

Basic Soils Course

Coast Forest Region

prepared by
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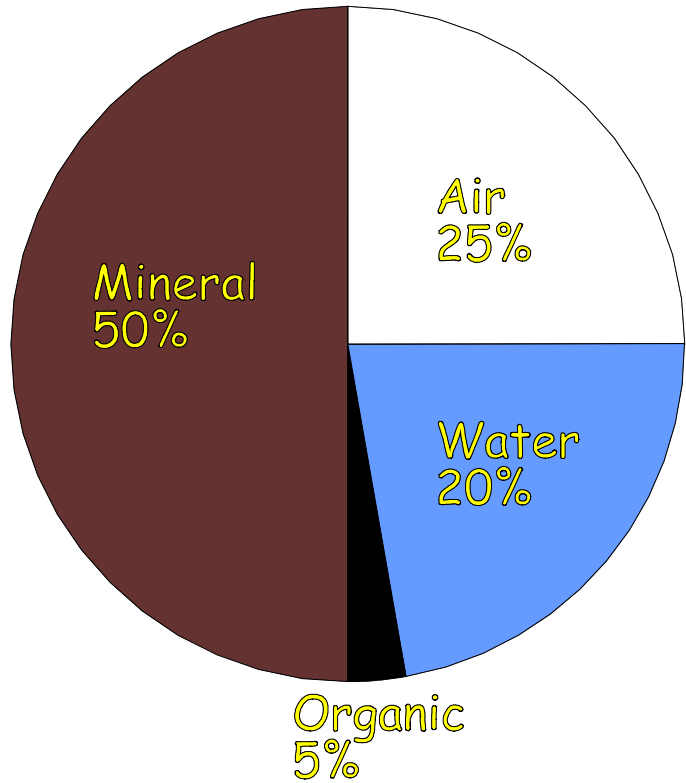


This course is as an introduction to forest soils for the Coast Forest Region. It is designed to cover those soil characteristics necessary for an adequate description of soils as part of a forest site assessment. Most of the material covered is illustrated with soil pictures that feature soil profiles determined as part of past silviculture prescriptions or research projects.



What is Soil?

Soil is the unconsolidated naturally occurring material at the earth's surface. It is important to note that the solid components of soil are mineral and/or organic in composition. Some soils are solely made up of organic matter such as the LFH material over bedrock on some upland sites or the O horizons of a bog woodland soil (left). Soil depth, rooting depth and other properties are always described from the surface of the forest floor (= humus form).



Soil Components

Soils are composed of mineral and/or organic matter, water and air. Soil porosity is the pore space of a soil. Soils with good porosity have between 40-60% pore space. Aeration is that % of the pore space not occupied by water. Good growth of forest crops features 50% soil aeration, i.e. an air:water ratio of 50:50.



A horizons

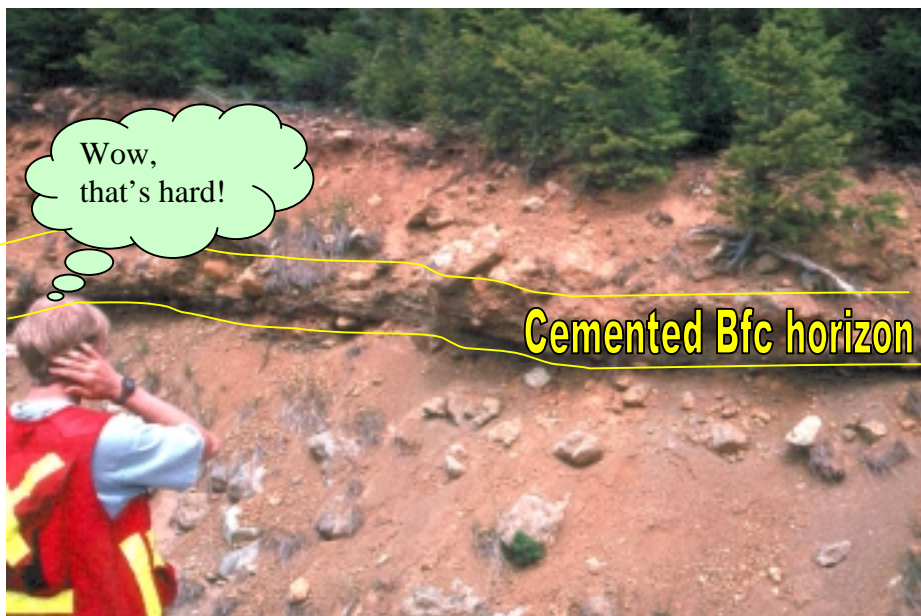
Two master A horizons are recognized in Canadian Soil Classification. The Ae horizon is a lighter coloured (left) leached horizon developed through the eluviation of the soil. This is the translocation of Fe, Al and organic matter usually leaving the Ae lighter in colour. The Ah horizon (below) originates from organic matter enrichment either by soil organisms such as in coastal soils or the root growth such as the Chernozemic Ah associated with interior grasslands. Ae and Ah indicate opposite ends of soil fertility, the Ah is enriched with organic matter, the Ae is impoverished by the leaching process.

The Ah horizon on the right arose due to earthworm activity in an alder soil. Alder leaf litter provides food for the earthworms and through burrowing and ingestion of soil and organic material the surface layer becomes darkened and enriched.



Cemented layers

Soils can be hardened by a number of mechanisms such as the weight of glacial ice as in a BC or C horizon yielding what is called hardpan, or by chemical agents in the soil such as silica, CaCO_3 , organic matter, sesquioxides, etc. It is important to recognize cemented layers as they often restrict drainage and root growth. The soil below has a cemented layer called an Ortstein horizon and would be classified as an Ortstein Humo-Ferric Podzol. It is an impediment both to rooting and water infiltration





Gleyed horizons

Poor drainage and low oxygen levels can result in reducing conditions and colour changes in soils. When Fe and Mn are reduced, compounds are formed which give the grayish and bluish colours of gleyed horizons. If conditions are part oxidizing and part reducing, perhaps due to a fluctuating water table, some of the Fe will be oxidized, and compounds with yellow-brown, brown and red colour will be formed. Quite commonly under fluctuating moisture conditions part of the matrix is reduced and part is oxidized, and the characteristic colours are mixed; these intermixed colours are described as mottled. Gleying conditions can be described throughout a soil if the water table is high or be restricted to only a part of the profile if downward movement of water is impeded. Soils with prominent mottling within 50 cm of the soil surface are classified as Gleysols. The soil on the right has an Ah horizon less than 10 cm and therefore is described as an Orthic Gleysol.



sil textured Bg horizon

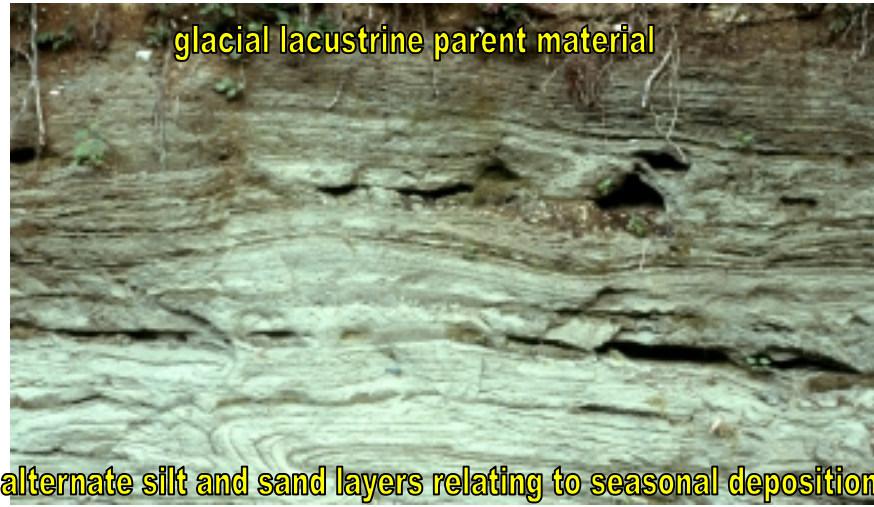
The bluer soil deeper in this profile indicating longer periods of anaerobic conditions throughout the year. It is from the silt loam textured Bg horizon

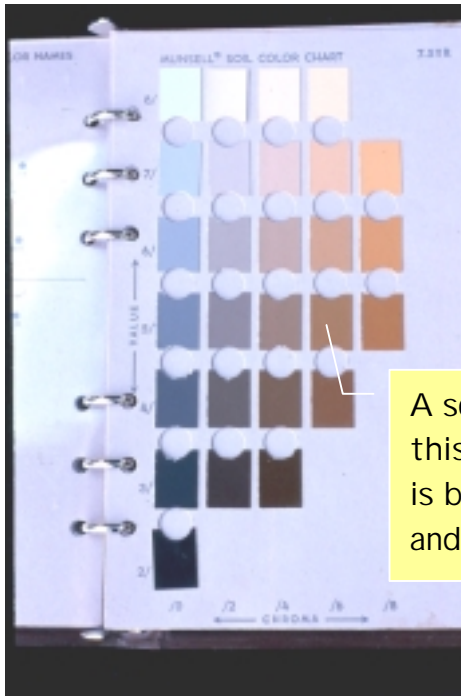


Parent materials

Soils develop from parent materials or the weathering of underlying bedrock. There are many types of parent materials classified by mode of deposition. The grey basal till on the left was transported by glaciers. All of the C horizon is considered unweathered till. The brown soil above it is the result of the weathering of the till over the past 10,000 years since glaciation.

parent material	mode of deposition	characteristics
glacial till	glaciation	unsorted, rounded coarse fragments, can be compacted
fluvial, alluvial	glacial meltwater, rivers	sorted, rounded coarse fragments, bedding planes, buried horizons
colluvium	gravity	unsorted, angled coarse fragments
glacial lacustrine	water	glacial lakebed deposits, uplifted through earth movements, alternating layers of finer, coarser textures
eolian	wind	sand, silt sized particles, coarse fragment free
glacial-marine	water	ocean deposition ranging from coarse to fine materials
organic	decomposition	accumulation of organic matter either in wetland (e.g. peat bog) or upland (e.g. folisol) environments





A soil with this colour is brown and has a

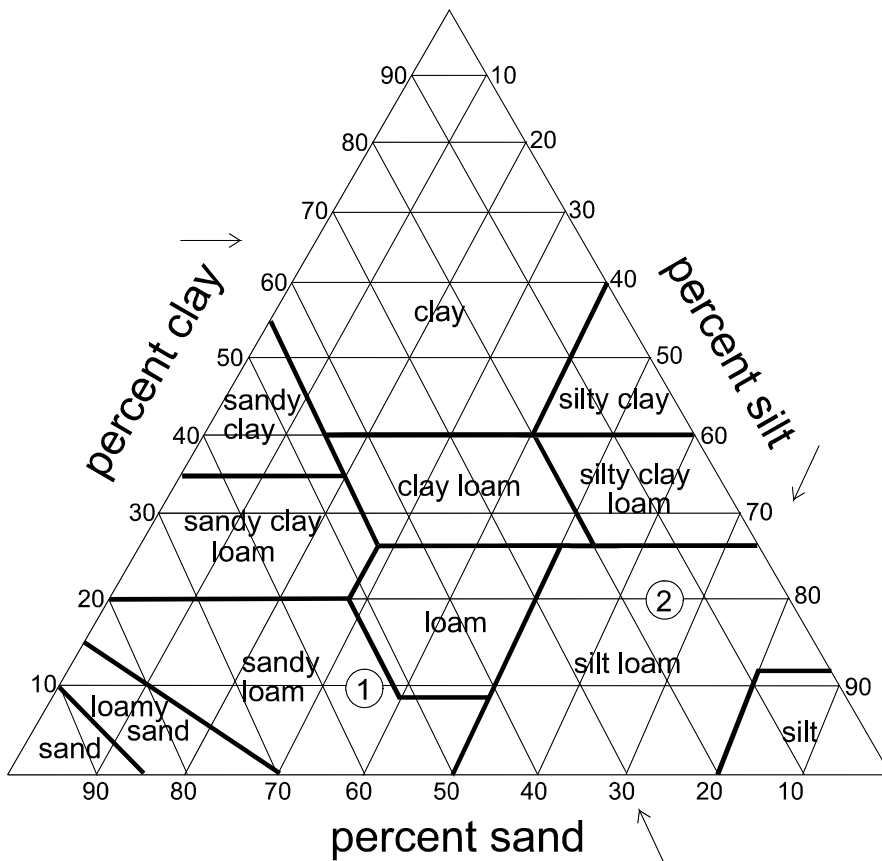
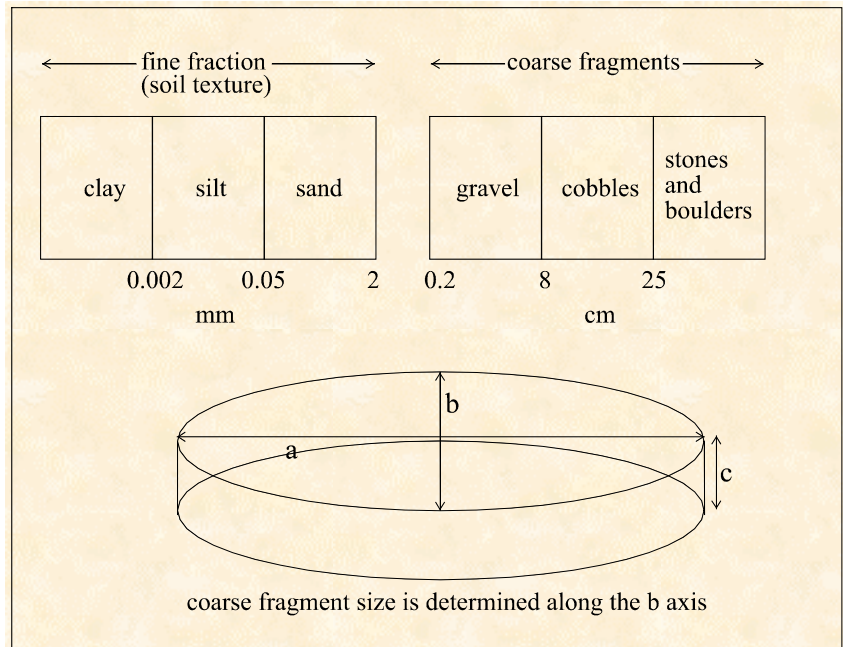
Soil colour

Soil colour is useful to assess organic matter content and drainage. Darker coloured soils usually contain higher amounts of organic matter and are more fertile. Conversely lighter coloured soils contain less organic matter and are often less fertile and may have a low base status. Base status refers to the amount of cations such as Ca^{2+} , Mg^{2+} and K^{2+} occupying exchangeable sites in the soils.

Drainage can be inferred from soil colours. Higher chroma (see below) colours usually indicate free drainage whereas low chroma (see gleyed soils) indicate poor drainage. The standard colour notation for soils is the Munsell system. A book of colour chips organizes colour by hue, value and chroma (left). Describing soil colour with this system insures consistency.

Soil particle size

Soil particles are divided into fines which are less than 2 mm and coarse fragments which are greater than 2 mm. Fines are composed of sand, silt and clay, coarse fragments include gravels, cobbles and boulders. Coarse fragments are determined in the field as % volume on a visual basis



Soil texture

Texture refers to the percentages of sand, silt and clay in the fine fraction. Texture can be approximately determined in the field by hand texturing or exactly by lab sedimentation tests. A soil that is 55% sand, 45% silt and 10% clay is a sandy loam ①. A soil that is 15% sand, 65% silt and 20% clay is a silt loam ②. Texture is one of the most important things to determine in evaluating site productivity and soil management.

An Ah horizon under a hardwood stand



Soil Structure

Soil structure is the size, shape and strength of the naturally occurring soil aggregates (called peds). Many things contribute to soil structure including texture, organic and mineral composition, water content, soil organisms, biological processes such as root growth etc. The structure of the Ah horizon on the left has been affected by earthworm casts, creating what is termed a granular structure. The peds are rounded and between 1 and 10 mm in diameter. This horizon has high pore space and good aeration.

Soils can be structureless with a single grained or massive structure. Blocky structures are common in B horizons. Platy structures can result naturally or can form under compaction. The horizontal arrangement of platy peds results in reduced penetration of air, water and roots.