Volcanoes on Earth and Mars.

Background

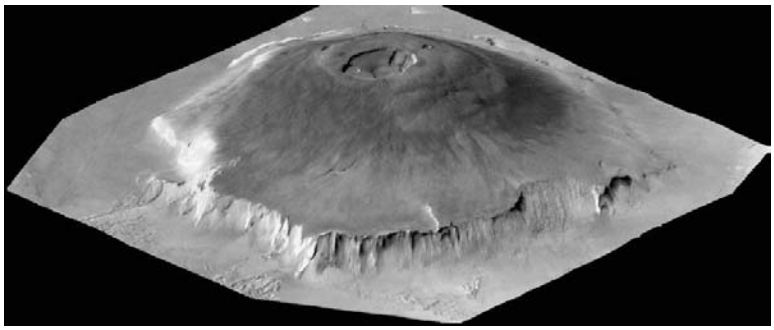
Volcanism: *The manifestation at the surface of a planet or satellite of internal thermal processes through the emission of solid, liquid or gaseous products.*

Volcano: *A site at which material reaches the surface of the planet from the interior.*

Throughout the Solar System there are only two fundamental geological processes – impact cratering and **volcanism**. Volcanoes and lava fields are found on all the rocky planets of the Solar System: on the Earth and Moon, Mercury, Venus, Mars, and many smaller satellites of the outer planets, for example Triton.

Some volcanic provinces have been extinct for billions of years – starting with our own Moon – and are rocky exhibits of the early days of planetary volcanism. The dark areas that we can see clearly on the Moon with our un-aided eyes are Lunar Maria (Latin for 'seas'). These are giant impact basins that have been flooded with basaltic lavas following volcanic activity. Other features are much younger, such as the volcanoes of Mars and Venus; and two planetary bodies are still active today: our own planet Earth (the image on the left is Mount St. Helens erupting in 1980), and Jupiter's Moon Io.

The widespread occurrence of volcanic areas – past or present – throughout the Solar System stresses the importance of volcanism in the creation and evolution of the planets. This prominent role is due to the fact that planets are born hot, and continue to produce heat (although at a declining rate) throughout their lifetime. Magmatism (the production of magma – molten rock from below the Earth's surface) and volcanism are the fundamental mechanisms that allow planets to cool off, by transporting heat upward to the surface, where it is radiated to space.



Large rocky planets produce more heat than smaller planetary bodies, and use volcanic activity to get rid of the surplus – the prime example being the Earth. Mars, being smaller than the Earth, has cooled itself down to a sufficient level and is therefore no longer volcanically active. However, the relics of Mars' past volcanic history still can be seen in the form of some of the largest volcanoes in the Solar System. In fact Olympus Mons, at 27 km high (three times as high as Mount Everest – see the image on the right), is the largest volcano known to man.

Topic

Volcanoes.

Overview

Students will use topography data to plot the shapes of various volcanoes on Mars, and compare these with the shapes and dimensions of volcanoes on the Earth. They will then investigate reasons why volcanoes on Mars are so much higher and broader than those on the Earth.

Key Question

What are the similarities and differences between volcanoes on the Earth and those on Mars?

Key Ideas

Volcanoes can be found on many planets and satellites in the Solar System, although not all volcanoes are the same as those found on Earth. For example, the volcanoes on Jupiter's moon Io are violently active and erupt mainly sulphur dioxide and silicate lavas, unlike the Earth where lavas are basaltic and the gases released are usually water vapour and carbon dioxide; volcanoes on Mars are more than three times as high as the tallest mountains on the Earth. It is the conditions on the planet and its composition that determine the shape of the volcanoes and the material that is erupted.

National Curriculum Links

Science Key Stage 3:	**Scientific Enquiry 2i – k, m** **Materials and their Properties 2f**
Science Key Stage 4:	**Scientific Enquiry 2j, k, m, o**
Maths Key Stage 3:	**Shape, Space and Measure 3e** **Handling Data 1e; 4a, b; 5b, c**
Maths Key Stage 4:	**Foundation – as above** **Higher - Shape, Space and Measure 3e** **Handling Data 1c; 4a; 5b, c**

Geography Key Stage 3:	**Geographical Enquiry and Skills 1a, d; 2c, e** **Patterns and Processes 4a, b** **Themes 6bii**
Geography Key Stage 4: **OCR Syllabus**	**Landscapes are a result of geomorphological processes** **Volcanic eruptions** **Interpreting data, analysing data to reach conclusions** **Representing data in a graphical form**

Materials and Preparation

This activity can be done individually or in small groups. It should take a double lesson to complete.

Each student or group will need:

- Volcanoes on Earth and Mars – Student Worksheet
- Volcanoes on earth and Mars – Student Activity
- Topography of Martian Volcanoes – Student Data (in hard copy or electronic format)
- Topography of Earth's Volcanoes – Student Data
- Graph Paper or P.C. and computer package such as Excel

Management

1. Introduce the class to the idea that both Mars and the Earth have volcanoes. Use the transparency to look at the relative sizes of the planet and the enormous size of the volcanoes on Mars. You could also talk about how Earth volcanoes are usually found on plate boundaries, but Martian volcanoes are concentrated in smaller areas over hotspots of magma (as can be seen in the transparency).

2. Get the students (in their groups or as individuals) to fill in the student worksheet (should take about 10 – 15 minutes). Discuss the answers to the questions with the whole class and get students to come and draw their Martian volcanoes on the board.

3. Students will then work on the activity to compare the volcanoes of the Earth with those on Mars. They can plot the Martian volcanoes on graph paper, or use the electronic format of the topography files in a package such as Excel to make a plot. After plotting the shapes of the volcanoes on Mars and extracting data from the images of Earth volcanoes, the students will work through the questions on the sheet.

4. When all the questions are completed – draw together the answers to the questions and discuss with the class using the Teacher's Answer Sheet.

Further Activities

1. Divide students into groups of 3/4 and give each group a famous eruption to research. The groups must then present the details of the eruption in the form of a news broadcast where one member of the group is a newsreader – giving all the facts e.g. dates, places, number of people killed etc; another member is a scientist – talking about the type of eruption and how it happened; and the final member(s) are people from the local community or witnesses who describe what they saw, the social impact of the eruption and how it effects their lives. A list of famous eruptions is given below:

   - Santorini (Thera), Greece – 1620 BC
   - Mt Vesuvius, Pompeii, Italy – 79AD
   - Tambora, Indonesia – 1815
   - Krakatau, Indonesia – 1883
   - Mt Pelee, Martinique, Caribbean – 1902
   - Surtsey, Iceland – 1963
   - Mt Etna, Sicily, Italy – 1971
   - Mt St Helens, USA – 1980
   - Mt Pinatubo, Philippines – 1991
   - Soufriere Hills, Montserrat, Caribbean – 1995 – 1998

2. 'Lava in the Laboratory' – students design, plan and carry out an investigation to change and measure the 'runniness' of treacle (where the treacle represents volcanic lava). For further information see the 'Lava in the Laboratory' worksheets. This activity is reproduced with the permission of The Earth Science Education Unit, Keele University.