

No part of the candidate evidence in this exemplar material may be presented in an external assessment for the purpose of gaining credits towards an NCEA qualification.

# 2

91191



911910



NEW ZEALAND QUALIFICATIONS AUTHORITY  
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD  
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

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## Level 2 Earth and Space Science, 2019

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

9.30 a.m. Wednesday 27 November 2019

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 and clearly number the question.

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

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

**Achievement**

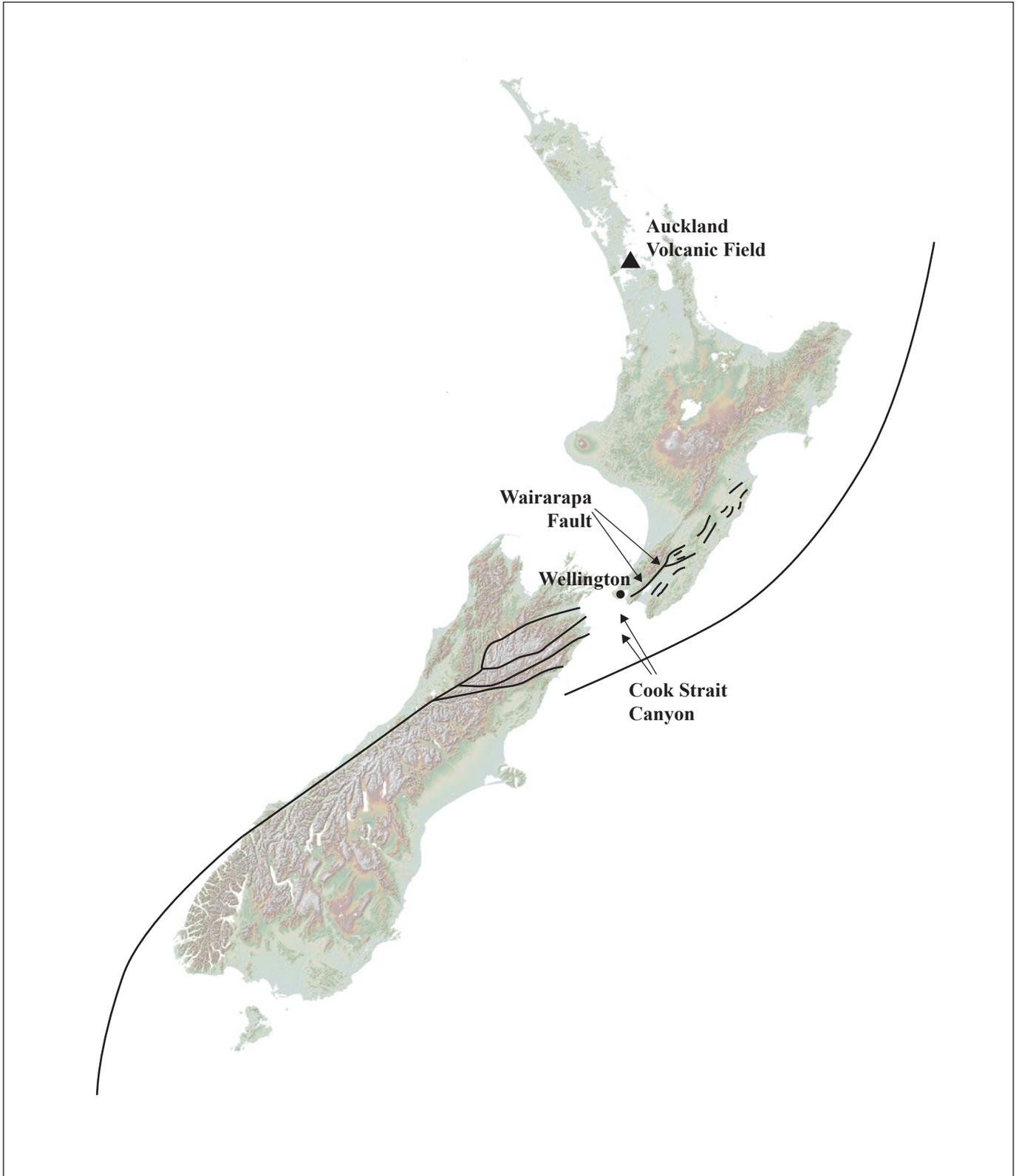
**TOTAL**

**11**

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The examination starts on the following page.**

**Regional Map Showing Locations Referred to in this Paper**



**QUESTION ONE: AUCKLAND VOLCANIC FIELD**



Adapted from: [www.sciencelearn.org.nz/images/716-auckland-volcanic-field](http://www.sciencelearn.org.nz/images/716-auckland-volcanic-field)

Auckland sits over an active volcanic field, which includes more than 50 volcanoes. While scientists don't expect any of these existing volcanoes to erupt again, they are almost certain that more eruptions are likely to take place at some time in the future. The type of eruption that occurs may depend upon whether the eruption meets water as it rises through the crust.

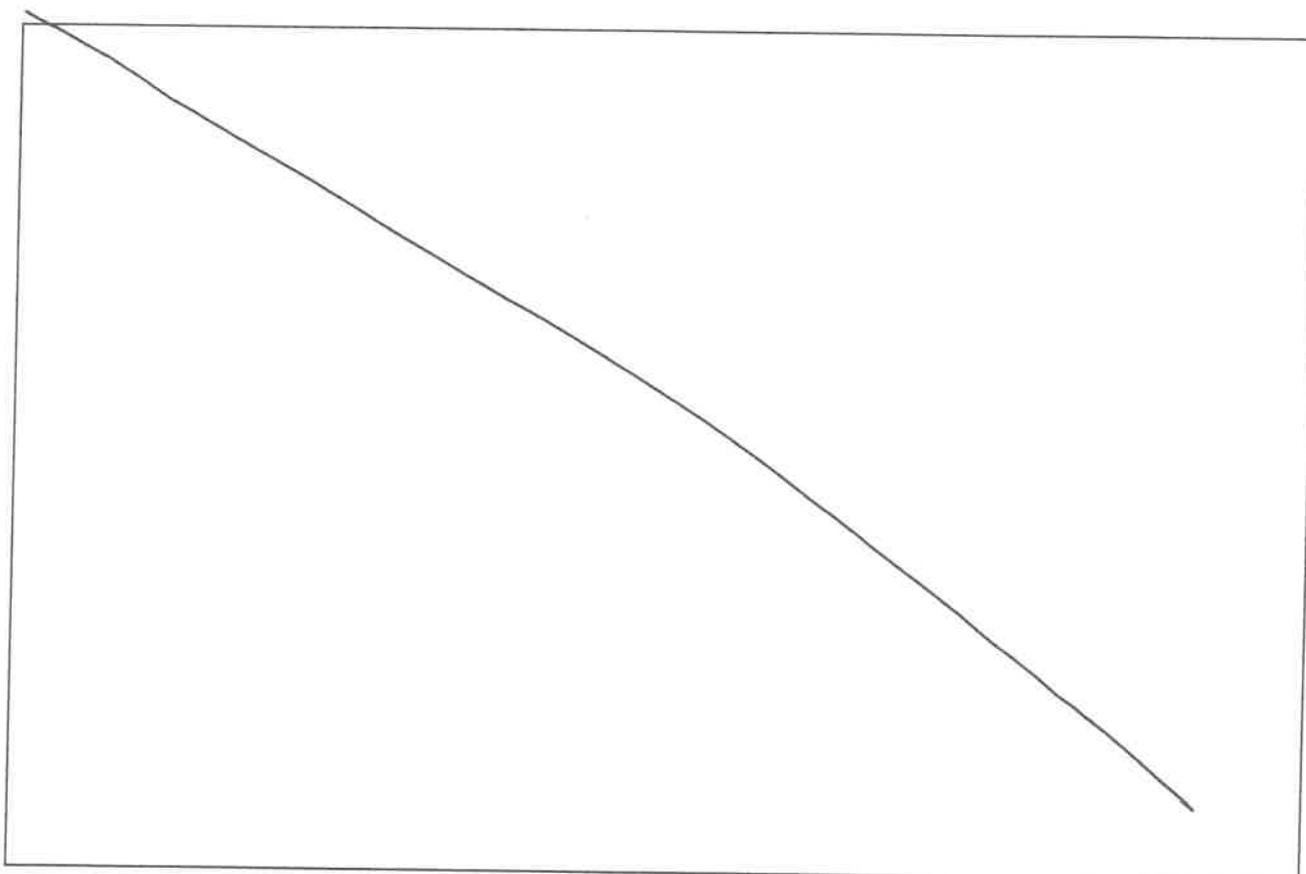
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Explain in detail how possible future eruptions in the Auckland Volcanic Field may be formed, and their likely characteristics.

In your answer, you should refer to:

- the processes within the upper mantle and crust that may cause an eruption within the Auckland Volcanic Field
- the type of magma that is likely to erupt in this area, and the characteristics of this type of magma
- the likely phases of an eruption in this area, and the features that may form from this type of eruption.

*A diagram may assist your explanation.*



The Auckland volcanic field is formed due to a hotspot within the upper mantle and crust. This means that all the volcanoes are formed by magma and gas that comes up through the hotspot. Due to the location of the Auckland volcanic region, many of

**More space for this answer is available on the following pages.**

The volcanoes that are formed come up to the surface to become phreatomagmatic, this is a volcano formed from lava from the crust and mantle coming up to the surface and coming into contact with water, this causes a large explosion, creating a maar crater from the explosion, and as more magma erupts it comes into contact with water and builds up a scoria cone. The magma that is likely to occur in this area is magma with a high silica content, causing it to have a high viscosity and as such moving slowly and posing very little threat to life.

A large area of lined paper with a diagonal line drawn across it from the top-left to the bottom-right. The lines are horizontal and evenly spaced. The diagonal line starts near the top-left corner and ends near the bottom-right corner, bisecting the page.

A3

## QUESTION TWO: WAIRARAPA EARTHQUAKE 1855

ASSESSOR'S  
USE ONLYSource: [www.nzgeo.com/stories/the-day-the-earth-shifted/](http://www.nzgeo.com/stories/the-day-the-earth-shifted/)

In 1855, the most severe earthquake in New Zealand's recent history occurred along the Wairarapa Fault. The depth was shallow, and it was recorded as a magnitude 8.2–8.3.

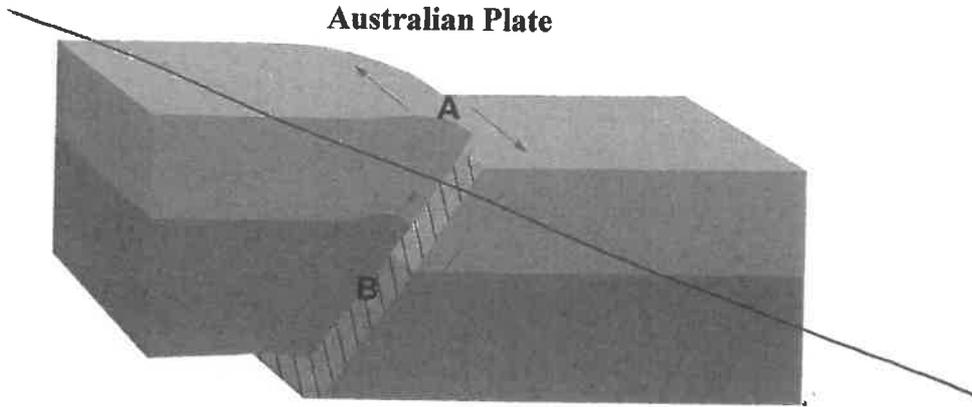
Explain in detail how a rupture along this fault could lead to a large-magnitude earthquake.

In your answer, you should consider:

- the types of faults represented by letters A and B on the block diagram opposite
- the tectonic plate movements that may have resulted in this fault
- the cause of this large magnitude earthquake
- the effects seen on the land (**do not include tsunami effects**).

A is a strike slip fault, and B is a normal fault, since the wairarapa fault is not directly ~~over~~ a ~~subduct~~ plate boundary, the likely cause of this fault is the squash and stretch of the large plate moving, as the australian —

## Australian Plate

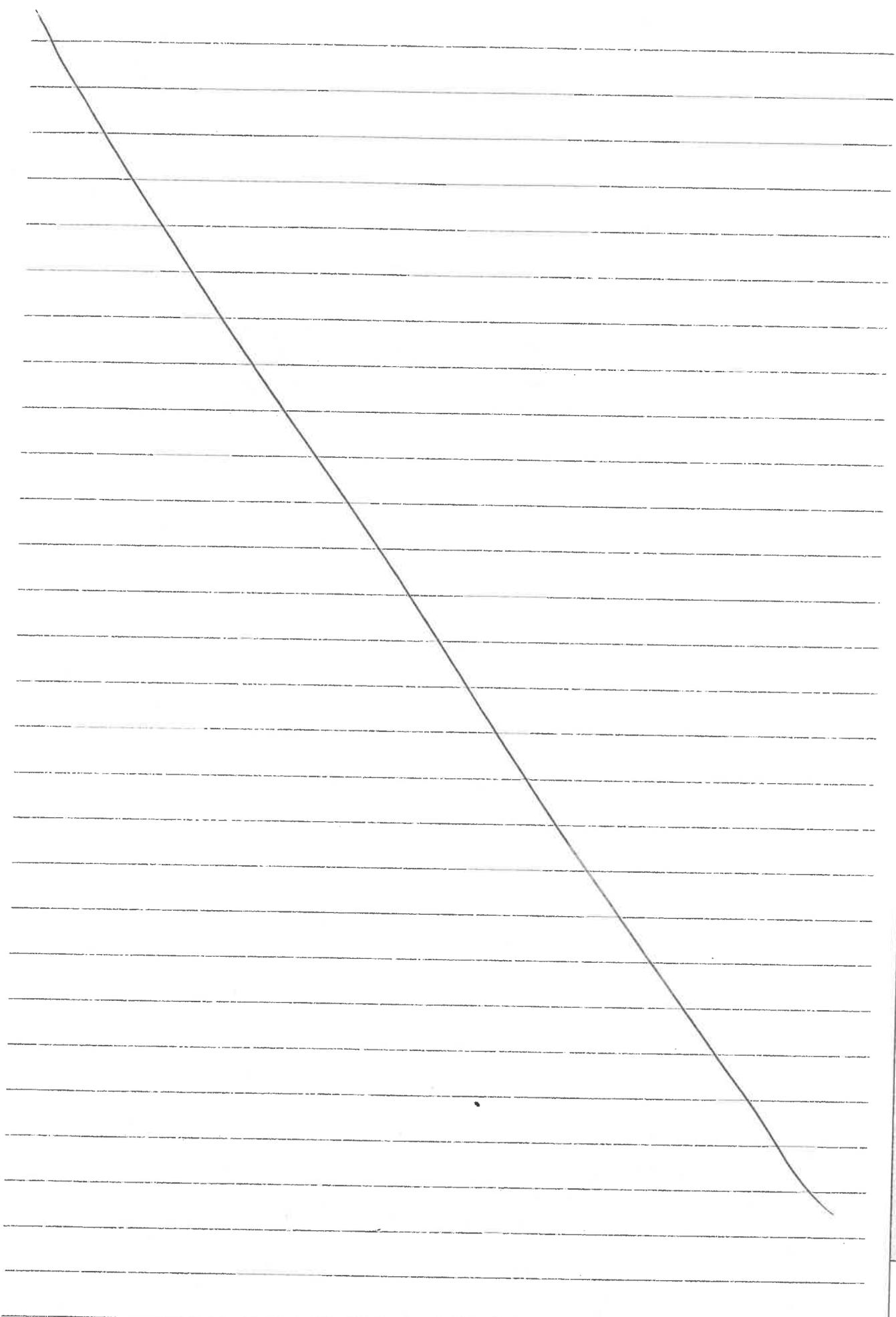
ASSESSOR'S  
USE ONLY

Labelling the diagram may assist your answer.

plate is ~~pushed~~<sup>pushing</sup> up by the ~~subducting~~ land plate, because of this one side of the Wairarapa fault pushes up against the other, and over time builds up more and more pressure, until the rock breaks and the rock moves upward quickly, at the highest point being 5 metres of uplift. For the earthquake to build up to 8.2 magnitude it would have to build up pressure for a long time.

The effects on land would be very bad, as such a high magnitude earthquake, close to the surface and nearby a city would destroy roads and buildings, and the 5m of uplift would be highly noticeable along the coast. //

More space for this answer is available on the following pages.



A4

### QUESTION THREE: WELLINGTON TSUNAMI 1855

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The 1855 Wairarapa Fault rupture triggered uplift of the Australian Plate and a series of landslides into the Cook Strait Canyon. This resulted in a number of tsunami, up to 11 metres high, reaching Wellington.

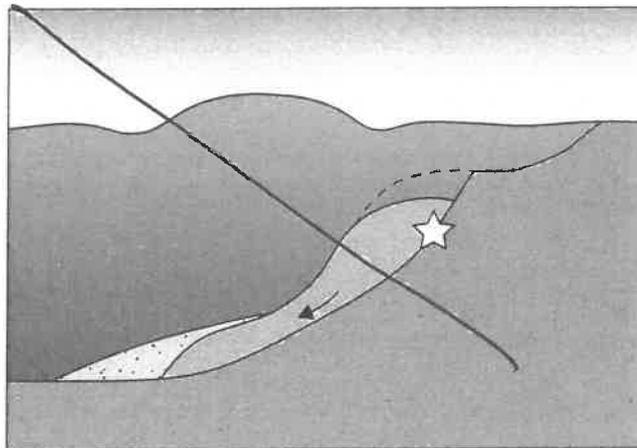
Explain in detail how tsunami could have formed as a result of the sea floor uplift and landslides into the Cook Strait Canyon.

In your answer, you should:

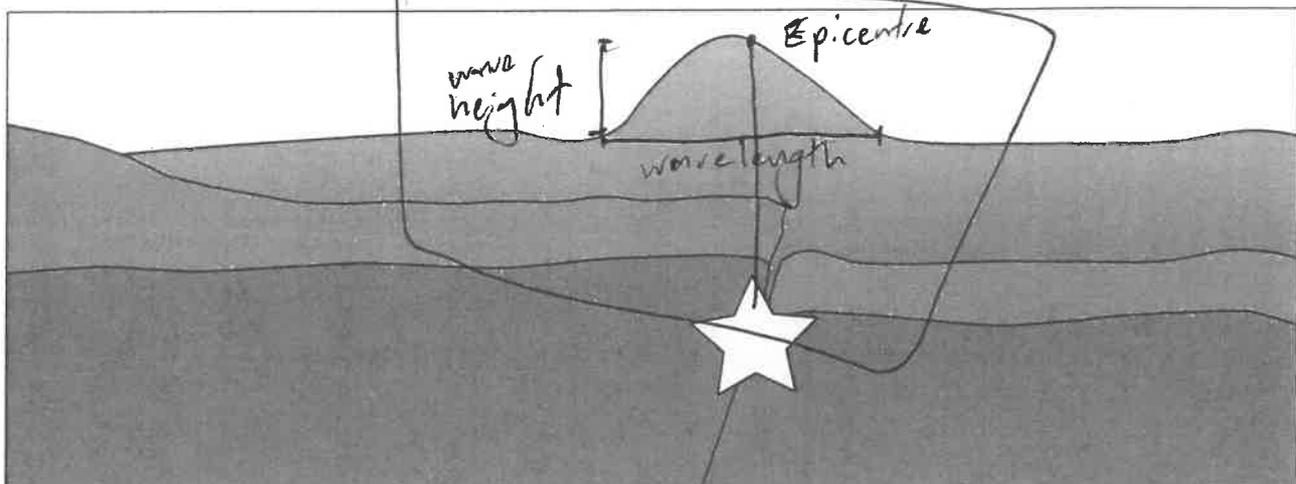
- annotate the diagrams below, showing how tsunami are produced
- explain, in detail, how sea floor uplift in the Cook Strait AND underwater landslides into the Cook Strait Canyon can generate tsunami
- explain, in detail, the energy transfers that occur in each type of tsunami formation
- explain, in detail, the factors which may affect the size of the Wellington tsunami.

<https://teara.govt.nz/en/map/5604/underwater-canyon>

**Tsunami caused by underwater landslide**



**Tsunami caused by seafloor uplift**



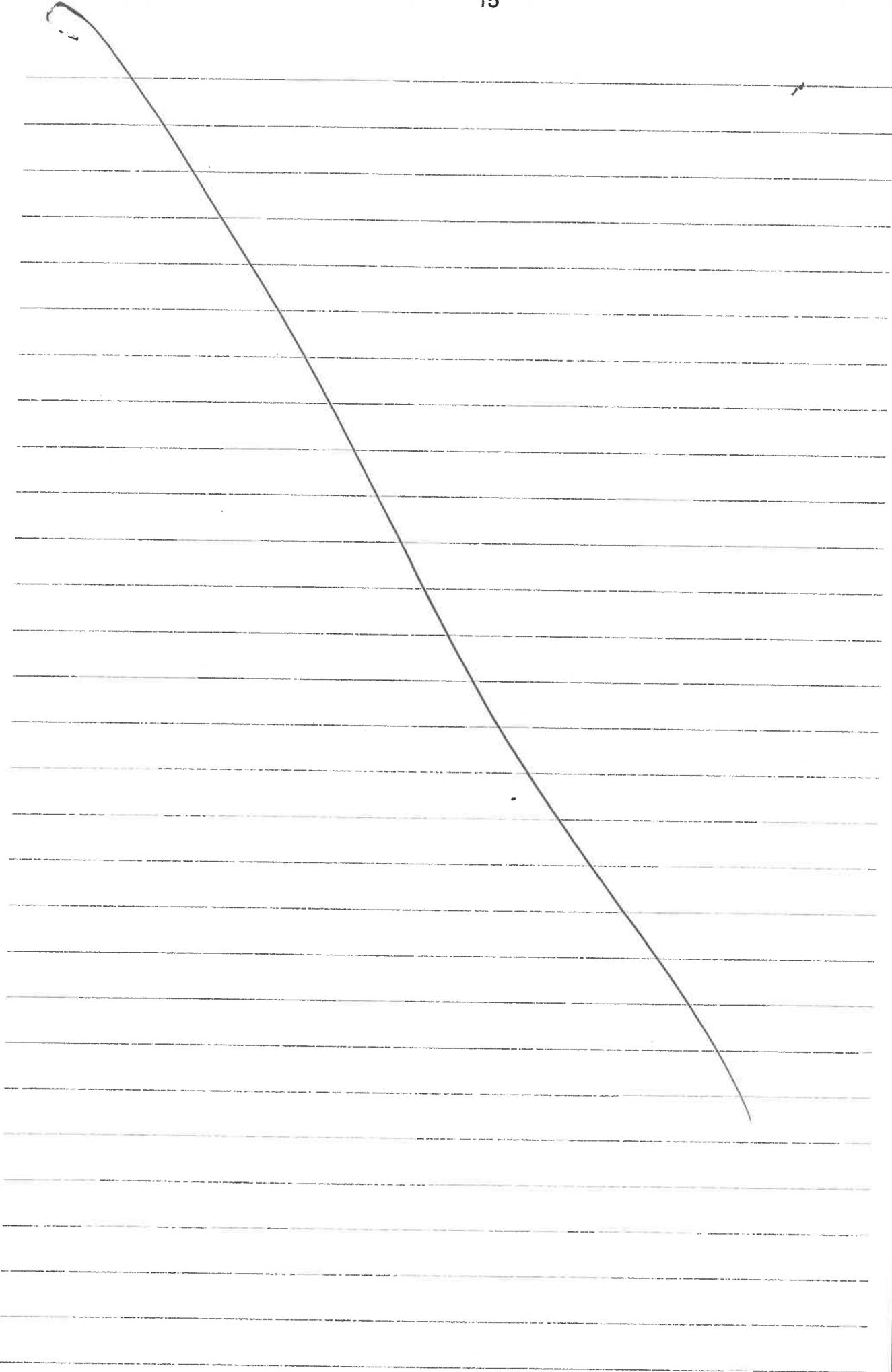
A tsunami from sea floor uplift occurs when an earthquake occurs below the ocean, causing a large amount of land to rise upwards very quickly, causing a large displacement of water. Very quickly, this causes the water to rise and fall quickly, forming large waves that spread out in a circle from the epicentre.

underwater landslides work in a similar fashion, however the displacement of water is caused by the landslide leaving empty space, the water rushes in to fill the space but is pushed back out due to overcompensation.

The main factors that affect size are how much energy is transferred from the earthquake and size of displacement, as the greater the earthquake the more energy that is transferred to the water, the higher the underwater uplift the more water is displaced.

for landslides the larger amount of ~~mass~~ rock and debris moved the greater the displacement, causing a larger tsunami. ||

More space for this answer is available on the following pages.



AL4

<b>Subject</b>	L2 Earth Space Science	<b>Standard</b>	91191	<b>Total score</b>	11
<b>Q</b>	<b>Grade score</b>	<b>Annotation</b>			
1	A3	The candidate has made statements about a volcanic formation related to basaltic magma and hotspots for an A3. For an A4, more detailed statements about the magma type were needed.			
2	A4	The candidate provides enough evidence in this question for an A4. They explained aspects of earthquake formation but more detail was required to reach M5.			
3	A4	This question provides evidence towards A4 rather than M5. They have described how the water was displaced and the energy transferred to the water, but for a higher grade, a link to wave amplitude in the narrow space of the Cook Strait or canyon was needed.			

<b>Confirmation of check</b>	<b>Y/N</b>
This exemplar has been checked for similarities with current online exemplars.	Y