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NZQA

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Level 2 Earth and Space Science 2022

91191 Demonstrate understanding of the causes of extreme Earth events in New Zealand

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the causes of extreme Earth events in New Zealand.	Demonstrate in-depth understanding of the causes of extreme Earth events in New Zealand.	Demonstrate comprehensive understanding of the causes of extreme Earth events in New Zealand.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

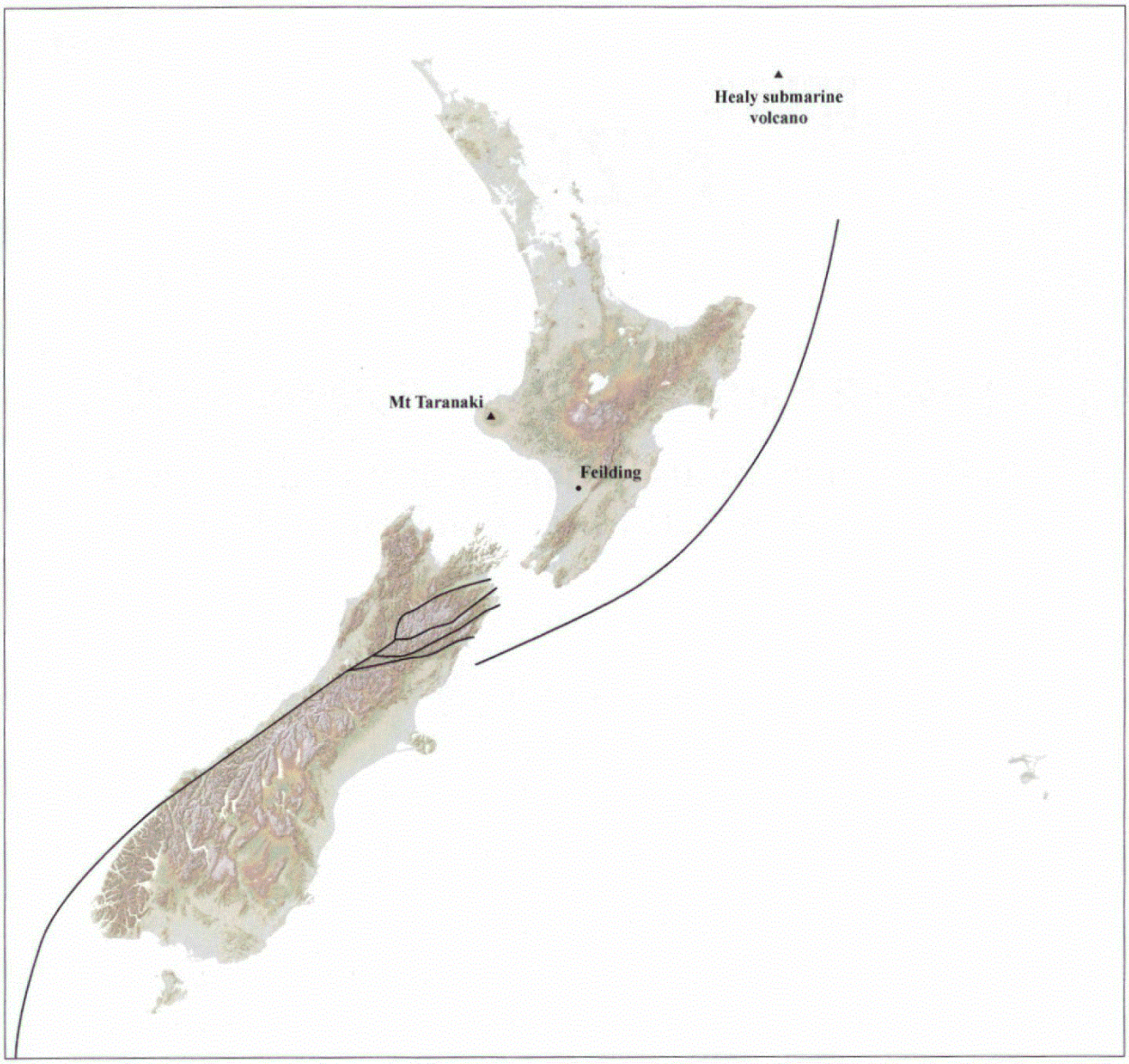
Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 17

Regional map showing locations referred to in this paper



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The examination continues on the following page.

QUESTION ONE: MT TARANAKI

Mt Taranaki is a stratovolcano found on the west coast of the North Island of New Zealand. It is the most recent of a sequence of volcanoes that erupted in this region over the last 600 000 years (see the diagram below). Mt Taranaki last erupted in 1854; Fantham's Peak is expected to be the next location of an eruption.

Adapted from: https://upload.wikimedia.org/wikipedia/commons/b/b7/NEO_egmont_big.jpg

(a) Annotate and label the diagram below to show how plate tectonics led to the formation of Mt Taranaki.

In your answer, you should:

- add arrows to show the plate movements
- name the two tectonic plates
- explain the key process indicated.

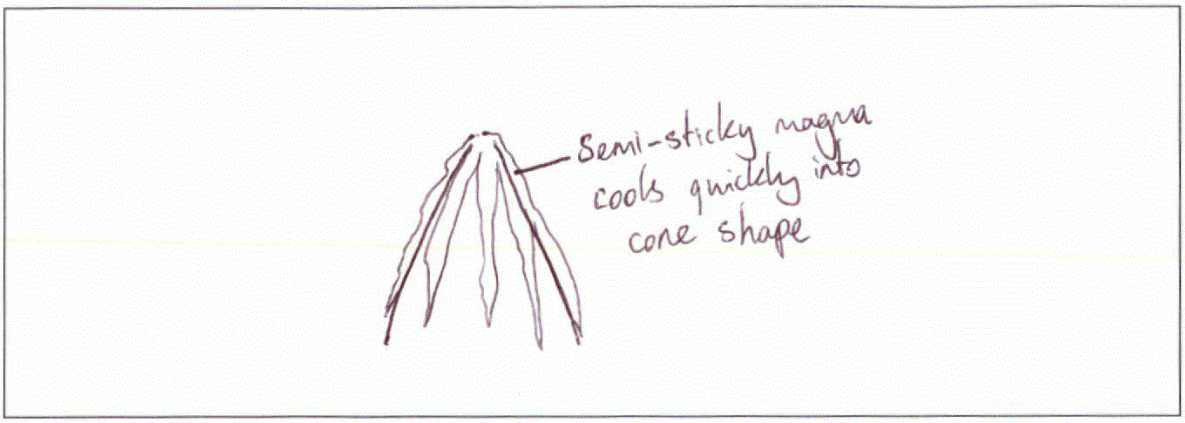
Adapted from https://teara.govt.nz/en/diagram/8693/subduction-under-the-north-island

(b) Explain, in detail, how andesitic magma leads to the formation of a stratovolcano.

In your answer, you should:

- describe the characteristics of andesitic magma
- explain how layering contributes to the shape of Mt Taranaki
- explain the link between magma composition and the shape of Mt Taranaki.

An annotated diagram may assist your answer.



Andesitic magma ~~is~~ has a moderate amount of silica, a moderate amount of viscosity and a moderate temperature, this produces semi-sticky magma that cools ~~quickly~~ relatively quickly and gives the stratovolcano it's cone shape. The andesitic magma has about 55-65% silica and is about 800-1000°c which is what makes it semi-sticky. The andesitic magma and other volcanic rocks layer the formation of the stratovolcano that contributes to the cone shape. These volcanic rocks like scoria and the andesitic magma make up alternating layers which create the cone shape of strato volcanoes. The andesitic magma being semi-sticky and cooling quickly to form alternating layers is because of it's moderate amount of silica which makes it moderately viscous. And it's moderate amount of gas makes it magma that is suitable to slowly create the cone shape.

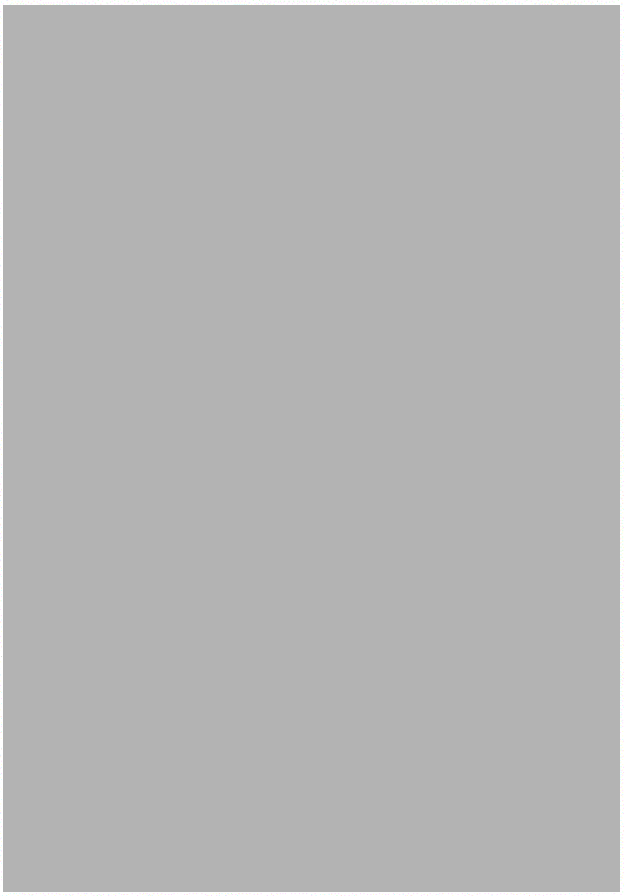
(c) Past eruptions of Mt Taranaki have produced lavas, pyroclastic flows, ash, and landslides.

A volcanic eruption from Fantham's Peak, south-west of Mt Taranaki, has been assessed as a moderate to very high hazard for the Taranaki region.

Explain, in detail, how the likely products of a future eruption may affect the surrounding area.

In your answer, you should consider:

- the links between magma composition and eruptive products produced
- the potential distance travelled by the eruptive products
- the potential effects of the eruptive products on the surrounding area.



Adapted from: https://resiliencechallenge.nz/wp-content/uploads/2018/08/McDonald-Cronin-et-al-2017.pdf

The magma of Mt Taranaki is andesitic and thus has a moderate amount of silica (55-65%), a moderate viscosity, a moderate temperature (800-1000°C), and a moderate amount of gas. Stratovolcanoes like Mt Taranaki can produce pyroclastic flows which go a long distance very fast and are harmful to all life they run into. Stratovolcanoes also produce ash clouds which can travel long distances and make breathing very difficult for any organisms in nearby areas. The pyroclastic flows and potential landslides from the Mt Taranaki erupting would change the surrounding land forever and have a high chance of harming organisms caught in a zone in which the flows could get to them.

QUESTION TWO: RECLASSIFIED FAULT LINE IN FEILDING

A science report published in 2021 has reclassified a number of fault lines in the Manawatū area from inactive to active.

One of these fault lines is the Rauoterangi fault, which passes through the centre of Feilding township, including underneath a local school.

Adapted from: https://data.gns.cri.nz/af/

(a) Describe what a fault line is.

A crack in the Earth's crust that has formed due to pressure from the build-up tension of plate movement.

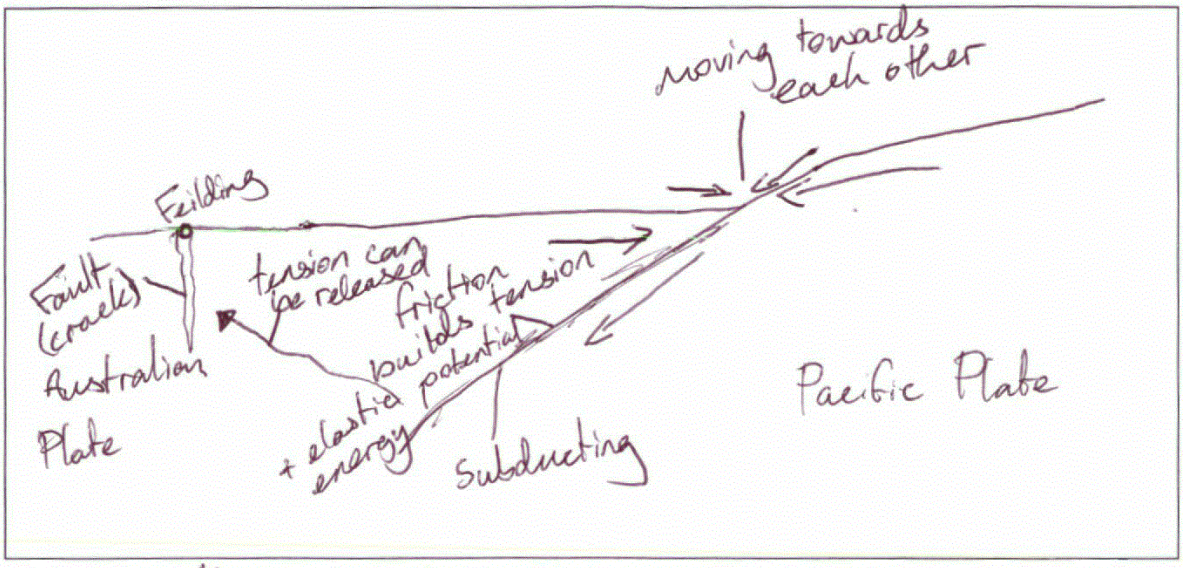
(b) Explain, in detail, how tectonic plate movement could lead to an earthquake along the Rauoterangi fault, which is over 200 km away from the plate boundary (refer to the New Zealand map on page 2).

In your answer, you should:

- name and describe the tectonic plates involved
- describe the type of plate boundary involved
- link the plate movement to the formation of an earthquake.

An annotated diagram may assist your answer.

The plates involved are the Australian Plate and the Pacific Plate. In this zone, the Pacific Plate is made from denser oceanic crust and is subducting



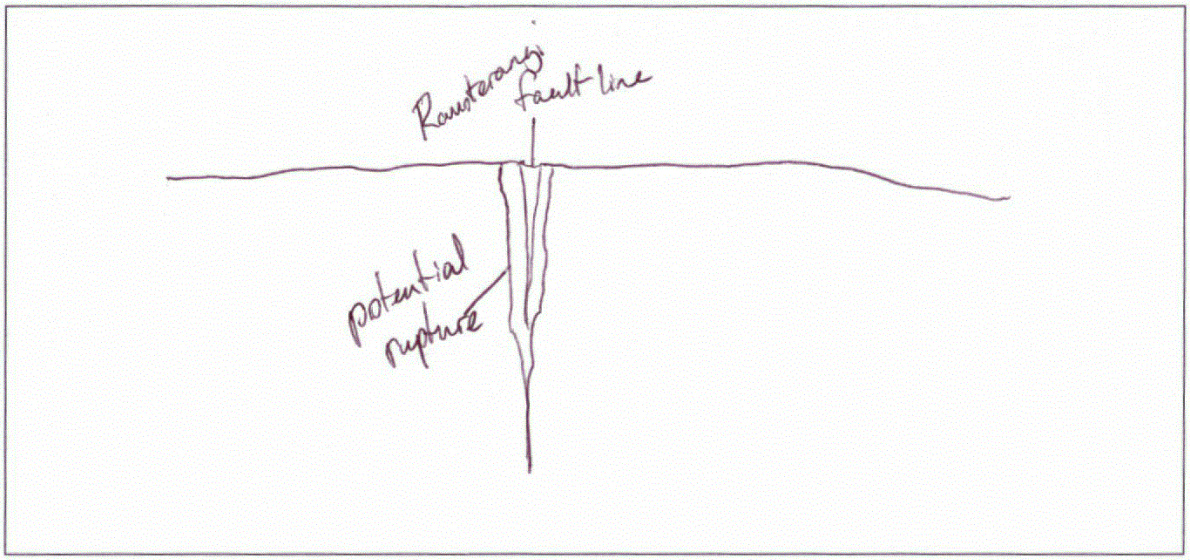
under the Australian Plate which is made of less dense continental crust in this zone. It is a convergent plate boundary which means the plates are moving towards each other and the denser plate made of oceanic crust will subduct under the less dense plate made of ~~crust~~ continental crust. In this zone the Pacific Plate is made of oceanic crust and subducts under the Australian Plate which is continental crust. The plates are building up a lot of tension from the friction of the plates moving against each other as they are subducting which is creating elastic potential energy because the plates want to snap back to their previous position to release the pressure. But instead, the pressure will be released through a crack in the Earth's crust nearby and cause an earthquake. The subduction can also go very deep and release the tension as close as possible which could end up being

(c) Explain, in detail, the factors that would affect the amount of damage experienced in Feilding if the Rauoterangi fault line were to rupture.

In your answer, you should consider:

- magnitude
- depth
- bedrock (underlying rock beneath Feilding)
- local area.

An annotated diagram may assist your answer.



If the Rauoterangi fault line were to rupture, Feilding may experience an extreme earthquakes. If the magnitude was big and the depth was shallow, Feilding would experience a very large earthquake with intense shaking and destruction. If the earthquake was deep and had a small magnitude, the earthquake produced would be much less intense. An earthquake with a shallow depth and a big magnitude (size) will be more destructive than a deep earthquake with a small magnitude. The Rauoterangi fault line runs right through the center of Feilding which could potentially lead to buildings being destroyed

QUESTION THREE: THE HEALY TSUNAMI

In 1360, the Healy underwater (submarine) volcano on the Kermadec Ridge erupted, forming a caldera and a tsunami that reached the Bay of Plenty in New Zealand.

(a) Describe what a tsunami is.

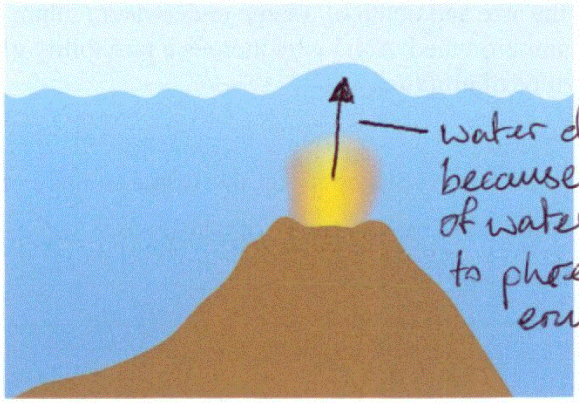
A tsunami is a series of waves that moves in all directions caused by a large vertical displacement of water. A tsunami can be caused by a landslides (that slide into water), an earthquake, an underwater volcano erupting or an underwater cliff fall in an underwater canyon.

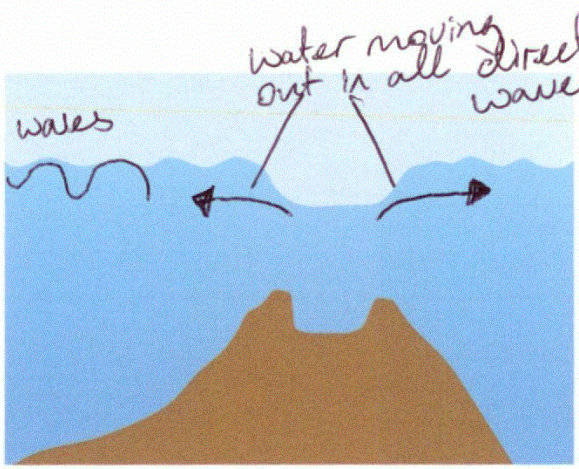
(b) Explain, in detail, how an eruption of an underwater (submarine) volcano, like Healy, can create a tsunami.

In your answer, you should:

- add arrows to the TWO diagrams opposite to show the direction of the water displacement
- annotate the TWO diagrams to explain the displacement and movement of sea water
- explain the energy transfer involved from the eruption.

As the submarine volcano, Healy, erupts, the magma meets water and causes it to be a phreato magmatic eruption where the water molecules rapidly expand due to the heat and become water vapour, causing a massive eruption. As the massive eruption causes a large vertical displacement of water, the displaced water is displaced upwards and then moves out in all directions as waves. The energy in the tsunami goes from potential energy as the water is displaced into kinetic energy as the water quickly begins





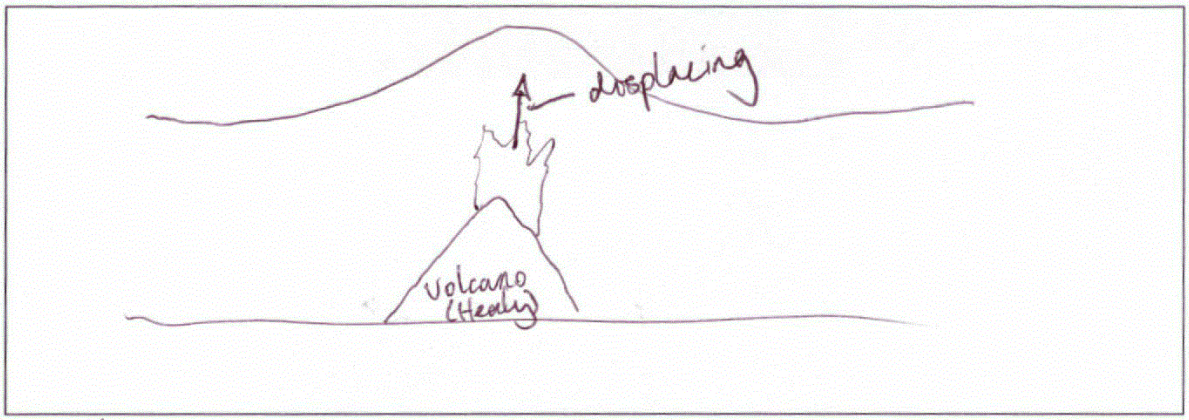
Question Three continues on the following page

(c) Explain, in detail, how the size and depth of a large underwater (submarine) volcano like Healy affect the size of a tsunami produced, AND why there is a possibility of more than one tsunami event as a result of this type of eruption.

In your answer you should:

- link the size and depth of the volcano to the size of the tsunami produced
- link the stages of eruption to the formation of tsunamis.

An annotated diagram may assist your answer.



The Healy volcano produces a phreato magmatic eruption where the magma meets water. As the magma meets the water when it erupts the heat from the magma causes the water molecules to rapidly expand into water vapour in a large explosive eruption. If the volcano was big and shallow then this might cause a very explosive eruption and create even worse tsunamis as the water is forced away by the displacement from the eruption. If the volcano was small and deep then the tsunami might be smaller. But it is because of the phreato magmatic eruption that there is a possibility of more than one tsunami as the displaced water tries to cope with the rapid expansion of the water molecules into water vapour and the continuing eruption creating a massive displacement of the water.

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

Standard	91191	Display ID	62137018 NSN-139032243	**Total score**	17 =M
Q	**Grade score**	**Annotation**			
1	M6	The candidate provides enough evidence in this question for a M6. They explained the shape of the volcano and one volcanic product. To reach an E7 the candidate needed to provide more detail for a second volcanic product.			
2	M5	To reach M6 the candidate needed to link the concept of energy to magnitude, depth, and distance.			
3	M6	This answer provides evidence towards M6 rather than E7. They have described how the tsunami was formed by a phreatomagmatic eruption but also needed to link to the caldera.			