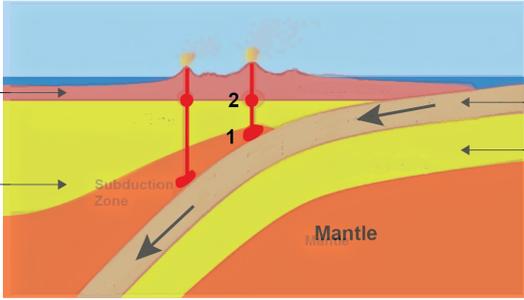


**Assessment Schedule – 2025**

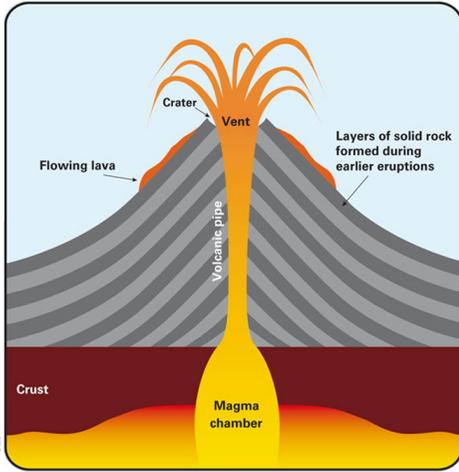
**Earth and Space Science: Demonstrate understanding of the causes of extreme Earth events in New Zealand (91191)**

**Evidence Statement**

**Question One**

Q	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(a)	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Type of crust: <b>Continental</b></p> <p>Tectonic plate: <b>Australian</b></p> </div> <div style="width: 10%; text-align: center;">  </div> <div style="width: 45%;"> <p>Type of crust: <b>Oceanic</b></p> <p>Tectonic plate: <b>Pacific</b></p> </div> </div>	<ul style="list-style-type: none"> <li>Continental and oceanic.</li> <li>OR</li> <li>Australian and Pacific.</li> </ul>		
(b)	<p>Off the east coast of the North Island of New Zealand, the oceanic Pacific plate (PP) subducts under the continental Australian plate (AP), as it is denser and is pulled down by gravity. The friction of the plates melt the plate and water within the oceanic PP lowers the melting point of the rock as it subducts, causing partial melting to occur, forming less dense (basaltic) magma (tectonic process 1). The (basaltic) magma is less dense than the surrounding rock, and therefore rises towards the surface.</p> <p>As the less-dense magma rises, it collects at the bottom of the AP, where it causes the AP to melt, increasing the silica content of the magma, causing it to change to andesitic magma (tectonic process 2).</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>Pacific Plate is pulled down by gravity</li> <li>Friction causes the melting</li> <li>water lowers melting point of rock in the Pacific Plate</li> <li>basaltic magma is less dense than surrounding rock, therefore, rises</li> <li>melting continental rock increases silica content.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>subduction of PP under AP causing partial melting of the rock, leading to less dense (basaltic) magma. Linked to the role of friction or water in partial melting of oceanic crust</li> <li>magma pooling under the AP causing the melting of continental crust, linked to increase in silica forming andesitic magma.</li> </ul>	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> <li>how tectonic processes led to the initial formation of basaltic magma.</li> <li>how tectonic processes led to the subsequent formation of andesitic magma.</li> </ul>

(c) Mt Ngauruhoe is formed from andesitic magma, which has intermediate amounts of silica, gas, and viscosity, making the magma sticky.  
 Stratovolcano eruptions alternate between gas eruptions and lava flows.  
 The cone shape of a stratovolcano is formed from the relatively quick cooling of the ash and lava layers which build up over successive eruptions. Sticky magma / lava results in a steep sided cone shape of volcano as magma / lava does not flow far from vent before solidifying / crystallising.



[https://www.bgs.ac.uk/wp-content/uploads/2020/04/StructureOfaVolcano\\_website.jpg](https://www.bgs.ac.uk/wp-content/uploads/2020/04/StructureOfaVolcano_website.jpg)

Describes:

- TWO characteristics of andesitic magma – intermediate silica, viscosity, gas content
- TWO types of eruption – ash and lava
- link between lava distance and cooling rate.

Explains:

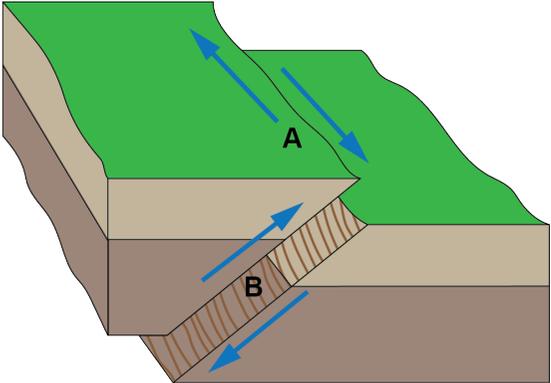
- the link between magma composition and cone shape
- how successive eruptions over time contribute to the cone shape.

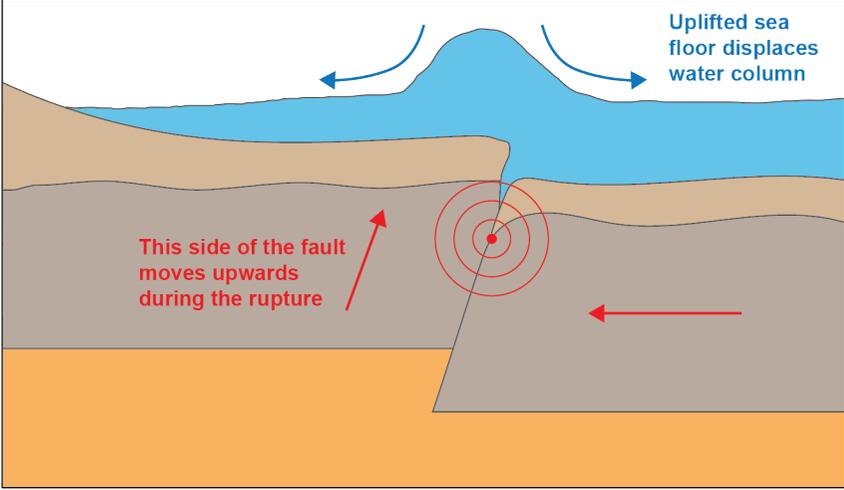
Explains comprehensively:

- how magma composition and alternating eruptive products lead to the cone shape of a stratovolcano.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at Achievement level.	Describes TWO points at Achievement level.	Describes THREE points at Achievement level.	Describes FOUR points at Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level (with minor errors or omissions).	Explains comprehensively ONE point at Excellence level.

Question Two

Q	Expected Coverage	Achievement	Merit	Excellence
(a)	 <p>A fault line is a crack in the Earth's crust, along which stress from an earthquake is / has been released.</p> <p>OR</p> <p>A crack or fracture caused by crust movement.</p>	<ul style="list-style-type: none"> <li>• One correct arrow pair.</li> <li>• Describes a fault line.</li> </ul>		
(b)	<p>When this earthquake occurred, elastic potential energy was converted to kinetic energy and released into the surrounding rock at the focus. The focus is the point below the surface where the rupture occurs, in this earthquake this occurred at a depth 33km.</p> <p>The kinetic energy radiated out from the focus as seismic waves travelling in all directions. As the waves travel through the rock, they lose energy as heat.</p> <p>As the focus was quite deep, a lot of energy was lost by the time the seismic waves reached the surface as they had to travel further.</p> <p>The epicentre is the point on the surface directly above the focus, in this case 124 km, east of Te Araroa.</p> <p>As the seismic waves move away from the focus, they spread out; the further they travel in the crust to reach the surface, the more spread out they are when they reach the surface, meaning the earthquake was felt over a much larger area.</p> <p>As this was a relatively deep earthquake, there was less intense shaking at the surface due to the loss of energy as the seismic waves travelled to the surface, leading to no damage.</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>• the focus and the epicentre</li> <li>• seismic waves carry the energy of wave</li> <li>• seismic waves lose energy as they travel through rock</li> <li>• seismic waves travel in all directions.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>• energy transfer from rupture to the rocks and how seismic waves carry the energy from the focus in all directions</li> <li>• deep focus leads to more energy lost by the time it reaches the surface. Link between depth of focus and less intense shaking at surface / felt over a large area.</li> </ul>	<p>Explains in detail:</p> <ul style="list-style-type: none"> <li>• why this earthquake produced no damage, referring to seismic waves and the focus</li> <li>• why this earthquake was felt over of a large area, referring to seismic waves, the focus and epicentre.</li> </ul>

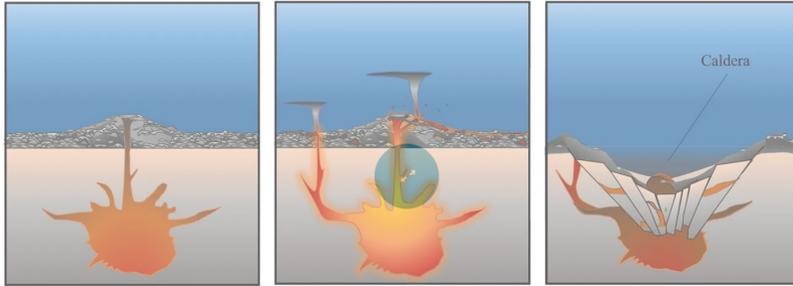
<p>(c)</p>	<p>The earthquake on the fault causes one side of the fault to uplift. This causes the water column above to be displaced upwards, causing a tsunami to be generated,</p> <p>The energy transformed into movement of the water is due to the energy from the vertical displacement of the seafloor, which will relate to the height of displacement. The energy of the uplift is directly related to the rise in height of the seafloor (gravitational potential energy GPE), which in turn is converted to (kinetic <math>E_k</math>) energy, causing the water displacement. Water is displaced in all directions, Energy is not lost as it moves through the open ocean but slows closer to the shore.</p> 	<p>Describes:</p> <ul style="list-style-type: none"> <li>• uplift of seafloor displaces water column above</li> <li>• energy of uplift transferred to water displacement</li> <li>• greater the uplift, the greater the water displacement or vice versa.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>• seafloor uplift, causes water to move in all directions. Energy cannot be absorbed fast by the water. Energy is not lost until reaches the shore</li> <li>• gravitational potential energy caused by uplift GPE is converted into kinetic energy <math>E_k</math>, causing the displacement of water, hence water moving at speed-</li> </ul>	<p>Explains in detail:</p> <ul style="list-style-type: none"> <li>• how this earthquake led to the formation of a tsunami, referring to energy changes.</li> </ul>
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N0	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE partial point at Achievement level.	Describes TWO points at Achievement level.	Describes THREE points at Achievement level.	Describes FOUR points at Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level (with minor errors or omissions).	Explains comprehensively ONE point at Excellence level.

**Question Three**

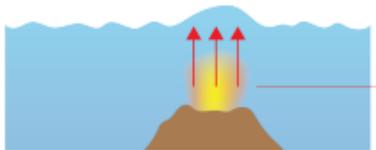
Q	Expected Coverage	Achievement	Merit	Excellence
(a)	<p>A tsunami affects the whole water column, and is caused by a disturbance (e.g. earthquake, volcanic eruption) which causes a displacement of the water column.</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>features of a tsunami in terms of water column.</li> </ul>		
(b)	<p>Tsunami waves will travel outward on the surface of the ocean in all directions away from the source / epicentre of the earthquake that caused it, and continue across the ocean.</p> <p>Tsunami waves in the deep ocean can travel at speeds as high as 1000 km / h for long periods of time for distances of thousands of kilometres and lose very little energy in the process. This is why a tsunami warning was issued throughout the whole Pacific area.</p> <p>As a tsunami wave approaches the coastline, the depth of water decreases, which increases the friction between the water column and the bottom of the water column. This causes the wave to slow down, causing the waves to bunch up, decreasing the wavelength and increasing the height (amplitude) of the wave.</p>	<ul style="list-style-type: none"> <li>tsunami waves travel at high speeds in open water</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>tsunami waves travel at low speeds in shallow water</li> <li>wavelength decreases / amplitude increases in shallow water.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>tsunami waves travel at high speeds in deep water losing little energy meaning they can travel long distances</li> <li>changes to the speed, wavelength and amplitude in shallow water.</li> </ul>	<p>Explains in detail:</p> <ul style="list-style-type: none"> <li>why tsunami warnings were issued throughout the Pacific</li> </ul> <p>AND</p> <p>what happens to a tsunami wave's speed, wavelength, and amplitude at the coastline.</p>

(c) A typical submerged caldera volcano has different stages of eruption. Initially the magma chamber is full of magma, causing the area above it to bulge. Eruptive products, such as magma and gas, are exploded through cracks in the magma chamber. These products would cause a phreatomagmatic eruption when the magma comes in contact with the seawater. Once the magma chamber has emptied, which can be quite a while after the initial eruption, the weight of the water above causes a caldera collapse.

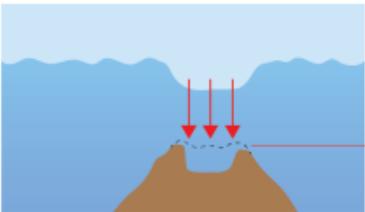


1. Prior to the eruption, with a full magma chamber. 2. The magma chamber empties as lava erupts on the seafloor. 3. The volcano and seafloor collapse into the emptied magma chamber.

During the phreatomagmatic eruption, seawater comes in contact with the high temperature magma, causing the seawater to evaporate with an explosive increase in volume, forming a large gas bubble. The gas bubble travels upwards, displacing the whole water column above it, generating a tsunami wave.



Once the roof of the caldera chamber collapses, seawater rushes in to fill the chamber, causing the water column to drop, generating a tsunami wave.



There is also the possibility of a landslide due to the collapse of one side of the caldera, leading to a submarine avalanche, leading to a tsunami.

Describes:

- one stage of eruption of a caldera volcano
- cause of water displacement for caldera eruption
- cause of water displacement for crater collapse.

Explains:

- one stage of a caldera eruption
- the link between ONE stage of a caldera eruption and tsunami formation.

Explains in detail:

- the different stages of eruption of a submerged caldera and the associated risk of tsunami in the Pacific from a submerged caldera.

<b>NØ</b>	<b>N1</b>	<b>N2</b>	<b>A3</b>	<b>A4</b>	<b>M5</b>	<b>M6</b>	<b>E7</b>	<b>E8</b>
No response or response does not relate the question.	Describes ONE partial point at the Achievement level.	Describes TWO partial points at the Achievement level.	Describes THREE points at the Achievement level.	Describes FOUR points at the Achievement level.	Explains ONE point at Merit level.	Explains TWO points at Merit level.	Explains ONE point at Excellence level.	Explains TWO points at Excellence level.

**Cut Scores**

<b>Not Achieved</b>	<b>Achievement</b>	<b>Achievement with Merit</b>	<b>Achievement with Excellence</b>
0 – 6	7 – 12	13 – 18	19 – 24