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

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Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Earth and Space Science 2025

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.

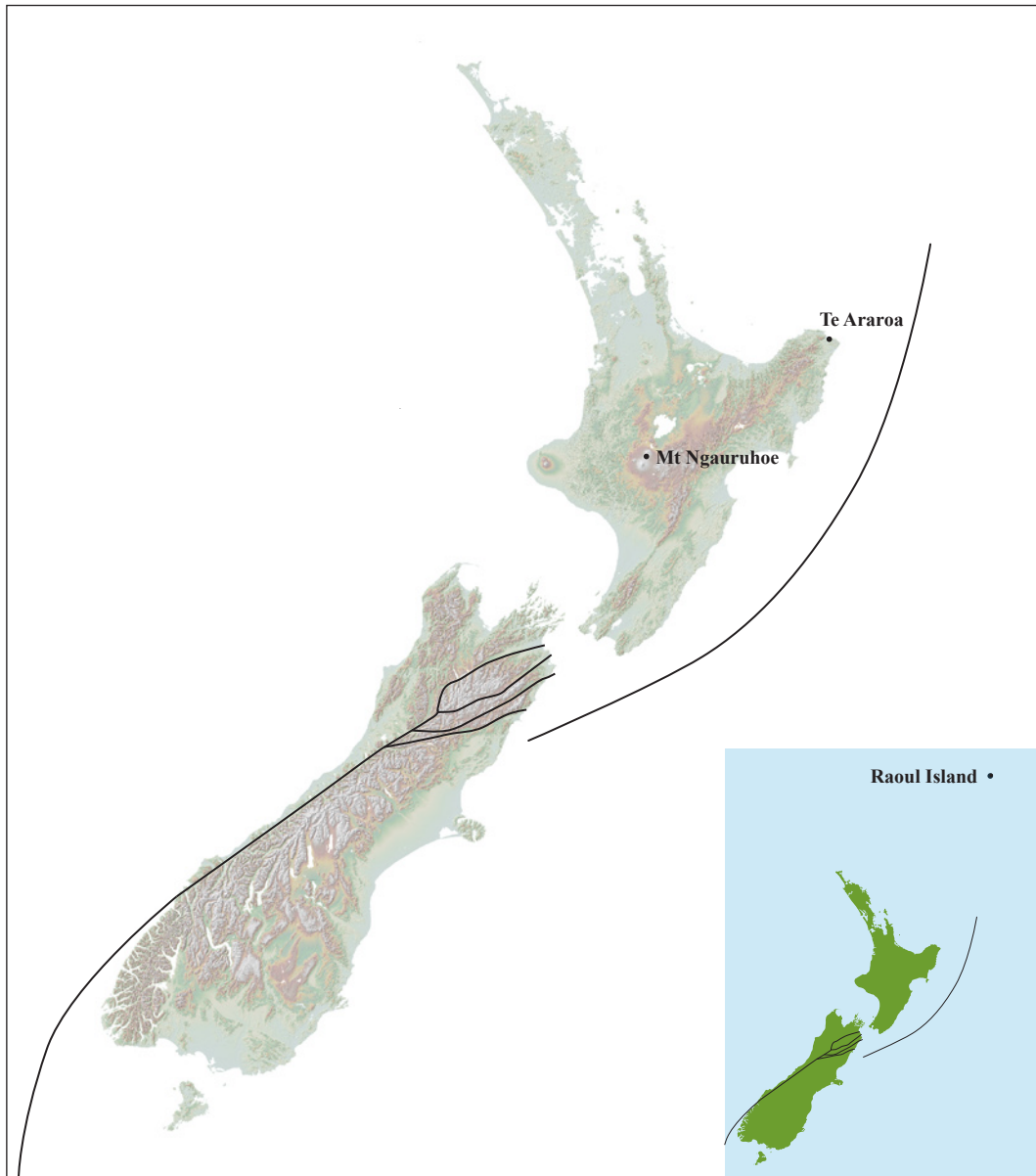
You should attempt ALL the questions in this booklet.

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 (X/X/X). 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

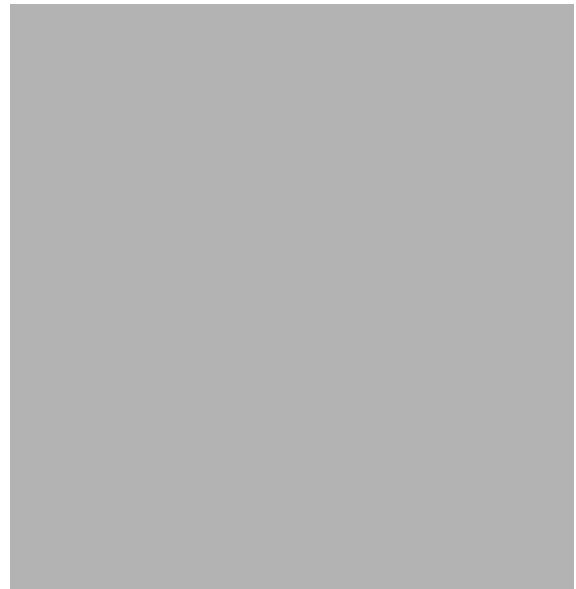
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The assessment begins on the following page.**

QUESTION ONE: MT NGAURUHOE

Mt Ngauruhoe is the youngest, largest, and most active cone of the much larger Tongariro volcanic complex in the central North Island of New Zealand.

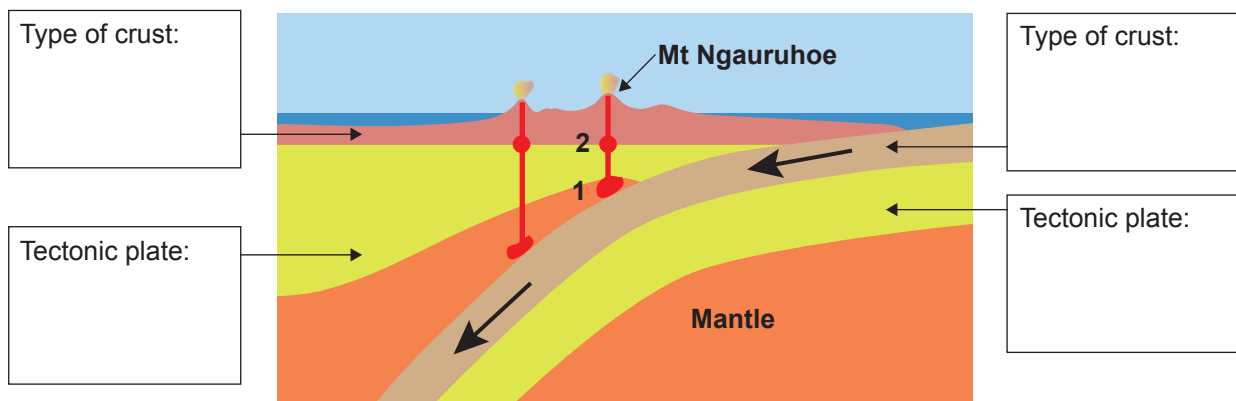
Mt Ngauruhoe formed approximately 7000 years ago, and is an andesitic stratovolcano.

More than 60 eruptions have been recorded since written records began in 1839; many of these were ash eruptions, while some have been lava flows, with the last occurring in 1975.



Source: www.gns.cri.nz/assets/Our-Science/Subfiles/Natural-Hazards-and-Risks/Subfiles/Volcanoes/Volcano-Fact-Sheet-Ngauruhoe.pdf

- (a) Label the diagram to name the tectonic plates involved in this area of the North Island and identify the type of crust (continental or oceanic).



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

In your answer you should consider:

- the map on page 2
- the labelled diagram in part (a)
- the key tectonic processes involved at **1** and **2** on the diagram above.

(c) Mt Ngauruhoe is an andesitic stratovolcano.

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

In your answer you should consider:

- the characteristics of andesitic magma
- the type of eruptive products produced by Mt Ngauruhoe
- how layering and magma composition link to the shape of Mt Ngauruhoe.

An annotated diagram may assist your answer.



QUESTION TWO: 2021 EAST CAPE EARTHQUAKE AND TSUNAMI

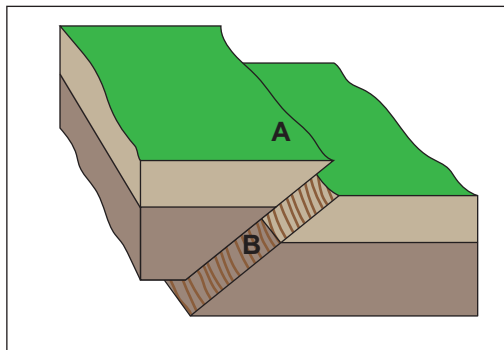
On 5 March 2021, a magnitude 7.2 earthquake at a depth of 33 km, struck 124 km east of Te Araroa, on the East Cape of the North Island.

Large parts of the East Cape and Hawkes Bay were pushed 1 cm to the southwest.



- (a) An oblique reverse fault caused this earthquake.

Describe what a fault is AND add arrows to the diagram below to show the movement that occurred along the fault at positions A and B.



- (b) The earthquake was reported as felt by over 52 000 people from across New Zealand, but no damage was reported.

Explain, in detail, why this earthquake was felt by so many people across the whole country, yet no damage was reported.

In your answer you should:

- explain what is meant by the focus and epicentre of an earthquake
- describe seismic wave movement from the focus and epicentre
- explain the links between energy, seismic wave movement, and damage caused by an earthquake.

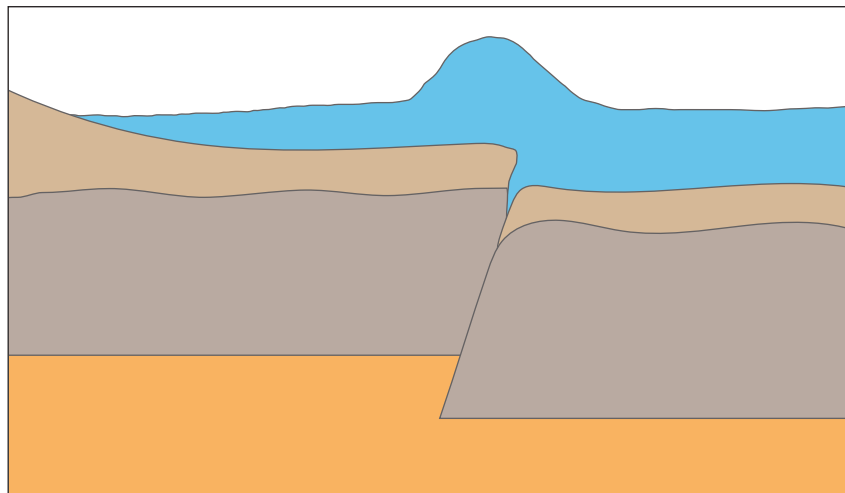
An annotated diagram may assist your answer.

- (c) As a result of this earthquake, a tsunami was produced.

Explain, in detail, how this earthquake led to the formation of a tsunami.

In your answer you should:

- annotate and add arrows to the diagram below to show how the crustal movement caused a tsunami
- explain the energy transfers involved.



QUESTION THREE: RAOUL ISLAND

On 5 March 2021, a few hours after the East Cape earthquake in New Zealand, two earthquakes occurred in the Raoul Island area, northeast of New Zealand; the first a magnitude 7.3, and the second a magnitude 8.1.

The magnitude 8.1 earthquake was the result of a megathrust earthquake along the subduction zone in the Kermadec trench.

- (a) Describe a tsunami wave.

In your answer you should consider the water column.



- (b) Both earthquakes led to tsunami warnings being issued throughout the Pacific.

Explain, in detail, why this megathrust earthquake led to tsunami warnings being issued throughout the Pacific.

In your answer you should consider:

- how tsunami travel in open ocean
- changes to the height (amplitude), wavelength, and speed of the tsunami wave as it approached New Zealand's coastline, and the reasons for this.

An annotated diagram may assist your answer.



Question Three continues
on the next page.

- (c) Raoul Island is the largest of the Kermadec Islands. The island is the summit of a mostly submerged volcano that has two caldera craters formed after previous eruptions.



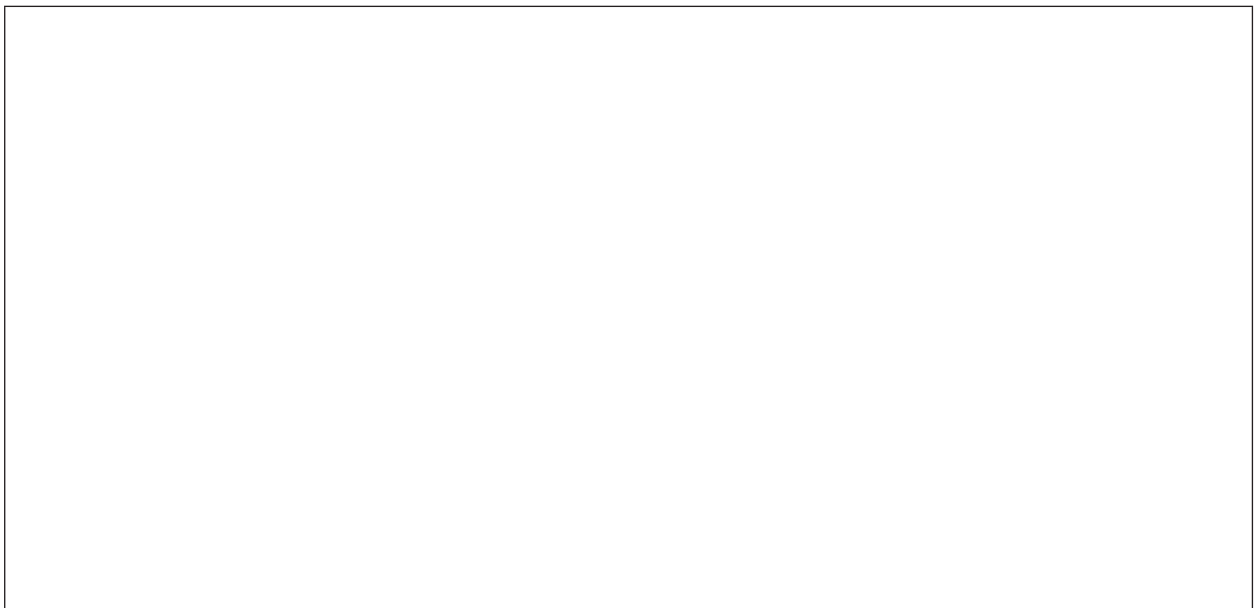
Adapted from: <https://www.geonet.org.nz/about/volcano/kermadecislands>

Explain, in detail, the tsunami risk associated with a caldera eruption from a volcano like Raoul Island in the Pacific Ocean.

In your answer you should consider:

- the stages of eruption for a typical submerged caldera volcano
- the different ways a caldera eruption can cause a tsunami.

An annotated diagram may assist your answer.



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

QUESTION
NUMBER

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