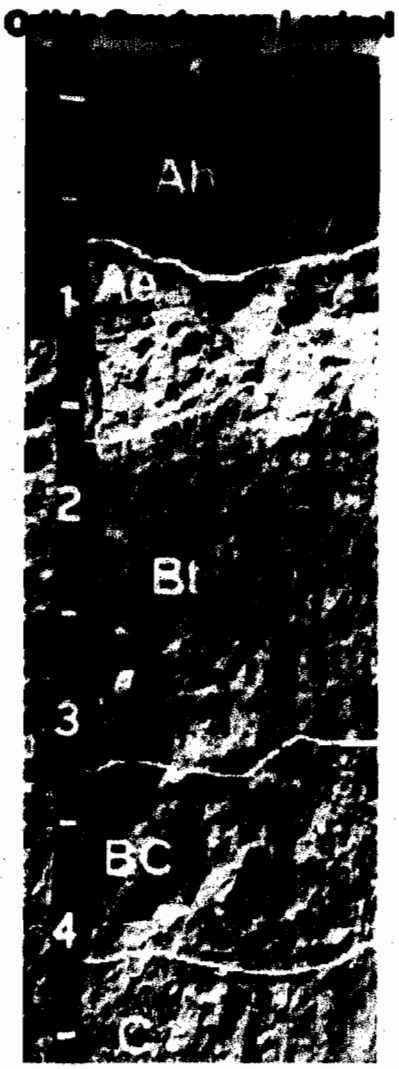
# 3
# SOIL CLASSIFICATION

*It is embarrassing not to be able to agree on what soil is. In this the pedologists are not alone. Biologists cannot agree on a definition of life and philosophers on philosophy.*
—HANS JENNY, THE SOIL RESOURCE: ORIGIN AND BEHAVIOR


Ah
Ae
1
2
Bt
3
BC
4
C

# Soil Organic Horizons

**Of-Om-Oh horizons** An organic layer developed mainly from mosses, rushes, and woody materials.

- **Of** least decomposed organic layer, containing large amounts of well-preserved fiber, and called the fibric layer.

- **Om** An intermediately decomposed organic layer containing less fiber than an Of layer and called the mesic layer.

- **Oh** The most decomposed organic layer, containing only small amounts of raw fiber and called the humic layer.

**L-F-H layers** Organic layers developed primarily from leaves, twigs, and woody materials, with a minor component of mosses.

- **L**: The original structures of the organic material are easily recognized.
- **F**: The accumulated organic material is partly decomposed.
- **H**: The original structures of the organic material are unrecognizable

## Common A horizons

The horizons of the soil that have been altered by surface-related soil forming processes are called **A horizons**. These horizons are at the top of the soil profile. Suffixes are used to further differentiate **A horizons**. The complete list of suffixes is presented in a separate table. The common kinds of **A horizons** include:

**Ah**
Enriched in organic carbon, because of root senescence and / or soil faunal activity, especially earthworm activity.

**Ahe**
A transition between Ah and Ae, with both carbon enrichment and clay depletion.

**Ae**
Depleted of clay, and sometimes of iron and organic acids. Normally has a horizontal "platy" structure, and an ash-white colour when dry.

**B horizons** are normally found below the A horizon(s), and above the C horizon(s). Many kinds of **B horizons** can be identified. Those most common to Alberta are:

**Bm**
slightly modified structure and/or colour.

**Bt**
Enriched in clay, from Ae above.

**Bn**
High Na content in the clays.

**Bnt**
A combination of Bn and Bt.

**Bg**
Gleyed, due to frequent saturation.

**Bfh**
Enriched in Fe and organics from Ae above.

The bottom of a soil pit will have material that has not been modified much by soil forming processes. This material is called the **C horizon**. Different kinds of **C horizons** may be found, including:

**Ck**
Contains free carbonates, from the parent material.

**Cca**
Enriched in carbonates, from horizons above.

**Csk**
Contains carbonates and salts, normally gypsum.

**Cg**
Gleyed and mottled, because it is normally saturated.

# Pictures of soil profiles that have developed in different parts of Canada are shown below:

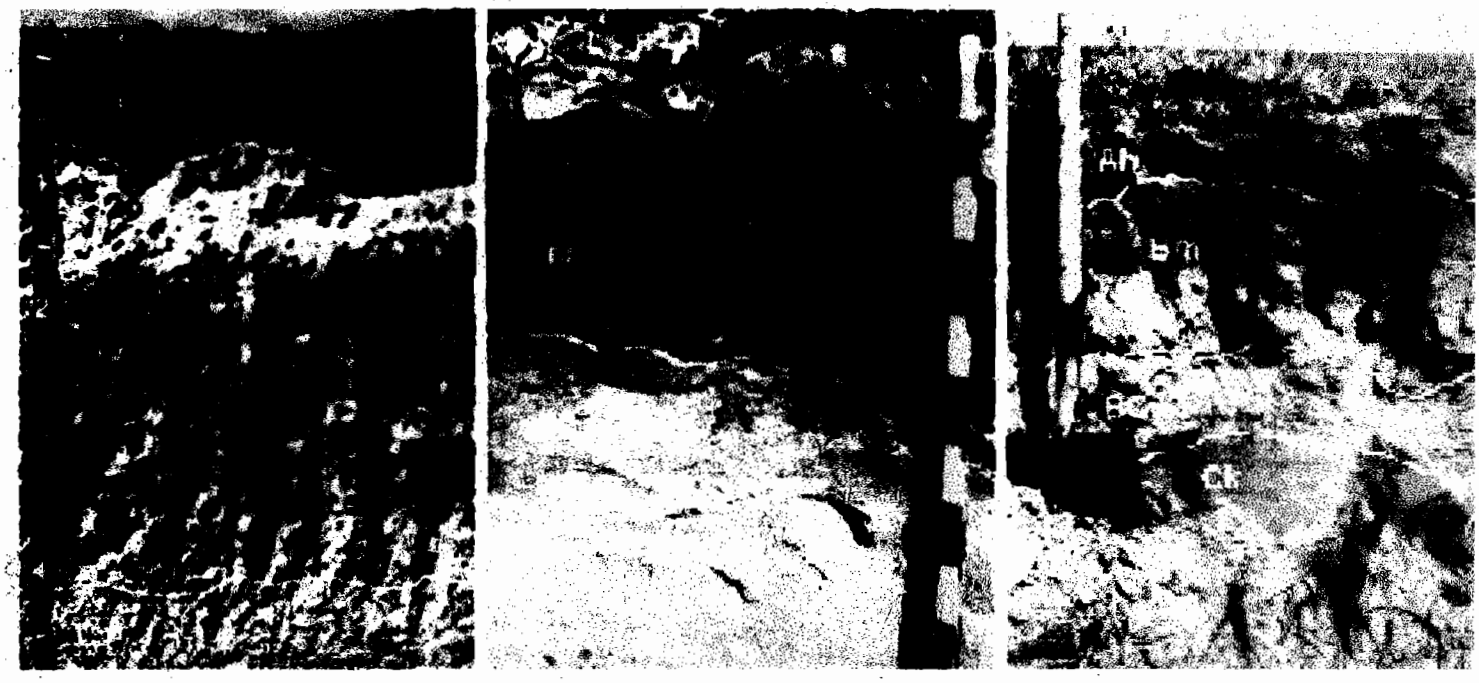



Photo credit for original images: Arosena, J. M. and Abley, M. Soils of Canada [Online]. Available HTTP: http://quarles.unbc.edu/nres/soc/.

# Introduction to the Canadian System of Soil Classification

http://129.128.49.169/Pedosphere/content/section05/page03.cfm

| Taxa of the Canadian System of Soil Classification | |
|---|---|
| **Orders** | Taxa at the order level are based on properties of the pedon that reflect the nature of the soil environment and effects of the dominant, soil-forming processes. |
| **Great Groups** | Great groups are soil taxa formed by subdividing each order. Thus each great group carries with it the differentiating criteria of the order to which it belongs. In addition, taxa at the great group level are based on properties that reflect differences in strengths of dominant processes, or a major contribution of a process in addition to the dominant one. |
| **Subgroups** | Subgroups are soil taxa formed by subdividing each great group. Therefore they carry the differentiating criteria of the order and great group to which they belong. Subgroups are also differentiated on the basis of the kind and arrangement of horizons that reflect a conformity to the central concept of the great group (e.g., Orthic), intergrading towards soils of another order (e.g., Gleyed, Brunisolic) or additional features within the control section (e.g., Ortstein, Vertic). A control section is the vertical section of soil upon which classification is based. |
| **Family** | Taxa at the family level are formed by subdividing subgroups. Thus they carry the differentiating criteria of the order, great group, and subgroup to which they belong. Families are differentiated on the basis of the parent material characteristics, such as particle size, mineralogy, calcareousness, reaction, and depth, and on soil climatic factors. |
| **Series** | Taxa at the series level are formed by subdividing families. Thus they carry the differentiating criteria of the order, great group, subgroup and family to which they belong. Series with a family are differentiated on basis of detailed features of the pedon. Pedons belonging to a series have similar kinds and arrangements of horizons whose color, texture, structure, consistence, thickness, reaction, and composition fall within a narrow range. |

For Example

- **Order** - Chernozemic - ecol. zones
- **Great Group** - Black - climate, veg.
- **Subgroup** - Orthic Black Chernozemic - posi • in landscape
- **Family** - fine loamy, mixed, neutral, cool, subhumid ↳ texture mineral. pH
- **Series** - Angus Ridge - specific pedyfedon prop.

**A simplified key to classify soils at the soil order level.**

| | | |
|---|---|---|
| **A.** | Does the soil have **permafrost** within 1 m of the surface or within 2 m if strongly cryoturbated? | If this is true, then the soil belongs to **Cryosolic order**.<br>If false, go to the next step. |
| **B.** | Does the soil have organic horizons (**Of, Om, Oh**)? | If this is true, then the soil belongs to **Organic order**.<br>If false, go to the next step. |
| **C.** | Does the soil have both a vertic horizon and a slickenside horizon within 1 m of mineral surface? | If this is true, then the soil belongs to **Vertisolic order**.<br>If false, go to the next step. |
| **D.** | Is the **Bf, Bhf**, or **Bh** at least 10 cm thick? | If this is true, then the soil belongs to **Podzolic order**. If false, go to the next step. |
| **E.** | Is the **Bg** or **Cg** within 50 cm of surface? | If this is true, then the soil belongs to **Gleysolic order**.<br>If false, go to the next step. |
| **F.** | Is solonetzic B (**Bn** or **Bnt**) horizon present? | If this is true, then the soil belongs to **Solonetzic order**.<br>If false, go to the next step. |
| **G.** | Is chernozemic A (**Ah** or **Ap**) present? | If this is true, then the soil belongs to **Chernozemic order**.<br>If false, go to the next step. |
| **H.** | Is **Bt** horizon present? | If this is true, then the soil belongs to **Luvisolic order**.<br>If false, go to the next step. |
| **I.** | Is the **Bm**, **Btj**, or **Bfj** at least 5 cm thick or a **Bf** < 10 cm thick? | If this is true, then the soil belongs to **Brunisolic order**.<br>If false, go to the next step. |
| **J.** | Does this soil **not** meet any of the above criteria? | If this is true, then the soil belongs to the **Regosolic order**. |

The Canadian System of Soil Classification, 3rd edition

## Lower Case Suffixes for Soil Mineral Horizons

**b** A buried soil horizon.

**c** A cemented (irreversible) pedogenic horizon. Ortstein, placic, and duric horizons are examples.

**ca** A horizon of secondary carbonate enrichment where the concentration of lime exceeds that in the unenriched parent material.

**cc** Cemented (irreversable) pedogenic concretions.

**e** Horizon characterized by removal of clay, iron, aluminum, or organic matter.

**f** A horizon enriched with amorphous material, principally Fe and Al combined with organic matter. It usually has a chroma of 3 or more. The criteria for an f horizon except for Bgf are: it contains 0.6% or more pyrophosphate-extractable Fe plus Al in textures finer than sand and 0.4% or more in sands; the ratio of pyrophosphate-extractable Fe plus Al to clay (less than 2 Fm) is greater than 0.5; and organic carbon exceeds 0.5%. These horizons are differentiated on the basis of organic carbon content into: Bf, 0.5% to 5% organic carbon Bhf, more than 5% organic carbon.

**g** A horizon characterized by gray colors, or prominent mottling indicative of permanent or periodic intense reduction, or both; for example, Aeg, Btg, Bg, and Cg.

**h** A horizon enriched with organic matter.

**j** This is used as a modifier of suffixes e, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies; for example, Aej is an eluvial horizon that is thin, discontinuous, or faintly discernible.

**k** Presence of carbonate.

**m** A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color, or structure, or both.

**n** A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less.

**p** A layer disturbed by man's activities, for example, Ap.

**s** A horizon containing detectable soluble salts.

**sa** A horizon of secondary enrichment of salts more soluble than Ca and Mg carbonates, where the concentration of salts exceeds that present in the unenriched parent material.

**ss** Denotes the presence of several (more than two) slickensides.

**t** A horizon enriched with silicate clay, as indicated by a higher clay content (by specified amounts) than the overlying eluvial horizon, a thickness of at least 5 cm, oriented clay in some pores, or on ped surfaces, or both, and usually a higher ratio of fine (less than 0.2 um) to total clay than in the C horizon.

**u** A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation or argillipedoturbation caused by Vertisolic processes.

**v** A horizon affected by argillipedoturbation, as manifested by disruption and mixing caused by shrinking and swelling of soil mass.

**x** A horizon of fragipan character.
**y** A horizon affected by cryoturbation.
**z** A perennially frozen layer.

# Soil Orders in the Canadian System of Soil Classification

## Chernozemic:

Soils that have developed under xerophytic or mesophytic grasses and forbs, or under grassland-forest transition vegetation, in cool to cold, subarid to subhumid climates.

These soils have a dark-colored surface (Ah, Ahe, Ap) horizon and a B or C horizon or both, of high base saturation.

The order consists of the Brown, Dark Brown, Black, and Dark Gray Great Groups.

**Podzolic:**

Soils of coniferous forests having podzolic B horizons (Bh, Bhf, or Bf) in which combinations of amorphous Al, Fe, and organic matter have accumulated.

The sola are acid and the ion exchange capacity of the B horizons is characterized by pH dependent charge.

Three Great Groups are Humic Podzol, Ferro-Humic Podzol, and Humo-Ferric Podzol.

**Brunisolic:**

Soils whose horizons are developed sufficiently to exclude the soils from the Regosolic order, but that lack the degrees or kinds of horizon development specified for soils of other orders.

These soils, which occur under a wide variety of climatic and vegetative conditions, all have brownish Bm or Btj horizons.

The four Great Groups - Melanic Brunisol, Eutric Brunisol, Sombric Brunisol, and Dystric Brunisol - are separated on basis of thickness of Ah horizons and soil reaction.

**Organic:**

Soils that have developed in organic deposits. The majority of organic soils are saturated for most of the year.

They contain more than 17% organic carbon. The four Great Groups are the Fibrisol, Mesisol, Humisol, and Folisol.

**Cryosolic:**

Mineral or organic soils of sub-arctic and arctic regions that have permafrost within 1 m of the surface (2 m of the surface if more than one-third of the pedon has been strongly cryoturbated, as indicated by disrupted, mixed, or broken horizons).

There are three Great Groups - Turbic Cryosol, Static Cryosol, and Organic Cryosol.

**Solonetzic:**

Soils developed mainly under grass or grass-forest vegetative cover in semiarid to subhumid climates.

The soils have a stained brownish solonetzic B (Bn or Bnt) horizon and a saline C horizon.

The surface may be an Ap, Ah, Ahe, and/or Ae horizon.

The order includes the Solonetz, Solodized Solonetz, and Solod Great Groups.

**Luvisolic:**

Soils that may have eluvial (Ae) horizons, and must have illuvial (Bt) horizons in which silicate clay is the main accumulation product.

These soils develop under deciduous or mixed forest or forest-grassland transition in a moderate to cool climate.

The order is divided into the Gray Luvisol and the Gray Brown Luvisol Great Groups.

**Regosolic**:

Soils having insufficient A or B horizon development to meet the requirements of other orders, perhaps on young parent materials.

The order is divided into the Regosol and the Humic Regosol Great Groups.

**Gleysolic:**

Soils developed under wet conditions and permanent or periodic reduction.

These soils have low chromas, or prominent mottling, or both, in some horizons. The Gleysol, Humic Gleysol, and Luvic Gleysol are the three Great Groups.

**Vertisolic:** (A ***newly introduced*** soil Order) Clay soils that lack the degree of development necessary for other Orders and that have deep, wide cracks at some time during the year and have high bulk density between the cracks.

These soils have marked shrink-swell tendencies with changes in soil water content resulting in wedge-shaped aggregates and/or evidence of severe disruption of horizons in the solum.