— University of Mosul —
College of Petroleum & Mining Engineering

General Geology 1

Lecture 1

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Geology

Definition

Geology is the scientific study of the Earth, including its materials, structure, processes, and history. Geologists examine rocks, minerals, and fossils to understand the Earth's physical structure and the processes that have shaped it over time, such as volcanic activity, earthquakes, erosion, and plate tectonics. Geology also explores the origins and age of the Earth, helping scientists gain insights into natural resources, environmental changes, and past climates.

BRANCHES OF GEOLOGY(EARTH SCIENCES)

Geology has a range of specialized branches that focus on different aspects of Earth, its history, and its processes. Here are some of the main branches:

1. **Petrology** – Studies rocks and their origins, classifications, and compositions.
2. **Mineralogy** – Focuses on minerals, their properties, structures, and classifications.
3. **Paleontology** – The study of fossils and ancient life forms to understand Earth's biological history.
4. **Sedimentology** – Examines sedimentary rocks and processes of sedimentation.
5. **Stratigraphy** – Looks at rock layers (strata) and their relationship to geological time and history.
6. **Structural Geology** – Studies the deformation and arrangement of rocks, including faults, folds, and rock stress.
7. **Volcanology** – Investigates volcanic activity, lava, magma, and eruption processes.
8. **Seismology** – Focuses on earthquakes, seismic waves, and Earth's internal structure.
9. **Geophysics** – Applies physics to study Earth's physical properties, including magnetic and gravitational fields.
10. **Geomorphology** – Studies Earth's surface features and the processes that shape them, such as erosion and sedimentation.
11. **Geochemistry** – Examines Earth's chemical composition and the processes influencing it.
12. **Environmental Geology** – Looks at human interactions with the Earth, including natural hazards, pollution, and resource management.
13. **Hydrogeology** – The study of groundwater, its distribution, and movement through rocks and soils.
14. **Economic Geology** – Focuses on materials of economic value, such as minerals, fossil fuels, and resources.
15. **Planetary Geology** – Examines geology beyond Earth, studying other planets and celestial bodies.

Each of these branches offers insights into different facets of Earth's systems, helping scientists understand its past, present, and future dynamics.

Why Study Geology:

We study geology to gain a deeper understanding of the Earth, its resources, and the processes that shape it. Key reasons include:

1. Natural Resources: Geology helps us locate and manage valuable resources like minerals, oil, natural gas, and groundwater.
2. Natural Hazards: Studying geology allows us to understand and predict natural hazards such as earthquakes, volcanic eruptions, landslides, and tsunamis, which can help in disaster preparedness and risk mitigation.
3. Environmental Protection: Geology informs our knowledge of soil composition, water quality, and the impact of human activities on Earth, which is essential for sustainable environmental management and pollution control.
4. Historical Insight: By studying rocks and fossils, we can learn about Earth's history, including past climates, evolution of life, and ancient landscapes.
5. Climate Change: Geology provides critical information about past climate changes, helping scientists predict future climate trends and their potential impacts.
6. Engineering and Construction: Knowledge of the Earth's structure and materials is essential for safe construction of buildings, dams, and infrastructure.

The Earth's Structure Earth's structure is divided into several layers, each with distinct properties. These layers include:

1. Crust

The Earth's outermost layer, relatively thin and solid.

Types of Crust:

Continental Crust: Thicker, ranging from 25-70 km; composed mostly of granite.

Oceanic Crust: Thinner, about 5-10 km; denser, primarily composed of basalt.

The crust contains all known life forms and is where tectonic plates reside.

2. Mantle

Located below the crust, extending to a depth of about 2,900 km.

Composed mostly of silicate rocks rich in magnesium and iron.

Layers of the Mantle:

Upper Mantle: Extends to around 660 km and includes the lithosphere (rigid layer that includes the crust) and the asthenosphere (semi-fluid, enabling tectonic plate movement).

Lower Mantle: Extends from 660 km to 2,900 km and is more rigid due to increased pressure.

The mantle is where convection currents occur, driving plate tectonics.

3. Core

Divided into two parts and primarily composed of iron and nickel.

Outer Core: A liquid layer about 2,200 km thick, generating Earth's magnetic field through convection.

Inner Core: A solid sphere with a radius of about 1,220 km, incredibly hot and under intense pressure.

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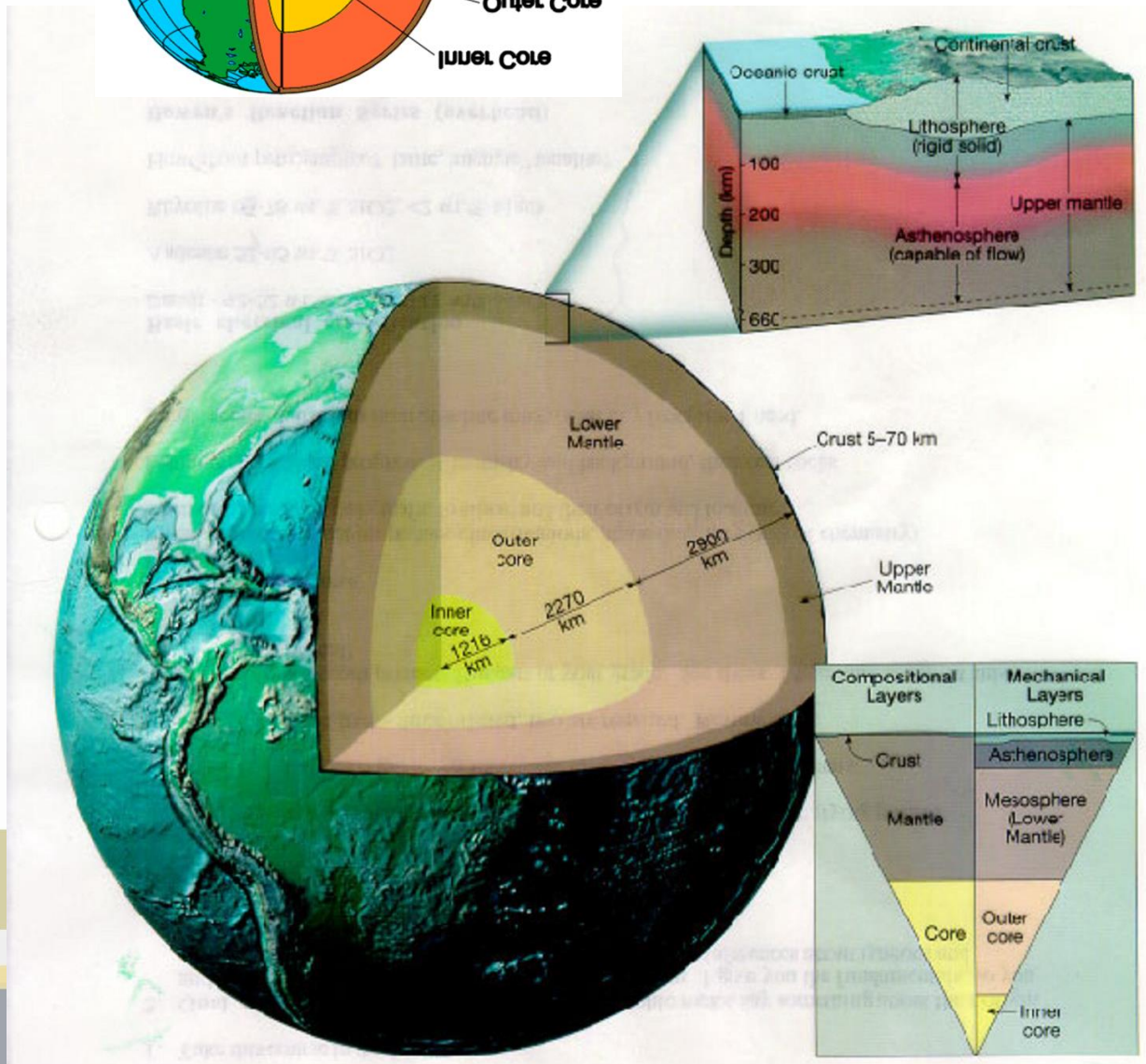

القشرة الأرضية Crust هي الطبقة الخارجية الصلبة من كوكب الأرض، تتكون القشرة من صخور صلبة ومعادن، وهي أقل طبقات الأرض سمكًا مقارنةً باالجبة واللب. وتنقسم إلى نوعين رئيسيين:

1. القشرة القارية: وهي القشرة التي تشكل القارات، وتكون عادةً أكثر سمكًا وأقل كثافة، وتحتوي على صخور قديمة مثل الجرانيت.
2. القشرة المحيطية: وهي القشرة التي تشكل قاع المحيطات، وتكون أرق وأكثر كثافة من القشرة القارية، وتحتوي بشكل أساسي على صخور البازلت.

تعتبر القشرة الأرضية جزءًا أساسيًا في دراسة الجيولوجيا لأنها تحتوي على السجل التاريخي للأحداث الجيولوجية، وتؤثر في الظواهر الطبيعية مثل الزلازل والبراكين.

الجبة Mantle تتكون الجبة بشكل اساس من سليكات الحديد والمغنيسيوم وتمتد من أسفل القشرة إي تحت خط إنقطاع موهو وإلى خط إنقطاع الجبة – اللب على عمق 2900 كم ويبلغ سمكها حوالي 2850 كم وتقسم الجبة إلى ثلاثة أقسام:

أ. الجبة العليا Upper Manlte

ب. النطاق الانتقالي Transition Zone

ج. الجبة السفلى Lower Mantle

اللب Core

اللب Core : يمتد من أسفل الجبة إي من خط انقطاع الجبة – اللب وإلى مركز الكرة الأرضية عند عمق 6371 كم ويبلغ قطر الكرة التي تمثل اللب 3471 كم تقدر درجة حرارة اللب بحوالي 4000 درجة مئوية ويقسم اللب إلى قسمين:

أ. اللب الخارجي Outer Core:

ب. اللب الداخلي Inner Core: