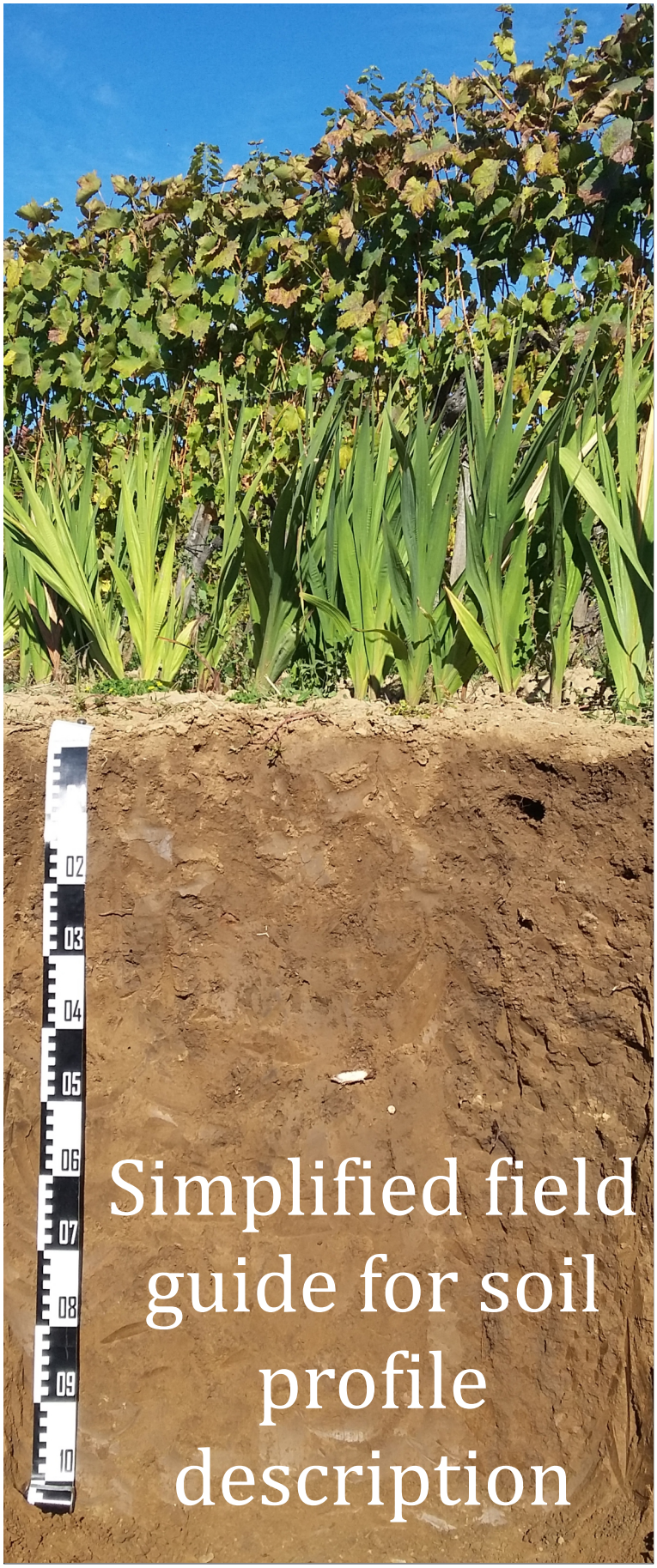

Simplified field guide for soil profile description

Introduction

Description of soil profile is the first step in understanding soil as a natural body and a way how to understand soil forming processes. Soil profile description in the field provides many information that can be further enriched by laboratory analysis.
An experienced soil scientist is able to describe the soil profile with many details and advanced findings. To be able do that, one needs an appropriate training and experiences. Undersdanding the soil is much more complicated for beginners, such as undergraduate or graduate students. The curriculum of theirs study program often does not allow to spend enough time for such a training. Therefore we have prepared a simplified version of the guide that can be used by students in field. This manual is not meant to replace the official guidelines such Guidelines for soil description published by FAO. This booklet serves as an introductory material for an understanding of the principles and procedures of soil description.

We hope this publication will attract more students to soil science and will help them to better understand one of the most important natural resources.

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Soil description

1. Horizon designation
2. Horizon boundary
3. Colour
4. Structure
5. Texture and rock fragments
6. Moisture and consistency
7. Concentrations, biological activity and neo-formations

Main diagnostic horizons, properties and materials

1. Diagnostic horizons
2. Diagnostic properties
3. Diagnostic materials

Soil horizons designation

Master horizons

H - horizons dominated by partially decomposed or undecomposed organic material saturated with water (peat)

O - surface layers or horizons dominated by partially decoposed organic material (litter)

A - mineral surface horizon enriched by humus substances

E - subsurface horizons with evidence of removal of substances such as clay, iron, aluminium.

B - subsurface horizons with evidences of pedogenesis such as removal of carbonates, illuvial concentrations, weathering and structure development

C - parent material without obvious signs of pedogenesis

R - hard bedrock

Subordinate characteristics

a - highly decomposed material (O, H only)

c - presence of concentrations or nodules

e - moderately decomposed material (O, H only)

g - stagnic conditions - horizons with distinct pattern of mottling of reduced and oxidized matrix

h - accumulation of organic matter (humus)

i - slightly decomposed material (O, H only)

i - presence of slickensides (A, B. C hor.)

k - presence of secondary carbonates

l - mottling caused by long term stagnation of groundwater. Interiors of peds are reduced

p - ploughing or other human disturbance (typical for A)

r - strong reduction; iron in reduced form

s - accumulation of sesquioxides

t - accumulation of silicate clay (clay coatings)

w - development of colour or structure (in B hor.)

Horizon transition

Distinctness

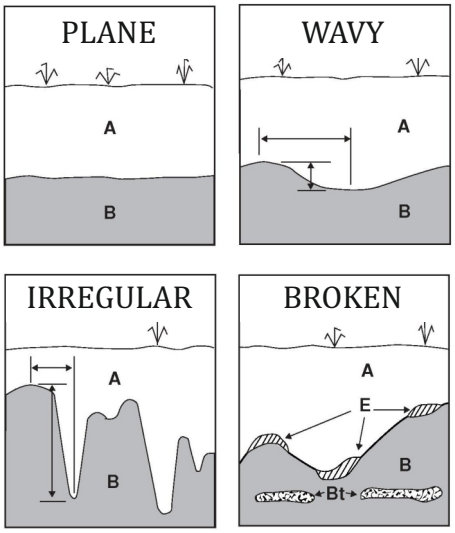
abrupt (< 2 cm)

clear (2-5 cm)

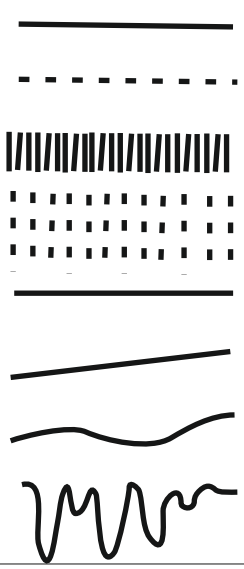
gradual (5- 15 cm)

difuse (5- 15 cm)

Topography



Graphical indication



abrupt (< 2 cm)

clear (2-5 cm)

gradual (5- 15 cm)

difuse (5- 15 cm)

nearly plane

skewed

wavy

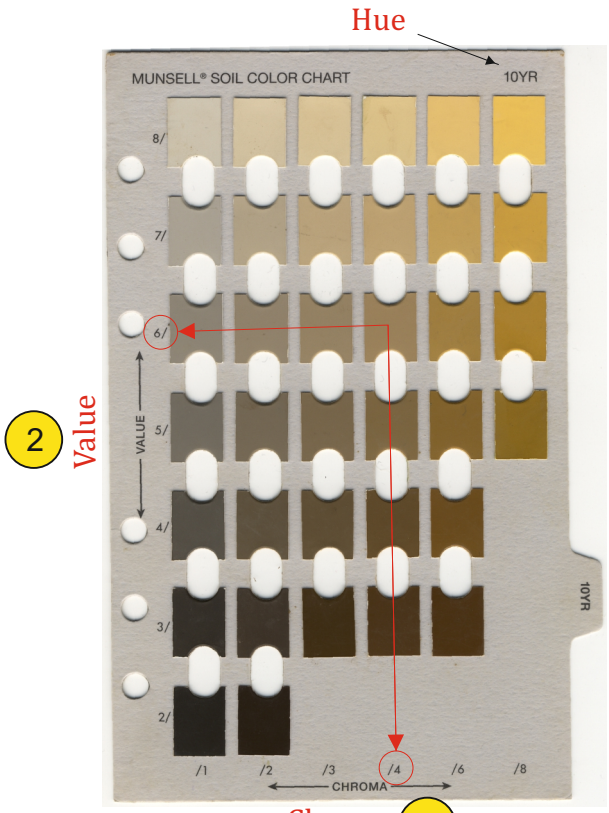
irregular

Soil colour

Colour of matrix

Soil colour is described using Munsell colour charts. The colour is describer at both moist and dry condition. The colour should be described at freshly broken clod of soil.

How to describe the colour: 1



10YR 6/4

Heterogeneity (mottling)

Mottles are spots of different colours or shades of colour interspersed with the dominant colour of the soil.

COLOUR

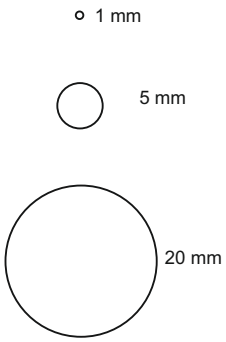
Colour
Munsell colour charts. Both of the colours are designed to the material.

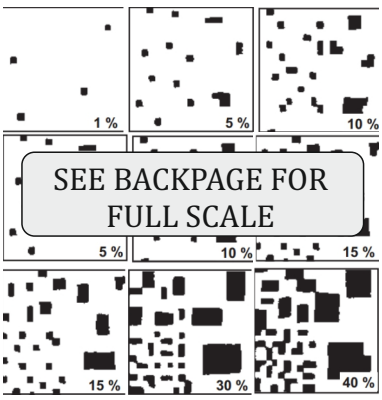
Abundance
Share of the two colours is indicated as an abundance of the minor colour:

<u>Classification of the abundance %</u>
F Few 1–5
C Common 5–15
M Many 15–40
A Abundant > 40

Size
Size of the mottles can be indicated as additional characteristic

<u>Classification of the size (mm)</u>
F Fine 1–5
M Medium 5–20
C Coarse > 20





SEE BACKPAGE FOR FULL SCALE

Soil structure

Soil structure refers to the natural organization of soil particles into discrete soil units (aggregates or peds). Soil structure is described in terms of **grade** and **shape (type)** of aggregates.

Grade of development

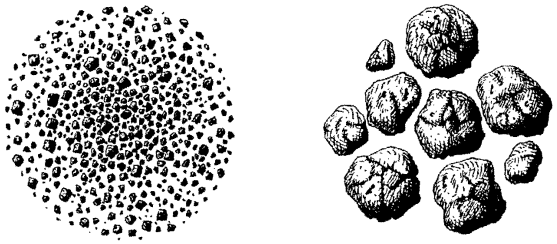
Non-developed - no aggregates: soil consists of single grains or soil is massive

Weak - aggregates are rare, most of the soil consist of single grains. The existing aggregates easily breaks when touched.

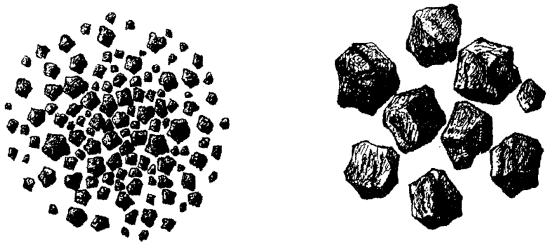
Moderate - little material without aggregation. When disturbed, it easily breaks apart into smaller aggregates

Strong - aggregates are clearly observable. Soil aggregates are stable, only breakable with force.

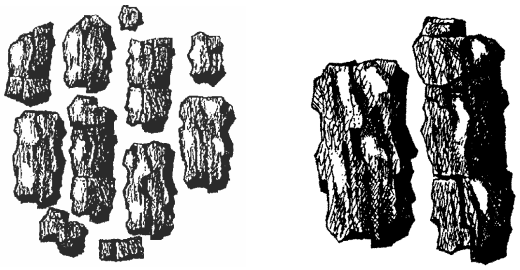
Shape of peds



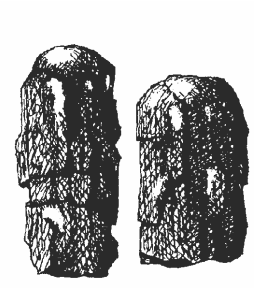
GRANULAR



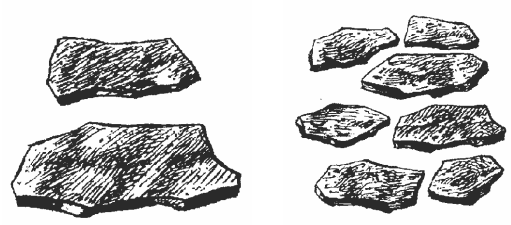
POLYHEDRIC(ANGULAR)



PRISMATIC



COLUMNAR



PLATY

Size of aggregates

Size (mm)	Granural/ platy	Prismatic/ columnar	Angular
Fine	**< 2**	**< 20**	**< 10**
Medium	**2 - 5**	**20 - 50**	**10 - 20**
Coarse	**> 5**	**> 50**	**> 20**

Texture and fragments

This section presents the procedure used for a description of soil texture and the nature of the primary rock and mineral fragments, which are subdivided into: 1) the fine earth fraction; and 2) the coarse fragments fraction.

Fine earth fractions

Soil texture refers to the proportion of three particle-size fractions: **sand** (0.05 mm - 2 mm), **silt** (0.002 - 0.05 mm)and **clay** (< 0.002 mm).

Soil texture classes

Soil texture classes are defined by proportion of the three soil particle fractions. The textural class can be estimated in the field by **simple field tests** and feeling the constituents of the soil (see next page).
The texture class identification in the field is just a rough estimate. A laboratory analysis serves as exact measurement procedure for soil classes definition.

Coarse fragments fraction

Large rock and mineral fragments (> 2 mm) are described according to abundance, size, shape and state of weathering.

Abundance	**(% by volume)**
None	0
Very few	0–2
Few	2–5
Common	5–15
Many	15–40
Abundant	40–80
Dominant	> 80

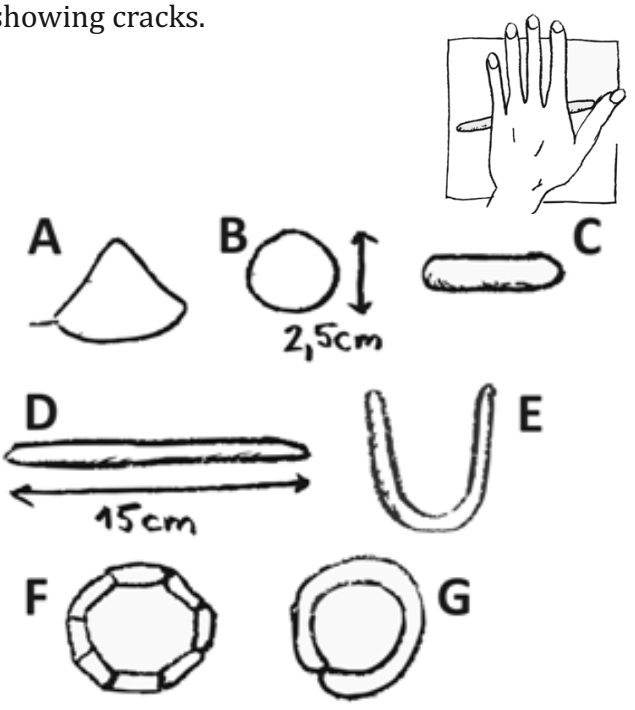
Size	**(mm)**
Fine gravel	2–6
Medium gravel	6–20
Coarse gravel	20–60
Stones	60–200
Boulders	200–600
Large boulders	> 600

Shape	
Flat	Subrounded
Angular	Rounded

Field texture assessment:

Place approximately 1/2 tablespoon of fine, dry earth in the palm of your hand. Drip water slowly onto the soil until it approaches sticky point (i.e. the point at which the soil just begins to stick to your hand). Next form a ball about 2.5 cm in diameter. The extent to which the moist soil can be shaped is indicative of its texture:

(A**) Sand** - Soil remains loose and single-grained; can only be heaped into a pyramid.
(B) **Loamy sand** - The soil contains sufficient silt and clay to become somewhat cohesive; can be shaped into a ball that easily falls apart.
(C) **Silt loam** - Same as for loamy sand but can be shaped by rolling into a short, thick cylinder.
(D) **Loam** - About equal sand, silt, and clay content means the soil can be rolled into a cylinder about 15 cm long that breaks when bent.
(E) **Clay loam** - As for loam, although soil can be bent into a U, but no further, without being broken.
(F) **Loamy clay** - Soil can be bent into a circle that shows cracks.
(G) **Clay** - Soil can be bent into a circle without showing cracks.



TEXTURE

Moisture and consistence

Soil-water status (moisture)

Soil-water status is the term used for the moisture condition of a horizon at the time the profile is described. The moisture status can be estimated in the field based on consistency status and changing colour when moistured.

Description:

very dry - dusty or hard, not possible to form a ball; soil seems warm

dry - no dusty; not possible to form a ball; not possible to form a ball; soil seems warm; gets very dark when moistened

moist - possible to form a ball, fingers moist and cool; no change of colour when moistened

wet - drops of water separate from soil

Consistence

refers to the degree of cohesion and adhesion of the soil mass.

when **(very) dry** we observe **friability** of the soil by breaking the soil mass between thumb and forefinger:
loose - not coherent
soft - soil breaks into single grains under very slight pressure; a knife can be easily pulled into the profile
slightly hard - easily broken between the two fingers
hard - can be broken by hand, not by fingers; it is hard to pull the knife into the soil profile
extremely hard - the soil can not be broken; the knife can not be pulled into the soil profile

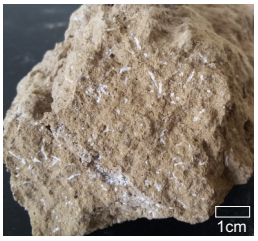
when **moist** we observe **plasticity** by rolling the soil
non-plastic - it is not possible to form a wire
plastic - it is possible form a wire (diameter approx. 10mm) , but it breaks when bend
very plastic - it is possible to form a wire of diameter 1 mm that not breaks when bend

when **wet** we observe **stickiness** by pressing the soil between thumb and forefinger:
non-sticky - after release of the pressure, the soil not adheres to the fingers
slightly sticky - soil adheres to both fingers but comes off rather cleanly
sticky - soil adheres to both fingers; a slight power is needed to get the fingers off
very sticky - soil adheres strongly on the fingers a significant effort is needed to separate the fingers

MOISTURE

Concentrations and neo-formations

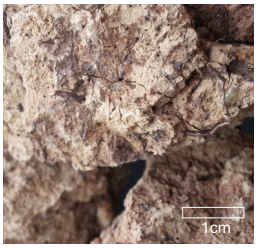
Carbonates concentrations



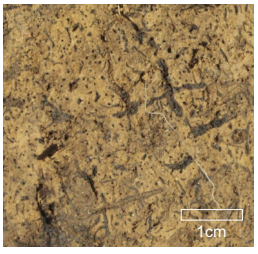
pseudomycelia - secondary $CaCO_3$ filling in pores

„dolls" - hard $CaCO_3$ concentrations found in loess material,

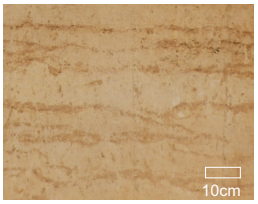
Clay concentrations



clay coatings (cutans)- formed by dispersal translocation of clay; Surface of coating is distinctly smoother or different in colour from the adjacent surface (inner part of aggregates).

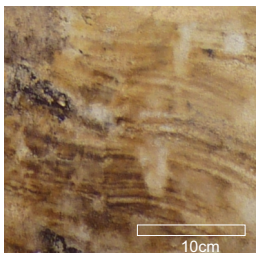


organo-clay coatings - clay coatings enriched by humus substances formed by dispersal translocation of the material



lamellae - lamellic arrangement of clay concentrations in sandy material with max. thickness 1-(2) cm.

Sesquioxides concentrations



sesquioxides coatings - rusty coloured coatings formed by translocation of iron and alluminium together with humus substances,

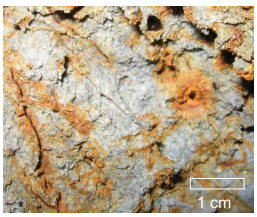
ortstein - hard, cemented sandy material by sesquioxides,

Neo-formation by water stagnation

1. Oxidation and accumulation:

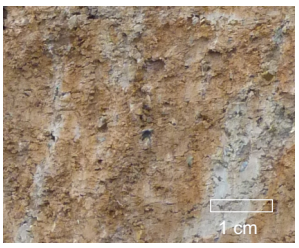
Mn coatings - dark shiny coating formed by manganese (and iron) oxides at surfaces of clods and cracks in places with periodic stagnation of (rain) water,

Fe - Mn concretions and nodules - more or less rounded rusty to black concentrations of iron and manganese oxides, often hard; formed under periodic stagnation of water in parts of profile with eluviation process



mottling - rusty coatings and concentrations in gray matrix preferentially formed at surfaces of clods and large pores; formed by periodic penetration of oxygen into the reduced matrix

2. Reduction

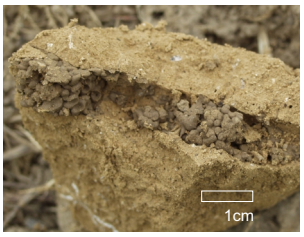


reduced and bleached surfaces and spots - continuous or broken grayish surfaces of peds are result of periodic stagnation of (surface) water in the profile;

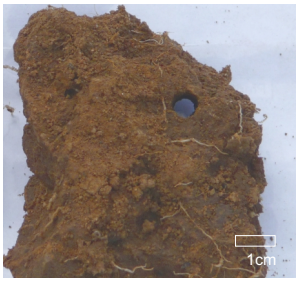
mottling - polygonal or net-like structure of reduced matrix surrounded by soil material with no reduction features; the reduced matrix is often influenced by leaching and removal of iron and clay

Biological activity

krotovinas - burrows of animals (mices, moles,...) that causes disturbanion of the soil profiles in both direction.



earthworm casts and channels - coprolites (earthworms excrements) and channels



root channels - channels originated by growth of larger roots

Shrink and swell features

slickensides - smoothly polished soil surfaces caused by frictional movement between material with different moisture due to presence of high proportion of swelling clays

wedge-shaped aggregates - typical in clay soils; originates by opening and closing of cracks due to swelling and shrinking of clay minerals. Visible only in dry period.

surface cracks - open and close due to shrinking and swelling of clay minerals with changing water content of the soil. ≥ 0.5 cm wide, when the soil is dry.

Main diagnostic horizons, properties and materials

The classification of soils is based on soil properties defined in terms of diagnostic horizons, diagnostic properties and diagnostic materials, which to the greatest extent possible should be measurable and observable in the field.

Short list of the most common diagnostic horizon, properties and materials that are typical for Central Europe soils is presented.

Listed diagnostic criteria are a shortened and simplified version of the World Reference Base for Soil resources and should serve as a tool to understand the procedure of soil classification.

Criteria connected by **„and**" have to be fulfilled all, at least one criterium should be fulfilled when connected by „**or**".

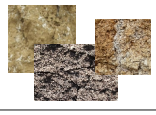
Icons interpretation

morphological criteria based on field observation

criteria based on simple chemical testing

criteria based on structure properties

criteria based on colour properties



criteria based on presence of concentrations and neo-phormations

Diagnostic horizons

HISTIC

surface or subsurface horizon that consist of **poorly aerated organic material**

DIAGNOSTIC CRITERIA:

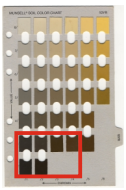
A) presence of accumulated organic debris (> 20 % by volume) **and**
B) saturation by water **and**
C) thickness >20 cm, **or** >10 cm if underlayed by continuous rock

MOLLIC

surface horizon is typical by well developed structure, **dark colour** and high or moderate humus content

DIAGNOSTIC CRITERIA:

A) well developed granular(subangular) structure **and**
B) Munsell value =<3 and chroma =<3 when moist **and**
C) base saturation >50% (pH > 5.5) **and**
D) thickness >25 cm

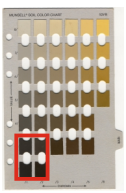


CHERNIC

surface horizon is typical by well developed structure, **very dark colour** and high humus content

DIAGNOSTIC CRITERIA:

A) well developed granular(subangular) structure **and**
B) Munsell value =<3 and chroma =<2 when moist **and**
C) base saturation >50% (pH > 5.5) **and**
D) thickness >25 cm

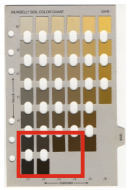


UMBRIC

surface horizon is deep, humus rich, **dark-coloured** horizon with base-depletion low base saturation

DIAGNOSTIC CRITERIA:

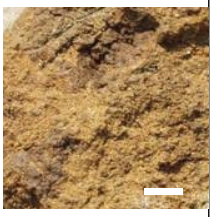
A) well developed granular(subangular) structure **and**
B) Munsell value =<3 when moist (5 when dry) **and**
C) thickness >25 cm **and**
D) base saturation <50% (pH < 5.5)



ARGIC

subsurface horizon with distinct **higher clay content** than in overlaying horizon

DIAGNOSTIC CRITERIA:



A) increased clay content (20%) **or**
B) clay coatings **and**
C) prismatic or angular structure

CALCIC

subsurface horizon with **secondary calcium carbonates** ($CaCO_3$)

DIAGNOSTIC CRITERIA:

A) presence of secondary carbonates (pseudomycelia,...) **and**
B) content of $CaCO_3$ > 15%

DIAGNOSTIC HORIZONS, PROPERTIES AND MATERIALS

CAMBIC

subsurface horizon showing **evidence of weathering**

DIAGNOSTIC CRITERIA:

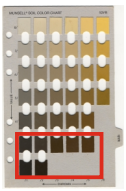
A) higher Munsell chroma and value than to lower laying horizon **and**

B) presence of structure more than 50% of volume is fine earth

SPODIC

subsurface horizon showing evidence of **illuviation of sesquioxides and humic substances**

DIAGNOSTIC CRITERIA:



A) low pH (<5.9) **and**

B) colour:

hue 5YR or redder, or

hue 7.5YR with value =< 5/chroma =<4 or

hue 10YR with value =< 2/chroma =<2 or

hue 7.5YR with value 5 /chroma 5-6 **and**

C) coated sand grains or ortstein

VERTIC

clayey subsurface horizon with **evidence of shrinking and sweling** (slickensides, wedge-shaped peds, crackings)

DIAGNOSTIC CRITERIA:

A) high clay content (>30%) **and**

B) slickensides **and**

C) wedge-shaped peds **and**

D) suface cracks (when dry)

Diagnostic properties

GLEYIC properties

is given by majority of the **soil mass that is reduced** due to stagnation of groundwater

DIAGNOSTIC CRITERIA:

A) reductimorphic grey colour (Munsell N1-N8) or bluish to greenish colour (Munsell 2.5Y, 5Y, 5G, 5B) in >90% of soil mass **and**

B) complementary contrasting oximorphic features around macropores)

STAGNIC properties is given by **periodic water stagnation**

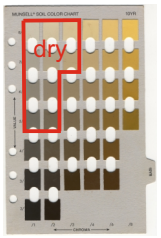
DIAGNOSTIC CRITERIA:

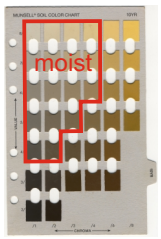
A) colour mottling with lighter colour at ped surfaces (cracks, root channels) and more reddish colour in ped interiors

Diagnostic materials

ALBIC

material is characterized by **light colour** due to clay or iron oxides removal





DIAGNOSTIC CRITERIA:

A) Munsell colour (dry)
Value 7 or 8 and Chroma =< 3 *or*
Value 5 or 6 and Chroma =< 2 **or**
B) Munsell colour (moist)
Value 6,7 or 8 and Chroma =< 4 *or*
Value 5 and Chroma =< 3 *or*
Value 4 and Chroma =< 2 **and**
B) thickness > 1 cm

FLUVIC

material consists of fresh **sediment** of fluvial, lacustrine or maritine origin

DIAGNOSTIC CRITERIA:

A) stratification of the material (layers with different soil texture and skeleton content) **and**
B) inregular distribution of organic matter troughout profile

Chart for estimation of proportion of coarse fragments and colour mottles

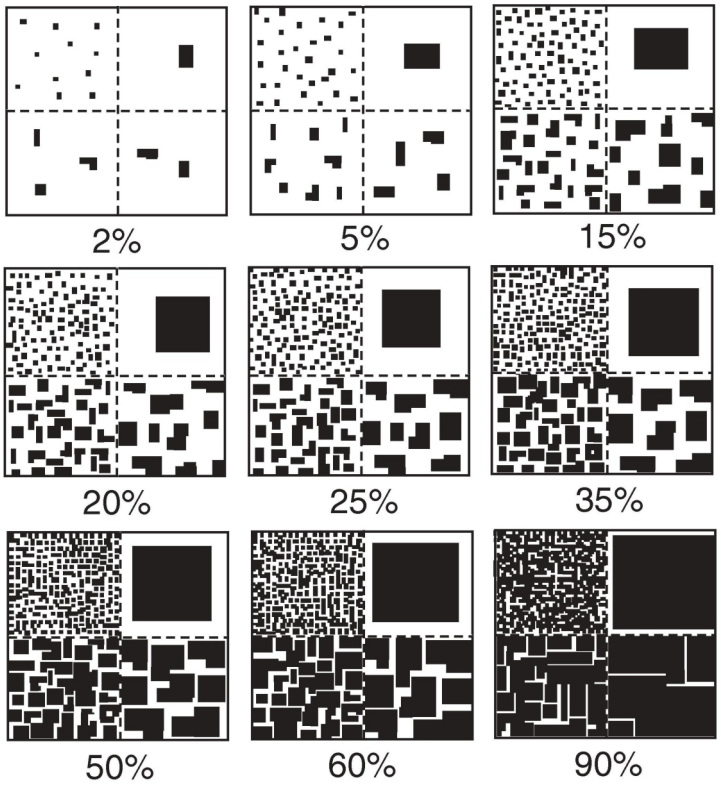
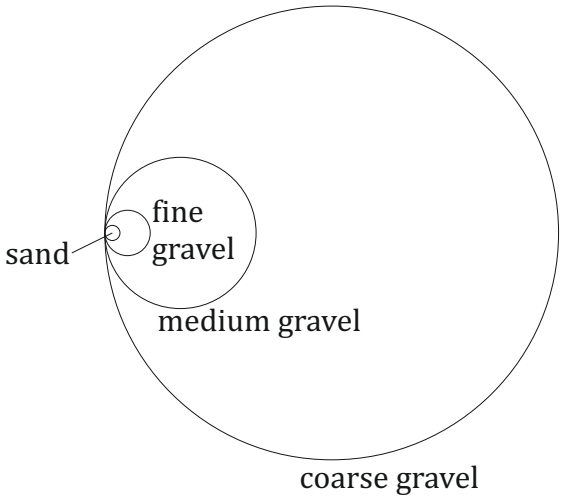


Chart for fragments size



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