# Classification of the Near Surface

Is it needed?

Is it time to start?

# Milton Whitney, 1899
## on the purpose for classifying soils

"We needed to be able to transfer experience, from research or the use of soils, from the fields or areas where we have experience, to other soils or areas where it is applicable"

## Compass Loamy Sand - Auburn, AL

Coarse-loamy, siliceous, subactive, thermic Plinthic Paleudult

- Auburn University Experimental Farm
- Comparisons:
  - Conventional-till
  - No-till
  - Grass
  - Planted Pines

# Cropland Carbon Distribution

# Carbon Storage

- 10 years of no-till has led to a doubling of carbon (OM) in the upper 3 inches in this sandy, southeastern soil.

# Stability of Peds

# Water Movement (into soil)

- Cornell Infiltrometer.
- Slowest For Conventional Tillage.
- No-Till and Grass most variable.

# Water Movement (subsoil)

- Amoozemeter
- Slowest for conv. tillage and grass.
- Most variable for no-till and pines.

| |
|---|
| 0.2-0.6 = mod. Slow |
| 0.6-2.0 = moderate |
| 2.0-6.0 = mod. rapid |

# Soil Erosion

- Dramatic soil loss reduction due to residue cover, more stable peds, higher OM, and increased infiltration.

# Near Surface Classification

- Why haven’t we been classifying the surface ?
- Why we need to consider starting?
- What properties need to be considered?
- Do we need a classification system?
- How do we classify them?

# Guy Smith Interviews

"It has been suggested that properties of surface soil horizons be used as family criteria to enhance interpretive values. But no, I see no way that can be done economically. The physical, chemical properties of the plow layer admittedly are critical to the growth of plants, and yet they can vary enormously from one system of management to another on what is essentially the same kind of soil".

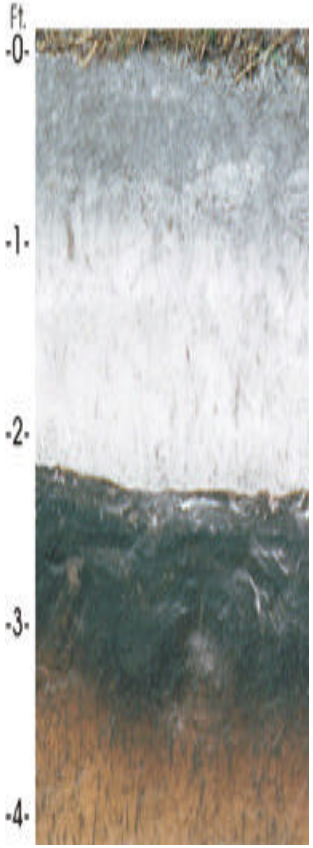
# G. Smith, cont.

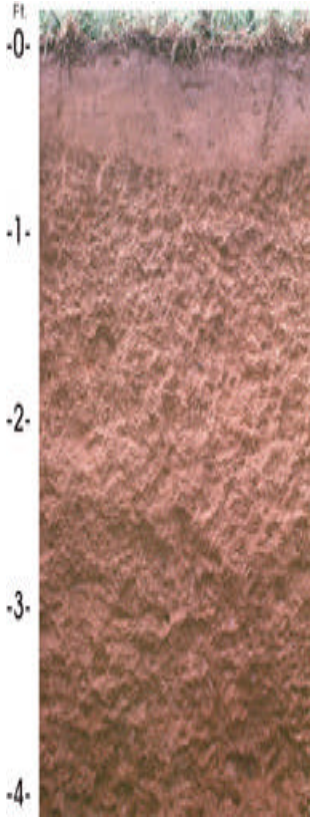
"The poor physical and chemical properties that stunted the crops of the man with poor management will have disappeared and you will have good chemical and physical properties on both sides of the fence. To build this into the taxonomy is difficult. It is readily changed by the death of an owner or the sale of a farm, to bring in a new manager with higher managerial skills. That means you have to go back and re-map every few years, …"

# Charles Kellogg

"Thus it becomes important that we distinguish clearly between soil characteristics, which can be seen and measured in the field or measured in the laboratory, and soil qualities, which result from interactions between these characteristics and practices. The first are relatively permanent, whereas the second are subject to frequent change".

# Morpho-genetic vs Utilitarian

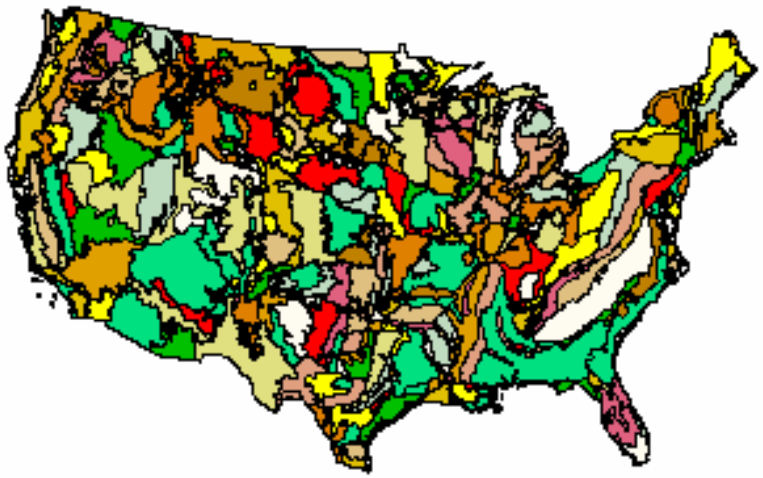



# Soil Taxonomy & Current Interpretations

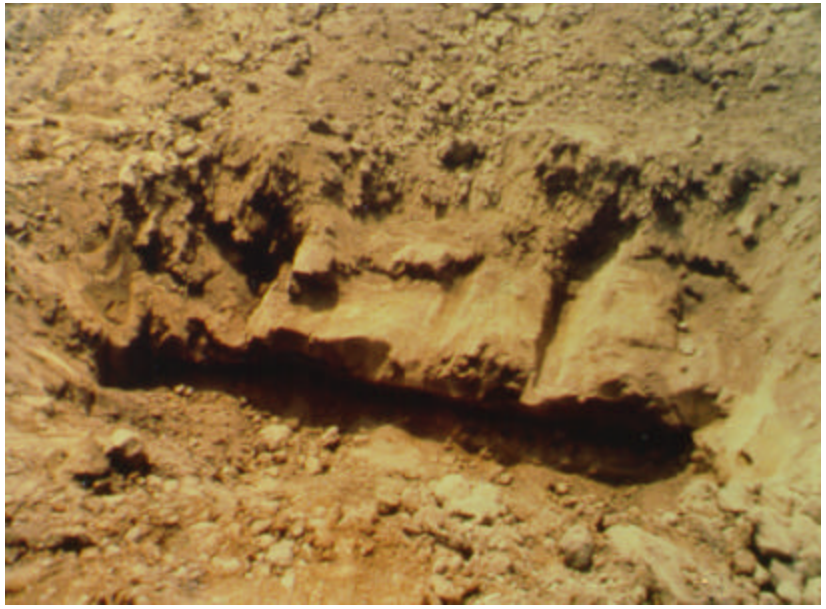
- What do we have?
- How can we use it?
- How do we describe it?

S=c,r,o,p,t



# Utilitarian

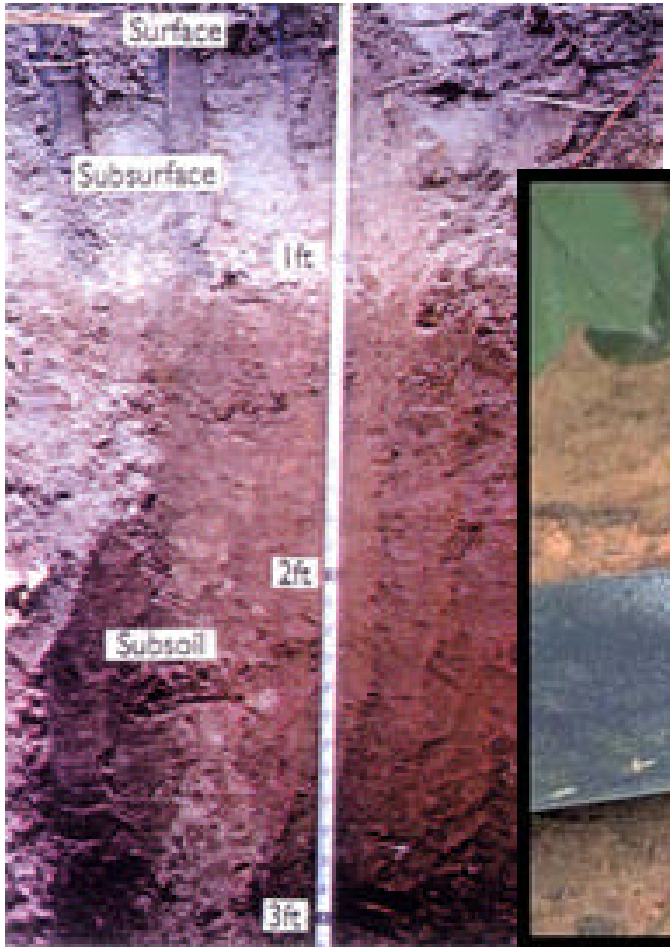
- What have we done?
- What is the potential for change?
- How should we manage it?
- How do we describe it?



# Today's Questions

- Carbon Sequestration
- Water Quality
- Air Quality
- Productivity – profitable
- Economic value to society: clean air, water, wildlife habitat, aesthetic landscapes, etc.
- *Economic value to research program*

# What properties do we consider?




Genetic

Dynamic

# Dynamic Properties

- Those properties subject to frequent change.
- Change readily with changes in landuse and management.

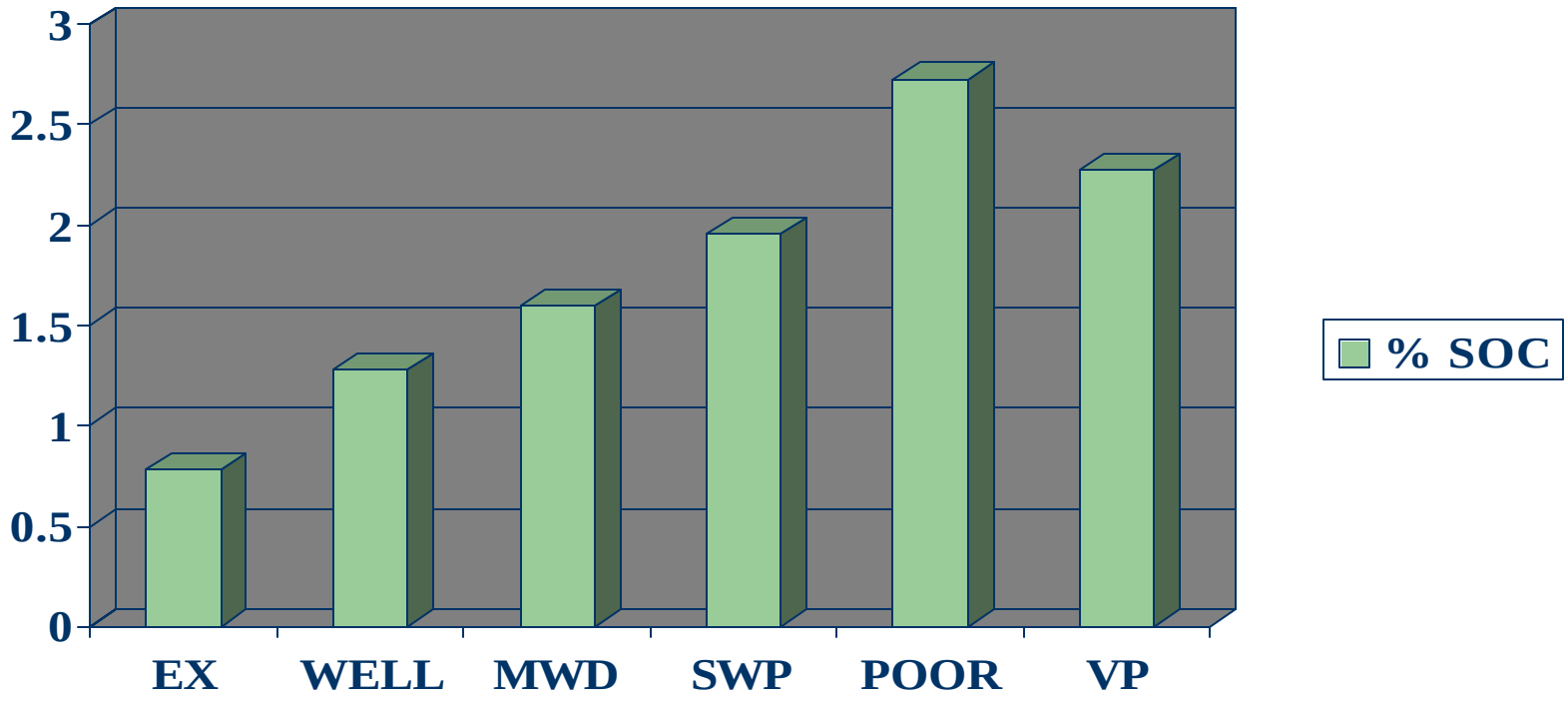
- Inherited: result of past management on inherent properties
- Natural: result of abnormal or catastrophic events: flood, fire, drought, earthquake, etc.

# Genetic Properties:

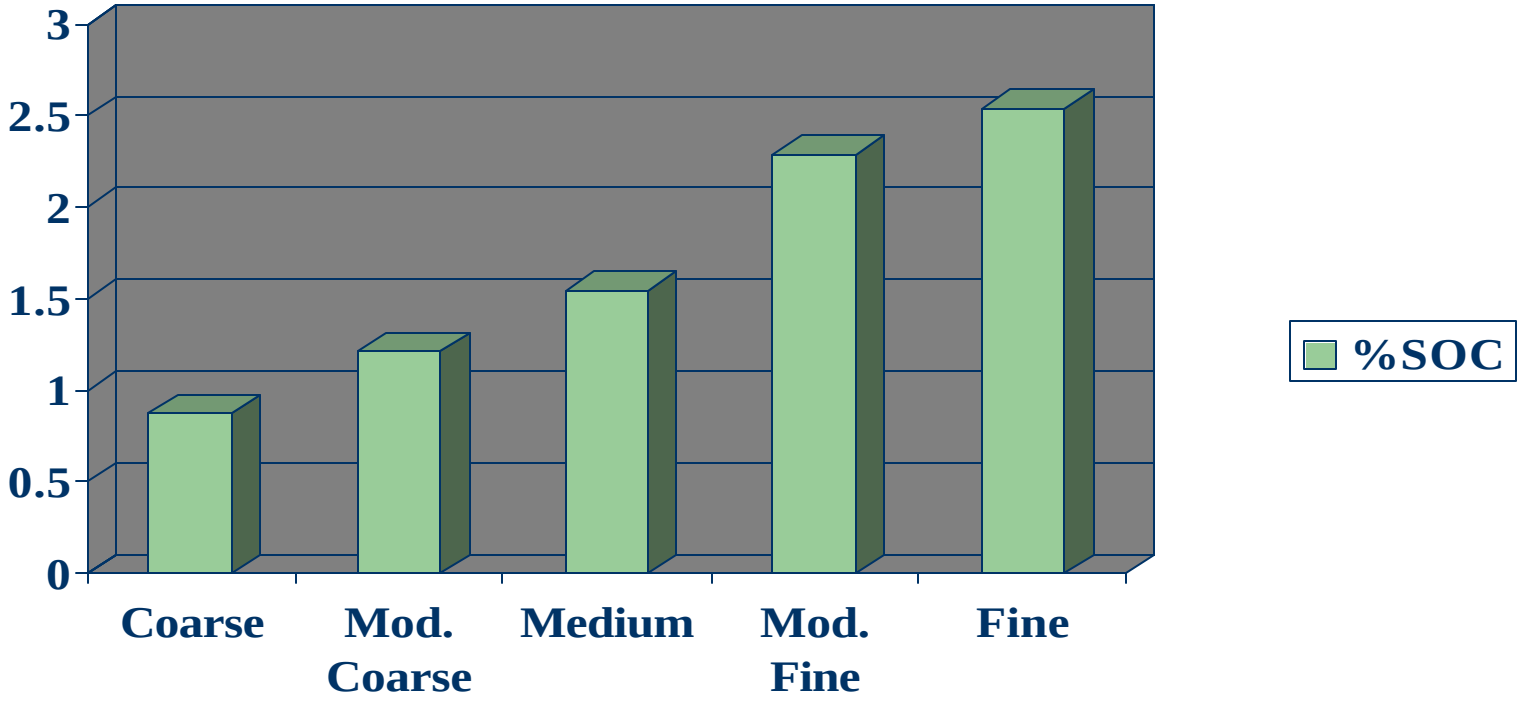
- ? Developed according to Jenny's S=c,r,o,p,t.
- ? We based much of taxonomy upon them since they were seemingly unchanging.
- ? Can be physical, chemical, biological (?), and morphological.
- ? ***DICTATE*** the range in which dynamic properties tend to exist.

# Genetic Influence on Dynamic Properties

# Drainage and Carbon



# Surface Texture and Carbon



# S=c,r,o,p,t

- Time:
  Inherent: Geologic
  Dynamic: Seasonal to Generational

- Organisms:
  Inherent: Native vegetation
  Dynamic: Humans

# Classifying the Near Surface

- Classification Systems
- FAO and ISRIC Example
- Proposed approach
- Challenges

# Technical & Functional systems

- In a **technical** system, there is no attempt to classify into natural groupings.
- Soils are classified directly by a chosen set of characteristics that are thought to relate directly to a certain use or group of uses.
- An example is the Unified system for engineering.

# Topsoil Classifications

Soil classification tends to ignore or downplay the diversity of topsoil characteristics, mainly because they can change fairly rapidly under human influence.

However, the topsoil determines to a large extent soil-related Land Qualities, especially for infiltration, erosion, crusting and other surface processes.

A draft proposal has been developed by ISRIC and FAO..

- *"Topsoil Classification for Sustainable Land Management"*

# EXAMPLE: PROPERTY DESCRIPTION

- Allophanic
- Chernic (m0)
- Brunic
- Calcic
- Duric
- Fibric
- Melanic
- Natric
- Para-ombric
- Thixotropic
- Vitric
- Vermic

# EXAMPLE: PROPERTY DESCRIPTION

- **Allophanic (x)** Topsoils that have Al(o) + 1/2 Fe(o) of 2% or more in the fine earth fraction, Si(o) of 0.6% or more; pH (NaF) is >9.4, a BD of 0.9 Mg m-3 or less and a P retention capacity of >85%, that have a Al(p)/Al(o) ratio of <0.5; pH of 5.0 or more; and KCl extractable Al of <2 cmol(+) kg-1, that have dark brown colours (value 3, chroma 3.5,moist); an OC content of 5% or more with stable organo-mineral complexes; dominated by allophane that have a fine very friable crumb or granular structure with fluffy microstructures, non or slightly plastic; and a high biological activity.

# EXAMPLE: PROPERTY DESCRIPTION

- Chemically Degraded
- Drained
- Hard-setting
- High Al Saturation
- High Fe Oxides & Hydroxides (P adsorp)
- Low K reserves
- Low Nutrient Reserves
- Moderately Eroded
- Physically degraded
- Puddled
- Surface Seal
- Truncated
- Wind Eroded

# EXAMPLE: PROPERTY DESCRIPTION

- **Compacted (p2)** Topsoils that have a BD in the upper 10 cm of 1.7 Mg m-3 or more.
- **Crusting (r1)** Topsoils with >25 % silt and (sealing) < 35 % sand, that have a CEC of 24 cmol(+) kg-1 clay, and an OM/clay ratio of <0.07, with or without an ESP of 15% or more, or 50% or more exchangeable Mg
- **Depositional Crust (r3)** Topsoils where soil particles, suspended in water, are deposited on the soil surface as the water infiltrates or evaporates. Externally derived materials are always involved in the construction of depositional crusts.

# Suitability Classifications

- These group soils by specific properties important for a land use or set of land uses. They are directly usable by land managers working in a specific geographic area and for specific land uses.

Cooperative Research in Forest Fertilization (CRIFF) soil groups

- This is a system of grouping Florida (USA) soils according to how they respond to certain forestry management activities. All the soils in Florida are classified in eight management groups

# Proposed Approach

# A Near Surface System Should:

- NOT be incorporated INTO our current system of classification, but be a companion or addendum
- NOT be mapped at order two or above
- Be used for technical soil services (public and private), research, consulting, precision agriculture, farm policy, environmental issues

# Surface Soil Formation

Surface Soil = $S_J$ + $S_I$ + Mgt + T, where:

$S_J$ = Jenny's S=c,r,o,p,t

$S_I$ = Inherited properties from past land use

Mgt = Current management

T = Time under Mgt

# Land Use Driven System

- ORDER:
  Broad Landuse
- SUBORDER:
  Specific Landuse

- Cropland, Rangeland, Forestland, Urban, Recreational Lands, etc.
- Cultivated Cropland, Commercial Forest, Residential Urban

# Land Use Driven System
## Great Groups and Subgroups

Genetic Grouping

Link to Soil

Taxonomy

- Erodibility, Exchange Capacity, Texture, Drainage, Surface Thickness, Mineralogy

Management

- Tillage Intensity, Cropping System, Grazing System, Athletic Field, Timber or Pulp, National Park/Forest, etc.

# Land Use Driven System
## Family Classification

Based on properties that reflect the functions or services soil provides.

- Water Partitioning
- Nutrient Cycling
- Filtering and Buffering
- Productivity

# Challenges

- What are the key soil properties for each landuse?
- What are the expected ranges for these key properties given past management effects and genetics?
- How do we group soils based on Soil Taxonomy? On Management?

# Challenges

- How do we link changes in soil properties to dollar benefits to landowners and society?