ANDOSOLS and ARENOSOLS

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ISRIC – World Soil Information

Wageningen

The Netherlands

Definition of Andosols (WRB 2001)

Soils having

1. an ***andic*** or a ***vitric*** horizon starting within 25 cm from the soil surface; and
2. no diagnostic horizons (unless buried deeper than 50 cm) other than a *histic*, *fulvic*, *melanic*, *mollic*, *umbric*, *ochric*, *duric* or *cambic* horizon.

Andic horizon (WRB 2001)

1. BD at field capacity < 0.9 kg dm^{-3}; and
2. ≥ 10 percent clay, and Al_{ox}+½Fe_{ox} ≥ 2 percent in the fine earth; and
3. P-retention ≥ 70 percent; and
4. < 10 percent volcanic glass in fine earth fraction; and
5. thickness of 30 cm or more.

Vitric horizon (WRB 2001)

1. ≥ 10 percent volcanic glass and other primary minerals in the fine earth fraction; and either

2. - BD > 0.9 kg dm^{-3}; or
   - Al_{ox}+½Fe_{ox} > 0.4 percent; or
   - P-retention > 25 percent; and

3. thickness of 30 cm or more.

Vitric horizon (WRB 1998)

1. ≥ 10 percent volcanic glass and other primary minerals in the fine earth fraction; and either
2. < 10 percent clay in the fine earth fraction, or
3. BD > 0.9 kg dm^{-3}; or
4. Al_{ox}+½Fe_{ox} > 0.4 percent; or
5. P-retention > 25 percent; and
6. thickness of 30 cm or more.

Tephric soil material (WRB 2001)

Tephric soil material must have:

1. ≥ 60 percent tephra; and
2. < 0.4 percent Al_{ox}+½Fe_{ox}.

(Definition adapted from Hewitt, 1992)

Tephric RSGs are predecessors to various types of **Andosols**.

Genesis of Andosols

Main soil-forming factor is:

Parent material

Main soil-forming processes are:

- Rapid chemical weathering of porous, fine-grained minerals, releasing large amounts of Al, Fe and Si;
- Formation of stable Al-humus complexes;
- *Either* precipitation of opaline silica *or* formation of allophane and imogolite if not all Al is tied up in complexes, and formation of ferrihydrite;
- Accumulation of organic matter.

Subdivision of Andosols

Based on:

- Degree of weathering
- Silica-aluminium chemistry
- Presence of horizons or properties typical for Andosols
- Intergrades to other reference groups
- Chemical characteristics other than the silica-aluminium chemistry

Andosol qualifiers (WRB 2001)

Vitric
Silandic
Aluandic
Eutrisilic

Melanic
Fulvic
Hydric

Arenic

Histic
Leptic
Gleyic
Mollic
Duric
Luvic
Umbric

Placic
Pachic

Calcaric

Skeletic
Acroxic
Vetic
Sodic

Dystric
Eutric

Bottlenecks

- *Vitric* horizon definition still unsatisfactory
- Colour requirement in *fulvic* horizon should be changed
- Lacking qualifiers, e.g. Fluvic, Folic, Humic, Stagnic, Turbic

These and other bottlenecks will hopefully be removed in the Revised Edition of WRB, foreseen for 2006

Examples of Andosols (1)

Umbri-Vitric Andosol, Italy

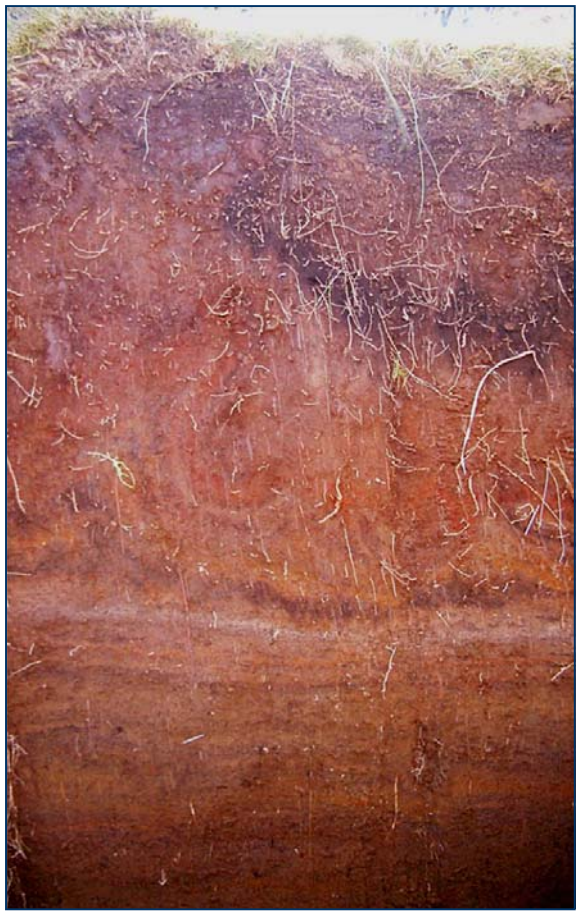
cm		Clay	BD	$Al_{ox}+½Fe_{ox}$
0- 4		27	-	4.2
4- 29	15	0.50	5.3	
29- 47	3	0.58	6.2	
47- 66	7	0.57	6.2	
66-120	3	0.58	5.2	

Examples of Andosols (2)

Molli-Silandic Andosol (Calcaric), Nicaragua

cm	Clay	BD	Si_{ox}	$Al_{ox}+½Fe_{ox}$
0- 12	18	-	0.8	3.0
12- 33	15	0.82	0.7	2.8
33- 55	16	0.69	0.9	3.4
55- 78	11	0.70	0.8	3.6
78-104	29	-	1.1	3.5
104-115	27	-	1.9	5.8

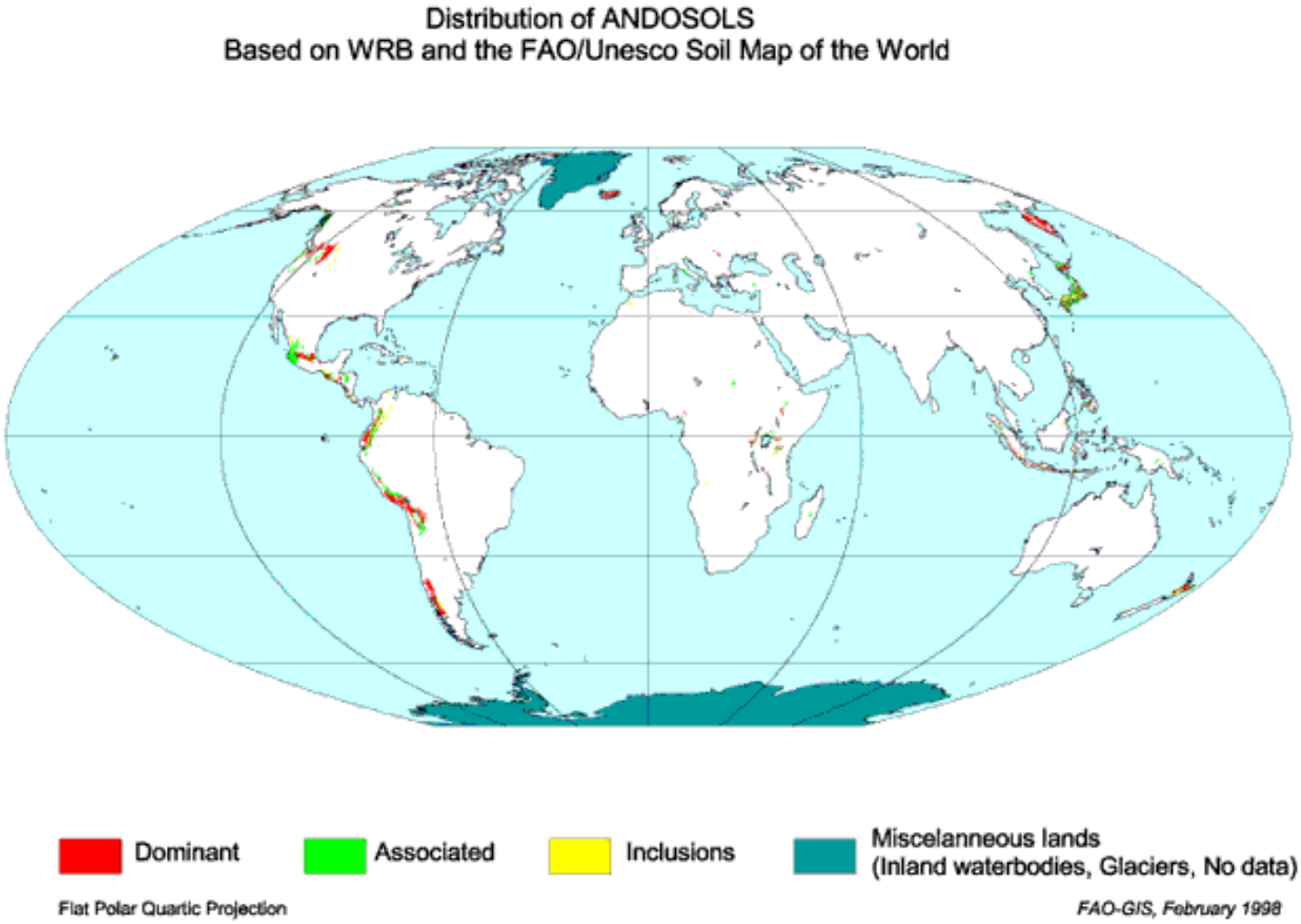
Examples of Andosols (3)



Molli-Silandic Andosol *("Turbic")*, Iceland

cm	Text	BD	Si_{ox}	Al_{ox}+½Fe_{ox}
0-11	SiL	0.56	3	2.5
11-26	SiL	-	4	2.5
26-37	SiL	-	5	5
37-47	CL	-	5	5
47-70	SiCL	0.39	2	6
70-82	SiCL	0.18	2	7

Distribution of Andosols (1)



Distribution of Andosols (2)

Andosols cover some 110M ha or 0.9 % of the Earth's land surface. They occur in active volcanic regions, such along the Pacific rim, the Mid-Atlantic islands, the African Rift and in the Mediterranean region as well as in areas with extinct volcanism such as Germany, France, Hungary and Slovakia.

Definition of Arenosols

Soils having

1. A texture loamy sand or coarser ***either*** to a depth of at least 100 cm from the soil surface, ***or*** to a *(petro)plinthic* or *salic* horizon between 50 and 100 cm from the soil surface; and
2. Less than 35% coarse fragments; and
3. No diagnostic horizons other than an *ochric*, *yermic* or *albic* horizon, or a *(petro)plinthic* or *salic* horizon below 50 cm from the soil surface.

Why Arenosols?

Arenosols group together all coarse-textured soils that have a low water-holding capacity, rapid permeability, and a low nutrient content.

They also group together soils that, with little vegetation cover, are highly vulnerable to wind erosion.

Genesis of Arenosols

Main soil forming factor(s) is/are:

Parent material (climate, time)

Main soil forming processes are (three pathways):

1. Recent sandy deposits, too young to show signs of significant soil formation;
2. Stand-still of soil forming processes, particularly in dry regions;
3. Extreme weathering of coarse-grained acid parent material.

Subdivision of Arenosols

Based on:

- Linkages with other RSGs
- Material characteristics
- Surface characteristics
- Age
- Nutrient status
- Colour

Arenosol qualifiers

Gelic
Hyposalic
Gleyic
Hyperalbic Albic
Plinthic
Hypoferralic
Hypoluvic

Tephric
Gypsiric
Calcaric
Lamellic
Fragic

Yermic
Aridic

Protic

Dystric
Eutric

Rubic

Haplic

Examples of Arenosols (1)

Eutri-Aridic Arenosol (Rubic), Namibia

cm	Sand	CEC
0- 5	96	0.7
5- 20	97	0.9
20- 40	97	0.7
40-120	94	0.8

Examples of Arenosols (2)

Proti-Aridic Arenosol (Eutric), China

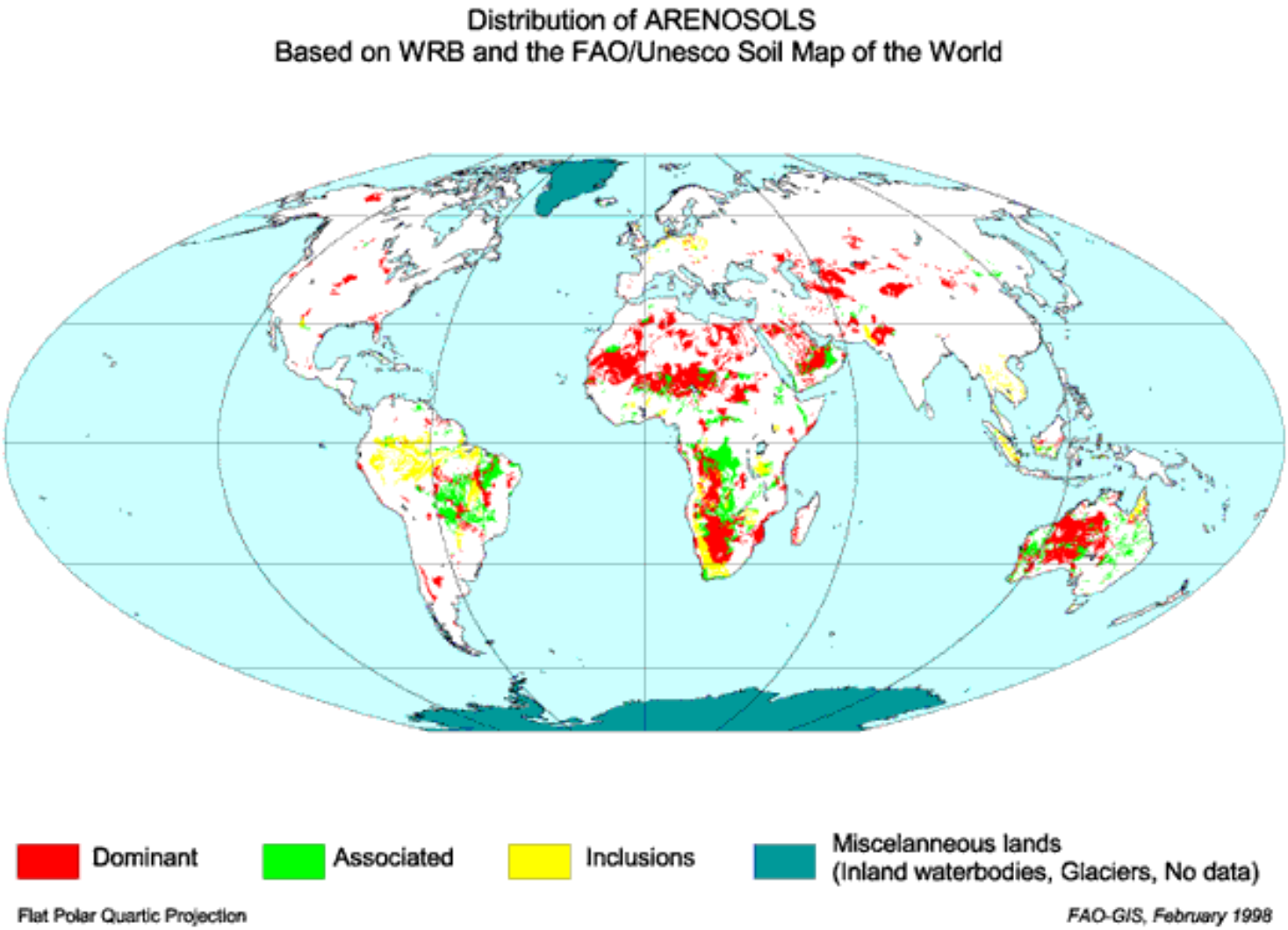
cm	Sand	CEC
0- 50	96	2.1
50-100	96	2.3

Examples of Arenosols (3)

Dystri-Hyperalbic Arenosol, Surinam

In the humid tropics, such soils frequently develop as part of a ***"Giant Podzol"***.

Distribution of Arenosols (1)



Distribution of Arenosols (2)

Arenosols cover some 900M ha or about 7% of the land surface. They are most extensive in desert regions (Sahara, Kalahari, Saudi Arabia, Central Asia and Australia), large alluvial basins (Amazon, Congo), and along coasts with dune fields.

Associated soils

Arenosols in *dry regions* are associated with Leptosols, Regosols, Gypsisols, Durisols and Calcisols.

In the *humid tropics* they occur together with Ferralsols, Acrisols and Lixisols, Plinthosols and Podzols.

In the *young alluvial basins and coastal regions* they are associated with Fluvisols and Gleysols.