COLOUR PATTERNS AND FEATURES IN SUBSURFACE PROFILES

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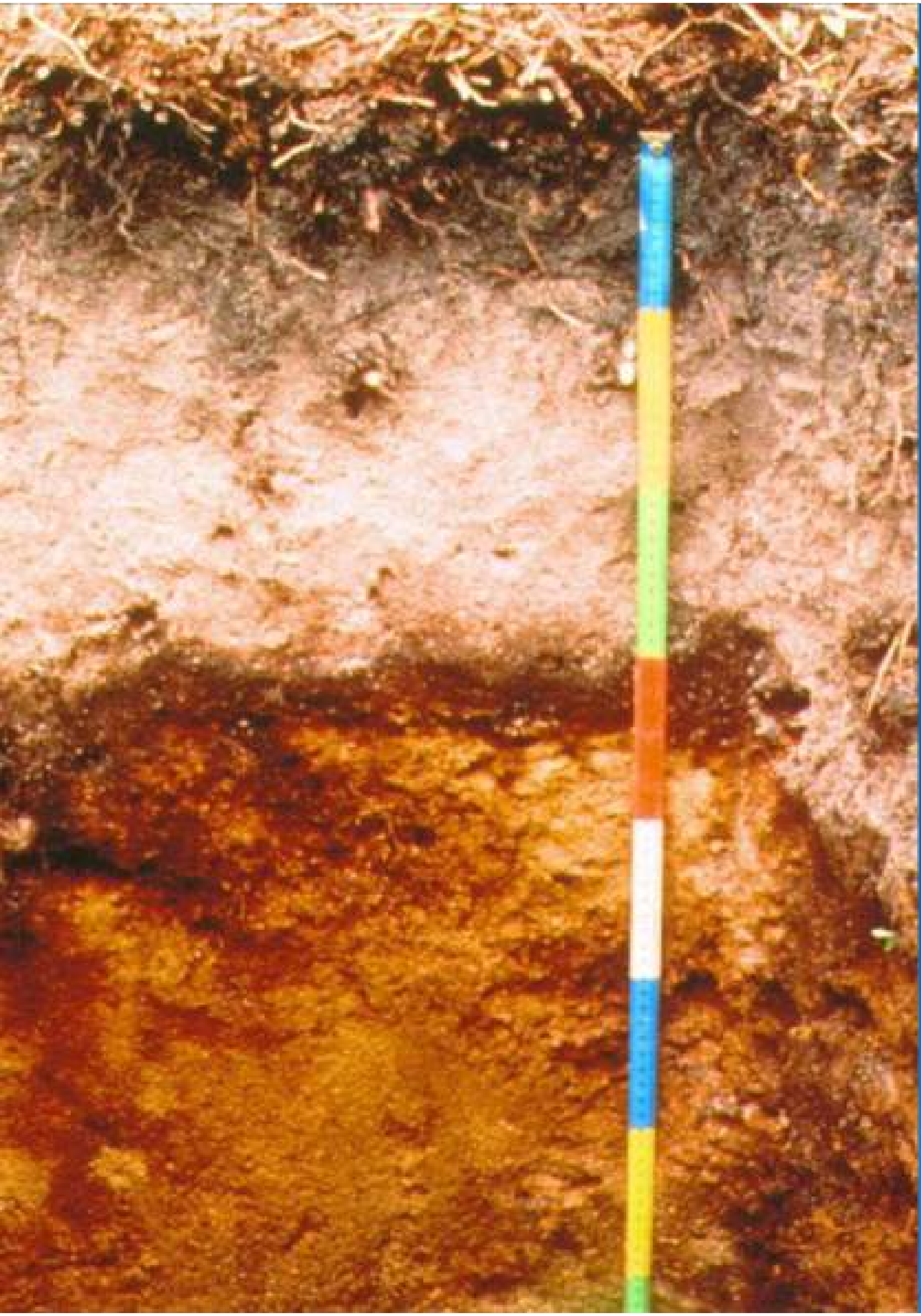
WHAT DO THEY MEAN?



Coniferous Vegetation

- Acidic
- Highly leached by organic acids
- Low fertility

Mixed Forest Vegetation

- In general more fertile
- In general less acidic
- No leaching

Glacio-fluvial Deposit

Note stratification, coarse to fine

Residual Material

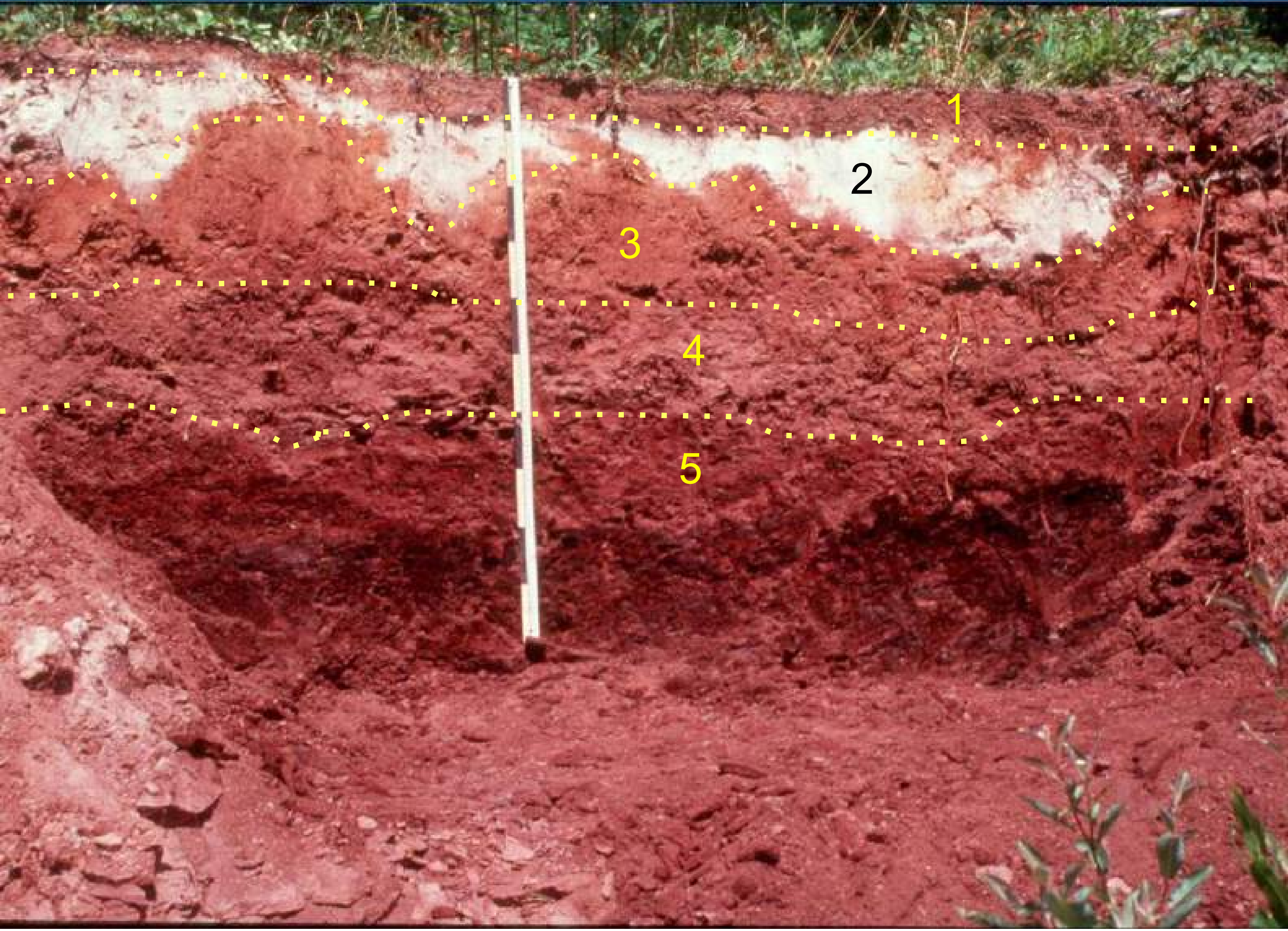
Rock becoming soil due to soil forming processes

Soil Drainage Classes

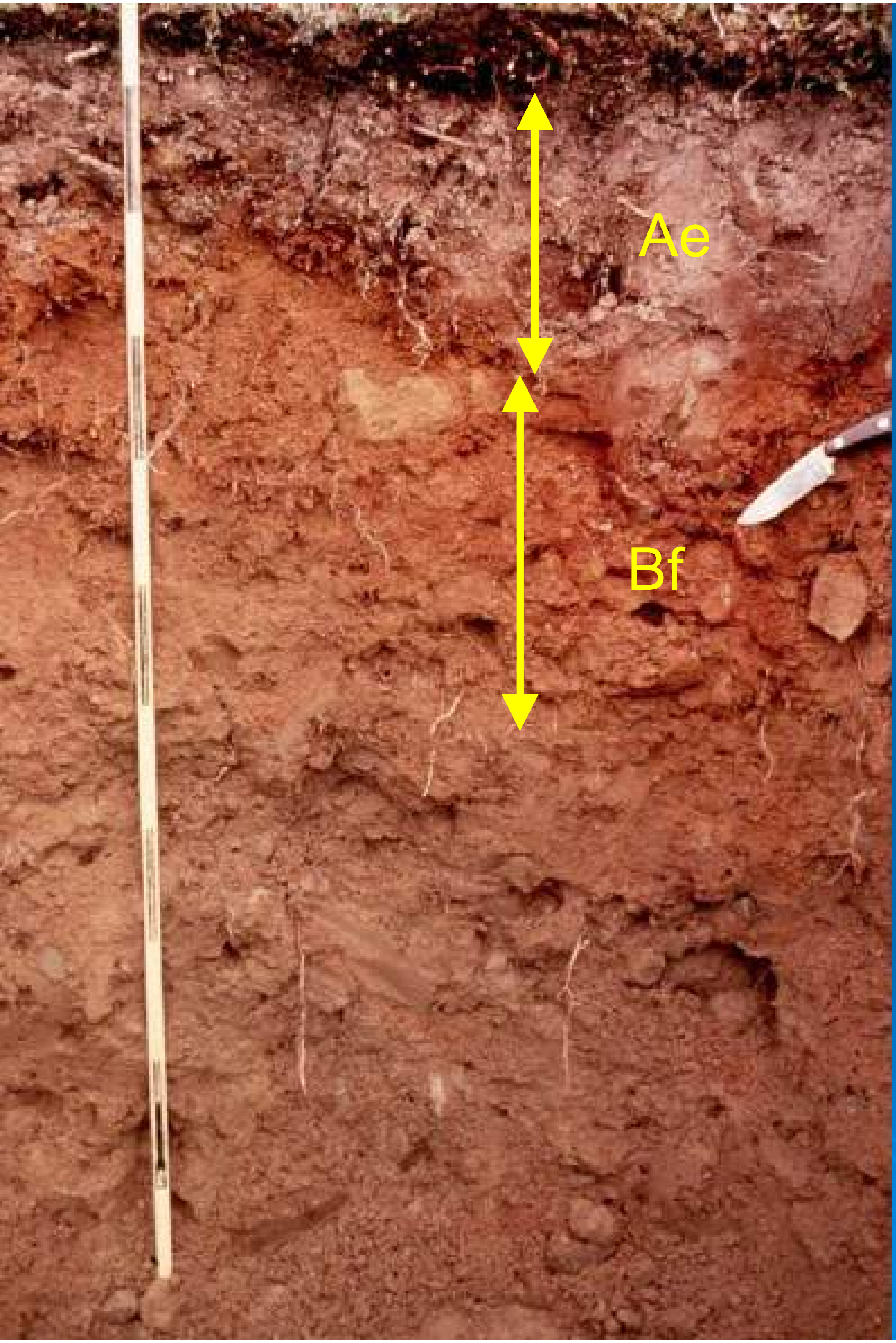
Name	Description
Rapidly drained	Soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions.
Well-drained	Soil moisture content does not normally exceed field capacity in any horizon except possibly the C horizon, for a significant part of the year.
Moderately well drained	Soil moisture in excess of field capacity remains for a small but significant period of the year.
Imperfectly drained	Soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year.
Poorly drained	Soil moisture in excess of field capacity remains in all horizons for a large part of the year.
Very poorly drained	Free water remains at or within 30 cm of the surface most of the year.

When drainage is good, soil horizons show bright colours and clear layering differences.

Scan 10



E horizon with a low chroma (< 2) matrix in a well drained soil



Forested site,
Non-compact till,
sandy loam,
Well drained,
permeable

Note gradual transition from B to C horizon
(roots are a clue)

- Forest floor over thick, ashy coloured Ae and orange-brown Bf horizons.
- Well drained
- 40-60 cm of coarse loamy ablation till over compact, clay loam basal till subsoil
- Slowly permeable subsoil
- Roots stop abruptly

Dull colours and mottles appear in poorly drained soils.

poor drainage = reduction = Fe^{2+} = grey

aerated pockets = oxidation = Fe^{3+} = orange

Why does this soil look like this?

Redox Reactions

- Most common reactions in saturated soils
- Redox reactions control
  - **Soil Colour**
  - **Organic matter contents**
  - **Soil water chemistry**

Redoximorphic Features

- Formed by changes in redox conditions in seasonally saturated soil
- Reduction and oxidation of C, Fe, Mn, and S compounds
- Translocation of C, Fe, Mn, and S compounds

In order to form Redox features:

- must have anaerobic conditions (reduced and saturated)
- must have Fe and/or Mn (electron acceptor)
- must have microbes (*bugs*)
- must have carbon (food for the bugs)

Effects of Reduction on Colour

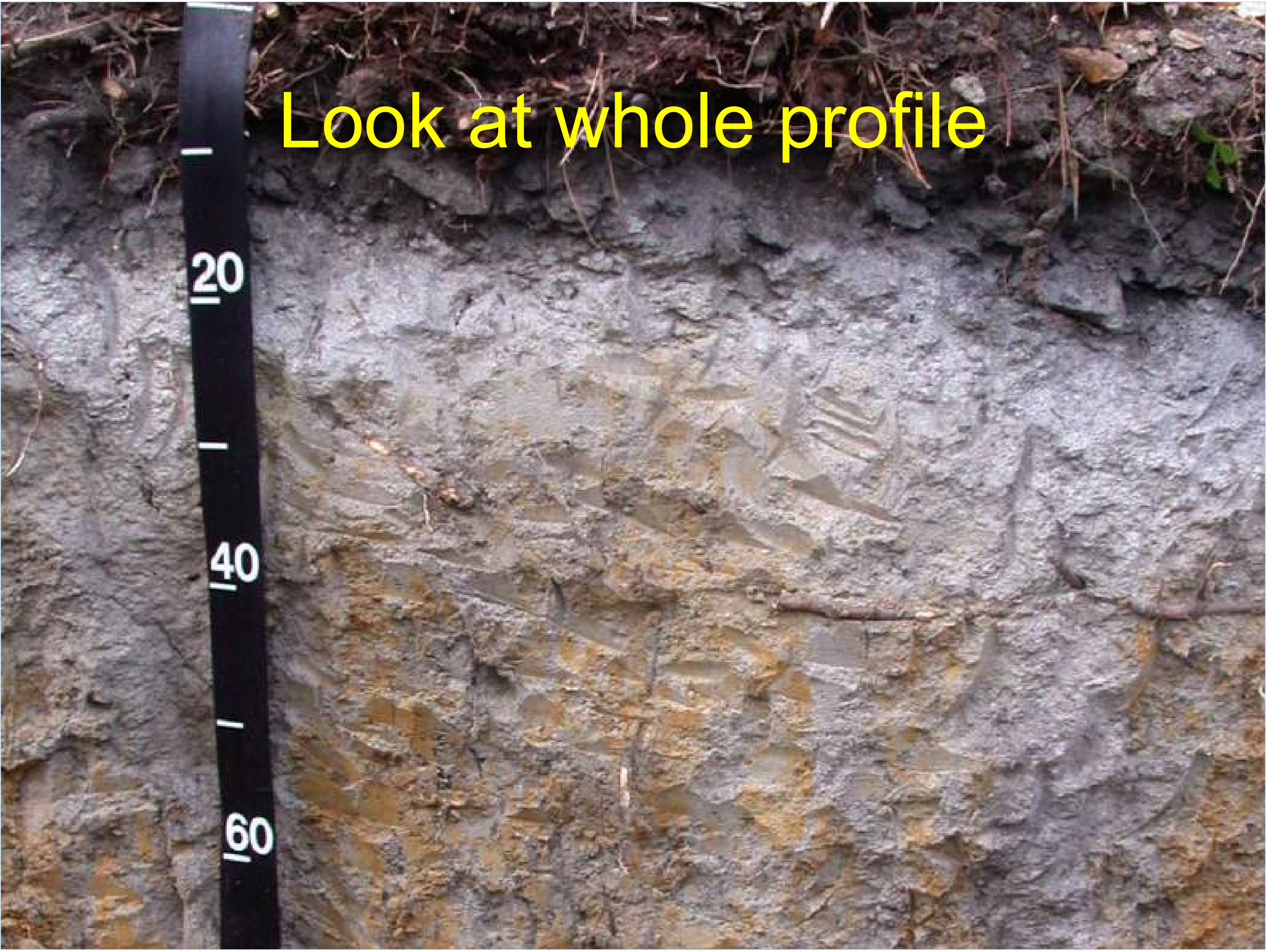
- Gray colors usually mean "no iron" on particle surface
- Sometimes gray colours mean there was never any iron present
- High (rust) and low (gray) colours are evidence of soil wetness (redox reactions)
- Soils with gray colours produced by reduction usually have some Fe concentrations within the profile

What to look for

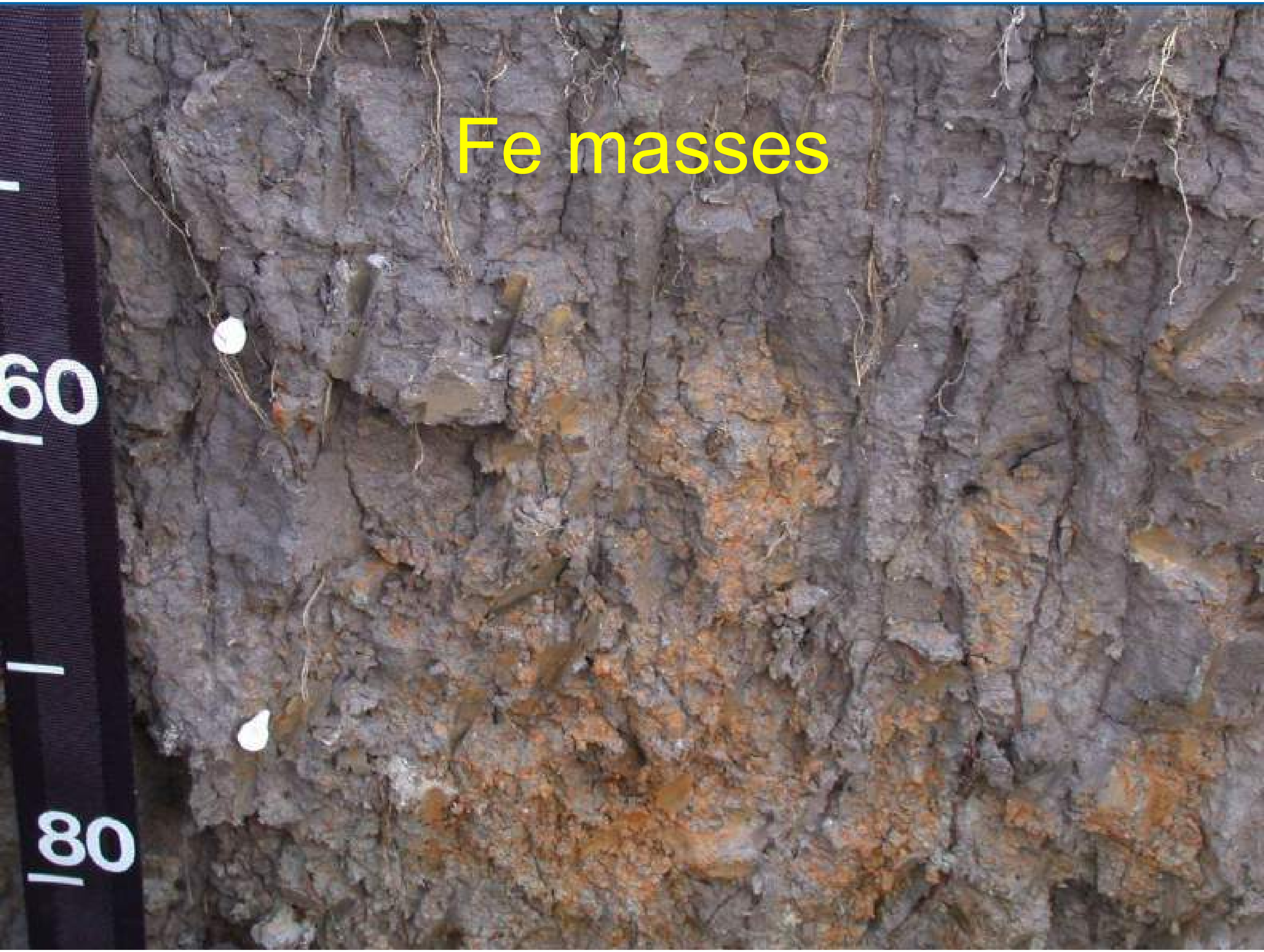
- Whole profile – must see evidence of redox chemistry
- Depletions in the A and E Horizons
- Concentrations in A and E Horizons


Redoximorphic features talking
I'm just feeling depleted today
Not now I'm concentrating
reddit


Reduction, oxidation and
translocation = saturation
40
60


Look at whole profile
20
40
60

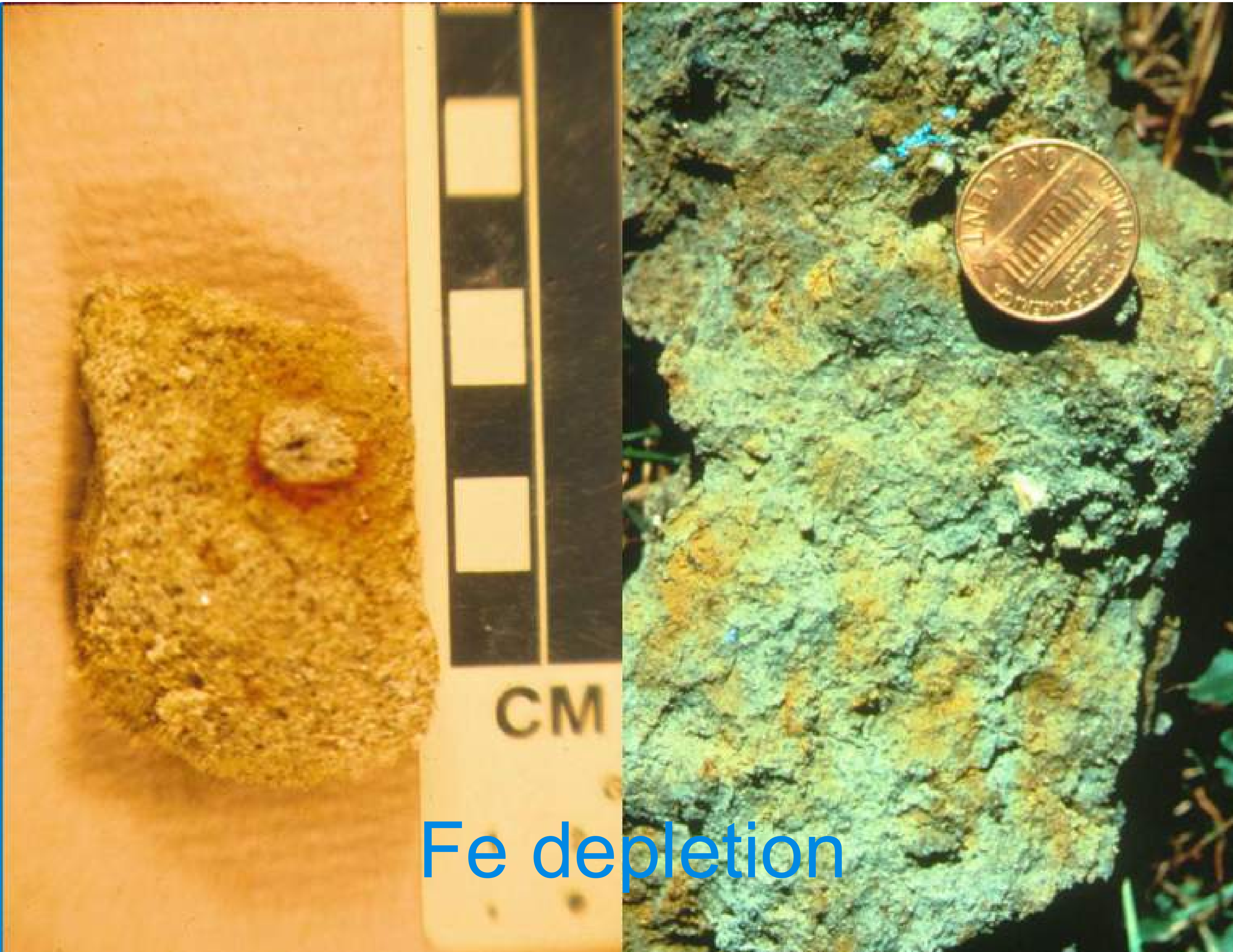

Concentration should relate to depletions somewhere in the profile
60
80


Fe masses
60
80

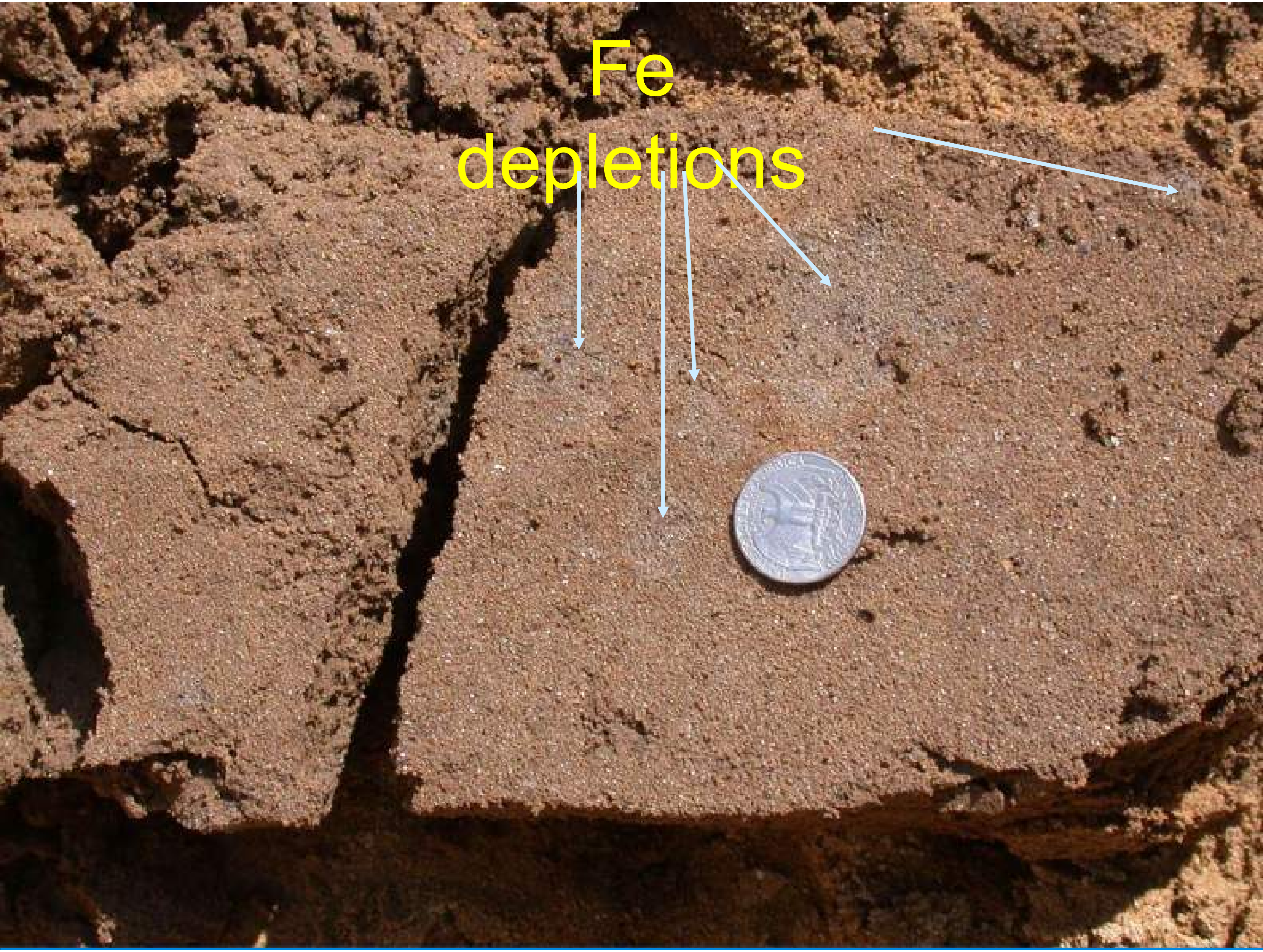

Fe pore linings

Redox depletions

Iron (Fe) depletions

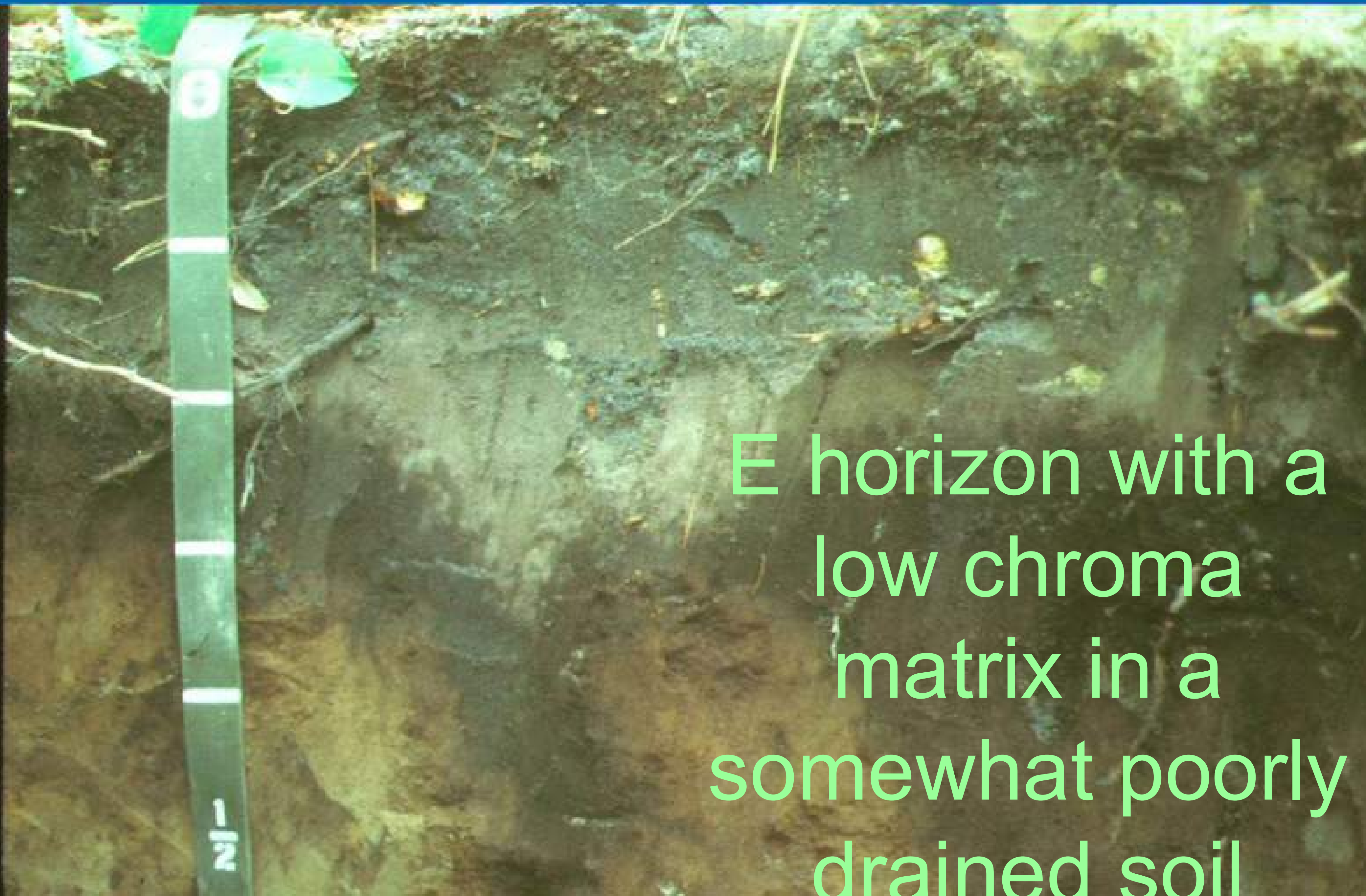


Fe depletion


Fe
depletions

Reduced matrix


Osier
20
40
60
80
Reduced matrix
“Black over gray, walk away…”



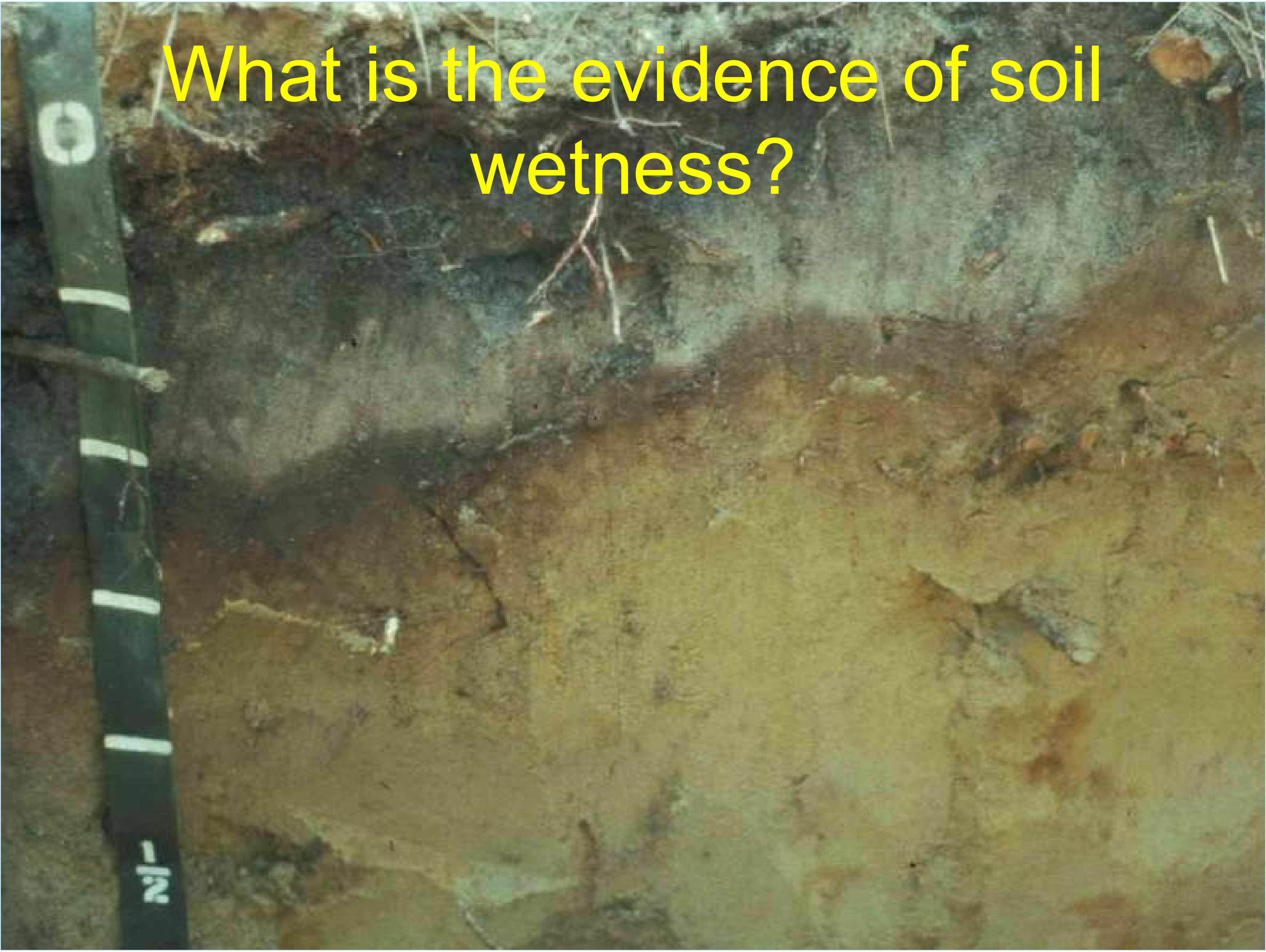
E horizon with a low chroma matrix in a somewhat poorly drained soil

Sandy soils may lack low chroma (< 2) colors

Even gray parent materials may show redox depletions and concentration


Red colors from parent material
hard to reduce

What is the evidence of soil wetness?



What is the evidence of soil saturation at this PEI site?

Fe-Mn soft mass

Concentrations as pore linings on ped faces and in root channels.

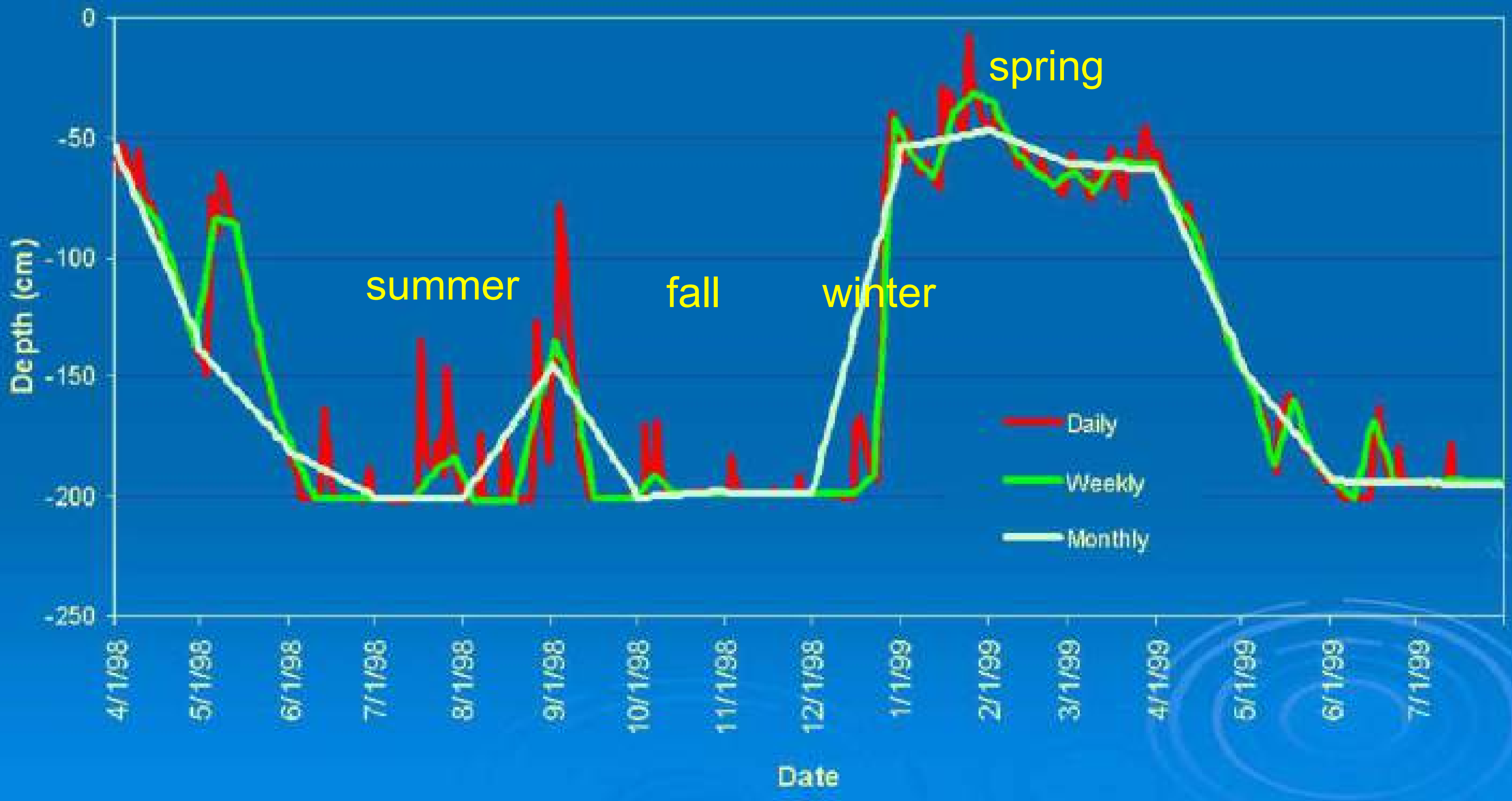

Upper part of the profile is depleted.
Reduction also has occurred along root channels below the depleted part of the profile.

Typical redox pattern of depletions and concentrations.

Look for evidence of redox reaction throughout the profile…


Depletions
related to roots

Where is the water table for design purposes?



SEASONAL FLOODING

Note “plow pan” - Platy structure,

Redox features

Note “plow pan” - Platy structure,

Redox features: Reduction and concentration of iron

Impermeable till, causing temporary flooding.

Prominent redox features.

Reduction and concentration of iron

Horizontal rooting

Indicates they cannot penetrate easily.

Compact subsoil

Imperfectly drained

- Soil is wet for a significant part of the growing season.
- Precipitation water moves slowly downward. Soils have a wide range in textures and depth.
- Imperfectly drained soil are commonly mottled in the B and C horizons.
- If present, the Ae may be mottled.

Poorly drained

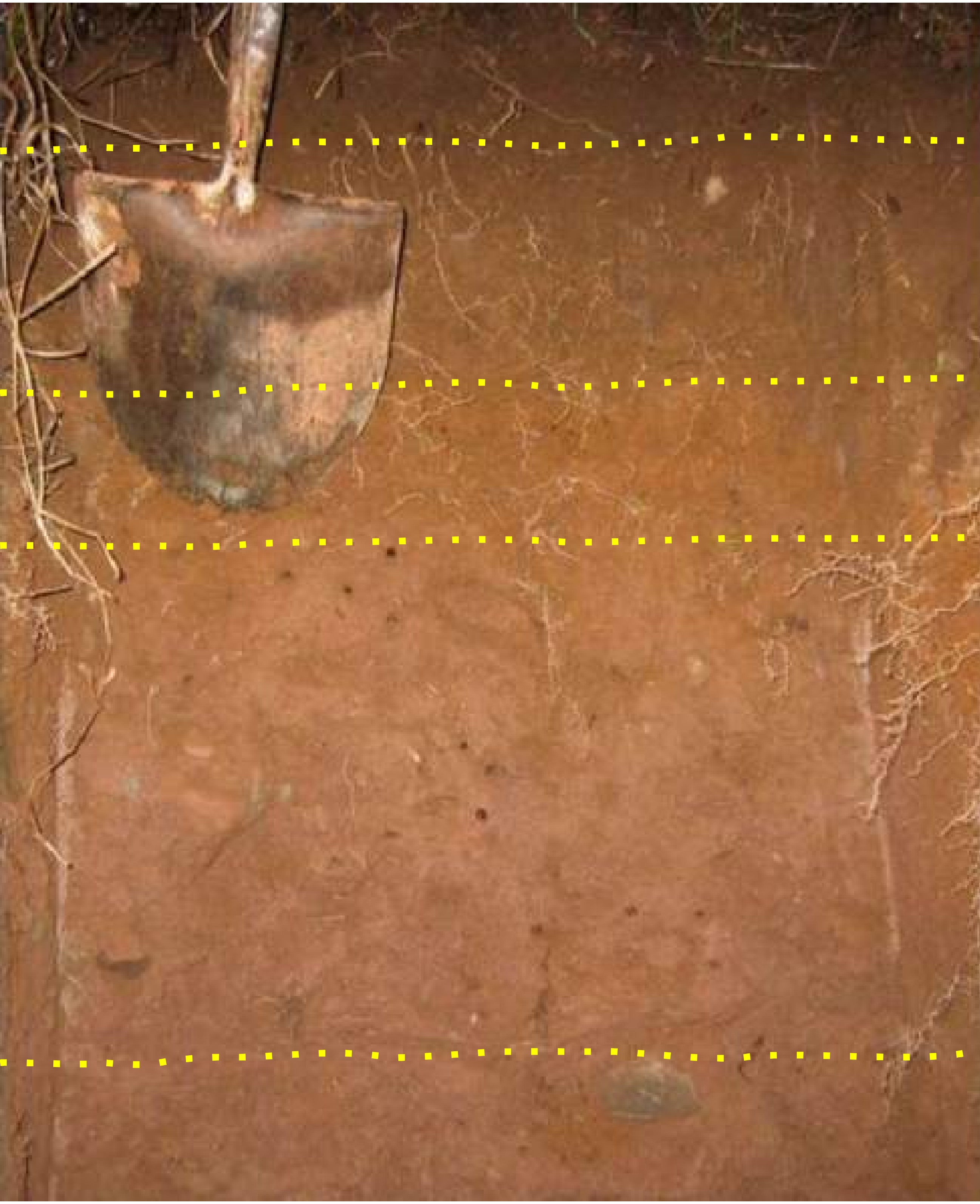
- Soil remains wet for a large part of the time that it is not frozen.
- Profiles are grey and strongly mottled in the top 40 cm.
- Groundwater, subsurface flow and precipitation are the major water sources; perched watertable may be present.
- Soils have a wide range of texture and depth.
- Increased thickness of forest floor.

Very Poorly Drained

- The watertable remains at or on the surface for the greater part of time the soil is not frozen.
- Profiles are grey and strongly mottled in the top 40 cm.
- Groundwater and subsurface water are the major water sources.
- Soils have a wide range in available water, texture, and depth.
- Increased thickness of forest floor.

- Tracadie soil type, found along east coast NB
- Grey or gleyed colours in upper profile, poorly drained
- Red coloured subsoil masks indications of poor drainage
- Clayey sediments, marine material
- Very slowly permeable subsoil

- NB Harcourt soil type
- Grey or gleyed colours throughout profile
- Poorly drained
- 30-40 cm of coarse loamy till over very dense, clay loam basal till subsoil
- Very slowly permeable subsoil



NB Queens Clay Loam

8 cm Rootmat

0-25 cm Loam

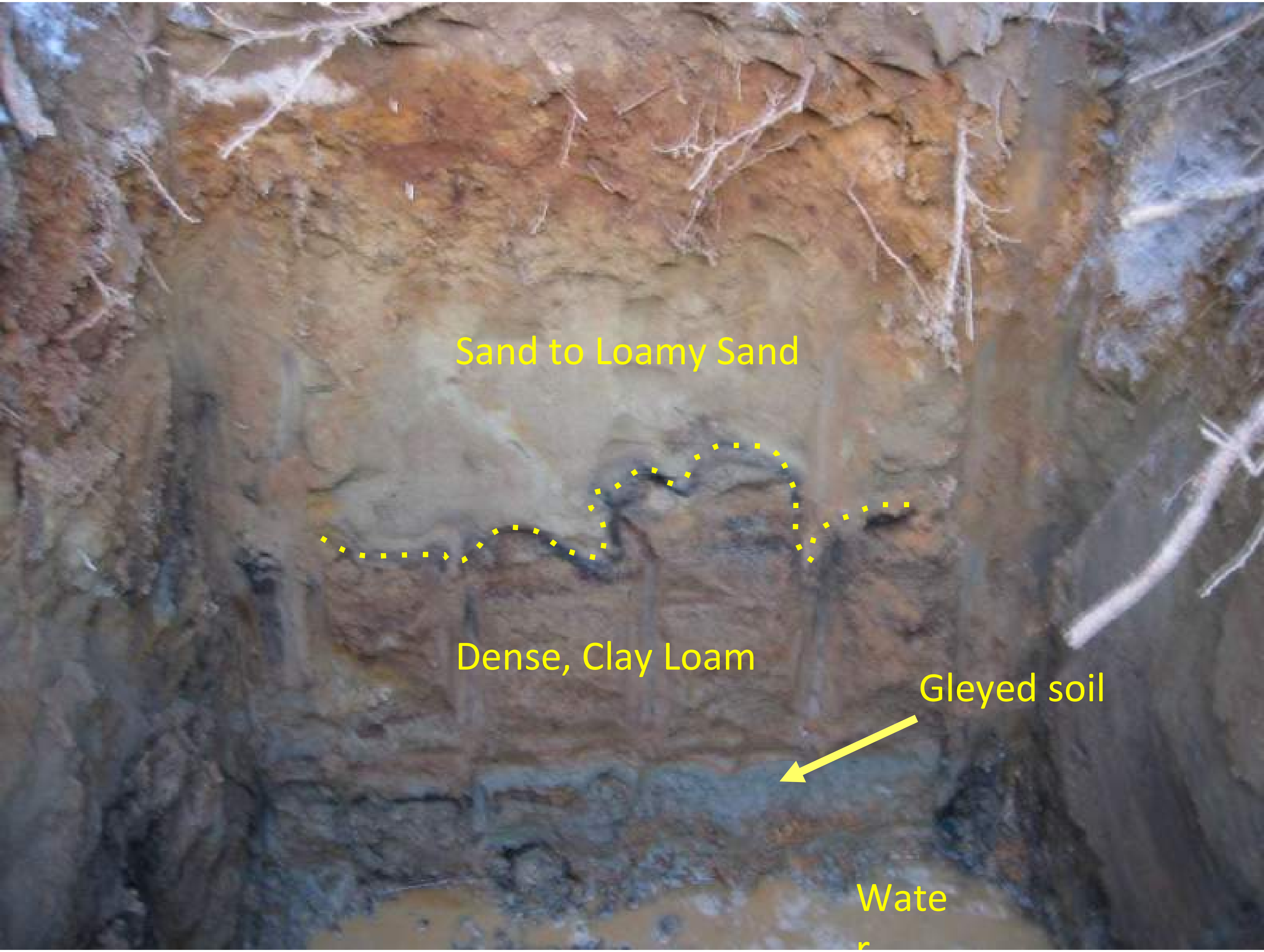
25-35 cm Sandy Loam
Strong, fine granular

35-75 cm Clay Loam
Weak to moderate
Blocky structure,
compact

75-170 cm Clay Loam
Weak to massive
Structure, dense

- NB Riverbank soil type
- Tabusintac area
- Rapidly drained
- 50-60 cm of coarse sandy loam over highly weathered, greyish green sandstone bedrock
- Groundwater table at 120 cm depth
- Fractured bedrock would provide little treatment for effluent


Sand to Loamy Sand
Dense, Clay Loam

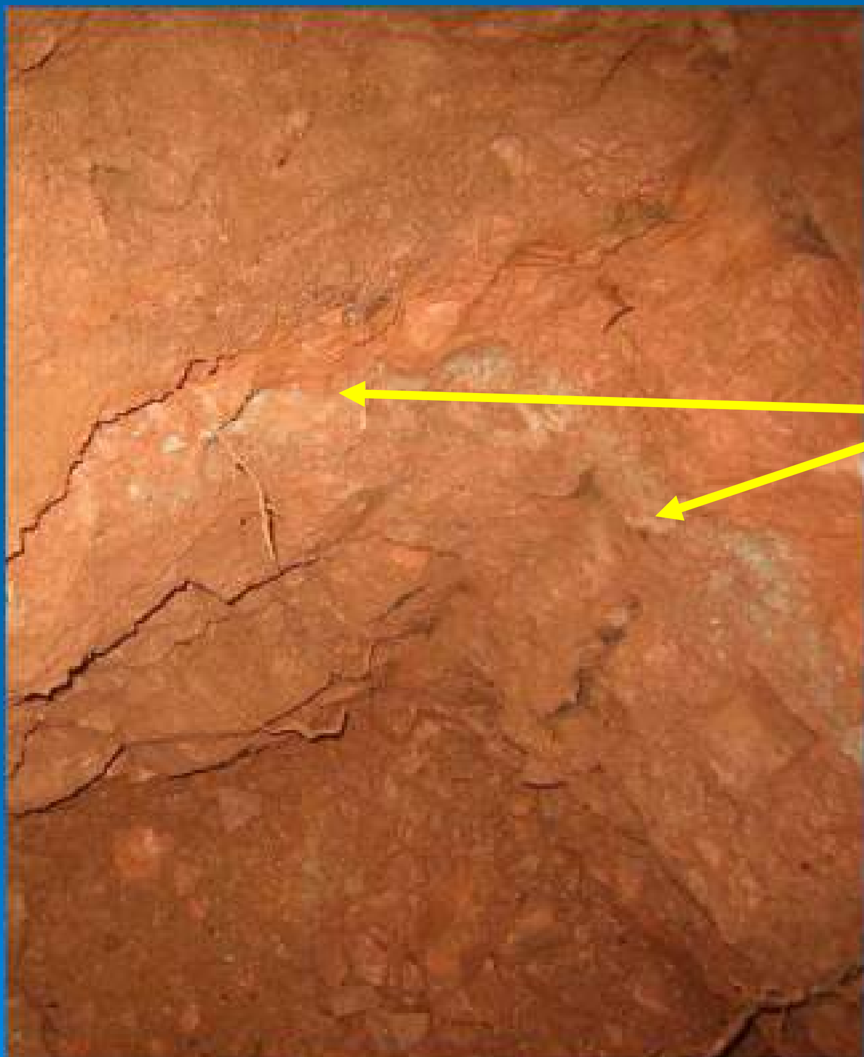

Sand to Loamy Sand
Dense, Clay Loam
Gleyed soil
Wate
r

These colour patterns are sometimes encountered in PEI

- Greyish green, friable, sandstone, black patches
- This layer was encountered just below a dry, silty/clayey layer.
- Just above layered fine grained sandstone

What does it mean?

It's not Redox…
It's Radioactive!



- Work by the GSC in PEI in 1968, revealed "*anomalous radioactivity in many of the greenish-grey phases of the redbeds*". Van de Poll (1983)
- 4-5 x background readings
- Uranium-Vanadium mineralization of the rock
- Highest readings "consistently found in association with greyish green reduction zones, within the redbeds along the base of fluvial channels overlying orange-red very fine grained sandstone and siltstone".

Mineralization Reduction Spheroids

- Can be observed in PEI sandstone and siltstone bedrock

- Dark core containing possible Uranium and/or Vanadium

Conclusions

1. Soil wetness or seasonal high water table is determined by the occurrence of dull < 2 chroma colors
2. < 2 chroma colors are formed by saturation and Fe-reduction, ***not*** by saturation alone
3. Soil color (< 2 chroma) may not always be an accurate indicator of the seasonal high water table

Conclusions

4. When morphology cannot be used, site monitoring (wells) or re-assessment during the spring of the year may be advised and should follow accepted guidelines.
5. The extent of the monitoring will depend on the reason the site is being monitored
6. Data interpretation is the most controversial aspect of site monitoring