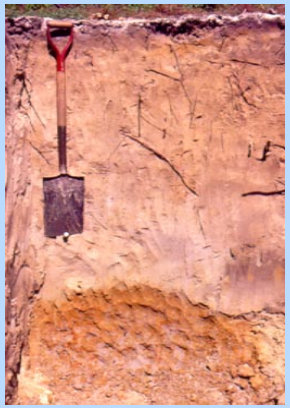
Clues and Impediments to the Understanding of SE US Coastal Plain Soils

Acknowledgments:

Personnel who contributed to the Florida Soil Survey Program. Data generated through their effort prompted research reported in this talk.

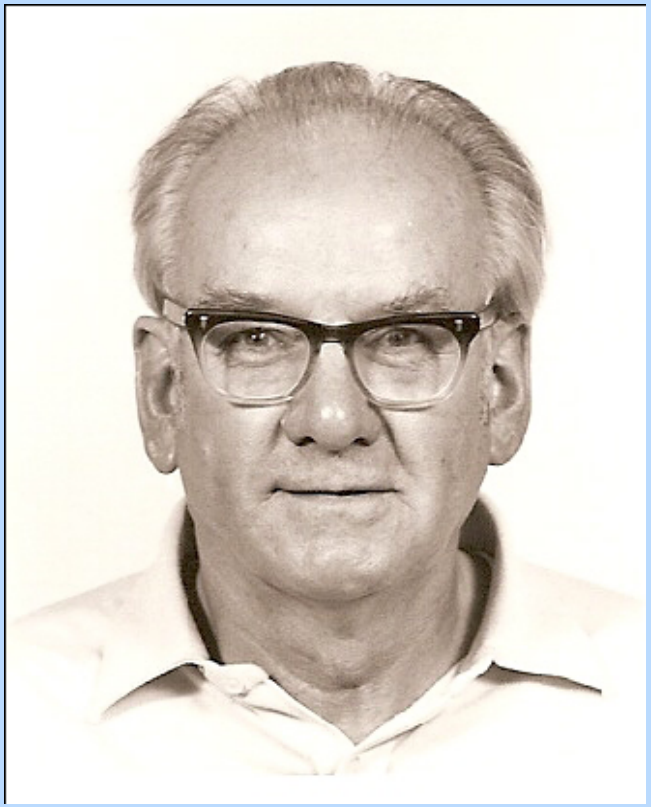
Collaboration of UF Soil and Water Science colleagues.

Florida soil scientists who shared soil photographs.



In memory of two people who enriched my life …

Dr. Vic Carlisle



Dr. Earl Stone

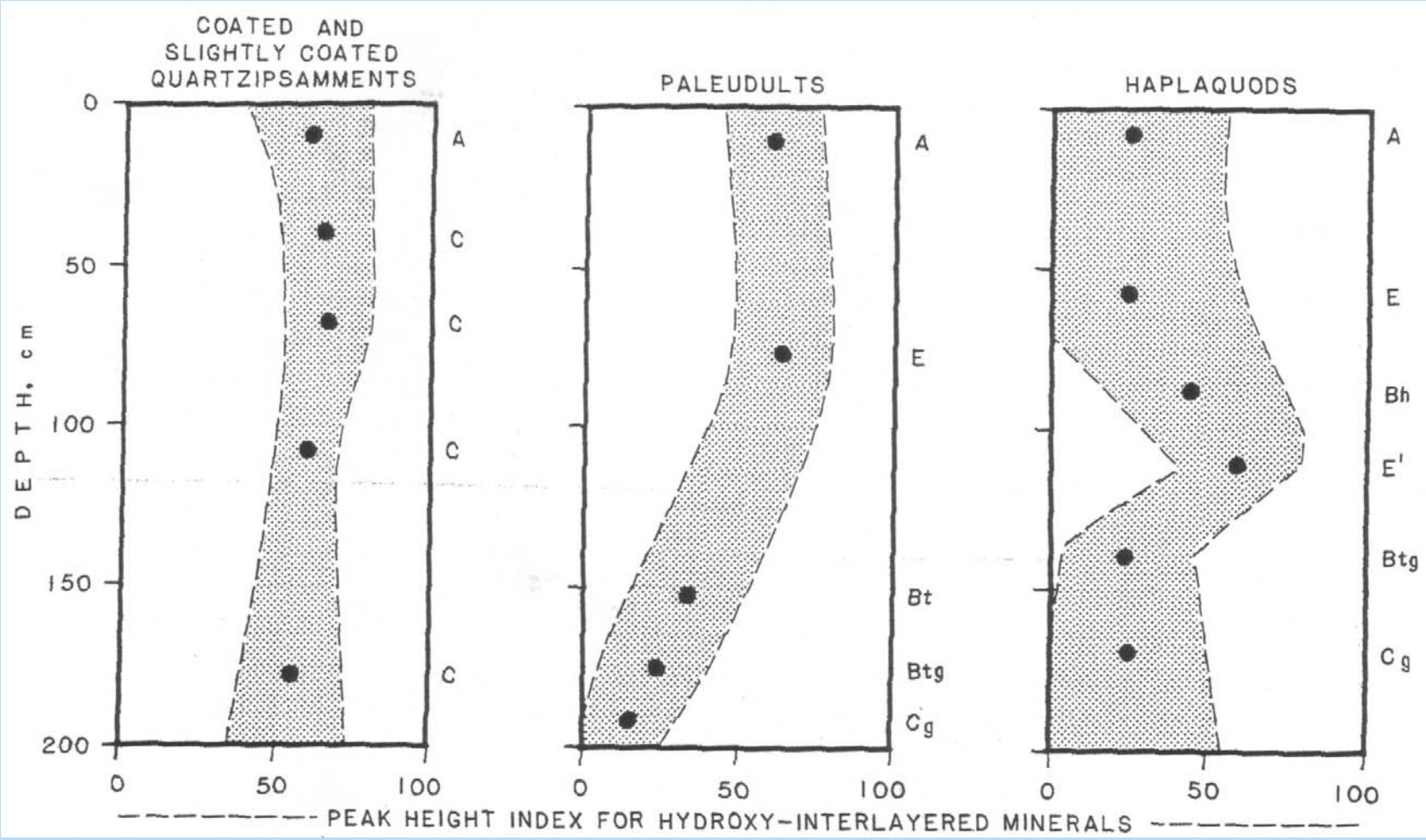
Topics Addressed

- Clues
  - At E-Bt boundaries
  - At E-Bh boundaries
- Impediments
  - Terms that confound communication
  - Terms that mislead
  - Horizon designation mismatch with genetic context

Clues

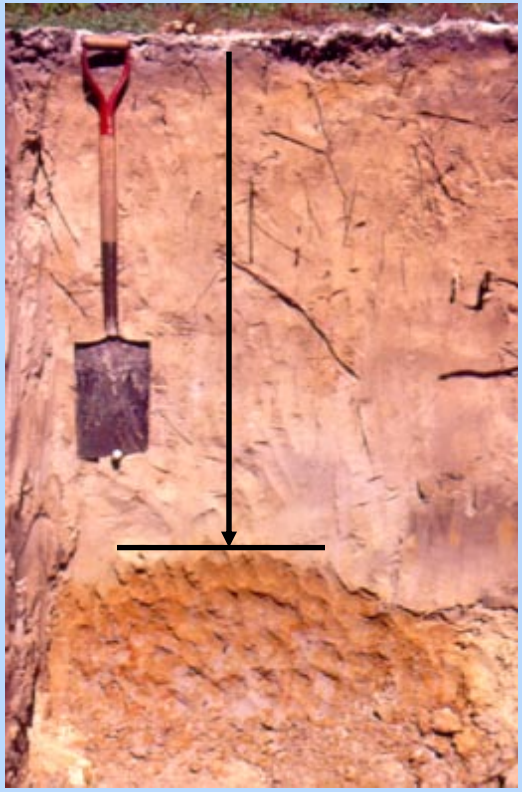
E-Bt mineral distributions

Florida Soil Survey Data Tell a Story

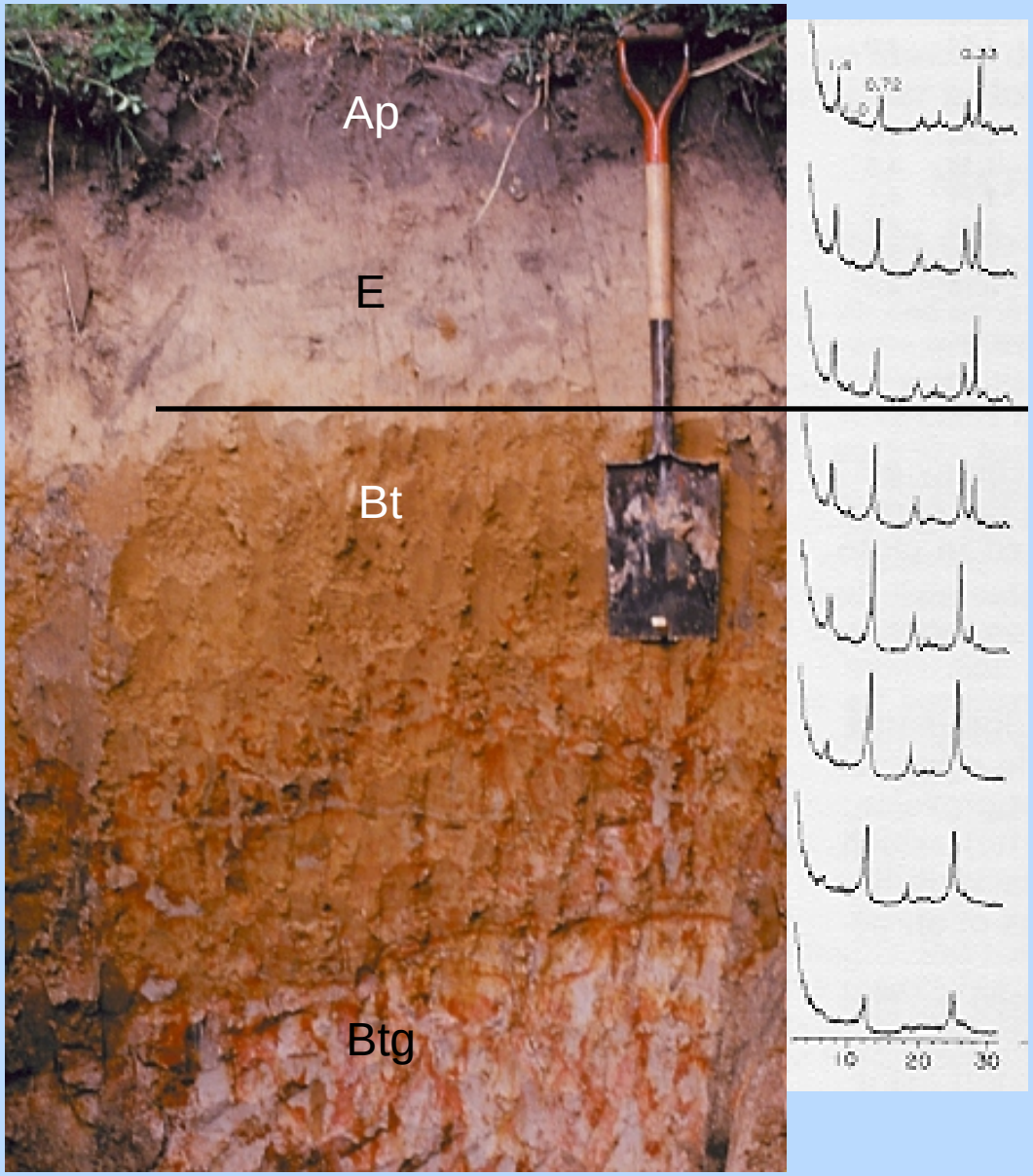


In effect …

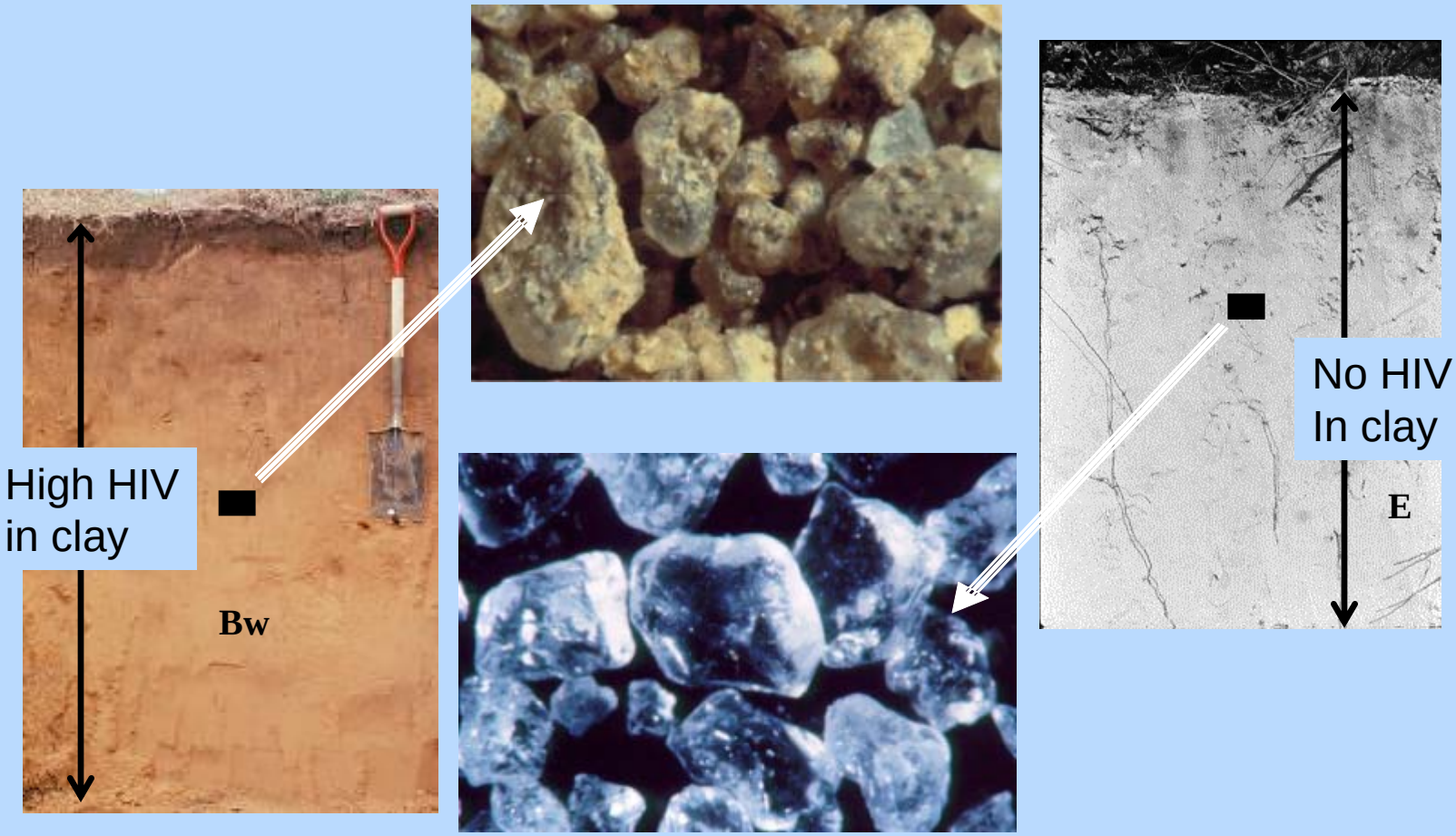
No matter how deep the boundary, clay mineralogy changes there



Example, one of many



Coated vs. Clean Sand Grains



Conclusion: HIV is large proportion of small amount of clay in grain coatings

Coated vs. Clean Sand Grains (cont.)

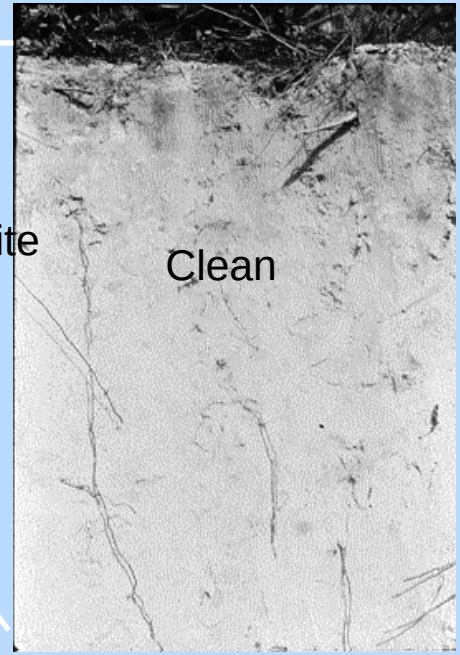
Lakeland

Coated = high HIV in clay

Myakka

Clean = high quartz, maybe smectite in clay

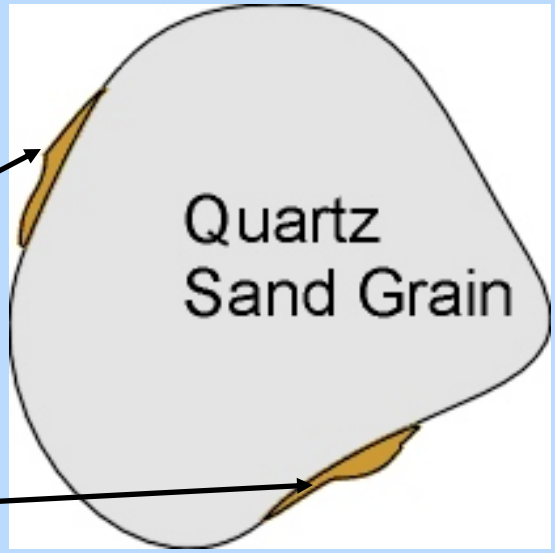
St. Lucie



… in Panhandle & N. Central Florida

… no matter how deep or thick

Characteristics of Sand Grain Coatings

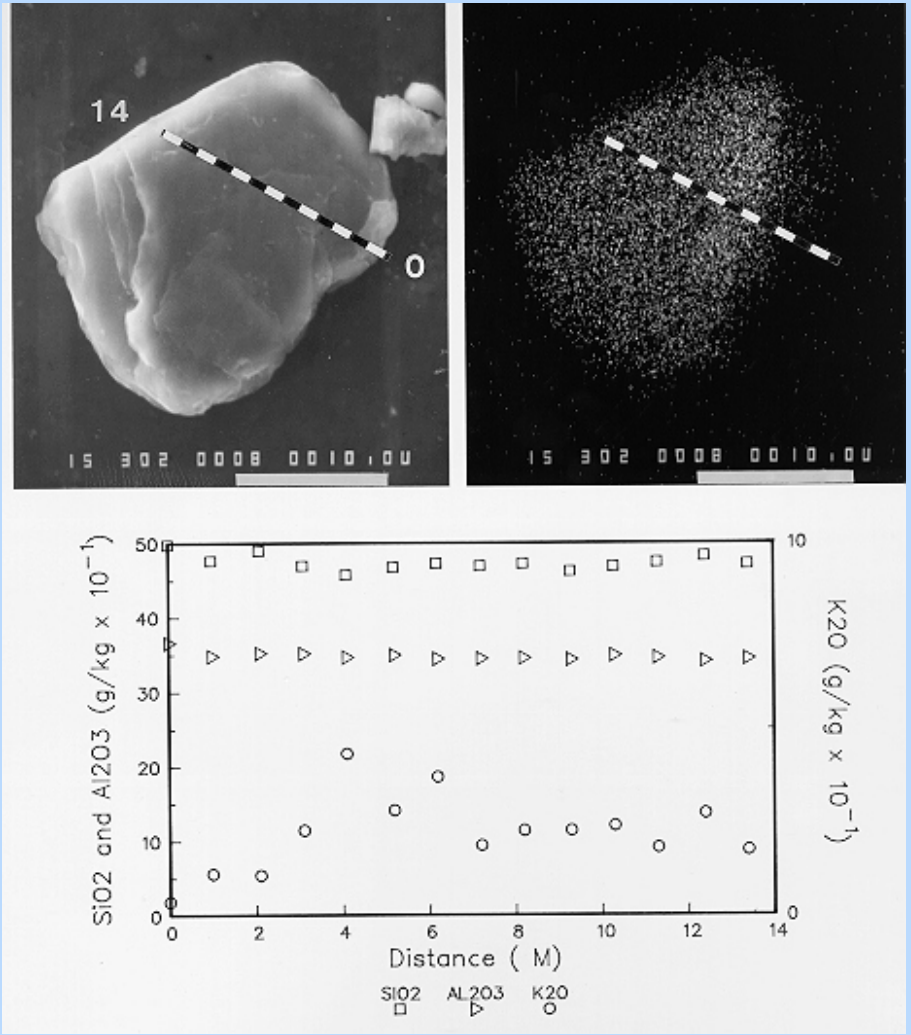


Coatings

- Patchy, not uniform
- About 2-8 % of sandy soil mass
- Contain similar proportions of silt & clay
- Silt – mostly quartz
- Clay – quartz, phyllosilicates, gibbsite, & oxides of Al & Fe
- NOT “iron oxide coatings”, although …
- Al- & Fe oxides largely control P sorption
- Al- & Fe oxides serve as “cement”

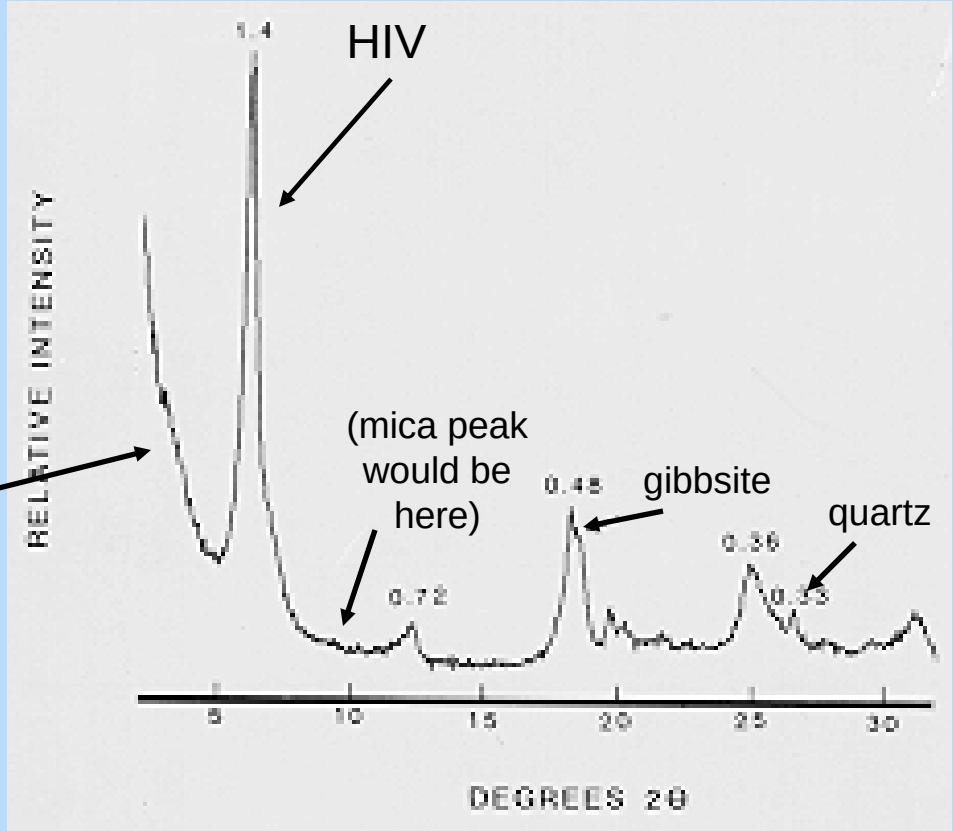
Potassium as a Clue …

HIV-rich silts have platy grains containing K

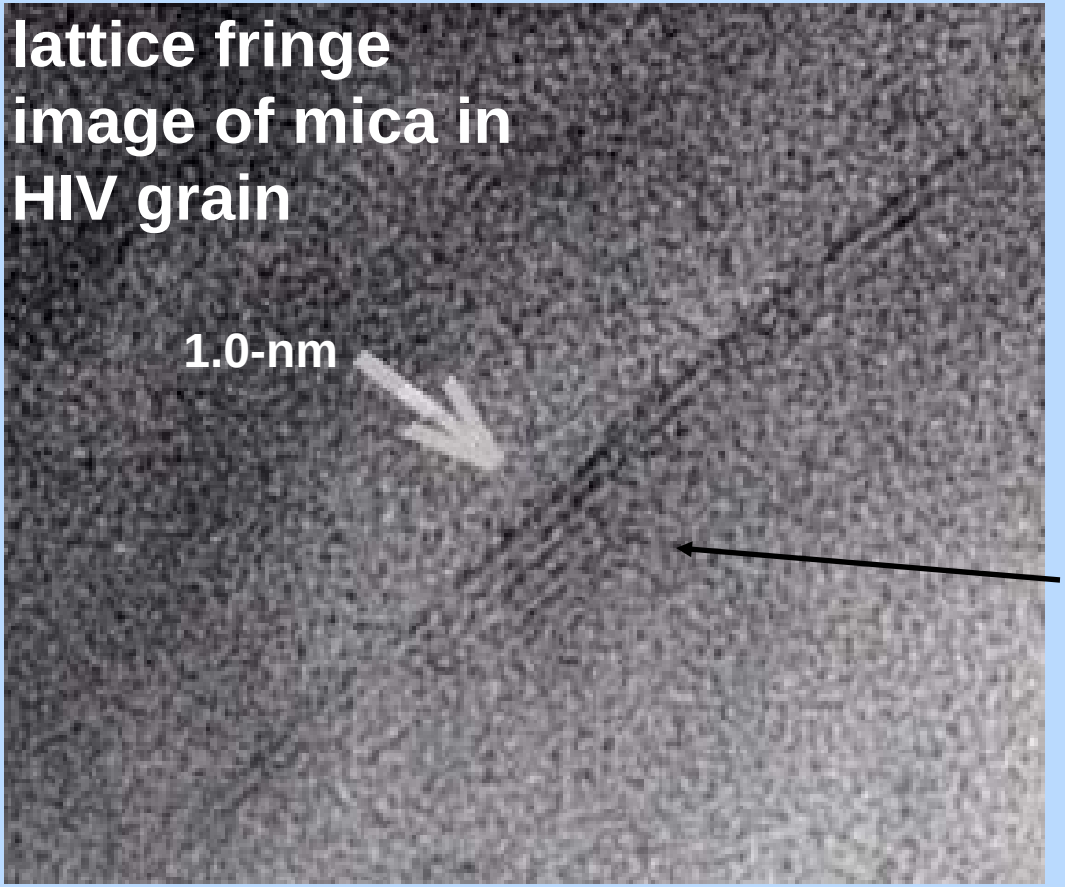


But despite K, mica evades detection by x-ray diffraction

X-ray diffraction pattern of HIV concentrated in Medium silt



A Glimpse of Ghostly Mica … Finally!



Evidence of occluded mica zones in HIV grains

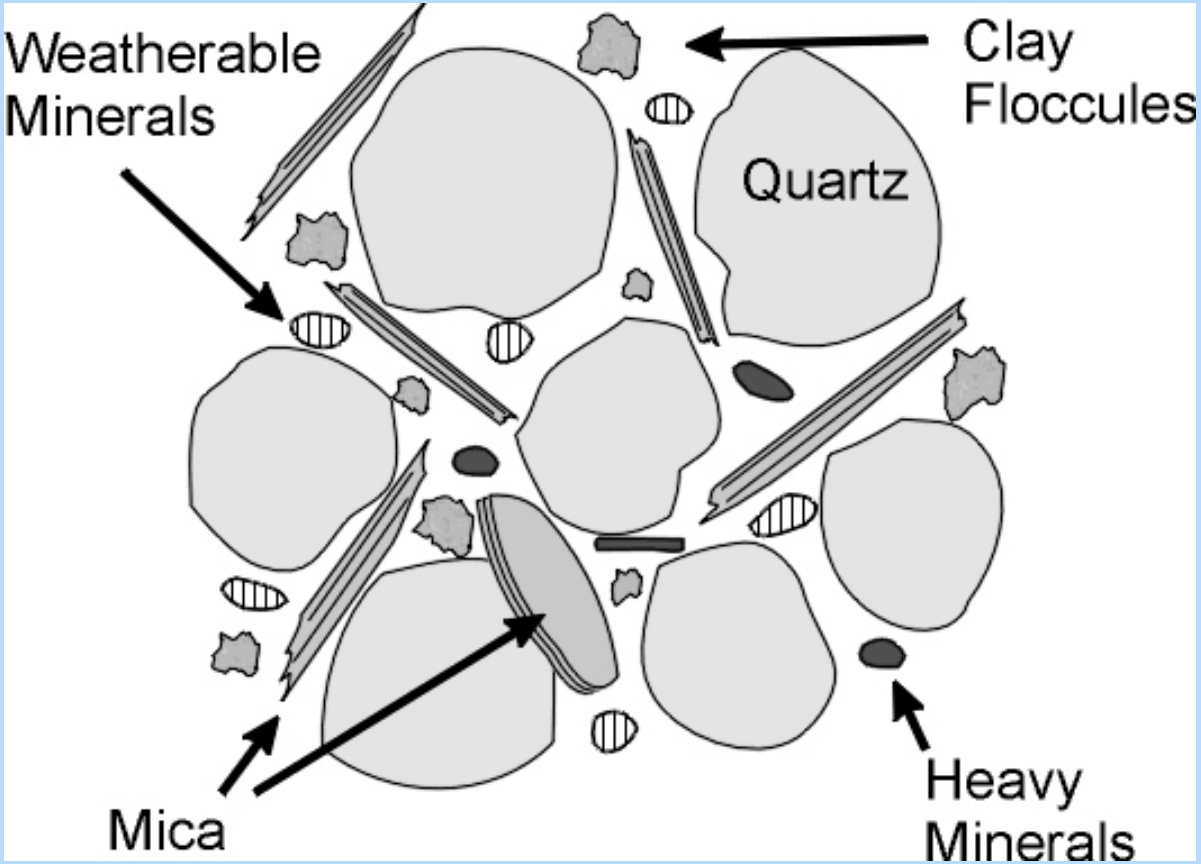
Mica as a Ghostly Clue …

Mica – Metal Oxide – Grain Coating Connections:

Theory to explain HIV-kaolinite distribution

Non-quartz mineral abundance grossly exaggerated for illustration purposes.

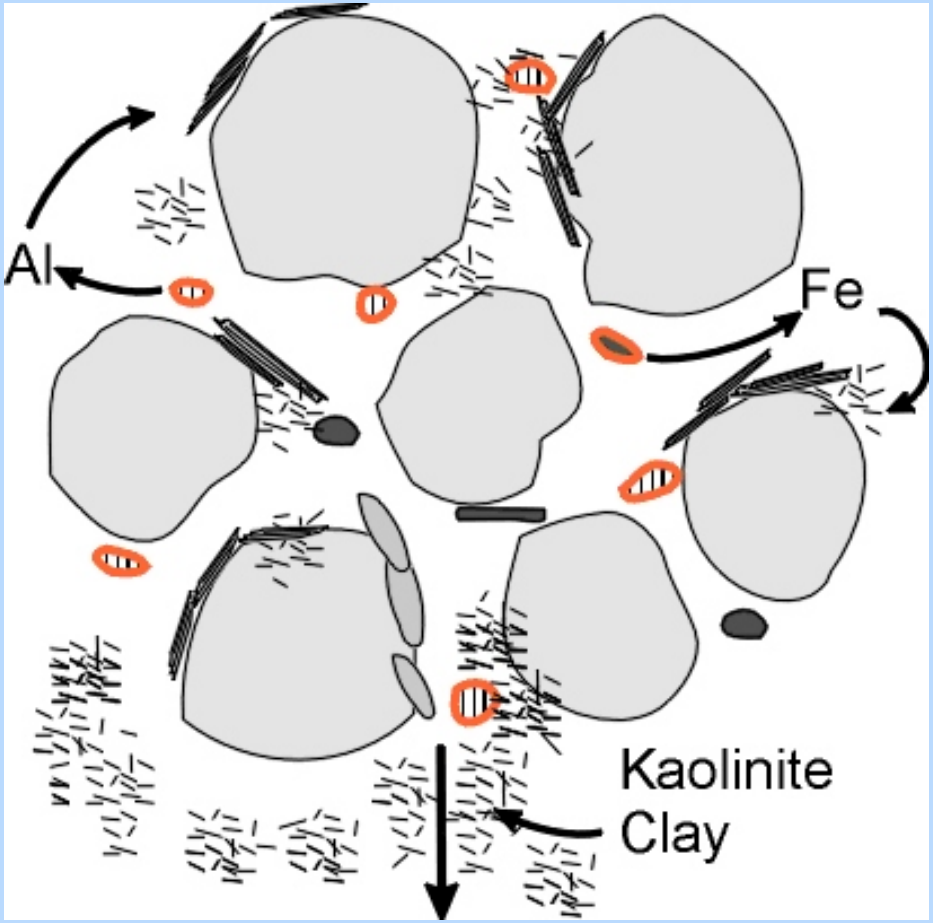
(Mica is considered a weatherable mineral, too.)



Mica as a Ghostly Clue …

Theory to explain HIV-kaolinite distribution (cont.)

- Clay dispersed & mobilized
- New clay generated by weathering
- Mica weathers *in-situ*
- Al- & Fe oxides form and bind other components
- Mica products (HIV) & some kaolinite become incorporated into coatings
- HIV less subject to eluviation than kaolinite, explaining depth trend



To Bt

E-Bt pedological vs lithological issue

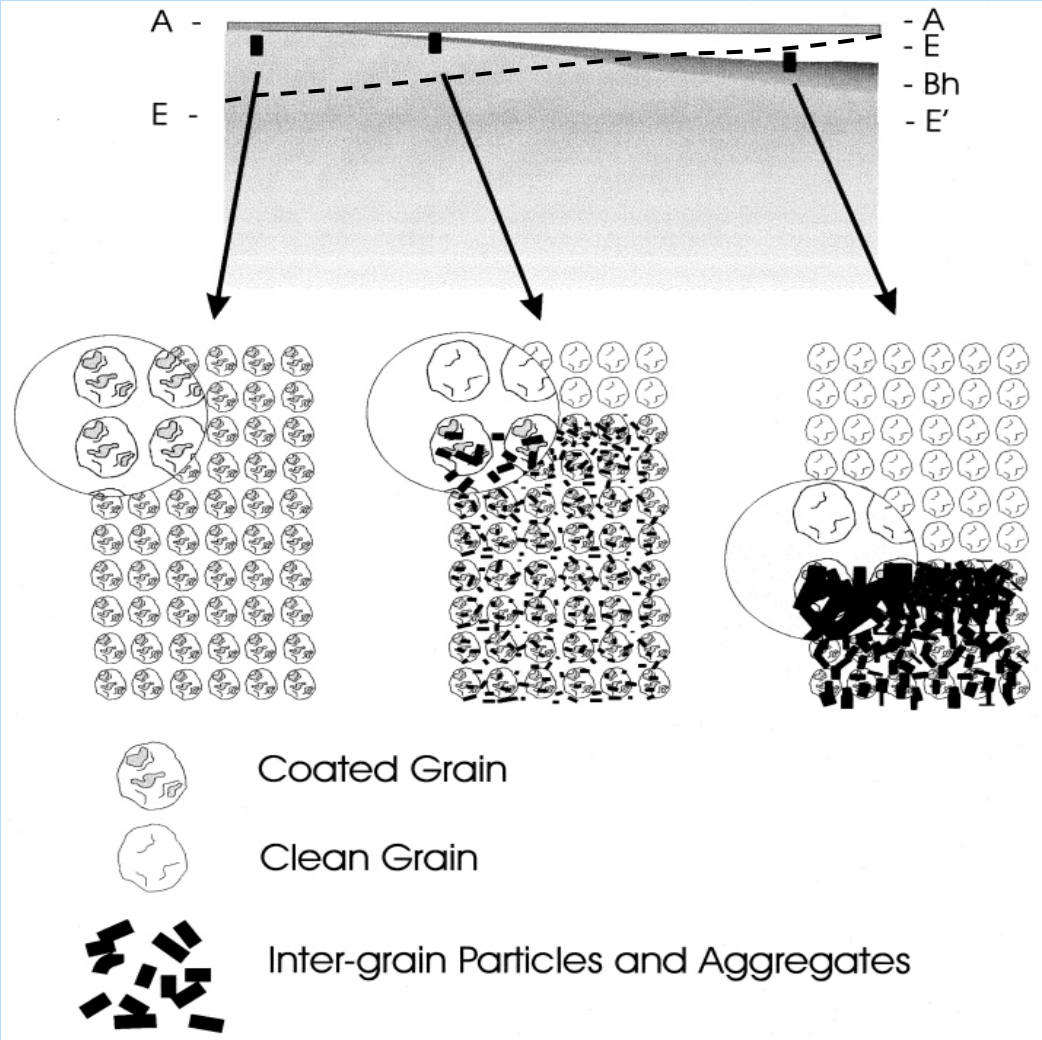
- Dominant-sand to total-sand ratio
- Heavy mineral abundance
- Heavy mineral species

↓

Most data I've read or collected support pedological

E-Bh and fluctuating water table

Sand grain coatings are again clues …

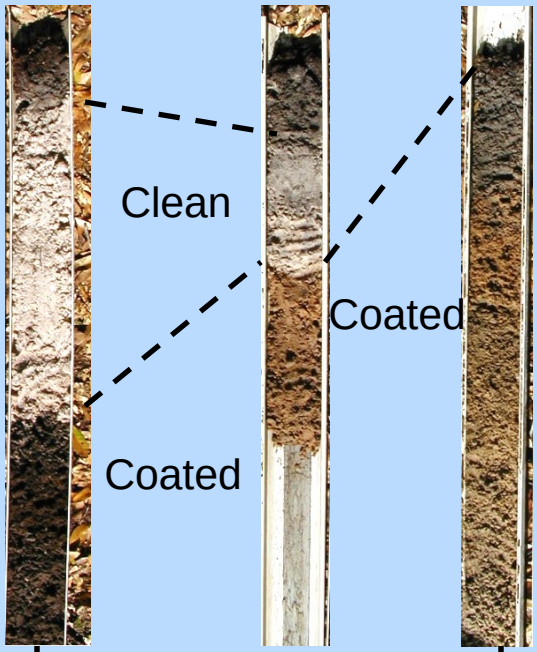


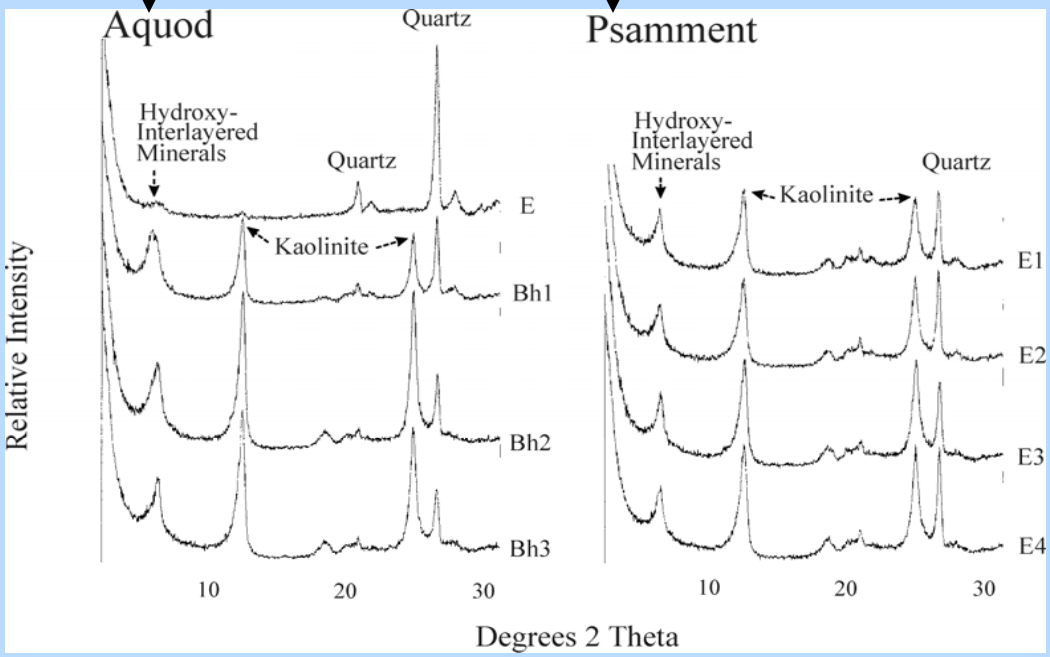
Initial observations:

- Looks like a coating redistribution
- Bh fades upward as seasonal high water table drops

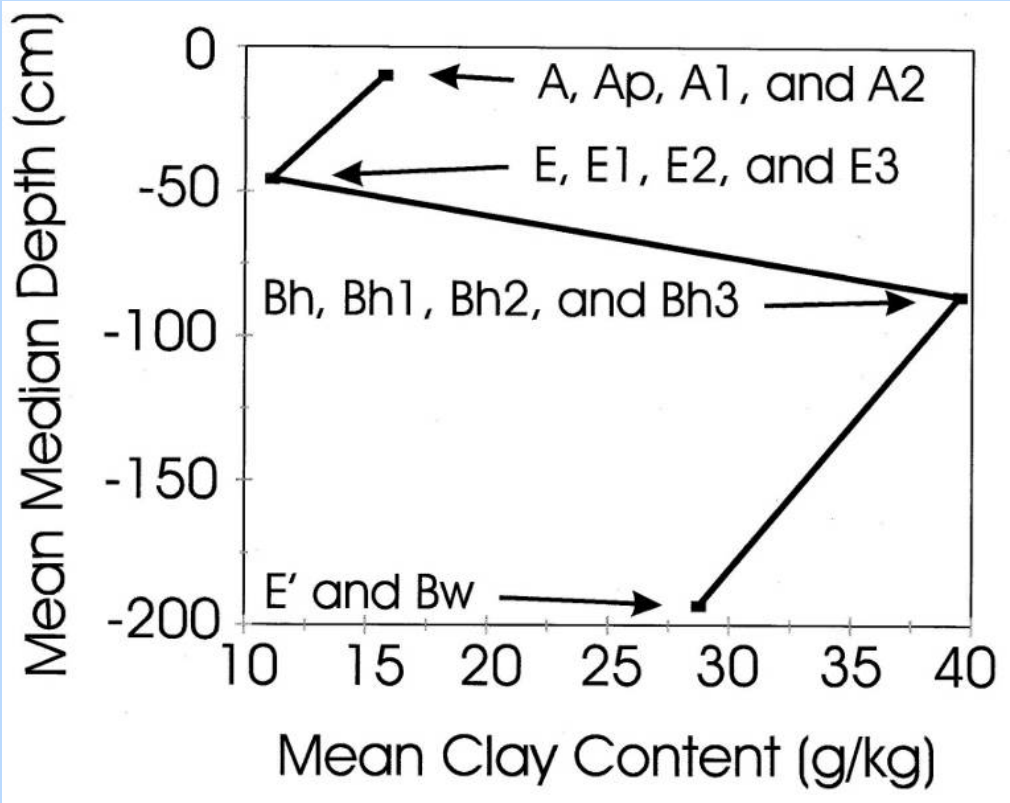
Morphological & mineralogical evidence of coating redistribution

- Aquod to Psamment sequence moving up from the shore of a sandhill lake
- About a 10-m transect





Florida Soil Survey Program data suggesting Bh is clay-enriched, too



… but **why** is a fluctuating water table required?

Why is a fluctuating water table required? Some ideas -

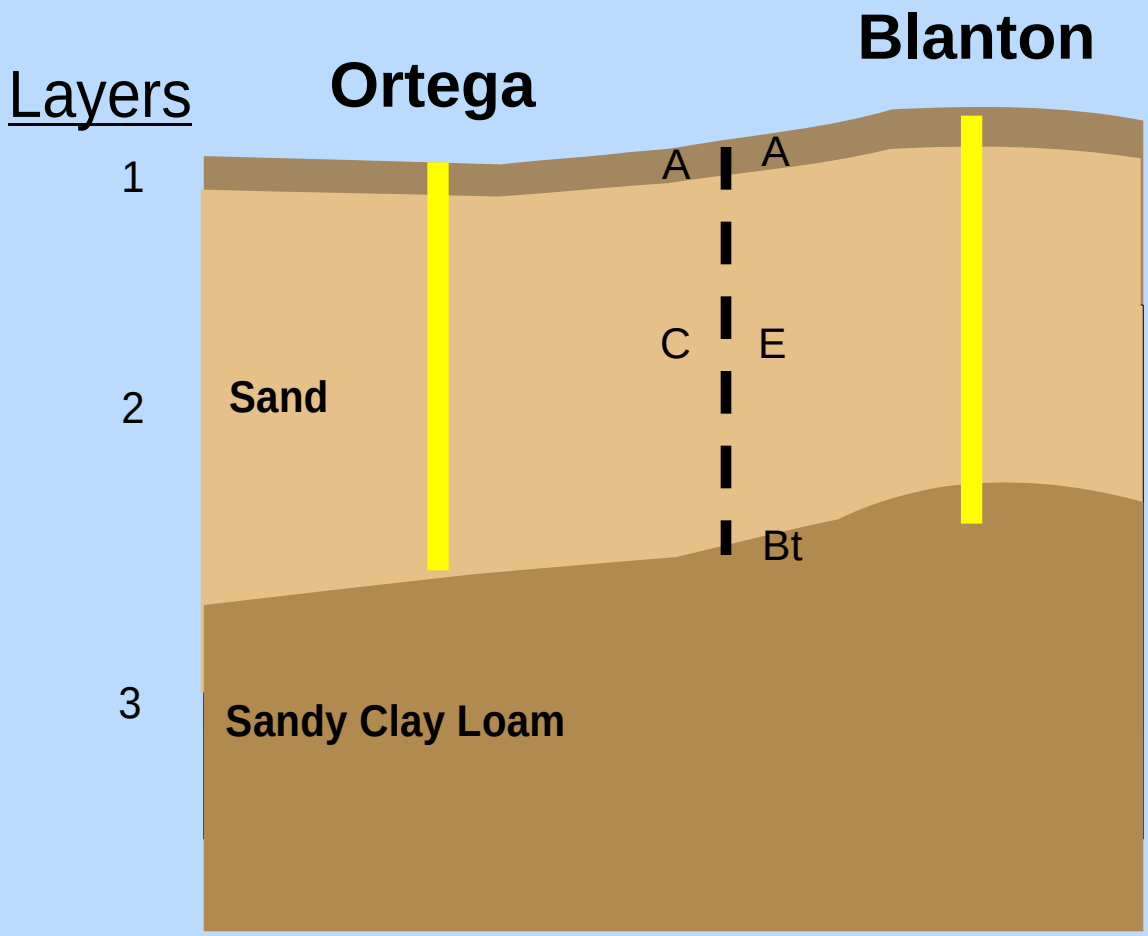
- Metal sources for Bh - metal oxides – stable on well-drained landscapes
- Redox partially depletes Fe on poorly drained uplands (“flatwoods”)
- Al => less crystalline & more vulnerable to organic complextion
- ***Thresholds in frequency & duration of saturation*** dissolve Al oxide via
  - Organic acids reach activities & kinetic thresholds
  - Reduced movement and microbial degradation rate
- Al oxide dissolution releases all coating components
- C moves Al, but Al eventually stops C within a finer matrix of colloid origin

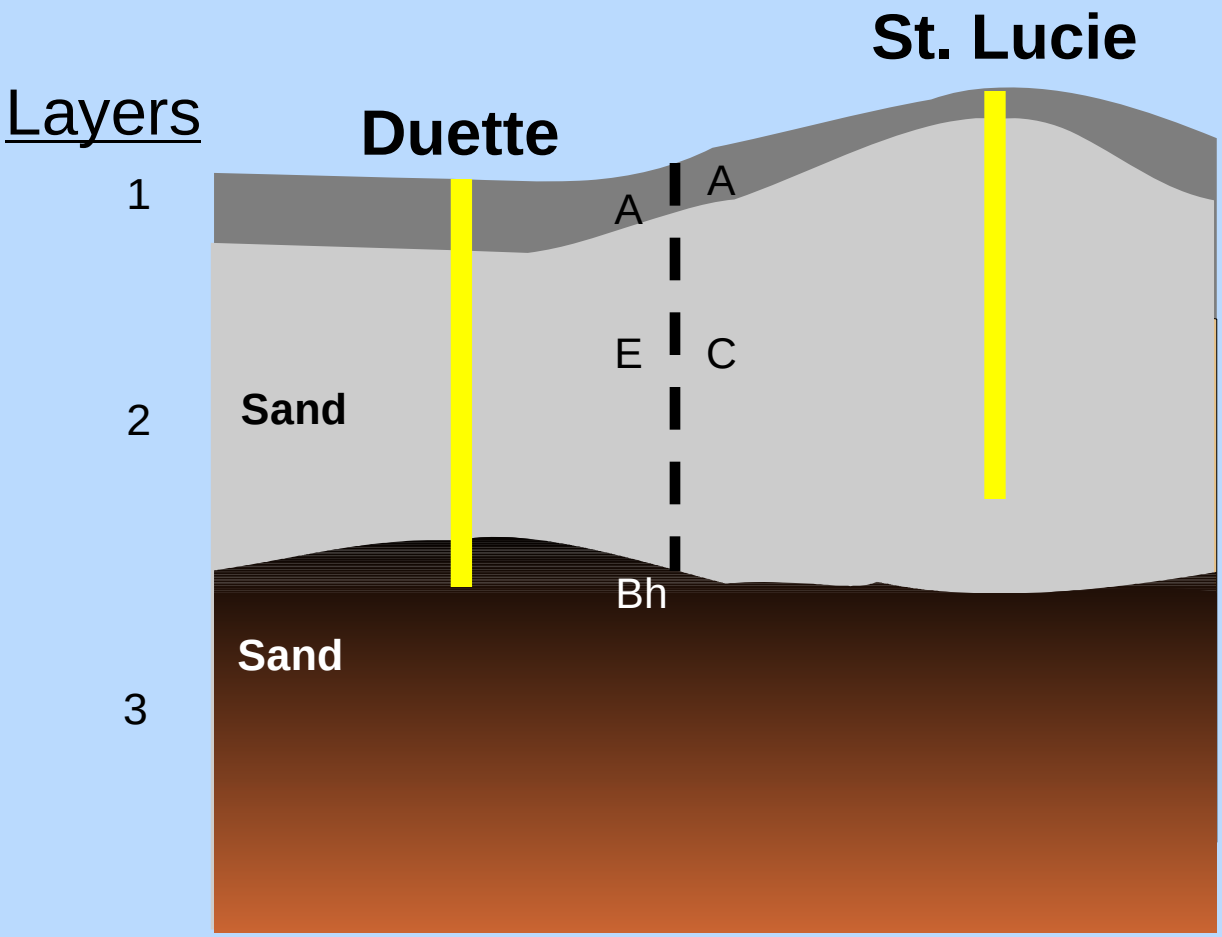
Impediments

Horizon designations of Psamments on older landscapes

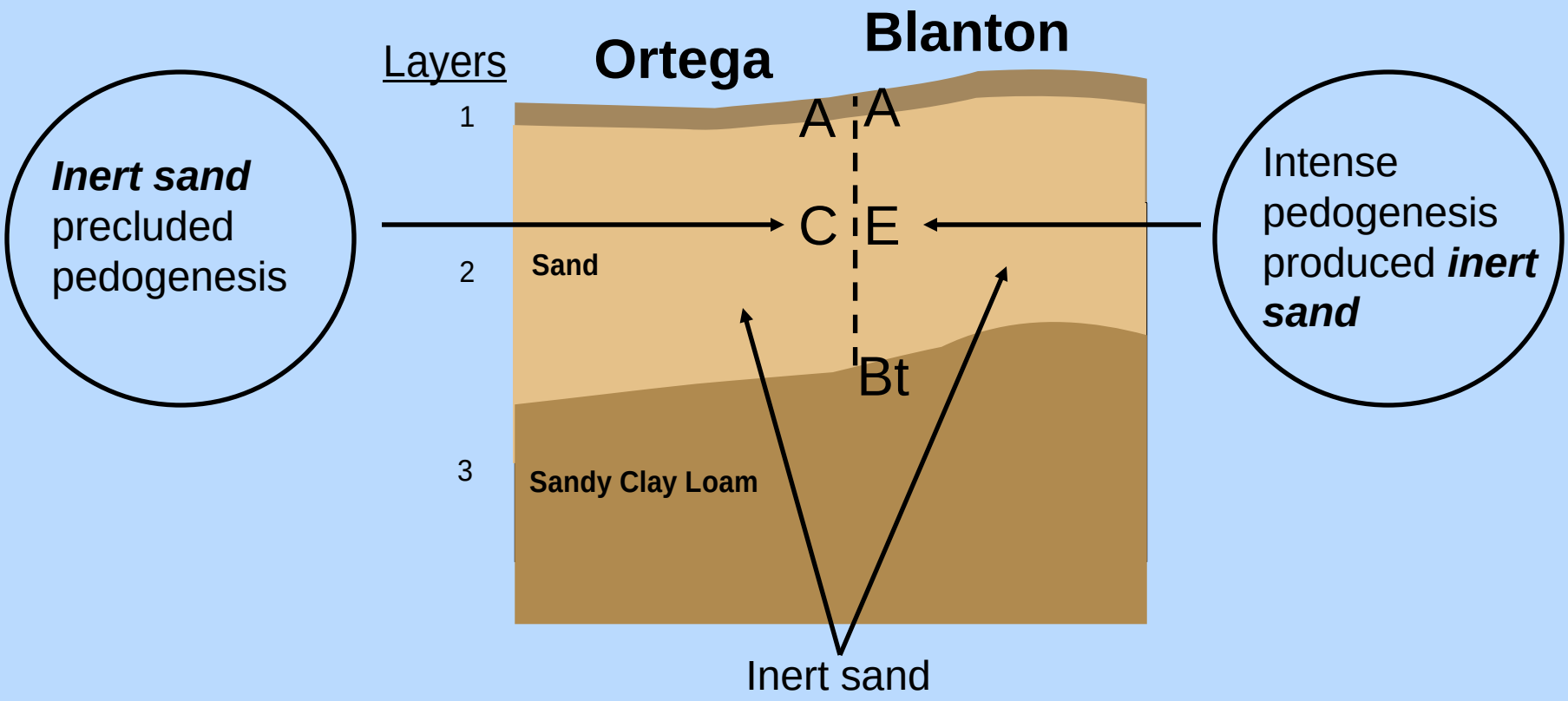
Examples of Landscape Associations, Psamment and Udult or Udalf:

- Candler and Apopka
  - Candler-Apopka, Levy Co.
- Ortega and Blanton
  - Blanton-Ortega, Lafayette Co.
- Ridgewood and Albany
  - Albany-Ridgewood, Lafayette Co.
- Tavares and Millhopper
  - Tavares-Millhopper, Hillsborough Co.
- Penney and Otela
  - Otela-Penney, Gilchrist Co.


Layers
Ortega
Blanton
1
2
3
A
A
C
E
Bt
Sand
Sandy Clay Loam


St. Lucie
Layers
Duette
1
A
A
E
C
2
Sand
Bh
Sand
3

Concept of “inert sand”



It can’t be both

Family “Coated” – “Uncoated” distinction

Lake, etc.

Has Fe & Al
Some P retention
Grains un-stripped

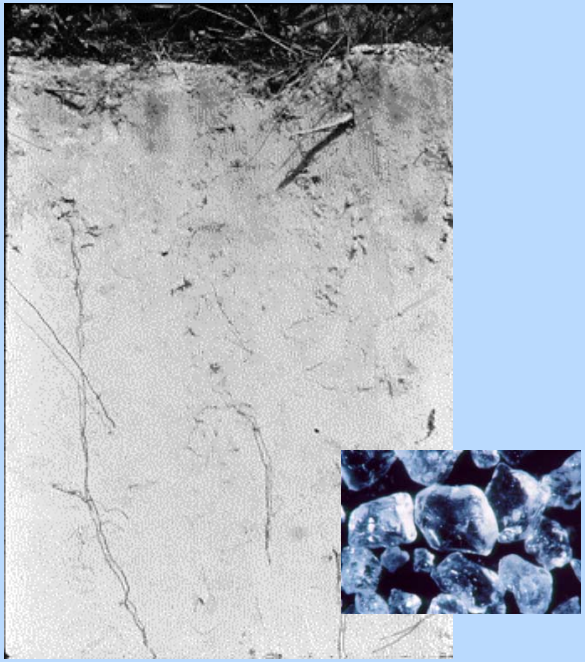
“Coated”

Candler, etc.

Has Fe & Al
Some P retention
Grains un-stripped

“Uncoated”

St. Lucie, etc.



No Fe & Al
No P retention
Grains stripped

“Uncoated”

Bh and Bt horizons as “hardpans”

Data that do NOT support presumptions of Bh being a “hardpan”

Means of selected data for Bh, Bh1, Bh2, and Bh3 horizons sampled during the Florida Soil Survey Program

	Saturated Hydraulic Conductivity cm/h	**Bulk Density** g/cm^{-3}	**Organic Carbon** %	**Clay %**
Non-Ortstein (vfr or fr)	**14.10** n=440	**1.50** n=440	**1.38** n=466	**3.50** n=466
Ortstein (vfi or fi)	**8.05** n=43	**1.51** n=42	**2.59** n=43	**5.71** n=43

Data that do NOT support presumptions of Bh being a “hardpan”

Bh horizon consistence & roots as described on OSDs of Alaquods of large extent

Myakka	**Very friable**	**Many fine & medium roots**
Leon	**Firm to friable**	**Many fine & medium roots**
Immokalee	**Friable to loose**	**Common fine & medium roots**
Wabasso	**friable**	**Common fine & medium roots**

Conclusions

- Soil survey data are a powerful resource in understanding soil genesis
- Sand grain coatings and their distribution are major clues to genesis of SE USA Coastal Plain soils
- Horizon designation precedes and remains independent of soil classification
- Words ill chosen can lead to misunderstanding (e.g., “hardpan”) and hamper communication (e.g., “uncoated”)