

## Volcano Variations 1 – Teacher Notes

Volcanoes change the surface of the earth. They create classic conical volcanic mountains like Mt Fujiyama and low rising domes like Kilauea in Hawaii. Outpourings from fissures in the crust created major igneous provinces that form the stepped mountains of the Deccan of India and in the past covered most of Siberia to a depth of many kilometres. Collapsed magma chambers result in the cauldron subsidence that on land created the lakes at Mt Gambier and at sea, tsunamis. The landforms produced however are dependant on the type of magma extruded from the volcano. There are two major types of volcano, **stratovolcanoes** that produce the classical Mt Fujiyama outline and **shield volcanos** that are much lower and rounded. They are called shield volcanoes because they have the same profile as a warrior's shield laid on the ground. Hot springs and geysers are also produced by volcanic activity.



These paper models of a stratovolcano (left) and shield volcano (right) are downloadable from Geoscience Australia. <http://www.ga.gov.au/metadata-gateway/metadata/record/79350/> and from [http://www.ga.gov.au/image\\_cache/GA8583.pdf](http://www.ga.gov.au/image_cache/GA8583.pdf).

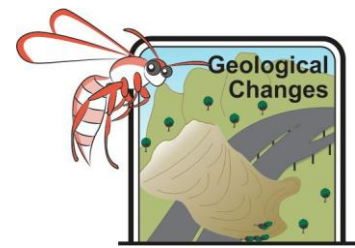
Moving tectonic plates create conditions for volcanic activity:

### 1. Plate convergence - Strato (or composite) volcanoes

Where two tectonic plates are pushed together at a zone of convergence, continental crust may be pushed down (subducted) and partially melted. The convergence of the northward moving Pacific Plate and the Asian Plate produce the famous belt of volcanoes known as the "Ring of Fire". Earthquakes will occur from the downward travelling plate rubbing against the over-riding slab. Magma formed from melting crust along with water and sediment pulled down with it, will be rich in silica creating explosive, sticky lava and explosive eruptions. These are the most dangerous volcanoes for living things. They produce clouds of super-heated steam and poisonous gas. They belch out clouds of red-hot volcanic ash (pyroclastics) that can instantly smother and burn the countryside. They can also produce lahars, unstable fast moving mudflows of ash, rocks and water which flow downhill along river valleys. They are the greatest danger from stratovolcano eruptions. Recent examples of volcanoes causing devastating lahars are from Mt Ruapehu in New Zealand, Mt Pinatubo in the Philippines and Mt Rainer in Washington State USA.

### 2. Plate divergence - Shield volcanoes

When plates diverge (pull apart) continental crust thins and hot melted oceanic crust rises to the surface. At hot spots the mantle also punches up through the crust. There is much less likelihood of earthquakes as tectonic plates are not rubbing together. Most of these eruptions occur under the sea. This silica poor magma is free flowing. Layer upon layer of basalt flows out to form new ocean



## Volcano Variations 1 – Teacher Notes

floor. When the supercontinents of Rhodinia and Pangea broke up about 750 and 250 million years ago, many eruptions happened along fissure lines in the crust. Free flowing magma filled any cracks in the rock or weaknesses between layers of rock to create black dykes (vertical dykes) and sills (horizontal layers). Because the igneous rock is hard and crystalline these rocks will not weather as easily as sediments and become outstanding.

Volcanoes can be described as active (erupt frequently) dormant (presently inactive but liable to erupt again) and extinct.

A combination of lava type and water content controls how a volcano behaves.

Water content	Lava type	Volcano type created	Explosion
Lots	Runny (mafic)	Cinder cone volcano	Often
Little	Runny (mafic)	Shield volcano	Rare
Lots	Sticky/viscous (SiAl)	Stratovolcano	Often
Little	Sticky/viscous (SiAl)	Plug dome volcano	Rare

### Viscosity and Lava Flow - Student Activity

**Viscosity describes the reluctance of a material to flow.**

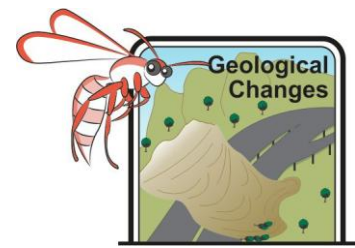
We cannot work with molten rock but we can observe how liquids with different viscosities behave. High viscosity liquids are honey, sunscreen, Vaseline and margarine or butter. Peanut butter is a fine example of a highly viscous liquid and has almost the same viscosity as the lava erupting from stratovolcanoes. It is not acceptable in the classroom however as allergic students can have fatal reactions.

Low viscosity liquids are water, milk, blood (again not acceptable in the classroom laboratory) and vegetable oil. Most tomato ketchup has medium viscosity.



#### Materials per group or teacher

- A plate, dish or student tray
- Spoons
- Samples of liquids of different viscosities E.g. Water, tomato sauce, vegetable oil and margarine
- Newspaper to protect the table top



## Volcano Variations 1 – Teacher Notes

### Method

1. Place one teaspoon of each liquid onto the plate.
2. Observe the shapes the different liquids make on the plate.
3. Describe the shapes of the materials on the plate after one minute in the table below.
4. Place another (second) spoonful of the same material on top of the original ones.
5. Place a third spoonful on top of the pile.
6. Write your observations in the table provided.

### Observations

Material	First spoon	Second spoon	Final shape	Viscosity
1 Oil	Spread out	Spread out	Flat and spread out	Low
2 Tomato ketchup	Low mound	Low mound	Rounded low mound	Medium
3 Margarine	High mound	Higher mound	High mound	High

Volcanos erupt layer upon layer of lava. Do you think the viscosity of lava will control the shape of the volcano? Explain your answer.

**Yes. Thick viscous lava will pile up and form a high pointed volcano whilst a less viscous lava will form a low rounded volcano.**

Stratovolcanoes have high conical peaks and do not extend over great areas. What kind of lava would build a strato volcano like Mt Fujiyama or Vesuvius? **A highly viscous lava (like andesite).**

Shield volcanos are low rounded mounds which extend for many tens of kilometres. What kind of lava would build a shield volcano like Mt Kilauea. **A low viscosity lava (like basalt)**

### OPTION

Perhaps the result would be different if these materials were flowing down a slope. Design an experiment to find out what would happen.

HINT This must be a "Fair Test"

What materials are required?

Which variable or variables will you change?

What method will be used?

How will you report your observations

Which variable or variables will you keep the same?



The speed lava travels at depends on its viscosity and the slope it is travelling down. Low viscosity lavas can move at 40-60km/h if a channel has been cut downhill.

Over flat lying ground, viscous lava flows move only a few metres an hour.

Less viscous basalts move at about 6km

Could you run faster than a viscous lava flow? **YES (The average human walking speed is 5-7km/h)**

Most people can get out of the way of flowing lava. Deaths occur only when they get too close to the lava and become burned or their escape route is cut off by another lava flow.

**Vocabulary** Strato volcano, shield volcano, lava and viscosity.