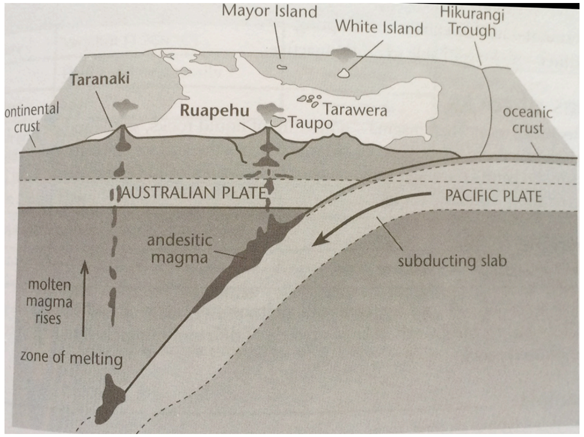
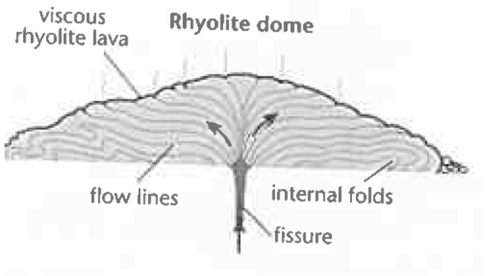
Assessment Schedule – 2016

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

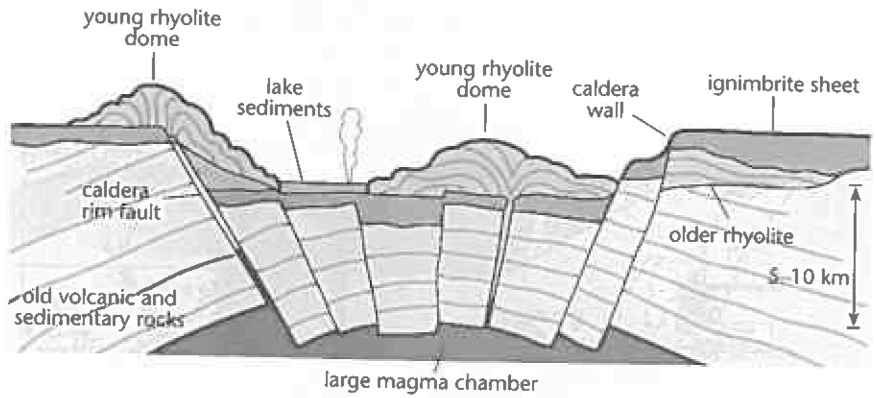
Evidence Statement

Question One:

Expected Coverage	Achievement	Merit	Excellence
The Pacific and Australian plates are converging and the more dense oceanic crust of the Pacific Plate is subducting under the less dense Australian plate. Heat generated at the boundary between the two crusts causes the overlying Australian Plate to melt; this silica-rich, gaseous, melted, continental crust rises as magma to produce rhyolite, which usually has a high gas content and may be highly explosive.  From ESA year 13 Science Study Guide Blacker and Talbett, 2005, page 163 Dome volcanoes are one form of the subduction volcanoes found in the OVC / TVZ. These are formed from molten overlying continental crust from the Australian Plate. Rhyolite oozes from the vent as a great bubble of rock forming a dome. As more eruptions occur, a volcano of overlapping domes results. The top of the volcano cools forming a flat top with steep sides.	Describes: • plate tectonics under OVC (subduction, as the denser Pacific Plate (PP) subducts and melts beneath Australian Plate (AP) • physical characteristics of a dome volcano • physical characteristics of a caldera • the role of trapped gases being released explosively.	• Explains the plate tectonic process under the OVC where the denser PP is subducting under the AP and melting due to friction • Explains that rhyolitic magma is a result of molten overlying continental / Australian crust. • Explains the formation of dome volcanoes. • Explains the formation of caldera volcanoes. • Explains the role of trapped gases in producing explosive eruptions at OVC.	• Explains comprehensively the role of trapped gases in formation of both dome AND caldera volcanoes. • Explains comprehensively the processes leading to the formation of rhyolitic magma – i.e. molten overlying continental crust.



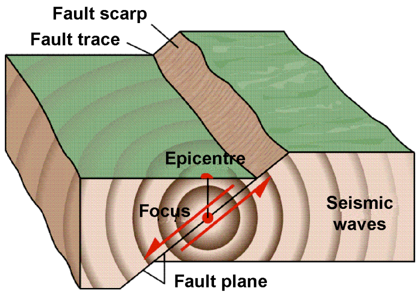
Caldera volcanoes found in the OVC / TVZ are formed when a large volume of continental crust melts over a subduction zone, a huge chamber of rhyolitic magma forms under the surface. The viscous thick magma traps gas, but when the internal pressure of this chamber is suddenly released, an (ignimbrite) eruption occurs.



Powered by the release and expansion of volcanic gases, the entire chamber contents are blown out in a few hours, ejecting as much as 500 cubic km of pumice and ash up to 50 km high. As the eruption column loses energy, the heavier components collapse back to earth as superheated clouds of gas and pumice. The very hot pyroclastic flows that form from the collapsing column explode away from the vent across the land at huge speeds, knocking over everything in their path. Thick deposits form, which are often deep enough to retain their heat long enough for the cooling ash and pumice to weld into rock (ignimbrite). The roof of the emptying chamber collapses, forming a huge surface crater, a caldera which may fill with water and form a lake.

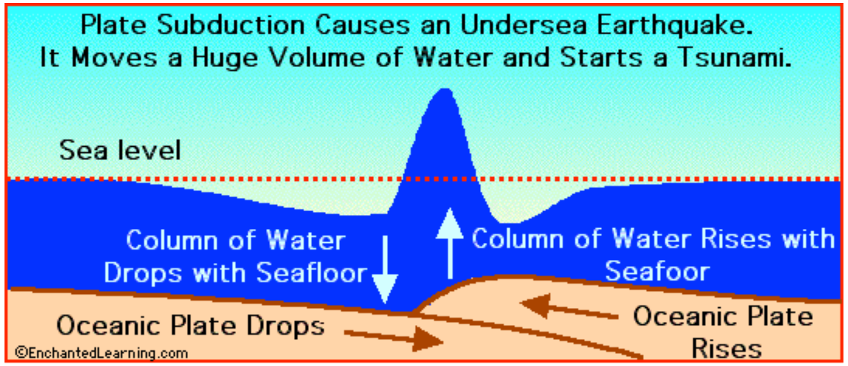
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Partially describes TWO points.	Describes THREE points.	Describes FOUR points.	Explains ONE points.	Explains TWO points.	Explains comprehensively ONE point.	Explains comprehensively TWO points.

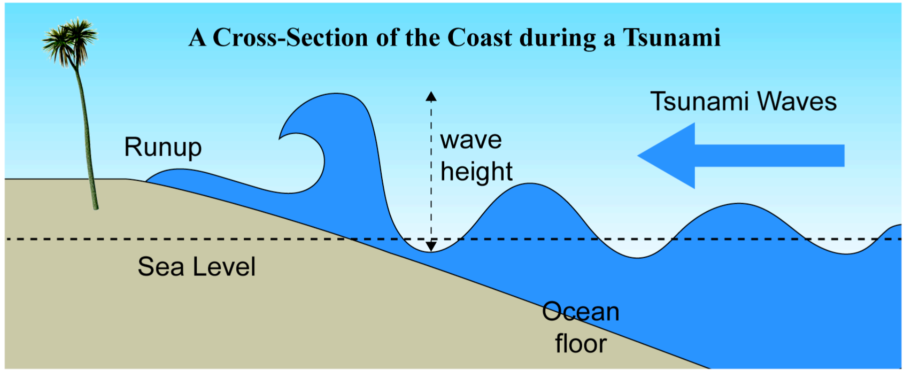
Question Two:

Expected Coverage	Achievement	Merit	Excellence
 http://geologicallyspeaking.com/category/earthquakes/ The continental crusts of the Pacific and Australian Plates are locked together along the Alpine Fault. These two plates are pushing into each other in a transform (right-lateral strike-slip) fault – this is a major 600 km transform fault, which also causes uplift, forming the Southern Alps. Strain energy (30 mm per year) builds up over a period of time, and eventually the rock cannot withstand any more strain. The energy is released as the plates move, releasing a huge amount of energy in an earthquake. The point within the earth where an earthquake rupture starts, the focus would be shallow. Damage decreases away from the epicentre (the point directly above it at the surface of the Earth). The amount of energy released and shaking affects the amount of structural damage. Visible effects of a magnitude 8 earthquake centred on the Franz Josef area are likely to include: • physical damage to structures e.g. buildings, roads, bridges • landscape changes e.g. landslide caused by rock on hillside above township collapsing, deviation to the river. • aftershocks may cause further physical damage to structures or rock falls above the township.	Describes: • plate tectonics along Alpine Fault (transform fault) under Franz Josef • earthquake as release of strain energy • the amount of physical damage is proportional to the energy released • example of physical damage or landscape change caused by earthquake • damage decreases away from point of origin / focus / epicentre.	Explains: • earthquake as release of strain energy built up over time • that EQ is due to the lateral / sideways movement of the AP and PP • physical changes to the landscape caused by the earthquake e.g. rock falls or diversion of river • physical damage to structures in the area in terms of buildings, roads, bridges.	Explains comprehensively: • earthquake as release of strain energy due to the lateral / sideways movement of the AP and PP and gives direction i.e. PP moving N / NE and AP moving S / SW • physical changes to the landscape AND physical damage to structures in the area, in terms of buildings, roads, bridges, related to the release of energy in the form of seismic waves.

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

Question Three:

Expected Coverage	**Achievement**	**Merit**	**Excellence**
A **tsunami** is a series of long wavelength water waves caused by the displacement of a large volume of a body of water. The most physically destructive tsunami is most commonly caused by a seafloor earthquake generated at a subduction zone (generally earthquake is over magnitude 7). Sudden changes to the seafloor cause the ocean to flow away from the disturbance, causing waves. Tsunami, like that generated by the Chilean earthquake can be generated when thrust faults associated with convergent (destructive) plate boundaries move abruptly, resulting in water displacement, owing to the vertical component of movement involved.  www.enchantedlearning.com/subjects/tsunami/ Tsunami waves will travel outward on the surface of the ocean in all directions away from the source, and continue across the ocean. As the waves approach the coast, their wavelength decreases and wave height increases. On the open ocean, the wavelength of a tsunami may be as much as two hundred kilometres, many times greater than the ocean depth, which is in the order of a few kilometres. In the deep ocean, the height of the tsunami from trough to crest may be only a few centimetres to a metre or more. It is this inability to measure both wavelength and amplitude which makes predicting possible impact difficult.	Describes: • earthquake caused the large displacement of water • tsunami carries energy which leads to wave • waves increase in height / smaller wavelength as they approach land. • waves decrease in height / larger wavelength in the deep ocean • monitoring difficulties of tsunamis in the Pacific.	Explains: • a tsunami as a large displacement of water caused by energy transmission which radiates out from the point of origin of the earthquake • tsunami continues over a long distance with long wavelengths but little height but as waves approach land wavelength shortens but height / amplitude increases • monitoring difficulties of tsunamis in the Pacific.	Explains comprehensively: • how the wave forms and how energy in initial wave causes the wave to continue unabated until the wave reaches land (see reference diagram or similar); the more initial energy / large water displacement the bigger the wave on reaching land • links that tsunami waves continue over a long distance with long wavelengths but little height / amplitude until they approach land. Combination of long wavelength and the lack of height makes monitoring difficult compounded by a lack of monitoring stations in open Pacific ocean.

 Adapted from www.enchantedlearning.com/subjects/tsunami/ The large distance and open ocean mean that there are almost no monitoring stations between New Zealand, Pacific Islands and Chile; reliance on Hawaii USGS is essential for any tsunamis generated by long distance earthquakes off the coast of South America.			

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

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24