

Chapter 2: Shaping of the Earth's Surface

Easy-to-Understand Study Notes | Tiwari Academy

Chapter at a Glance: *The Earth's surface is continuously changed by forces acting inside the Earth and by processes operating on its surface. Plate movements create major features, while weathering, erosion, transportation and deposition reshape them over time.*

- Internal forces include plate movement, earthquakes, volcanoes, folding and faulting.
- External forces include weathering, erosion and deposition.
- Major agents of gradation are running water, waves, glaciers, wind and underground water.
- Landforms influence resources, agriculture, settlements, transport, tourism, culture and human safety.
- Landform-related hazards include landslides, avalanches, glacial lake outburst floods (GLOFs) and sandstorms.

1. Earth's Interior

Layer / Zone	Key Features
Crust	Outermost layer; about 30–40 km beneath continents and 5–7 km beneath oceans.
Mantle	Very thick and hot layer below the crust; mostly solid.
Core	Innermost, extremely hot and dense region.
Lithosphere	Rigid crust + upper mantle; about 100 km.
Asthenosphere	Hot, mobile, partially molten layer below the lithosphere; permits plate movement.
Outer Core	Fluid layer mainly of iron and nickel.
Inner Core	Solid, hot and densest part of the Earth.

2. Plate Tectonics

- The plate tectonics as a theory given by W. J. Morgan.
- The lithosphere is broken into large and small tectonic plates that move a few centimetres per year.
- Plate types: continental, oceanic and mixed plates.
- Major plates include Pacific, Eurasian, African, North American, South American, Indo-Australian and Antarctic plates.
- Heat from the core produces convection currents in the mantle: hot material rises and cooler material sinks, pushing and pulling plates.

3. Plate Boundaries

Boundary	Plate Movement	Major Result / Example
Convergent	Plates move towards each other.	Continental collision forms fold mountains such as the Himalaya; oceanic–continental collision can produce volcanoes and earthquakes.
Divergent	Plates move apart.	Magma rises and forms new crust; mid-ocean ridges such as the Mid-Atlantic Ridge.
Transform	Plates slide past each other.	Crust is neither created nor destroyed; earthquakes are common, e.g. San Andreas Fault.

4. Effects of Plate Movement

- Formation of mountains, valleys and ocean basins.
- Volcanic activity and earthquakes.
- Helps explain the distribution of continents and oceans.
- Most earthquakes and volcanoes occur near plate boundaries; the Pacific margin is called the Ring of Fire.
- India is also vulnerable to earthquakes; the extensive damage caused by the 2001 Gujarat earthquake.
- Baratang Island in the Andaman and Nicobar Islands has a rare mud volcano, where mud bubbles out due to underground gases and pressure.

5. Weathering and Erosion

Weathering	Erosion
Breakdown of rocks into smaller pieces at or near the surface.	Wearing away and carrying of soil, rocks and other surface material.
Broken material is not transported.	Broken material is moved from one place to another.
Physical, chemical and biological weathering.	Water, wind, glaciers and coastal waves are important agents.

Types of Weathering

- Physical: rock breaks due to temperature changes, frost, wind, heating/cooling or ice expansion.
- Chemical: minerals change through reactions with water, air or acids.
- Biological: plants, animals and micro-organisms break rocks; roots growing into cracks are an example.
- Weathering also contributes to soil formation.

Erosion and Human Life

- Removal of fertile topsoil lowers agricultural productivity.
- River and coastal erosion may damage land, houses and roads.
- It can destabilise construction and mining sites and affect tourism and fishing.
- Soil and water conservation methods mentioned include contouring, bunding, terracing and check dams.

6. Agents of Gradation

Agents of gradation wear down, transport and deposit material, gradually lowering high areas and filling low areas.

Agent	Important Landforms / Work
Running Water	V-shaped valleys, waterfalls, rapids, meanders, oxbow lakes, floodplains, deltas, levees and alluvial fans.
Waves & Currents	Beaches, sand bars, sea cliffs, wave-cut platforms, caves, arches, stacks and bays.
Glaciers	U-shaped valleys, cirques, aretes, hanging valleys, fjords and moraines.
Wind	Yardangs, ventifacts, deflation hollows, desert pavements and dunes.
Underground Water	Karst topography: caves, stalactites, stalagmites, pillars, sinkholes/dolines and underground rivers.

7. Running Water

- Upper course: steep gradient and strong erosion form V-shaped valleys, waterfalls and rapids.
- Middle course: meanders, oxbow lakes and floodplains develop as erosion and deposition operate.
- Lower course: slower river deposits sediment and forms deltas, levees and alluvial fans.
- Waterfall: forms where resistant hard rock overlies softer rock that erodes more rapidly.
- Meander: winding river bend formed by erosion on outer banks and deposition on inner banks.
- Delta: sediment deposited at a river mouth forms a fan-shaped or triangular area; deltas are fertile but may be flood-prone.

8. Waves and Coastal Landforms

- A beach forms by deposition of sand, pebbles or rocks along a shoreline.
- Coastal erosion by waves, tides and currents produces cliffs and wave-cut platforms.
- Weak rock may be enlarged into a cave; caves may form an arch; collapse of an arch can leave an isolated stack.
- Coastal landforms support tourism and fishing but vulnerable settlements may require protection.

9. Glaciers

- Moving glaciers erode and reshape mountain landscapes.
- U-shaped valleys form when glaciers widen and deepen former river valleys.
- Cirques are bowl-shaped depressions; aretes are sharp ridges; hanging valleys form where smaller glacial valleys meet larger ones; fjords are flooded glacial valleys.
- Glaciers are important sources of fresh water and feed rivers downstream.
- Moraines are deposits of till left by glaciers. Types noted: lateral, terminal and medial moraines.

10. Wind

- Strong winds pick up and carry loose sand and soil, especially in dry regions.
- Yardangs are streamlined rock ridges; ventifacts are rocks shaped and polished by wind-blown sand.
- Deflation hollows form where loose material is removed; desert pavements remain after finer particles are blown away.
- Dunes are hills or ridges of wind-deposited sand. Here we discuss barchans, longitudinal, star and parabolic dunes.

11. Underground Water

- In limestone and other soluble rocks, chemical weathering and erosion create Karst topography.
- Caves form when acidic water dissolves rock.
- Stalactites hang from cave ceilings; stalagmites rise from cave floors; they may join to form pillars.
- Sinkholes or dolines are depressions formed when ground collapses into underground cavities.
- Underground rivers flow through cave systems and can provide fresh water and tourism opportunities.

12. Landforms and Human Civilisation

- Fertile river plains supported early agricultural societies and cities.
- Mountains served as barriers and protectors but passes also enabled cultural exchange.
- Deserts limited large settlements but encouraged trade routes.
- Coasts and harbours supported trade, travel and cultural contact.
- Landforms continue to influence settlements, occupations, resources and cultural life.

13. Landforms and Disasters

Disaster	Main Causes
Landslides	Heavy rainfall, earthquakes, volcanic eruptions, steep/weak slopes; worsened by deforestation, mining, road building, unplanned construction and poor drainage.
Avalanches	Unstable snow on steep slopes due to heavy snowfall, warming, strong winds; may be triggered by earthquakes, vibrations or human activity.
GLOFs	Sudden release of water from glacial lakes; glacier melt, heavy rain/snow, earthquakes, avalanches or landslides may weaken or breach natural dams.
Sandstorms	Associated with dry, sandy landscapes and strong winds that lift and transport loose particles.

Disaster Preparedness – Core Ideas

- Identify hazard-prone areas and avoid unsafe construction.
- Protect vegetation and manage slopes and drainage carefully.
- Use monitoring, early-warning systems and evacuation planning where appropriate.
- Follow local disaster-management instructions and prepare emergency supplies.
- Our main stresses understanding landforms so communities can manage associated disasters more wisely.

14. Important Conservation Practices

Practice	Purpose
Contouring	Trenches along contour lines slow, hold and infiltrate rainwater, reducing erosion and recharging groundwater.
Bunding	Earthen embankments slow runoff, reduce erosion and improve infiltration and soil moisture.
Terracing	Level or gently sloping steps on hillsides reduce soil erosion.
Check dams	Slow stream flow, reduce erosion, encourage sediment deposition and groundwater recharge.
Zabo system	Nagaland's integrated farming approach uses earthen bunds for soil and water conservation.

15. Quick Revision

Term	One-line Meaning
Landform	Natural feature of Earth's surface produced by crustal movement, weathering, erosion or deposition.
Plate tectonics	Movement of lithospheric plates over the semi-molten layer below.
Convection currents	Mantle circulation caused by rising hot material and sinking cooler material.
Weathering	Breaking down of rock without transport.
Erosion	Wearing away and transport of surface material.
Gradation	Wearing, transport and deposition that gradually smooth Earth's surface.
Meander	Winding bend in a river.
Delta	Depositional landform at a river mouth.
Moraine	Glacial deposit of rock, soil and debris.
Karst topography	Landforms made mainly by dissolution of soluble rocks by underground water.
Ring of Fire	Pacific-zone concentration of many earthquakes and volcanoes.
GLOF	Sudden destructive release of water from a glacial lake.

One-Line Conclusion

Earth's internal and external forces constantly shape its surface, creating useful and beautiful landforms as well as hazards that humans must understand and manage.