



## From magma to igneous rocks

Rocks are categorized into three distinct types according to their formation: igneous, metamorphic and sedimentary.

Sedimentary rocks are produced by processes operating mainly at the Earth's surface by the disintegration of mostly older igneous rocks, igneous – and metamorphic – rocks are formed by internal processes that cannot be directly observed and that necessitate the use of physical-chemical arguments to deduce their origins. Igneous rocks are crystalline or glassy rocks formed by the cooling and solidification of molten earth material, called **magma**, hot material (600 to 1,300 °C, or 1,100 to 2,400 °F) thought to be generated within the plastic **asthenosphere** at a depth below about 60 kilometres. Because magma is less dense than the surrounding solid rocks, it rises toward the surface. It may settle within the crust or erupt at the surface from a volcano as a lava flow. Rocks formed from the cooling and solidification of magma deep within the crust are distinct from those erupted at the surface mainly owing to the differences in physical and chemical conditions prevalent in the two environments.

Within the Earth's deep crust the temperatures and pressures are much higher than at its surface; consequently, the hot magma cools slowly and crystallizes completely, leav-

ing no trace of the liquid magma. The slow cooling promotes the growth of minerals large enough to be identified visually without the aid of a microscope.

On the other hand, magma erupted at the surface is chilled so quickly that the individual minerals have little or no chance to grow. As a consequence, the rock is either composed of minerals that can be seen only with the aid of a microscope or contains no minerals at all (in the latter case, the rock is composed of glass, which is a highly viscous liquid).

This results in two groups: **plutonic intrusive igneous rocks** that solidified deep within the crust and **volcanic, or extrusive, igneous rocks** formed at the Earth's surface. The great majority of the igneous rocks are composed of silicate minerals – meaning that the basic building blocks for the magmas that formed them are made of silicon (Si) and oxygen (O), but minor occurrences of carbonate-rich igneous rocks are found as well.

**Asthenosphere** is the layer of partially molten rock underlying the Earth's crust

### ACTIVITIES

**1** Answer the following questions.

- 1 How are rocks categorized?
- 2 How are sedimentary rocks produced?
- 3 What are igneous rocks?
- 4 How deep is magma generated?
- 5 Why does magma come to the surface?
- 6 What may magma do?

- 7 What happens to magma that solidifies within the crust?
- 8 How different is magma erupted at the surface?
- 9 What are the two different types of rocks called?
- 10 What are rocks mainly made up of?

**2** Find a synonym for the following words.

- |                  |                     |
|------------------|---------------------|
| 1 Distinct ..... | 6 Differences ..... |
| 2 Surface .....  | 7 Slowly .....      |
| 3 Cooling .....  | 8 Completely .....  |
| 4 Molten .....   | 9 Chilled .....     |
| 5 To rise .....  | 10 Minor .....      |

**3** What is the main difference between plutonic intrusive igneous rocks and volcanic or extrusive igneous rocks? Discuss it in groups.

**4** What do you know about sedimentary and metamorphic rocks? Do some research and write a short paragraph about them.