Topic 3: Geology and Landforms

1. Definition and Overview

Geology is the branch of Earth science that studies the origin, structure, composition, and processes of the Earth. It helps us understand how the planet has evolved over billions of years and how natural processes shape the landforms we see today.

Aspect	Description
Etymology	From Greek *geo* = Earth, *logos* = study
Focus	Rocks, minerals, Earth structure, plate tectonics, and surface processes
Core Goal	Understanding Earth's materials and the dynamic processes forming its surface

2. Major Branches of Geology

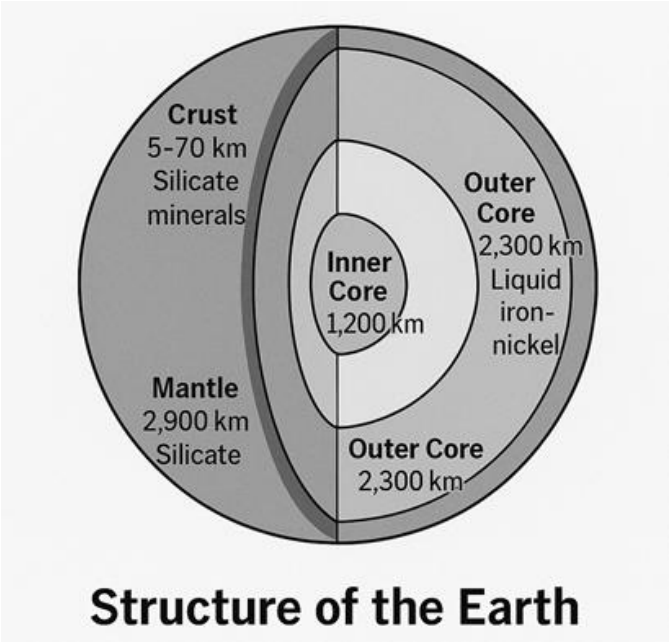
Branch	Focus Area	Examples / Applications
Physical Geology	Processes shaping Earth's surface	Volcanoes, earthquakes, erosion
Historical Geology	Evolution of Earth through time	Fossil records, geological time scale
Structural Geology	Deformation of rocks	Faults, folds, tectonics
Petrology	Origin and composition of rocks	Igneous, sedimentary, metamorphic rocks
Geomorphology	Landform study and evolution	Mountains, valleys, deltas
Economic Geology	Mineral and resource studies	Mining, petroleum geology

3. Earth's Internal Structure

The Earth consists of **three main layers**—Crust, Mantle, and Core.

Layer	Thickness (approx.)	Composition	Temperature (°C)
Crust	5–70 km	Silicates (Si, Al)	Up to 870
Mantle	2,900 km	Mg, Fe silicates	870–2,200
Core	3,500 km	Fe, Ni	2,200–6,000

Diagram 1: Simplified Structure of the Earth

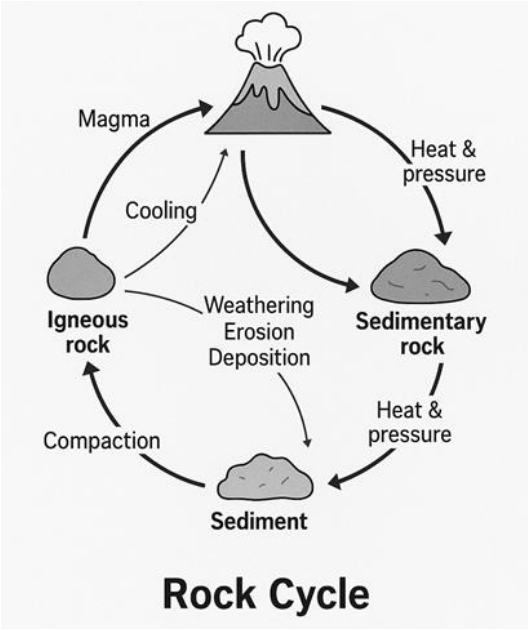


4. Rocks and the Rock Cycle

Rocks are classified into **three major types** based on their origin.

Rock Type	Formation Process	Example
Igneous	Cooling of magma/lava	Basalt, Granite
Sedimentary	Deposition and compaction of sediments	Sandstone, Limestone
Metamorphic	Alteration under heat and pressure	Marble, Schist

Diagram 2: The Rock Cycle



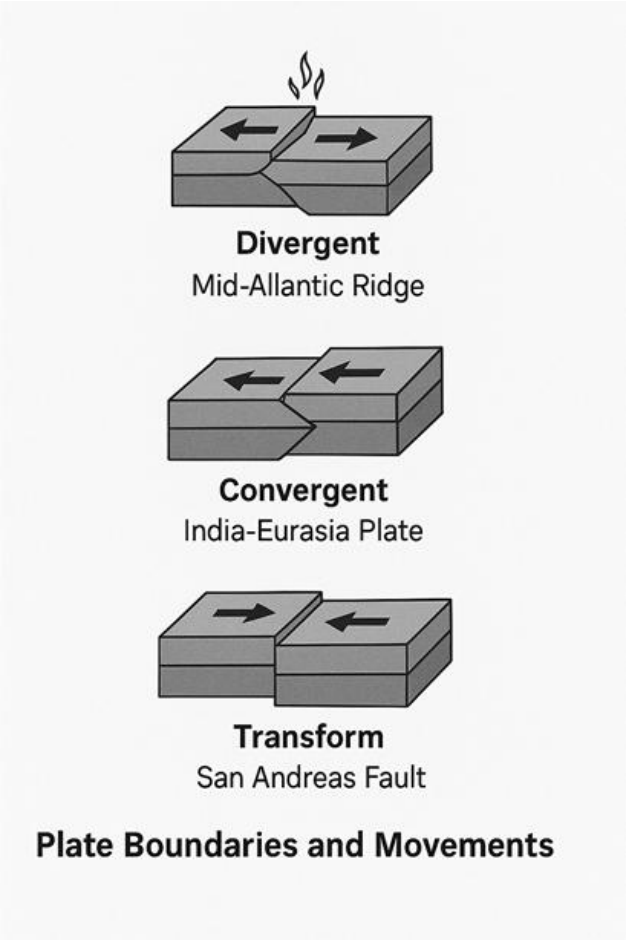
Magma → Cooling → Igneous Rocks → Weathering → Sediments → Sedimentary Rocks → Metamorphism → Metamorphic Rocks → Melting → Magma.

5. Plate Tectonics and Landform Development

The **theory of plate tectonics** explains the movement of Earth's lithospheric plates and formation of major landforms.

Plate Boundary Type	Movement	Landform Produced	Example
Convergent	Plates collide	Mountains, trenches	Himalayas
Divergent	Plates move apart	Mid-ocean ridges	Mid-Atlantic Ridge
Transform	Plates slide past each other	Faults, earthquakes	San Andreas Fault

Diagram 3:



6. Major Landform Types

Landform Type	Origin	Examples
Mountains	Tectonic uplift / volcanism	Himalayas, Andes
Plains	Sediment deposition	Indo-Gangetic Plain
Plateaus	Uplifted flat regions	Deccan Plateau
Valleys	Erosional processes	Great Rift Valley
Deltas	River deposition	Ganga Delta
Deserts	Aeolian (wind) processes	Thar Desert

7. Geomorphological Agents

Agent	Process Type	Resulting Landforms
River (Fluvial)	Erosion, transportation, deposition	Meanders, floodplains
Glacier (Glacial)	Ice erosion and deposition	Moraines, U-shaped valleys
Wind (Aeolian)	Deflation and abrasion	Sand dunes, loess
Sea (Marine)	Wave action	Cliffs, beaches
Groundwater	Dissolution and deposition	Caves, sinkholes

8. Case Studies

Region	Dominant Process	Resulting Feature
Himalayas	Plate collision (convergent)	Fold mountains
Grand Canyon, USA	River erosion	Deep valley
Deccan Plateau	Volcanic activity	Basaltic plateau
Nile Delta	River deposition	Fertile delta

9. Summary

- Geology explains **Earth's composition, history, and dynamic processes**.
- Landforms arise from **endogenic (internal)** and **exogenic (external)** processes.
- Plate tectonics and surface agents (water, ice, wind) continually reshape the Earth.