When will it blow? – predicting eruptions

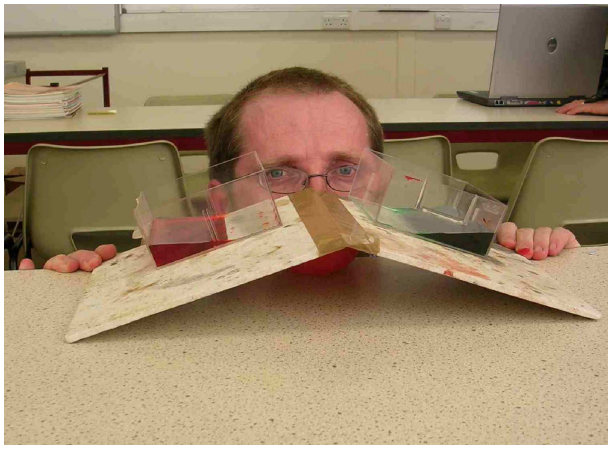
How a simple tiltmeter can demonstrate the bulging of a volcano before eruption

Tape two boards together along one edge, and place them near the edge of the table. Pour about 1cm depth of water into two containers and colour the water with ink, coffee or tea, if available. Place one container on each board, equal distances from the join, held in place by tape.

Place a balloon or small paper or plastic bag under the axis of the boards.

Ask a pupil to inflate the balloon/bag, gently! Invite another pupil to measure (with a protractor) how much the boards are tilted from the horizontal. (this is most easily done in relation to the bench, which will give the same angle as that between the tilted boards and the water surface).

This is how tiltmeters placed on volcanoes work. If the volcano 'bulges', changing shape because the magma beneath is rising, the liquid in the tiltmeter will move – sending an electric signal 'back to base'.



Imitating the inflation of a volcano with a balloon

Photo: Peter Kennett

Tiltmeter in use on the volcanic island of Montserrat

The back up

Title: When will it blow?

Subtitle: Predicting eruptions

Topic: How a simple 'tiltmeter' can demonstrate the bulging of a volcano before eruption – using trays of water to highlight 'bulging' as a bag or balloon is inflated.

Age range of pupils: 7 – 18 years

Time needed to complete activity: 5 minutes

Pupil learning outcomes: Pupils can:

- describe how magma rising beneath a volcano before eruption can cause the surface to 'bulge' upwards;
- explain how the amount of tilt of a surface can be measured with respect to the horizontal water surface in a tiltmeter;

Context: The activity could form part of a lesson about volcanic eruptions and their effects. It could be used as part of the preparation for the best response to an eruption in a volcanic area.

Following up the activity: Websearch for real data.
http://hvo.wr.usgs.gov/kilauea/update/main.html

Discuss whether it is better to use one source or several in trying to predict an eruption, e.g. On Galeras, when gravity and gas emission data were being monitored at the summit of the volcano during a volcanological conference, seismic tremors were not being interpreted (because the seismologist was away). The volcano erupted violently, killing Professor Geoff Brown of the Open University and several colleagues, and injuring others.

Underlying principles:

- Magma or liquid rock underground is less dense than the surrounding rock.
- Prior to eruption, the magma forces its way upwards, often causing the ground surface to bulge upwards.
- The bulging can be detected by tiltmeters as well as by devices that measure change in altitude or distance.
- Electronic signals from these remote sensing instruments feed back data to monitoring stations, aiding the prediction of eruptions.
- Prediction of eruptions has allowed the evacuation of populations to safety.

Thinking skill development: Pupils are asked to 'bridge' between a simple classroom demonstration and the reality of tiltmeters of a similar type being used to predict volcanic eruptions.

Resource list:

- 2 small rigid boards
- sticky tape
- balloon (round or long) or a small paper or plastic bag
- 2 small containers for water, preferably rectangular in shape e.g. clear plastic boxes.
- optional ink, coffee or tea to colour the water
- protractor

Useful links:

Tiltmeters in action are described in the daily report of the eruption of the volcano Kilauea on Hawaii at:
http://hvo.wr.usgs.gov/kilauea/update/main.html

See how tiltmeters helped scientists to predict eruptions at Mt. St. Helens at:
http://volcanoes.usgs.gov/About/What/Monitor/Deformation/TiltMSH.html

Source: 'The Earth and plate tectonics' workshop booklet published by the Earth Science Education Unit, http://www.earthscienceeducation.com