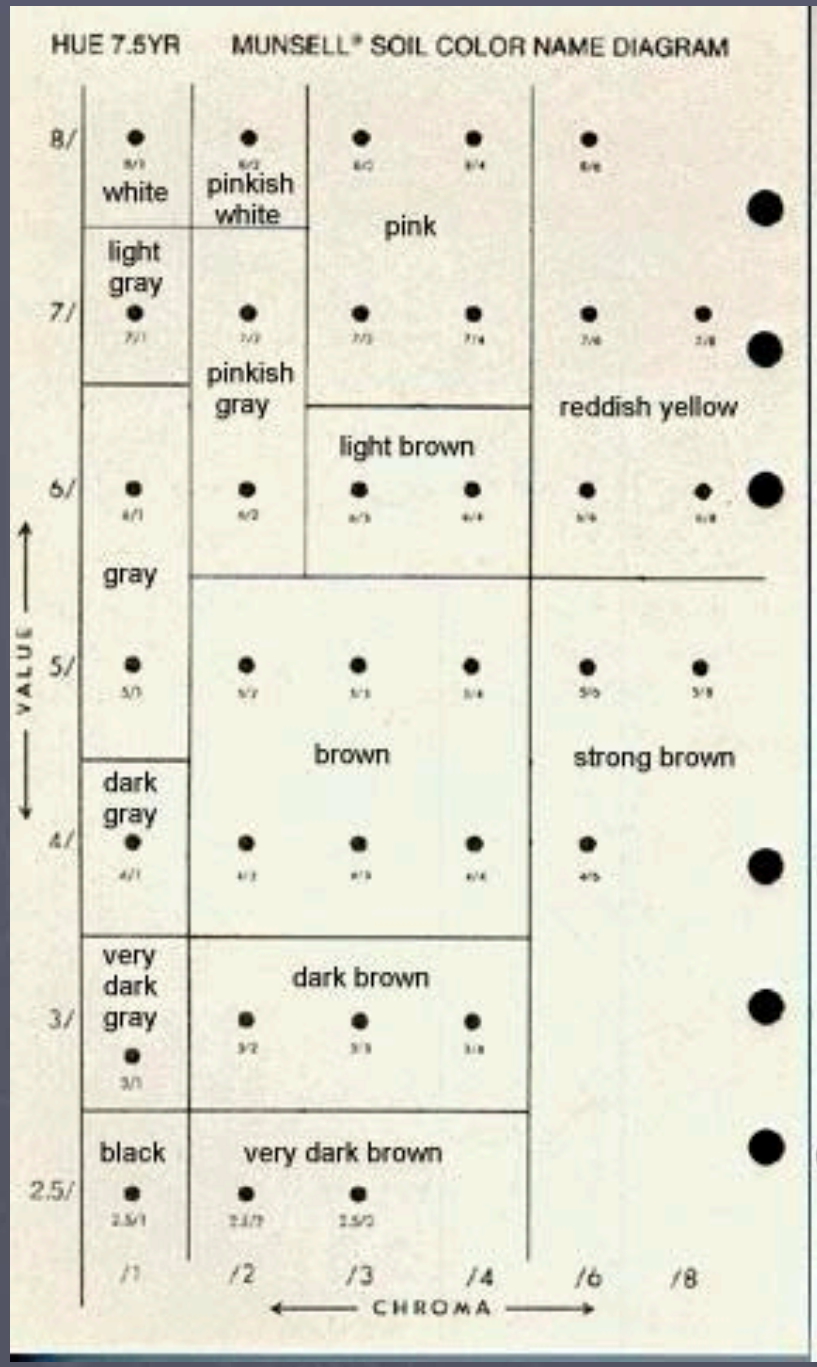
Classifying Soil - Soil Texture Triangle

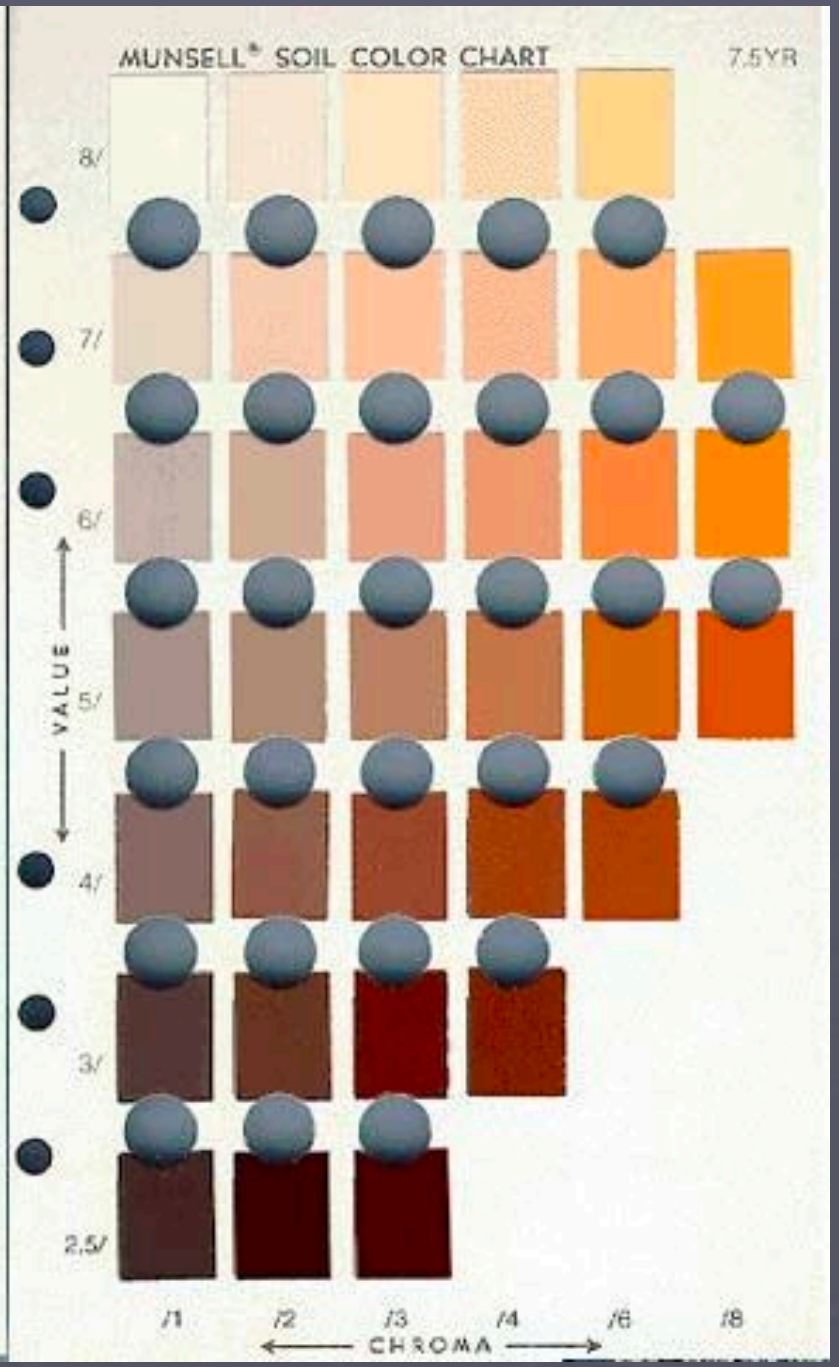
- Calculating Soil Texture

clay% + sand% + silt% = 100%

silt% = 100% – clay% – sand%







Classifying Soil - Color

Munsell Color Chart

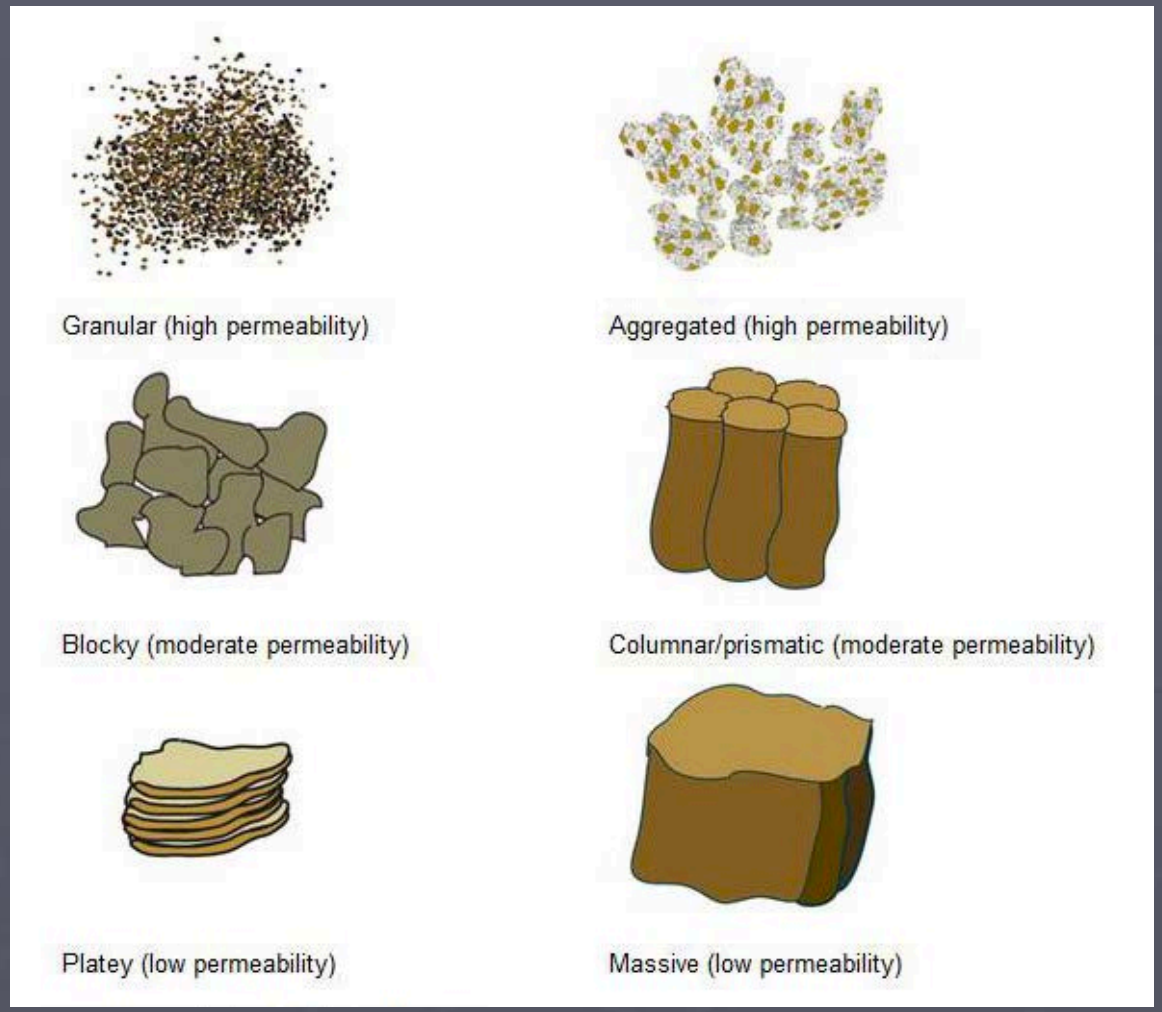
Classifying Soil - Consistency

- Wet soil is sticky and moldable.
- Moist soil is filled to half of field capacity and is loose to friable to firm.
- Dry soil is brittle and rigid and ranges from loose to soft to extremely hard.

Resistance-to-crushing class	*Method used*	*Condition of failure of 30 mm test cube or aggregate*
Very weak	Force applied between extended	Fails under very gentle force
Weak	forefinger and thumb either on horizontal faces of cubes as	Fails under gentle force
Slightly firm	oriented in the profile, or normal to defined aggregate	Fails under moderate force
Firm	axes, or on defined aggregate faces	Fails under strong force, the maximum that most people can exert
Very firm	Force applied slowly under foot on a hard flat surface or between both hands locked	Fails with gentle force under foot; can be crushed between locked hands of average person
Hard	Force applied slowly under foot on hard surface	Fails under the force which is applied by full body weight of c. 80 kg applied slowly
Very hard		Withstands the force applied slowly under foot by average body weight of c. 80 kg.

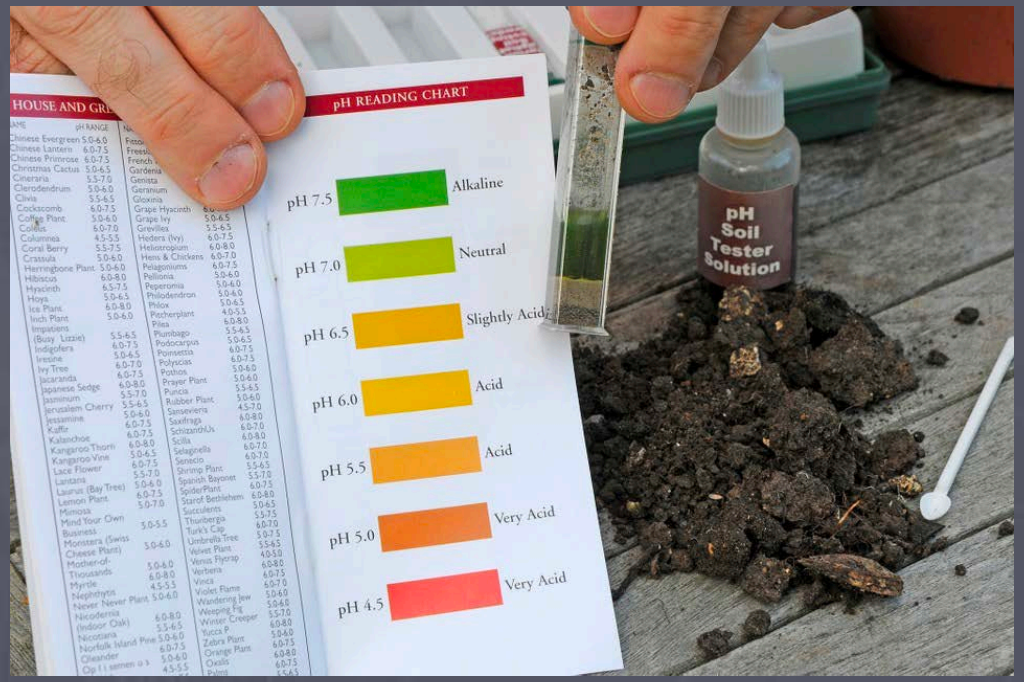
Classifying Soil - Structure

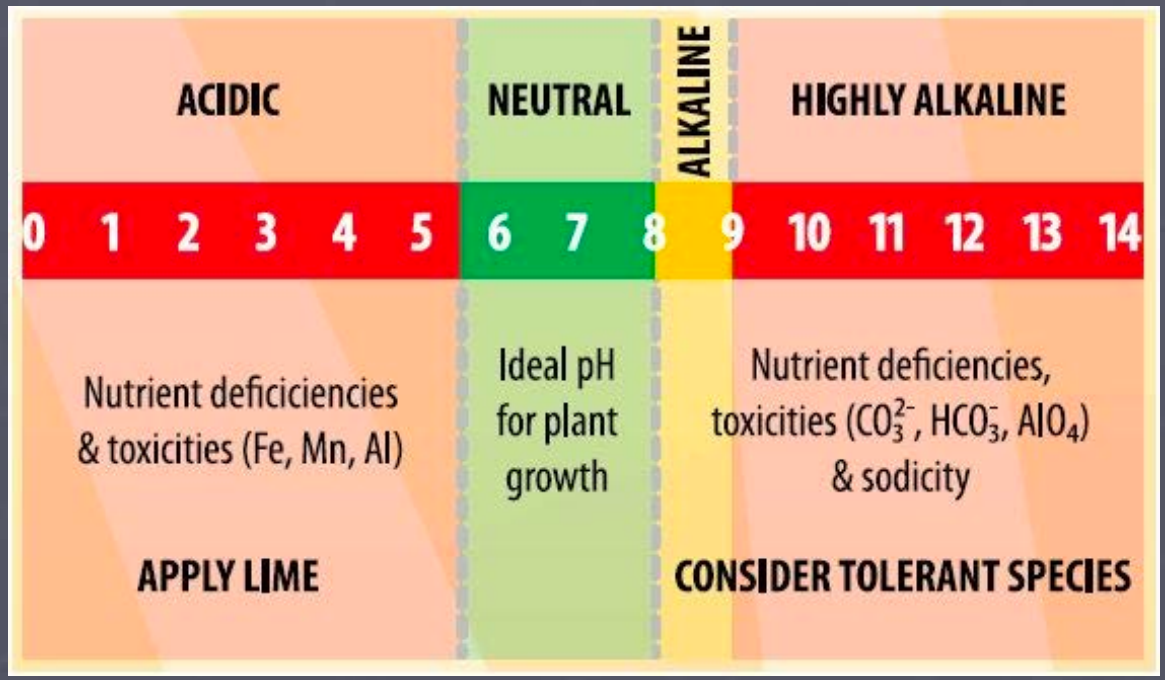
- Soil texture describes the size of soil particles.
  - Soil structure refers to their arrangement.
- The smallest natural lump or cluster of particles is a ped.
  - Types of peds from Granular to Massive



Classifying Soil - Chemistry

- Soil Colloids – tiny particles of clay or organic materials
- Soil chemistry helpful in determining types of plants able to grow
  - A soil rich in hydrogen ions (cations) is an acid soil.
  - A soil high in base cations (calcium, sodium) is a basic or alkaline soil.





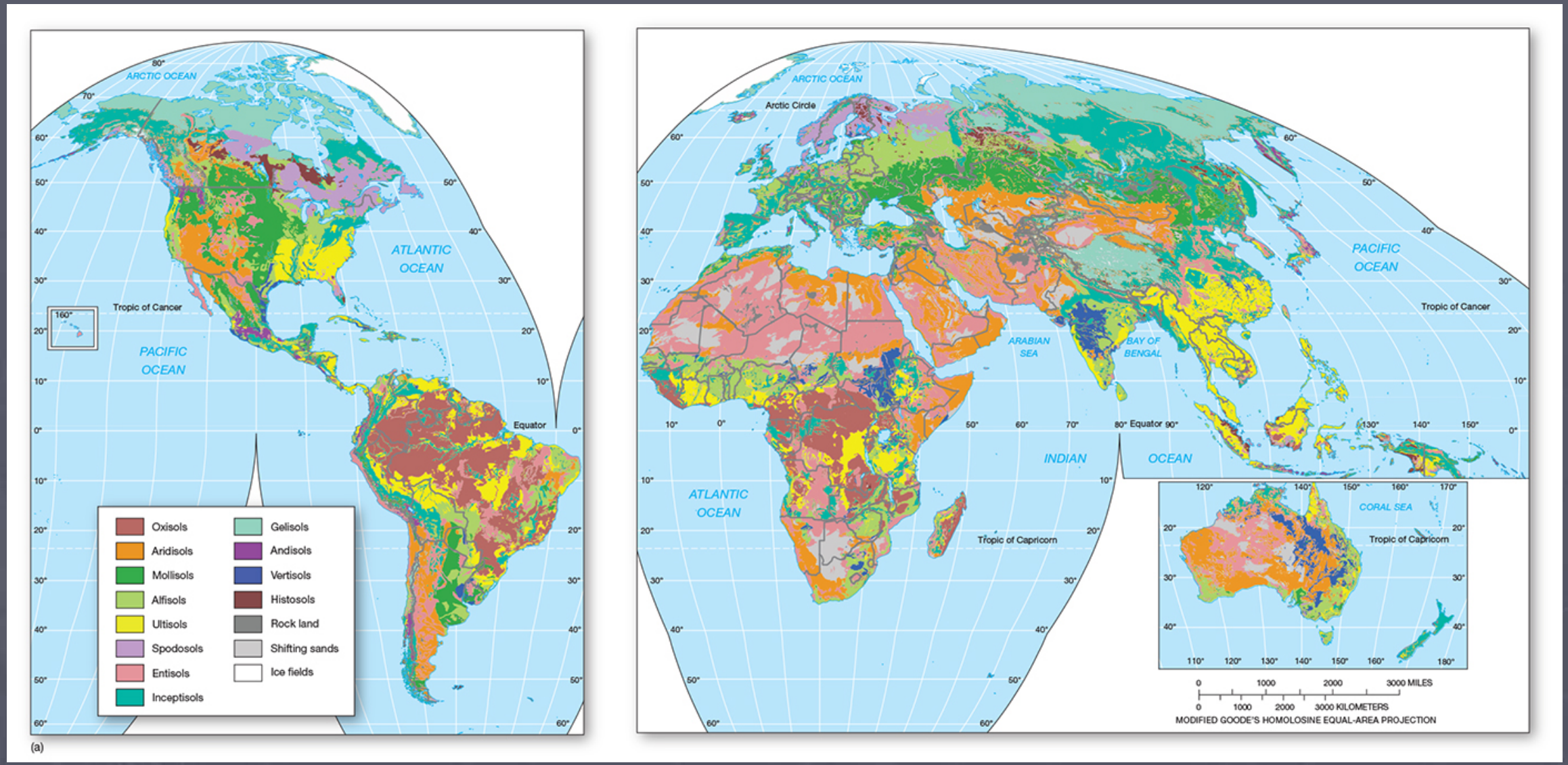
Soil Taxonomy

- Types of soils classified similar to types of species
  - Soil classification system, emphasizes the physical and chemical properties of the soil profile.

TABLE 18.1 Soil Orders

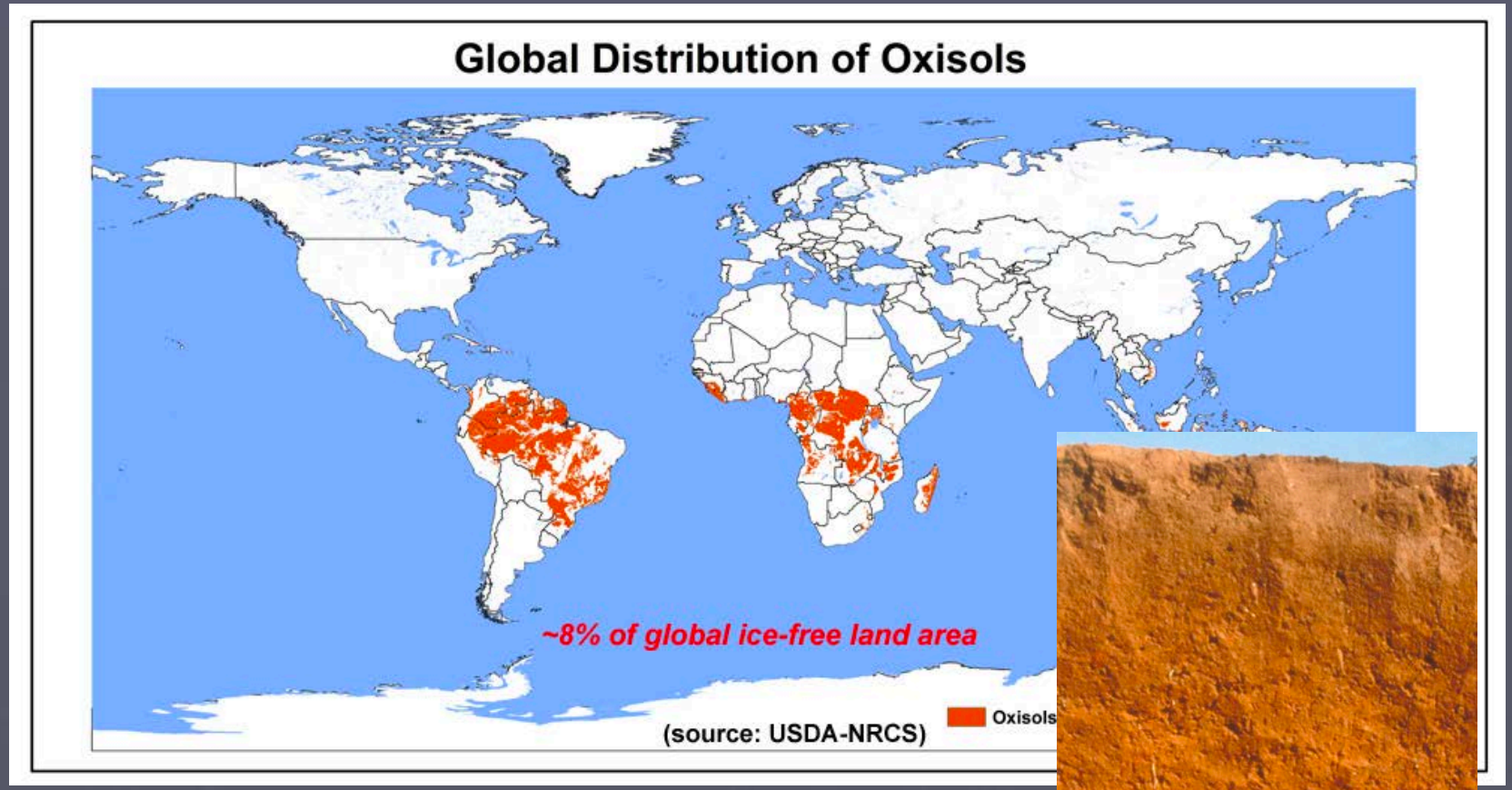
Order	Description/Climate/Location	Characteristics
Oxisols	Tropical soils; hot, humid areas	Maximum weathering of Fe and Al and eluviation; no clearly marked horizons.
Aridisols	Desert soils; hot, dry areas	Limited alteration of parent material; light color; low humus content; subsurface illuviation of carbonates.
Mollisols	Grassland soils; subhumid, semiarid lands	Noticeably dark with organic material; humus-rich; surface with well-structured horizons.
Alfisols	Moderately weathered forest soils; humid temperate climate	B horizon high in clays; no pronounced color change with depth.
Ultisols	Highly weathered forest soils; subtropical climate	Similar to Alfisols; B horizon high in clays; strong weathering in subsurface horizons.
Spodosols	Northern conifer forest soils; cool, humid climate	Illuvial B horizon of Fe/Al clays; partially cemented; highly leached; strongly acid.
Entisols	Recent soils; profile undeveloped; all climates	Limited development; inherited properties from parent material; pale color; low humus; hard and massive when dry.
Inceptisols	Weakly developed soils; humid regions	Young soils with few diagnostic features.
Gelisols	Permafrost-affected soils; tundra climate at high latitude and in mountain highlands	Permafrost within 100 cm of the soil surface; evidence of cryoturbation and/or an active layer.
Andisols	Soils formed from volcanic activity; especially common along the Pacific Rim	Volcanic parent materials; weathering and mineral transformation important; generally fertile.
Vertisols	Expandable clay soils; subtropics, tropics; sufficient dry period	Forms large cracks on drying; self-mixing action; contains >30% swelling clays; light color; low humus content.
Histosols	Organic soils; wetlands	Peat or bog; >20% organic matter; surface organic layers; no diagnostic horizons.

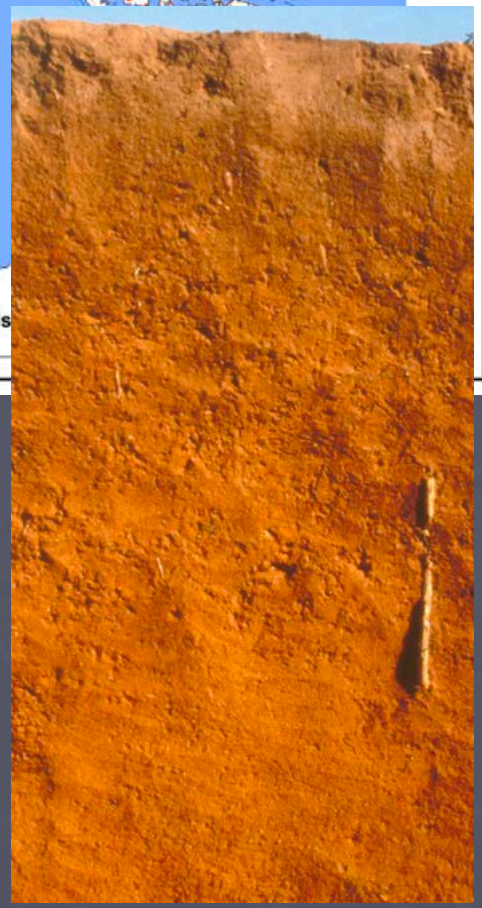
Soil Taxonomy



Oxisols

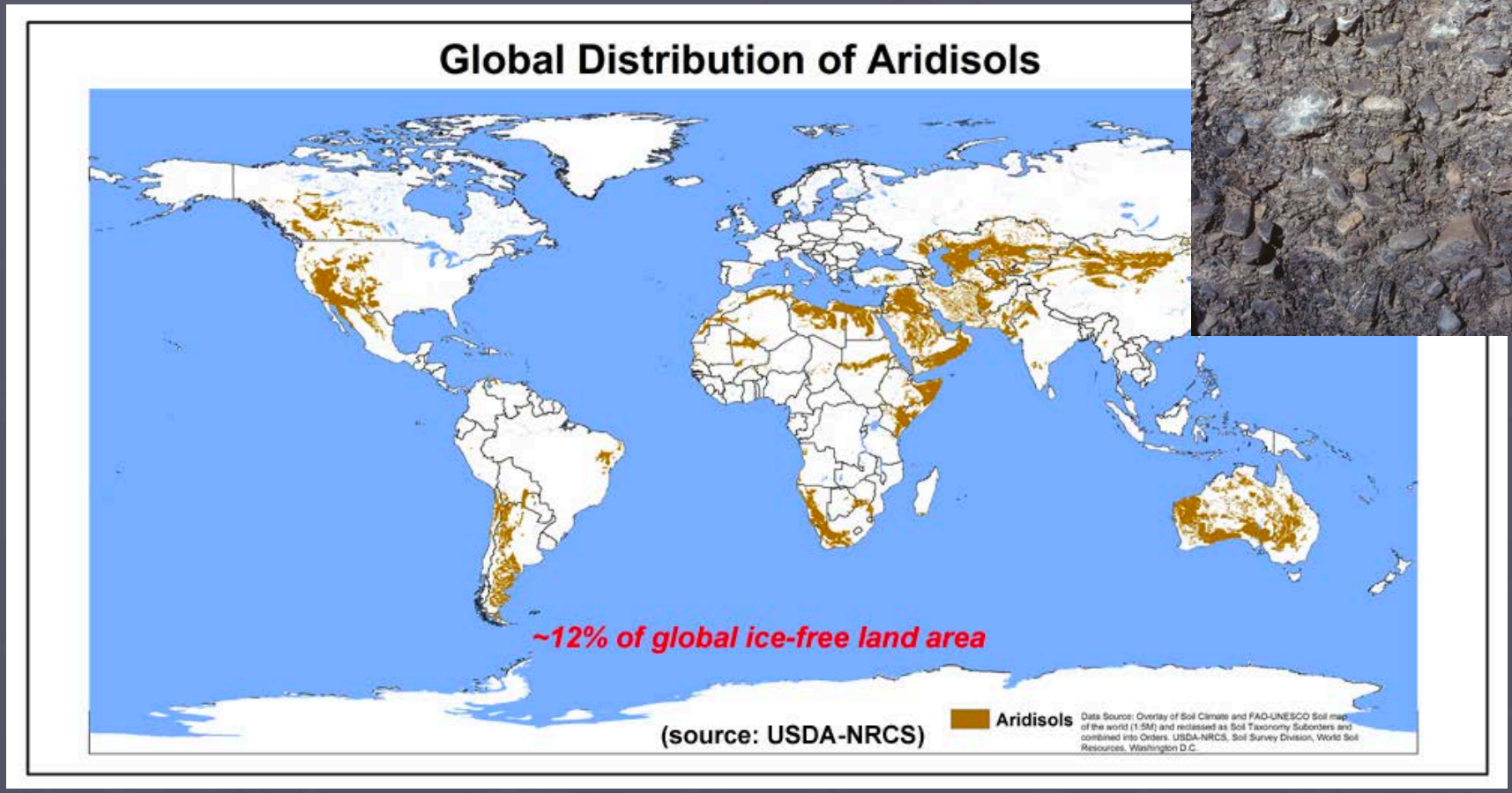
- Less defined layers
  - Typically called “old soils”
- Even layering, even at depth
  - Little horizontal separation





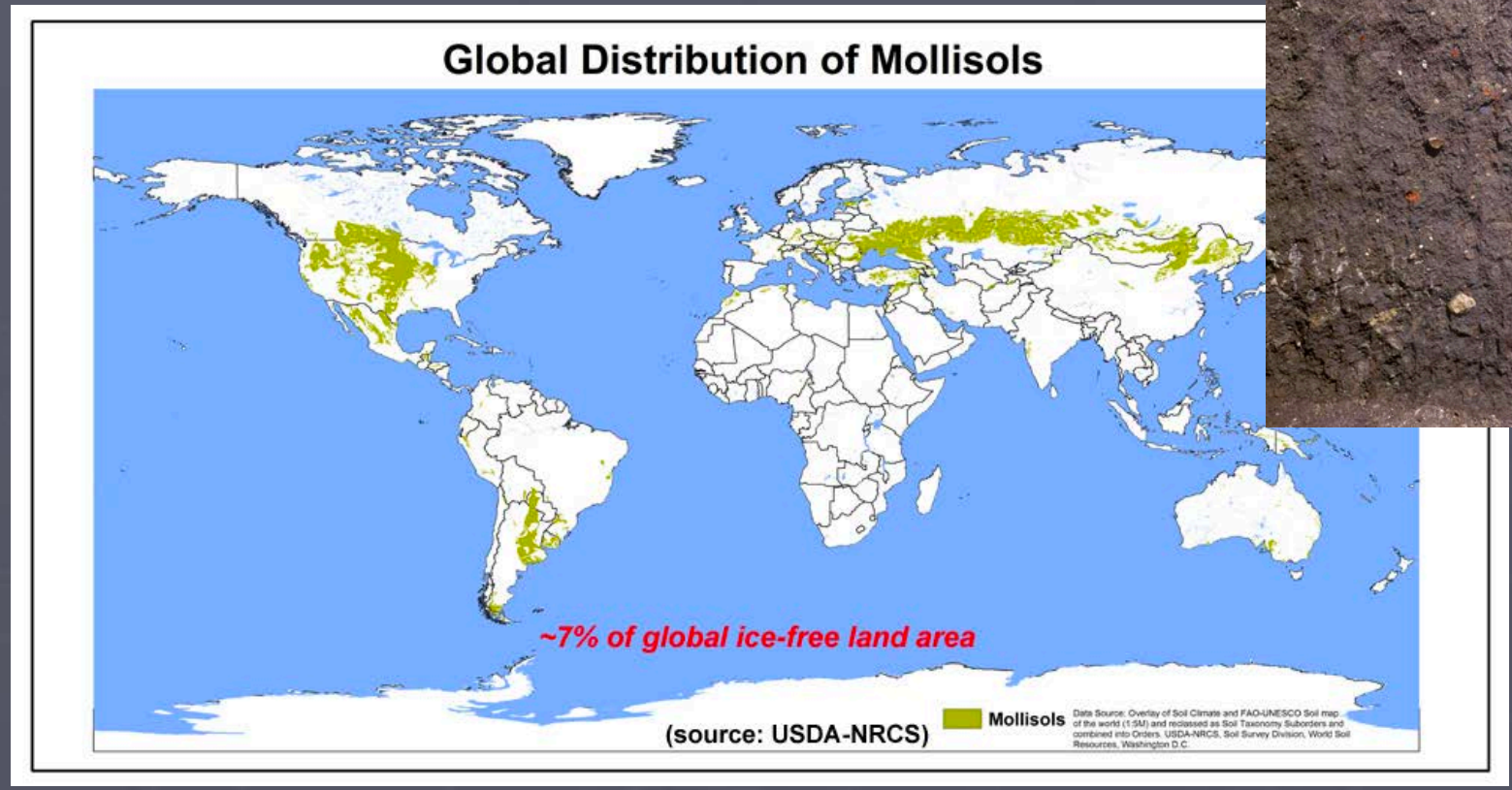
Aridisols

- Also known as “desert soils”
- Pale in color
- Shallow Horizons
- Susceptible to salinization



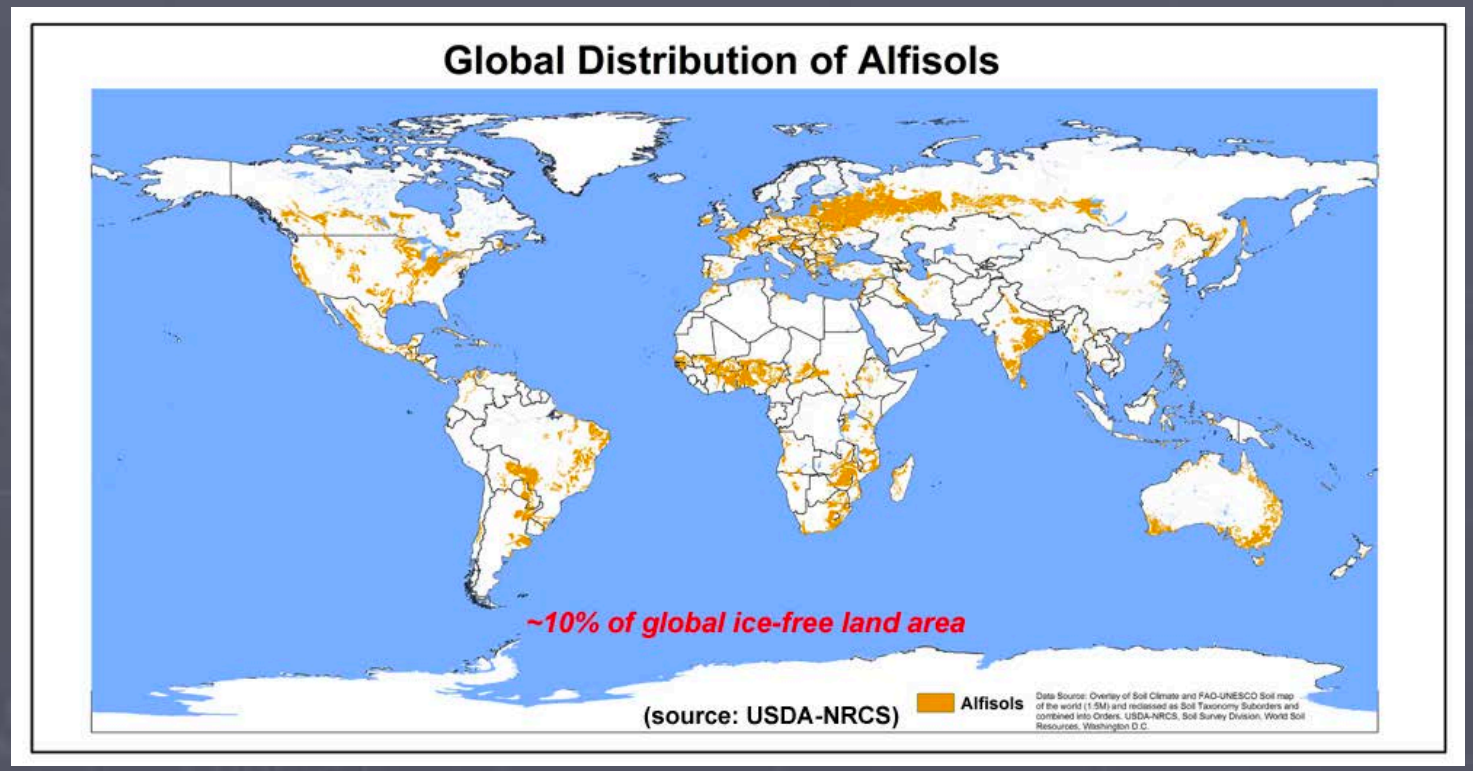
Mollisols

- Primarily found in grasslands
- Thick soft, usually dark brown or black in color
- Great fertility

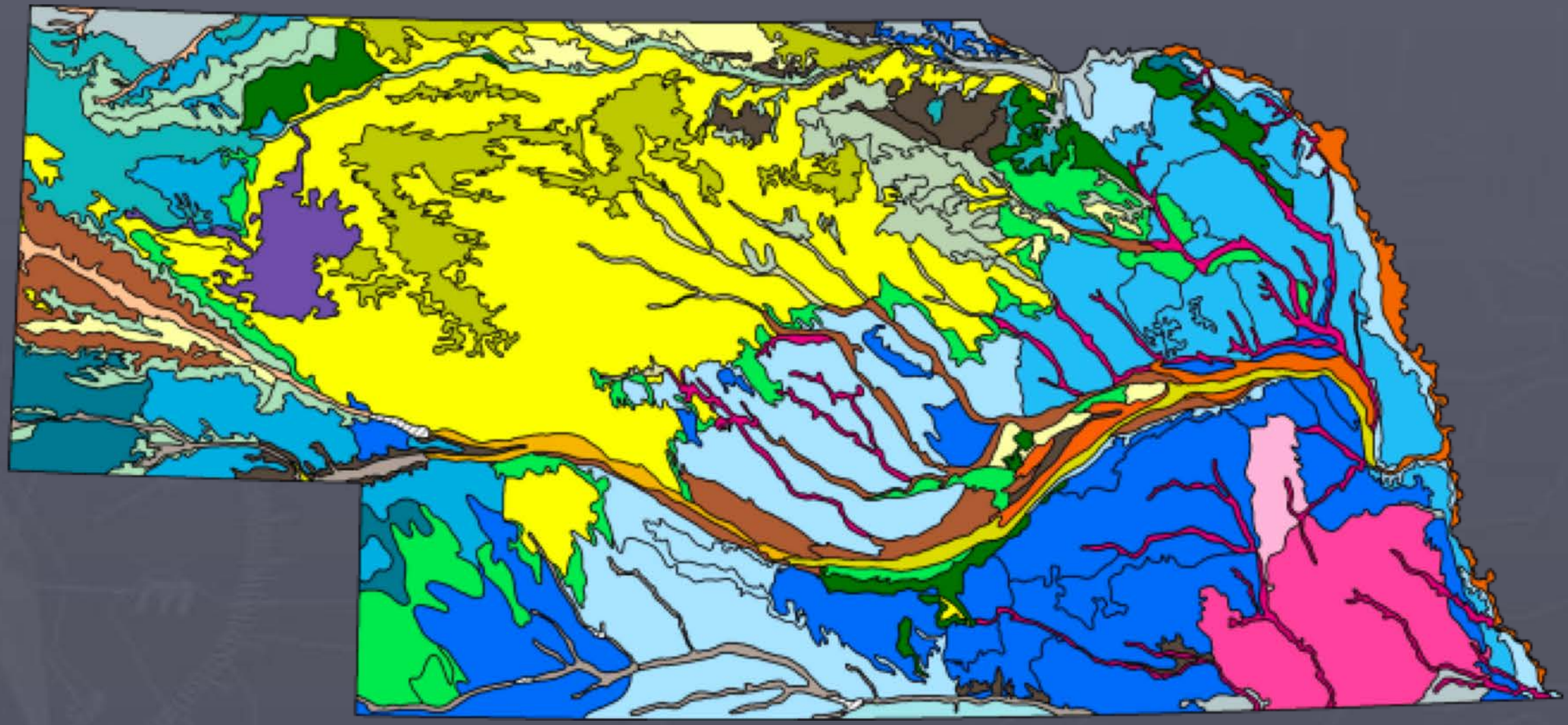


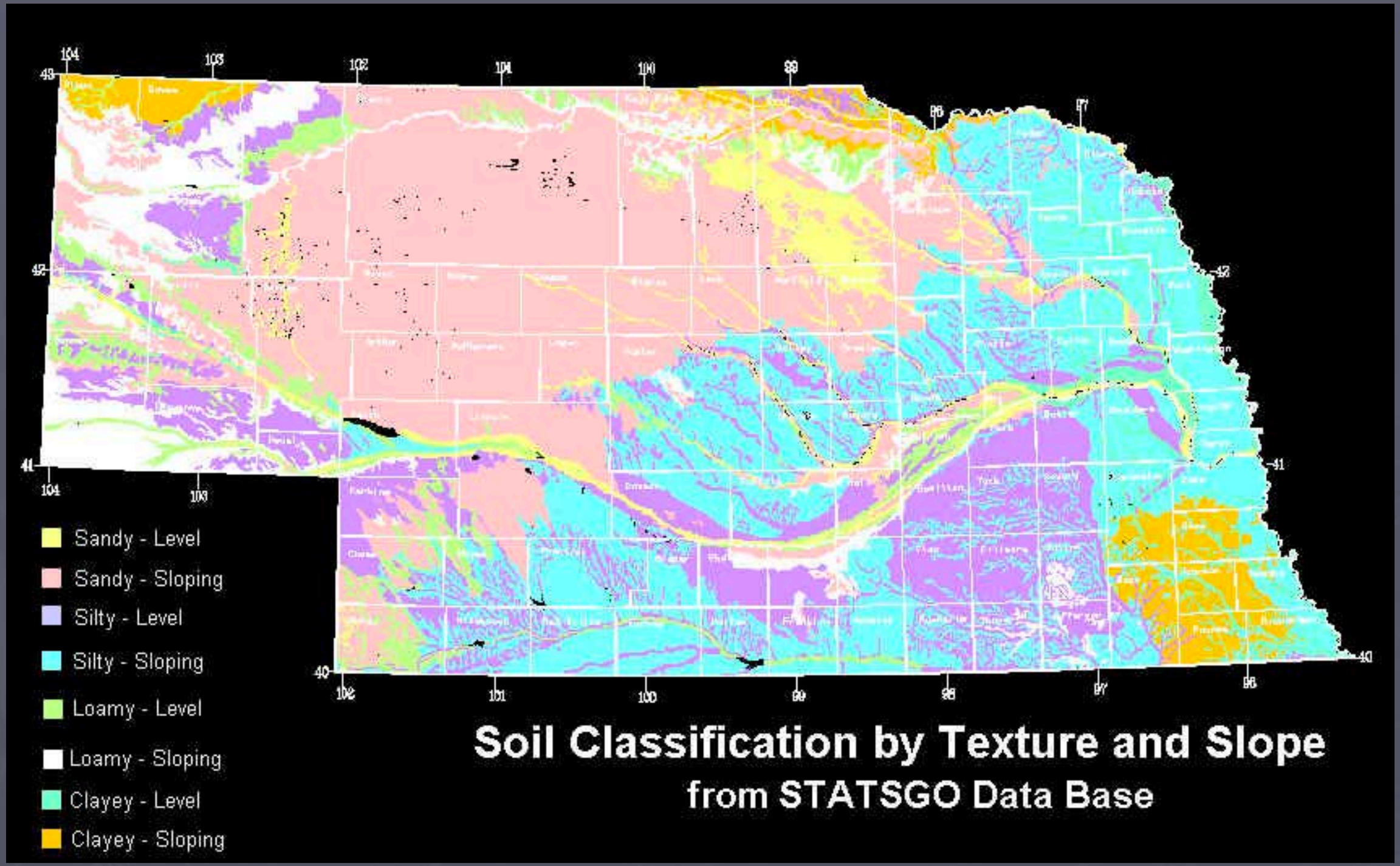
Alfisols

- Associated with forest ecoregion
- Productivity depends on climate
  - Determines decomposed organic material



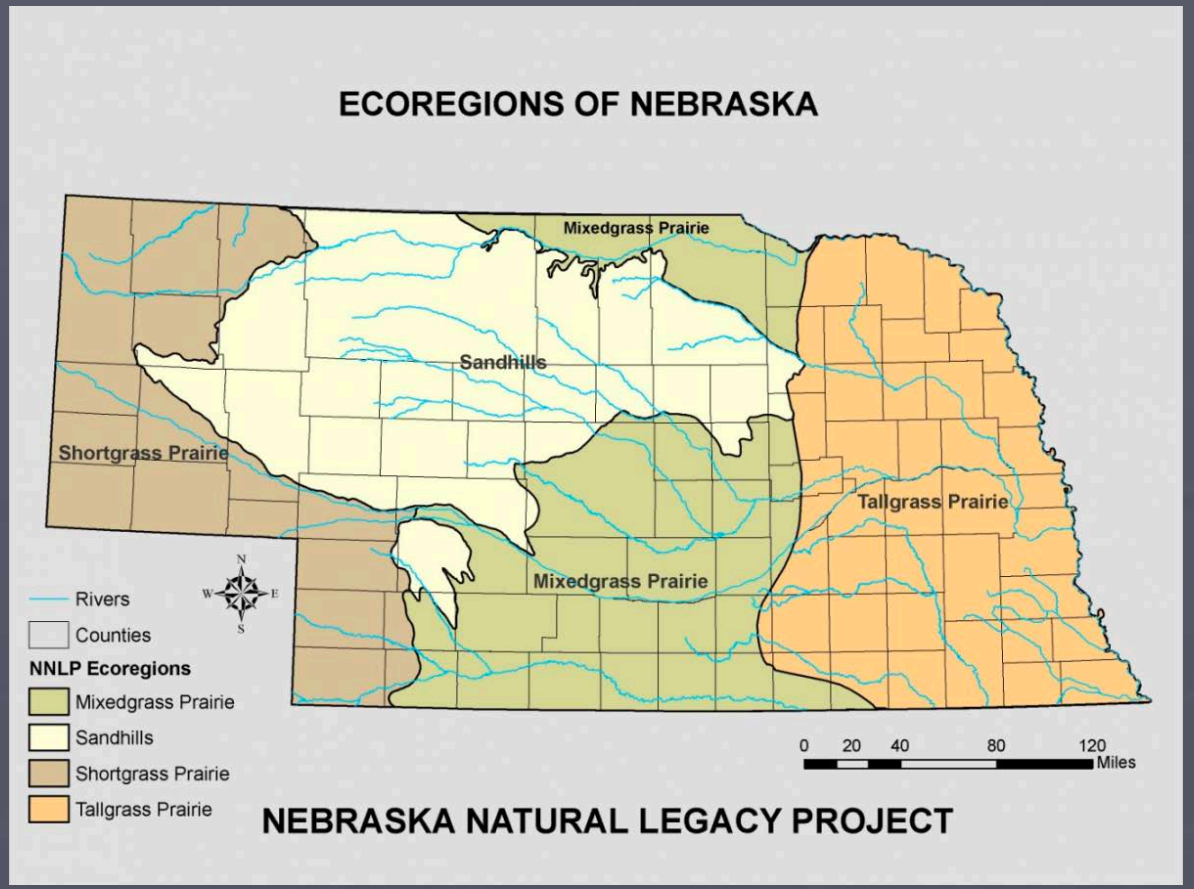
Nebraska’s Soil Regions



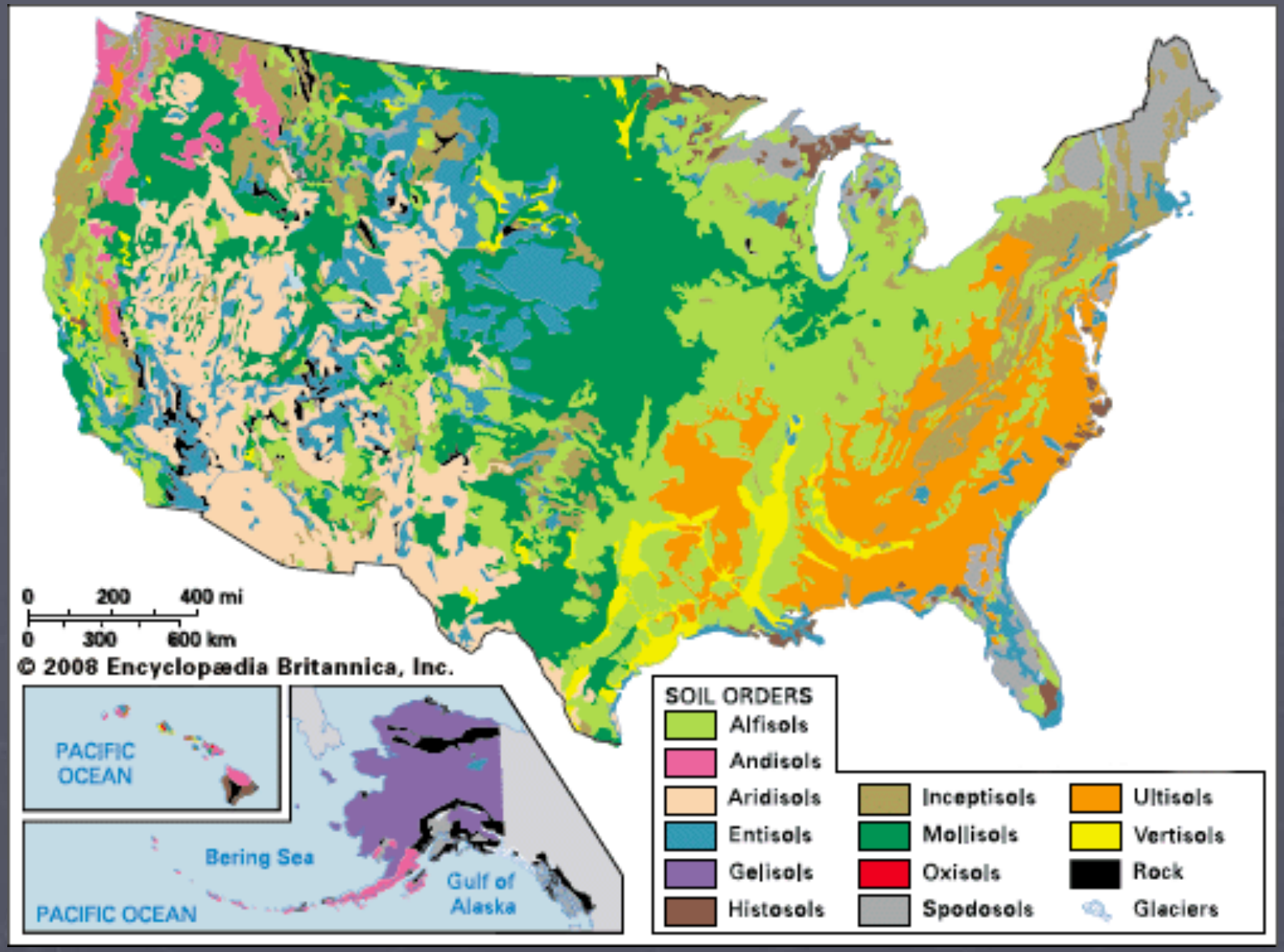

Sandy - Level
Sandy - Sloping
Silty - Level
Silty - Sloping
Loamy - Level
Loamy - Sloping
Clayey - Level
Clayey - Sloping
Soil Classification by Texture and Slope
from STATSGO Data Base

Sand Hills

- Primarily made up of sediment from Rocky Mountains and washed to Great Plains during Pleistocene Era
  - Primarily sand, stabilized by grasses
  - Very poor for cultivation

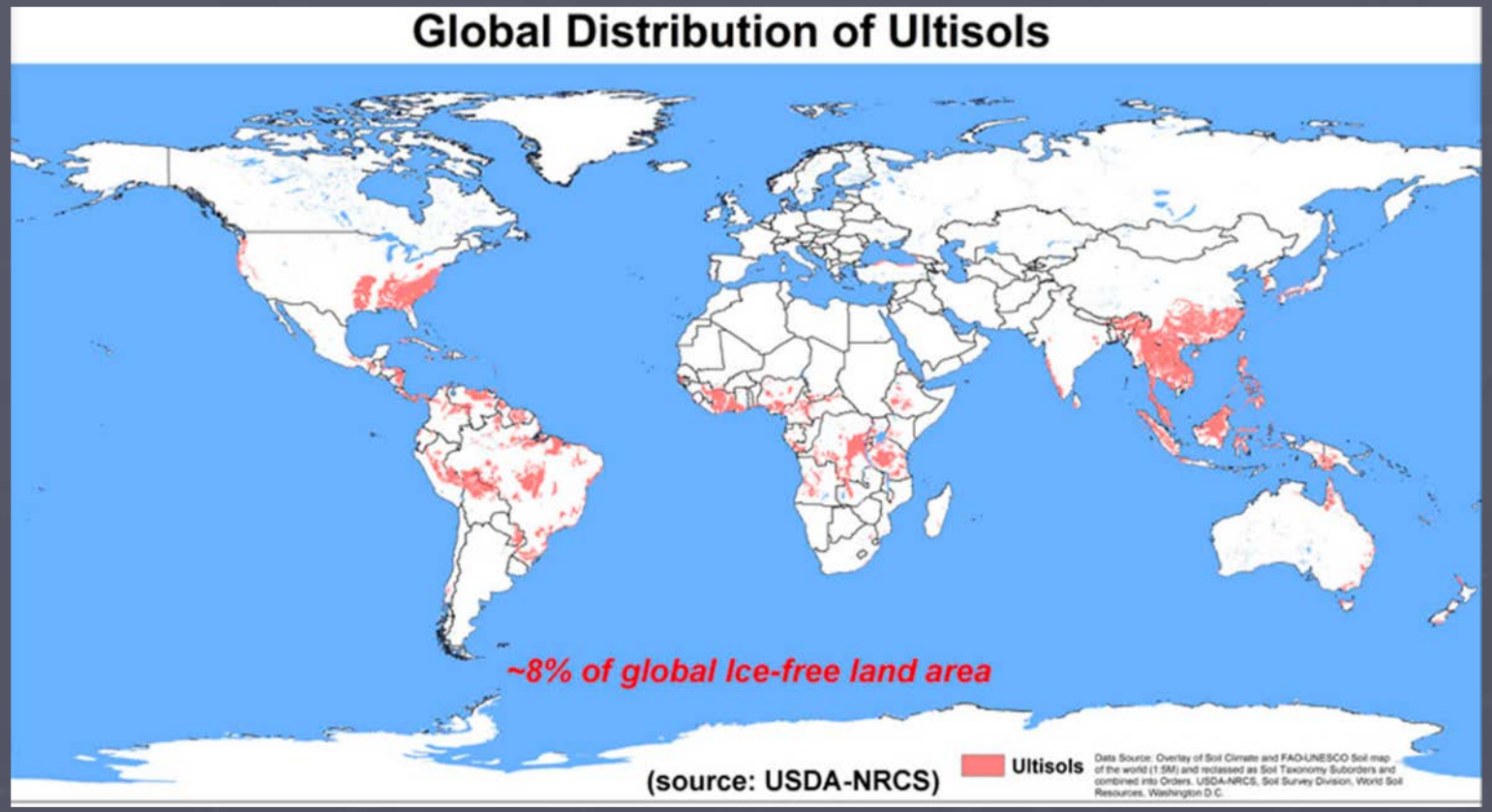


Soils of the United States



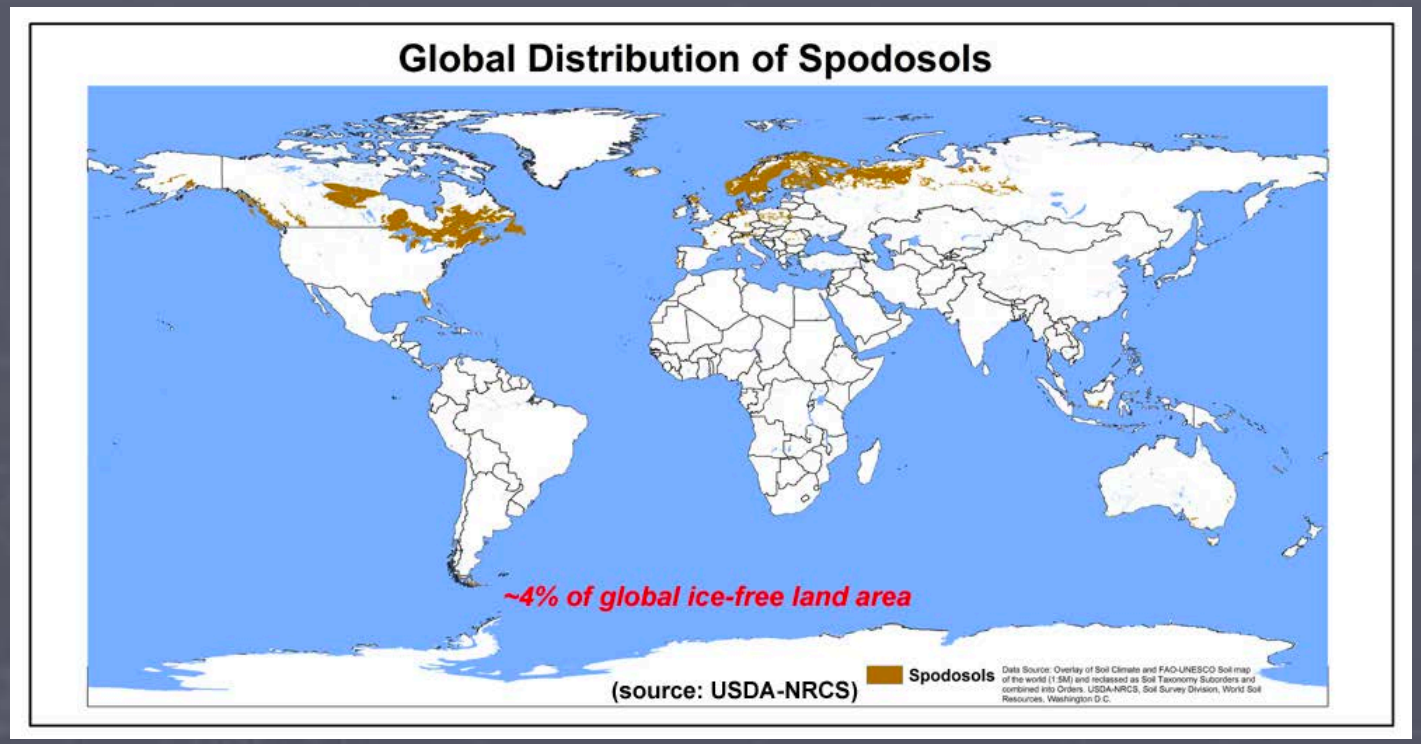
Ultisols

- Heavily weathered, found in subtropical areas
- Very clayey with large amounts of Iron
  - Low productivity



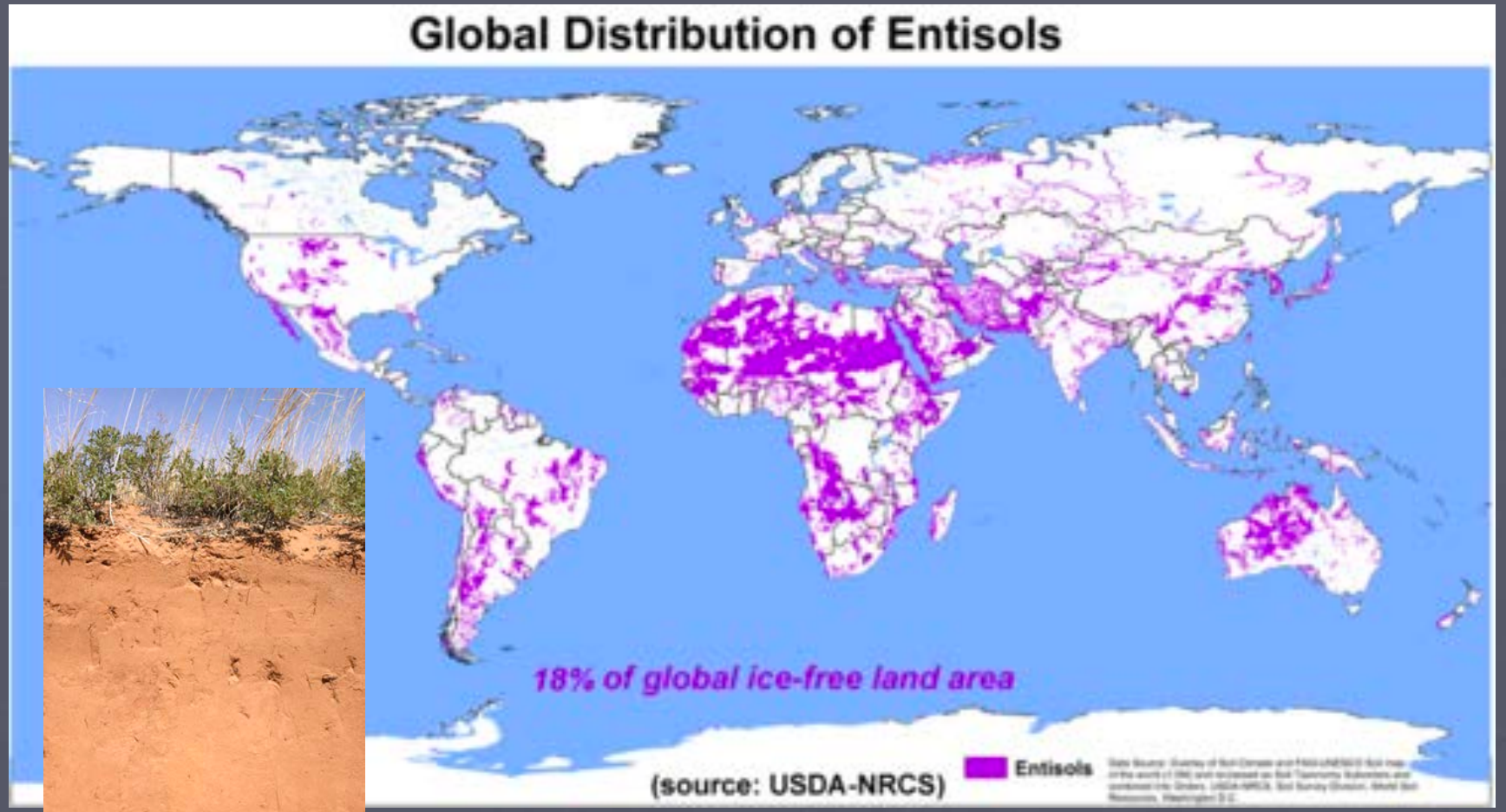
Spodosols

- Conifer forest soils
- Form from sandy parent materials
- Acid accumulation in the soil



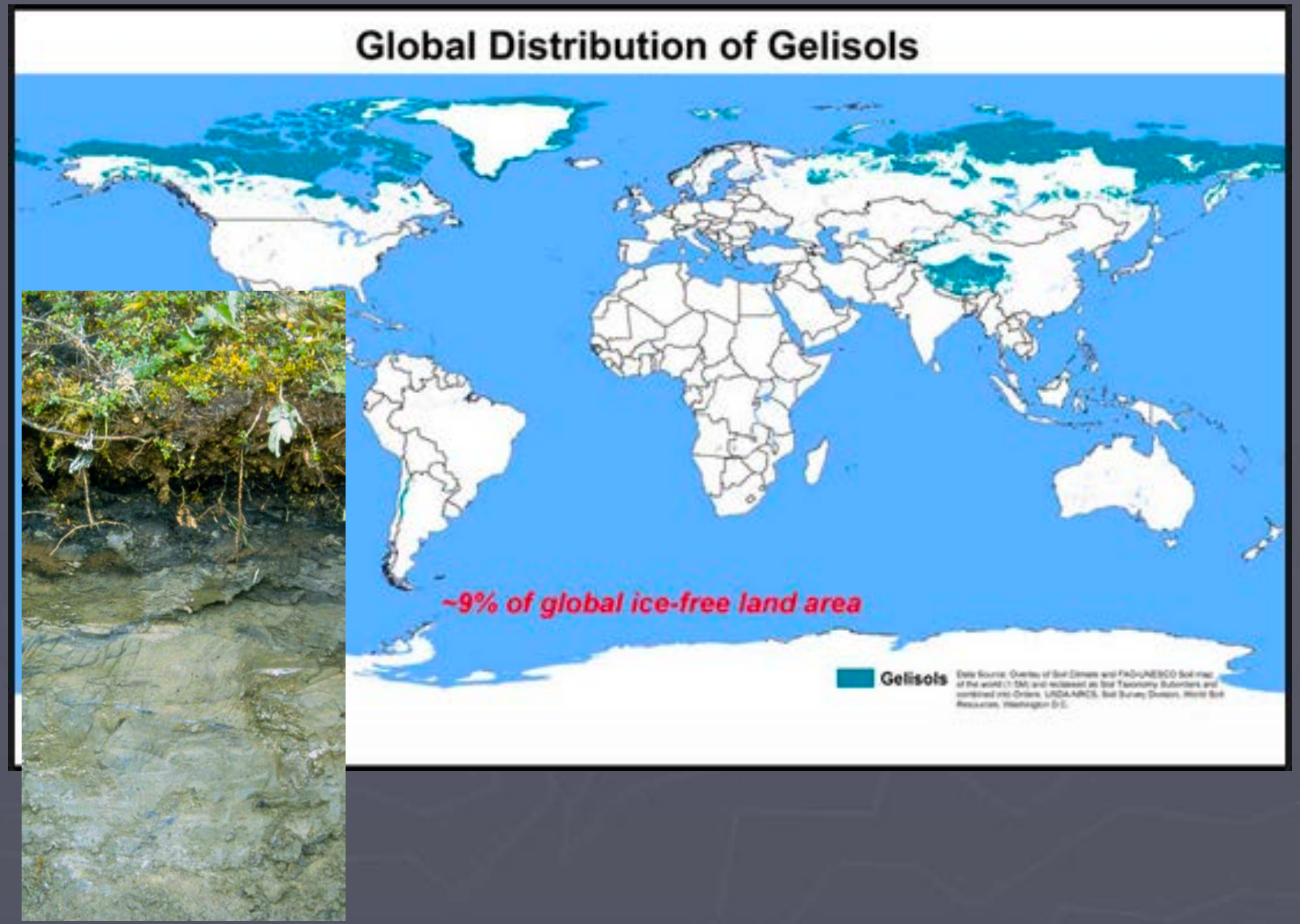
Entisols

- Newer soils
  - A catch-all classification for soils with no other order
- Not much vertical development
- Frequent in deposition and mountains



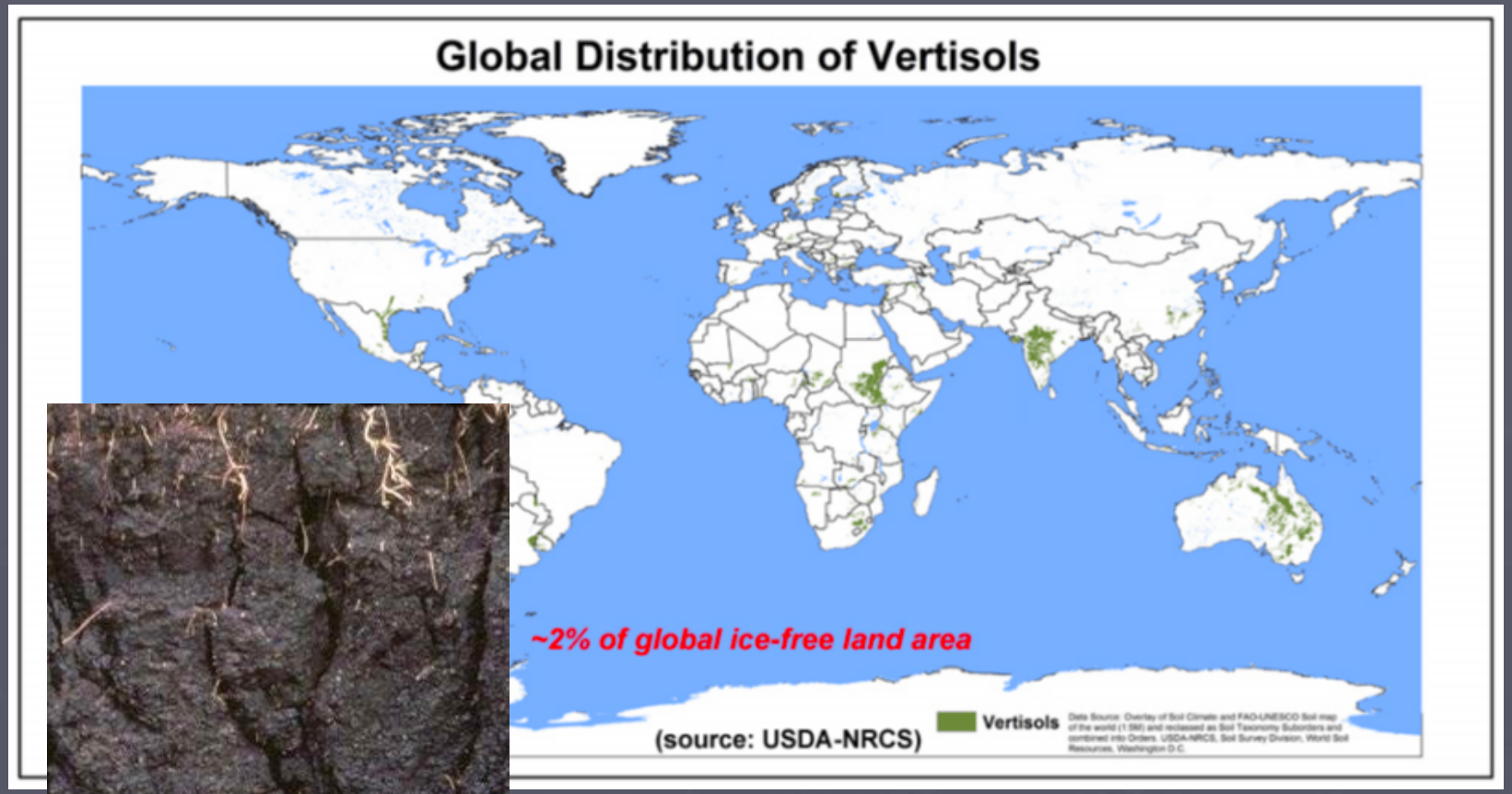
Gelisols

- Defined by presence of permafrost within 2 meters of surface
- Very unproductive



Vertisols

- Contain more than 30% clay
  - Clay swells when wet and shrinks when it dries, creating cracks and destroying foundation.
- Black color is due to specific mineral content rather than organics.

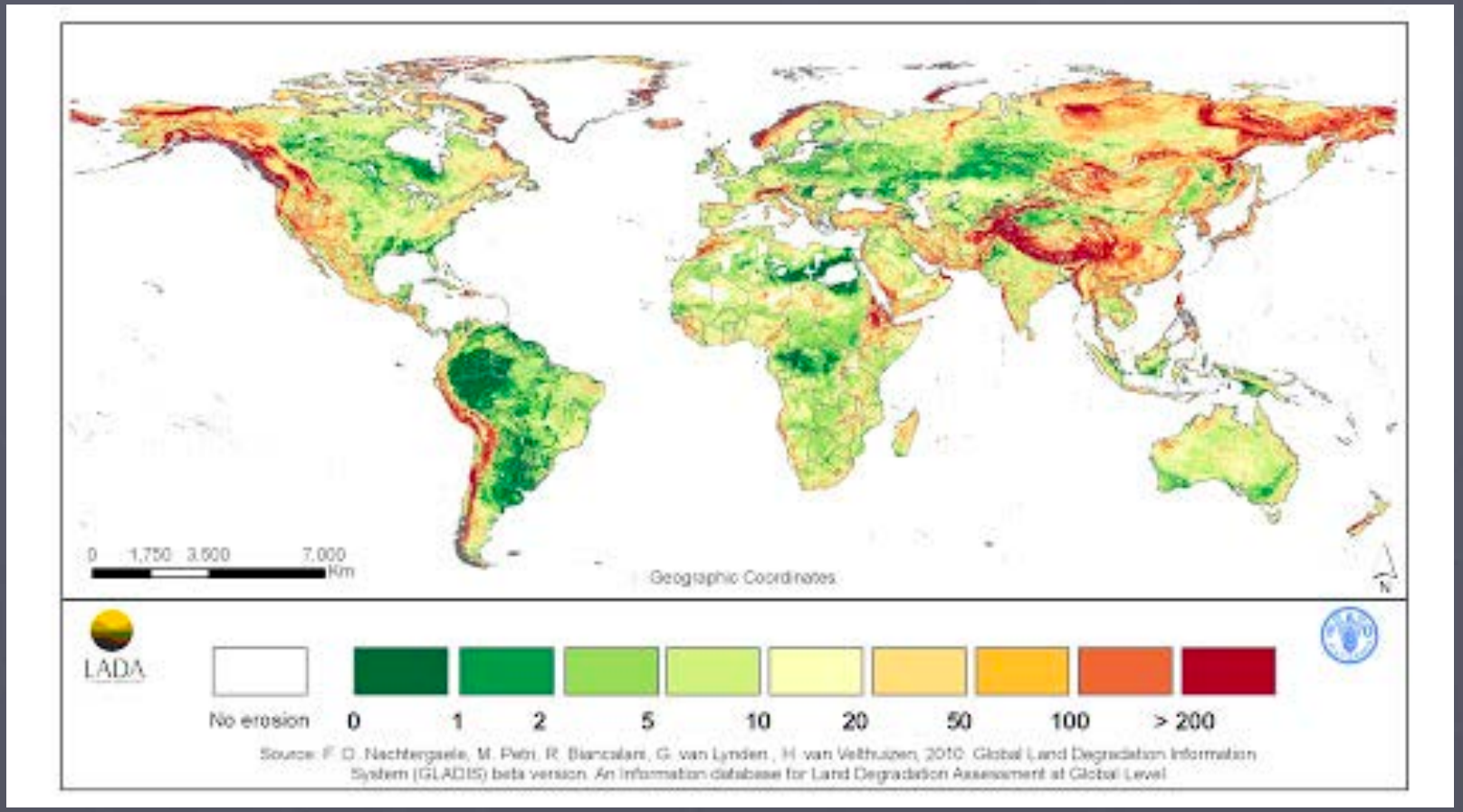


Histosols

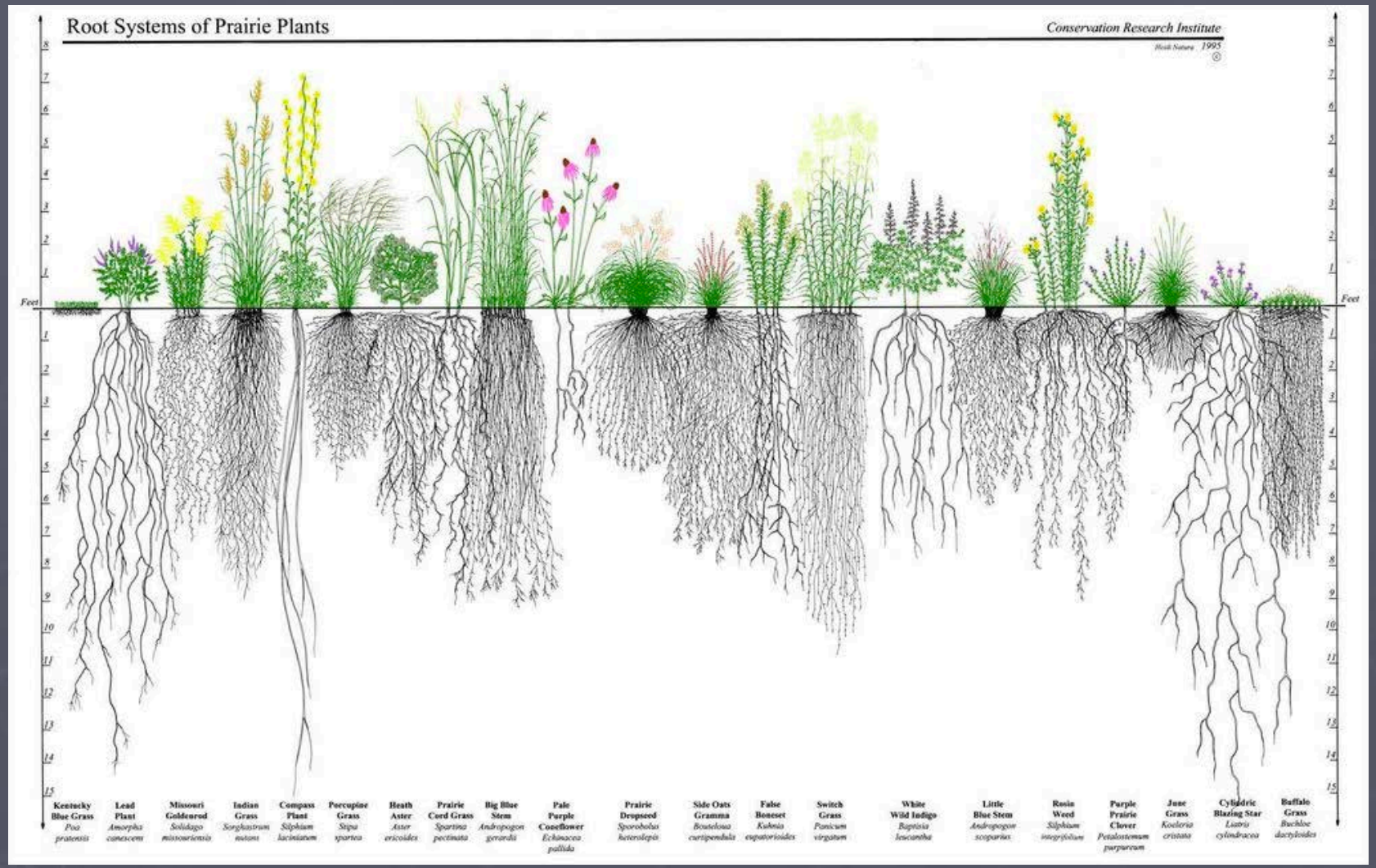
- Largely made up of organic materials
- Presence in bogs, much, or peats
  - Poor drainage, slow decomposition

Soil Conservation

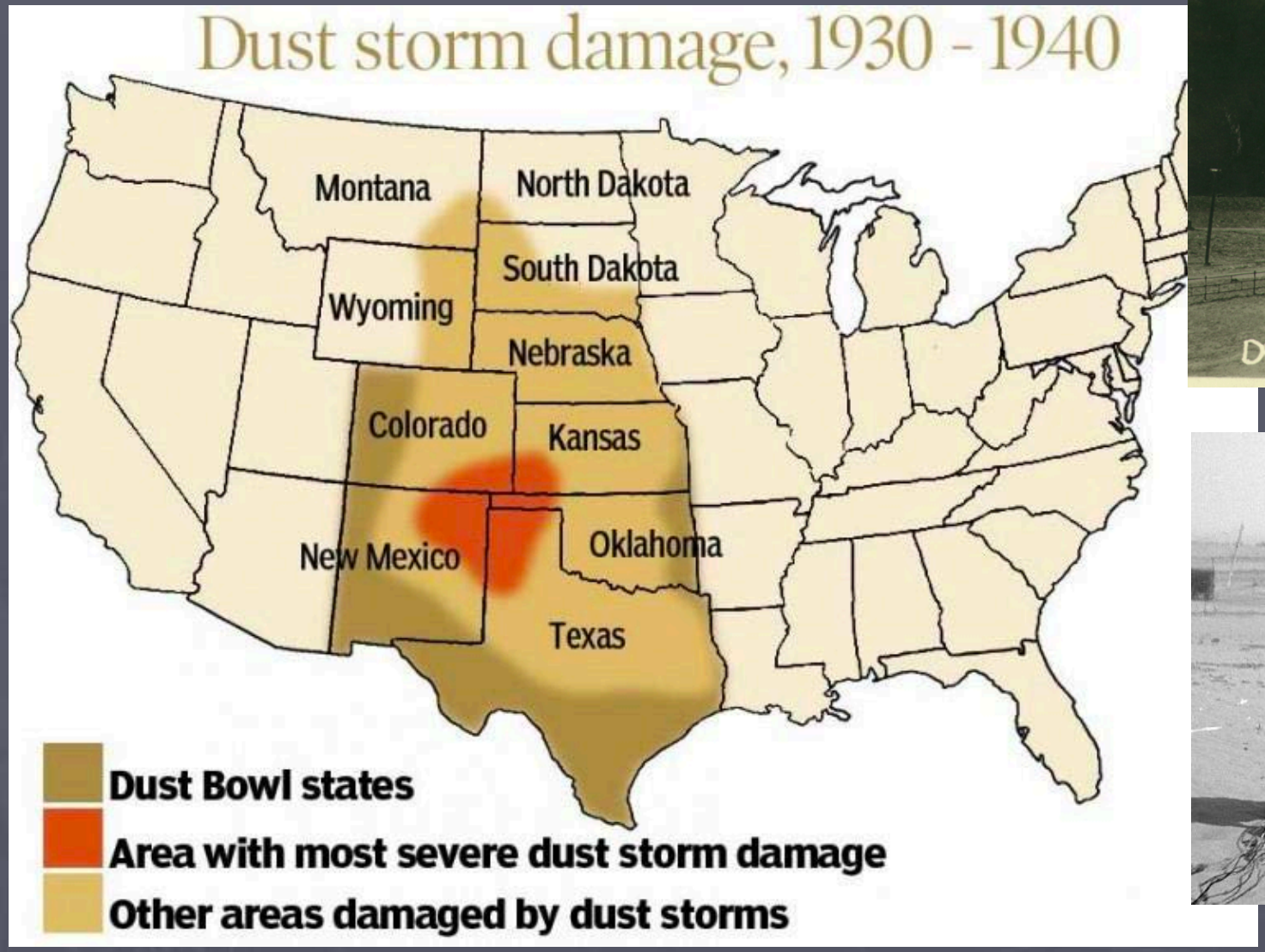
- Soil quickly eroding across world by wind and water
  - 35% of farmland losing soil faster that is can form
  - Estimates of loss of soil by 2120
- Desertification: Land degrading and becoming unproductive



Carbon Sequestering of Prairie Plants



Dust Bowl


Dust storm damage, 1930 - 1940
Montana
North Dakota
South Dakota
Wyoming
Nebraska
Colorado
Kansas
New Mexico
Oklahoma
Texas
Dust Bowl states
Area with most severe dust storm damage
Other areas damaged by dust storms


Dust Storm 3/26/35, Naponee Nebr.

Soil Conservation

- Wind Breaks/Shelter Belts
- Crop Rotation
- No-Till Farming
- Contour Farming