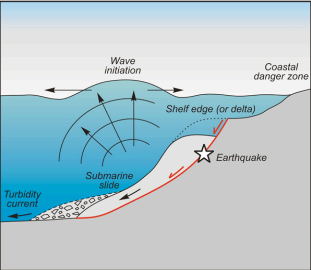


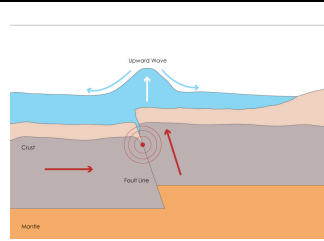
## Assessment Schedule – 2015

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

#### Evidence Statement

##### Question One:

Expected Coverage	Achievement	Merit	Excellence
<p>A <b>tsunami</b> is a series of long-wavelength water waves caused by the displacement of a <b>large</b> volume of a body of water.</p> <p><b>Landslides</b> The Kaikoura coast is vulnerable to tsunamis generated by landslides into the canyon. The topography of the canyon is steep and twisting, leaving a large area at risk of landslides. The sides of the canyon are made up from unconsolidated material (sands and gravels) eroded from the land and deposited on the slope. The slopes are therefore unstable and more likely to slump with only a minor (seismic) disturbance or a minor sediment load increase sending the sediment falling into the canyon. The funnelling effect of the canyon would also act to magnify the size of the initial waves.</p> <p>Large tsunamis may be caused by submarine landslides. These rapidly displace <b>large</b> water volumes as energy transfers to the water at a rate faster than the water can absorb. Characteristically the first two waves are the largest and size diminishes. These waves are closer together than tsunami triggered by earthquakes.</p>  <p><a href="https://rovicky.files.wordpress.com/2009/01/slide_tsunami.jpg">https://rovicky.files.wordpress.com/2009/01/slide_tsunami.jpg</a></p> <p><b>Submarine Earthquakes</b> A tsunami can be generated when a thrust fault associated with a convergent plate boundary moves abruptly, resulting in water displacement, owing to the vertical movement of the plate. There are many known faults off the Kaikoura coast, and visible on the map; some of these are capable of generating a shallow 'large' / severe earthquake (above magnitude 6.8).</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>• A tsunami as a displacement of water.</li> <li>• How a submarine landslide (the downwards movement of sediment) could lead to a tsunami.</li> <li>• How a sea floor earthquake (vertical movement of the plate) could lead to a tsunami.</li> <li>• Energy transfer from the earthquake/ landslide to the water.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>• A tsunami is a water wave caused by a large body of water being displaced AND how a tsunami can be caused by a submarine landslide. OR</li> <li>• A tsunami is a water wave caused by a large body of water being displaced AND how a tsunami can be caused by a sea floor earthquake. OR</li> <li>• A tsunami is a water wave caused by a large body of water being displaced AND energy transfer / wavelength.</li> </ul>	<ul style="list-style-type: none"> <li>• Compares and contrasts the two likely causes of this tsunami: <ul style="list-style-type: none"> <li>- Sea floor earthquake less likely cause as, although there are known faults capable of producing a large magnitude earthquake, these occur less frequently than smaller magnitude earthquakes.</li> <li>- Submarine landslide most likely cause due to the shape of the canyon acting to magnify the water displacement. OR Due to the loose steep canyon slides, which require only a small additional sediment load. OR Seismic event to dislodge material into the canyon.</li> </ul> </li> </ul>

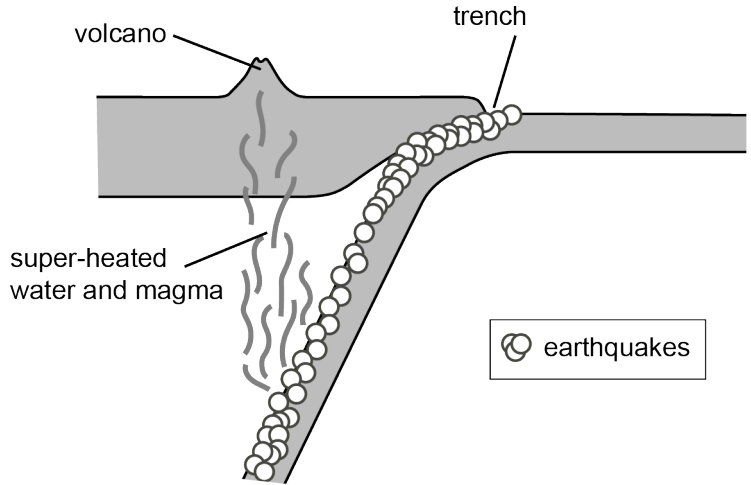


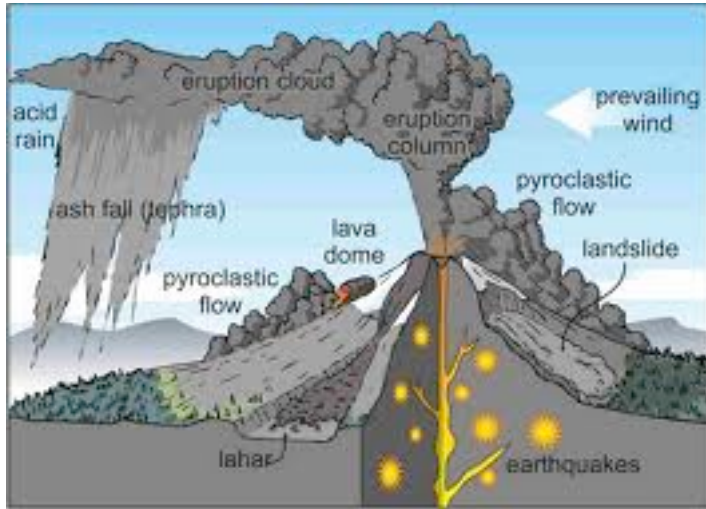
<http://www.n-d-a.org/images/tsunami-diagram.jpg>

Kaikoura is an area with active faulting capable of producing large earthquakes. It is at the convergence of the Pacific and Australian plates. Although large earthquakes can occur, they are not frequent. More frequent are smaller earthquakes (below 6.5), which can displace the loose material on the canyon wall. Combined with the funnel effect of the canyon, which magnifies the water displacement, there is a greater chance of tsunamis generated by a landslide into the canyon causing the wave. Because this requires a smaller seismic event, this is likely to be more frequent (shorter return rate) and therefore more likely than an earthquake-generated tsunami, which requires a large 7+ earthquake.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Describes ONE point.	Describes TWO point.	Describes THREE points.	Explains ONE point.	Explains TWO points.	Comprehensively explains a likely cause of a tsunami – ONE point (can be opposite with reasonable justifications).	Compares and contrasts the TWO likely causes of this tsunami.

**Question Two:**

Expected Coverage	Achievement	Merit	Excellence
<p>The oceanic Pacific Plate is subducting under the continental Australian Plate at a convergent boundary.</p>  <p>They collide at a convergent boundary, which leads to a subduction zone at the Taupo Volcanic Zone (TVZ). Subduction is happening because of the different densities of the plates. Pacific Plate is wholly oceanic and mostly basalt so is denser than Australian Plate. It is dragged down under the Australian Plate by gravity. Above this zone is the TVZ.</p> <p>Subduction is not smooth; friction between the plates leads to pressure build-up. Eventually pressure is released as volcanic activity. The friction between the top of the subducting crust and underside of overriding Australian Plate results in the partial melting of crust which is silica-rich magma dacite / andesite depending on which volcano referred to – eruptive material is a mix of both types of crust – proportion varies according to which volcano is selected. The addition of water to the already hot mantle rocks lowers their melting temperature resulting in partial melting of rocks. The newly formed magma is less dense so rises.</p> <p>Stratovolcanoes are made up of alternating layers of pyroclastic material and lava – the initial part of a subduction volcanic eruption is mainly gases and ash. The hot ash (tephra) and gas is erupted into an eruption column, which descends (due to gravity) producing a pyroclastic flow / density current.</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>• Plate tectonics under Taupo Volcanic Zone (subduction as Pacific Plate (PP) subducts and melts beneath Australian Plate (AP)).</li> <li>• PP is denser than the AP.</li> <li>• The alternating layers of ash and lava which produce a stratovolcano.</li> <li>• Initial eruption / pyroclastic flow layer as a mixture of ash and gases.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>• The cause of volcanic activity in the TVZ in terms of plate boundary.</li> <li>• The alternating sequence of gases / ash (tephra) and lava which produce the layers of a stratovolcano.</li> <li>• Lava composition of the selected material with reference to silica % which determines the 'shape' of the 'cone'.</li> <li>• Pyroclastic flows – a mix of gases, mainly carbon dioxide and sulphur dioxide and ash. 'Flow' is due to eruption column collapsing under gravity.</li> </ul>	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> <li>• The cause of volcanic activity in the TVZ in terms of the plate boundary.</li> <li>• How lava composition of the selected material with reference to silica % which determines the 'shape' of the 'cone' – each eruptive event has slightly different lava.</li> <li>• That pyroclastic flows are produced during initial stage of the eruption and contain hot gases mainly sulphur dioxide and carbon dioxide. Tephra is of different sizes from fine ash to larger blocks / bombs. The eruption column collapses due to gravity, with the finer particles being carried the furthest from the vent.</li> <li>• And so this leads to layers of slightly different material being laid down each time an eruption occurs.</li> </ul>



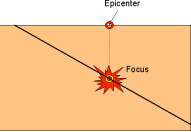
<http://worldlywise.pbworks.com/f/1272808249/volcanichazards.jpg>

**Characteristics**

Lava may be produced after the initial gases and ash. The composition of the lava andesite / dacite depends on the amount of silica and proportions of crust – e.g. dacite is predominantly the overlying Australian continental crust (melting point of rock reduced because of water), whereas andesite is a mixture of both crusts continental and oceanic. Each eruptive event from the same vent is geochemically slightly different, which is why the layering / strata is visible.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Describes ONE point.	Describes TWO point.	Describes THREE points.	Explains ONE point.	Explains TWO points.	Explains in detail ONE point along with the cause of volcanic activity in the TVZ.	• Explains in detail BOTH points along with the cause of volcanic activity in the TVZ.

**Question Three:**

Expected Coverage	Achievement	Merit	Excellence
<p>The continental crusts of the Pacific and Australian Plates are locked together under the Wairarapa region (Eketahuna) (bottom of the North Island).</p> <p>These two plates are pushing into each other in a transform (strike-slip) fault as their densities are similar. As the plates are pushing this causes elastic potential energy to build up and eventually this is released and the plates move, releasing a huge amount of kinetic energy in an earthquake. The focus is the point of origin of the release of energy underground, and the epicentre is the point directly above the focus on the Earth’s surface. The energy from the earthquake radiates out from the focus of the quake and is transmitted in different directions.</p>  <p><a href="http://jornalvisaoleste.com.br/wp-content/themes/premiumnews/premiumnews/functions/the-focus-and-epicentre-of-an-earthquake-i18.gif">http://jornalvisaoleste.com.br/wp-content/themes/premiumnews/premiumnews/functions/the-focus-and-epicentre-of-an-earthquake-i18.gif</a></p> <p>At 34 km depth, this earthquake and the ‘aftershocks’ were considered ‘shallow’; energy is released in the form of ground shaking. As distance decreases from the focus point to the epicentre, the amount of shaking is increased. The amount of shaking affects the amount of structural damage, therefore because the epicentre was on land rather than sea and the focus was close to the surface it caused more damage than a deeper earthquake of the same magnitude. Damage on the surface structure depends on underlying soil, water content and rock as well as the structures. Buildings whose foundations were directly on rock that has been fractured by the shaking will lose structure, and the buildings will experience a sudden loss of support, which will result in drastic and irregular settlement of the building causing structural damage, including cracking of foundations and damage to the building structure itself e.g. chimneys collapse. Long cracks in the ground or structures are caused by lateral spreading. ‘Liquefaction’ is the process in which water-logged, loose / un-compacted (particularly sandy) solids lose strength. The water rises and the soil acts like quicksand.</p>	<p>Describes:</p> <ul style="list-style-type: none"> <li>• Earthquake as release of energy.</li> <li>• Plate tectonics under Eketahuna (transform fault).</li> <li>• Damage decreases with distance from epicentre / focus.</li> <li>• Damage on the surface structures depends on underlying soil, water content and rock OR the quality / build of the structure.</li> <li>• Describes a focus.</li> <li>• Describes an epicentre.</li> </ul>	<p>Explains:</p> <ul style="list-style-type: none"> <li>• Earthquake as release of energy and how the energy is transmitted through material above the focus.</li> <li>• Damage decreases with distance from epicentre / focus.</li> <li>• Damage on the surface structure depends on underlying soil, water content and rock as well as the structures.</li> <li>• How a transform plate boundary leads to earthquakes.</li> </ul>	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> <li>• Earthquake as release of energy and how the energy is transmitted through material above the focus.</li> <li>• Damage decreases with distance from epicentre / focus and how the damage observed on the surface depends on underlying soil, water content and rock.</li> </ul>

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Describes ONE point.	Describes TWO point.	Describes THREE points.	Explains ONE point.	Explains TWO points.	Explains in detail ONE point.	Explains in detail BOTH points.

**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