

Unit 1 Weathering

The concept of weathering

Weathering is the breaking down of rock into small particles by physical, chemical and biological processes. These small particles can then be eroded by rivers, moving ice, the wind and wave action.

Physical weathering

Physical weathering involves the breakdown of rocks into smaller fragments due to temperature changes. Two types of physical breakdown are freeze-thaw weathering and thermal fracturing. Pressure release can also cause weathering without temperature changes.

- Physical weathering by temperature changes occurs in areas where there is a large daily temperature range, hot in the day and cold at night. The repeated heating and cooling can cause the rock's outer layers to peel off in thin sheets – a process also called exfoliation (see Figure 3.1).
- Fires can also cause weathering of rocks. Intense heat can rapidly expand a boulder.
- Pressure release is also called unloading. This happens when rocks such as granite, which form deep within the Earth's crust, are exposed by erosion. These rocks were subjected to great pressure when buried under other rocks. They expand and fracture when pressure is reduced, causing the layers of rock to separate (see Figure 3.2). Pressure release may also cause exfoliation.

Freeze-thaw weathering is also called frost shattering. Water becomes trapped in a crack or joint in the rock. If the air temperature drops below freezing, the water will freeze and expand by nine to 10 per cent, putting pressure on the rock. When the temperature rises above freezing, the ice will melt. If this process happens repeatedly, the rock will weaken and eventually shatter into angular fragments. It is most effective when the temperature fluctuates around 0 °C. The fragments may then be deposited as scree at the foot of a slope.

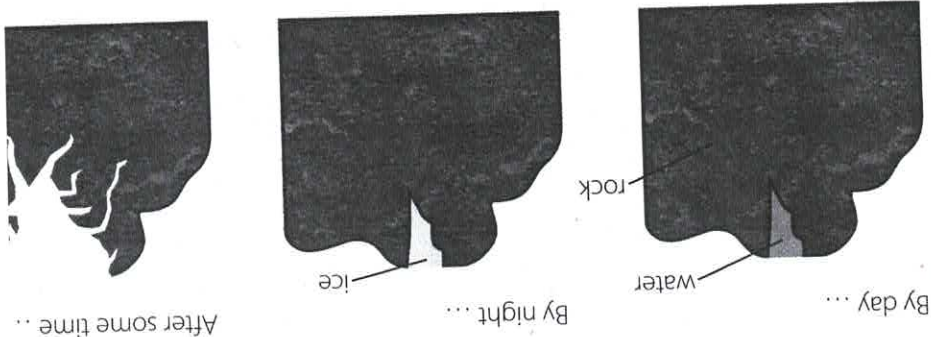
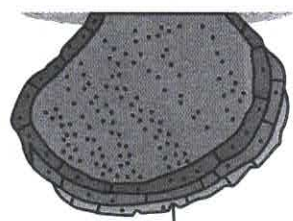


Figure 3.2: Freeze-thaw weathering

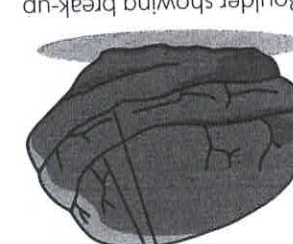
Figure 3.1: Expansion and contraction cause exfoliation.

Sectional view of boulder



Expansion and contraction causes outer layers to break off

Boulder showing break-up by exfoliation



Layers of rock peel off with expansion and contraction during hot days and cold nights

Keywords

particle: a very small piece of something

fragment: a small piece broken off something

thermal: affected by heat

fracturing: breaking, splitting or cracking

something

scree: an accumulation of loose stones or rocky debris lying on a slope or at the base of a hill or cliff

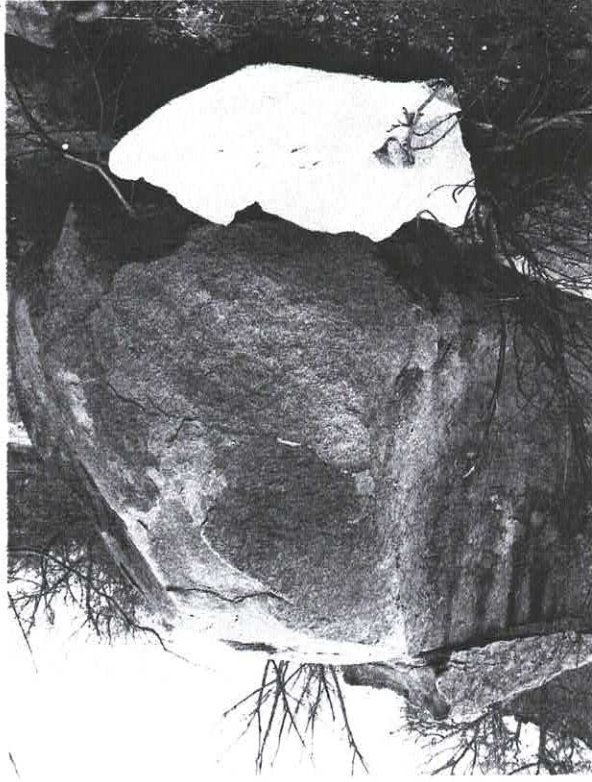
Source: Bigstock

Scree in the Caucasus mountains Ebrus area, Russia



Source: Anthony Hamby

caused a piece of rock to break off (exfoliation).



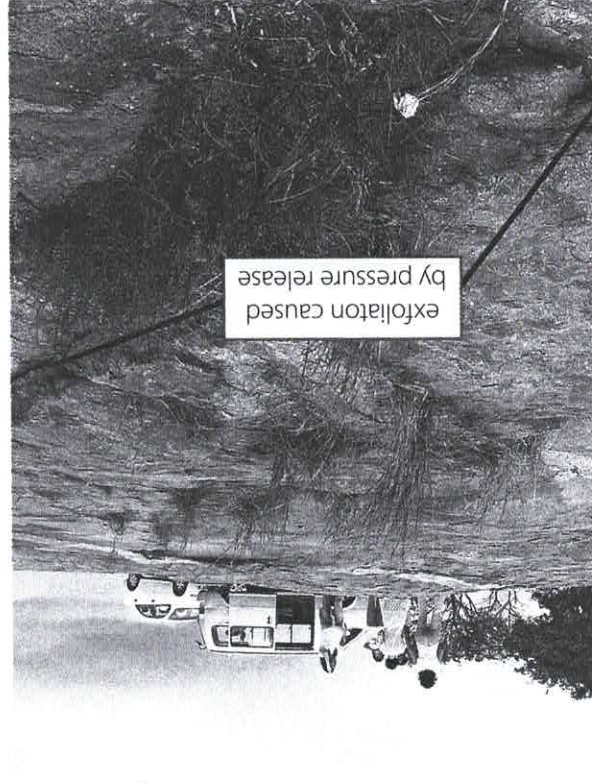
Source: Anthony Hamby

Spheroidal weathering



Source: Anthony Hamby

ure release in granite



Keywords

- decompose: to rot or break down
- dissolved: to become absorbed in a liquid

Chemical weathering is the process by which rocks are decomposed, dissolved or loosened by chemical processes. Chemical weathering changes the composition of rocks, often when water interacts with minerals to cause chemical reactions.

Rain is really a weak acid because it dissolves oxygen and carbon dioxide as it falls through the air. Some minerals, especially limestone compounds, are dissolved out of rocks by rainwater. These rocks are weakened and begin to break up. The limestone surface is called a limestone pavement and is weathered to form grooves called grikes and flat-topped ridges called clints.

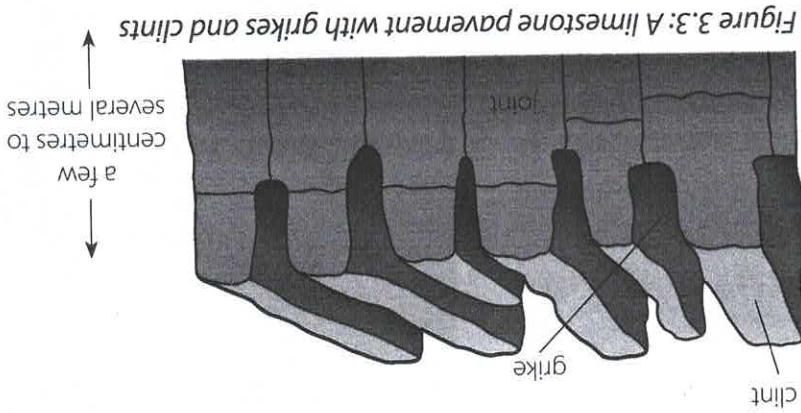


Figure 3.3: A limestone pavement with grikes and clints

Limestone caves are another feature of chemical weathering. The underground limestone is dissolved and removed, leaving a cave.

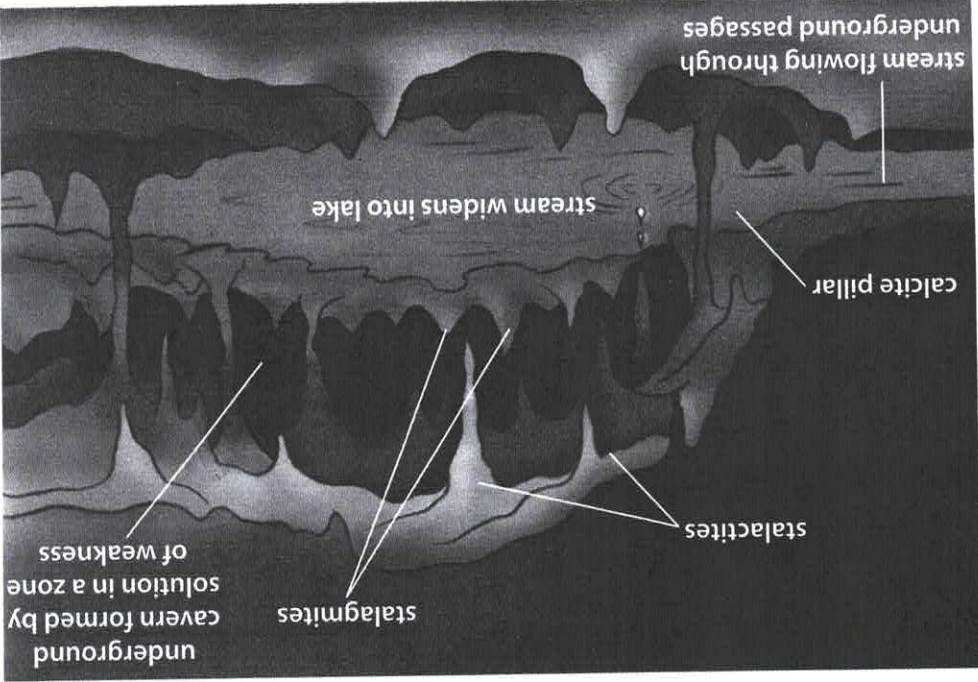
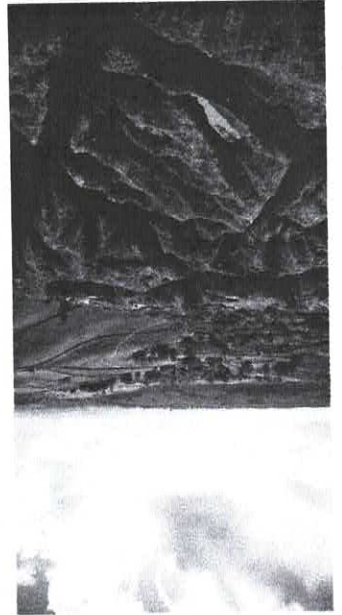


Figure 3.4: A limestone cave

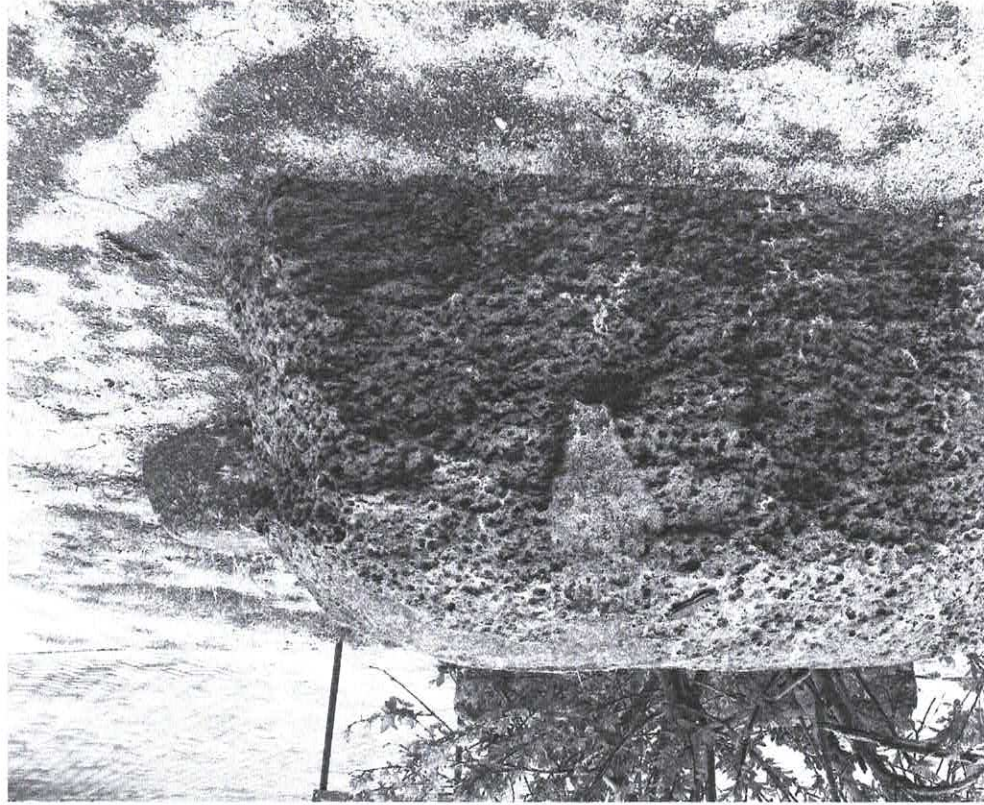
Source: Moikha/Bigstock



A limestone pavement with grikes and clints.

honeycomb weathering

Source: Anthony Hamby



honeycomb weathering is another form of chemical weathering. This is caused by different minerals in the rock decomposing at different rates. The minerals with the faster chemical reaction break down first, leaving small holes in the rock.

the Cango Caves

Source: Michael Jung/Bigstock

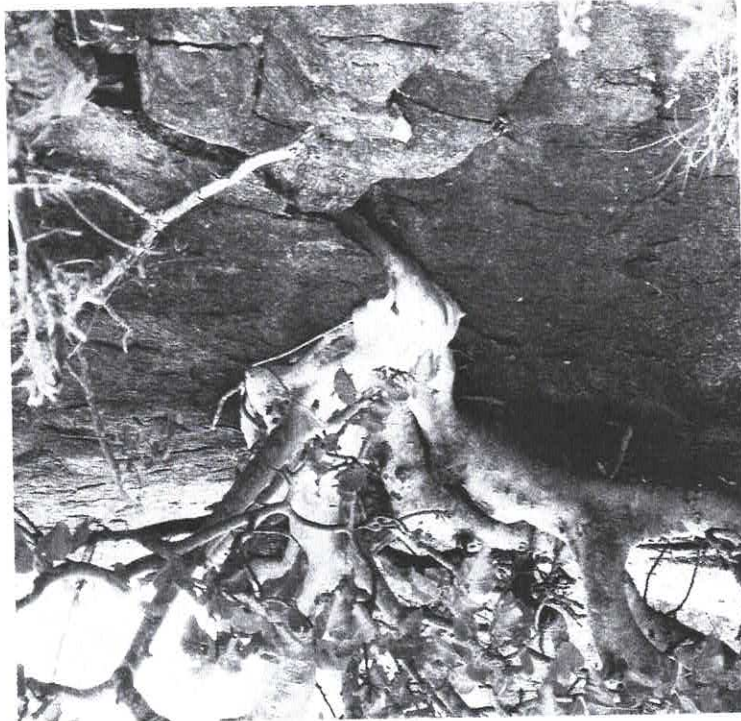


The most famous limestone caves in South Africa are the Cango Caves near Oudtshoorn in the Western Cape.

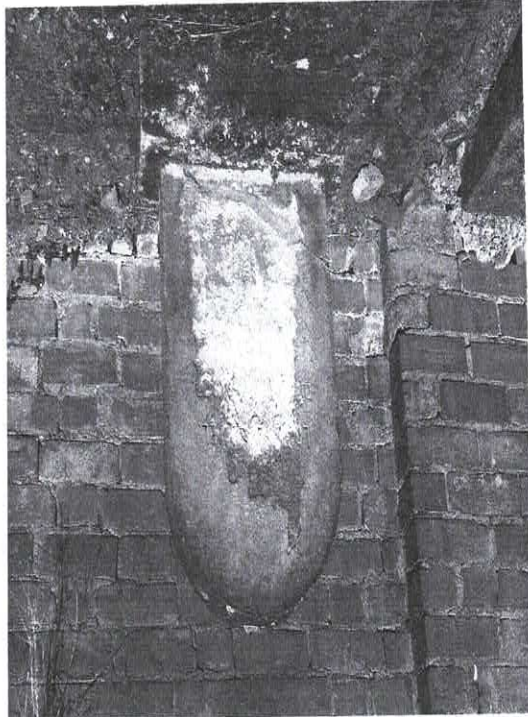
Geography

Biological weathering

Biological weathering is a form of weathering caused by living organisms. This happens with the growth of roots or the burrowing of animals. Plants also give off organic acids that help to break down rocks chemically. Tree roots are the most important agents of biological weathering as they are capable of breaking rocks apart by growing into cracks and joints. As the tree grows, its roots get bigger and force open cracks.



The roots of this fig tree have enlarged the joint in the rock.
Source: Anthony Hamby



Pollution in the form of acid rain has caused severe weathering of this gravestone.
Source: Anthony Hamby

Location of weathering types

Physical weathering takes place in regions where there are changes in temperature, but is most often seen in hot deserts where there are big differences between day and night temperatures. Freeze-thaw weathering is found in cold areas where the day temperatures are above freezing and the night temperatures below freezing.

Chemical weathering takes place in all areas where there is rain, but since heat speeds up chemical reactions it is most common in hot regions that have a high rainfall, such as equatorial regions.

Impact of human activities on weathering

Humans have greatly increased rates of weathering by increasing chemical pollution in the atmosphere through industry, power stations and vehicle emissions.

Activity 3.1 Weathering

15 minutes

- (1) a) Antarctica
- (1) b) the Amazon River area
- (1) c) the Namib
- (4) a) Exfoliation by temperature changes
- (4) b) Freeze-thaw weathering
- (4) c) Grikes and clints
- (4) Describe the effect that humans have had on weathering.
- (1) Why is granite increasingly being used as a building material?
- (2) Report your observations to the class and provide evidence of it if possible.

1. Explain what type of weathering would be most common in the following areas? Use your atlas to help you locate them.

2. Draw fully labelled diagrams to show:

3. Describe the effect that humans have had on weathering.

4. Why is granite increasingly being used as a building material?

5. Look for signs of weathering on different objects, such as buildings, garden furniture, cars, and flower pots outside at school or at home. Report your observations to the class and provide evidence of it if possible.

The increase in gases, such as carbon dioxide, sulphur dioxide and nitrogen oxide has led to the formation of acid rain. Acid rain is able to erode rocks, such as limestone and increases chemical weathering processes. The effect of this can be seen in cities where there are buildings and statues made of limestone. Granite is a rock that is very resistant to chemical weathering and South Africa exports large quantities to Europe where buildings made of limestone are given a granite covering to prevent their deterioration.

Chemical pollution by power stations

Source: Photo: Bigstock/loss



A truck causing pollution via gas emission.

Source: Alamy/Atrpics

