

Mineral Hydric Soil Morphology

Part 1 of 2

Ch. 7 – Richardson & Vepraskas

Outline:

1. Redox Reactions and Associated Soil Conditions
2. Principal Types of Morphological Features in Hydric Soils



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1.A. Conditions Associated With Development of Hydric Soil Morphology

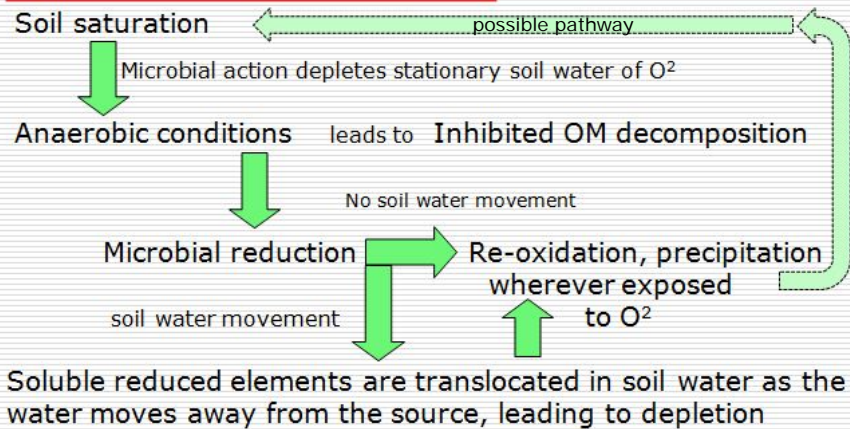
1. Saturation
2. Anaerobiosis
3. Inhibited OM Decomposition
4. Microbial Reduction
5. Translocation
6. Re-oxidation

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Development of Hydric Soil Morphology (Flowchart)



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1.A.2. Inundation and Soil Saturation

- Inundation – Covering the soil surface by water through flooding or ponding. Flooding and ponding frequency, depth, and duration are indicated on-site by evidence such as rack lines, broken tree limbs, and infrastructure damage, and high water marks (such as dirt left after floodwater recedes). This information is found posted on Web Soil Survey as part of the USDA-NRCS soil series databases.
- Soil Saturation – Filling all connected pores with water, bringing the water pressure (or suction) to zero

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Saturation Types

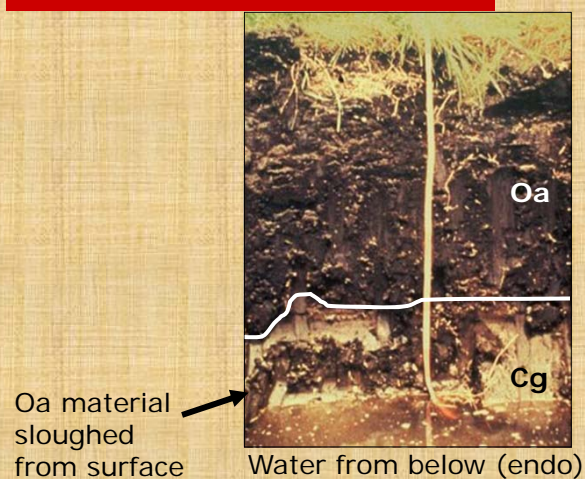
- Endosaturation – evidence of saturation by an apparent water table in all layers from the top of the uppermost saturated layer down to 2m or more
- Episaturation – evidence of saturation by an apparent water table in a part of the soil above an unsaturated horizon (perched or suspended water table)
- Anthric saturation – a special type of episaturation caused by puddling and agronomic flooding

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Endosaturation



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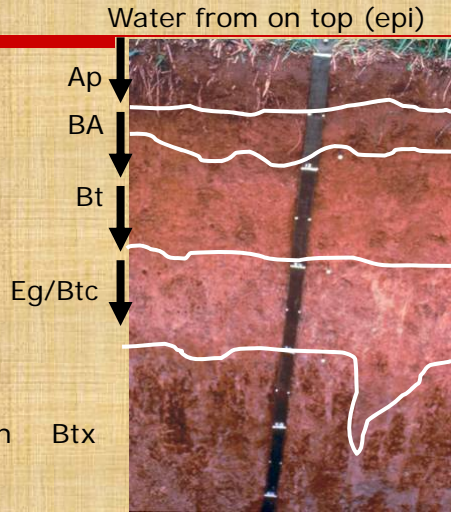
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Episaturation

This Eg/Btc horizon is seasonally episaturated from water perched on top of the fragipan

Fragipan = Perching Horizon Btx

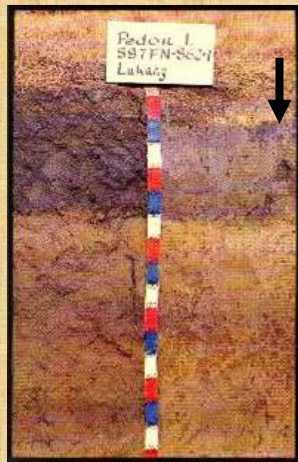


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Anthric Saturation



Saturation from puddling and controlled flooding.

This is a rice paddy soil from China

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1.A.5. Fate of Organic Matter Compounds

- In very sandy soils with pronounced reducing conditions, coatings of organic compounds disintegrate and become soluble, leaving zones of clean sand grains (not coated with OC, clays or oxides). When viewed as individual grains, most are clear, but when viewed as a mass of grains, they appear grayish, especially if some soil water fills the voids between the grains.
- The reduced, soluble organic compounds may be translocated or remain in place and re-oxidized to form new coatings or new precipitated compounds.

1.A.5. and 1.A.6. Fate of Reduced Mineral Elements

- When the elements discussed in this Chapter (O, N, Mn, Fe, S, C) become reduced, they become soluble or turn to gas.
- They may stay in place or they may be translocated in the soil solution.
- Whether translocated or not, when exposed to gaseous oxygen (O_2), they re-oxidize in place to form insoluble crystalline compounds (EX: Fe oxides).
- IF the soil becomes saturated again where the oxidized compounds occur, the process may begin again.

2. Principal Types of Morphological Features in Hydric Soils

A. Accumulation/depletion of OM (see Ch. 6 lectures)

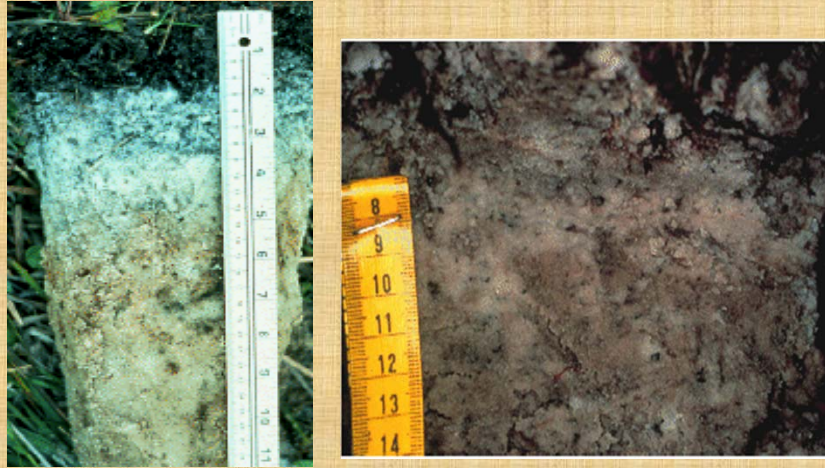
B. Redoximorphic Features

1. Depletions of C, Mn, Fe, clay in linings, coatings, or zones
2. Concentrations of Mn and Fe in soft masses, linings, coatings, or cemented forms

2.A. Accumulation/depletion of OM (Ch. 6)

- In addition to the morphology of accumulated organic matter and carbon compounds already discussed in Ch. 6, sandy hydric soils may also accumulate organic compounds in zones where they are translocated by a fluctuating water table and then re-oxidized or where they synthesized as new insoluble compounds such as *spodic materials* or *orstein*.
- Organic compound depletion is observed as the removal of disintegrated coatings of organic compounds on sand grains, leaving very light-colored zones in the soil.

Sandy Soils with Irregular Subsoil Patterns of Organic Carbon Compound Accumulations and Depletions

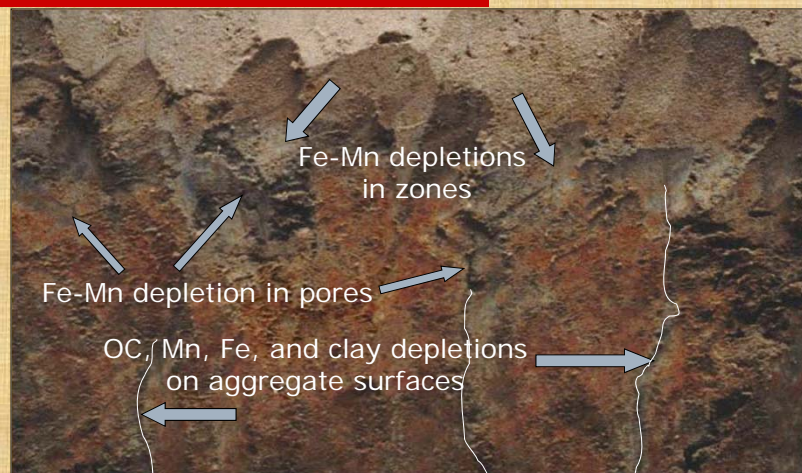


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2.B.1. Redox Depletion Types



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2.B.1. Redox Depletions (closeup)

- In this example, a depletion is lining an earthworm burrow. The slime from the earthworm was an easily digestible form of OC for microbes, and the burrow may have filled with water. Several depleted zones occur around aggregate surfaces and in the soil mass.



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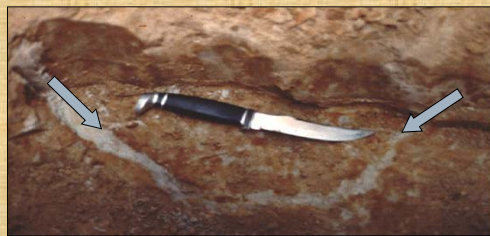
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2.B.1. Clay Depletions (closeup)

Also called "albans" (alba means white)

Following removal of the readily-available O, N, Mn, Fe, S, and C, the O, Mn and Fe inside of silicate clays are reduced and removed from the clay minerals, resulting in destruction and dissolution of the mineral structure, and then removal of the soluble weathering by-products



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2.B.2. Redox Concentration Types (Uncemented and Cemented)

Uncemented Forms

- ❑ Soft Masses well inside aggregates
- ❑ Soft Masses adjacent to ped surfaces, pores and root channels
- ❑ Linings inside pores or root channels
- ❑ Coatings on aggregate surfaces but not inside aggregates



Cemented Forms

- ❑ Nodules (next slide)
- ❑ Concretions (next slide)

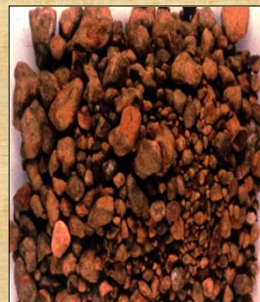
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2.B.2. Nodules and Concretions (closeup)

- ❑ Nodules and concretions are cemented by high concentrations of Mn/Fe oxides.
- ❑ Nodules do not have concentric rings inside, but concretions do.



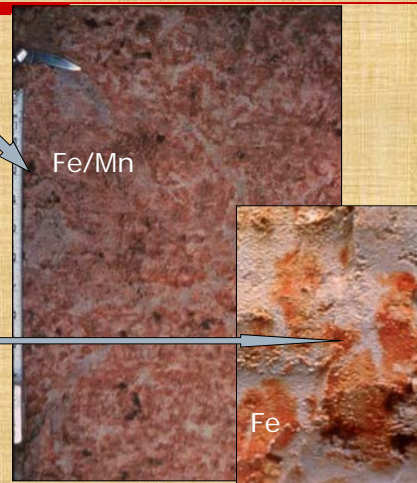
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2.B.2. Soft Masses (closeup)

- Variable in shape and color. Dark colors indicate increased Mn concentration.
- Adjacent to and higher chroma than the depletions.
- Often a higher chroma or value than the unmodified soil matrix.
- May surround pores or root channels or aggregate surfaces.



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2.B.2. Pore or Root Channel Linings (closeup)

- Precipitated Fe/Mn-oxides line the pore surface or the root channel but do not extend into the soil matrix.
- Note that this soil has reduced coatings on ped surfaces.



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