Soil profile description

Tuesday May 29, spring school 2018

ISRIC World Soil Information

Johan Leenaars, Thomas Caspari

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- Soil classes are carriers of, a set of, morphologic and analytic soil properties and associated land qualities. Mapping of soil classes permits to reduce the number and costs of soil analytical measurements needed to map soil analytical properties.

Soil profile description - classification

Alti-tude	Slope (%)	Color	Consis-tency wet/dry	Texture	Soil depth	Soil water	Soil ferti-lity	Work-ability	Local class
3550	36	~	NST/LO	L-low BD	0	+	0	0	Yeguasa
2300	24	~	NST/HA	CL-stony	-	--	-	-	Chincha
2200	19	White	NST/SO	L	-	-	-	0	Borebor
2150	10	Red	SST/SHA	C	0	0	0	+	Keyattie
1950	4	Black	VST/VHA	HC	+	+	+	-	Walka
1800	4	Black	SST/SHA	CL	+	0	+	+	Deshen

Kehali Jembere, Tekalign Mamo and Kibebew Kibret, 2017

Soil profile description - classification

Alti-tude	Slope (%)	Color	Consis-tency wet/dry	Texture	Soil depth	Soil water	Soil ferti-lity	Work-ability	Local class	WRB
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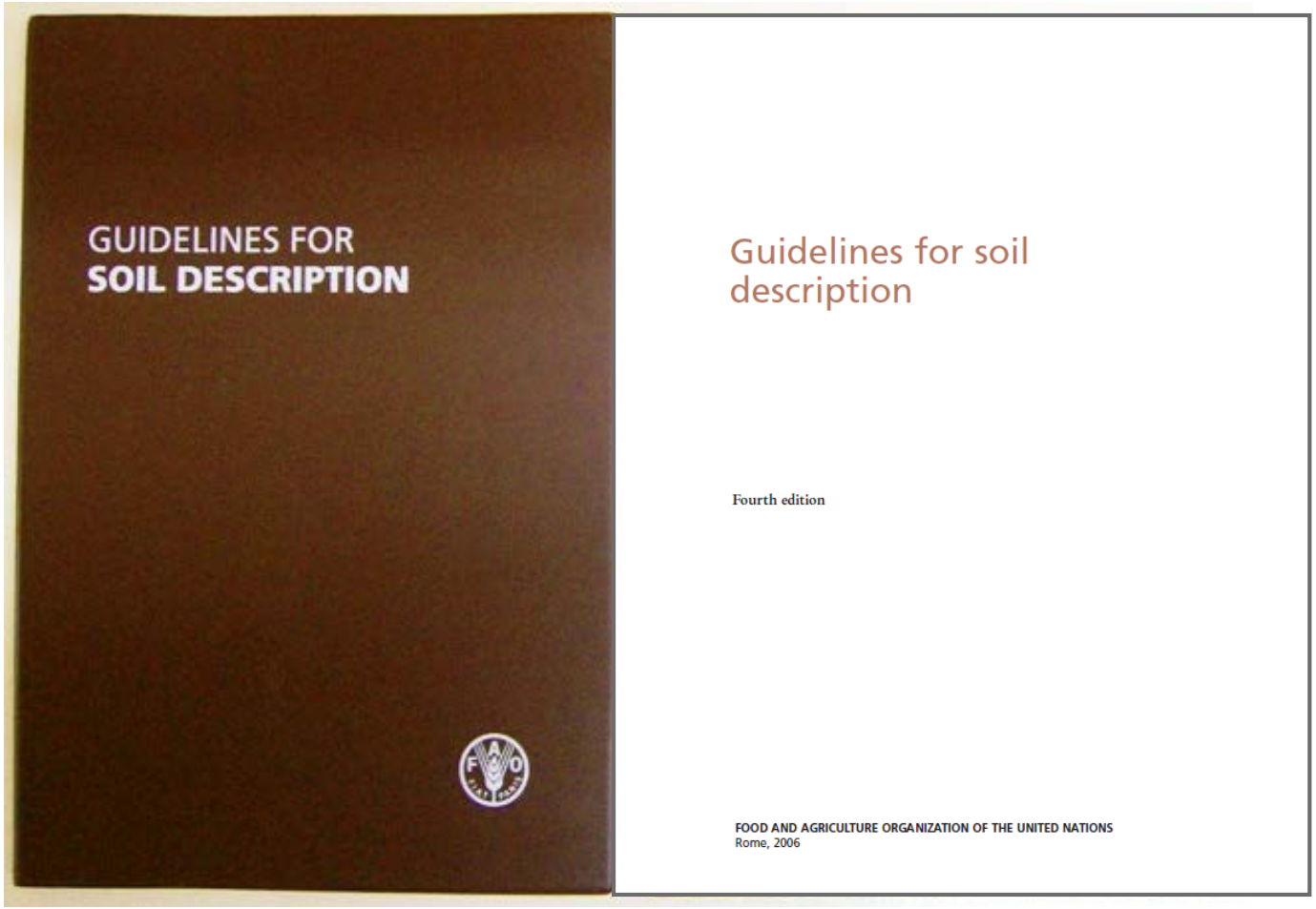
2300	24	~	NST/HA	CL-stony	-	--	-	-	Chincha	LP
2200	19	White	NST/SO	L	-	-	-	0	Borebor	CM
2150	10	Red	SST/SHA	C	0	0	0	+	Keyattie	LV
1950	4	Black	VST/VHA	HC	+	+	+	-	Walka	VR
1800	4	Black	SST/SHA	CL	+	0	+	+	Deshen	FL

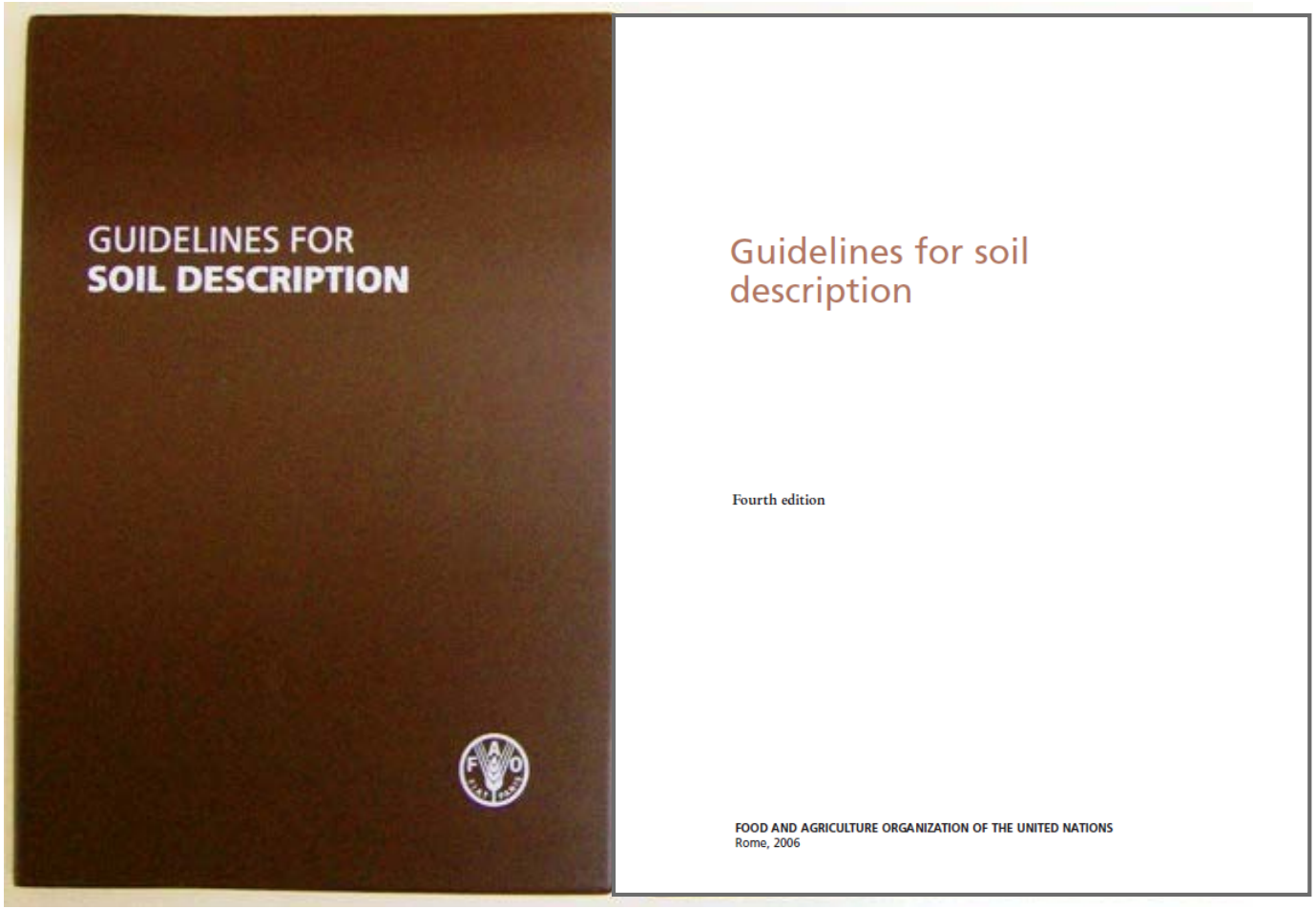
Soil profile description (FAO, 2006)



FAO2006_GuidelinesForSoilDescription_a0541e00.pdf

Soil profile description (FAO, 2006)

(international standard)



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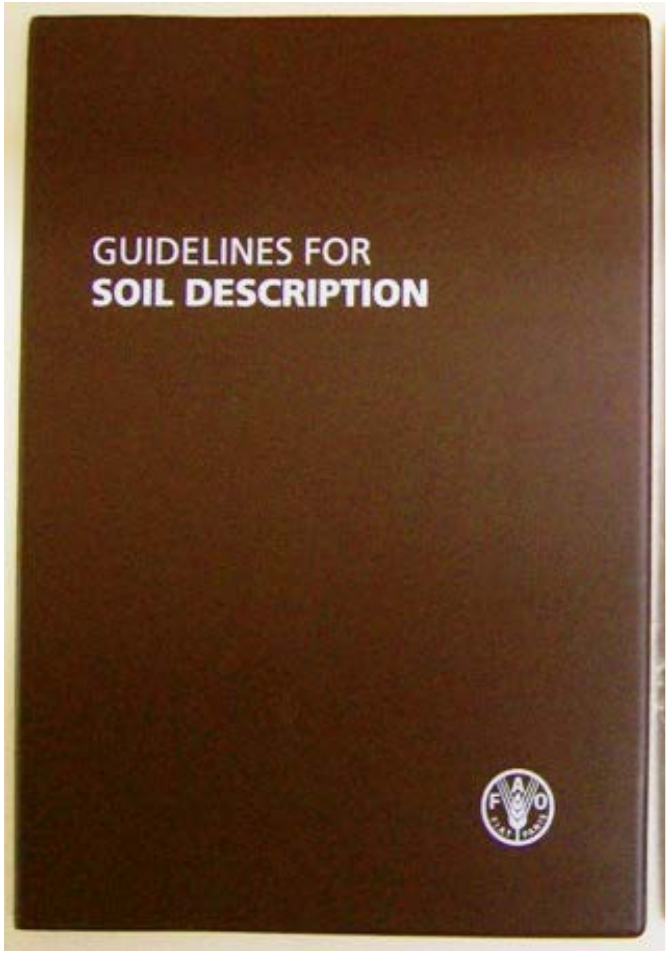


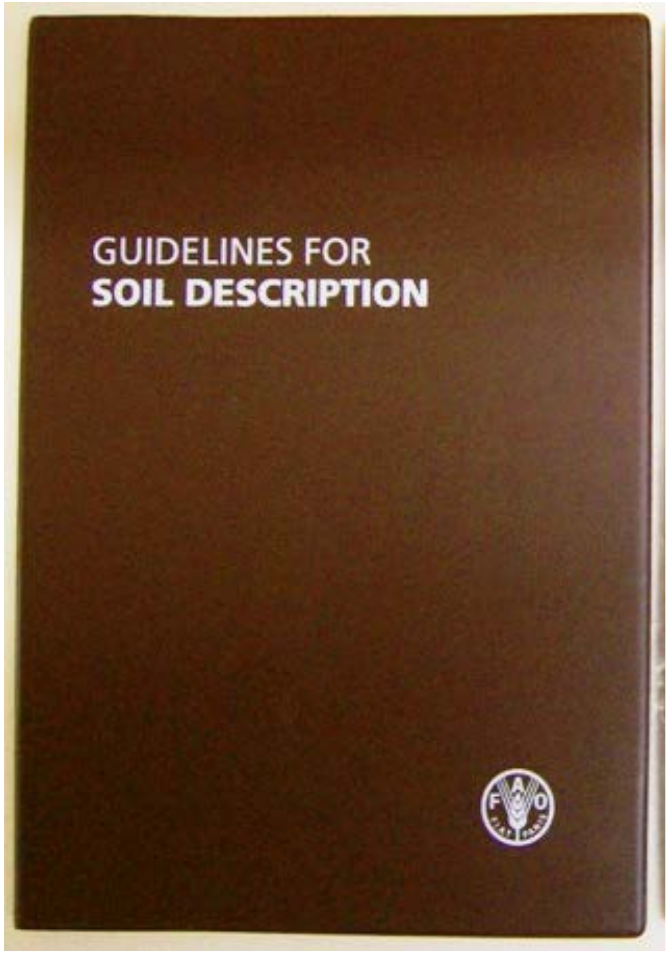
Soil observations & measurements:

- object: x, y, z, t
- property
- method
- value (incl. units or dictionary)

to be made and recorded according to the standards defined by the guidelines.

Soil profile description (FAO, 2006)

(international standard)



Soil observations & measurements:

- object: x, y, z, t
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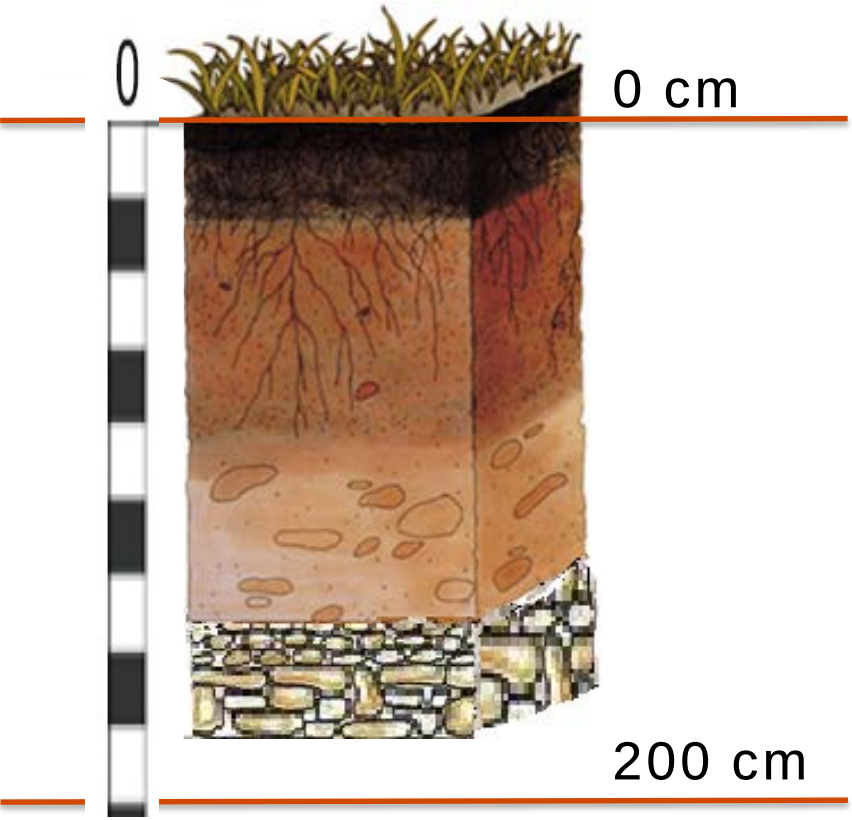
to be made and recorded according to the standards defined by the guidelines & classified according to WRB (IUSS, 2015).

Soil profile description (FAO, 2006)

(international standard)



Soil observations & measurements:

- object: x, y, **z**, t
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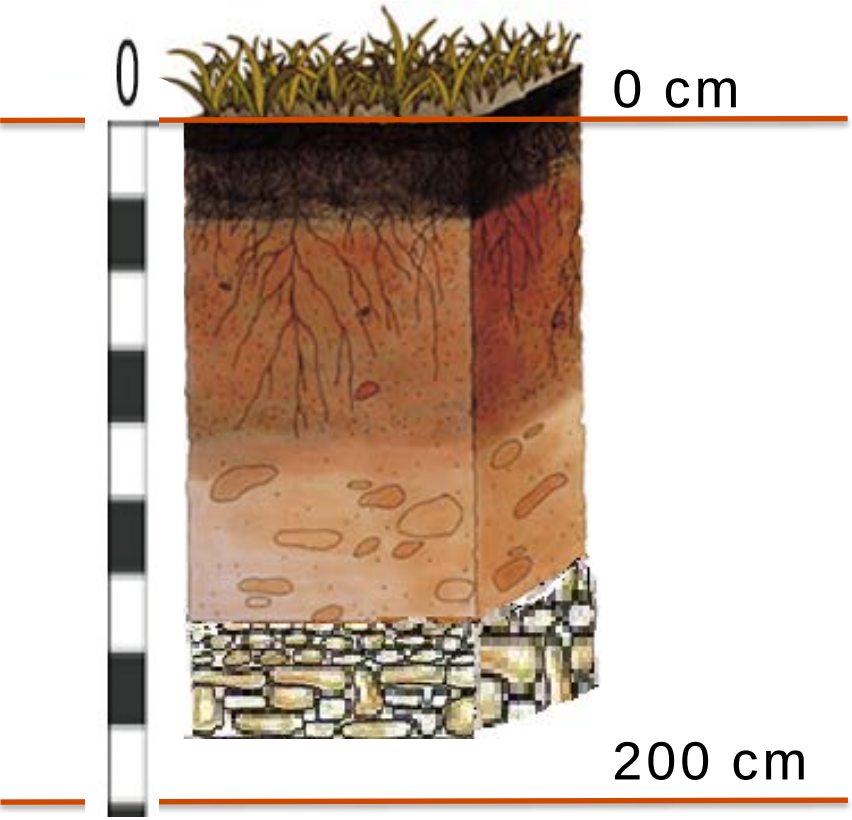
The object, according to WRB (2015), is any material within 2 m of the Earth's surface that is in contact with the atmosphere, excluding living organisms, areas with continuous ice not covered by other material and water bodies deeper than 2 m.

Soil profile description (FAO, 2006)

(international standard)



Soil observations & measurements:

- object: x, y, **z**, t
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The object, according to WRB (2015), is any material within 2 m of the Earth's surface that is in contact with the atmosphere, excluding living organisms, areas with continuous ice not covered by other material and water bodies deeper than 2 m, including litter (up) and rock (low).

Soil profile description (FAO, 2006)
(general procedure)

- Metadata, including x, y, z, t
- Site data (soil forming factors)

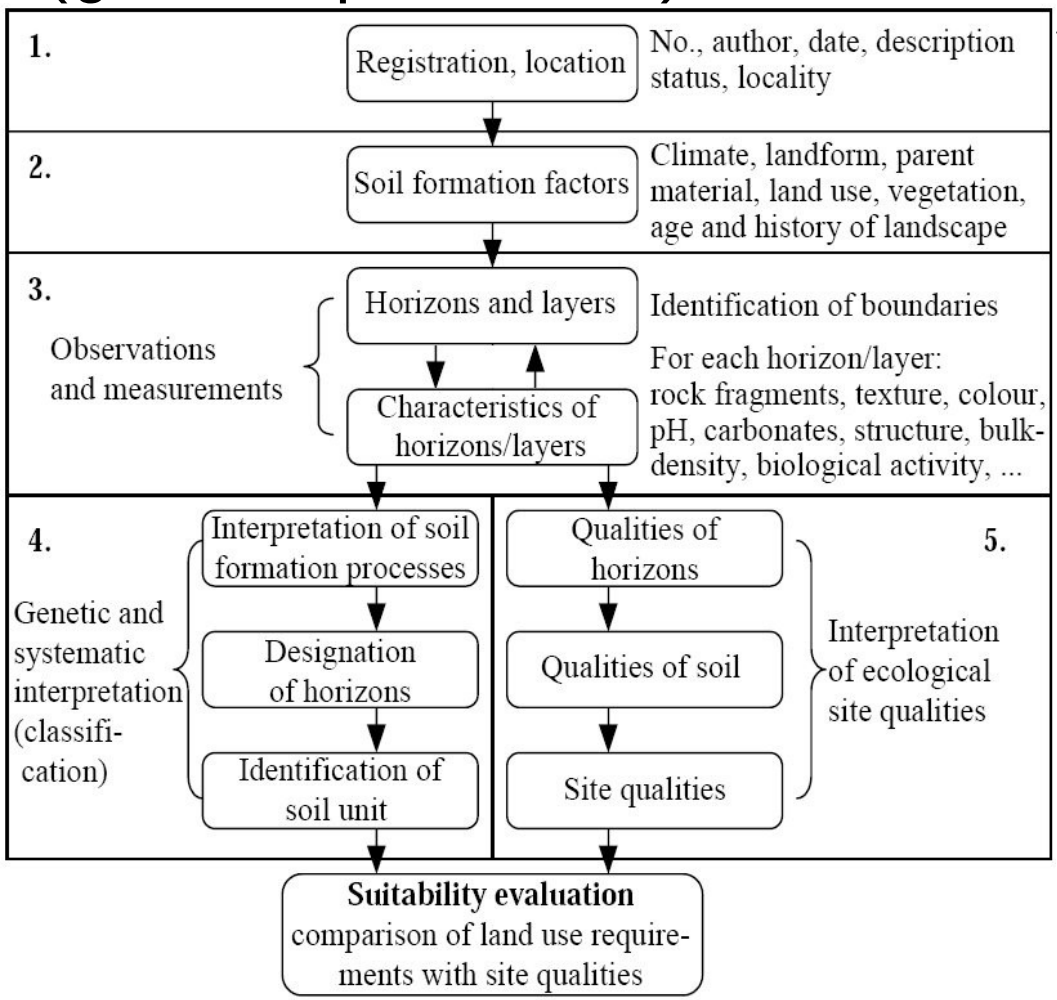
- Distinguish soil horizons
- Soil data per horizon

- Horizon designation

- Horizon diagnosis according to WRB
- Profile classification according to WRB

FAO2006_GuidelinesForSoilDescription_a0541e00.pdf

Soil profile description (FAO, 2006)
(general procedure)



FAO2006_GuidelinesForSoilDescription_a0541e00.pdf

Soil profile description (FAO, 2006) example

Profile ID	HE/GRW/LH/P2	Land cover	Protected forest, scattered agro-forestry trees, bushes, herbaceous
Date	27/01 (dd/mm)	Land use	Crop cultivation, animal husbandry, forestry
Year	2014	Crop	Cereals, pulses, vegetables, some fruits, khat
Surveyor	KibebewKibret	Human influence	Vegetation moderately disturbed, ploughing, furrow/flood irrigation
Status	Reference profile description	Surface stone cover	Very few
Location country	Ethiopia	Surface stone size	Stones
Location region	East Hararghe	Erosion category	None
Location woreda	Gurawa	Crack width	Wide (2-5 cm)
Location kebele	Lencha	Crack depth	Very deep (> 20 cm)
Longitude	41°46'53.5"	Crack distance	Very closely spaced (< 0.20 m)
Latitude	09°11'49.7"	Surface drainage	Well
Elevation	2380 m	Soil drainage	Well
Map ID		Flooding frequency	None
Map scale		Depth to groundwater	Not observable
Map unit ID		Depth to bedrock	Not observable
Topography	Strongly sloping, 10-15%	Rootable depth	200 cm
Major landform	Medium gradient hill	Rooted depth	120 cm
Position on slope	Middle slope	Depth of observation	200 cm
Slope form	Concave straight	Local soil type	*Supe Dimma (Red soil)*
Slope gradient	14%	Field WRB soil type	Nitisol
Geology	Igneous	WRB soil type	Luvic Nitisol (Eutric)
Parent material	Basalt		

Description of the soil horizons (morphology)

Horizon	Depth (cm)	Description
Ap	0-20	Black (10YR 2/1, moist) and dark grayish brown (10YR 4/2, dry) colour; clay; strong very coarse angular blocky structure; hard (dry), very friable (moist), and very sticky and very plastic (wet) consistence; many, very fine to fine pores; very few, faint clay coatings; very few, fine coarse fragments of unspecified nature; no mottles; few, fine roots; very few burrows; gradual, smooth boundary; slight effervescence with dilute HCl; field pH of 6.5.
B1	20-45	Olive (5Y 4/3, moist) and dark yellowish brown (10YR 4/4, dry) colour; clay; strong coarse angular blocky structure; very hard when dry, very friable when moist, and very sticky and very plastic when wet; common, very fine to fine pores; very few, faint clay coatings; no coarse fragments; no mottles; very few, fine roots; very few burrows; diffuse, smooth boundary; no reaction with HCl and field pH of 6.
B2	45-90	Black (5YR 2.5/1, moist) and yellowish brown (10YR 5/4, dry) colour; clay; strong coarse angular blocky structure; very hard (dry), friable (moist), and very sticky and very plastic (wet) consistence; few, very fine to fine pores; very few, faint clay coatings; no coarse fragments; no mottles; very few, very fine roots; no other indicators of biological activity; diffuse, smooth boundary; no reaction with HCl; field pH of 6.5.
B3	90-120	Very dark gray (5YR 3/1, moist) and dark grayish brown (10YR 4/2, dry) colour; clay; strong medium prismatic structure; very hard when dry, friable when moist, and very sticky and very plastic when wet; few, very fine pores; no coatings; no coarse fragments; very few, very fine, faint black mottles; very few, very fine to fine roots; no other indicators of biological activity; diffuse, irregular boundary; no reaction with HCl; pH value of 6.5.
BC	120-200	Light olive brown (2.5Y 5/4, moist) and brown (10YR 5/3, dry) colour; clay; strong coarse angular blocky structure; extremely hard (dry), friable (moist), and very sticky and very plastic (wet) consistence; few, very fine pores; no coatings; no coarse fragments; no mottles; no roots and other indicators of biological activity; no reaction with HCl; filed pH value of 6.5.

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Surveyor	KibebewKibret	Human influence	Vegetation moderately disturbed, ploughing, furrow/flood irrigation
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Location region	East Hararghe	Erosion category	None
Location woreda	Gurawa	Crack width	Wide (2-5 cm)
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Parameters	HE/GRW/LH/P2				
Depth (cm)	0-20	20-45	45-90	90-120	120-200
Horizon	Ap	Bt1	Bt2	Bt3	BC
Sand (%)	51.79	44.09	39.90	33.46	35.49
Silt (%)	7.50	10.75	9.66	10.73	20.43
Clay (%)	40.71	45.16	50.44	55.81	44.08
Textural class	SC	C	C	C	C
pH-H_2O	5.27	4.93	5.14	5.29	5.68
pH-KCl	4.30	4.01	4.20	4.33	4.72
EC (µS/cm)	0.06	0.04	0.04	0.04	0.07
OC (%)	2.87	1.81	1.03	0.92	0.25
TN (%)	0.28	0.22	0.10	0.07	0.03
Av.P (mg/kg)	24.90				
Av. S (%)	0.93				
Na (meq/100 g)	0.78	0.78	0.98	1.02	0.93
K (meq/100 g)	0.57	0.41	0.37	0.39	0.22
Ca (meq/100 g)	17.93	18.83	23.92	21.36	25.68
Mg (meq/100 g)	5.98	6.85	8.54	7.69	7.63
CEC (meq/100 g)	34.79	41.87	44.58	45.51	38.61
SB (meq/100 g)	25.25	26.87	33.82	30.47	34.46
ESP (%)	2.24	1.87	2.21	2.24	2.41
Zn (mg/kg)	3.04				
Mn (mg/kg)	40.31				
Cu (mg/kg)	4.29				
Fe (mg/kg)	87.61				

Soil profile description

"In view of the high costs of field work,

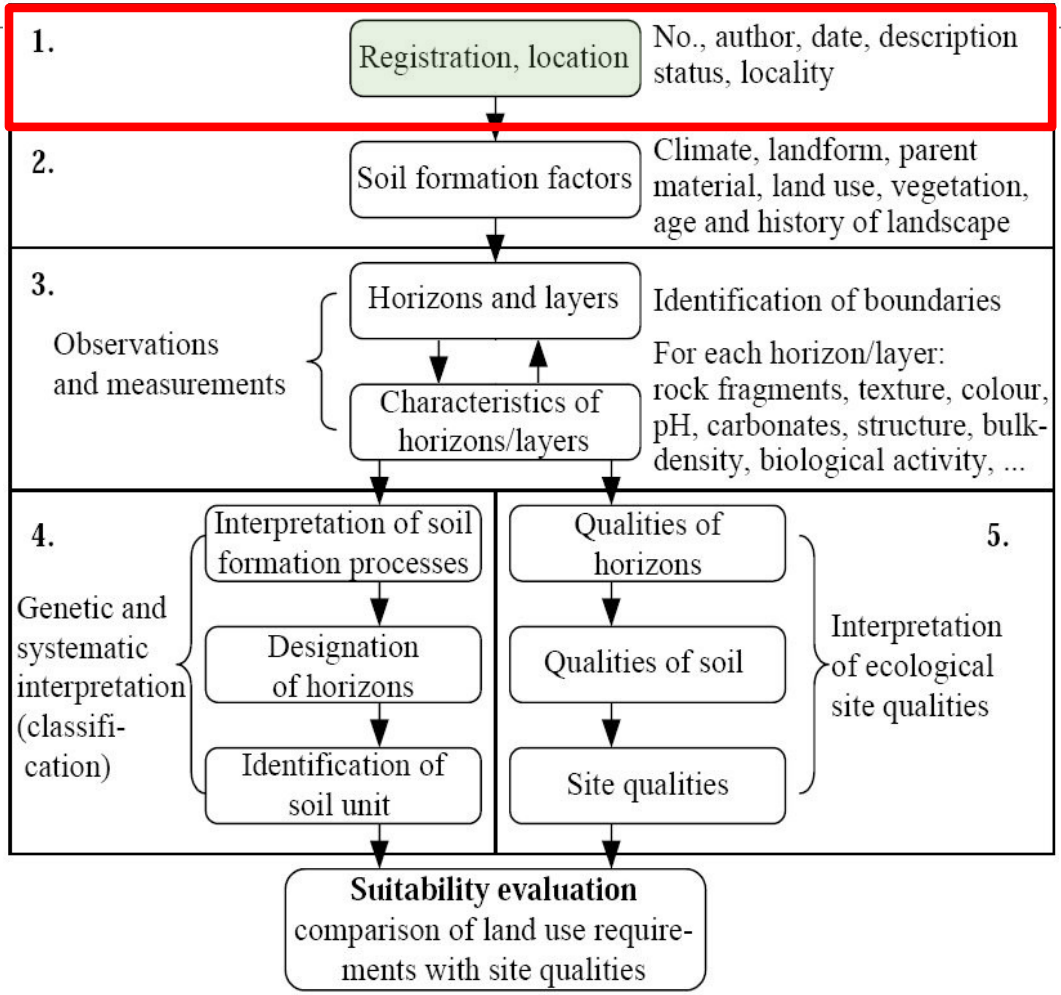
soil profile ***descriptions should be made***

as detailed and comprehensive as possible,

so that they serve multiple purposes."

Otto Spaargaren (1945-2015)

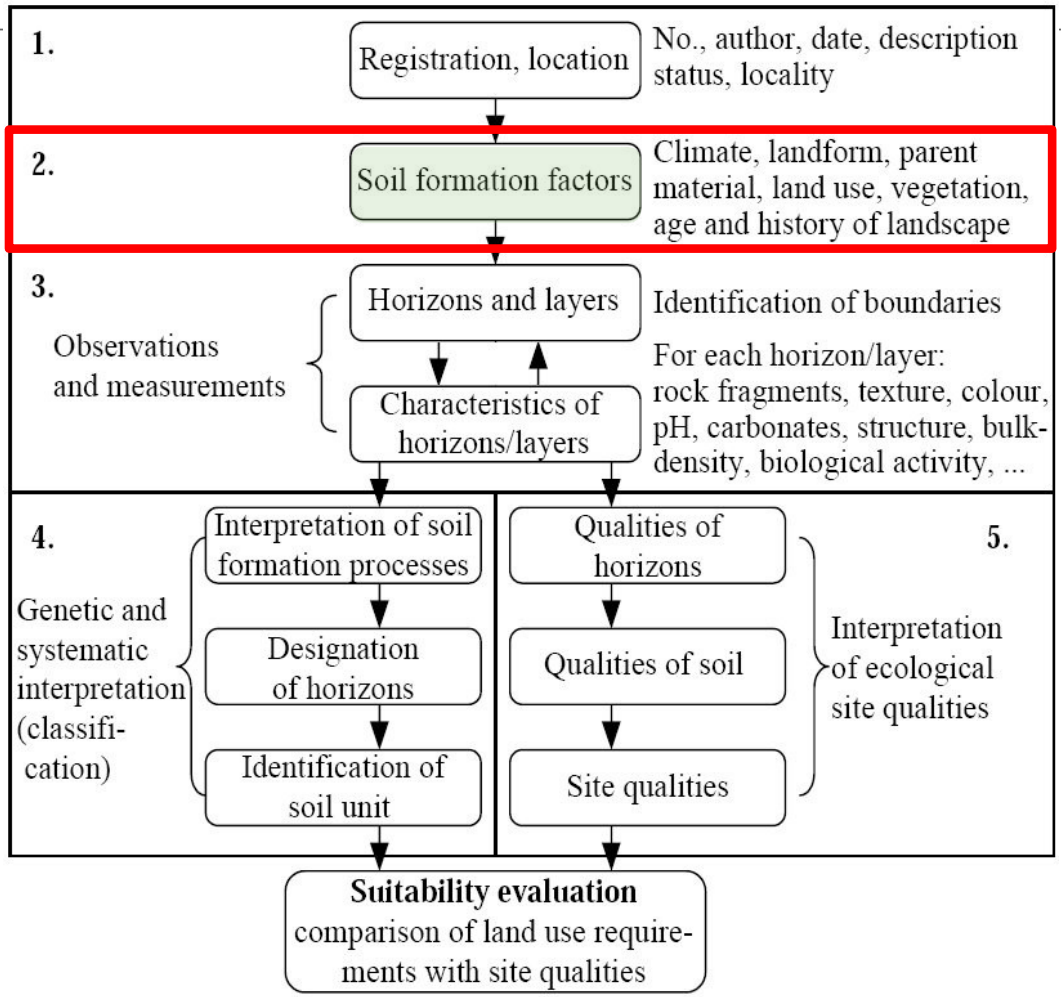
Soil profile description – metadata



Soil profile description - metadata

- Soil profile ID
- Description status
- Lineage (project, author, institute)
- Definition of the object: **x, y, z, t**

Soil profile description - site

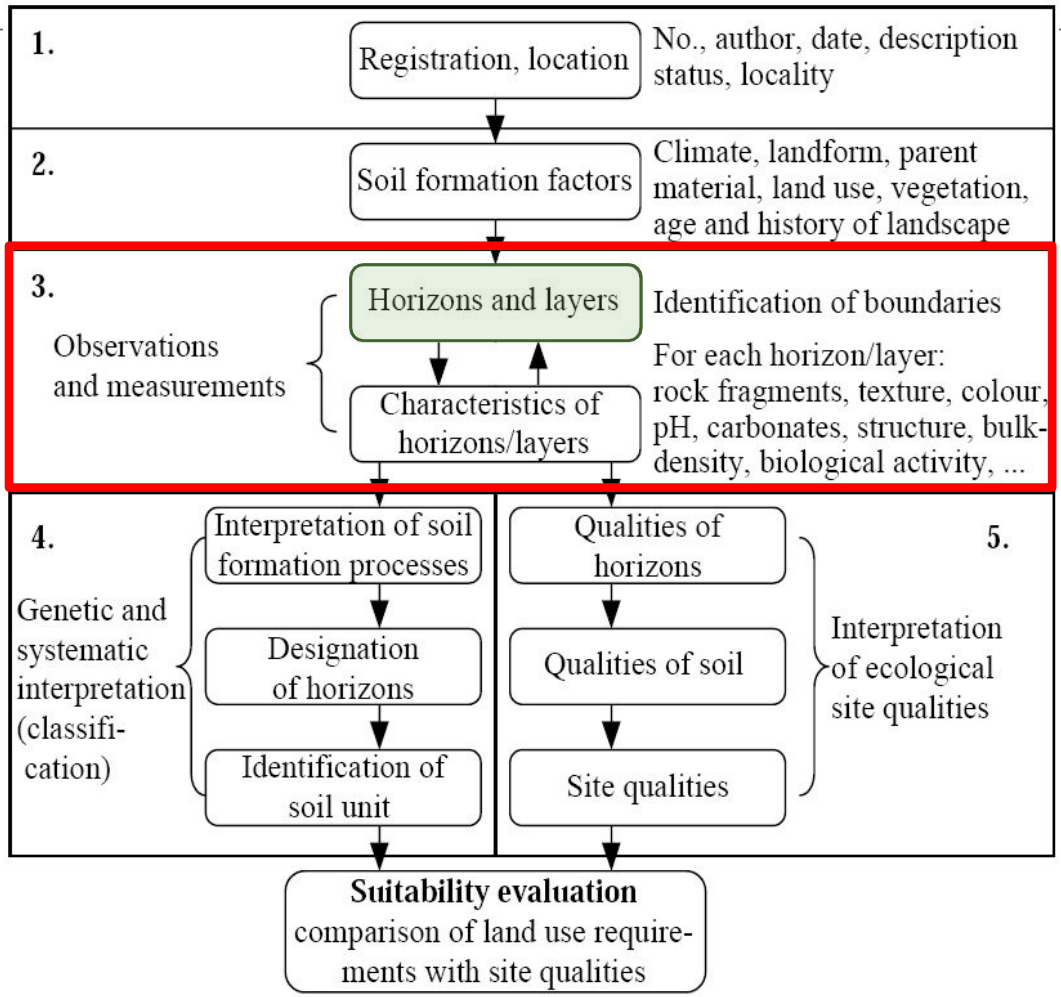


Soil profile description - site

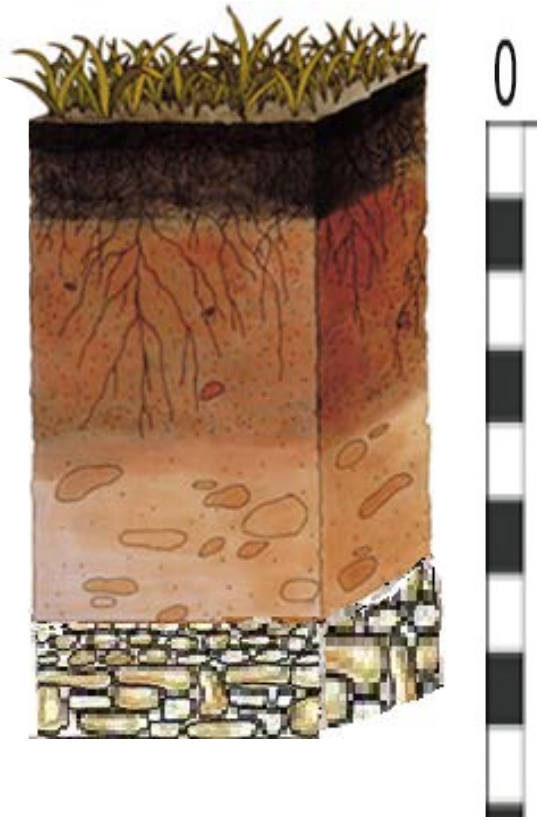
Site description

- Climate
- Relief (landform, slope position, slope gradient)
- Land use and land cover
- Parent material
- Age of the land surface

Soil profile description - horizons



Soil profile description - horizons



Soil observations & measurements:

- **object**: x, y, **z**, t
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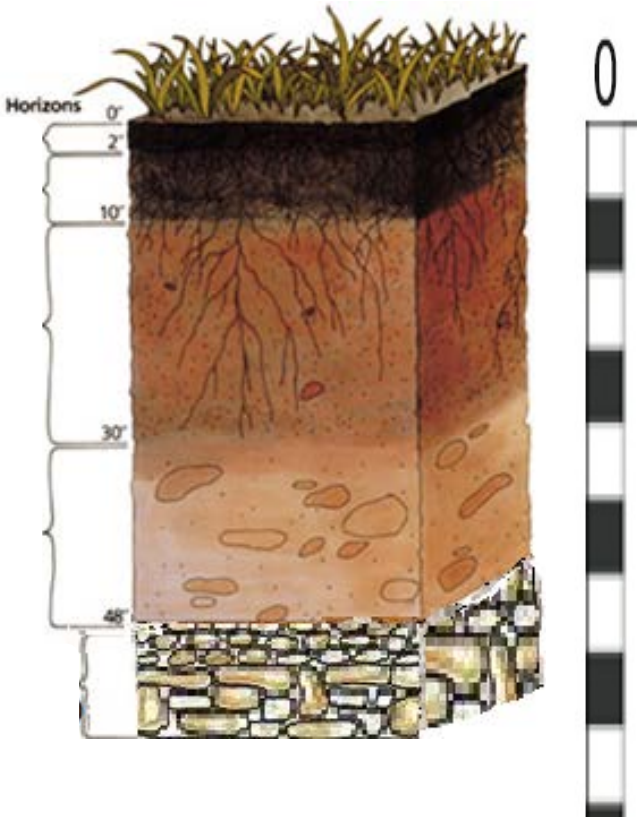
Soil profile description – horizons



Soil observations & measurements:

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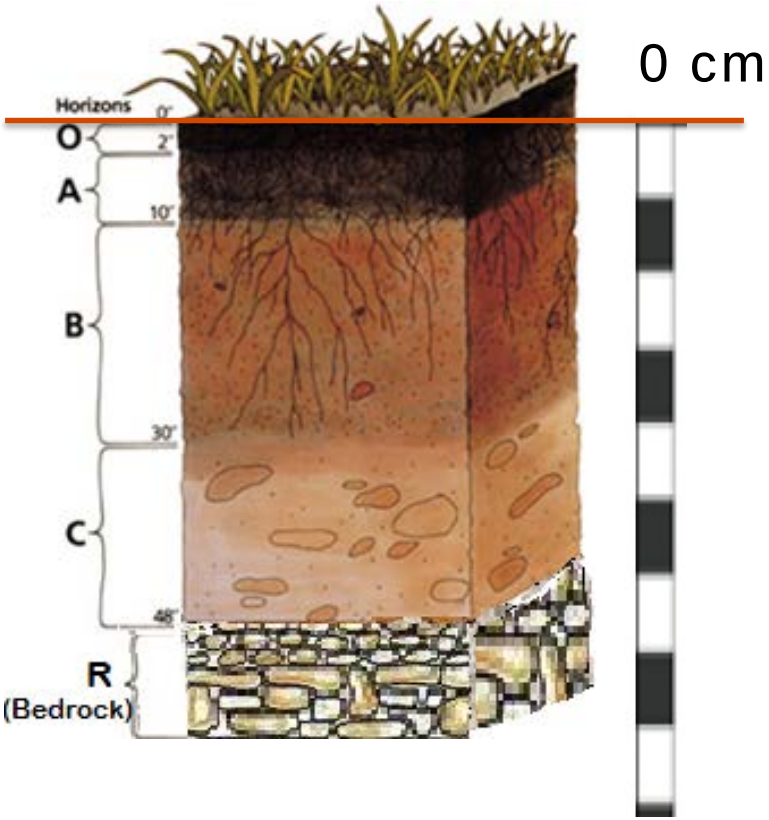
5 master horizons (or layers)

Soil profile description – horizons



Soil observations & measurements:

- **object**: x, y, **z**, t
- property
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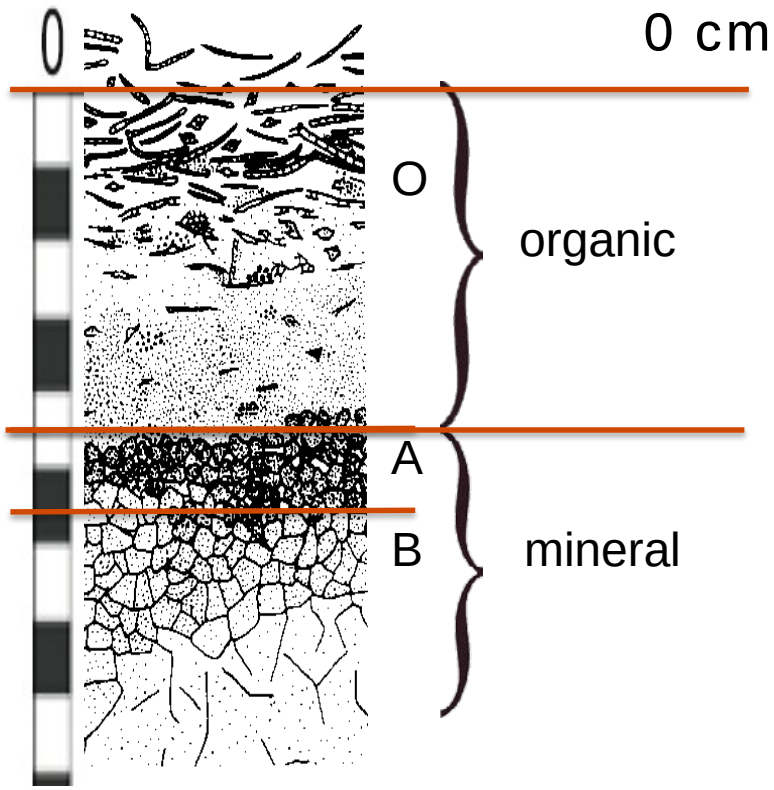
5 master horizons (or layers):

O = organic soil horizon (litter)
A = mineral soil horizon
B = mineral soil horizon
C = mineral soil horizon
R = mineral soil layer

Soil profile description – horizons



Soil observations & measurements:

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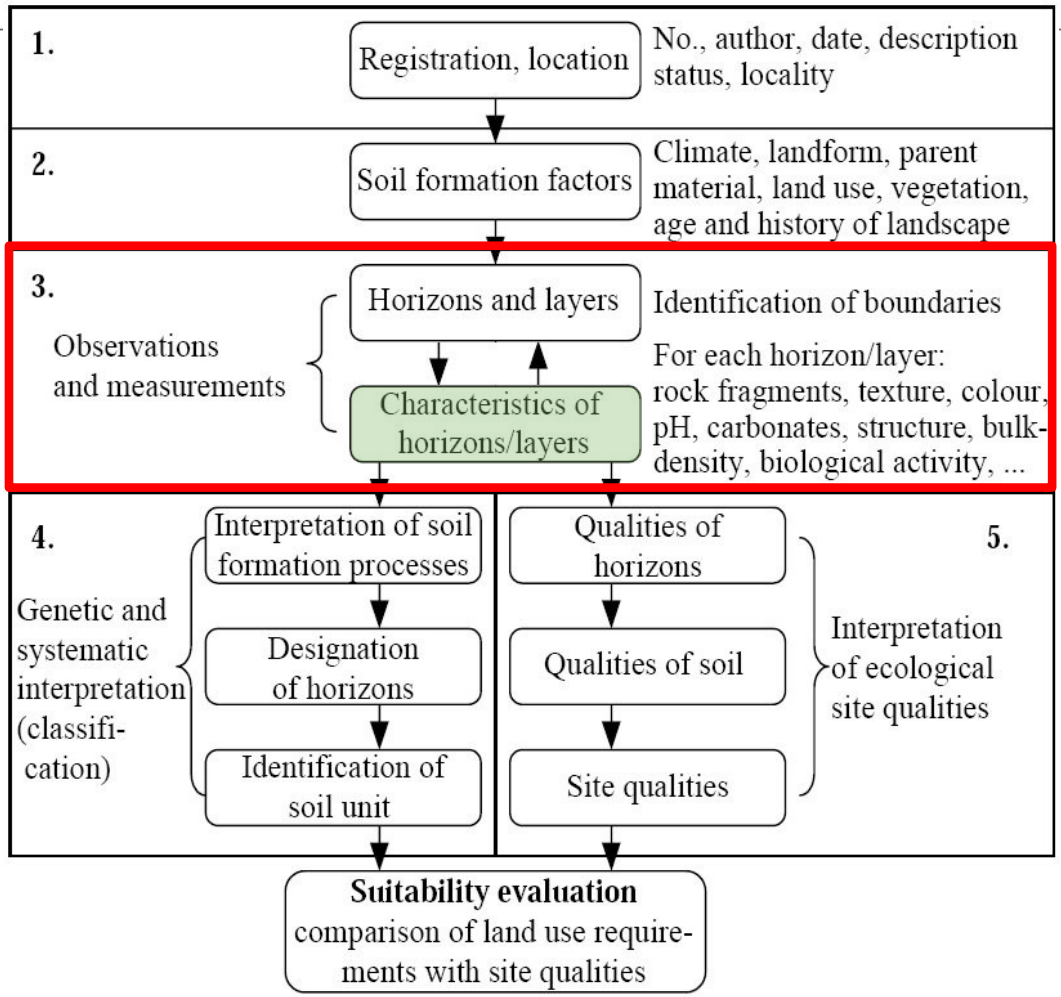
5 master horizons (or layers):

O : decomposing OM

A : mineral soil with decomposed OM

B : mineral soil

Soil profile description - horizons

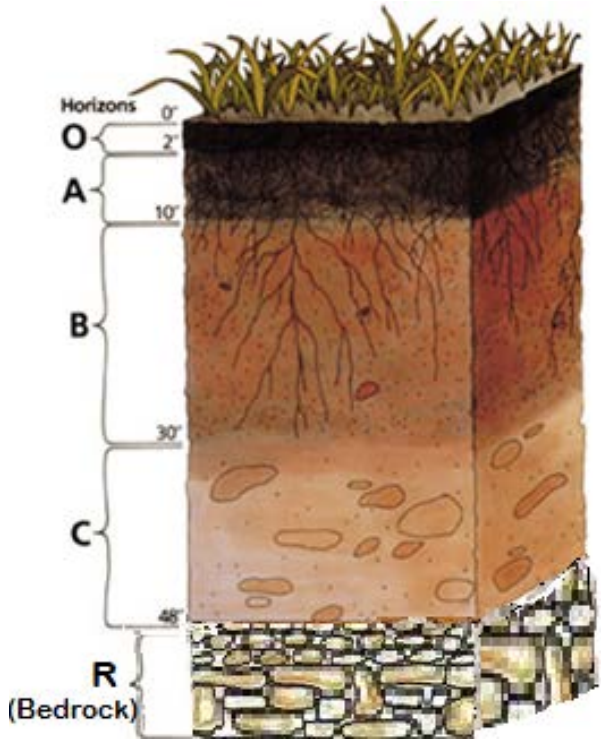


Soil profile description - horizons

Characteristics

- Horizon boundaries (cm) & horizon designation
- Texture of fine earth
- Coarse fragments, stoniness
- Colour, mottling
- Field measurements (carbonates, gypsum, EC, pH)
- Structure and consistency
- Porosity
- Concentrations (coatings, cementation/compaction, mineral)
- Biological activity, including rooting
- Sampling

Soil profile description – horizons



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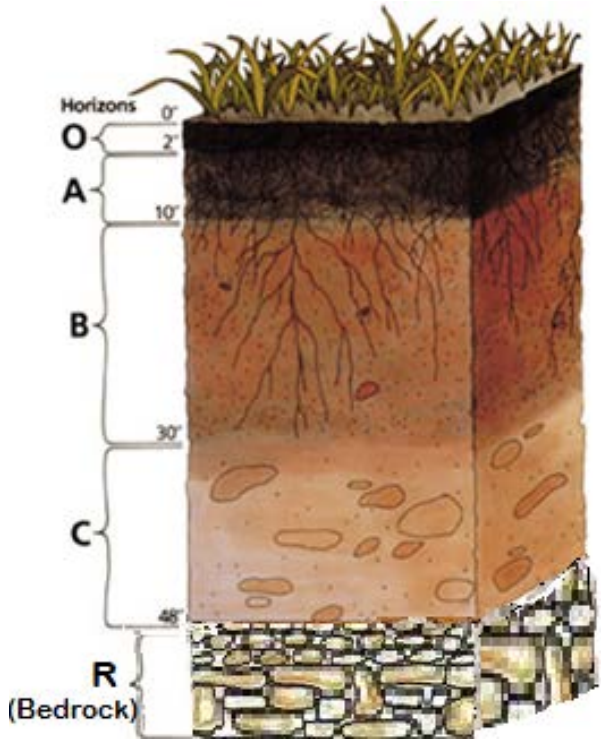
- **value** (incl. units or dictionary)

Soil profile description – horizons colour



Soil observations & measurements:

- object: x, y, z, t
- **property**
- **method**
- **value** (incl. units or dictionary)

O. Black
A. Dark brown
B. Reddish brown
C. Yellowish brown
R. Yellowish white

Soil profile description – horizon colour (moist & dry)

Hue

is the **dominant spectral colour** (red, yellow, green, blue, violet) which is mostly influenced by the parent material.

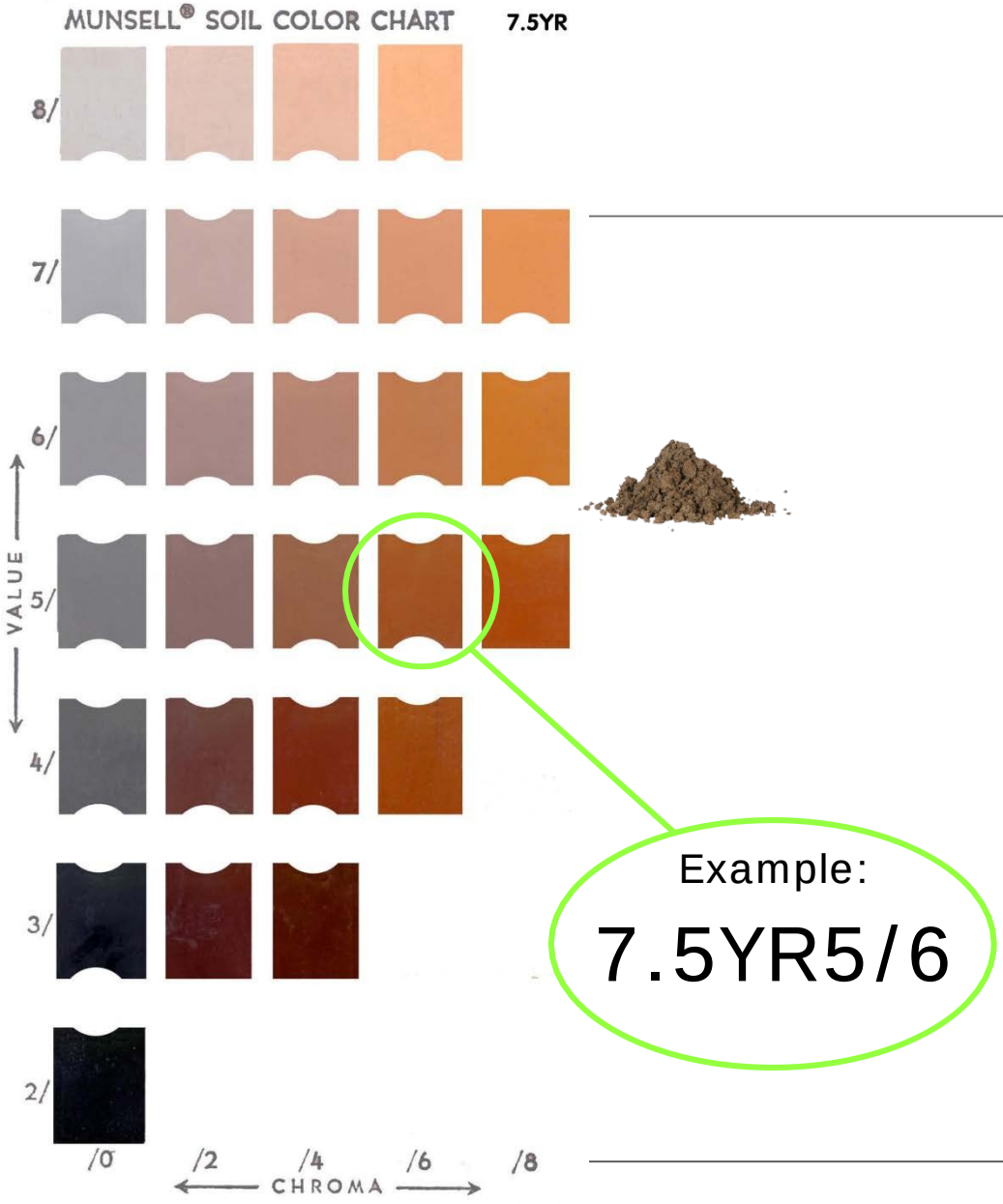
Value

is the **lightness or darkness** of colour and is in soils largely influenced by the content of organic matter. In the Munsell Soil Colour Charts, it ranges from 1 (towards „black“) to 8 (towards „white“).

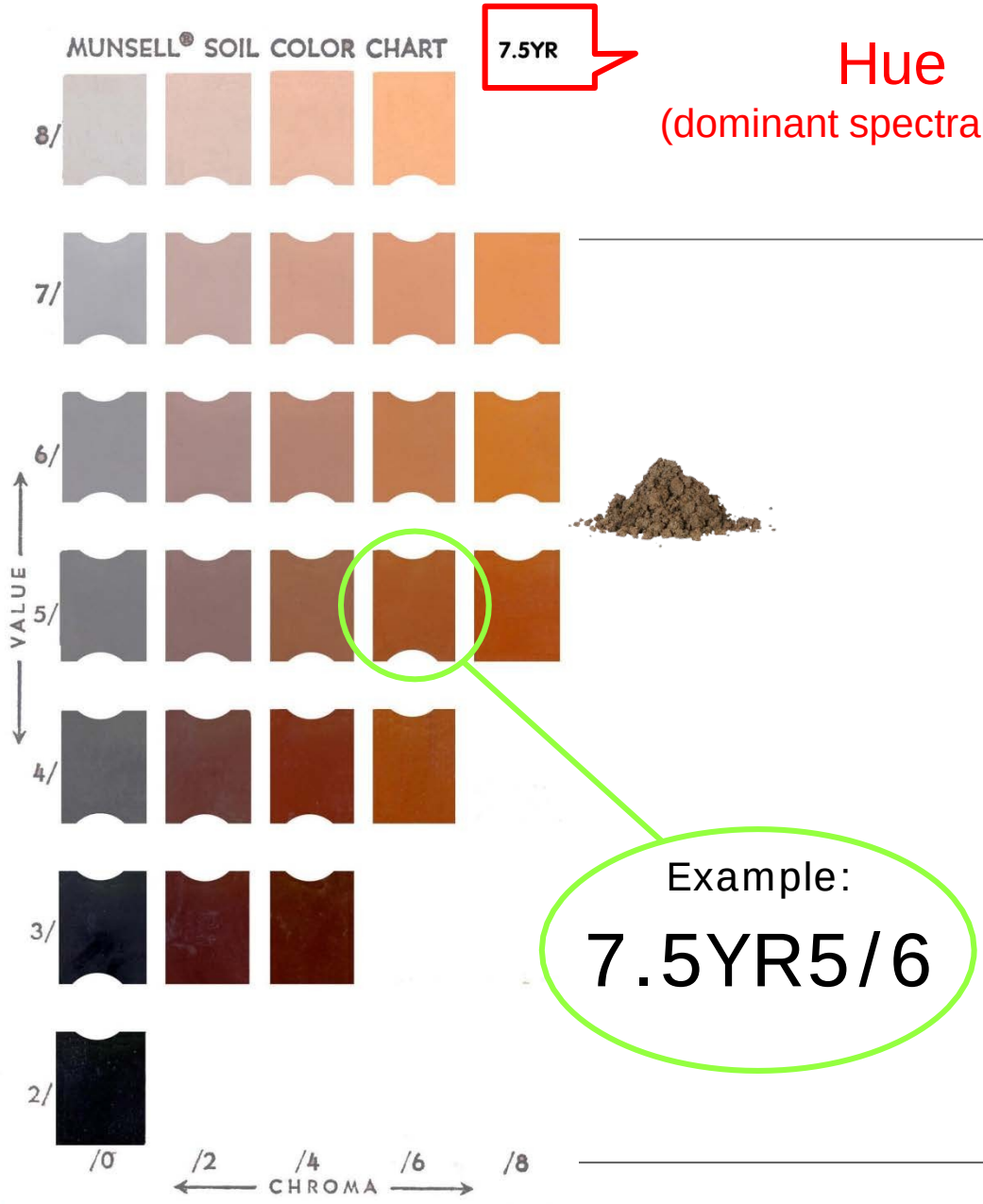
Chroma

is the colour i**ntensity** (pigment concentration**)** ranging from 1 (low intensity, „pale“ colours) to 8 (high intensity, „bright“ colours).

Soil colour

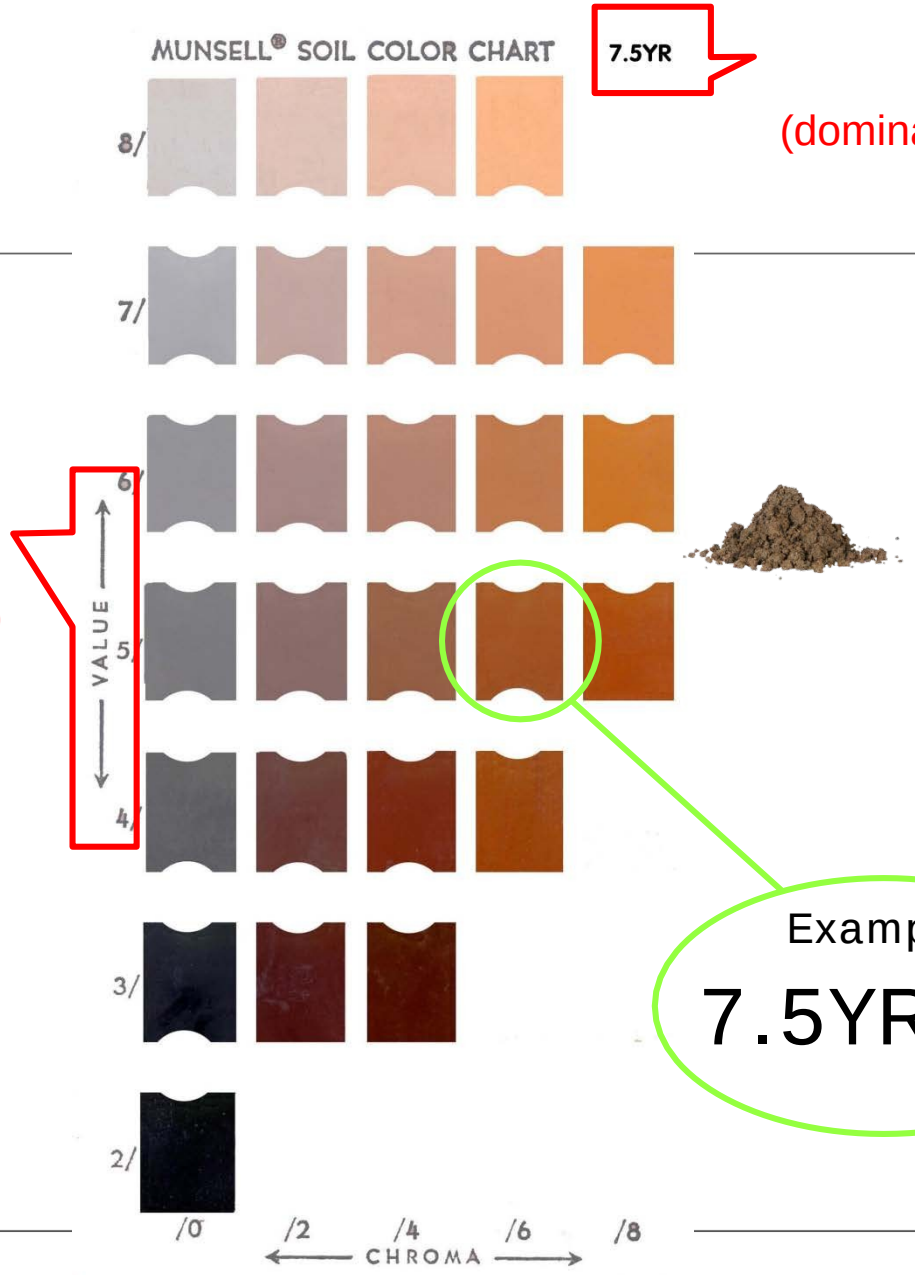

MUNSELL® SOIL COLOR CHART
7.5YR
8/
7/
6/
5/
4/
3/
2/
VALUE
/0
/2
/4
/6
/8
CHROMA
Example:
7.5YR5/6

Soil colour



Hue
(dominant spectral colour)

Soil colour

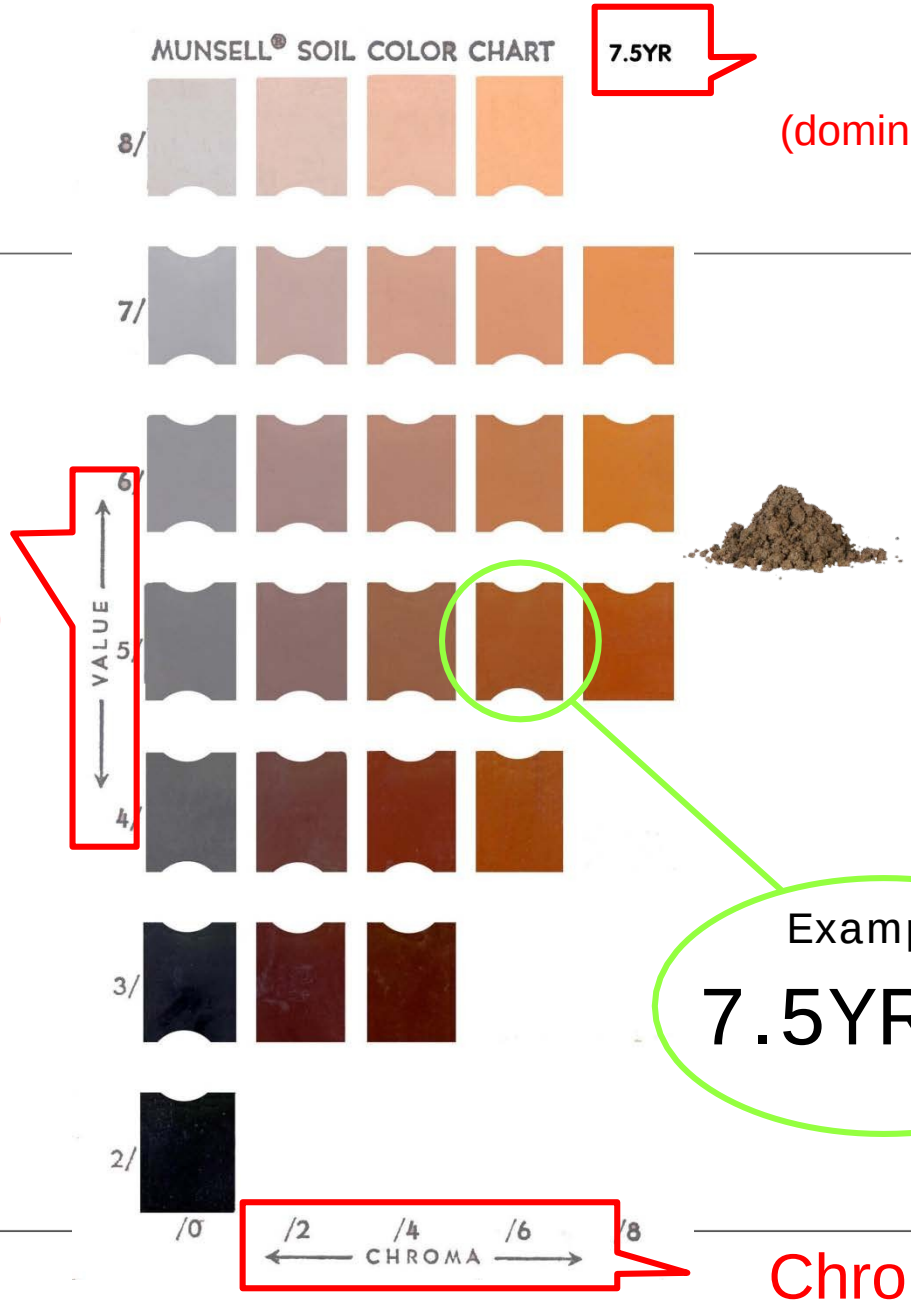


Hue
(dominant spectral colour)

Value
(lightness/darkness)

Example:
7.5YR5/6

Soil colour



Hue
(dominant spectral colour)

Value
(lightness/darkness)

Example:
7.5YR5/6

Chroma
(intensity of colour)

Soil colour

Important diagnostic hues, values and chromas are:

- ✓ Abrupt changes in colour not resulting from pedogenesis → lithological discontinuity.
- ✓ Redder hue, higher value or higher chroma than the underlying or an overlying layer → cambic horizon.
- ✓ Hue redder than 10 YR or chroma ≥ 5 (moist) → ferralic properties, Hypoferralic and Rubic qualifier.
- ✓ Hue 7.5 YR or yellower and value ≥ 4 (moist) and chroma ≥ 5 (moist) → Xanthic qualifier.
- ✓ Hue redder than 7.5 YR or both hue 7.5 YR and chroma > 4 (moist) → Chromic qualifier.
- ✓ Hue redder than 5 YR, value < 3.5 (moist) → Rhodic qualifier.
- ✓ Hue 5 YR or redder, or hue 7.5 YR and value ≤ 5 and chroma ≤ 5, or hue 7.5 YR and value ≤ 5 and chroma 5 or 6, or hue 10 YR or neutral and value and chroma ≤ 2, or 10 YR 3/1 (all moist) → spodic horizon.
- ✓ Hue 7.5 YR or yellower or GY, B or BG; value ≤ 4 (moist); chroma ≤ 2 (moist) → puddled layer (anthraquic horizon).
- ✓ Hue N1 to N8 or 2.5 Y, 5 Y, 5 G or 5 B → reductimorphic colours of the gleyic colour pattern.
- ✓ Hue 5 Y, GY or G → gyttja (limnic material).
- ✓ Chroma < 2.0 (moist) and value < 2.0 (moist) and < 3.0 (dry) → voronic horizon.
- ✓ Chroma ≤ 2 (moist) → Chernozem.
- ✓ Chroma ≤3 (moist) and value ≤ 3 (moist) and ≤ 5 (dry) → mollic and umbric horizon.
- ✓ Value and chroma ≤ 3 (moist) → hortic horizon.
- ✓ Value ≤ 4 (moist) and ≤ 5 (dry) and chroma ≤ 2 (moist) → plaggic horizon.
- ✓ Value > 2 (moist) or chroma > 2 (moist) → fulvic horizon.
- ✓ Value ≤ 2 (moist) and chroma ≤ 2 (moist) → melanic horizon.
- ✓ Values 4 to 8 and chroma 4 or less (moist) and values 5–8 and chromas 2–3 (dry) → albic horizon.
- ✓ Lower value or chroma than the overlying horizon → sombric horizon.
- ✓ Value ≥ 3 (moist) and ≥ 4.5 (dry) and chroma ≥ 2 (moist) → aridic properties.
- ✓ Value ≤ 4 (moist) → coprogenous earth or sedimentary peat (limnic material).
- ✓ Value 3, 4 or 5 (moist) → diatomaceous earth (limnic material).
- ✓ Value ≥ 5 (moist) → marl (limnic material).
- ✓ Value ≤ 3.5 (moist) and chroma ≤ 1.5 (moist) → Pellic qualifier.
- ✓ Value ≥ 5.5 (dry) → Hyperochric qualifier.

Soil mottling

TABLE 32

Classification of the abundance of mottles

		%
N	None	0
V	Very few	0–2
F	Few	2–5
C	Common	5–15
M	Many	15–40
A	Abundant	> 40

TABLE 33

Classification of the size of mottles

		mm
V	Very fine	< 2
F	Fine	2–6
M	Medium	6–20
A	Coarse	> 20

TABLE 34

Classification of the contrast of mottles

F	Faint	The mottles are evident only on close examination. Soil colours in both the matrix and mottles have closely related hues, chromas and values.
D	Distinct	Although not striking, the mottles are readily seen. The hue, chroma and value of the matrix are easily distinguished from those of the mottles. They may vary by as much as 2.5 units of hue or several units in chroma or value.
P	Prominent	The mottles are conspicuous and mottling is one of the outstanding features of the horizon. Hue, chroma and value alone or in combination are at least several units apart.

TABLE 35

Classification of boundary between mottle and matrix

		mm
S	Sharp	< 0.5
C	Clear	0.5–2
D	Diffuse	> 2

Soil constituents

- Soil coarse fragments (> 2 mm)
- Soil fine earth fraction (< 2 mm)

between upper and lower boundary

Soil constituents

- Soil coarse fragments (> 2 mm)
- Soil fine earth fraction (< 2 mm)

TABLE 26

Abundance of rock fragments and artefacts, by volume

		%
N	None	0
V	Very few	0–2
F	Few	2–5
C	Common	5–15
M	Many	15–40
A	Abundant	40–80
D	Dominant	> 80
S	Stone line	any content, but concentrated at a distinct depth of a horizon

between upper and lower boundary

Soil constituents

- Soil coarse fragments
- Soil fine earth fraction:

-minerals (sand, silt, clay)
-pores
water
gases
-organic material, both live and dead,

between upper and lower boundary

Soil constituents

- Soil coarse fragments
- Soil fine earth fraction of good quality:

-minerals (sand, silt, clay); 45%,
-pores; 50%
water; 25%,
gases; 25%,
-organic material, both live and dead; 5%,

between upper and lower boundary

Soil constituents – texture

(= particle size distribution)

Clay (<2µm)

“Soils” fingers, is cohesive (sticky), is formable, has a high plasticity and has a shiny surface after squeezing between fingers.

Silt (2-63µm)

“Soils” fingers, is non-sticky, only weakly formable, has a rough and ripped surface after squeezing between fingers and feels very floury.

Sand (63-2000µm)

Cannot be formed, does not “soil” fingers and feels very grainy.

Soil texture

Soil textural classes

Sand + silt + clay = 100%

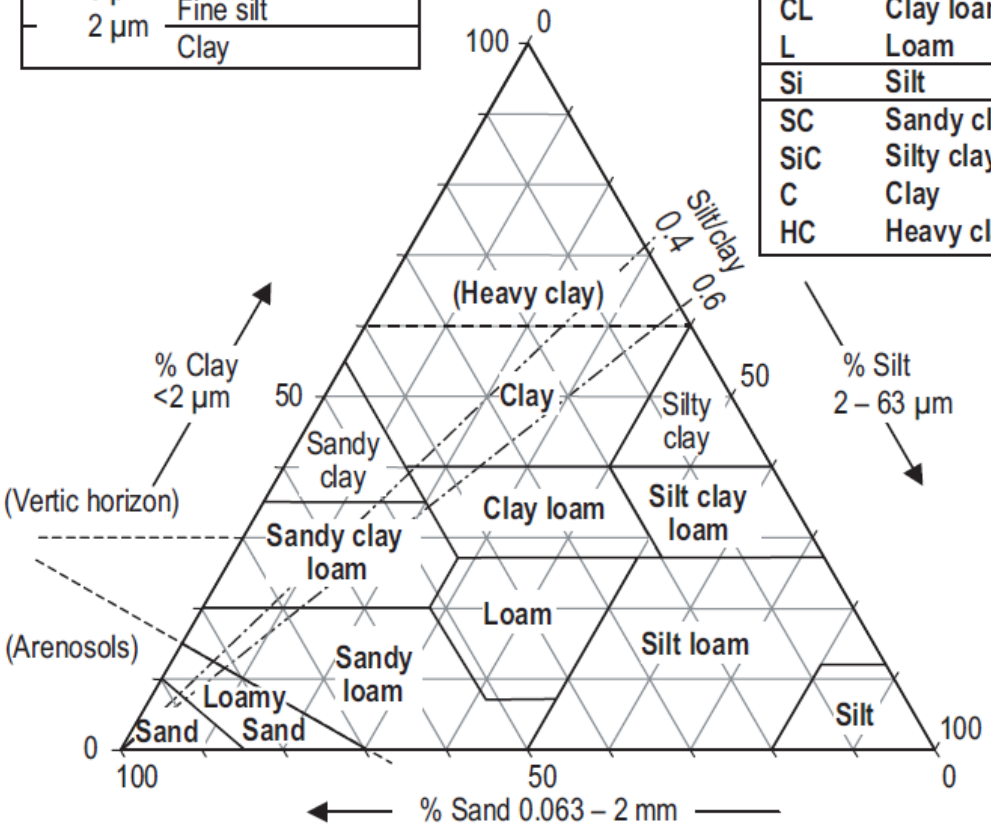
Relation of constituents of fine earth by size, defining textural classes

Particle-size classes

2 000 µm	Very coarse sand
1 250 µm	Coarse sand
630 µm	Medium sand
200 µm	Fine sand
125 µm	Very fine sand
63 µm	Coarse silt
20 µm	Fine silt
2 µm	Clay

Textural classes

S	Sand (unspecified)
LS	Loamy sand
SL	Sandy loam
SCL	Sandy clay loam
SiL	Silt loam
SiCL	Silty clay loam
CL	Clay loam
L	Loam
Si	Silt
SC	Sandy clay
SiC	Silty clay
C	Clay
HC	Heavy clay

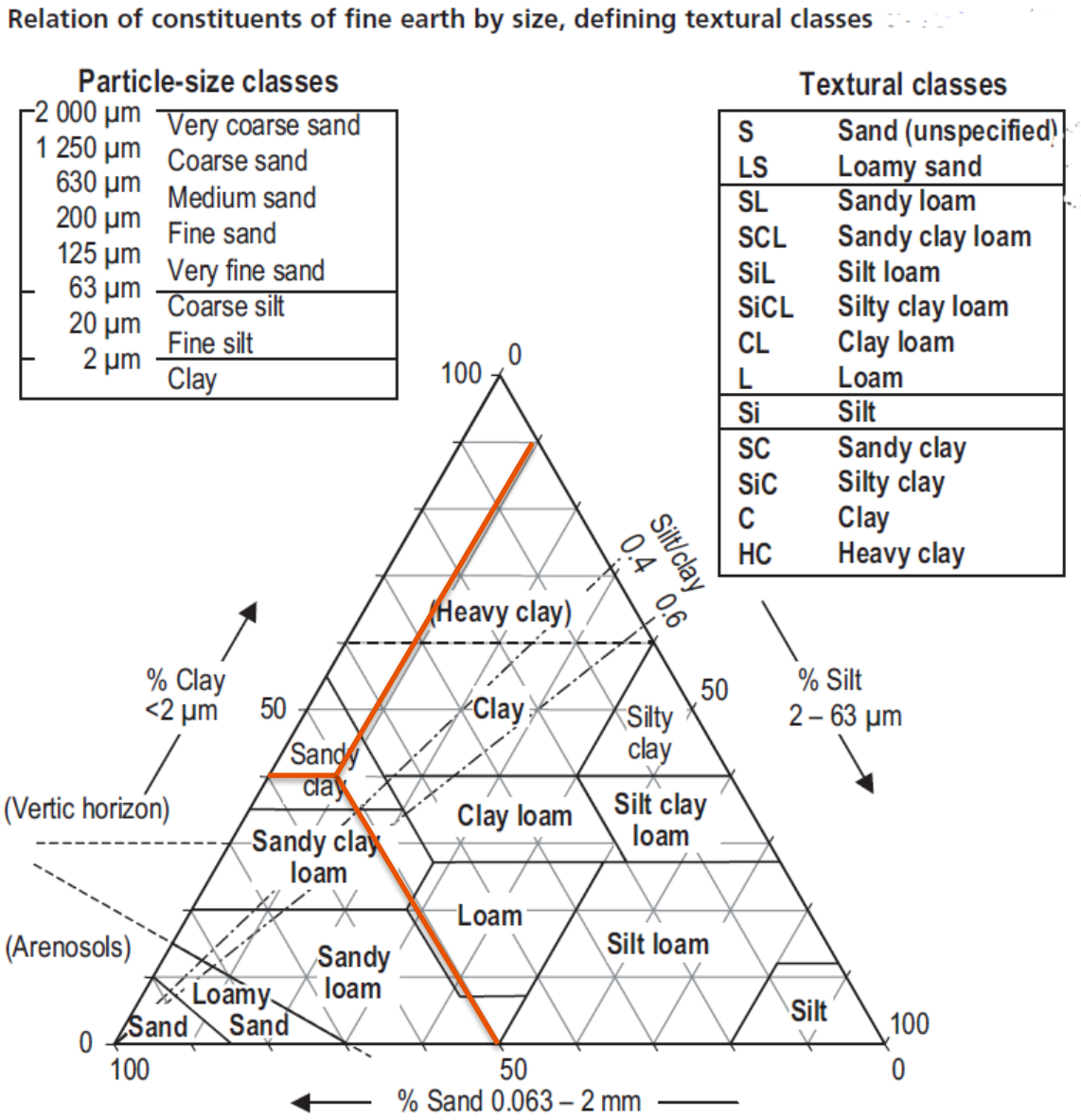


Soil texture

Soil textural classes

Sand + silt + clay = 100%

50 + 10 + 40 = SC



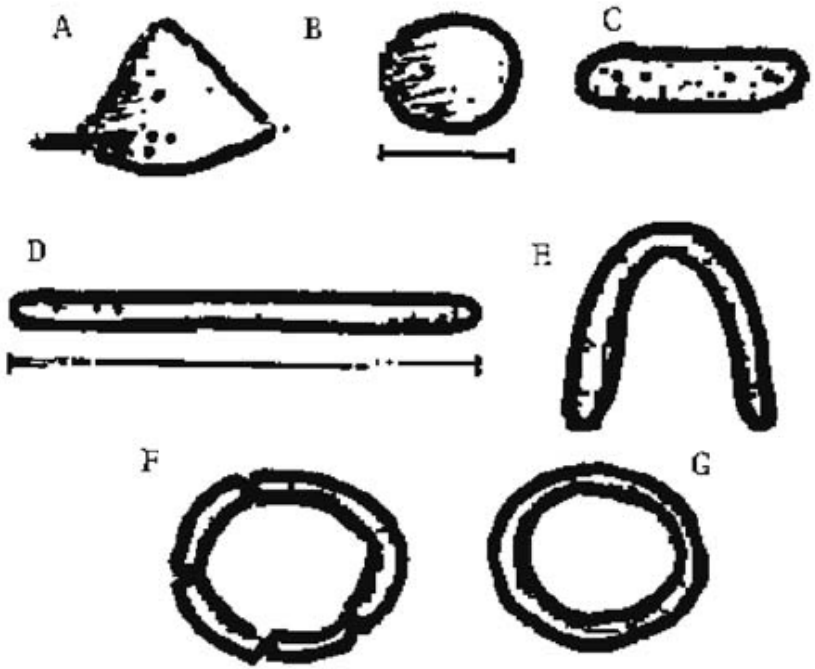


FIGURE 10 **Hand assessment of soil texture**

TABLE 17 **Soil texture descriptions**

A **Sandy**	The soils stays loose and separated and can be accumulated only in the form of a pyramid
B **Sandy loam**	The soil contains enough silt and clay to become sticky, and can be given the shape of an easy-to-take-apart ball
C **Silty loam**	Similar to a sandy loam, but the soil can be shaped by rolling it into a small short cylinder
D **Loam**	Contains almost equal amounts of sand, silt and clay. Can be rolled into approx. 14 cm long cylinder that breaks when bent.
E **Clayey loam**	Similar to the loam, but the rolled cylinder can be bent and given a Ü" shape (without forcing it) without breaking
F **Fine clay**	The soil cylinder can be bent into a circle, but shows some cracks
G **Heavy clay**	The soil can be shaped as a circle without any cracks

Soil texture & colour to estimate OM content (organic matter)

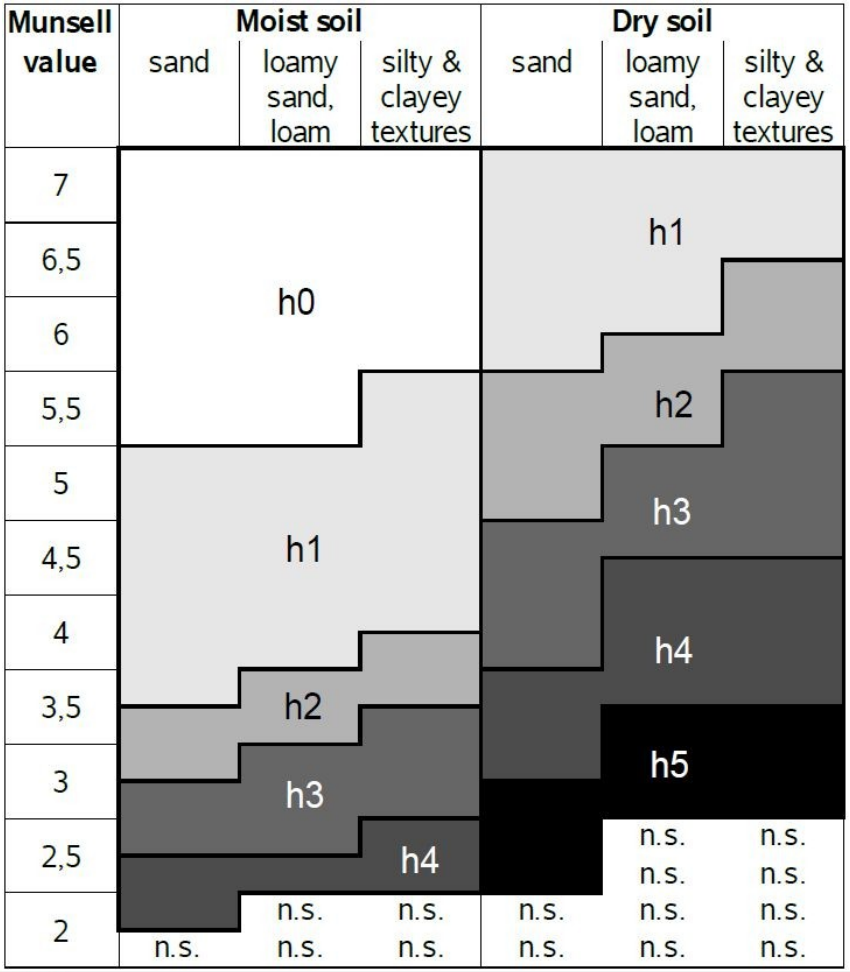
TABLE 46

Estimation of organic matter content based on Munsell soil colour

Colour	Munsell value	Moist soil			Dry soil		
		S	LS, SL, L	SiL, Si, SiCL, CL, SCL, SC, SiC, C	S	LS, SL, L	SiL, Si, SiCL, CL, SCL, SC, SiC, C
		(%)					
Light grey	7				< 0.3	< 0.5	< 0.6
Light grey	6.5				0.3–0.6	0.5–0.8	0.6–1.2
Grey	6				0.6–1	0.8–1.2	1.2–2
Grey	5.5			< 0.3	1–1.5	1.2–2	2–3
Grey	5	< 0.3	< 0.4	0.3–0.6	1.5–2	2–4	3–4
Dark grey	4.5	0.3–0.6	0.4–0.6	0.6–0.9	2–3	4–6	4–6
Dark grey	4	0.6–0.9	0.6–1	0.9–1.5	3–5	6–9	6–9
Black grey	3.5	0.9–1.5	1–2	1.5–3	5–8	9–15	9–15
Black grey	3	1.5–3	2–4	3–5	8–12	> 15	> 15
Black	2.5	3–6	> 4	> 5	> 12		
Black	2	> 6					

Soil texture & colour to estimate OM content

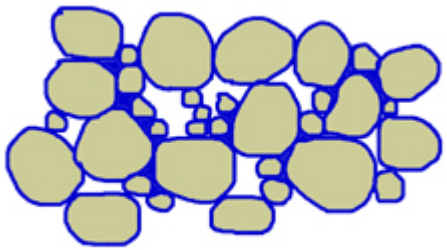
(organic matter)



humus content %	humus class	short form
0	only in places	h0
< 1	very weak	h1
1 - 2	weak	h2
2 - 5	moderate	h3
5 - 10	strong	h4
10 - 15	very strong	h5
15 - 30*	extreme	h6

Soil structure

Pore spaces are a function of soil texture and structure.



Relation of constituents of fine earth by size, defining textural classes

Particle-size classes

2 000 µm	Very coarse sand
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2 µm	Clay

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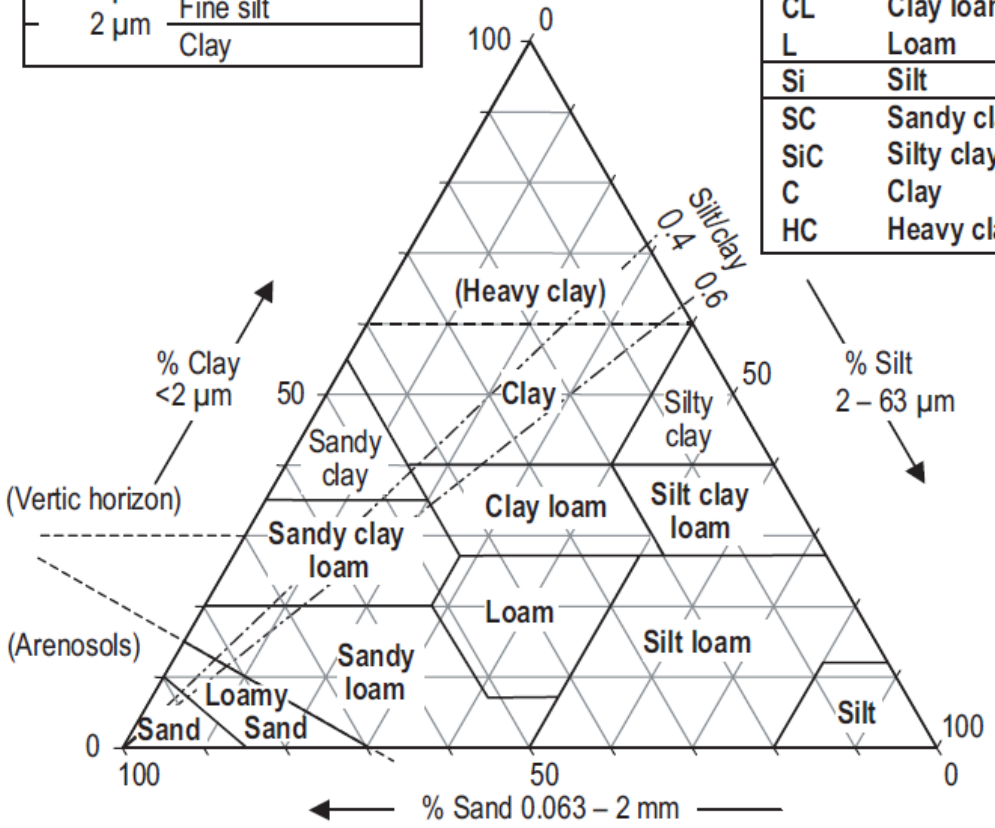
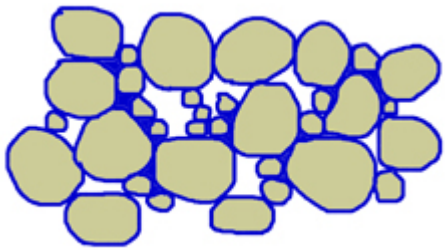


Soil structure

Structure refers to the natural arrangement and aggregation of soil particles and the space between them. Soil structure thus has a major influence on the bulk density and the movement of water and air and root growth.



Soil structure

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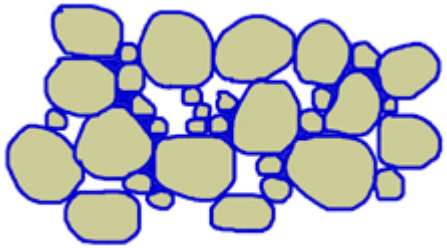
Land Qualities:



Water retention

Aeration, drainage

Rootability

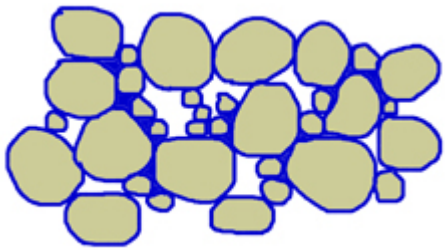
Workability

Germination

Soil structure

Distinguish differences in soil structure

- Grade (or degree of development and aggregation)
- Type (or shape)
- Size

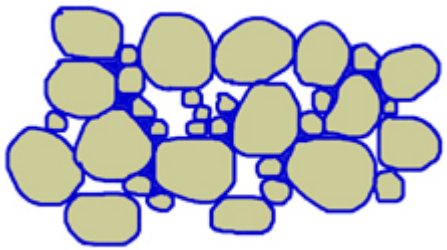


Soil structure

Distinguish differences in soil structure

- Grade (or degree of development and aggregation)
- Type (or shape)
- Size

Soil structure 1 breaking into soil structure 2



Grade

Soil structure

Classification of structure of pedal soil materials

WE	Weak	Aggregates are barely observable in place and there is only a weak arrangement of natural surfaces of weakness. When gently disturbed, the soil material breaks into a mixture of few entire aggregates, many broken aggregates, and much material without aggregate faces. Aggregate surfaces differ in some way from the aggregate interior.
MO	Moderate	Aggregates are observable in place and there is a distinct arrangement of natural surfaces of weakness. When disturbed, the soil material breaks into a mixture of many entire aggregates, some broken aggregates, and little material without aggregates faces. Aggregates surfaces generally show distinct differences with the aggregates interiors.
ST	Strong	Aggregates are clearly observable in place and there is a prominent arrangement of natural surfaces of weakness. When disturbed, the soil material separates mainly into entire aggregates. Aggregates surfaces generally differ markedly from aggregate interiors.

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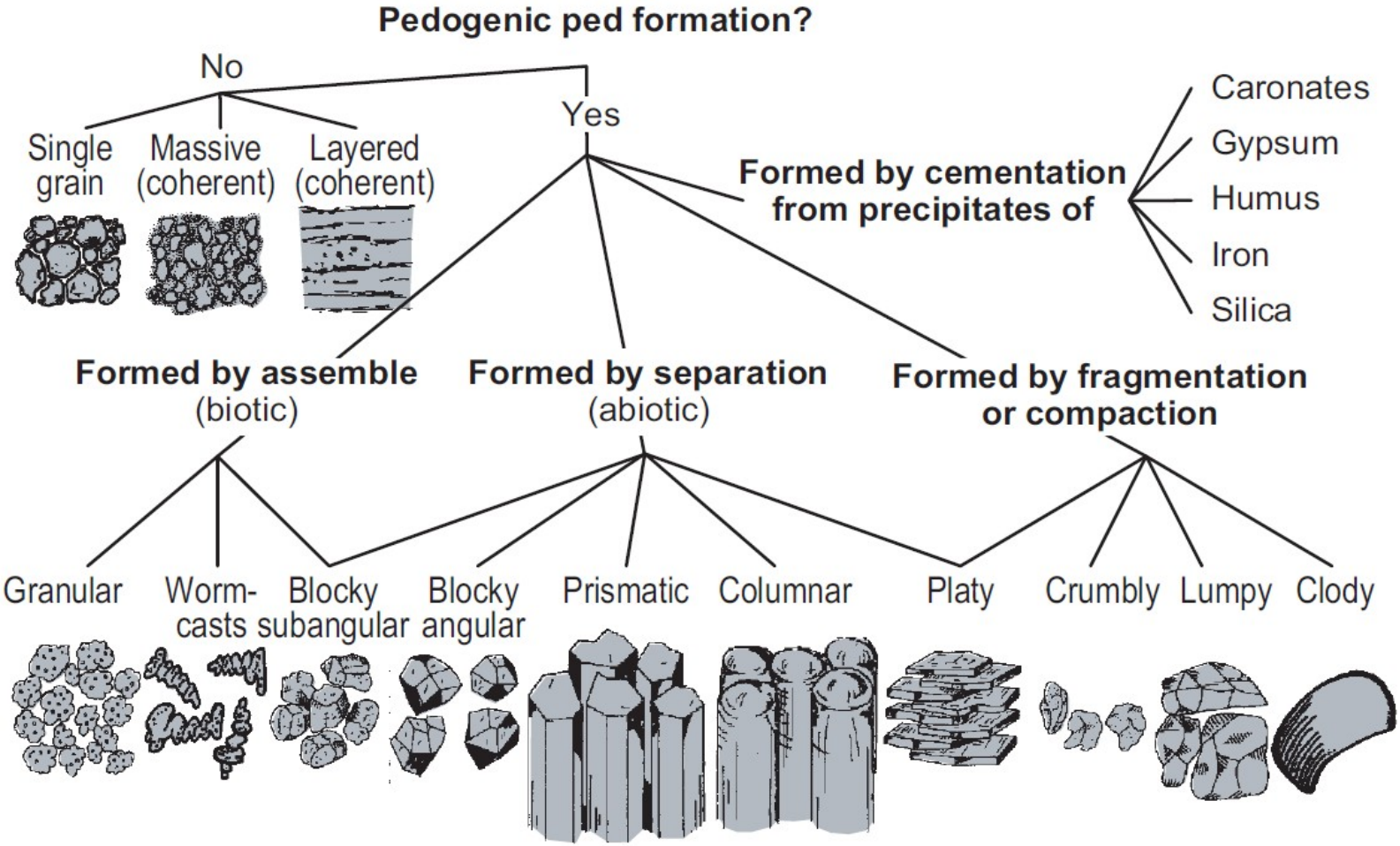
Type

Soil structure



Type

Soil structure

Classification of types of soil structure	
Blocky	Blocks or polyhedrons, nearly equidimensional, having flat or slightly rounded surfaces that are casts of the faces of the surrounding aggregates. Subdivision is recommended into angular, with faces intersecting at relatively sharp angles, and subangular blocky faces intersecting at rounded angles.
Granular	Spheroids or polyhedrons, having curved or irregular surfaces that are not casts of the faces of surrounding aggregates.
Platy	Flat with vertical dimensions limited; generally oriented on a horizontal plane and usually overlapping.
Prismatic	the dimensions are limited in the horizontal and extended along the vertical plane; vertical faces well defined; having flat or slightly rounded surfaces that are casts of the faces of the surrounding aggregates. Faces normally intersect at relatively sharp angles. Prismatic structures with rounded caps are distinguished as Columnar.
Rock structure	Rock structure includes fine stratification in unconsolidated sediment, and pseudomorphs of weathered minerals retaining their positions relative to each other and to unweathered minerals in saprolite from consolidated rocks.
Wedge-shaped	Elliptical, interlocking lenses that terminate in sharp angles, bounded by slickensides; not limited to vertic materials.
Crumbs, lumps and clods	Mainly created by artificial disturbance, e.g. tillage.

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Type

Soil structure

Classification of types of soil structure	
Blocky	Blocks or polyhe that are casts of into angular, wi faces intersectin
Granular	Spheroids or pol faces of surroun
Platy	Flat with vertical overlapping.
Prismatic	the dimensions vertical faces we faces of the surr Prismatic structu
Rock structure	Rock structure in of weathered mi minerals in saprc
Wedge-shaped	Elliptical, interlo limited to vertic
Crumbs, lumps and clods	Mainly created b

Codes for types of soil structure		
RS	Rock structure	
	SS	Stratified structure
SG	Single grain	
MA	Massive	
PM	Porous massive	
BL	Blocky	
	AB	Angular blocky
	AP	Angular blocky (parallelepiped)
	AS	Angular and subangular blocky
	AW	Angular blocky (wedge-shaped)
	SA	Subangular and angular blocky
	SB	Subangular blocky
	SN	Nutty subangular blocky
PR	Prismatic	
	PS	Subangular prismatic
WE	Wedge-shaped	
CO	Columnar	
GR	Granular	
WC	Worm casts	
PL	Platy	
CL	Cloddy	
CR	Crumbly	
LU	Lumpy	

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Size

Soil structure

Size classes for soil structure types

		Granular/platy	Prismatic/columnar/wedge-shaped	Blocky/crumbly/lumpy/cloddy
		(mm)	(mm)	(mm)
VF	Very fine/thin	< 1	< 10	< 5
FI	Fine/thin	1–2	10–20	5–10
ME	Medium	2–5	20–50	10–20
CO	Coarse/thick	5–10	50–100	20–50
VC	Very coarse/thick	> 10	100–500	> 50
EC	Extremely coarse	–	> 500	–

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Soil structure

Soil structure

- Soil structure, or absence of rock structure (including unconsolidated sediments in which stratification is still visible), in half of the volume or more of the fine earth

  >> *cambic horizon.*

- Wedge-shaped structural aggregates with a longitudinal axis tilted 10–60° from the horizontal

  >> *vertic horizon.*

- Moderate to strong, angular blocky structure breaking to flat-edged or nut-shaped elements with shiny ped faces

  >> *nitic horizon.*

- Columnar or prismatic structure in some part of the horizon

  >> *natric horizon*.

- Platy structure

  >> *puddled layer (anthraquic horizon).*

Field estimation of bulk density for mineral soils

Observation	Frequent ped shape	Bulk density (kg dm^{-3}) Code
Sandy, silty and loamy soils with low clay content		
Many pores, moist materials drop easily out of the auger; materials with vesicular pores, mineral soils with andic properties.	granular	< 0.9 BD1
Sample disintegrates at the instant of sampling, many pores visible on the pit wall.	single grain, granular	0.9–1.2 BD1
Sample disintegrates into numerous fragments after application of weak pressure.	single grain, subangular, angular blocky	1.2–1.4 BD2
Knife can be pushed into the moist soil with weak pressure, sample disintegrates into few fragments, which may be further divided.	subangular and angular blocky, prismatic, platy	1.4–1.6 BD3
Knife penetrates only 1–2 cm into the moist soil, some effort required, sample disintegrates into few fragments, which cannot be subdivided further.	prismatic, platy, (angular blocky)	1.6–1.8 BD4
Very large pressure necessary to force knife into the soil, no further disintegration of sample.	prismatic	> 1.8 BD5
Loamy soils with high clay content, clayey soils		
When dropped, sample disintegrates into numerous fragments, further disintegration of subfragments after application of weak pressure.	angular blocky	1.0–1.2 BD1
When dropped, sample disintegrates into few fragments, further disintegration of subfragments after application of mild pressure.	angular blocky, prismatic, platy, columnar	1.2–1.4 BD2
Sample remains mostly intact when dropped, further disintegration possible after application of large pressure.	coherent, prismatic, platy, (columnar, angular blocky, platy, wedge–shaped)	1.4–1.6 BD3
Sample remains intact when dropped, no further disintegration after application of very large pressure.	coherent (prismatic, columnar, wedge–shaped)	>1.6 BD4, 5

Note: If organic matter content is > 2%, bulk density has to be reduced by 0.03 kg dm^{-3} for each 1% increment in organic matter content.

Soil consistency

- Consistency refers to the degree of cohesion or adhesion of the soil mass

  - Consistency when dry
  - Consistency when moist
  - Consistency when wet

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Soil consistency when dry

TABLE 53

Consistence of soil mass when dry

LO	Loose	Non-coherent.
SO	Soft	Soil mass is very weakly coherent and fragile; breaks to powder or individual grains under very slight pressure.
SHA	Slightly hard	Weakly resistant to pressure; easily broken between thumb and forefinger.
HA	Hard	Moderately resistant to pressure; can be broken in the hands; not breakable between thumb and forefinger.
VHA	Very hard	Very resistant to pressure; can be broken in the hands only with difficulty.
EHA	Extremely hard	Extremely resistant to pressure; cannot be broken in the hands.

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Soil consistency when moist

TABLE 54

Consistence of soil mass when moist

LO	Loose	Non-coherent.
VFR	Very friable	Soil material crushes under very gentle pressure, but coheres when pressed together.
FR	Friable	Soil material crushes easily under gentle to moderate pressure between thumb and forefinger, and coheres when pressed together.
FI	Firm	Soil material crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.
VFI	Very firm	Soil material crushes under strong pressures; barely crushable between thumb and forefinger.
EFI	Extremely firm	Soil material crushes only under very strong pressure; cannot be crushed between thumb and forefinger.

Note: Additional codes are: VFF, very friable to friable; FRF, friable to firm; and FVF, firm to very firm.

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Soil consistency when wet

TABLE 55

Classification of soil stickiness

NST	Non-sticky	After release of pressure, practically no soil material adheres to thumb and finger.
SST	Slightly sticky	After pressure, soil material adheres to both thumb and finger but comes off one or the other rather cleanly. It is not appreciably stretched when the digits are separated.
ST	Sticky	After pressure, soil material adheres to both thumb and finger and tends to stretch somewhat and pull apart rather than pulling free from either digit.
VST	Very sticky	After pressure, soil material adheres strongly to both thumb and finger and is decidedly stretched when they are separated.

Note: Additional codes are: SSS, slightly sticky to sticky; and SVS, sticky to very sticky.

Soil consistency when wet

TABLE 56

Classification of soil plasticity

NPL	Non-plastic	No wire is formable.
SPL	Slightly plastic	Wire formable but breaks immediately if bent into a ring; soil mass deformed by very slight force.
PL	Plastic	Wire formable but breaks if bent into a ring; slight to moderate force required for deformation of the soil mass.
VPL	Very plastic	Wire formable and can be bent into a ring; moderately strong to very strong force required for deformation of the soil mass.

Note: Additional codes are: SPP, slightly plastic to plastic; and PVP, plastic to very plastic.

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GOOD CONDITION VS = 2
Good distribution of friable finer aggregates with no significant clodding.

MODERATE CONDITION VS = 1
Soil contains significant proportions of both coarse firm clods and friable, fine aggregates.

POOR CONDITION VS = 0
Soil dominated by extremely coarse, very firm clods with very few finer aggregates.

Scoring (after Shepherd 2000)

Soil porosity

TABLE 60

Classification of porosity

		%
1	Very low	< 2
2	Low	2–5
3	Medium	5–15
4	High	15–40
5	Very high	> 40

TABLE 63

Classification of abundance of pores

		< 2 mm (number)	> 2 mm
N	None	0	0
V	Very few	1–20	1–2
F	Few	20–50	2–5
C	Common	50–200	5–20
M	Many	> 200	> 20

Soil measurements – carbonates

TABLE 38

Classification of carbonate reaction in the soil matrix

	%		
N	0	Non-calcareous	No detectable visible or audible effervescence.
SL	≈ 0–2	Slightly calcareous	Audible effervescence but not visible.
MO	≈ 2–10	Moderately calcareous	Visible effervescence.
ST	≈ 10–25	Strongly calcareous	Strong visible effervescence. Bubbles form a low foam.
EX	≈ > 25	Extremely calcareous	Extremely strong reaction. Thick foam forms quickly.

TABLE 39

Classification of forms of secondary carbonates

SC	soft concretions
HC	hard concretions
HHC	hard hollow concretions
D	disperse powdery lime
PM	pseudomycelia* (carbonate infillings in pores, resembling mycelia)
M	marl layer
HL	hard cemented layer or layers of carbonates (less than 10 cm thick)

Soil measurements – carbonates & gypsum

TABLE 38

Classification of carbonate reaction in the soil matrix

	%		
N	0	Non-calcareous	No detectable visible or audible effervescence.
SL	≈ 0–2	Slightly calcareous	Audible effervescence but not visible.
MO	≈ 2–10	Moderately calcareous	Visible effervescence.
ST	≈ 10–25	Strongly calcareous	Strong visible effervescence. Bubbles form a low foam.
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Classification of forms of secondary carbonates

SC	soft concretions
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D	disperse powdery lime
PM	pseudomycelia* (carbonate infillings in pores, resembling mycelia)
M	marl layer
HL	hard cemented layer or layers of carbonates (less than 10 cm thick)

TABLE 40

Classification of gypsum content

	%	
N	0	Non-gypsiric
SL	≈ 0–5	Slightly gypsiric
MO	≈ 5–15	Moderately gypsiric
ST	≈ 15–60	Strongly gypsiric
EX	≈ > 60	Extremely gypsiric

TABLE 41

Classification of forms of secondary gypsum

SC	soft concretions
D	disperse powdery gypsum
G	"gazha" (clayey water-saturated layer with high gypsum content)
HL	hard cemented layer or layers of gypsum (less than 10 cm thick)

Soil measurements – carbonates & gypsum

Note for classification purposes

Important carbonate contents for classification are:

- ✓ ≥ 2 percent calcium carbonate equivalent → calcaric material.
- ✓ ≥ 15 percent calcium carbonate equivalent in the fine earth, at least partly secondary → calcic horizon.
- ✓ Indurated layer with calcium carbonate, at least partly secondary → petrocalcic horizon.
- ✓ 15–25 percent calcium carbonate equivalent in the fine earth, at least partly secondary → Hypocalcic qualifier.
- ✓ ≥ 50 percent calcium carbonate equivalent in the fine earth, at least partly secondary → Hypercalcic qualifier.
- ✓ Where a soil has a calcic horizon starting 50–10 cm from the soil surface, it is only a Calcisol if the soil matrix between 50 cm from the soil surface and the calcic horizon is calcareous throughout.

Note for classification purposes

Important contents of gypsum for classification are:

- ✓ ≥ 5 percent (by volume) gypsum → gypsiric material.
- ✓ ≥ 5 percent (by mass) gypsum and ≥ 1 percent (by volume) secondary gypsum → gypsic horizon.
- ✓ Indurated layer with ≥ 5 percent (by mass) gypsum and ≥ 1 percent (by volume) secondary gypsum → petrogypsic horizon.
- ✓ 15–25 percent (by mass) gypsum and ≥ 1 percent (by volume) secondary gypsum → Hypogypsic qualifier.

Soil measurements - salt

TABLE 42

Classification of salt content of soil

		$EC_{2.5}$ = dS m^{-1} (25 °C)
N	(nearly)Not salty	< 0.75
SL	Slightly salty	0.75–2
MO	Moderately salty	2–4
ST	Strongly salty	4–8
VST	Very strongly salty	8–15
EX	Extremely salty	> 15

Note for classification purposes

- ✓ Threshold values of ≥ 8 and ≥ 15 dS m^{-1} (EC_{SE}, 25 °C) → salic horizon.
- ✓ ≥ 4 dS m^{-1} (EC_{SE}, 25°C) in at least some layer within 100 cm → Hyposalic qualifier.
- ✓ ≥ 30 dS m^{-1} (EC_{SE}, 25°C) in at least some layer within 100 cm → Hypersalic qualifier.

Soil measurements - salt & pH

TABLE 42

Classification of salt content of soil

		$EC_{2.5}$ = dS m^{-1} (25 °C)
N	(nearly)Not salty	< 0.75
SL	Slightly salty	0.75–2
MO	Moderately salty	2–4
ST	Strongly salty	4–8
VST	Very strongly salty	8–15
EX	Extremely salty	> 15

Note for classification purposes

As the pH value in many soils correlates with the base saturation, it may be used in the field for preliminary classification purposes (Table 44). However, proof in the laboratory is necessary.

Note for classification purposes

- ✓ Threshold values of ≥ 8 and ≥ 15 dS m^{-1} (EC_{SE}, 25 °C) → salic horizon.
- ✓ ≥ 4 dS m^{-1} (EC_{SE}, 25°C) in at least some layer within 100 cm → Hyposalic qualifier.
- ✓ ≥ 30 dS m^{-1} (EC_{SE}, 25°C) in at least some layer within 100 cm → Hypersalic qualifier.

Soil concentrations - coatings

TABLE 64

Classification of abundance of coatings

		%
N	None	0
V	Very few	0–2
F	Few	2–5
C	Common	5–15
M	Many	15–40
A	Abundant	40–80
D	Dominant	> 80

TABLE 65

Classification of the contrast of coatings

F	Faint	Surface of coating shows only little contrast in colour, smoothness or any other property to the adjacent surface. Fine sand grains are readily apparent in the cutan. Lamellae are less than 2 mm thick.
D	Distinct	Surface of coating is distinctly smoother or different in colour from the adjacent surface. Fine sand grains are enveloped in the coating but their outlines are still visible. Lamellae are 2–5 mm thick.
P	Prominent	Surface of coatings contrasts strongly in smoothness or colour with the adjacent surfaces. Outlines of fine sand grains are not visible. Lamellae are more than 5 mm thick.

TABLE 66

Classification of the nature of coatings

C	Clay
S	Sesquioxides
H	Humus
CS	Clay and sesquioxides
CH	Clay and humus (organic matter)
CC	Calcium carbonate
GB	Gibbsite
HC	Hypodermic coatings (Hypodermic coatin as hydromorphic features. Micromorphol *al.*, 1985].)
JA	Jarosite
MN	Manganese
SL	Silica (opal)
SA	Sand coatings
ST	Silt coatings
SF	Shiny faces (as in nitic horizon)
PF	Pressure faces
SI	Slickensides, predominantly intersecting (produced by aggregates sliding one past
SP	Slickensides, partly intersecting
SN	Slickensides, non intersecting

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Soil concentrations - coatings

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SP	Slickensides, partly intersecting
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Soil concentrations - coatings

Note for classification purposes

- ✓ Evidence of silica accumulation, e.g. as coatings → petroduric horizon.
- ✓ Slickensides → vertic horizon and vertic properties.
- ✓ Evidence of clay illuviation → argic and natric horizons.
- ✓ Cracked coatings on sand grains → spodic horizon.
- ✓ Uncoated sand and silt grains → Greyic qualifier.
- ✓ Clay coatings in the argic horizon → Cutanic qualifier.
- ✓ Illuviation in the form of lamellae in the argic, natric and spodic horizon → Lamellic qualifier.

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Soil concentrations - cementation/ compaction

TABLE 71

Classification of the nature of cementation/compaction

K	Carbonates
Q	Silica
KQ	Carbonates–silica
F	Iron
FM	Iron–manganese (sesquioxides)
FO	Iron–organic matter
I	Ice
GY	Gypsum
C	Clay
CS	Clay–sesquioxides
M	Mechanical
P	Ploughing
NK	Not known

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Soil concentrations - cementation/ compaction

TABLE 72

Classification of the degree of cementation/compaction

N	Non-cemented and non-compacted	Neither cementation nor compaction observed (slakes in water).
Y	Compacted but non-cemented	Compacted mass is appreciably harder or more brittle than other comparable soil mass (slakes in water).
W	Weakly cemented	Cemented mass is brittle and hard, but can be broken in the hands.
M	Moderately cemented	Cemented mass cannot be broken in the hands but is discontinuous (less than 90 percent of soil mass).
C	Cemented	Cemented mass cannot be broken in the hands and is continuous (more than 90 percent of soil mass).
I	Indurated	Cemented mass cannot be broken by body weight (75-kg standard soil scientist) (more than 90 percent of soil mass).

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Soil concentrations – mineral concentrations

TABLE 77

Examples of the nature of mineral concentrations

K	Carbonates (calcareous)
KQ	Carbonates–silica
C	Clay (argillaceous)
CS	Clay–sesquioxides
GY	Gypsum (gypsiferous)
SA	Salt (saline)
GB	Gibbsite
JA	Jarosite
S	Sulphur (sulphurous)
Q	Silica (siliceous)
F	Iron (ferruginous)
FM	Iron–manganese (sesquioxides)
M	Manganese (manganiferous)
NK	Not known

Note for classification purposes

- ✓ ≥ 10 percent (by volume) of weakly cemented to indurated, silica-enriched nodules (durinodes) → duric horizon.
- ✓ Reddish to blackish nodules of which at least the exteriors are at least weakly cemented or indurated → ferric horizon.
- ✓ Firm to weakly cemented nodules or mottles with a stronger chroma or redder hue than the surrounding material → plinthic horizon.
- ✓ Strongly cemented or indurated reddish to blackish nodules → pisoplinthic horizon.

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Soil biological activity

TABLE 81

Classification of the abundance of biological activity

N	None
F	Few
C	Common
M	Many

TABLE 82

Examples of biological features

A	Artefacts
B	Burrows (unspecified)
BO	Open large burrows
BI	Infilled large burrows
C	Charcoal
E	Earthworm channels
P	Pedotubules
T	Termite or ant channels and nests
I	Other insect activity

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Soil rooting

TABLE 79

Classification of the diameter of roots

		mm
VF	Very fine	< 0.5
F	Fine	0.5–2
M	Medium	2–5
C	Coarse	> 5

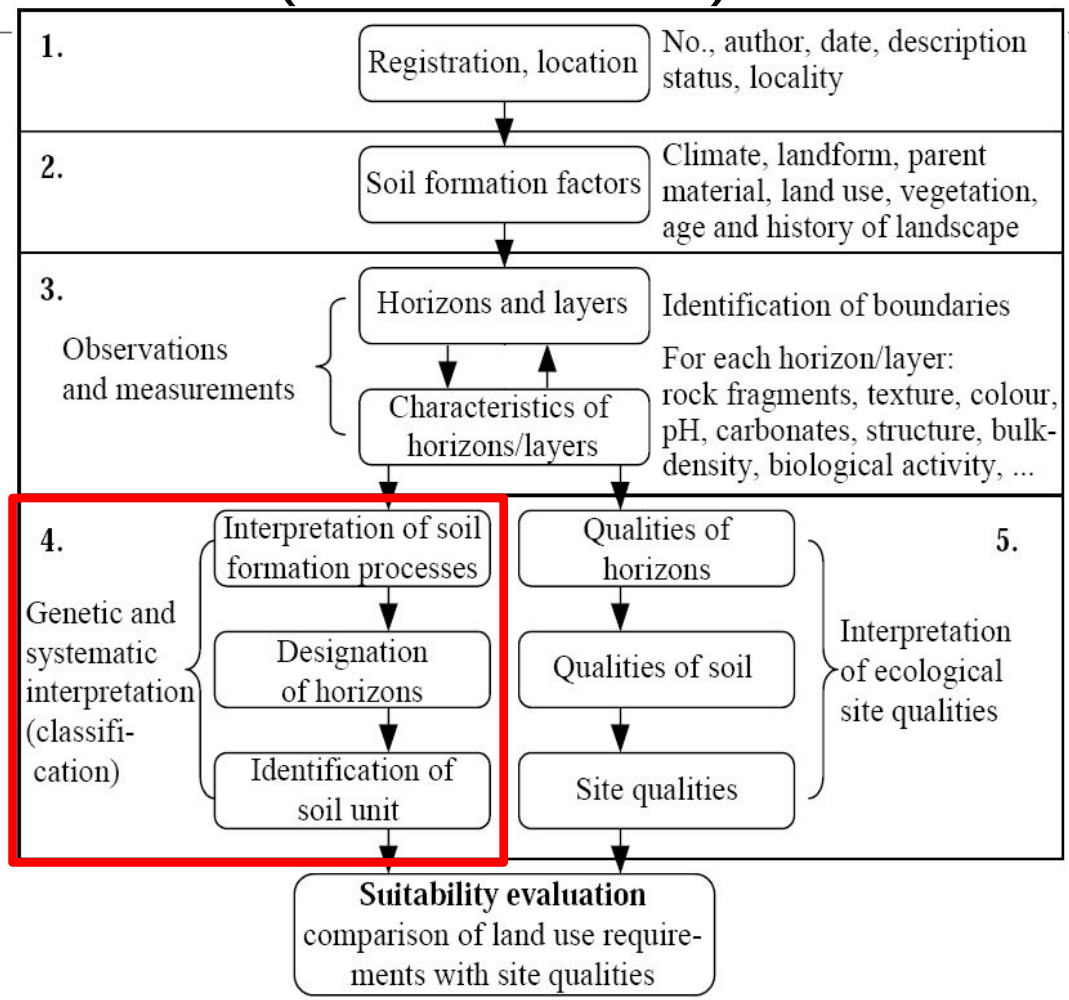
Note: Additional codes are: FF, very fine and fine; FM, fine and medium; and MC, medium and coarse.

TABLE 80

Classification of the abundance of roots

		< 2 mm	> 2 mm
N	None	0	0
V	Very few	1–20	1–2
F	Few	20–50	2–5
C	Common	50–200	5–20
M	Many	> 200	> 20

Soil profile description – interpretation (classification)



Soil profile description – interpretation (classification)

0. Soil description

1. Interpret soil description for references to soil forming processes and express those in the horizon designation,

2. Identify WRB diagnostic horizons, properties and materials

3. Identify WRB Ref Soil Group

4. Identify WRB qualifiers

Including the soil description, classification is done in four steps.

Step 1

The profile description is checked to find references to soil-forming processes (qualitatively) and express them in the horizon designation. Examples may be:

- Darkening of topsoil in comparison to subsoil → enrichment with organic material → Ah-horizon.
- Browning and finer texture in the middle part of a soil profile in comparison to the parent material → enrichment of Fe-oxides and clay → weathering → Bw-horizon.

Step 2

The profile description and the horizon designation are to be checked whether the expression, thickness and depth of certain soil characteristics correspond with the requirements of WRB diagnostic horizons, properties and materials. These are defined in terms of morphological characteristics and/or analytical criteria (IUSS Working Group WRB, 2006). In line with the WRB objectives, attributes are described as much as possible to support field identification.

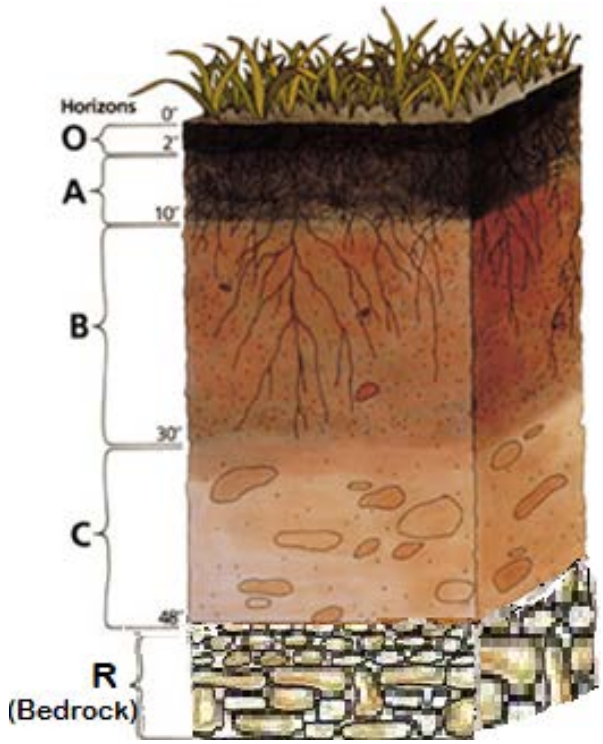
Step 3

The described combination of diagnostic horizons, properties and materials is compared with the WRB Key (IUSS Working Group WRB, 2006) in order to find the RSG, which is the first level of WRB classification. The user should go through the Key systematically, starting at the beginning and excluding one by one all RSGs for which the specified requirements are not met. The soil belongs to the first RSG for which it meets all specified requirements.

Step 4

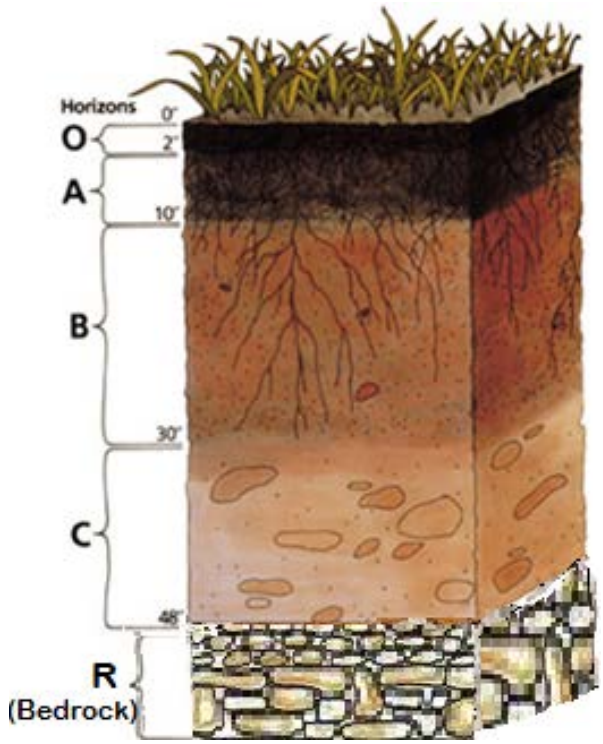
For the second level of WRB classification, qualifiers are used. The qualifiers are listed in the Key with each RSG as prefix and suffix qualifiers. Prefix qualifiers comprise those that are typically associated to the RSG and the intergrades to other RSGs. All other qualifiers are listed as suffix qualifiers. For classification at the second level, all applying qualifiers have to be added to the name of the RSG. Redundant qualifiers (the characteristics of which are included in a previously set qualifier) are not added.

Soil horizon designation – master horizons



O) Organic matter: Litter layer of plant residues in relatively undecomposed form.

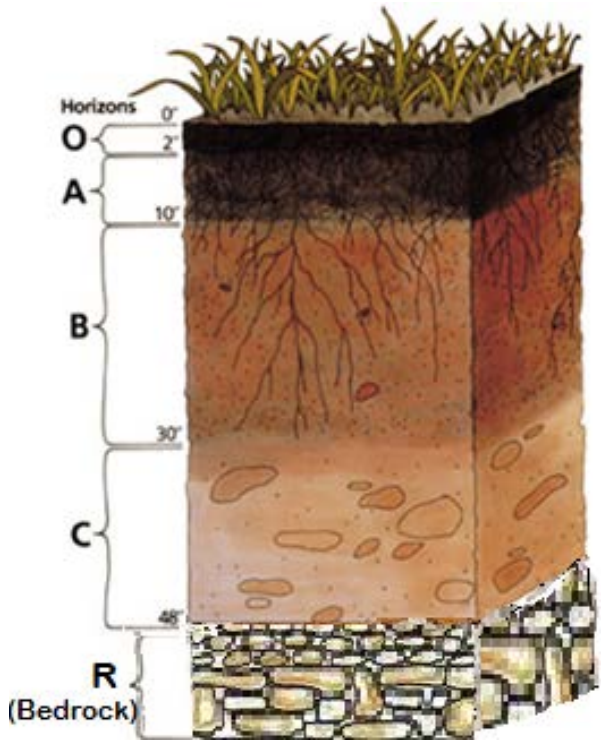
Soil horizon designation – master horizons



O) Organic matter: Litter layer of plant residues in relatively undecomposed form.

A) Surface soil: Layer of mineral soil with most organic matter accumulation and soil life. This layer eluviates (gets depleted of) iron, clay, aluminium, organic compounds, and other soluble constituents.

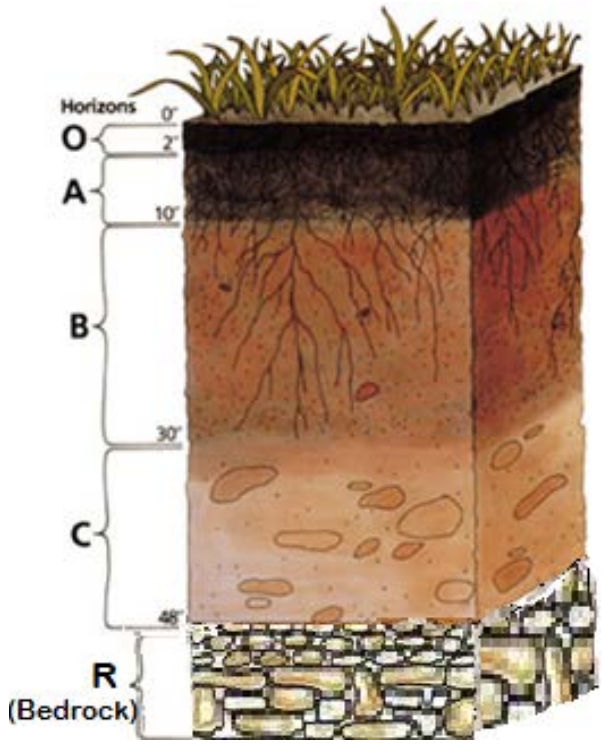
Soil horizon designation – master horizons



O) Organic matter: Litter layer of plant residues in relatively undecomposed form.

A) Surface soil: Layer of mineral soil with humified organic matter accumulation and soil life. This layer eluviates (gets depleted of) iron, clay, aluminium, organic compounds, and other soluble constituents. When eluviation is pronounced, a lighter colored "**E**" subsurface soil horizon is apparent at the base of the "A" horizon.

Soil horizon designation – master horizons

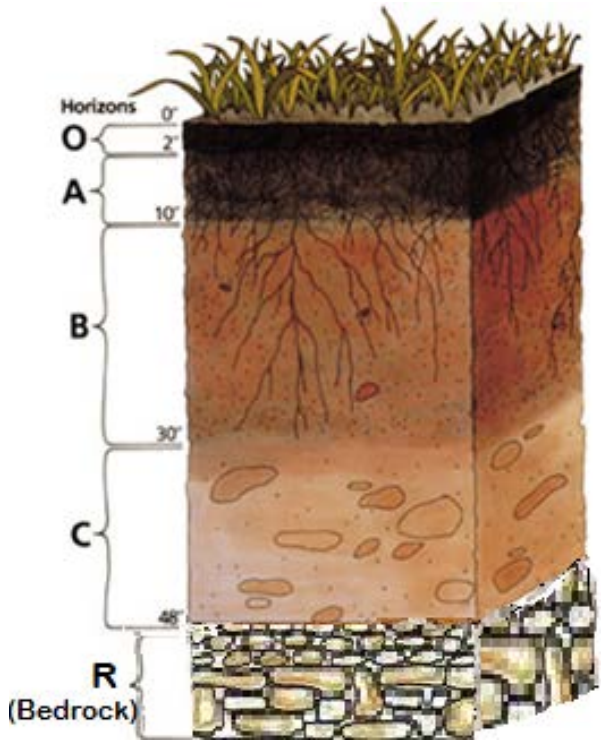


O) Organic matter: Litter layer of plant residues in relatively undecomposed form.

A) Surface soil: Layer of mineral soil with humified organic matter accumulation and soil life. This layer eluviates (gets depleted of) iron, clay, aluminium, organic compounds, and other soluble constituents. When eluviation is pronounced, a lighter colored "E" subsurface soil horizon is apparent at the base of the "A" horizon.

B) Subsoil: This layer accumulates illuvial clay, Fe, Al, humus and/or residual Fe/Al oxides, and/or shows alteration that forms silicate clay and/or liberates oxides and/or shows pedogenetic ped formation.

Soil horizon designation – master horizons



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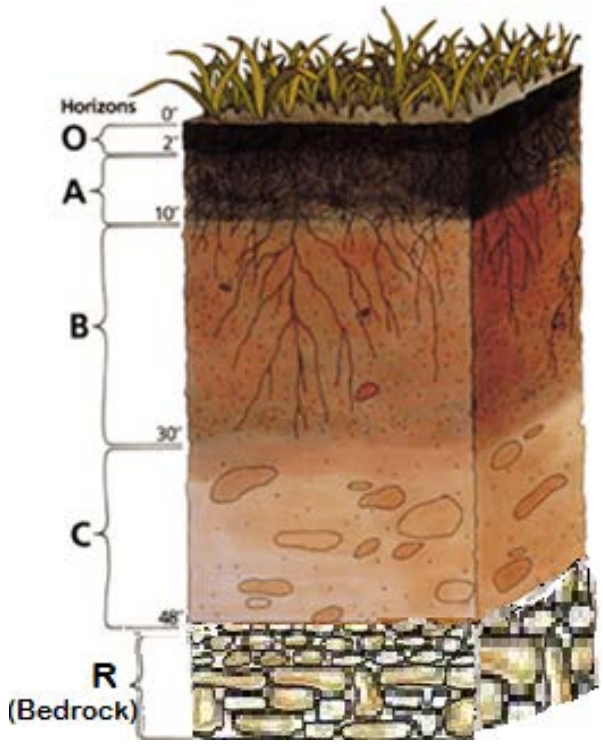
B) Subsoil: This layer accumulates illuvial clay, Fe, Al, humus and/or residual Fe/Al oxides, and/or shows alteration that forms silicate clay and/or liberates oxides and/or shows pedogenetic ped formation.

C) Layer underlying the soil, wherein roots can penetrate, including unconsolidated or weathered parent material.

Soil horizon designation – master horizons



O) Organic matter: Litter layer of plant residues in relatively undecomposed form.

A) Surface soil: Layer of mineral soil with humified organic matter accumulation and soil life. This layer eluviates (gets depleted of) iron, clay, aluminium, organic compounds, and other soluble constituents. When eluviation is pronounced, a lighter colored "E" subsurface soil horizon is apparent at the base of the "A" horizon.

B) Subsoil: This layer accumulates illuvial clay, Fe, Al, humus and/or residual Fe/Al oxides, and/or shows alteration that forms silicate clay and/or liberates oxides and/or shows pedogenetic ped formation.

C) Layer underlying the soil, wherein roots can penetrate, including unconsolidated or weathered parent material.

R) bedrock: R horizons denote the layer of hard bedrock that cannot be excavated by hand. Soils formed *in situ* will exhibit strong similarities to this bedrock layer.

Soil horizon designation – subordinate characteristics

Subordinate characteristics within master horizons

d	Dense layer (physically root restrictive)	mineral horizons, not with m
d	Diatomaceous earth	L horizon
e	Moderately decomposed organic material	H and O horizons
f	Frozen soil	not in I and R horizons
g	Stagnic conditions	no restriction
h	Accumulation of organic matter	mineral horizons
i	Slickensides	mineral horizons
i	Slightly decomposed organic material	H and O horizons
j	Jarosite accumulation	no restriction
k	Accumulation of pedogenetic carbonates	no restriction
l	Capillary fringe mottling (gleying)	no restriction
m	Strong cementation or induration (pedogenetic, massive)	mineral horizons
m	Marl	L horizon
n	Pedogenetic accumulation of exchangeable sodium	no restriction
o	Residual accumulation of sesquioxides (pedogenetic)	no restriction
p	Ploughing or other human disturbance	no restriction, E, B or C as Ap
q	Accumulation of pedogenetic silica	no restriction
r	Strong reduction	no restriction
s	Illuvial accumulation of sesquioxides	B horizons
t	Illuvial accumulation of silicate clay	B and C horizons
u	Urban and other human-made materials	H, O, A, E, B and C horizons
v	Occurrence of plinthite	no restriction
w	Development of colour or structure	B horizons
x	Fragipan characteristics	no restriction
y	Pedogenetic accumulation of gypsum	no restriction
z	Pedogenetic accumulation of salts more soluble than gypsum	no restriction
@	Evidence of cryoturbation	no restriction

Soil

Subordinate characteristics within master horizons

Suffix	Short description	Used for
a	Highly decomposed organic material	H and O horizons
b	Buried genetic horizon	mineral horizons, not cryoturbated
c	Concretions or nodules	mineral horizons
c	Coprogenous earth	L horizon
d	Dense layer (physically root restrictive)	mineral horizons, not with m
d	Diatomaceous earth	L horizon
e	Moderately decomposed organic material	H and O horizons
f	Frozen soil	not in I and R horizons
g	Stagnic conditions	no restriction
h	Accumulation of organic matter	mineral horizons
i	Slickensides	mineral horizons
i	Slightly decomposed organic material	H and O horizons
j	Jarosite accumulation	no restriction
k	Accumulation of pedogenetic carbonates	no restriction
l	Capillary fringe mottling (gleying)	no restriction
m	Strong cementation or induration (pedogenetic, massive)	mineral horizons
m	Marl	L horizon
n	Pedogenetic accumulation of exchangeable sodium	no restriction
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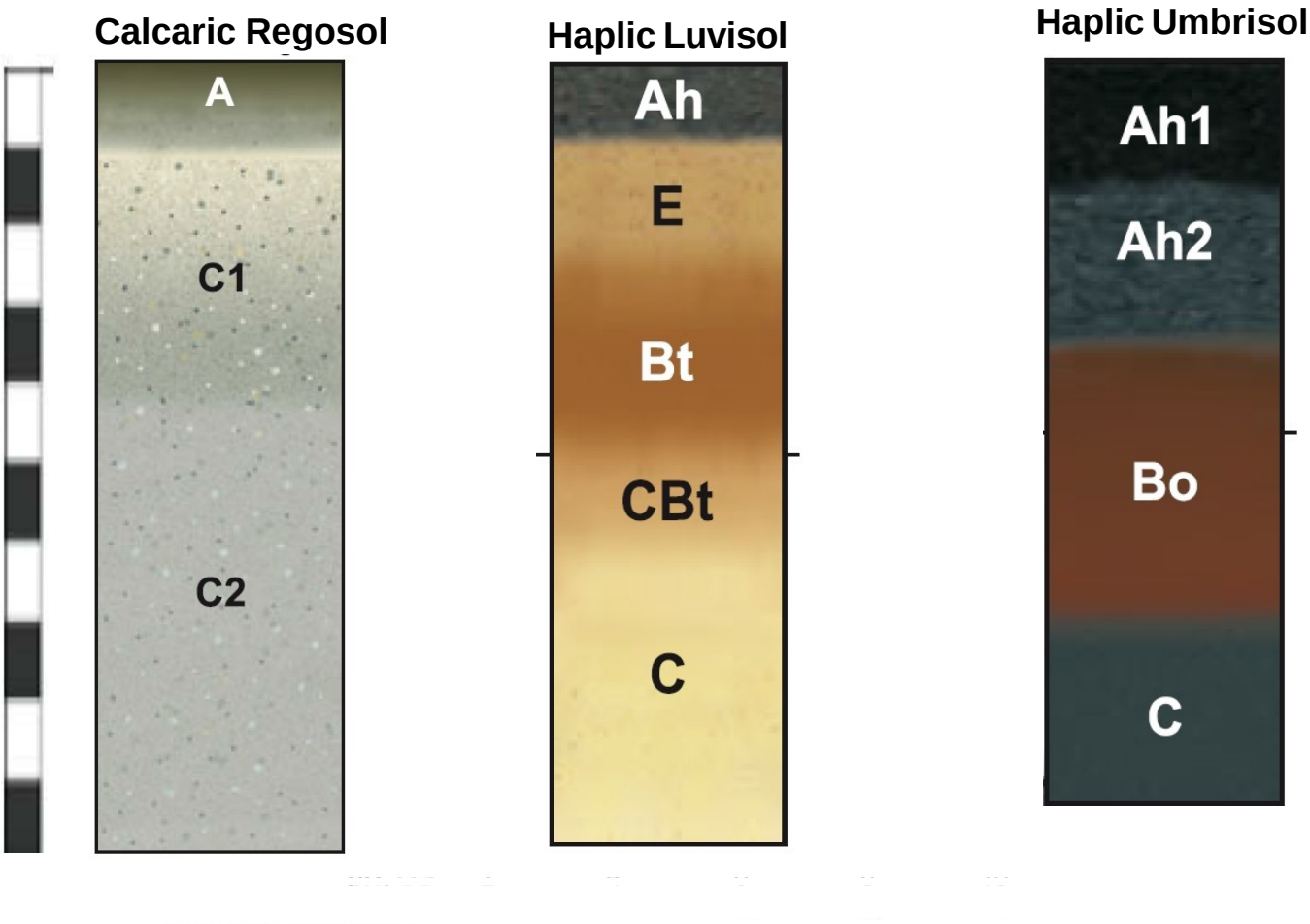
z	Pedogenetic accumulation of salts more soluble than gypsum	no restriction
@	Evidence of cryoturbation	no restriction

Soil horizon designation - examples



Soil horizon designation - examples

- **Oi/Oe/Oa** – slightly/moderately/highly **decomposed organic material**
- Ab/Bb/Cb – Buried genetic horizon in a mineral soil.
- **Ag/Bg/Cg – Strong gleying** in which iron has been reduced and removed during soil formation or in which iron has been preserved in a reduced state because of saturation with stagnantwater.
- **Ah – Accumulation of organic matter**
- **Ap – Plowing** or other anthropogenic disturbance of the surface layer
- **Bc – Concretions** or nodules with Fe, Al, Mn.
- Bd – Physical root restriction, either natural or man-made such as dense basal till, plow pans, etc.
- **Bh – Illuvial accumulation of organic matter** in the form of amorphous, dispersible organic matter-sesquioxide complexes.
- Bk – Accumulation of pedogenic carbonates, commonly calcium carbonate
- **Bs – Illuvial accumulation of sesquioxides** (Fe/Al oxides) and organic matter in the form of illuvial, amorphous, dispersible organic matter-sesquioxide complexes
- **Bt – Accumulation of silicate clay** that either has formed in the horizon and is subsequentlytranslocated or has been moved into it by illuviation.
- **Bw – Development of colour or structure** in a horizon but with little or no apparent illuvial accumulation of materials.
- Br/Cr – Strong reduction; indicated presence of Fe in reduced state

Soil diagnosis according to WRB

TABLE 86

Checklist of WRB diagnostic horizons, properties and materials

Diagnostic horizons		Diagnostic properties	Diagnostic materials
Albic horizon	Natric horizon	Abrupt textural change	Artefacts
Anthraquic horizon	Nitic horizon	Albeluvic tonguing	Calcaric material
Anthric horizon	Petrocalcic horizon	Andic properties	Colluvic material
Argic horizon	Petroduric horizon	Aridic properties	Fluvic material
Calcic horizon	Petrogypsic horizon	Continuous rock	Gypsiric material
Cambic horizon	Petroplinthic horizon	Ferralic properties	Limnic material
Cryic horizon	Pisoplinthic horizon	Geric properties	Mineral material
Duric horizon	Plaggic horizon	Gleyic colour pattern	Organic material
Ferralic horizon	Plinthic horizon	Lithological discontinuity	Ornithogenic material
Ferric horizon	Salic horizon.	Reducing conditions	Sulphidic material
Folic horizon	Sombric horizon	Secondary carbonates	Technic hard rock
Fragic horizon	Spodic horizon	Stagnic colour pattern	Tephric material
Fulvic horizon	Takyric horizon	Vertic properties	
Gypsic horizon	Terric horizon	Vitric properties	
Histic horizon	Thionic horizon		
Hortic horizon	Umbric horizon		
Hydragric horizon	Vertic horizon		
Irragric horizon	Voronic horizon		
Melanic horizon	Yermic horizon		
Mollic horizon			

Soil profile description (FAO, 2006) field form

Soil Profile Description

Profile ID	Date ... / ... / ...	Surveyor	Status (t1) 1 2 3 4 5
Location (admin.)	GPS E ... ° ... ' ... "	GPS N ... ° ... ' ... "	Elevation (m.) .....
(Base) map unit ID	Topography (t7) <0.5 0.5-2 2-5 5-10 10-15 15-30 30-45 45-60 >60		
Major landform (t4) L (P L D F V) - S (E H M P) - T (E H M V)	Position in landform, descr.		
Position on slope (f2) CR UP MS LS TS BO	Slope form (t6) S C V T X / S V C	Slope (%) ...	
Land Use (t8) A M H F P S Y O U	Crop (t9) Ce Oi Fo Ro Fr Fi Ve Pu Lu Ot	Human infl. (t10)	
Geology descr.	Parent material (t12) I M S U		
Outcrops/stoniness (t15)	Cover (%) ... ,N V F C M A D	Size (cm.) ... ,F M C S B L	
Erosion (t16, 17, 18)	Category N W A WA M NK	Area % ... ,0 1 2 3 4 5	Degree S M V E
Sealing (t20)	Thickness (mm) ... ,N F M T V	Consistence S H V E	
Cracks (t21)	Width (cm) ... ,F M W V E	Depth (cm) ... ,S M D V	Distance (m) ... ,C D M W V
Surface drainage V R W S E	Soil drainage E S W M I P V	Flooding freq. (. /yr)	duration (wks) ....
Depth to groundwater (cm) ..... / N	Depth to bedrock (cm) ..... / N	Rootable depth (cm) ....., V S M D X	
Local soil name	Field WRB		
Notes, observations, diagram			

Profile ID					
Horizon (p67 t85)	1	2	3	4	5
Depth interval (cm)	0 -				
Hor. Boundary Distinct. (t24)	A C G D	A C G D	A C G D	A C G D	A C G D
Topography (t24)	S W I B	S W I B	S W I B	S W I B	S W I B
Texture class (f4, t25)					
Coarse fragments					
Abundance % (t26)	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D
Size mm (t27)	F M C S B L	F M C S B L	F M C S B L	F M C S B L	F M C S B L
Weathering state (t29)	F W S	F W S	F W S	F W S	F W S
Colour munsell code moist					
Colour munsell code dry					
Mottles Abundance (t32)	N V F C M A	N V F C M A	N V F C M A	N V F C M A	N V F C M A
Size (t33)	V F M C	V F M C	V F M C	V F M C	V F M C
Prominence (t34)	F D P	F D P	F D P	F D P	F D P
Colour munsell code					

FAO, 2006. Guidelines for soil description, 4th ed.

Soil Profile Description

Carbonates (t38) by HCl	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX
Field pH					
Horizon (p67 t85)	1	2	3	4	5
Structure Grade (t47)	WE MO ST	WE MO ST	WE MO ST	WE MO ST	WE MO ST
Size (t50)	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC
Type (t49) (str breaking into str 2)	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU
Structure 2 Grade (t47)	WE MO ST	WE MO ST	WE MO ST	WE MO ST	WE MO ST
Size (t50)	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC
Type (t49)	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU
Consistency Dry (t53)	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SH A HA VHA EHA
Moist (t54)	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI
Wet (t55, 56)	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP
Moisture status (t57)	VD D SM M W VW	VD D SM M W VW	VD D SM M W VW	VD D SM M W VW	VD D SM M W VW
Porosity Volume % (t60)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Abundance (t53)	N V F C M	N V F C M	N V F C M	N V F C M	N V F C M
Coatings Abundance % (t64)	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D
Contrast (t65)	F D P	F D P	F D P	F D P	F D P
Nature (t66)	C S MN SF PF	C S MN SF PF	C S MN SF PF	C S MN SF PF	C S MN SF PF
Cementation Nature (t71) /compaction Degree (t72)	N Y W M C I	N Y W M C I	N Y W M C I	N Y W M C I	N Y W M C I
Mineral concentrations Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B
Roots Size mm (t79)	VF F M C	VF F M C	VF F M C	VF F M C	VF F M C
Abundance % (t80)	N V F C M	N V F C M	N V F C M	N V F C M	N V F C M
Biological activity Abundance % (t81) Kind (t82)	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I
Sample interval (cm)					
Sample ID					
Diagnostic horizon					
Diagnostic property					
Diagnostic material					

SOIL PIT

FAO, 2006. Guidelines for soil description, 4th ed.

Soil profile description (FAO, 2006) field form

Soil Profile Description

Profile ID …..	**Date** … / … / …	**Surveyor** …..	**Status (t1)** 1 2 3 4 5
Location (admin.) …..	**GPS E** … ° … ‘ … “	**GPS N** … ° … ‘ … “	**Elevation (m.)** …..
(Base) map unit ID …..	**Topography (t7)** <0.5 0.5-2 2-5 5-10 10-15 15-30 30-45 45-60 >60		
Major landform (t4) L (P L D F V) - S (E H M P) - T (E H M V)	**Position in landform, descr.** …..		
Position on slope (f2) CR UP MS LS TS BO	**Slope form (t6)** S C V T X / S V C	**Slope (%)** …	
Land Use (t8) A M H F P S Y O U	**Crop (t9)** Ce Oi Fo Ro Fr Fi Ve Pu Lu Ot	**Human infl. (t10)**	
Geology descr. …..	**Parent material (t12)** I M S U		
Outcrops/stoniness (t15)	Cover (%) … , N V F C M A D	Size (cm.) … , F M C S B L	
Erosion (t16, 17, 18)	Category N W A WA M NK	Area % … , 0 1 2 3 4 5	Degree S M V E
Sealing (t20)	Thickness (mm) … , N F M T V	Consistence S H V E	
Cracks (t21)	Width (cm) … , F M W V E	Depth (cm) … , S M D V	Distance (m) … , C D M W V
Surface drainage V R W S E	**Soil drainage** E S W M I P V	**Flooding freq.** (. /yr) ….	**duration (wks)** ….
Depth to groundwater (cm) ….. / N	**Depth to bedrock (cm)** ….. / N	**Rootable depth (cm)** ….. , V S M D X	
Local soil name	**Field WRB**		
Notes, observations, diagram			

Soil profile description (FAO, 2006) field form

Profile ID					
Horizon (p67 t85)	1	2	3	4	5
Depth interval (cm)	0 -				
Hor. Boundary Distinct. (t24)	A C G D	A C G D	A C G D	A C G D	A C G D
Topography (t24)	S W I B	S W I B	S W I B	S W I B	S W I B
Texture class (f4, t25)					
Coarse fragments					
Abundance % (t26)	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D	N V F C M A D
Size mm (t27)	F M C S B L	F M C S B L	F M C S B L	F M C S B L	F M C S B L
Weathering state (t29)	F W S	F W S	F W S	F W S	F W S
Colour munsell code moist					
Colour munsell code dry					
Mottles Abundance (t32)	N V F C M A	N V F C M A	N V F C M A	N V F C M A	N V F C M A
Size (t33)	V F M C	V F M C	V F M C	V F M C	V F M C
Prominence (t34)	F D P	F D P	F D P	F D P	F D P
Colour munsell code					
Carbonates (t38) by HCl	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX	N SL MO ST EX
Field pH					

Soil profile description (FAO, 2006) field form

Horizon (p67 t85)		1	2	3	4	5
Structure	Grade (t47)	WE MO ST	WE MO ST	WE MO ST	WE MO ST	WE MO ST
	Size (t50)	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC
(str breaking into str 2)	Type (t49)	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU
Structure 2	Grade (t47)	WE MO ST	WE MO ST	WE MO ST	WE MO ST	WE MO ST
	Size (t50)	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC	VF F M C VC
	Type (t49)	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU	RS SG MA PM PR AB SAB PR WE CO GR WC PL CL CR LU
Consistency	Dry (t53)	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SHA HA VHA EHA	LO SO SH A HA VHA EHA
	Moist (t54)	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI	LO VFR FR FI VFI EFI
	Wet (t55, 56)	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP	NS SS S VS NP SP P VP
Moisture status (t57)		VD D SM M W VW	VD D SM M W VW	VD D SM M W VW	VD D SM M W VW	VD D SM M W VW
Porosity	Volume % (t60)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
	Abundance (t63)	N V F C M	N V F C M	N V F C M	N V F C M	N V F C M

Soil profile description (FAO, 2006) field form

Coatings	Abundance % (t64) Contrast (t65) Nature (t66)	N V F C M A D F D P C S MN SF PF	N V F C M A D F D P C S MN SF PF	N V F C M A D F D P C S MN SF PF	N V F C M A D F D P C S MN SF PF	N V F C M A D F D P C S MN SF PF
Cementation /compaction	Nature (t71) Degree (t72)	N Y W M C I	N Y W M C I	N Y W M C I	N Y W M C I	N Y W M C I
Mineral concentrations	Abundance % (t73) Size mm (t75) Hardness (t76) Nature (t77)	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B	N V F C M A D V F M C H S B
Roots	Size mm (t79)	VF F M C	VF F M C	VF F M C	VF F M C	VF F M C
	Abundance % (t80)	N V F C M	N V F C M	N V F C M	N V F C M	N V F C M
Biological activity	Abundance % (t81) Kind (t82)	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I	N V F C M A B C E P T I
Sample interval (cm)						
Sample ID						
Diagnostic horizon						
Diagnostic property						
Diagnostic material						

SOIL PIT

ISRIC World Soil Information

Soil profiles database – site descriptions

FAO2006	FAO2006	FAO2006		FAO2006	SOTER1	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006
p5	p7	p7		p6	p65	t4	f2	t6	p12	t7	t8	t9	t10	t11	t12	t12	t13	t15	t15
	DecDeg	DecDeg	DecDeg	m					%										
Profile ID	Longitude	Latitude	XY accur	Elevation	Map ID	Major landforr	Position	Slope form	Slope gra	opo landscap	Land use	Crop	uman influen	Land cover	Geology	Parent mat	Age	Surface sto	Surface st
ProfileID	X_LonDD	Y_LatDD	XYAccur	Z_Alti	MapID	LndForm	SlpPosit	SlpForm	Slope	Topogrphy	LndUse	Crop	HumanInfl	LndCov	Geology	ParMat		SrfStoneC	SrfStoneS
ET_AM/SG/FA/AS/P1	38.13479	11.80170		2752		LP	LS	S	2.5	5	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/AS/P2	38.17929	11.80287		2976		TM	MS	X	48	9	HI	FoGr	N		I	IP1		M	S
ET_AM/SG/FA/AS/P3	38.16507	11.80391		2768		SV	UP	S	8	6	AA4	CeBa	PL		I	IP1		M	S
ET_AM/SG/FA/AS/P4	38.15488	11.80570		2804		LP	MS	S	4	5	AA4	CeBa	PL		I	IP1		F	S
ET_AM/SG/FA/AS/P5	38.16553	11.80043		2851		TH	UP	V	13	7	AA4	CeBa	PL		I	IP1		M	S
ET_AM/SG/FA/AA/P1	38.15753	11.74270		3288		LL	UP	X	18	8	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/AA/P2	38.14953	11.74698		3228		TM	MS	X	54	9	FP	Ot	VS		I	IP1		M	S
ET_AM/SG/FA/AA/P3	38.15025	11.76489		3221		TM	MS	X	25	8	AA4	eWh;RoP	PL		I	IP1		C	S
ET_AM/SG/FA/AA/P4	38.14425	11.76618		2936		SV	MS	X	13	7	AA4	RoPo	PL		I	IP1		N	N
ET_AM/SG/FA/AA/P5	38.13421	11.77032		2881		SV	MS	X	2	5	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/AA/P6	38.12963	11.77382		2934		TH	MS	V	30	9	FP	Ot	VS		I	IP1		M	S
ET_AM/SG/FA/WM/P1	38.08808	11.84869		2600		SV	UP	S	9	6	AA4	CeBa	PL		I	IP1		N	N
ET_AM/SG/FA/WM/P2	38.08014	11.82985		2675		TH	UP	X	23	8	AA4	CeBa	PL		I	IP1		C	S
ET_AM/SG/FA/WM/P3	38.08106	11.83492		2599		SX	MS	X	8	6	AA4	CeBa	PL		I	IP1		F	S
ET_AM/SG/FA/WM/P4	38.08132	11.84375		2557		SV	MS	S	6	6	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/WM/P5	38.08117	11.86632		2498		LP	MS	S	9	6	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/HA/P1	38.05526	11.84953		2622		LP	MS	S	4	5	HI	FoGr	N		I	IP1		N	N
ET_AM/SG/FA/HA/P2	38.04330	11.83068		2596		LP	MS	X	7	6	AA4	PuBe	PL		I	IB1		A	S
ET_AM/SG/FA/HA/P3	38.04568	11.83258		2634		LL	UP	V	12	7	AA4	PuBe	PL		I	IB1		C	S
ET_AM/SG/FA/HA/P4	38.02850	11.84186		2659		LL	UP	V	18	8	AA4	eBa;CeW	PL		I	IB1		C	S
ET_AM/SG/FA/HA/P5	38.05099	11.87452		2516		LL	UP	S	8	6	AA4	CeBa	PL		I	IB1		N	N

ISRIC World Soil Information

Soil profiles database – horizon descriptions

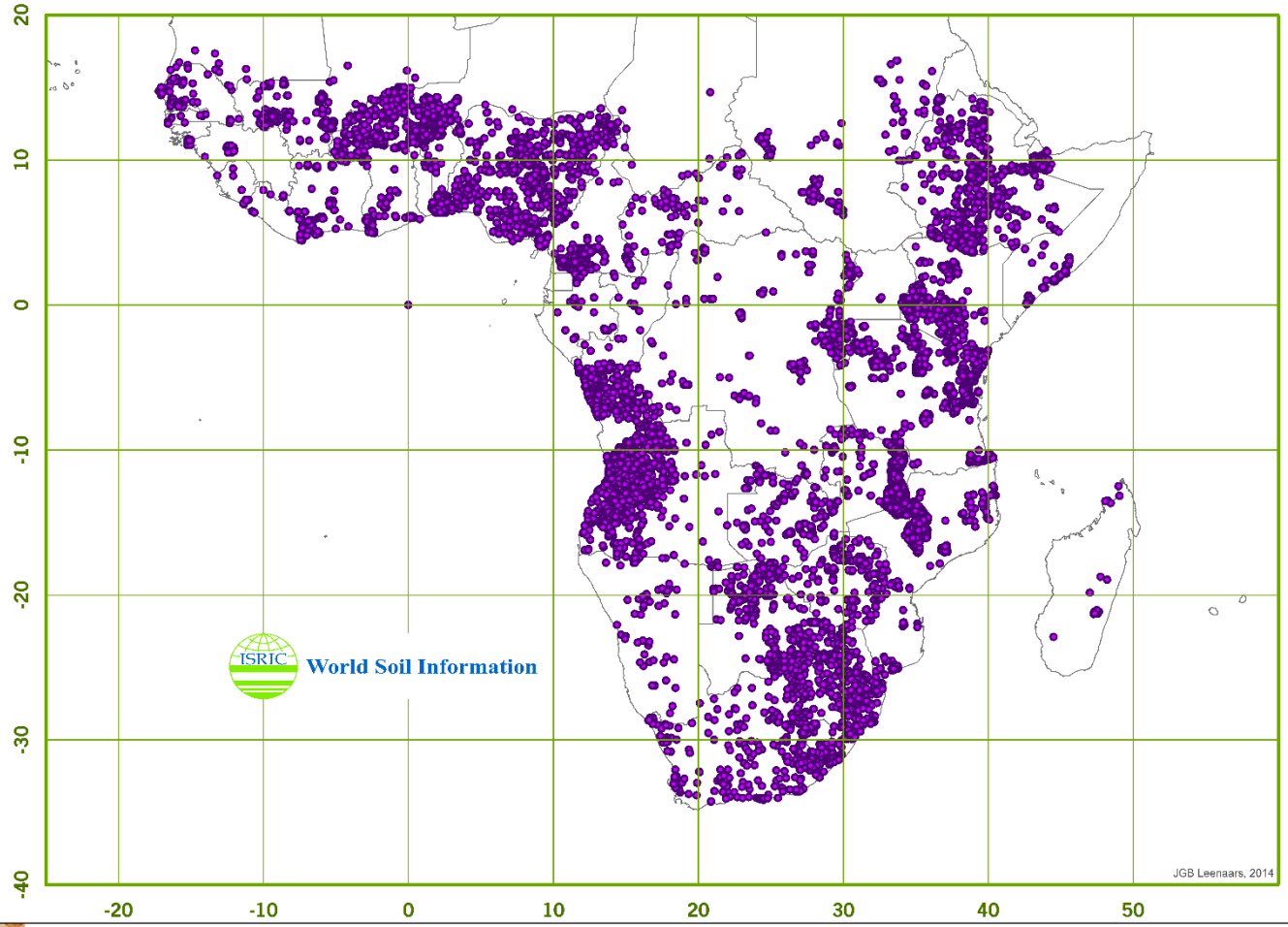
		FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006	FAO2006
		p67 / t85	p24	p24	t32	t33	t34		t38		t47	t50	t49	t47	t50
			cm	cm											
Layer ID	Layer number	Horizon designation	Upper depth	Lower depth	ottles abundanc	Mottles size	ottles prominen	Mottles colour	bonates by	Field pH	tructure 1 grade	Structure 1 size	Structure 1 type	tructure 2 grade	Structure 2 siz
LayerID	LayerNr	HorDes	UpDpth	LowDpth	MottlAbun	MottlSize	MottlProm	MottlColor	Carbonates	FldPH	Str1Grade	Str1Size	Str1Type	Str2Grade	Str2Size
ET_AM/SG/FA/AS/P1_1	1	A	0	10	N	NA	NA	NA	N		WE	F	SAB	WE	F
ET_AM/SG/FA/AS/P1_2	2	1A	10	20	N	NA	NA	NA	N		MO	M	SAB	MO	M
ET_AM/SG/FA/AS/P1_3	3	2A	20	36	F	F	D	Yellowish	N		MO	M	SAB	MO	F
ET_AM/SG/FA/AS/P1_4	4	3A	36	60	F	F	D	Yellowish	N		MO	M	SAB	MO	F
ET_AM/SG/FA/AS/P1_5	5	A1	60	80	F	F	D	Yellowish	N		ST	C	AB	ST	M
ET_AM/SG/FA/AS/P1_6	6	A2	80	130	F	F	D	Yellowish	N		ST	M	AB	ST	F
ET_AM/SG/FA/AS/P2_1	1	A	0	20	N	NA	NA	NA	N		MO	M	CR	MO	F
ET_AM/SG/FA/AS/P3_1	1	A	0	40	N	NA	NA	NA	N		WE	F	GR	WE	F
ET_AM/SG/FA/AS/P4_1	1	AP	0	20	N	NA	NA	NA	N		MO	M	GR	MO	F
ET_AM/SG/FA/AS/P4_2	2	B	20	40	N	NA	NA	NA	N		MO	M	SAB	MO	F
ET_AM/SG/FA/AS/P4_3	3	BC	40	100	C	M	D	Reddish	N		ST	M	SAB	ST	F
ET_AM/SG/FA/AS/P5_1	1	AP	0	20	N	NA	NA	NA	N		WE	F	CR	WE	F
ET_AM/SG/FA/AA/P1_1	1	AP	0	20	N	NA	NA	NA	N		MO	M	CR	MO	M
ET_AM/SG/FA/AA/P1_2	2	AC	20	40	N	NA	NA	NA	N		MO	F	SAB	MO	F
ET_AM/SG/FA/AA/P2_1	1	AP	0	20	N	NA	NA	NA	N		WE	F	CR	WE	F
ET_AM/SG/FA/AA/P3_1	1	AP	0	20	N	NA	NA	NA	N		WE	F	SAB	WE	F
ET_AM/SG/FA/AA/P4_1	1	AP	0	12	N	NA	NA	NA	N		MO	M	SAB	MO	F
ET_AM/SG/FA/AA/P4_2	2	Bt1	12	40	C	M	D	C	N		MO	M	SAB	MO	F
ET_AM/SG/FA/AA/P4_3	3	Bt2	40	65	N	NA	NA	NA	N		MO	M	AB	MO	F
ET_AM/SG/FA/AA/P4_4	4	BC	65	95	N	NA	NA	NA	N		WE	F	AB	WE	F
ET_AM/SG/FA/AA/P5_1	1	AP	0	40	N	NA	NA	NA	N		WE	M	GR	WE	F
ET_AM/SG/FA/AA/P5_2	2	Bg	40	90	N	NA	NA	NA	N		M	M	SAB	M	F
ET_AM/SG/FA/AA/P5_3	3	Btg	90	200	N	NA	NA	NA	N		ST	C	SAB	ST	M
ET_AM/SG/FA/AA/P6_1	1	AP	0	25	N	NA	NA	NA	N		WE	F	GR	WE	F

Soil profiles database – horizon samples

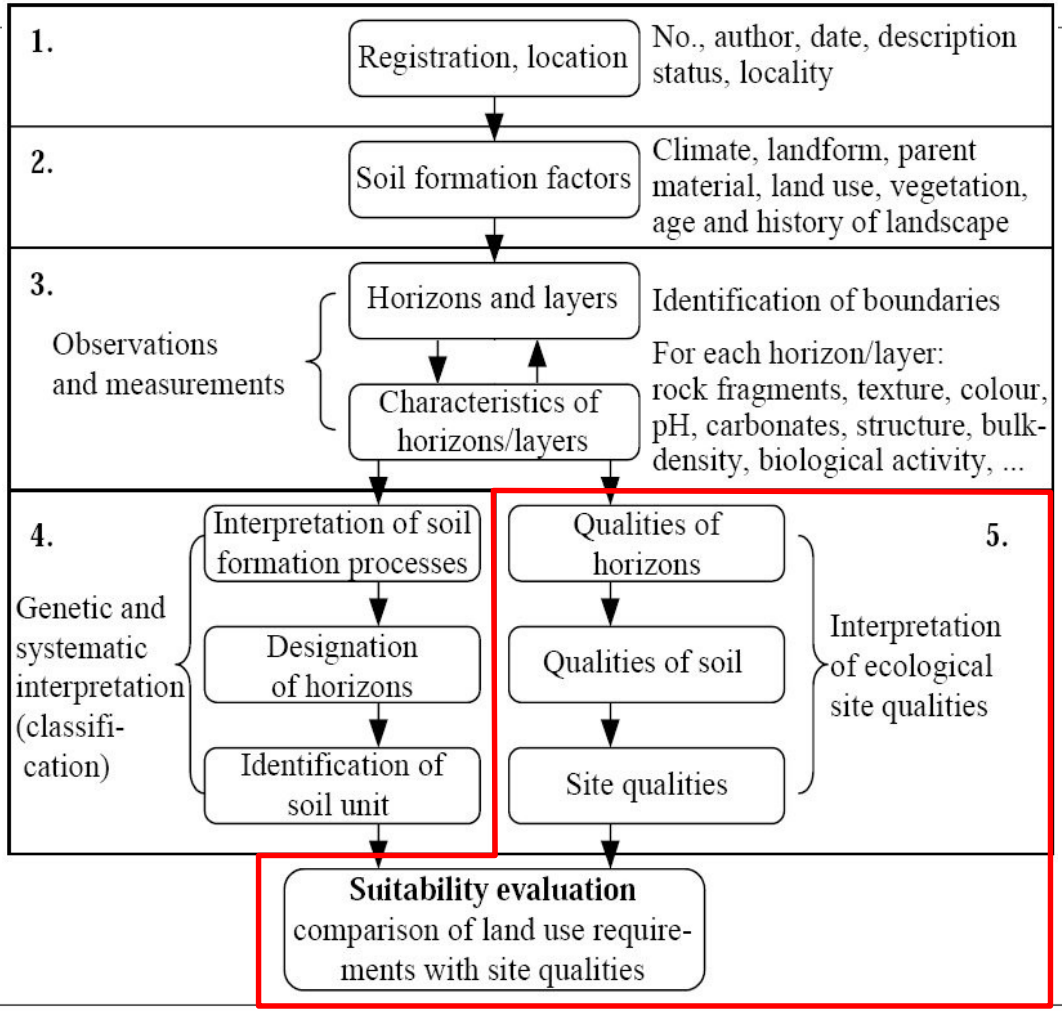
LyrObj	ProfileID	LayerID	ExAcid	Ecec	CecSoil	Bsat	CaSO4	CaCO3	OrgC	TotalN	CN	TotalP
79232	SO_28564_212	SO_28564_212_4	0.0	15.7	3.5	100.0	0.00	2.00	1.30	0.50	2.6	
79233	SO_28564_213	SO_28564_213_1	0.0	31.2	61.1	51.1	0.00	173.00	5.90	1.00	5.9	
79234	SO_28564_213	SO_28564_213_2	0.0	28.5	44.6	64.0	1.50	178.00	3.00	0.70	4.3	
79235	SO_28564_213	SO_28564_213_3	0.0	62.4	49.2	100.0	9.50	162.00	2.20	0.60	3.7	
79236	SO_28564_214	SO_28564_214_1	0.0	23.1	58.3	39.7	0.90	182.00	5.10	0.90	5.7	
79237	SO_28564_214	SO_28564_214_2	0.0	26.1	65.7	39.8	1.80	198.00	3.40	0.50	6.8	
79238	SO_28564_214	SO_28564_214_3	0.0	56.8	50.2	100.0	0.00	194.00	1.90	0.50	3.8	
79239	SO_28564_214	SO_28564_214_4	0.0	38.6	48.5	79.7	0.00	215.00	1.80	0.40	4.5	
79240	SO_28564_215	SO_28564_215_1	0.0	36.4	39.7	91.7	0.00	183.00	6.80	0.90	7.6	
79241	SO_28564_215	SO_28564_215_2	0.0	35.7	35.9	99.3	0.00	190.00	5.50	0.70	7.9	
79242	SO_28564_215	SO_28564_215_3	0.0	37.8	41.4	91.2	0.00	187.00	5.40	0.70	7.7	
79243	SO_28564_215	SO_28564_215_4	0.0	41.7	29.6	100.0	0.00	185.00	4.50	0.60	7.5	
79244	SO_28564_216	SO_28564_216_1	0.0	3.6	0.4	100.0	0.00	16.00	1.30	0.20	6.5	
79245	SO_28564_216	SO_28564_216_2	0.0	3.4	0.7	100.0	0.00	24.00	0.70	0.20	3.5	
79246	SO_28564_216	SO_28564_216_3	0.0	3.5	0.4	100.0	0.00	37.00	0.50	0.20	2.5	
79247	SO_28564_216	SO_28564_216_4	0.0	3.2	-9999.0	-9999.0	0.00	44.00	0.60	0.20	3.0	
79248	SO_28564_216	SO_28564_216_5	0.0	2.9	-9999.0	-9999.0	0.00	68.00	0.30	0.10	3.0	
79249	SO_28564_217	SO_28564_217_1	0.0	21.0	22.5	93.3	0.00	169.00	8.90	1.30	6.8	
79250	SO_28564_217	SO_28564_217_2	-9999.0	-9999.0	37.3	97.6	0.00	169.00	6.80	0.90	7.6	
79251	SO_28564_217	SO_28564_217_3	0.0	22.2	4.3	100.0	0.00	224.00	4.70	0.50	9.4	
79252	SO_28564_217	SO_28564_217_4	0.0	38.1	43.8	87.1	0.00	170.00	5.60	0.90	6.2	
79253	SO_28564_218	SO_28564_218_1	0.0	26.0	43.5	59.8	0.00	216.00	10.00	1.00	10.0	
79254	SO_28564_218	SO_28564_218_2	0.0	28.1	20.9	100.0	0.00	210.00	10.40	0.70	14.9	
79255	SO_28564_218	SO_28564_218_3	0.0	28.2	34.2	82.5	0.00	195.00	13.20	0.60	22.0	
79256	SO_28564_218	SO_28564_218_4	0.0	28.4	48.3	58.8	0.00	190.00	12.40	0.50	24.8	
79257	SO_28564_219	SO_28564_219_1	0.0	39.5	53.0	74.4	0.00	131.00	19.70	2.10	9.4	
79258	SO_28564_219	SO_28564_219_2	0.0	81.3	60.5	100.0	19.20	150.00	9.30	1.10	8.5	

AfSP01301Qry_AttrValuesLayers

Soil profiles database - example



Soil profile description – land evaluation



Soil profile description – land evaluation

(responsiveness to fertilisers) Saria

BD **BC** **BA** **HB** **HA**

Low on the 'hardly observable' slope are the sandy soil BD (very deep, poorly drained) and the sandy clay soils BC (deep) and BA (moderately deep). High on the slope are gravelly soils HB (moderately deep) and HA (shallow). Organic carbon, total nitrogen and available phosporus content of the BA and BC topsoils was twice of that of the BD, HB and HA topsoils

JGB Leenaars

Soil profile description – land evaluation
(out of scope)

Think about interpreting...

- ...soil colour in view of organic matter content
- ...soil pH in view of relative availability (mobility) of elements
- ...mottling in view of stagnating water
- ...density and depth distribution as positive/negative indicators for plant growth conditions
- ...soil texture in view of water infiltration, rooting, etc.
- ...soil structure in view of soil compaction

More on this topic on Thursday morning!

Thank you

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