SUPERVISOR'S USE ONLY

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Draw a cross through the box (☒) if you have NOT written in this booklet

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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Earth & Space Science 2023

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.

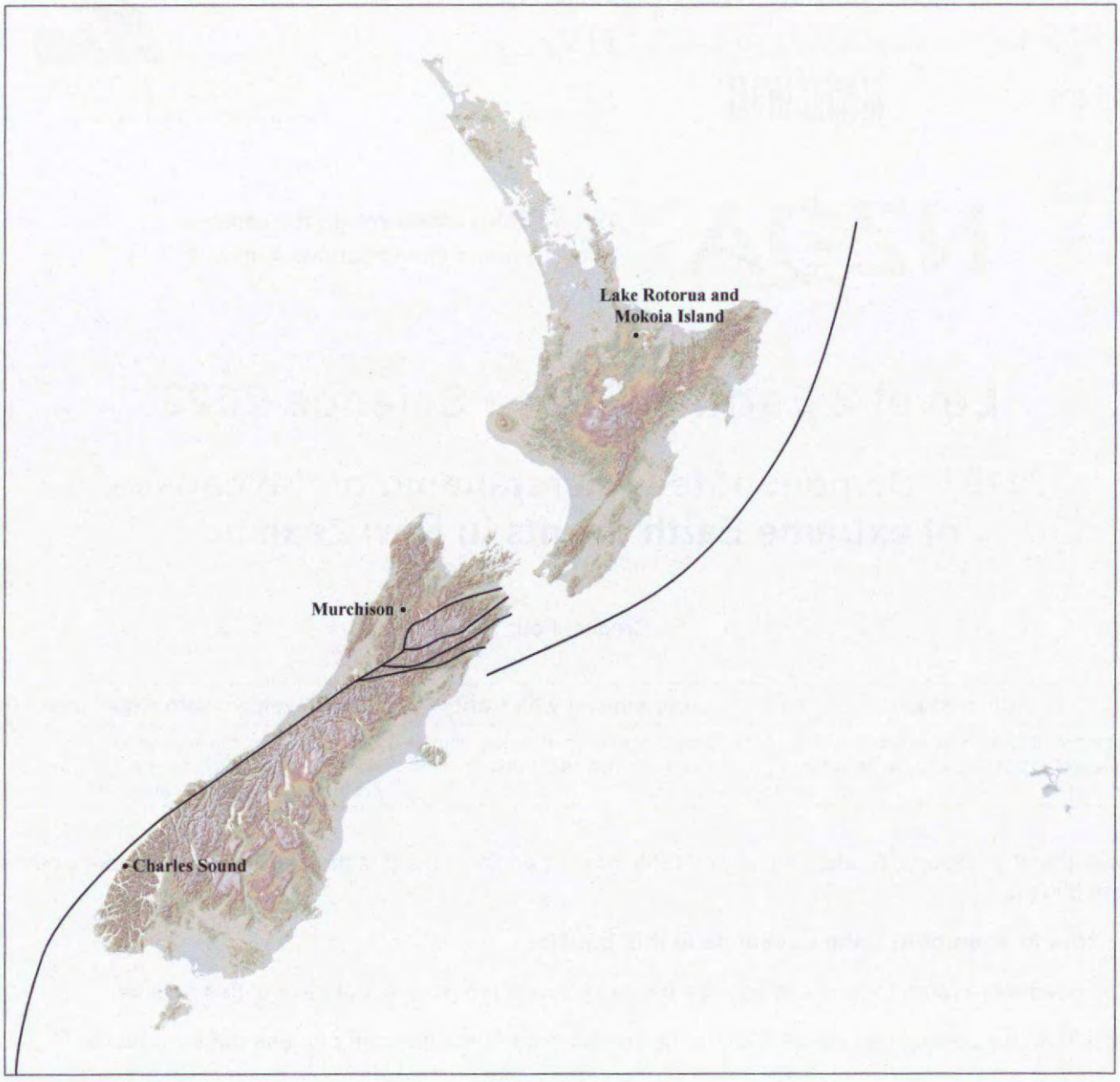
Check that this booklet has pages 2–20 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

Achievement TOTAL 12

Regional map showing locations referred to in this paper



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The assessment begins on the following page.

QUESTION ONE: LAKE ROTORUA AND MOKOIA ISLAND

Lake Rotorua is a large rhyolitic caldera found in the Taupo Volcanic Zone (TVZ) in the North Island of New Zealand.

It was formed in a single eruption about 240 000 years ago.

Mokoia Island, found roughly in the centre of Lake Rotorua, is a rhyolitic lava dome that erupted sometime after the Rotorua caldera collapsed.

Adapted from www.mokoiaisland.co.nz

(a) Complete the table below to describe the characteristics of rhyolitic magma as either HIGH, LOW, or INTERMEDIATE.

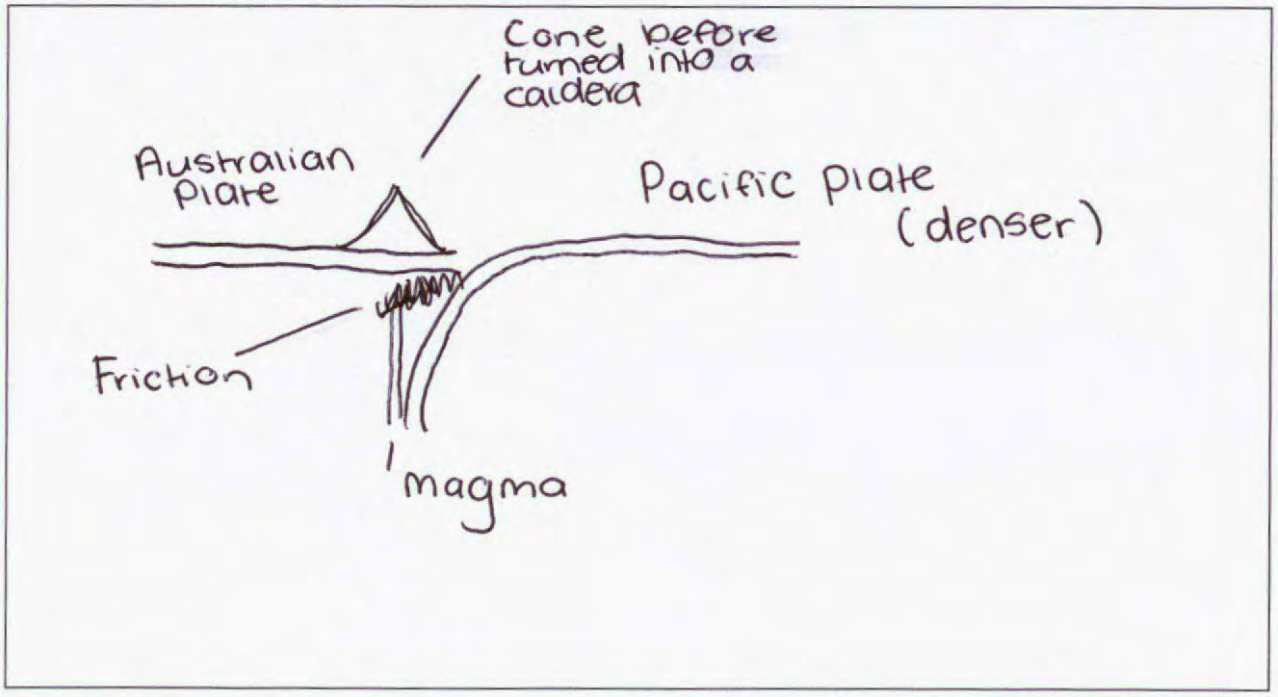
	Temperature	Silica Content	Viscosity	Gas Content
Rhyolitic magma	750 - 850°c 10 W	High	High	High

(b) Explain, in detail, how tectonic processes led to the formation of rhyolitic magma in the TVZ.

In your answer you should consider:

- the map on page 2
- the tectonic plates involved and their movement relative to each other
- the type of crust involved at the plate boundary
- the key tectonic processes that led to the formation of rhyolitic magma at this boundary.

An annotated diagram may assist your answer.



The formation of rhyolitic magma is by the tetonic plate movement. This is created by ~~sud~~ subduction zones. In the North island

The pacific plate subducts beneath the Australian plate the friction cause magma to rise up between these two plates and creates a cone volcano. The magma type is Rhyolite so the volcano errupts and causes a highly explosive eruption. The enery and power from the eruption cause the volcano to collapse and creates a crater.

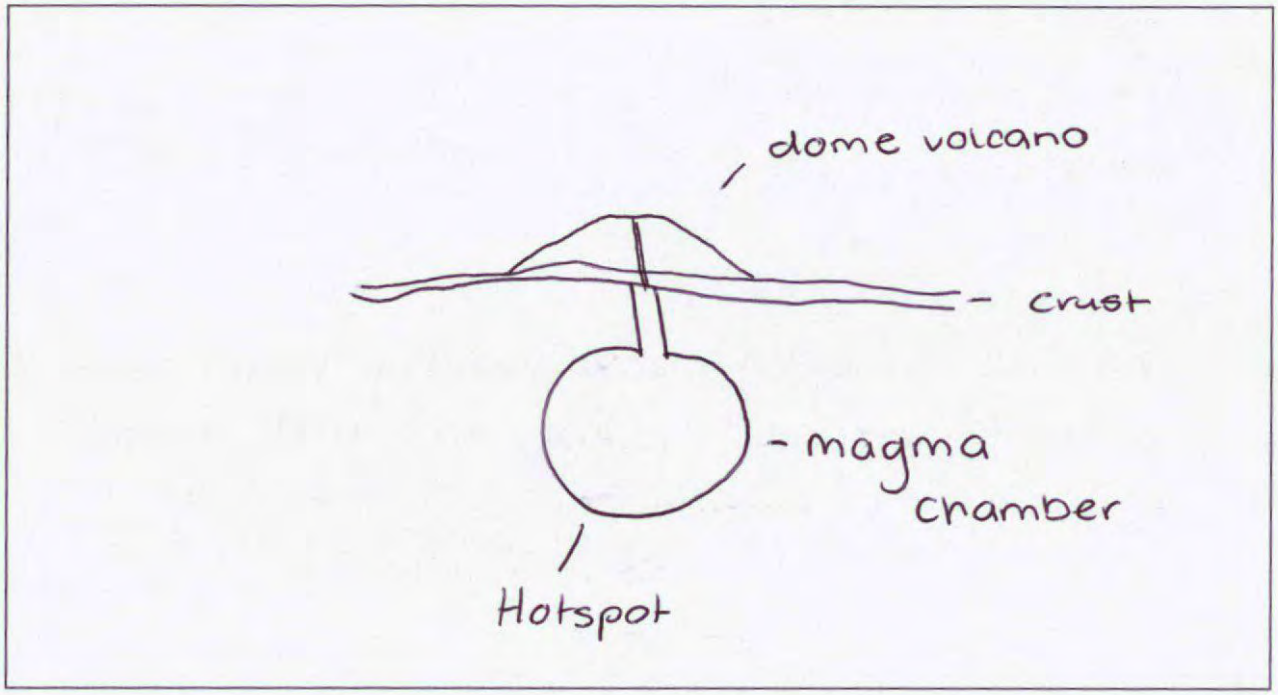
Rhyolitic magma is formed by high gas content trapped is sticky and thick and slowly flows.

(c) Explain, in detail, with reference to Lake Rotorua and Mokoia Island, how rhyolitic magma could produce both a caldera and a dome in the same location.

In your answer you should consider:

- any differences in the characteristics of rhyolitic magma in a caldera and dome volcano
- how a caldera is formed
- how a dome volcano is formed.

An annotated diagram may assist your answer.



Rhyolitic magma is the most explosive magma with high gas content, high viscocity and high sillica but is low in temperature.

A caldera is formed by a Strato volcano (cone) that has collapsed due to a large explosion of pressure and magma. The collapse of a cone makes a crater which then may become lakes like lake rotorua

A dome volcano is formed by the

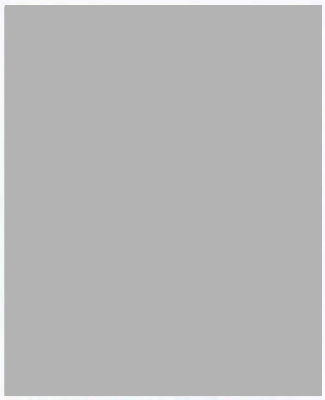
Subduction of the plates at plate boudaries. When the pacific plate subducts beneath the australian, magma rises between the two plates to the surface the magma flows out to create a dome volcano.

Rhyolitic magma can produce both a dome and caldera volcano because ~~beneath the~~ of a hotspot. A hotspot is a magma chamber that creates volcanoes as the magma rises and reaches the surface. The tectonic plates moving above because of convection creates a feild of volcanoes with Mokoia island being one of the many volcanoes in the area.

QUESTION TWO: 1929 MURCHISON EARTHQUAKE

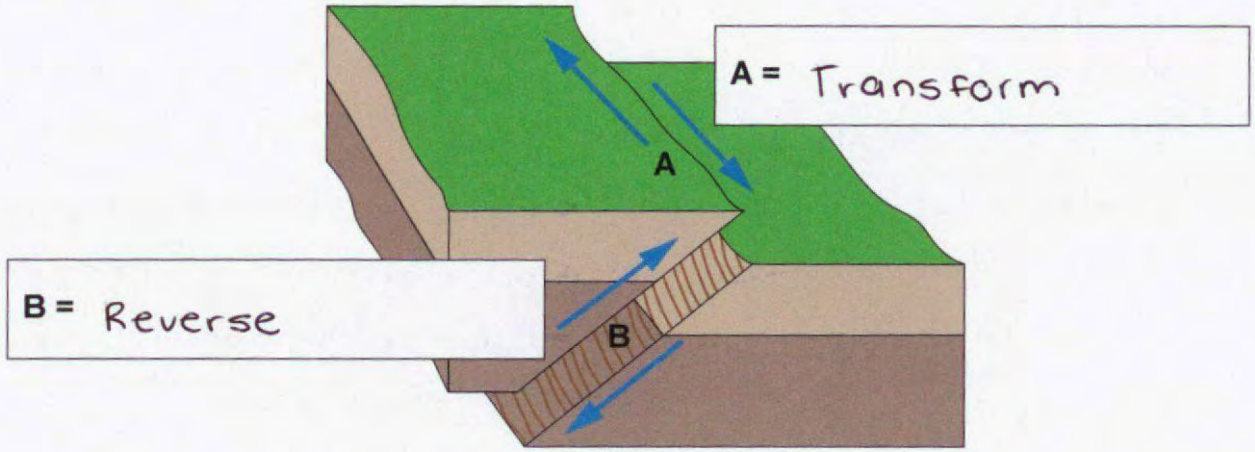
On 17 June 1929, a magnitude 7.3 earthquake at a depth of 20 km struck on the White Creek fault, 15 km northwest of Murchison.

The earthquake resulted in approximately 4.5 m of vertical uplift, and 2.5 m of sideways movement, along the White Creek fault.



Source: https://en.wikipedia.org/wiki/1929_Murchison_earthquake

(a) On the diagram below, name the fault type represented by the movement at **A**, and the fault type represented by the movement at **B**.

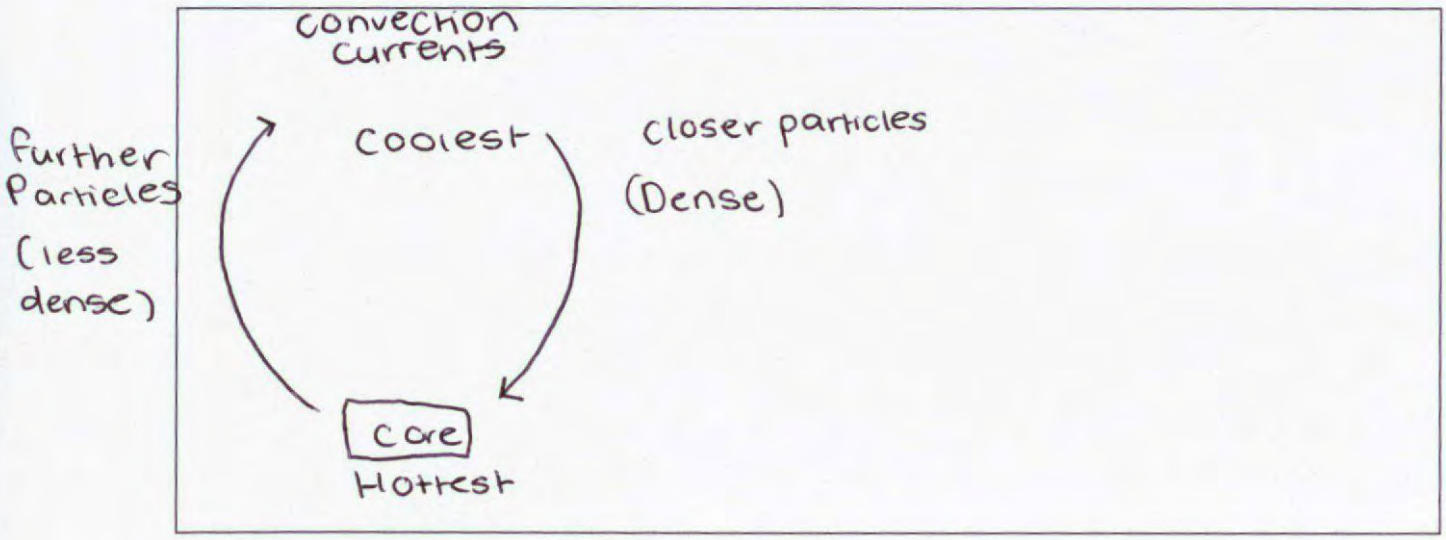


(b) Explain, in detail, how a rupture along the White Creek fault line could lead to a magnitude 7.3 earthquake.

In your answer you should consider:

- the map on page 2
- the tectonic plate movements associated with this earthquake
- what a fault is
- the likely cause of this large-magnitude earthquake.

An annotated diagram may assist your answer.



The tetonic plates are caused to move by convection currents. The magma is heated by the earths core in which it rises to the surface and when it cools it drop back down to the core. During this process the ~~mag~~ magma drags the tetonic plates ~~w~~ along with it.

Because this earthquake is in the South island this is a transform boundary, this means the two plates rub along eachother this builds up friction until a plate slips and theres a large release in energy causing an earthquake.

A fault line is a gap in between where tetonic plates meet. The likely cause of the large magnitude earthquake is the focus of the earthquake was reasonably deep with a large release of energy. The bigger the release of enegy the larger the earthquake.

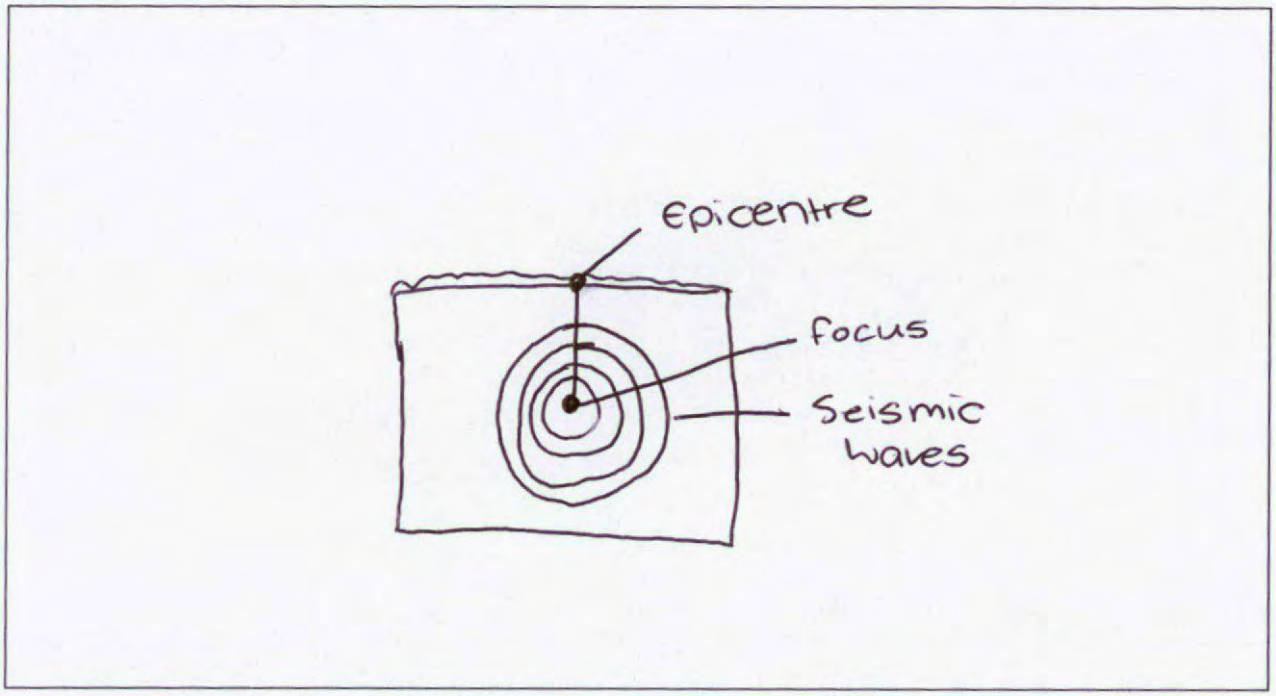
(c) The earthquake was felt throughout New Zealand, with the most intense shaking occurring within approximately 65 km of Murchison.

Explain, in detail, why damage and shaking was greatest close to Murchison, but the earthquake was felt throughout New Zealand.

In your answer you should consider:

- energy
- seismic waves
- the focus and epicentre of an earthquake.

An annotated diagram may assist your answer.



The energy from the earthquake was large that the seismic waves travelled a far distance from the ~~epicentre~~ focus.

The focus of an earthquake is the exact ~~local~~ location of the earthquake beneath the crust.

The epicentre of an earthquake is the point directly up from the focus on the earths surface.

QUESTION THREE: 2003 FIORDLAND TSUNAMI

On 22 August 2003, a magnitude 7.2 earthquake struck off the coast of Fiordland, triggering many landslides in the remote area.

One of these landslides fell into Charles Sound causing a small local tsunami with a 4 to 5-metre high run-up.

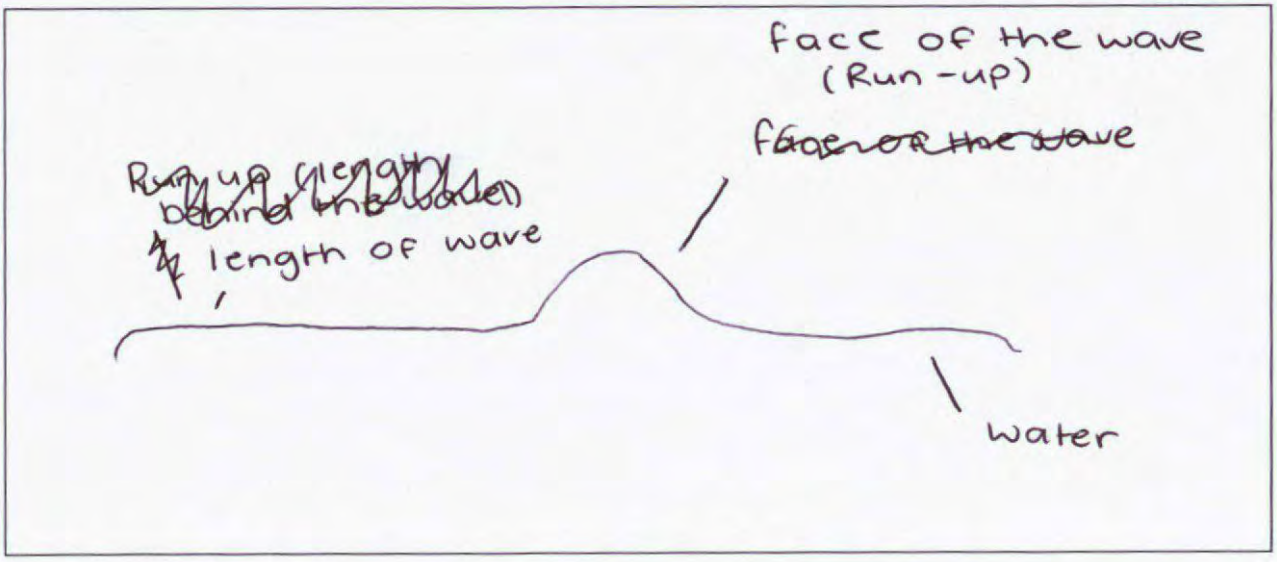
The earthquake also generated a small tsunami in the Tasman Sea, recording a 300 mm high run-up in Jacksons Bay, and a 170 mm run-up at Port Kembla, Australia.

Adapted from https://static.geonet.org.nz/info/images/tsunami/historic/Fiordland-earthquake-tsunami-August-22-2003.png

Charles Sound
Source: https://teara.govt.nz/en/photograph/6209/landslide-fiordland

(a) Describe what is meant by the run-up height of a tsunami.

An annotated diagram may assist your answer.



Run up of a wave is the height of the face of the wave (front). The face is the front of the wave.

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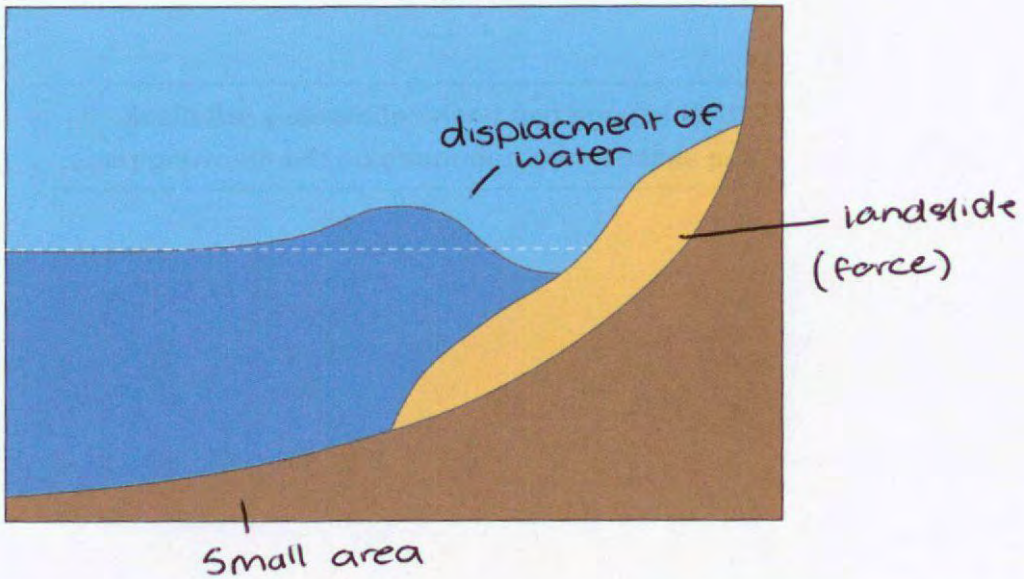
The assessment continues on the following page.

(b) Explain, in detail, how the landslide in Charles Sound generated a tsunami, and why it produced a large run-up height.

In your answer you should:

- consider what a tsunami is
- use arrows and annotations on the diagram below to show how a landslide can produce a tsunami
- consider how the height and width of Charles Sound affected the tsunami produced.



A tsunami is a displacement of water that is released energy in the formation of a wave. The force from a ~~landslide~~ Sudden landslide causes the displacment of water to move outwards. The height of the ~~landslide~~ tsunami was affected by the location because the width is very small so the larger the displacement of water in a small area the ~~force~~ force is acted upon by the floor of the water in its shallow depths to push the tsunamis wave upwards creating a taller run-up height (face of the wave). The height of the hills surrounding charles sound also has an impact on the wave because the higher

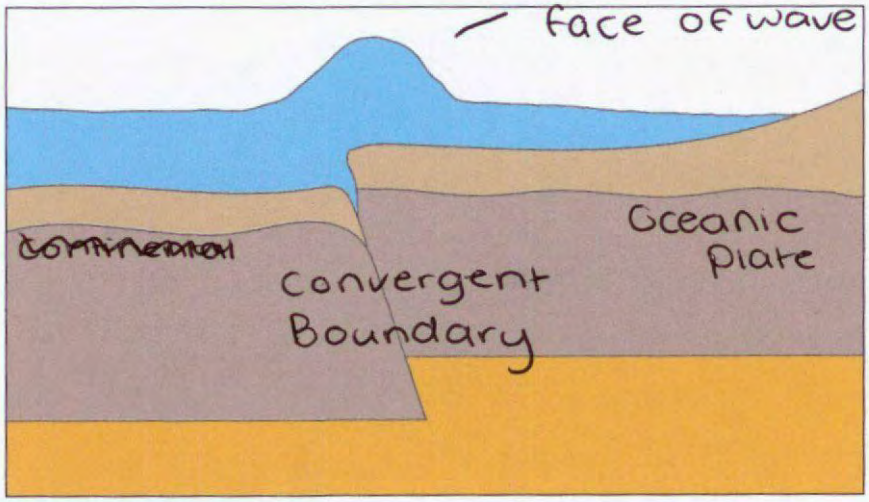
the height the landslide fell from the more energy and power can be generated.

Question Three continues on the next page.

(c) Explain, in detail, how the earthquake generated a tsunami in the Tasman Sea, and how this tsunami could produce a tsunami wave in Australia.

In your answer you should:

- annotate and add arrows to the diagram below to show how a tsunami can be produced by an earthquake in the Tasman Sea
- explain the energy transfers that occur
- explain how tsunami waves can travel long distances.



The sudden slip of energy upwards at a convergent boundary can cause a displacement of water the energy from the sea floor slipping is transfered into a wave moving outwards. The tsunami can travel long distances because the length behind the wave is long and the depth of the tasman sea is so deep it doesn't lose energy or speed until it meets the shore that forces the wave up to then crash onto the shore.

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

QUESTION NUMBER

Extra space if required.
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QUESTION NUMBER

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QUESTION NUMBER

Achievement

Subject: Earth & Space Science

Standard: 91191

Total score: 12

Q	Grade score	Marker commentary
One	A4	The candidate has provided a labelled diagram, an outline of magma formation, and statements around the difference between caldera and dome volcanoes. To reach an M5, the candidate needed to link friction to the melting of the pacific plate, which forms less dense magma. Alternatively, the candidate could describe the collapse of the magma chamber to form a caldera.
Two	A4	The candidate provides enough evidence in this question for an A4. To reach M5, the candidate needed to state the buildup of elastic potential energy or link the focus and epicenter to energy release.
Three	A4	The candidate provides enough evidence in this question for an A4. To reach M5 the candidate needed to either explain the gravitational energy of the landslide transferring to the water or wave amplitude and frequency in the ocean.