

Soil Formation

Soil Formation – Key Concepts & Processes

1. What Is Soil?

Aspect	Description
Definition	A natural, dynamic mixture of mineral particles, organic matter, water, air, and living organisms that supports plant growth. • Provides a medium for root anchorage • Stores and supplies water & nutrients
Functions	• Regulates climate (heat, moisture) • Filters pollutants • Habitat for countless organisms
Depth	Typically 0–2?m (active zone); deeper layers (subsoil, parent material) influence properties but are less biologically active.

2. The Five Factors of Soil Formation (CLORPT Model)

Factor	Symbol	Main Influence on Soil
Climate	C	Controls temperature & precipitation ? weathering rates, organic? matter decomposition, leaching, and moisture regime.
Organisms	L (Live)	Plants, animals, microbes ? add organic matter, bioturbation, nutrient cycling, and influence pH.
Relief (Topography)	R	Slope, aspect, elevation ? drainage, erosion, solar radiation, and micro?climate variations.
Parent Material	P	Source rock or sediment ? mineral composition, texture, and chemical supply.
Time	T	Duration of exposure to the above factors ? development of horizons, accumulation of stable minerals, and pedogenic processes.

All five interact; the dominant factor may differ from site to site.

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3. Pedogenic (Soil-Forming) Processes

Process	Description	Typical Result
Physical Weathering	Freeze-thaw, thermal expansion, abrasion, pressure release.	Breakdown of parent material into sand, silt, clay fractions.
Chemical Weathering	Hydrolysis, oxidation, carbonation, solution, hydration.	Formation of secondary minerals (e.g., clays, oxides), leaching of soluble ions.
Biological Activity	Root growth, burrowing, litter deposition, microbial metabolism.	Incorporation of organic matter, formation of aggregates, bioturbation.
Translocation (Illuviation)	Downward movement of water-soluble substances (clay, iron, organic compounds).	Development of B-horizon enrichment (Bt, Bf, Bs).
Erosion & Deposition	Removal or addition of material by water, wind, gravity.	Creation of thin soils on slopes, thick soils in depressions.
Carbonate Accumulation	Precipitation of calcium carbonate in arid/semiarid climates.	Formation of caliche or carbonate horizons (Ck).
Humification	Decomposition of organic residues into humus.	Dark, nutrient-rich A-horizon (Ah).

4. Soil Horizon Sequence (Typical Profile)

- O – Organic layer (litter, humus) – most common in forested soils
- A – Topsoil; mineral + organic matter; high biological activity
- E – Eluviation horizon; leached of silicate clays, iron, or organic matter
- B – Subsoil; accumulation (illuviation) of clays, iron, aluminum, carbonates
- C – Weathered parent material; little alteration
- R – Unweathered bedrock

Not every soil has all horizons; their thickness and characteristics reflect the CLORPT influences.