

Soils

Pedology = science studying the thinnest, organic part of the Earth's surface – soil cover.
1880s: soil was recognized as a natural body – worthy of study in its own right - by the Russian scientist Dokuchaev.

Soil = a complex mixture of mineral matter, organic matter and living organisms. Soil is a product of the environment, constantly changing.

Soils develop over time (very slowly in dry desert areas or more quickly in wet tropical regions).

Soil can be thought of as the "skin" of the land; without it the land would die.

Soil = constantly being eroded at its surface by *wind, water and man's activities* and being renewed at its base by weathering of its parent material. Think of this important resource in three dimensions i.e. soil has depth as well as area.

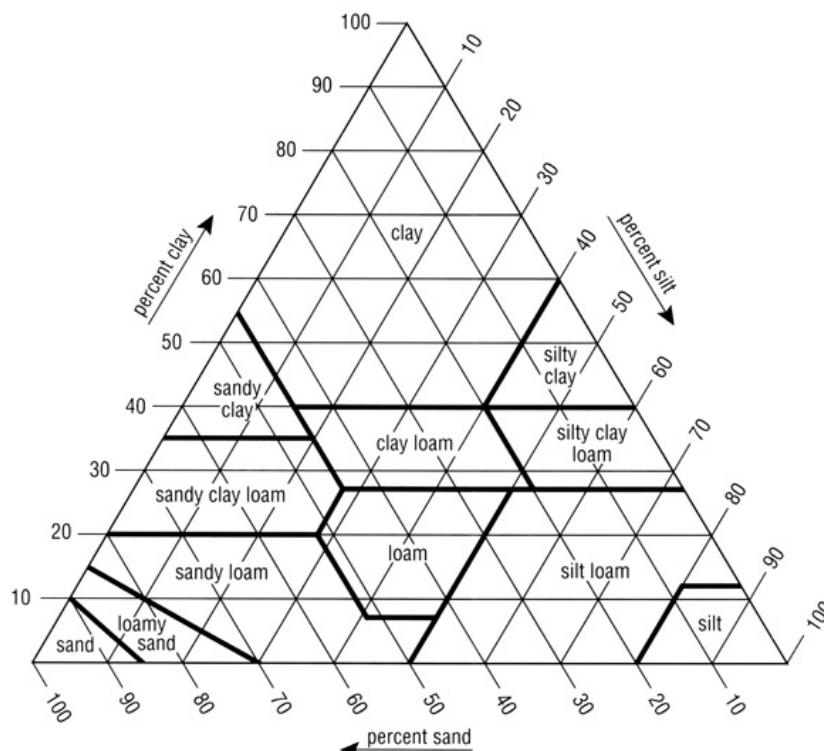
Soil = composed of solid particles of different sizes (minerals and organic matter) often "glued" together into tiny aggregates by organic matter, mineral oxides and charged clay particles. The gaps between the particles link together into a meandering network of pores of various sizes. Through this pore space the soil exchanges water and air with the environment. The movement of air and water also allows for heat and nutrients to flow.

Soil texture

= refers to the size of the solid particles in a soil, ranging from gravel to clay.

Most of soils = sand, silt and clay particles =>

- *sandy soils* – weak structure, large spaces between the coarse particles => rapid drainage of water
- *loamy soils* – smaller spaces between particles, during dry seasons structural damages can be caused
- *silty soils* – low organic matter content, weak structure, risk of erosion,



Soil structure

= shape of the individual grains =>

- *crumb* – suitable for agriculture
- *prismatic* – disabling of free movement of water and air

Soil horizons

Soil profile = 2-D, vertical section through a soil.

- ❖ Topsoil (humus) cover = organic horizon with dark colour (organic matter)
- ❖ Leached or removal (elluvial) horizon = leaching = removal of soluble material from the horizon downwards, e.g. podzols (intensive leaching) => ash-coloured horizon
- ❖ Deposited (illuvial) horizon = contain (re)moved material, e.g. Fe, humus and clay
- ❖ Bedrock (parent material) = rock situated below the soil

Factors affecting soils

- Geology – calcareous (base-rich nutrients) vs. non-calcareous rocks (acidic soils)
- Climate
 - *temperature* (affects the rate of chemical and biological reactions) → cool climates = bacterial action is slow (slow decomposition)
 - *precipitation* (leaching of aluminium and iron oxides deposited at depth within the soil)
- Organic matter – basic component of a soil (plant and animal remains)
- Topography – slope angle →
 - steeper slopes = thinner soils ⇔ erosion
 - lowlands = deposition

Draw a soil catena with a proper vegetation cover!

Soil-formation processes

- *Podzolisation* = common on acidic soils (under evergreen/coniferous forests, heathlands)
- *Ferralisation* = common in tropical rainforests (Fe is easily leached to upper parts of a soil horizon)
- *Gleying* = waterlogged soils, common in areas of poor drainage (within the water table)
- *Salinisation* = well-known process

Soil types and distribution of soils

Zonal soils = soils are determined by climatic factors

- e.g. brown earths in temperate climates, podzols in cool temperate climates, chernozems in continental climates

Intrazonal soils = located within any climatic zone with respect to local factors (geology) → limestone and chalk determine rendzina soil type, i.e. developed on a particular rock type rather than due to climatic conditions

Azonal soils = no relation between a soil type and bedrock or climatic zone

Soil types:

- ❖ Equatorial climatic zone: *Ferralitic soils* = chemically weathered ⇔ humid, hot conditions ⇔ aluminium and iron oxides remain in the soil => red colour, deep (30 m of thickness), with small humus cover, poor soil fertility
- ❖ Subequatorial climatic zone: *Ferrallitic soils of wet season* and *Ferruginous soils of dry season* = silica particles from roots and withering grass.
- ❖ The Tropics: *sandy soils*
- ❖ Mediterranean climatic zone: *Rendzinas* = on limestone or calcareous marl, black/brown upper horizon = rich in organic matter (calcium). *Terra Rosa (red rendzinas)* found on limestone, formed by weathering of limestone, CaCO_3 (calcium carbonate) is weathered by carbonation.
- ❖ Temperate climatic zone:
 - *Temperate grassland: Chernozem (Black earth)* = the most fertile soils on Earth, rich in calcium carbonate.
 - *Temperate deciduous woodland: Brown earth* = generally quite fertile, earthworms mixing soil nutrients.
 - *Temperate coniferous woodland: Podzols* = prec. > evt. => acidic topsoil, acidic nature of needles => iron and aluminium oxides => impermeable pan, few earthworms
- ❖ Polar climatic zone: *Permafrost* = permanently frozen, impermeable (sub)surface. *Pingoes* (landforms) created by ice-up of a groundwater, inside pingo is *ice lens*. Similar are *polygonal soils*. *Gleys* = waterlogged soils on flatter and *podzols* on steeper slopes. Both with poor fertility.