Soil Profile and Horizons

A soil profile displays a vertical section of soil from the ground surface down to the bed rock or parent material. A soil profile suggests vertical distribution of soil components, i.e. the flora and fauna, the inorganic minerals, etc. The profile of a soil can be determined from a specially dug soil pit. It usually shows different layers (or horizons) from which the soil is classified. A soil horizon is a well-defined layer within the soil profile, parallel to the ground surface. The main soil horizons are visually distinctive, reflecting their different physical and chemical properties, which result from various soil-forming processes, e.g., weathering, introduction of humus, movement of minerals, etc.

Although there are several views regarding the classification of major horizons, most of the scientists agree that there are three major horizons, *viz.*, the **A horizon** or **topsoil** which contains humus. The soil minerals are washed downwards from A horizon by gravitational pull and deposited in the **B horizon** or **subsoil**. The parent rock at the bottom has been designated as the **C horizon**.

The *Oxford Dictionary of Geography* has classified the major soil horizons as A, B, C and D, where A and B horizons are the same mentioned earlier. The C horizon has, however, been defined as unconsolidated rock below the soil, and D horizon as the consolidated parent rock. (Some scientists have used the letter 'R' in place of D.)

Apart from these major soil horizons, other layers have been recognised. The soil surface composed of plant material has been classified as the **L horizon** (fresh litter), **F horizon** (decomposing litter), **H horizon** (well-decomposed litter), and **O horizon** (peaty soil). The **E horizon** (eluviated horizon) signifies a leached A horizon.

Additional suffixes have been used to signify further types. The **A horizon** has been subdivided into $\mathbf{A_h}$ **horizon** found on uncultivated land, $\mathbf{A_{hp}}$ found under cultivated land, and $\mathbf{A_{pg}}$ on gleyed land. The **B horizon** has been subdivided into $\mathbf{B_f}$ **horizon** characterised by a thin iron pan, $\mathbf{B_g}$ with gleyed soil, $\mathbf{B_h}$ characterised by humic accumulations, $\mathbf{B_{ox}}$ having a residual deposition of sesquioxides, $\mathbf{B_s}$ with sesquioxide accumulation, $\mathbf{B_t}$ having clay minerals in soil, and $\mathbf{B_x}$ or fragipans with thin and brittle layers caused by compaction.

The subdivisions of the **C horizon** are $\mathbf{C_u}$ which shows little gleying, accumulation of salt, or fragipan, $\mathbf{C_r}$ while is so dense that plants are not able to penetrate it with their roots, and $\mathbf{C_g}$ which has gleyed soil.

Prof. Savindra Singh has given a modified version of the above classification.

The first two horizons, i.e., L and F, are the uppermost layers which belong to the organic horizon. The L horizon consists of original vegetative matter, partly decomposed organic matter, etc. The F horizon is characterised by greatly altered remains of plants and animals. The organic matter of F horizon is beyond recognition. It is called humus. (The process of humus formation is known as **humification**.)

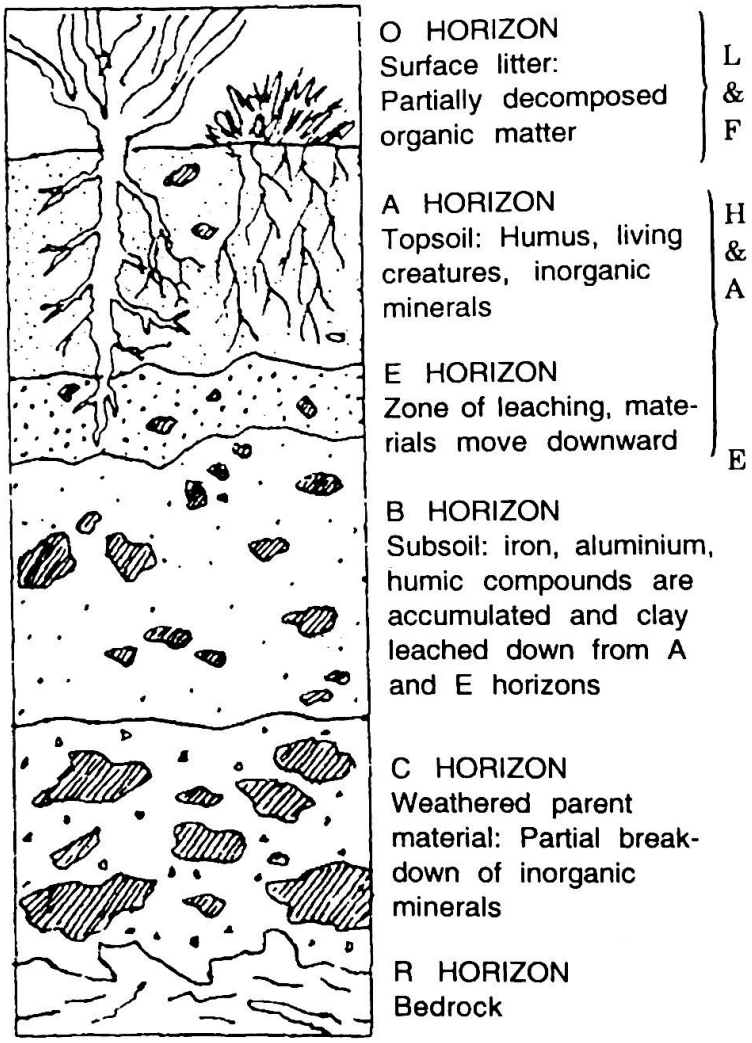

Fig. 4.4 Soil profile showing soil horizons. The composition, thickness and actual number of horizons vary in different soil types. (According to more recent views, the O horizon is same as L and F horizons. The A and E horizons coincide with A and H horizons. The E horizon is taken as a thin transitional zone.)

The uppermost layer in the mineral horizon is H. It is a mixed horizon made of minerals and organic matter. This horizon is dark and biologically more active than any other layer of the mineral horizon.

The A horizon is characterised by maximum downward movement of silicate clays, oxides of iron, aluminium, etc.

The E horizon is a transitional zone, marking transition to B and transition to A. The former layer has more characteristic affinity to A horizon than to the next B horizon. The latter is more like the B horizon than the A horizon.

The B horizon is a zone of maximum accumulation of silicate clay minerals or sesquioxides and organic matter.

The C horizon has unconsolidated weathered parent rock materials, also known as **regoliths**. This layer is also called subsurface horizon and gley horizon. It resembles the structure and composition of basal parent rock.

The R horizon is made of unconsolidated hard parent rock.

Characteristic Features The characteristic features of a soil profile may be described as follows:

(i) With increasing depth, the organic matter decreases along with a sharp decrease in the number of living organisms.

(ii) With increasing depth, the level of soil aeration decreases.

(iii) The number and variety of parent materials increase with descent.

(iv) No definite trend has been observed with regard to soil water and depth of soil because of the fluctuation of soil water. Such fluctuations occur due to the position and movement of groundwater, the frequency and volume of rainfall, and the capacity of different horizons of the soil profile to absorb water.

The soil surface has a thin veneer of leaf litter, crop residues and fresh or partly decomposed organic matter (O horizon). The A horizon or topsoil lies just beneath the O horizon and is composed of several minerals and organic material. The thickness of the A horizon varies from several metres in the prairie-region to zero in deserts. Most of the plants spread roots and derive their food from this layer. The surface or the A horizon often blends into the E horizon which is subject to leaching. The subsurface horizon or subsoil (the B horizon) has little organic matter but greater concentration of minerals. Soluble compounds and clay particles are washed downward from the upper layers and deposited in the B horizon. (Sometimes subsoil particles are cemented

Horizons of A Generalised Soil Profile

		General Usage	More Recent Usage	
Ground Surface		O1 (Aoo)	L	Organic horizon, Litter layer
SOLUM		O2 (Ao)	F	Organic horizon (decomposed organic matter)
	Zone of eluviation	A_1	H	Dark colour : rich in humus
		A_2	A	Light colour : zone of maximum eluviation (leaching or downard movement of minerals and organic matter)
		A_3	E	Transition to B
	Zone of illuviation (accumulation)	B_1		Transition to A
		B_2	B	Zone of maximum illuviation (accumulation of minerals)
		B_3		Transition to C
	Weathered parent materials	C	C	Unconsolidated weathered subsurface horizon, gley layer
	Solid bedrock	D	R	Solid bedrock

together to form an impervious layer called **hardpan**. Hardpans prevent the growth of plant roots and water from escaping downward.) The subsoil is followed by the C horizon or the parent material. The layer is made of comparatively undecomposed minerals and unweathered rock particles with little organic material. In the USA, about 70 per cent of the existing horizon material was transported to its present site by natural agents like glaciers, wind and water and it has no direct relation to the bedrock placed below it.

Factors Influencing soil Profile Water movement in the soil affects the soil profile. When evaporation cannot equal the rainfall, excess water moves downwards in the soil, mineral matter being removed from the top layer in the process. This matter settles in the B horizon, at times creating a hardpan and, thus, leading to poor drainage. The soil in such a case is said to be *leached*. Podzols in cold wet regions and laterites in hot wet regions are produced by leaching.

There is little organic matter in the soil water of humid tropical regions, and such water is not able to dissolve iron and aluminium hydroxides. Most of the other minerals dissolve and are carried in solution to be deposited in the B horizon. In course of time, a soil composed mainly of iron and aluminium compounds may be formed; this is laterite soil. (Laterites may form from any kind of rock.)

An upward movement of water takes place in the soils of hot desert or semi-arid regions. As a result, mineral matter is deposited in the A horizon. Significant saltpetre deposits have been formed in this way.