

## THE SCIENCE OF GEOLOGY

### **What is geology?**

Geology is the study of the Earth, including the material that it is made of the physical and chemical changes that occur on its surface and in its interior, and the history of the planet and its life forms.

### **What does a geologist do?**

Geologists work to understand the history of our planet. The better they can understand Earth's history, the better they can foresee how events and processes of the past might influence the future.

### **What are the branches of geology?**

Geology is divided into several branches, including:

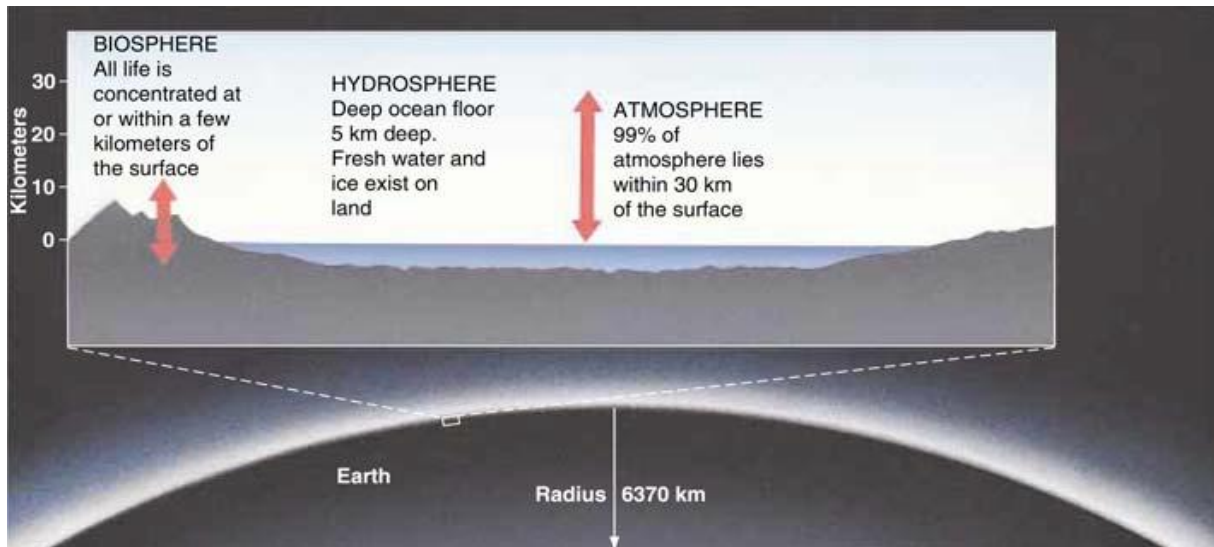
- a) mineralogy (the study of minerals and their classification)
- b) sedimentology (the scientific study of sediments)
- c) petrology (the study of origin, occurrence, structure and history of rocks)
- d) economic geology (understanding of ore deposits)
- e) stratigraphy (the deposition of successive beds of sedimentary rocks)
- f) palaeontology (science of the study of geological periods and the study of fossils)
- g) tectonics (the deformation and movement of the Earth's crust)
- h) geophysics (using physics to study the Earth's surface, interior, and atmosphere)
- i) environmental geology (the application of geology to problems created by man)
- j) seismology (study of earthquakes and related phenomena)
- k) hydrogeology (study of groundwater)
- l) geochemistry (study of the chemical composition of the Earth)

### **The Earth and its materials**

The Earth's radius is about 6370 kilometers (Fig. 1-1). If you could drive a magical vehicle from the center of the Earth to the surface at 100 kilometers per hour, the journey would take more than two and a half days.

Most of the Earth is composed of **rocks**. Rocks, in turn, are composed of **minerals**. Although more than 3500 different minerals exist, fewer than a dozen are common. Geologists study the origins, properties, and compositions of both rocks and minerals. Geologists also explore the Earth for the resources needed in our technological world: fossil fuels such as coal, petroleum, and natural gas; mineral resources such as metals; sand and gravel; and fertilizers. Some search

for water in reservoirs beneath Earth's surface.



**Figure 1-1.** Most of the Earth is solid rock, surrounded by the hydrosphere, the biosphere, and the atmosphere.

### **Internal processes**

Processes that originate deep in the Earth's interior are called **internal processes**. These are the driving forces that raise mountains, cause earthquakes, and produce volcanic eruptions.

### **Surface or external processes**

**Surface or external processes** are all of those processes that form the Earth's surface. Most surface processes are driven by water, although wind, ice, and gravity are also significant.

### **Layers surrounding the Earth**

The Earth is surrounded by three layers:

1. The **hydrosphere** includes water in streams, wetlands, lakes, and oceans; in the atmosphere; and frozen in glaciers (Fig. 1-1). It also includes ground water present in soil and rock to a depth of at least 2 kilometers.
2. The **atmosphere** is a mixture of gases, mostly nitrogen and oxygen (Fig. 1-1). It is held to the Earth by gravity and thins rapidly with altitude. Ninety-nine percent is concentrated within 30 kilometers of the Earth's surface, but a few traces remain even 10,000 kilometers above the surface.
3. The **biosphere** is the thin zone near the Earth's surface that is occupied by life (Fig. 1-1). It includes the uppermost solid Earth, the hydrosphere, and the lower parts of the atmosphere. Land plants grow on the Earth's

surface, with roots penetrating at most a few meters into soil. Animals live on the surface, fly a kilometer or two above it, or burrow a few meters underground. Sea life also concentrates near the ocean surface, where sunlight is available.

## **Layers of the Earth**

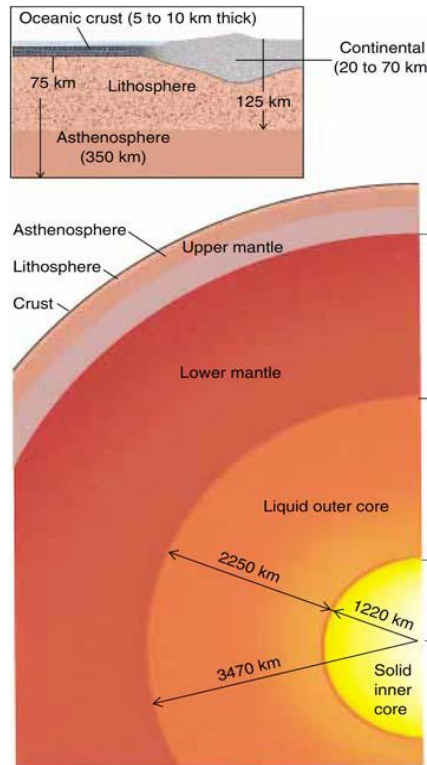
Scientists generally agree that the Earth formed by accretion of small particles. They also agree that the modern Earth is layered (Fig. 1-2).

1. The **crust** is the outermost and thinnest layer. Because the crust is relatively cool, it consists of hard, strong rock. Crust beneath the oceans differs from that of continents. Oceanic crust is 5 to 10 kilometers thick and is composed mostly of a dark, dense rock called **basalt**. In contrast, the average thickness of continental crust is about 20 to 40 kilometers, although under mountain ranges it can be as much as 70 kilometers thick. Continents are composed primarily of a light colored, less dense rock called **granite**.

2. The **mantle** lies directly below the crust. It is almost 2900 kilometers thick and makes up 80 percent of the Earth's volume. Although the chemical composition may be similar throughout the mantle, Earth temperature and pressure increase with depth. The upper part of the mantle consists of two layers which are named **lithosphere** and **asthenosphere**.

The uppermost mantle is relatively cool and consequently is hard, strong rock. In fact, its mechanical behavior is similar to that of the crust. The outer part of the Earth, including both the uppermost mantle and the crust, make up the lithosphere. At a depth, varying from about 75 to 125 kilometers, the strong, hard rock of the lithosphere gives way to the weak, plastic asthenosphere. In general, 1 to 2 percent of the asthenosphere is liquid, and because it is plastic, the asthenosphere flows slowly, perhaps at a rate of a few centimeters per year.

3. The **core** is the innermost of the Earth's layers. It is a sphere with a radius of about 3470 kilometers and is composed largely of iron and nickel. The outer core is molten because of the high temperature in that region. Near its center, the core's temperature is about 6000°C, as hot as the Sun's surface. The pressure is greater than 1 million times that of the Earth's atmosphere at sea level. The extreme pressure overwhelms the temperature effect and compresses the inner core to a solid.



**Figure 1-2.** The Earth is a layered planet.

**Read the passage above then answer the following questions.**

**Exercise:** according to the passage, which of the following statements are “true” or “false”?

1. Sand and gravel are mineral resources.
2. The atmosphere is a mixture of gases, mostly hydrogen and oxygen.
3. The biosphere includes the lithosphere, the hydrosphere, and the lower parts of the atmosphere.
4. Oceanic crust is 5 to 10 kilometers thick and is composed mostly of basalt.
5. The outer core is solid because of the high pressure in that region.
6. The asthenosphere is mechanically weak and plastic.

**Exercise:** Choose a, b, c, or d which best completes each sentence.

1. Coal, petroleum, and natural gas are .....  
a) rocks      b) minerals      c) fossil fuels      d) mineral resources
2. What is the composition of continents?  
a) Basalt      b) Granite      c) Lithosphere      d) Rocks
3. What does the upper part of the mantle consist of?  
a) lithosphere and asthenosphere      b) lithosphere and biosphere  
c) asthenosphere and hydrosphere      d) biosphere and hydrosphere
4. What is the composition of the core?

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- a) Nickel and Iron      b) Liquid      c) Basalt      d) Granite

**Exercise:** give a definition to the following words:

Altitude, lithosphere, burrow, accretion.

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**Homework:** Make a short research on the following :

1. The dictionary definition of your field of study, (speciality : Fundamental Geology, or Mineral resources).
2. Two (2) notable and famous figures who practiced this science: short biography (date and place of birth); and their notable scientific achievement.
3. One or two everyday applications of this science.

\*The answers of the exercises and the homework should be sent to this e-mail to be corrected and noted : [hibarabhallah@gmail.com](mailto:hibarabhallah@gmail.com).

p.s : Remember to write your names and specific group and speciality.