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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.

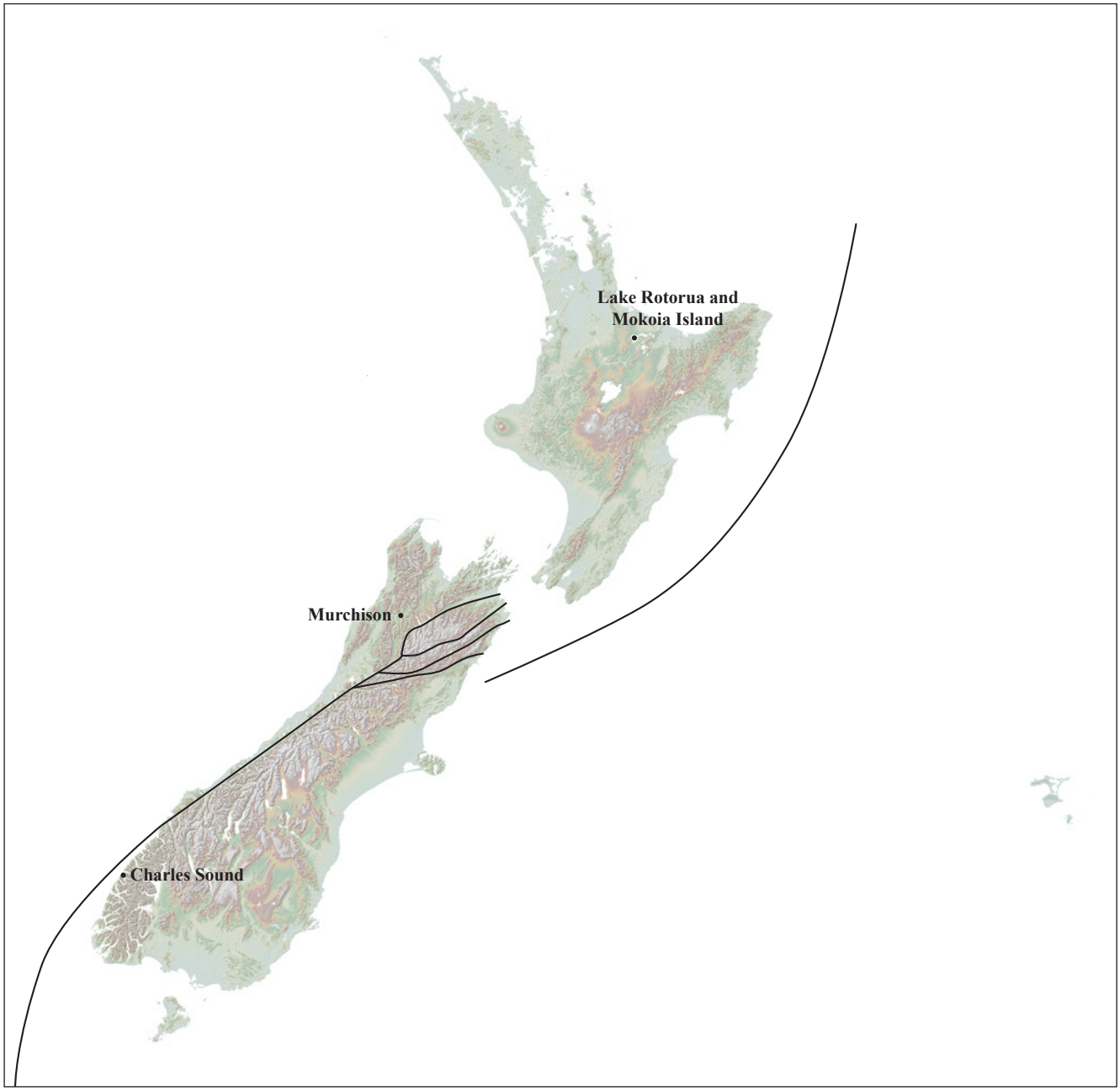
If you need more room for any answer, use the extra space provided at the back of this booklet.

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.

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				

(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.

(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:

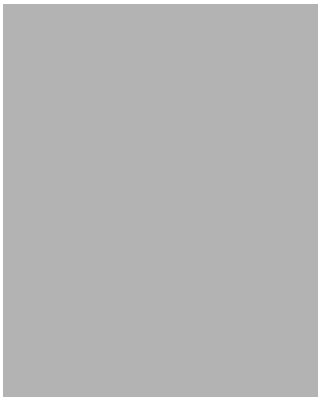
- any differences in the characteristics of rhyolitic magma in a caldera and dome volcano
- how a caldera is formed
- how a dome volcano is formed.

An annotated diagram may assist your answer.

QUESTION TWO: 1929 MURCHISON EARTHQUAKE

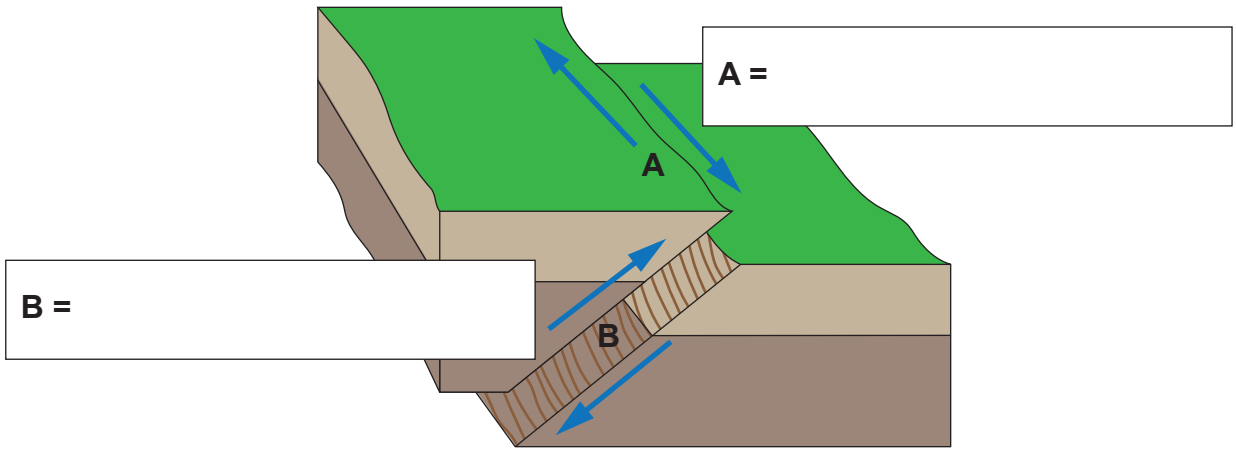
On 17 June 1929, a magnitude 7.3 earthquake at a depth of 20 km struck on the White Creek fault, 15 km northwest of Murchison.

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.

(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.

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.

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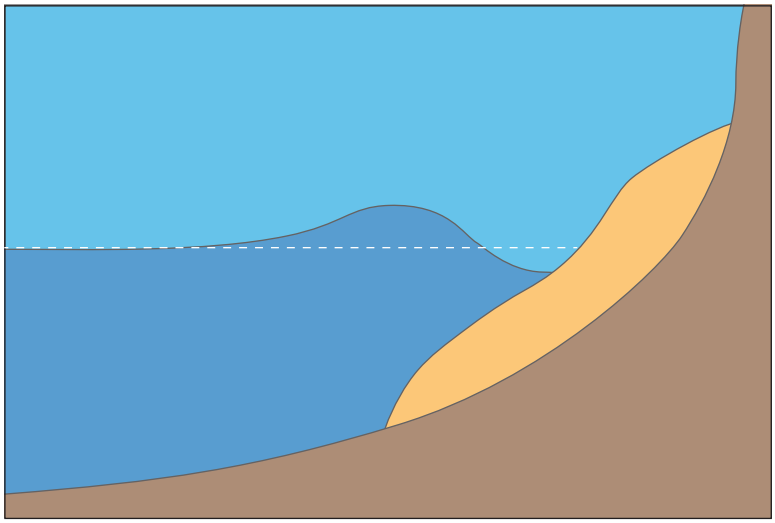
The assessment continues on the following page.

(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.

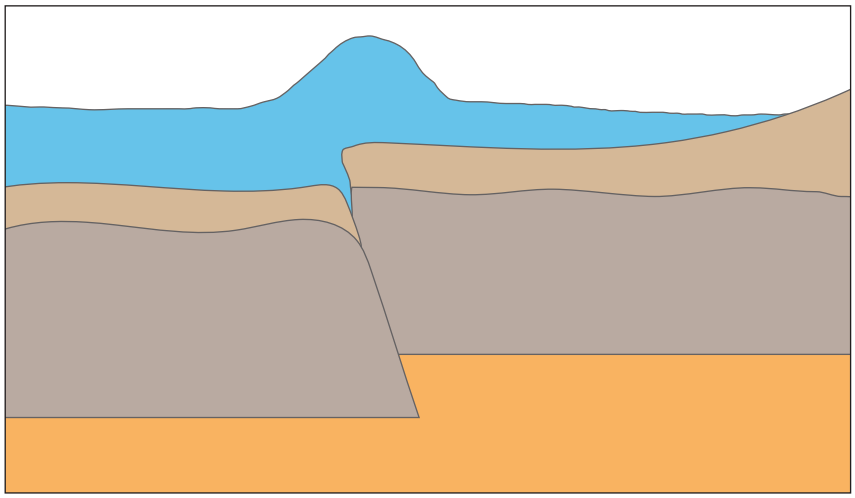


Question Three continues on the next page.

(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.



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