

CUET · GEOGRAPHY · CLASS XI · CODE 313

Geomorphic Processes

CUET unit: Natural Vegetation of India

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Snapshot

- Geomorphic processes are either endogenic or exogenic; these opposing forces continuously shape the earth's surface.
- Key vocabulary — geomorphic agents, processes, gradation, denudation — underpins all subsequent landform topics.
- CUET frequently tests definitions (weathering, exfoliation, slump, solifluction), the three groups of weathering processes, factors of soil formation, and the types of mass movements.
- Soil formation (pedogenesis) and the five soil-forming factors also fall under this topic, making it doubly important for Geography Section A (Physical Geography) questions.
- Students who master this chapter can answer ~6 questions on geomorphic processes and soil formation that appear across CUET papers.

Detailed Notes

2.1 Core concepts

- **Geomorphic processes defined:** The endogenic and exogenic forces causing physical stresses and chemical actions on earth materials and bringing about changes in the configuration of the earth's surface are known as **geomorphic processes**. Diastrophism and volcanism are endogenic geomorphic processes; weathering, mass wasting, erosion, and deposition are exogenic geomorphic processes. (NCERT §Geomorphic Processes, p. 37–38)
- **Geomorphic agent vs. process:** A process is a force applied on earth materials; an agent is a mobile medium (running water, moving ice masses, wind, waves, currents) that removes, transports, and deposits earth materials. Running water, groundwater, glaciers, wind, waves, and currents are geomorphic agents. (NCERT §Geomorphic Processes, p. 38)
- **Gradation:** The phenomenon of wearing down of relief variations of the earth's surface through erosion is known as **gradation**. Endogenic forces elevate parts of the surface; exogenic processes fail to even out relief as long as opposing actions continue. (NCERT §Geomorphic Processes, p. 37)
- **Role of gravity:** Gravity is a directional force activating all downslope movements; without gravity and gradients there would be no mobility and hence no erosion,

transportation, or deposition. Indirect gravitational stresses activate wave and tide-induced currents and winds. (NCERT §Geomorphic Processes, p. 38)

- **Stress:** Force applied per unit area is called stress. Shear stresses result in angular displacement or slippage and break rocks and other earth materials. Earth materials also become subject to molecular stresses due to temperature changes, crystallisation, and melting. (NCERT §Exogenic Processes, p. 39)
- **Denudation:** All exogenic geomorphic processes are covered under the general term denudation (from the word 'denude' — to strip off or uncover). It includes weathering, mass wasting/movements, erosion, and transportation. (NCERT §Exogenic Processes, p. 39)
- **Endogenic processes — energy source:** Energy for endogenic geomorphic processes comes from within the earth; mostly generated by radioactivity, rotational and tidal friction, and primordial heat from the earth's origin. This energy induces diastrophism and volcanism in the lithosphere. (NCERT §Endogenic Processes, p. 38)
- **Diastrophism:** All processes that move, elevate, or build up portions of the earth's crust. It includes: (i) orogenic processes (mountain building through severe folding); (ii) epeirogenic processes (uplift or warping of large parts of the crust); (iii) earthquakes; (iv) plate tectonics (horizontal movements of crustal plates). Orogeny is a mountain-building process; epeirogeny is a continental building process. (NCERT §Diastrophism, p. 38)
- **Volcanism:** Includes movement of molten rock (magma) onto or toward the earth's surface and formation of intrusive and extrusive volcanic forms. (NCERT §Volcanism, p. 39)
- **Exogenic processes — energy source:** Derive energy ultimately from the atmosphere determined by solar energy and from gradients created by tectonic factors. Temperature and precipitation are the two most important climatic elements that control various processes. (NCERT §Exogenic Processes, p. 39)
- **Climatic control on exogenic processes:** The density, type, and distribution of vegetation (largely dependent on precipitation and temperature) indirectly influence exogenic geomorphic processes. Within climatic regions, local variations arise from altitudinal differences, aspect variations, and insolation differences between north/south-facing and east/west-facing slopes. (NCERT §Exogenic Processes, p. 39)
- **Rock structure and geomorphic processes:** The term structure includes folds, faults, orientation and inclination of beds, presence/absence of joints, bedding planes, hardness or softness of minerals, chemical susceptibility, and permeability/impermeability. Different rock types offer varying resistances to geomorphic processes, operating at differential rates and giving rise to differences in topography. (NCERT §Exogenic Processes, p. 39–40)
- **Weathering defined:** Weathering is mechanical disintegration and chemical decomposition of rocks through the actions of various elements of weather and

climate. Very little or no motion of materials takes place — it is an in-situ or on-site process. (NCERT §Weathering, p. 40)

- **Three groups of weathering processes:** (i) Chemical; (ii) Physical or mechanical; (iii) Biological. Very rarely does any one of these operate completely by itself; dominance of one is common. (NCERT §Weathering, p. 40)
- **Chemical weathering processes:** Solution, carbonation, hydration, oxidation, and reduction act on rocks to decompose, dissolve, or reduce them to a fine clastic state through chemical reactions by oxygen, surface and/or soil water, and other acids. Water and air (oxygen and CO₂) along with heat must be present. Over and above CO₂ in the air, decomposition of plants and animals increases underground CO₂. (NCERT §Chemical Weathering Processes, p. 40)
- **Physical weathering processes — applied forces:** (i) Gravitational forces (overburden pressure, load, shearing stress); (ii) Expansion forces due to temperature changes, crystal growth, or animal activity; (iii) Water pressures controlled by wetting and drying cycles. Most physical weathering is caused by thermal expansion and pressure release. (NCERT §Physical Weathering Processes, p. 40–41)
- **Biological activity and weathering:** Burrowing and wedging by organisms (earthworms, termites, rodents) expose new surfaces to chemical attack and assist penetration of moisture. Human activities (disturbing vegetation, ploughing, cultivating) help mix and create new contacts. Decaying plant and animal matter produces humic, carbonic, and other acids which enhance decay and solubility of elements. (NCERT §Biological Activity and Weathering, p. 41)
- **Exfoliation:** A result (not a process) of unloading, thermal contraction and expansion, and salt weathering. Flaking off of more or less curved sheets of shells from over rocks or bedrock results in smooth and rounded surfaces. Exfoliation domes result from unloading; tors result from thermal expansion. (NCERT §Special Effects of Weathering — Exfoliation, p. 41)
- **Significance of weathering:** Responsible for breaking rocks into smaller fragments; prepares the way for formation of regolith, soils, erosion, and mass movements. Biomes and bio-diversity are basically a result of forests, which depend on the depth of weathering mantles. Weathering of rocks and deposits helps in enrichment of valuable ores of iron, manganese, aluminium, copper, etc. Weathering is an important process in soil formation. (NCERT §Significance of Weathering, p. 41)
- **Mass movements defined:** Transfer of mass of rock debris down slopes under direct influence of gravity. Air, water, or ice do not carry debris but the debris may carry with it air, water, or ice. Movements range from slow to rapid, affecting shallow to deep columns of materials; include creep, flow, slide, and fall. (NCERT §Mass Movements, p. 41–42)
- **Conditions favouring mass movements:** Weak unconsolidated materials, thinly bedded rocks, faults, steeply dipping beds, vertical cliffs or steep slopes, abundant

precipitation and torrential rains, and scarcity of vegetation. (NCERT §Mass Movements, p. 42)

- **Activating causes of mass movements (nine listed):** (i) removal of support from below; (ii) increase in gradient and height of slopes; (iii) overloading through addition of materials; (iv) overloading due to heavy rainfall and saturation; (v) removal of material or load from above original slope surface; (vi) earthquakes, explosions, or machinery; (vii) excessive natural seepage; (viii) heavy drawdown of water from lakes, reservoirs, and rivers; (ix) indiscriminate removal of natural vegetation. (NCERT §Mass Movements, p. 42)
- **Heave, flow, and slide:** The three forms of movements. Heave = heaving up of soils due to frost growth and other causes. (NCERT §Mass Movements, p. 42)
- **Landslides — types:** Relatively rapid and perceptible movements; materials involved are relatively dry. Types: **Slump** (slipping of rock debris with backward rotation); **Debris slide** (rapid rolling or sliding of earth debris without backward rotation); **Debris fall** (nearly free fall of earth debris from vertical or overhanging face); **Rockslide** (sliding of individual rock masses down bedding, joint, or fault surfaces); **Rock fall** (free falling of rock blocks over any steep slope). (NCERT §Landslides, p. 42–43)
- **Erosion and Deposition:** Erosion involves acquisition and transportation of rock debris. Abrasion by rock debris carried by geomorphic agents also aids erosion. By erosion, relief degrades (landscape is worn down). Erosion is largely responsible for continuous changes in the earth's surface. The five main agents: wind, running water, glaciers, waves, and groundwater. The first three are climatically controlled; they represent gaseous, liquid, and solid states of matter respectively. (NCERT §Erosion and Deposition, p. 43)
- **Deposition:** A consequence of erosion — erosional agents lose velocity on gentler slopes and materials start to settle. Coarser materials are deposited first, finer ones later. Depressions get filled up. The same erosional agents (running water, glaciers, wind, waves, groundwater) act as aggradational or depositional agents also. (NCERT §Erosion and Deposition, p. 43)
- **Soil formation (pedogenesis):** Depends first on weathering; the weathering mantle is the basic input for soil to form. The weathered material is colonised by bacteria and inferior plant bodies (mosses, lichens), then minor organisms; dead remains produce humus. Grasses, ferns, bushes, and trees grow gradually. Plant roots penetrate, burrowing animals bring up particles, making the mass porous and sponge-like, and finally a mature soil (complex mixture of mineral and organic products) forms. (NCERT §Soil Formation, p. 44)
- **Five soil-forming factors:** (i) Parent material; (ii) Topography; (iii) Climate; (iv) Biological activity; (v) Time. These factors act in union and affect each other's action. (NCERT §Soil-forming Factors, p. 44)

- **Parent material:** A passive control factor. Can be in-situ weathered rock debris (residual soils) or transported deposits (transported soils). Soil formation depends on texture (sizes of debris) and structure (disposition of individual grains/particles of debris) as well as mineral and chemical composition of rock debris/deposits. (NCERT §Parent Material, p. 44)
- **Topography:** A passive control factor. Influence felt through exposure of surface, amount of sunlight, surface and sub-surface drainage over parent materials. Soils will be thin on steep slopes and thick over flat upland areas. Over gentle slopes where erosion is slow and percolation is good, soil formation is very favourable. Soils over flat areas may develop thick clay layers with good organic matter accumulation (dark colour). (NCERT §Topography, p. 44–45)
- **Climate (active factor):** Climatic elements: (i) moisture (intensity, frequency, duration of precipitation; evaporation; humidity); (ii) temperature (seasonal and diurnal variations). Excess water causes eluviation (downward transport of soil components) and illuviation (deposition below). Removal of silica from soil is desilication. In dry climates, ground water is brought to surface by capillary action, evaporates, and leaves salts — these form a crust called **hardpans**. In tropical and intermediate precipitation areas, calcium carbonate nodules (**kanker**) are formed. (NCERT §Climate, p. 45)
- **Biological activity (active factor):** Vegetative cover and organisms add organic matter, moisture retention, nitrogen etc. Dead plants provide humus. Nitrogen fixation by *Rhizobium* bacteria (in root nodules of leguminous plants). In cold climates, humus accumulates as bacterial growth is slow; in humid tropical/ equatorial climates, bacterial action is intense, organic matter rapidly oxidised, leaving very low humus. Large animals (ants, termites, earthworms, rodents) mechanically rework soil. (NCERT §Biological Activity, p. 45)
- **Time (active factor):** Length of time soil-forming processes operate determines maturation of soils and profile development. A soil becomes mature when all soil-forming processes act for a sufficiently long time developing a profile. Soils from recently deposited alluvium or glacial till are young (no horizons or poorly developed horizons). No specific absolute time length can be fixed for soils to develop. (NCERT §Time, p. 45)

2.2 Definitions to memorise

Term	Definition	Page
Geomorphic process	Endogenic and exogenic forces causing physical stresses and chemical actions on earth materials, bringing about changes in the configuration of the earth's surface	37–38
Geomorphic agent	A mobile medium (running water, moving ice, wind, waves, currents) that removes, transports, and deposits earth materials	38
Gradation		37

Term	Definition	Page
	Wearing down of relief variations of the earth's surface through erosion	
Stress	Force applied per unit area on earth materials	39
Denudation	General term covering all exogenic geomorphic processes: weathering, mass wasting/movements, erosion, and transportation	39
Diastrophism	All processes that move, elevate, or build up portions of the earth's crust (includes orogeny, epeirogeny, earthquakes, plate tectonics)	38
Orogeny	Mountain-building process involving severe folding; deforms crust into folds	38
Epeirogeny	Continental building process involving uplift or warping of large parts of the crust; may involve simple deformation	38
Weathering	Mechanical disintegration and chemical decomposition of rocks through actions of elements of weather and climate; an in-situ (on-site) process	40
Exfoliation	Flaking off of more or less curved sheets of shells from over rocks/bedrock, resulting in smooth and rounded surfaces; a result, not a process	41
Mass movements	Transfer of mass of rock debris down slopes under direct influence of gravity (includes creep, flow, slide, fall)	41
Slump	Slipping of one or several units of rock debris with backward rotation with respect to the slope	42
Debris slide	Rapid rolling or sliding of earth debris without backward rotation	42–43
Rockslide	Sliding of individual rock masses down bedding, joint, or fault surfaces	43
Rock fall	Free falling of rock blocks over any steep slope, keeping itself away from the slope	43
Pedogenesis	Process of soil formation	44
Eluviation	Downward transportation of soil components through the soil	45
Illuviation	Deposition of soil components brought down by eluviation	45
Desilication	Removal of silica from the soil (occurs in wet equatorial climates with high rainfall)	45
Hardpan	Crust formed in soil when ground water is brought to the surface by capillary action in dry climates, evaporates, and leaves behind salts	45
Kanker	Calcium carbonate nodules formed in tropical and intermediate precipitation areas	45
Nitrogen fixation		45

Term	Definition	Page
	Process by which bacteria (e.g., Rhizobium in root nodules of leguminous plants) convert gaseous nitrogen into chemical form usable by plants	

2.3 Diagrams / processes to remember

- **Figure 5.1 — Denudational processes and their driving forces (p. 39):** Flow chart showing three processes under denudation: Weathering (driven by gravitational/molecular stresses and/or chemical actions), Mass Movements (driven by gravitational force), and Erosion/Transportation (driven by kinetic energy). Essential for understanding which driving force corresponds to which process.
- **Figure 5.2 — Climatic regimes and depth of weathering mantles (adapted from Strakhov, 1967) (p. 40):** Shows six zones of weathering from fresh rock (zone 1) to soil with oxides of iron and aluminium (zone 6), plotted against precipitation (mm) and temperature (°C) across climatic zones from Tundra to Tropical Forest (>3000 mm). Demonstrates that weathering depth increases with precipitation and temperature, highest in tropical zones.
- **Figure 5.3 — Exfoliation (Flacking) and granular disintegration (p. 41):** Photograph showing curved sheets flaking off from rock surfaces — the visual result of unloading/thermal expansion.
- **Figure 5.4 — Slumping of debris with backward rotation (p. 42):** Diagram showing initial position of slope vs. slump body exhibiting backward rotation — key to distinguishing slump from debris slide.
- **Figure 5.5 — Landslide scars in Shiwalik Himalayan ranges near river Sarada at India-Nepal border, Uttar Pradesh (p. 42–43):** Photograph showing planar failures along discontinuities like bedding planes that dip steeply.

2.4 Common confusions / NTA trap points

- **Weathering is NOT erosion:** Weathering is in-situ (no movement of material); erosion involves acquisition and transportation of rock debris. NTA may present options that conflate the two. A key trap: "weathering is a pre-condition for erosion" — this is partially true (weathering aids erosion) but weathering is NOT a pre-requisite for erosion to take place.
- **Mass movements are NOT erosion:** Although there is a shift of materials, no geomorphic agent (running water, glaciers, wind, waves, currents) participates. NTA may offer "erosion" as an answer to a question about landslides/slumps.
- **Orogeny vs. Epeirogeny:** Orogeny = mountain building (severe folding, narrow belts); Epeirogeny = continental building (simple uplift/warping, large parts). Students confuse the scale and mechanism. NTA likes statement-based questions mixing these two.

- **Three groups of weathering:** Chemical, Physical/Mechanical, Biological — NOT four. Students sometimes add "thermal weathering" separately; it falls under physical weathering.
- **Soil-forming factors — active vs. passive:** Parent material, topography, and time are passive control factors; climate and biological activity are active factors. NTA trap: a question asking which factors are active or listing all five and asking students to identify the passive ones.
- **Deposition is not an agent's work:** Deposition is not actually the work of any agent — it is the consequence of erosional agents losing velocity. NTA may test this with a "Which of the following is correct?" type question.

Practice MCQs

PYQ Alignment

Chapter 5 (Geomorphic Processes) is one of the most heavily tested chapters in CUET Geography, contributing questions on weathering types, mass movement categories (especially distinguishing slump from debris slide and rockslide), soil-forming factors (particularly identifying active vs. passive factors), and the distinction between geomorphic agents and geomorphic processes; CUET 2023–25 papers consistently include 1–2 statement-based or match-the-following questions from this chapter alongside 1–2 direct definition/recall questions on terms like exfoliation, denudation, gradation, and hardpan.