

Igneous processes: matching the evidence they leave behind: teachers' notes

Level

This activity is designed for students aged 11-14, as an introduction to igneous rocks. It can also be used for students aged 14-16, with discussion about the variety of ways in which igneous rocks form and the evidence that is left behind about how they were formed.

Topic

Igneous rocks form by exciting processes, and contain evidence about their origins. This is just as well, since many of them form below ground where they cannot be observed. Much detective work can be done on specimens, or on pictures of them.

Description

This activity consists of a simple 'match it' exercise, where students relate a series of photographs to descriptions. Two simple demonstrations can be used before the exercise to start students thinking about some of the processes involved in the formation of different types of rock.

Context

Pupils may well have witnessed volcanic eruptions, on TV reports, or even possibly on holiday. To reinforce this, some video clips of volcanic eruptions are available at volcano.und.nodak.edu. Students should have carried out an investigation into the relationship between cooling rate and crystal size, using experiments with lead iodide or with salol, for example (see *Investigating the effect of rate of cooling on crystal size*). They should be familiar with the main groupings of rocks (sedimentary, metamorphic and igneous), and realise that they are studying rocks of **igneous** origin in this activity.

At the end of the activity students should be aware of the variety of ways in which **igneous** rocks can form.

Teaching points

Some terms are used in Earth Science in different ways from their everyday meanings and these will need to be explained. Thus, the **texture** of a rock refers to the size of its constituent grains and the way they are arranged, and not the 'feel' or 'roughness' of the sample.

Pupils tend to think that volcanoes produce only lava. In fact, they all emit gases and many produce solid particles, including **volcanic bombs** and **ash**.

A striking start to the lesson is to shake up a bottle of fizzy lemonade and then rapidly remove the top. The resultant overflowing froth is akin to a very gassy lava eruption, which leaves evidence in the form of gas bubbles in the lava. The most extreme form of this is **pumice**, which is capable of floating on water. Students can be told that one of the photographs relates to this demonstration.

Then take a coffee jar, about two-thirds full of water. Ask pupils to predict what will happen when a well-mixed charge of sediment (ranging from gravel to fine sand) is added rapidly to the jar. The resulting distribution of material is an example of **graded bedding** (coarse particles at the base, fining upwards). Tell students that this, too, relates to one of the photographs.

Timing

The 'match-it' exercise itself takes about 10 minutes with discussion to follow.

Apparatus

Each group of students will need

- a copy of the sheet of photographs

Further pictures can be obtained free from www.geolsoc.org.uk, or by negotiation with the British Geological Society www.bgs.ac.uk. If specimens of some of the rocks were also available, this would greatly enhance the lesson. Suitable specimens can be obtained from a geological supplier. Click here for details of some suppliers www.earthscienceeducation.com/suppliers.

The teacher will need

- bottle of lemonade
- coffee jar
- mixture of gravel, coarse sand and fine sand, about 100g

The activity

Small groups of students study the pictures and try to match each one to its correct description.

Answers to questions

Picture	Description
1. Pumice.	A. This rock crystallised very quickly (in hours), trapping a lot of gas in bubbles in the lava. This results in a texture like a bubbly Aero™ chocolate bar.
2. Thick basalt, showing joints in columns (Fingal's cave).	D. This lava was erupted quickly, to form a thick sheet. The texture of the rock itself is too fine to see the crystals. As it cooled it contracted to form columns 60 cm or so across.
3. Lava, with some large crystals contained within it.	E. This rock began to crystallise from a molten magma, slowly below ground. Then, the magma, with the crystals in it, rose to the surface and erupted from a volcano.
4. Coarse granite.	B. This rock crystallised slowly below ground, where all the crystals had time to grow to a large size (perhaps taking several million years). The rock has a coarse-grained texture.
5. Volcanic bombs in a matrix of ash (random) .	F. The fragments in this rock were blasted out of a volcano up into the air. They landed on the sides of the volcano and then became cemented together to form a hard rock.
6. Volcanic ash showing graded bedding (coarse particles at the base, fining upwards).	C. The fragments in this rock were blasted out of a volcano and up into the air. They landed in the sea and then became cemented together to form a hard rock.

Q 1. The pumice (picture 1).

Q 2. Picture 6. The action of the particles of different sizes, having time to settle in the sea, will produce the graded bedding (coarse particles at the base, becoming finer upwards in a single layer).