

# HOW IS SOIL FORMED?

Soil is a product of our ecosystem, and as components of our ecosystem change, so does the characteristics of our soil. There are 5 Soil Forming factors that determine how and at what rate soil will form: Parent Material, Biota, Climate, Topography, and Time.

- 1) The primary stage of soil formation is the accumulation of the **parent material**, that being rock sediments from which the soil will form. Glaciation is the primary geomorphological process that has created these sediments in Canada. As glaciers moved, advancing and retreating across the bedrock, they over time ground the bedrock to varying degrees (large stones to sand). Meltwater from the glaciers also developed and dependent on its quantity: moved, mixed, sorted, and redeposited sediments thus leaving behind different glacial features and deposits (moraines, drumlins, outwash plains, spillways, eskers, and more) Furthermore, these sediments are also beneficial as they contain elements such as Potassium, Aluminium, Iron, Manganese, which eventually release into the soil, and provide critical components for plant growth.
- 2) **Biota**, which includes vegetation, organisms, and microorganisms, is the 2<sup>nd</sup> soil forming factor. Vegetation is multifaceted, the roots provide stabilization to the parent material while also splitting rock sediments via roots growing through cracks in the rock. Vegetation also institutes chemical weathering of minerals as they release acidic components (organic acids, carbon dioxide) during decomposition. Decomposition also adds organic matter, which will feed microorganisms and contribute components to soil development. Organisms, from worms to mice, will disturb and transport soils while also providing channels for roots, air and water to utilize.
- 3) Next is **Climate**; most specifically the Temperature and Moisture of a location, which have a large influence on soil formation because temperature controls the rate of chemical weathering reactions and the rate of biological activity. Moisture i.e. water controls the physical weathering processes, as it is a solvent, and a transport medium for most reactions and processes occurring in the soil. Wind is also a factor of climate, but to a lesser extent, as it enhances processes of erosion and deposition of soil, a more surficial action.
- 4) Soil is influenced by **Topography** primarily in respect to water movement. Land with rolling hills or slopes of any kind, will have differences in: soil moisture and soil quantity and quality at various locations on the slope. At the peak of hills or tops of slopes, soil erosion will take place and soil moisture will be lower as water follows the path of least resistance to the lowest land

point. These soils will be less developed, lighter in colour due to leaching of minerals, and have fewer soil horizons.

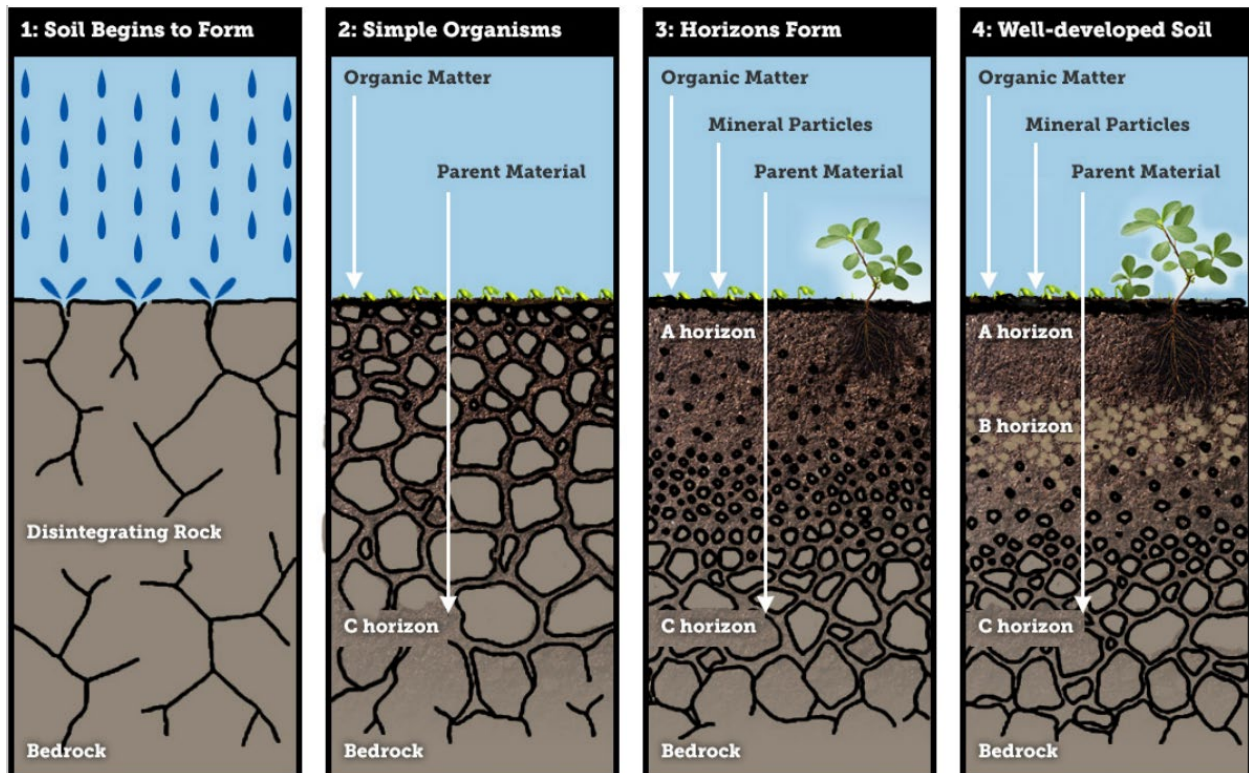
While at the base of the hill/slope, the eroded soil and runoff from above will collect, resulting in deeper and darker soils with higher water and mineral content, and a greater number of soil horizons.

We must also consider direction of our slopes as this affects soil temperature and therefore the activity of vegetation and organisms within the soil and their ability to be active and adding to the process of forming soil.

- 5) Soil formation is a long, slow process, and thus soil takes **Time** to form. Time is needed for the parent material, climate, topography, and biota to work through their processes to contribute to the creation of soil.

Canadian soils have been developing since the last glaciation, 14,000 years ago; in the grand scheme of soils, our soils are young and are therefore less weathered and richer in plant nutrients.

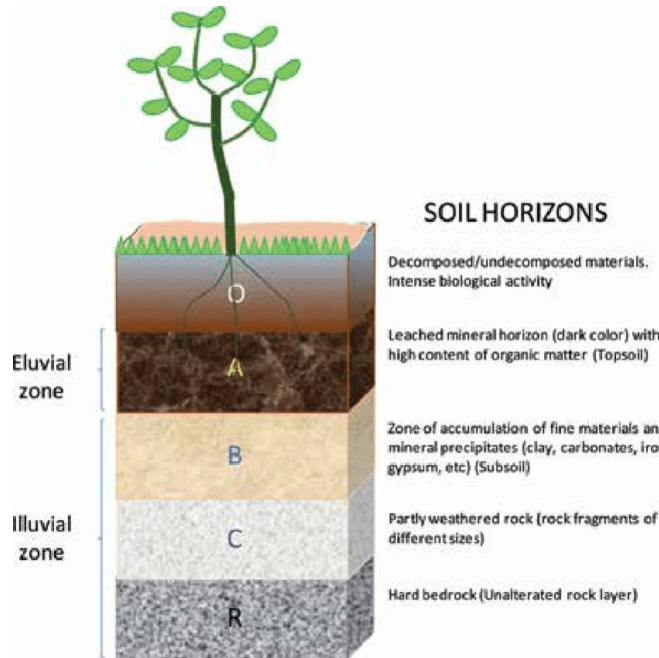
### Soil Formation from beginning to end



### After soil forms, what does it look like?

After a lengthy period of time, a soil profile appears. A soil profile is essentially layers of different types of soil and is arranged in layers, called horizons.

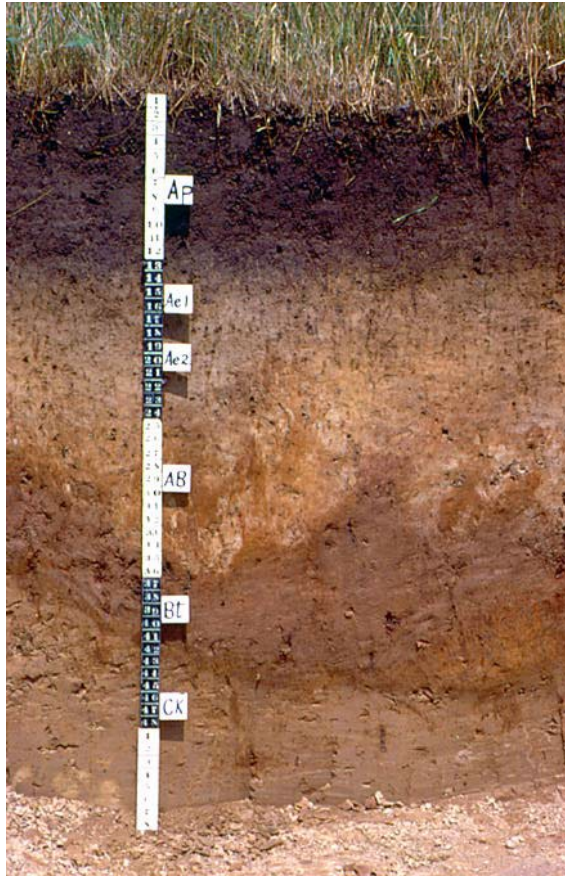
Processes that lead to horizon formation are: additions, losses, transformations, and translocations of materials or soil components from 1 horizon to another, or from the surface horizon to the atmosphere. The below image gives a simple representation of a soil profile and brief description of each horizon.



For interest's sake I have included 2 Ontario soil profiles, so that you can see the soil horizons and how they can be vastly different based on their geographic location, and what the purpose of the land area is, among many other factors.



Landscape: Cultivated land



Gray Luvisol soil



Landscape: Pasture / Forested land area



Humic Podzol soil

In the gray luvisol soil picture, you will see the labelled horizons, if you are curious about what the lettering indicates for each horizon, here is a link to learn about the lettering system and what defines it. <https://soilsofcanada.ca/soil-formation/horizons.php>