Collapsing volcanoes – cauldron subsidence
Forming circular 'cauldron subsidence' in jelly 'volcanoes'

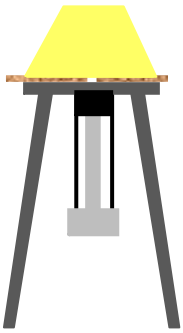
Try making a jelly model of the 'cauldron subsidence' that can occur when volcanoes erupt and collapse.

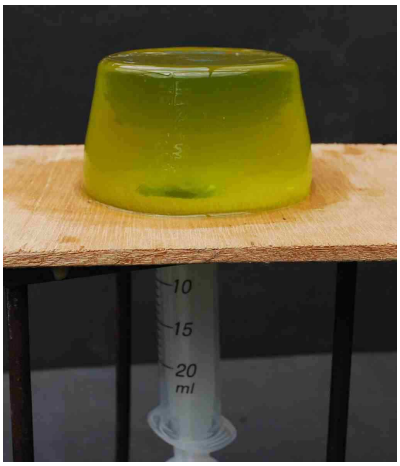
Make a jelly (jello or gelatin) 'volcano' in advance by mixing up the jelly as normal, pouring the liquid jelly into a circular plastic container (eg. an old yoghurt pot) and allowing it to set.

Saw off the narrow end of a 20 ml (or larger) syringe. Make a hole in a baseboard, large enough to take the barrel of the syringe, and fit the syringe as snugly as possible into the hole. Fully compress the plunger to the end of the syringe. Set up the board with the syringe beneath it on a tripod, as shown in the diagram, and turn out a fresh jelly onto the board.

Now produce a model of cauldron subsidence in a volcano by drawing the plunger gently back up the barrel of the syringe. It may be necessary to do this several times. When pushing the plunger forward again, do it very slowly, so as not to disturb the collapse and see if radial fracture patterns can be produced in the jelly, like those seen in the Earthlearningidea 'Volcanoes and dykes/ jelly and cream – radial dykes'.

The best way of cleaning up the result is to eat it!

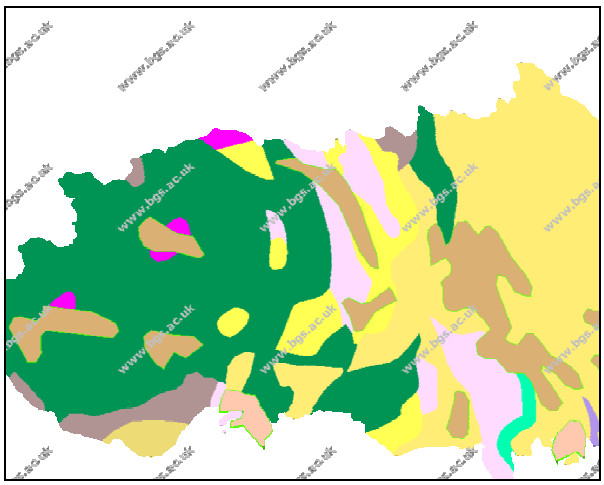




The apparatus for 'cauldron subsidence'.
The jelly has been made in an old yoghurt pot.

'Cauldron subsidence', after pulling the plunger back two or three times. A radial fracture can also be seen, produced when the plunger was pushed in again.

'Cauldron subsidence' and radial fractures, shortly before collapse of the whole structure!
(*Photographs by Peter Kennett*)



The Ardnamurchan Peninsula, W. Scotland. The dark green colour shows igneous rocks intruded as ring dykes beneath an ancient volcano, caused by several successive phases of cauldron subsidence. *(Derived from BGS DiGMAP 1:625 000 bedrock data. British Geological Survey © NERC. All Rights Reserved. CP12/096. Contains Ordnance Survey data © Crown copyright and database right 2012*)

The back up

Title: Collapsing Volcanoes - cauldron subsidence

Subtitle: Forming circular 'cauldron subsidence' in jelly 'volcanoes'

Topic: A simulation of cauldron subsidence beneath a volcano as it erupts and collapses

Age range of pupils: 8–80 years

Time needed to complete activity: 10 minutes

Pupil learning outcomes: Pupils can:
- describe how suction from below can produce a hollow in a jelly.
- appreciate that large scale surface features may be formed in volcanic regions, when magma beneath drains away or erupts and removes support from a vast cylinder of rock.

Context:
A demonstration of cauldron subsidence, that can be used in the classroom, lab or field. Note that it may be necessary to loosen the 'volcanoes' by dunking the mould into hot water for a few seconds if they don't turn easily out of the mould.

Following up the activity:
- Show pupils the geological map of the Ardnamurchan Peninsula in West Scotland and point out that the dark green colour shows where magma worked its way up through circular fractures caused by cauldron subsidence of an ancient volcano (about 58 million years ago). The magma solidified underground to form 'ring dykes'. The pink colour shows lavas from eruptions of the ancient volcano.
- Look up Ardnamurchan on the BGS website (see below) and change the 'transparency' slider to reveal the underlying land surface. The circular structure is still very clearly visible in the current landscape.
- Ask the pupils to search the web for pictures of volcanic calderas, possibly produced by cauldron collapse beneath the volcano.

Underlying principles:
- When a magma chamber beneath a volcano shrinks because the magma is either erupted or withdrawn, the lack of support may cause collapse of the overlying volcano, along a roughly circular fracture.
- If the collapse reaches the surface a large hollow 'caldera' forms in the landscape.
- Surface calderas may form by other processes, such as catastrophic explosive volcanic activity, as in the photograph.

Aniakchak Caldera, Alaska, about 10 km in diameter, formed about 3.400 years ago
(*This file is in the public domain since it was created by the National Park Service of the US Government*)

- Magma sometimes works its way up the circular fracture, rather like engine oil leaking from the sump into the upper cylinder of an old car engine when the piston rings are worn.
- This magma may solidify below the surface to form ring dykes.
- Later erosion of the volcano itself may reveal the ring dyke intrusions, as at Ardnamurchan.

Thinking skill development:
As pupils view several examples, they should be able mentally to 'construct' the subsidence hollow that results. Linking this to real cauldron collapse is a bridging process.

Resource list:
NB All items need to be carefully cleaned first, if the 'volcanoes' are to be eaten later.
- empty yogurt pots
- jelly (jello or gelatin)
- 15 cm square(ish) board with hole in middle, cut to allow a very snug fit for a sawn-off syringe
- a support for the board, e.g. a tripod
- syringe (20 ml or larger) with part of the point sawn off to fit hole
- a jug of hot water to loosen the jelly in the mould

Useful links:
http://mapapps.bgs.ac.uk/geologyofbritain/home.html?location=ardnamurchan

Source: Devised by Peter Kennett of the Earthlearningidea Team, as a sequel to 'Volcanoes and dykes/ jelly and cream – radial dykes: intruding cream radial 'dykes' into jelly 'volcanoes' until they erupt'.