10

Volcanic Eruptions in New Zealand

PROCESSES CAUSING VOLCANIC ERUPTIONS

What processes produce volcanic eruptions? How often do they occur in New Zealand?

Mt Tarawera eruption, 1886.

The processes causing volcanic eruptions are summarised in resource **10.1**.

10.1 PROCESSES PRODUCING VOLCANIC ERUPTIONS

PLATE TECTONIC PROCESSES

The effect of the movement of the earth's **crustal plates** on volcanic activity.

These processes combine to produce volcanic hazards in certain areas.

VOLCANIC PROCESSES

The ways volcanoes erupt and the materials produced by an eruption.

CULTURAL PROCESSES

The reasons people live and work in areas where natural processes can be a danger to them.

- Plate tectonic processes will be looked at in this unit.
- Volcanic processes will be looked at in Unit 11.
- Cultural processes will be looked at in Unit 14.

PLATE TECTONIC PROCESSES

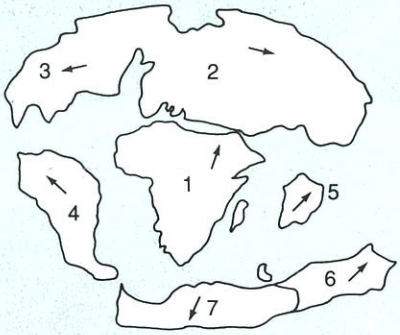
Continental drift

The earth's **continents** were once joined together. Slowly they drifted apart (see resource **10.2**) breaking the earth's hard outer crust into a number of segments called **plates**. The earth's continents sit on top of these plates and move with them (see resource **10.3**).

10.2 SEPARATING CONTINENTS

180 million years ago

135 million years ago

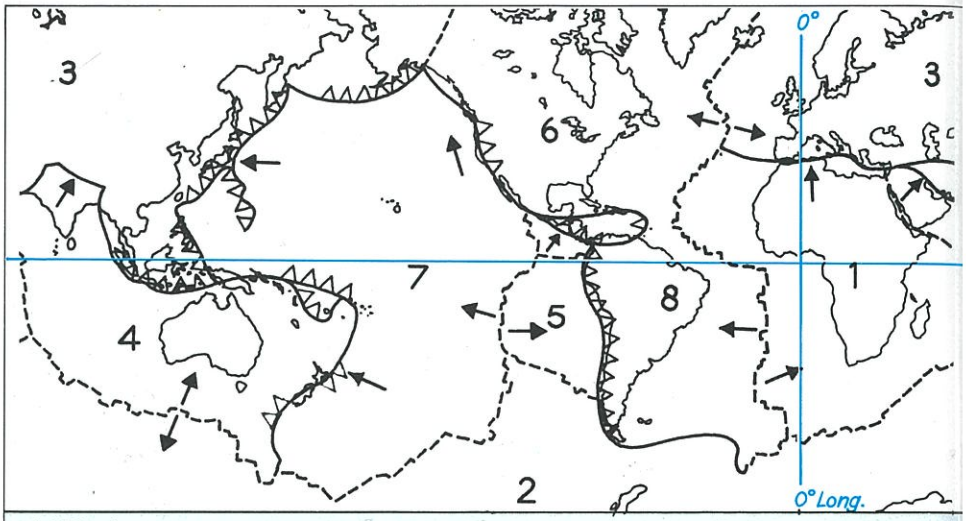


65 million years ago

1 Africa
2 Eurasia
3 North America
4 South America
5 India
6 Australia
7 Antarctica

→ direction of movement

10.3 CONTINENTAL PLATES

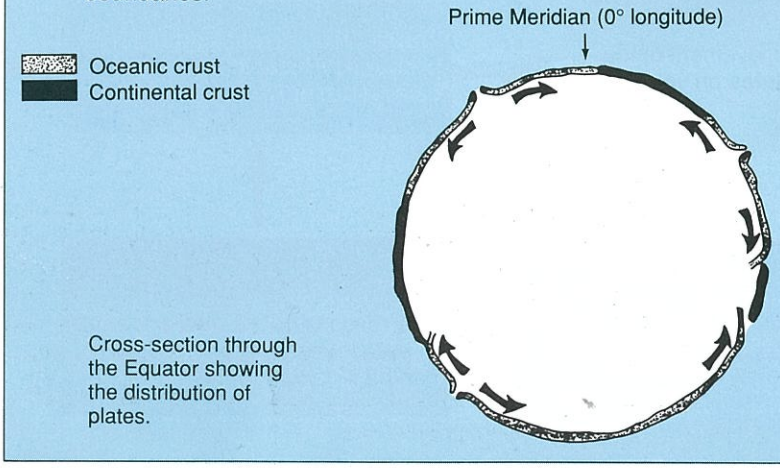


ACTIVITIES

1 Look at resource **10.2**:
   - **a** What resulted from the collision between 5 and 2?
   - **b** What could result in the future from the collision between 1 and 2?

2 From resource **10.3**:
   - **a** state the three possible movements occurring at plate boundaries.
   - **b** give two examples of each.

3 Copy the diagram below. Use resource **10.3** to:
   - **a** Name *each* of the plates and continental areas on your diagram.
   - **b** Name as many of the plate boundary types as you can find that are named in activity **2a**.

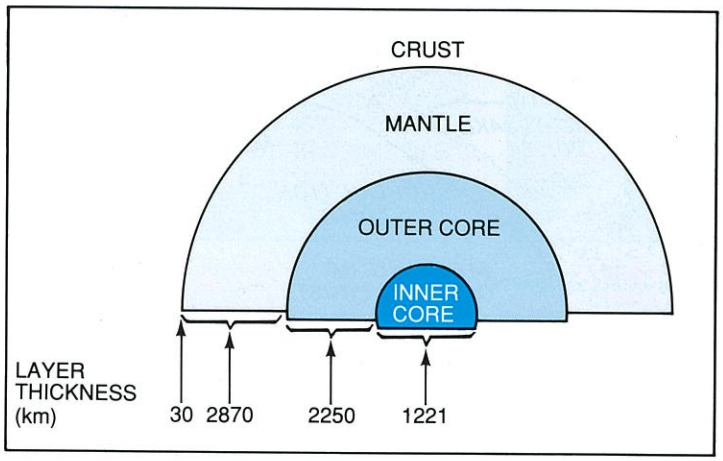


Cross-section through the Equator showing the distribution of plates.

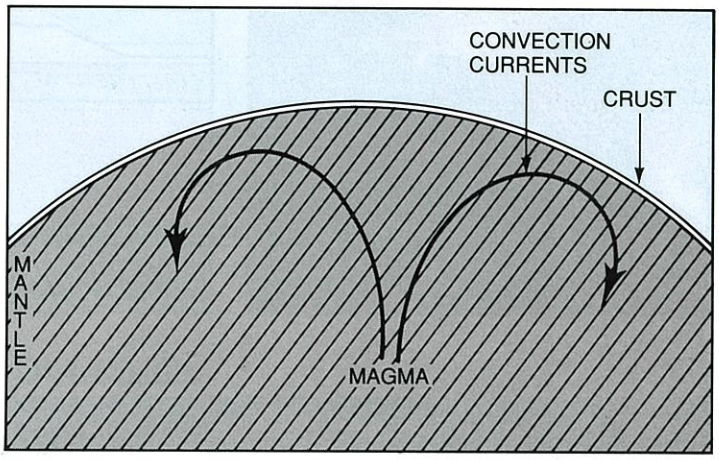
Cause of continental drift

- The earth's hard outer crust is very thin. If the earth were the size of an apple the crust would be thinner than the apple skin. The crust 'floats' on top of the **mantle** (see resource **10.4**).
- **Magma** slowly moves in **convection currents** beneath the crust, heated by the earth's core. The thick, hot magma wells up to the surface and sinks again as it cools (see resource **10.5**).
- Magma contains large quantities of gas. As the magma rises to the earth's surface the gas expands rapidly and can cause explosions, seen as violent eruptions on the earth's surface.

10.4 CROSS-SECTION OF THE EARTH



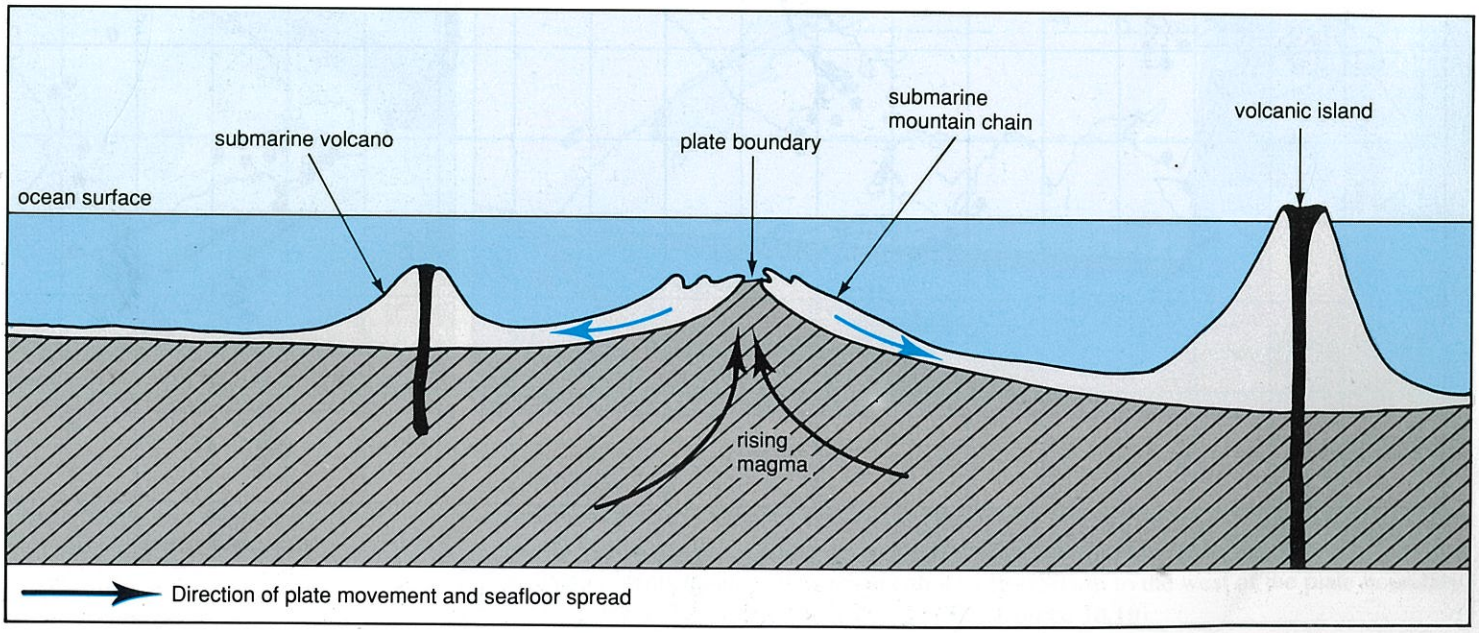
10.5 CROSS-SECTION OF THE MANTLE



Results of continental drift

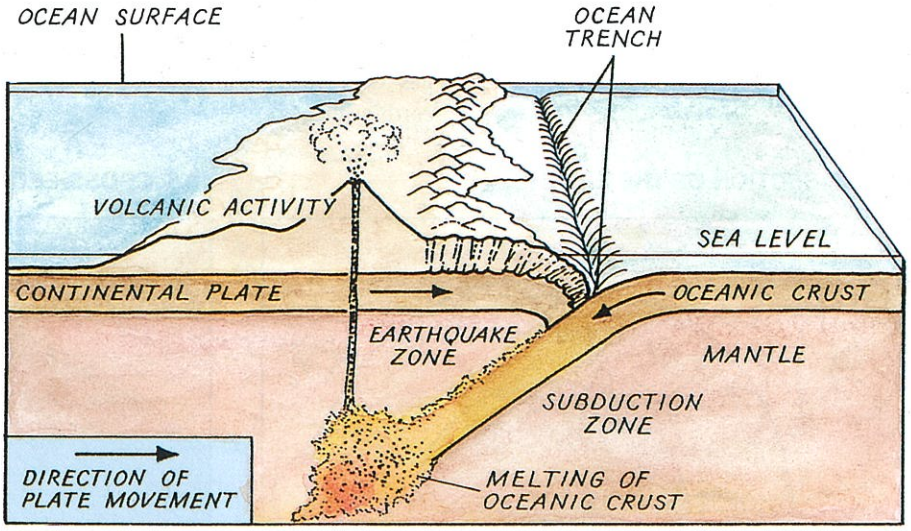
Some plates move apart Where plates are moving apart (such as in the middle of the Atlantic Ocean), magma rises to the surface in convection currents, and spreads outwards. This causes the two plates to move very slowly apart. As the rising magma explodes through weak points, volcanoes form. This whole process is called **seafloor spreading** (see resource **10.6**).

10.6 SEAFLOOR SPREADING



Some plates collide **Subduction** is said to occur when two plates are moving into eac other (see resource **10.7**). Oceanic plates are dense and heavy and are forced down under neath plates carrying continents. The sinking oceanic crust is carried down in to th mantle and starts melting to form magma. This magma then rises to the surface and pro duces volcanic activity along the edge of the subduction zone (see resource **10.7**).

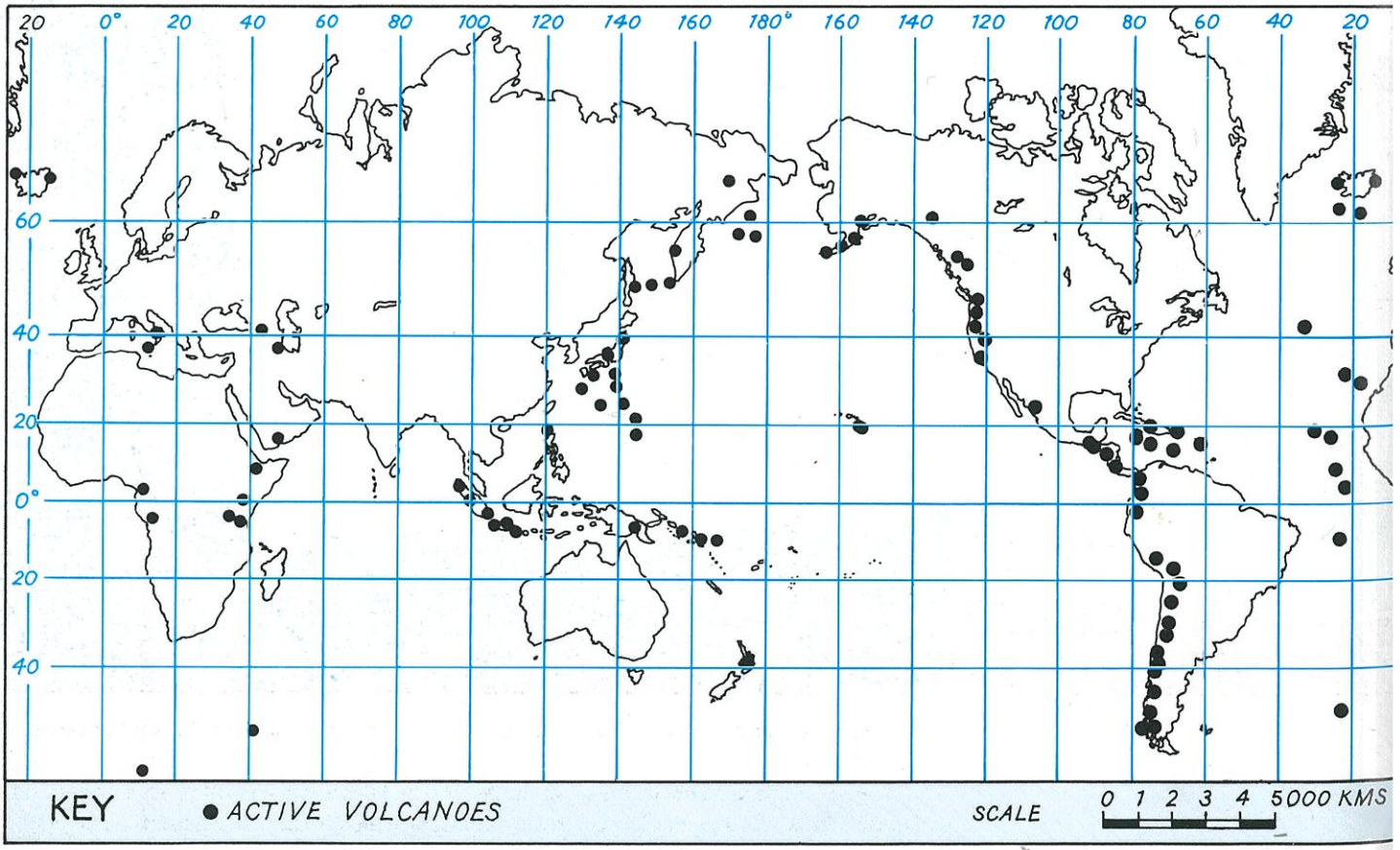
10.7 SUBDUCTION ZONE



VOLCANIC ACTIVITY AND PLATE BOUNDARIES

Nearly all volcanic activity occurs along **plate boundaries**, particularly at subductio zones (see resource **10.8**).

10.8 WORLD: DISTRIBUTION OF VOLCANOES



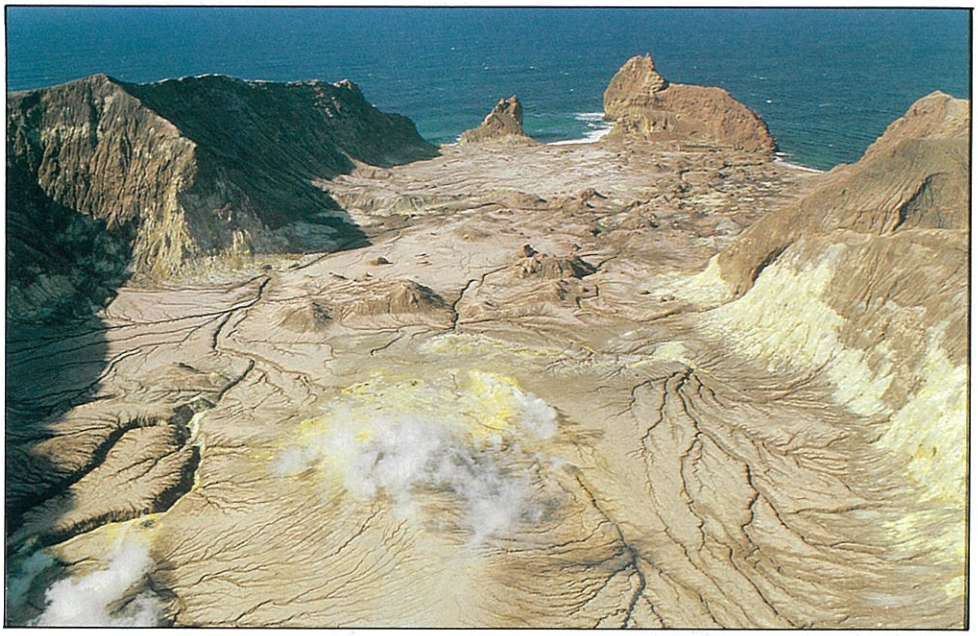
ACTIVITIES

1 Why would the boundary of the Pacific be called 'The Ring of Fire'?

2 Locate and name the following major volcanoes on a world map. Also record the country where each volcano is located.

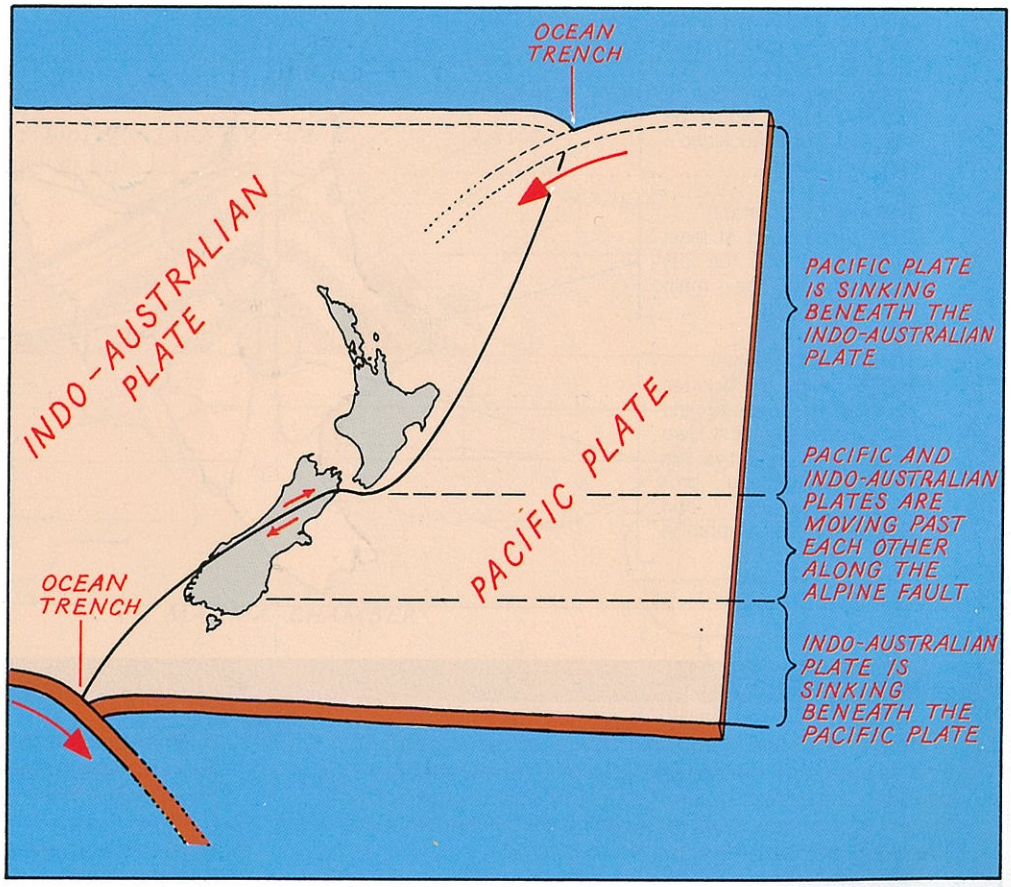
Volcano	Location
Mt Wrangell	61° 40'N 143° 0'W
Mt Katmai	58° 17'N 154° 56'W
Mt St Helens	46° 12'N 122° 11'W
Mt Paricutin	19° 28'N 102° 15'W
Mt Cotopaxi	0° 30'S 78° 30'W
Mt Mauna Loa	21° 08'N 157° 13'W
Mt Krakatoa	6° 07'S 105° 24'E
Mt Ruapehu	39° 18'S 175° 35'E
Mt Erebus	77° 32'S 167° 09'E
Mt Etna	37° 46'N 15° 00'E
Mt Vesuvius	40° 49'N 14° 26'E
Mt Surtsey	63° 16'N 20° 32'W
Mt Kilimanjaro	3° 04'S 37° 22'E

PLATE PROCESSES IN NEW ZEALAND



New Zealand is located on the boundary of the Pacific and Indo-Australasian plates (see resource **10.9**).

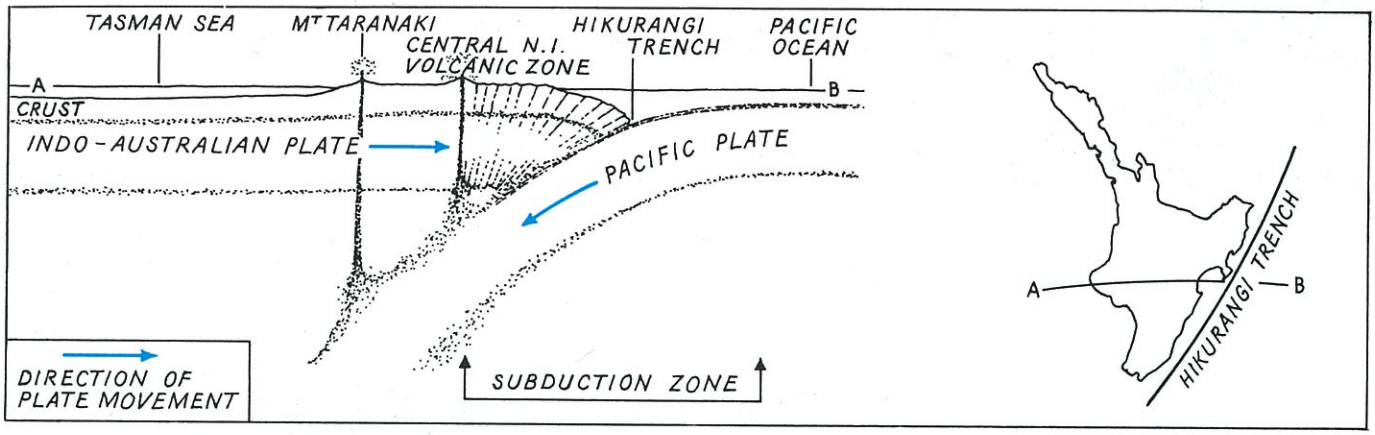
10.9 NEW ZEALAND AND THE PLATES



A subduction zone exists to the east of the North Island and to the southwest of the South Island.

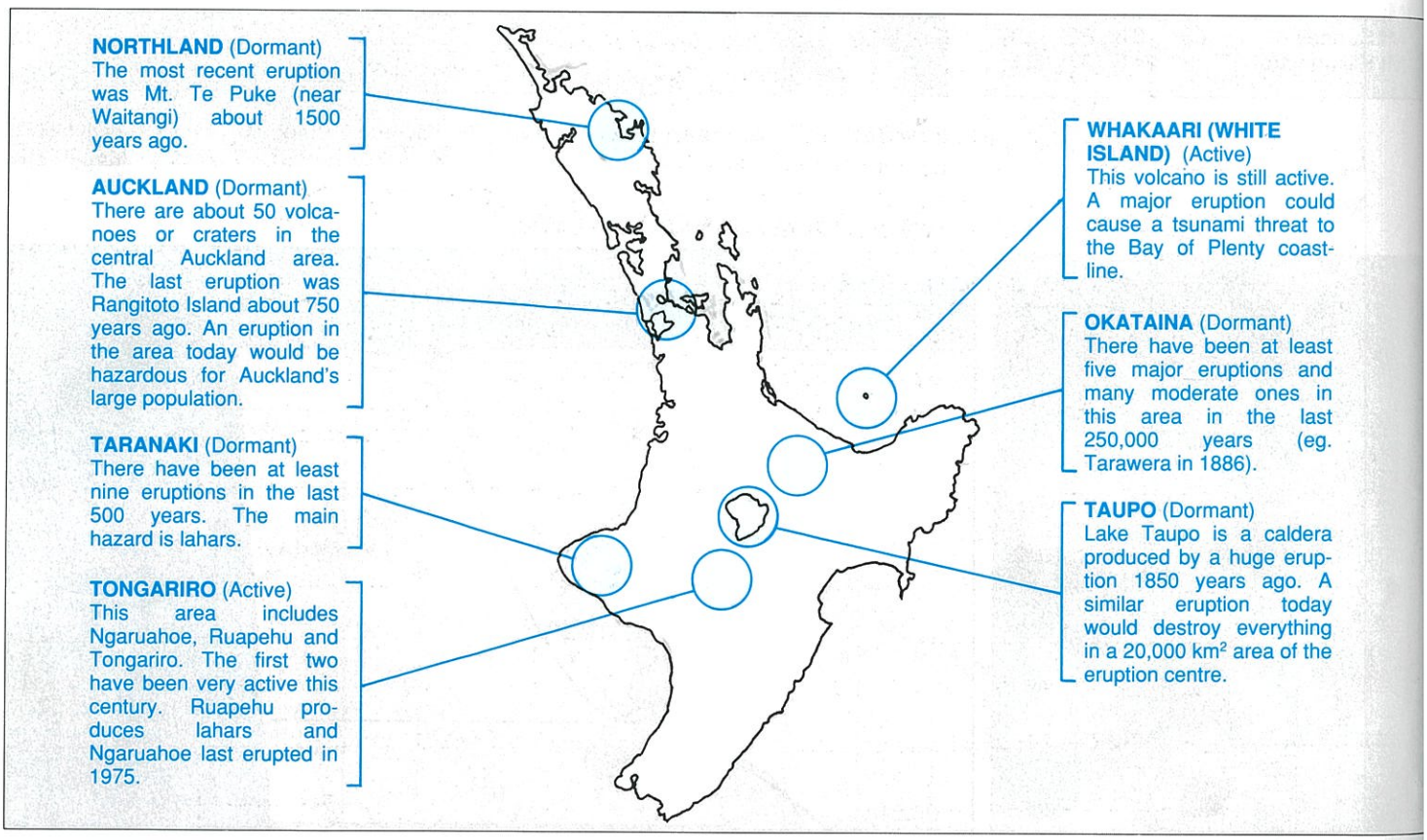
The subduction zone to the east of the North Island causes volcanic activity in the North Island. As the Pacific plate slowly sinks beneath the Indo-Australasian plate, it melts and forms magma. This occurs about 140–180 km to the west of the plate boundary between White Island and Mt. Taranaki (see resource **10.10**).

10.10 THE CENTRAL NORTH ISLAND'S SUBDUCTION ZONE



The plates in the South Island are passing each other and so there is little volcanic activity. Under the North Island however there is a subduction zone making it more volcanically hazardous. The pattern of volcanic activity in the North Island is shown in resource **10.11**.

10.11 NEW ZEALAND'S MAIN VOLCANIC REGIONS



ACTIVITIES

1 Is there a trend-line of volcanic activity on resource **10.11**? If so, is there any relationship between this line and the boundary line between the Pacific and Australasian plates? In view of this, how does resource **10.10** explain the trend-line of volcanic activity in the North Island?

2 Which of the following statements are TRUE and which are FALSE?

A All volcanoes are large mountains.
B Magma is made up of hot liquid gas and rock.
C The earth's continents were once one land mass which has slowly drifted apart.
D Volcanoes form away from plate boundaries.
E Volcanic eruptions are always violent.
F All plates move in the same direction.

3 When have volcanic eruptions been hazardous in New Zealand? Look at resource **9.1**. This summarises New Zealand's major natural hazard events. Bar graph the statistics showing loss of life owing to volcanic eruptions. There have of course been more volcanic eruptions than this in New Zealand but they have not been hazardous to people and so are not included.

11 Volcanic Eruptions in New Zealand

SEQUENCE OF EVENTS

What sequence of events occurs when a volcanic eruption is hazardous?

11.1 SEQUENCE OF EVENTS

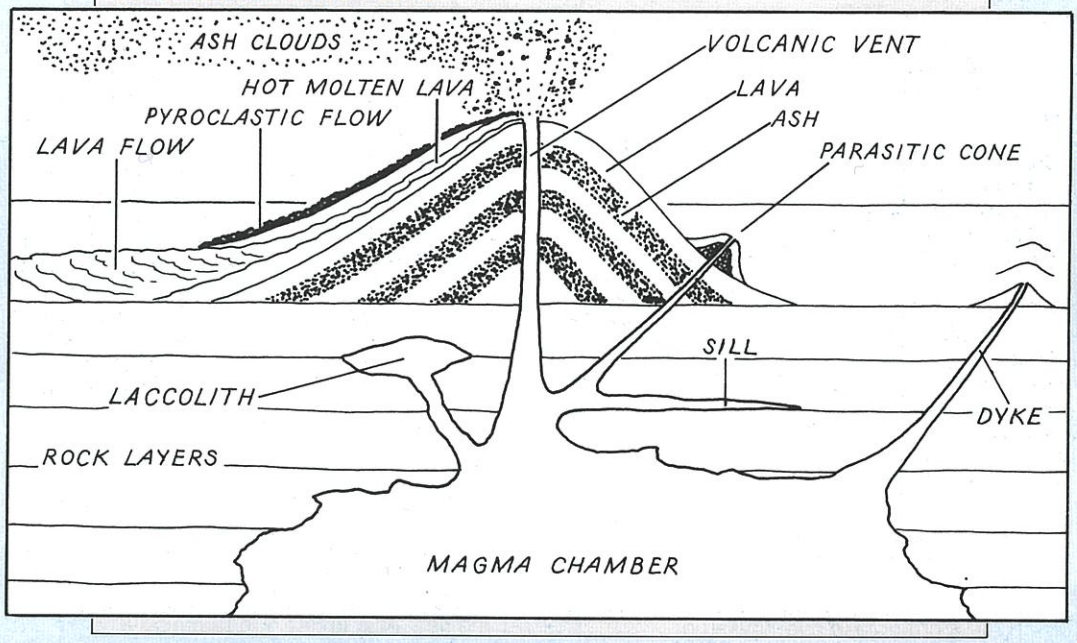
Every volcanic eruption is unique. Some last for only a few hours while others erupt over many months. Even eruptions from the same volcano can be different. However where volcanic eruptions are hazardous to people, a general sequence of events tends to occur.

STAGE 1: PROCESSES WITHIN THE EARTH

Magma rises to the crust within the **mantle**. The magma enters weaknesses in the crust caused by plate movement. A magma chamber may form (see resource **11.2**). From the magma chamber the magma may:

- stay underground in horizontal layers (called *sills*)
- extend from underground to the surface in diagonal layers (called *dykes*)
- stay underground in reservoirs (called *laccoliths*)
- enter an existing vent and blast out the plug
- enter an existing vent, be unable to dislodge the plug and burst out the side creating a parasite cone (see resource **11.2**).

11.2 VOLCANIC FEATURES



STAGE 2: PROCESSES ON THE EARTH

As the eruption approaches:

- pressure builds up below the surface
- earthquakes often occur
- an existing volcano can begin to bulge
- if a crater lake exists, the temperature of its water increases.

When the eruption occurs material can move as:

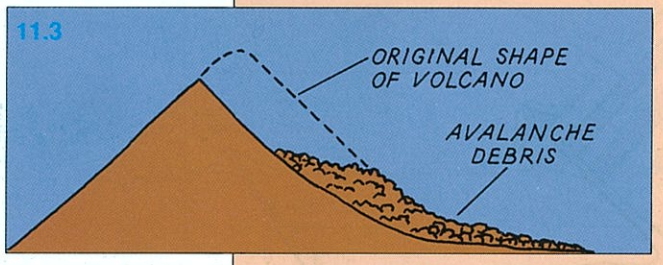
GROUND FLOWS

Lava – streams of hot molten rock (magma) that flow down the sides of volcanoes (see resource **11.2**).

Pyroclastic flows – glowing clouds of hot gases, lava and rock particles which flow down the volcano flanks at speeds of up to 190 km/hr (see resource **11.2**).

Dry avalanches – when part of a volcanic cone collapses and slides down the flanks:

11.3



For example, 9700 years ago part of Mt. Ruapehu collapsed spreading debris from 1–12 metres thick up to 12 km from the volcano.

Lahars – a mixture of mud and water that flows from a volcano like wet concrete caused by:

- a crater lake overflowing or collapsing
- heat from an eruption melting the snow and ice on the mountain.

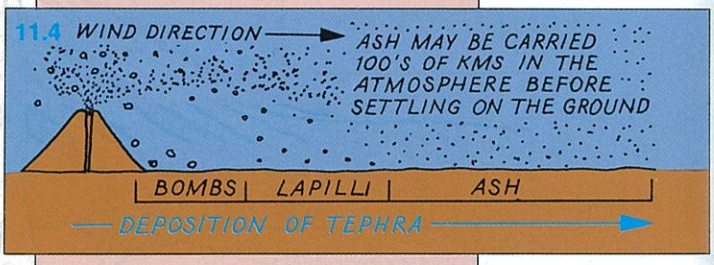
AIRBORNE MATERIAL (tephra)

Ash – debris less than 2 mm in diameter. Ash clouds can reach a height of 50 km and can be carried a long way by wind.

Lapilli – debris 2–64 mm in diameter.

Bombs – debris more than 64 mm in diameter. Bombs rarely land more than 4–5 km away.

11.4



TIDAL WAVES (tsunami)

An earthquake under the ocean floor can cause waves to travel over the ocean in ever-widening circles causing the sea level to rise. On reaching a coastline they form large waves. An eruption at White Island could result in a tsunami affecting the Bay of Plenty.

STAGE 3: EMERGENCY RESPONSE

If life or property is in danger in New Zealand, a civil defence emergency would be called in the area under threat. People would be evacuated where possible.

STAGE 4: FURTHER ERUPTIONS

It is likely that more eruptions would occur accompanied by the expulsion of more ground flow and airborne material.

STAGE 5: THE VOLCANO BECOMES DORMANT

The main eruption period would eventually cease.

STAGE 6: RECOVERY

Civil Defence would coordinate:

- treatment of injuries
- evacuation of people where necessary
- assessment of damage to buildings, roads, services and economic activities
- distribution of emergency provisions such as water, food, clothing and shelter.

STAGE 7: REHABILITATION

- Repair to buildings, roads, services and economic facilities may take months and will be very costly.
- Counselling for people who suffered trauma and stress through loss of life and property.

Lava flow damage to a ski lodge on Mt Ruapehu.

ACTIVITIES

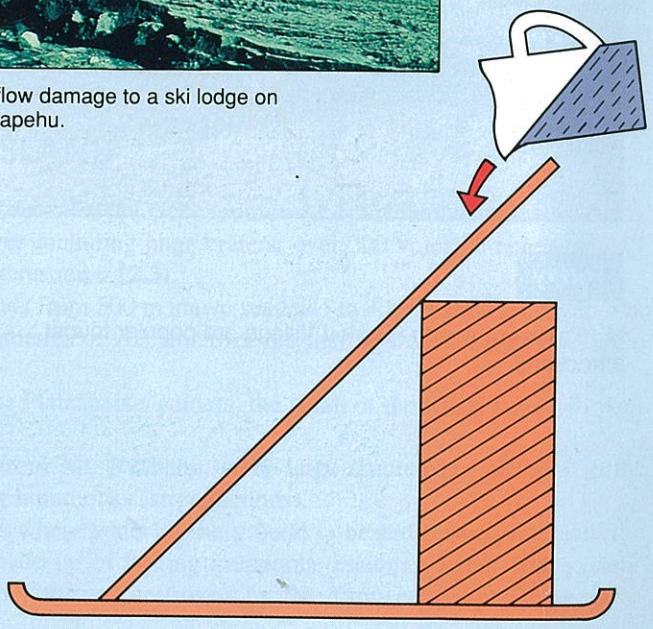
1 After reading resource **11.1** construct a flow diagram based on resource **4.1** for volcanic eruptions.

2 Explain the structure of the volcano in resource **11.2** using the information in STAGE 2.

3 **Lab Experiment**
Lava flows can be free-flowing or very viscous. The term *'viscosity'* means 'resistance to flow'. The degree of viscosity determines the final shape that the lava will take when it has cooled. The following experiment will demonstrate the different types of viscosity.

You will need:
A small board, water-proof tray or plastic sheeting, a support block, paint, flour, cold water, jugs.

What to do:
1 Set the board up as shown below.
2 Mix the flour with water and make two or three mixtures of varying thicknesses, ranging from thin to very thick.
3 Pour each mixture onto separate sections of the board and compare the different rates of flow.
4 Leave the 'flows' on the board to dry. Are the dried shapes different? In what way?



CASE STUDY: Mt. Tarawera

Before the eruption

- increased **geothermal** activity in the area.
- sudden changes in the water level of Lake Tarawera.
- A 'phantom' canoe is seen on Lake Tarawera.

The eruption

see page 21

1.30 am June 10th 1886 – An enormous cloud of ash and vapour rises out of Mt. Tarawera.

1.45 am – The eruption starts with a roar. A towering black eruption cloud rises into the air and red hot scoria is ejected from the volcano.

2.10 am – The summit of Mt. Tarawera explodes with a deafening noise and a violent earthquake.

2.30 am – The whole summit, 5 km in length, is in eruption.

3.30 am – Explosive eruptions from both lakes in the Rotomahana valley send up a cloud of steam and mud. Huge volcanic rocks up to 2m in diameter are thrown out of Mt. Tarawera.

5.30 am – The eruption is largely over. Volcanic activity in the nearby Waimangu Valley begins and continues on and off for a month.

After the eruption

The damage is inspected and it is found that three villages are totally buried with an estimated death toll of 153.

Today

Mt. Tarawera and the Buried Village are popular tourist attractions.

11.5 NEWSPAPER REPORTS FROM THE 'NEW ZEALAND TIMES' 1886

OHINEMOTU, June 10.

We have all passed a fearful night here. The earth has been in a continual quake since midnight. At 2.10 a.m. there was a heavy quake, then a fearful roar, which made everyone run out of their houses; and a grand yet terrible sight, for those so near as we were, presented itself. Mount Tarawera, close to Rotomahana, became suddenly an active volcano, belching out fire and lava to a great height. The eruption appears to have extended itself to several places southwards. A dense mass of ashes came pouring down here at 4 a.m., accompanied by a suffocating smell from the lower regions. This immense black cloud extended in line from Taheke to Paeroa. The mountain was one continual mass of electricity all night, and is still the same. Between the roar of the thunder, the roaring of three or four different craters, and the stench and the continual quaking of the earth, several families left their homes in their nightdresses with whatever they could seize in the hurry, and made for Tauranga, others who were lucky got horses and left for Oxford. Judging from the quantity of ashes and dust here, I fear serious results to the people at Wairoa and all Natives round Tarawera Lake. The fearful aspect of affairs is just as bad now (8 a.m.) as they were all night. I have sent my family away to Oxford this morning by special buggy, and if matters don't improve during the day shall follow them for a day or two. Hundreds of new boiling springs have broken out all round here, some in the middle of the road.

TAURANGA, June 10, 8.15 a.m.

Loud reports and heavy earthquakes began here, and continued until 5 a.m. Tauranga is in darkness, and thick clouds of sulphurous matter, gypsum, etc., are in the air. Mounts Tarawera and Rotomahana are reported to have broken out, and eruptions are going on continually.

ROTORUA, June 10.

Most of the people have fled in th nightdresses from here. The Postmas has sent his own family away, but remained at his post, but is unable to how long he will do so.

AUCKLAND, June 10, 11 p.m.

Telegraphic communication is interrupted toward Opotiki and Whakatane.

The latest news from Rotorua is more reassuring; the darkness is now clearing away, and it is hoped the worst is over. The Taupo telegraphist reports: "There is no sign of any eruption from Tongariro. Telegraphic communication is interrupted north of here, and for about six miles north of Te Awamutu. The whole of the roads and surrounding country is covered with blue mud three feet deep. At Wairoa it is 10 feet deep, and the houses are all buried up to the eaves." Mr Benner, postmaster at Maketu, reports that the atmospheric disturbances caused darkness there until 10 a.m. The earthquakes lasted from half-past 2 a.m. till a quarter-past 8, with very strong lightning and earth currents. office has not suffered any damage. He thunder and lightning, with sharp ea quakes took place from half-past 3 to h past 11 a.m. to-day. About 5 a.m. fine d fell, and about 8 o'clock pumice of size of pearl barley. The dust is still falli (two minutes to 1 a.m). It was pitch da till a quarter to 10 a.m. There is still haze, and a dust deposit of over an inc Rotomahana is reported to have broke out into one active volcano. The Tikitip bush has been uprooted, and the two smal lakes destroyed. Fresh eruptions ar reported to be taking place. The latest i that the terraces have all gone. Twenty-six bodies have been recovered.

WAIROA, June 10.

The scene here is terrible. Macrae's Hotel is completely wrecked. Mr Hazard, the schoolmaster, with his wife and family, except two children, have been killed, and great loss of life is believed to have taken place among the Natives.

ACTIVITI

1 Construct a diagram based on the structure of resource **4.1** for the Tarawera eruption.

2 How did the people living in the Tarawera area first find out about the eruption? What did they then do?

3 If the Tarawera eruption occurred today, how would people's actions be different from 1886. Think about the role of the media, Civil Defence etc.

4 In groups of about 6, use the information in resourc **11.5** and your own research to write a script about a family caught up i the Tarawera eruption. Produce the script for a video production.

12 Volcanic Eruptions in New Zealand

PHYSICAL CHANGES

What are the effects of volcanic eruptions on the land?

The 5th Form Geography prescription uses the word 'land' which could have a narrow meaning (soil and earth) or a wider meaning (**natural environment**). The authors have chosen to use the wider meaning to study the **physical** changes resulting from volcanic eruptions.

PHYSICAL CHANGES

The extent of changes caused by volcanic eruptions depends mainly on the type and size of the eruption. Resource **11.2** shows the changes diagrammatically and resource **12.1** summarises the possible effects a volcanic eruption can have on the natural environment.

12.1 PHYSICAL CHANGES TO THE NATURAL ENVIRONMENT

TOPOGRAPHY

- The land is built up as layers of **tephra, lava, lahar** and **pyroclastic flows** are deposited.
- The tops of volcanic cones can collapse or blow up depending on the type of eruption.
- New craters or **caldera** can form, some filling with water.
- The flanks of old volcanic cones can erode leaving the hard plug exposed.

VEGETATION

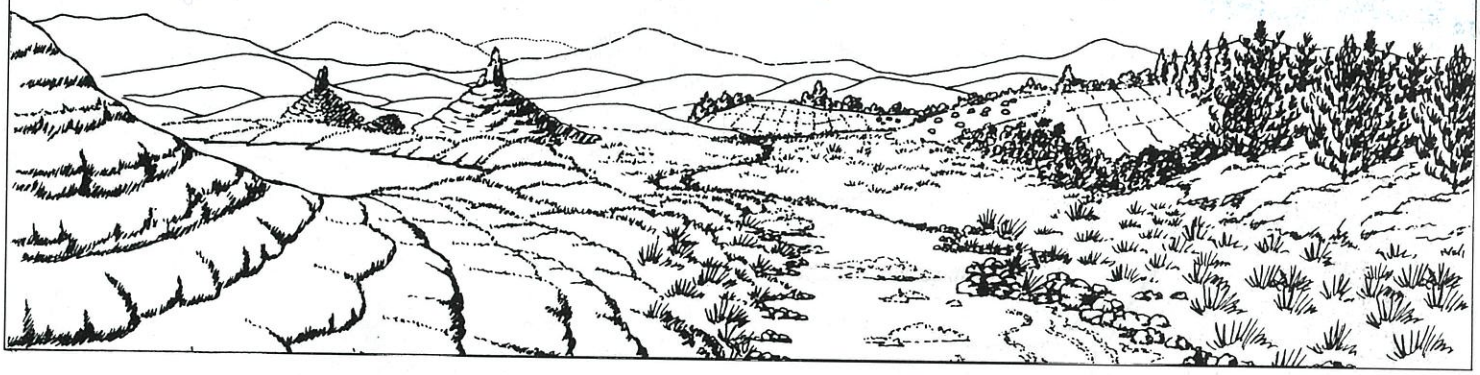
- Vegetation can be blown over or burnt, close to the eruption centre. This can result from lava and pyroclastic flows.

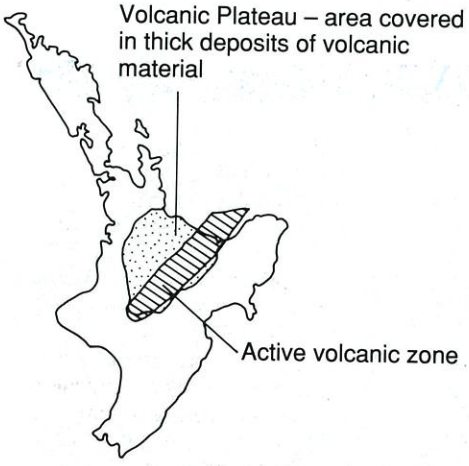
DRAINAGE

- Rivers can be diverted if volcanic material blocks old river courses.
- A change in the **topography** can change drainage patterns.
- Lahars can flow into rivers raising the water level (eg the Tangiwai Disaster, 1953).

SOIL

- Areas receiving volcanic ash will often enjoy an increase in soil fertility.
- Areas receiving scoria or pumice will develop as well-drained soil.
- Too much volcanic material can create a soil deficient in cobalt, making it unsuitable for farming, such as in Volcanic Plateau (central North Island).





12.2 VOLCANIC PLATEAU

CENTRAL NORTH ISLAND

Otherwise known as the Volcanic Plateau (see resource **12.2**) the central North Island is dominated by volcanic features including huge craters, over 200 volcanic cones, and 17 active geothermal regions (see resource **12.3**).

The Volcanic Plateau extends from 500 m above sea level to 4 km below sea level. It is made up of 20 000 cubic kilometres of volcanic rock originating from the many volcanic vents.

Lake Taupo, the heart of the Plateau, is a caldera, the result of the world's most violent known eruption.

Lahar flows, particularly from Mt. Ruapehu, carry large amounts of material to the base of the mountain, forming hummocks (large mounds).

Geothermal activity occurs where water in the ground is heated by volcanic activity. The resulting landscape is made up of boiling mudpools, escaping steam and geysers. The famous Pink and White Terraces, destroyed by the Tarawera eruption, were the result of geothermal activity.

ACTIVITIES

1 List the many volcanic features found in the Central North Island area (resource **12.3**).

2 Refer to resource **12.3** and answer the following questions.

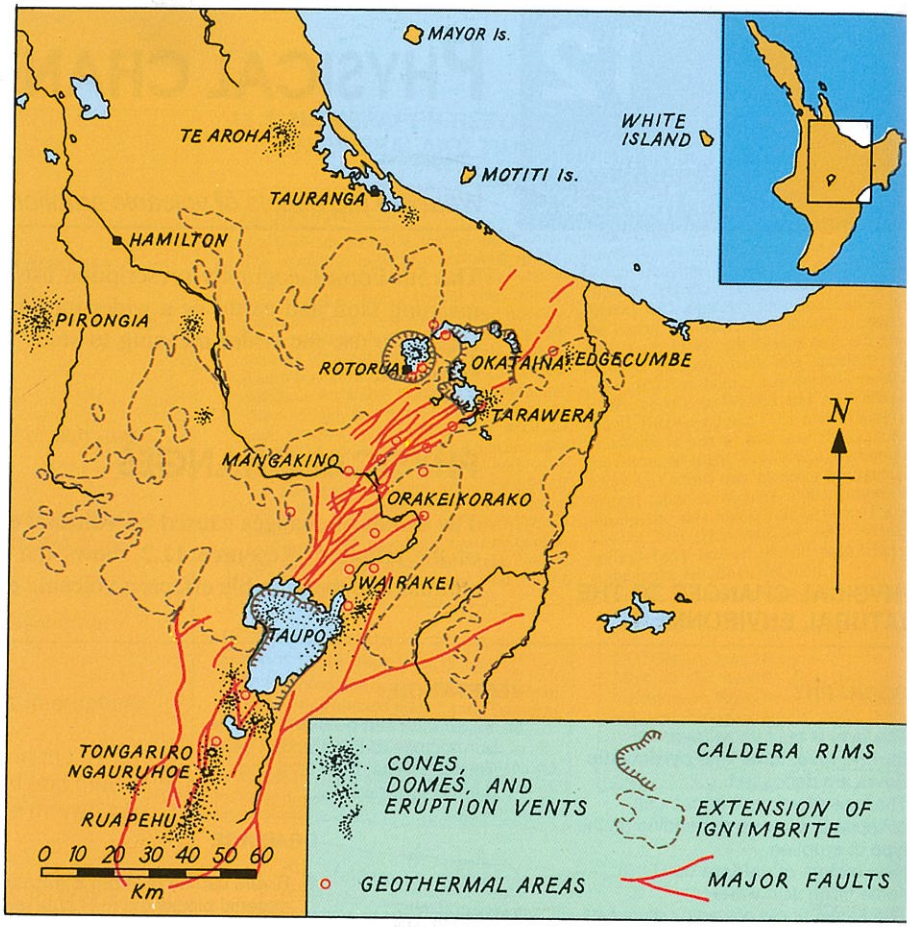
- **a** Where is the largest caldera in this area?
- **b** What is the distance across this caldera?

3 Using resource **12.5**:

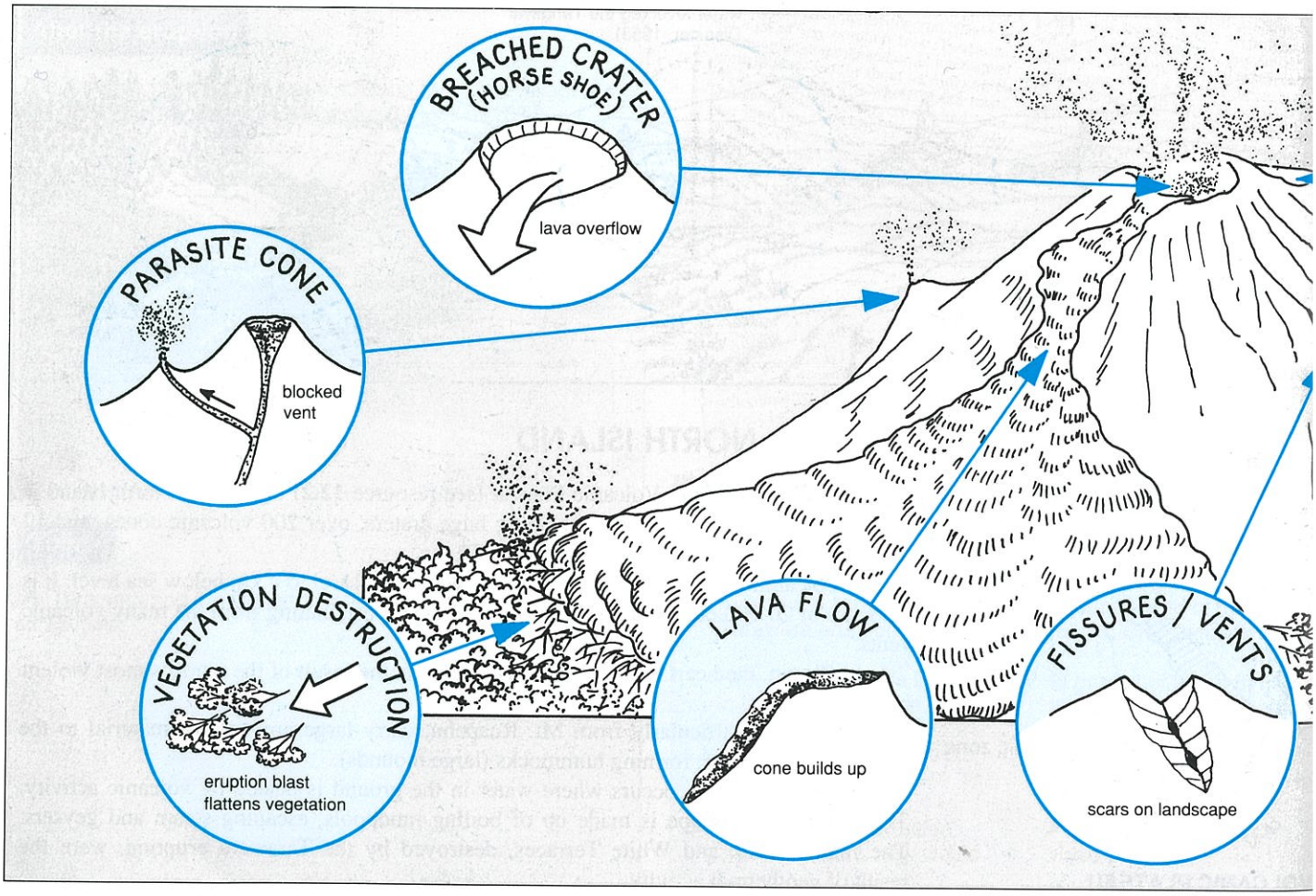
- **a** Name the largest volcano in the Auckland area?
- **b** What is the distance across this volcano?

4 In one paragraph compare the volcanic features of Auckland and those of the Central North Island.

12.3 VOLCANIC PLATEAU VOLCANIC FEATURES



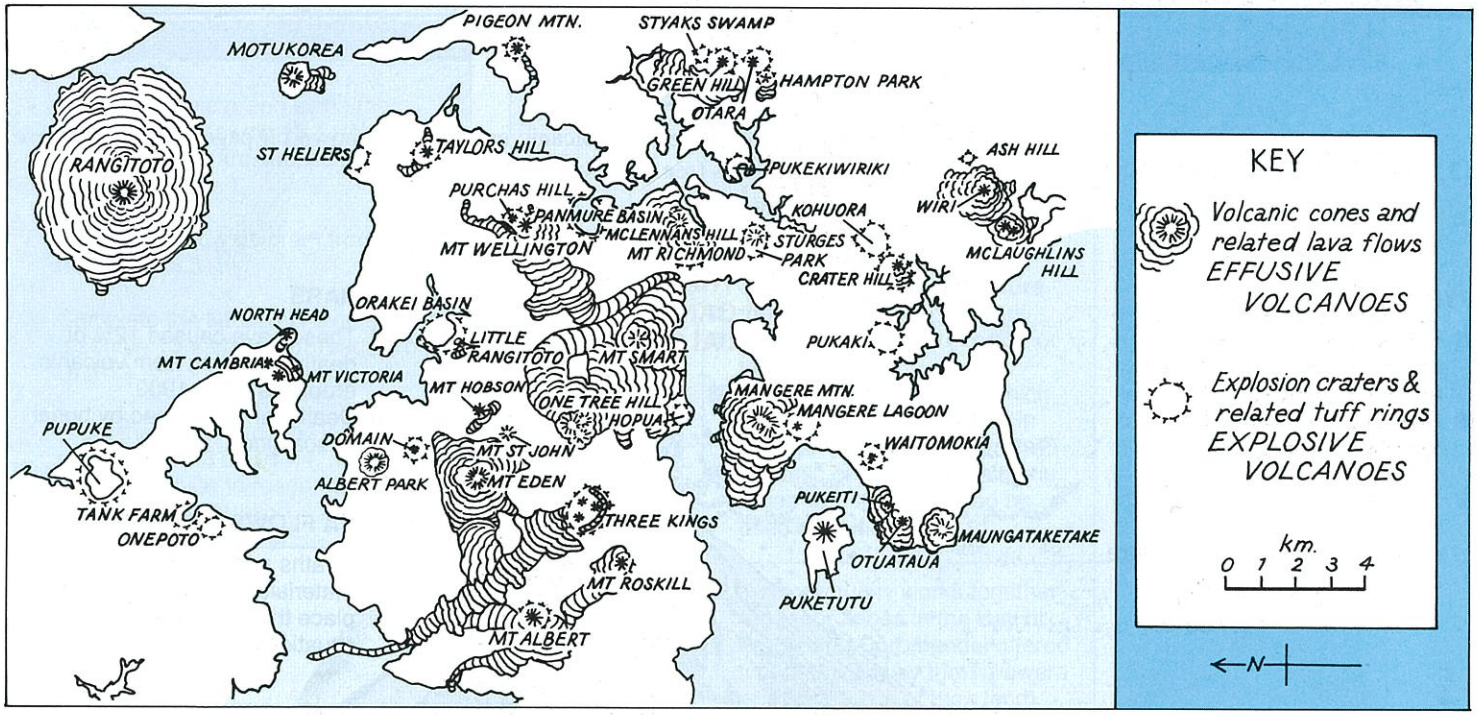
12.4 EFFECTS OF VOLCANIC ERUPTIONS

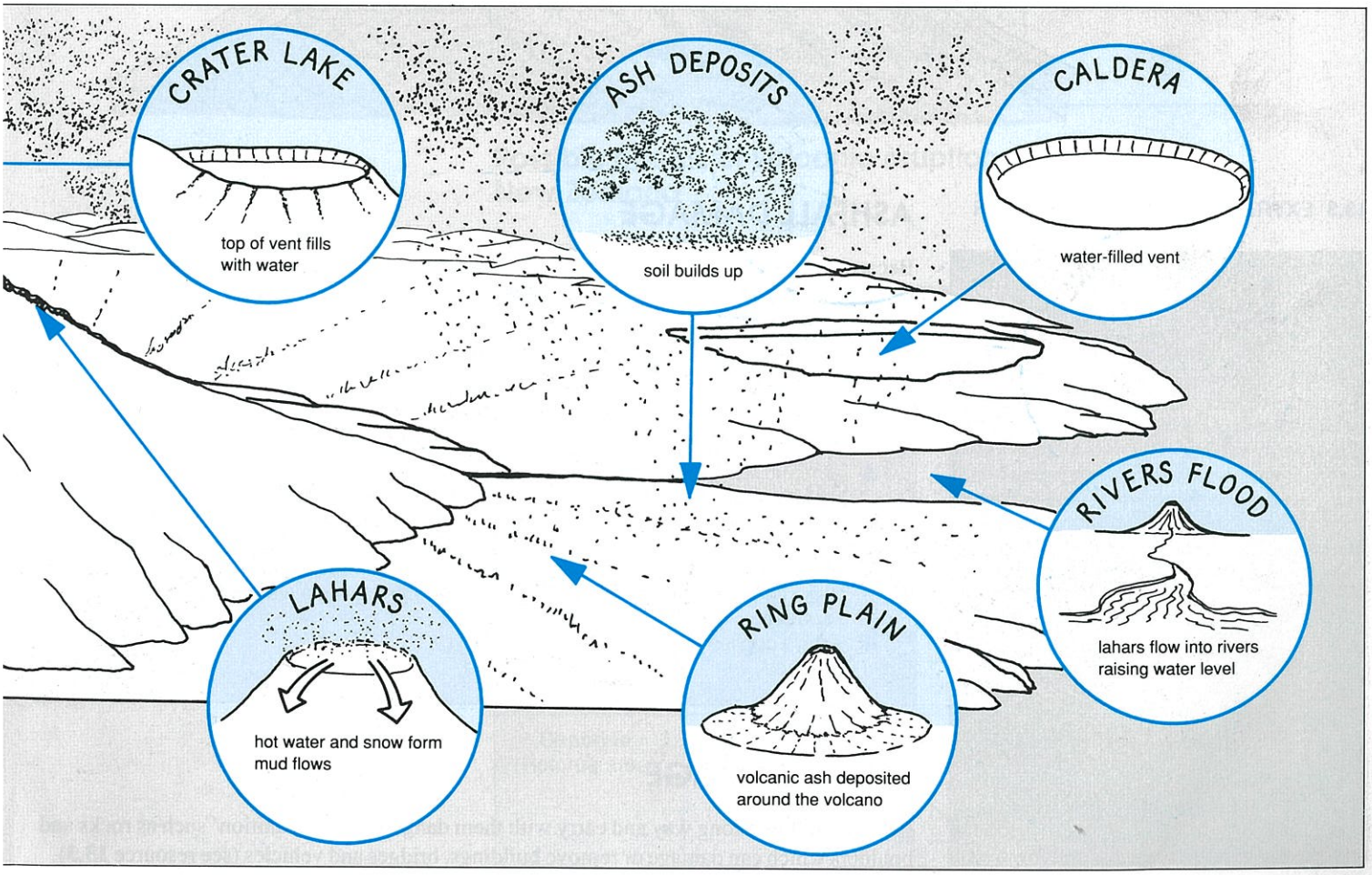


AUCKLAND

Metropolitan Auckland is built on an isthmus made up of volcanic material. The area is covered in volcanic cones, craters and lava flows (see resource **12.5**). There are 48 reasonably small (except for Rangitoto) volcanoes scattered over the area, surrounded by 75 square kms of lava flows.

12.5 AUCKLAND VOLCANIC FIELD





13 Volcanic Eruptions in New Zealand

EFFECTS ON PEOPLE

How do volcanic eruptions affect economic and social activities?

VOLCANIC DAMAGE

The types of material ejected by volcanic eruptions as shown on pages 28 and 29 po different kinds of threats (see resource **13.1**).

13.1 VOLCANIC THREATS (GLOBAL)

POSSIBLE THREATS BY VOLCANIC MATERIALS

PYROCLASTIC FLOWS

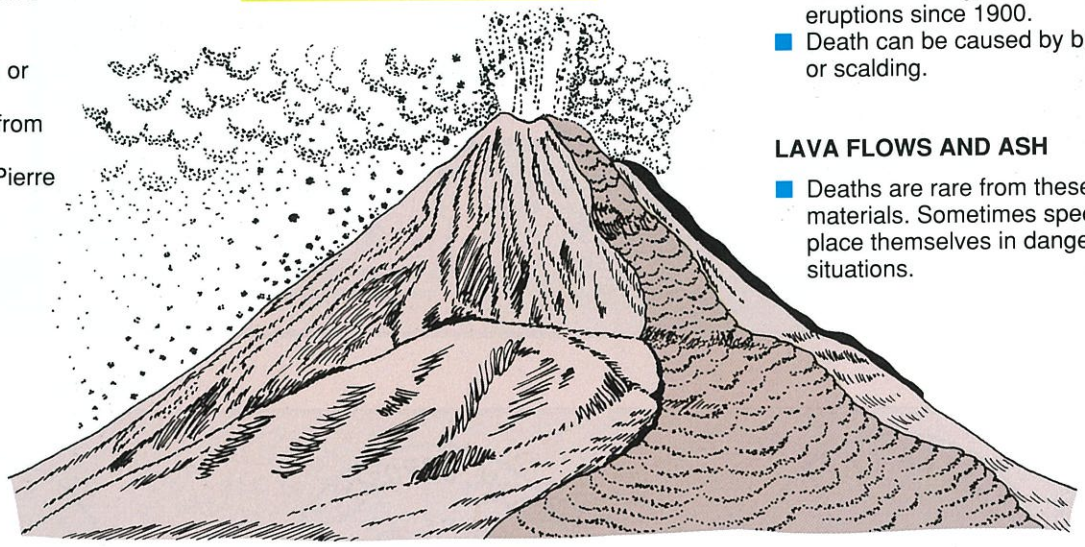
- These have caused 70% of deaths resulting from volcanic eruptions since 1900.
- Death can be caused by suffocation, burial, burning or collapsing buildings.
- In 1902 a pyroclastic flow from Mt. Pelee in Martinique, destroyed the town of St. Pierre and killed 30 000 people.

LAHARS

- These have caused 12% of deaths resulting from volcanic eruptions since 1900.
- Death can be caused by buria or scalding.

LAVA FLOWS AND ASH

- Deaths are rare from these materials. Sometimes spectat place themselves in dangerou situations.



ASHFALL DAMAGE

Because ash is carried long distances by wind, it can cause damage over a wide area (s resource **13.2**).

13.2 ASHFALL DAMAGE: TARAWERA, 1886

ECONOMIC EFFECTS

- farmland was covered in ash, killing pasture, crops and stock.
- roads, bridges and communications were destroyed.
- loss of the world-famous tourist attraction, the Pink and White Terraces.
- water supplies were contaminated or cut off.

SOCIAL EFFECTS

- 153 people killed by flying rocks and deposits of ash which caused buildings to collapse.
- three villages were buried in mud and ash.
- many people were isolated.

13.3 EXTRACT: TANGIWAI DISASTER

A lahar was responsible for New Zealand's worst railway disaster on Christmas Eve 1953. The lahar swept down Mt Ruapehu and completely destroyed the railway bridge at Tangiwai. The Wellington-Auckland express reached the bridge minutes later and plunged into the river. One hundred and fifty one people were killed. There have been many lahars at Mt Ruapehu and lahars are a major hazard to skiiers on the mountain today.

LAHAR DAMAGE

Lahars can flow a long way and carry with them dangerous 'ammunition' such as rocks a boulders which can damage or remove buildings, bridges and vehicles (see resource **13.3**

POSITIVE AND NEGATIVE EFFECTS

Most volcanic hazards have just negative effects but there can be some benefits (see resource **13.4**).

13.4 ECONOMIC AND SOCIAL EFFECTS

	POSITIVE	NEGATIVE
ECONOMIC	■ soil becomes suitable for forestry (eg Volcanic Plateau) ■ **geothermal** steam is used to generate electricity (eg Wairakei) ■ new tourist attractions are created (eg Mt. Tarawera) ■ a chance to rebuild the economy and **infrastructure** ■ the creation of employment ■ ash makes soil more fertile for farming ■ volcanic rock is formed which can be quarried and used in road construction ■ volcanic cones in high altitude areas with snowfalls can be used as skifields.	
SOCIAL	■ the community works together (eg Maori tribes in the Bay of Plenty and Coromandel offered tribes affected by the Tarawera eruption, some of their land) ■ national aid networks begin operating (eg Tarawera was the first time that New Zealand had a national common cause) ■ families work together and appreciate each other	

ACTIVITIES

1 Construct a pie graph using the statistics in resource **13.1**. (Note: 18% of deaths are caused by other volcanic threats.)

2 Construct a flow diagram from resource **13.3**.

3 Complete the NEGATIVE column in resource **13.4** from your reading of Unit 13.

4 From the information in Unit 13 and resources **11.3** and **11.4**, construct a diagram similar to resource **6.2** for the Tarawera eruption.

Possible effects of volcanic eruptions in areas of New Zealand

13.5 HAZARDOUS REGIONS

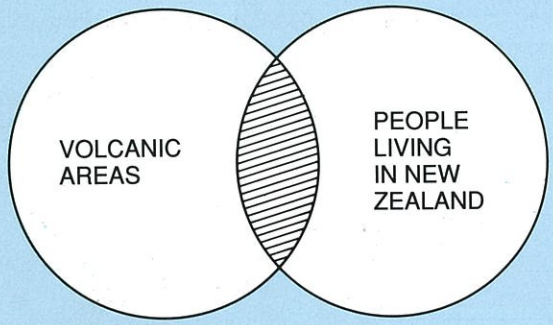
AREA	TYPE OF VOLCANIC HAZARD	LIKELY EFFECT OF HAZARD
Metropolitan Auckland	Violent eruption	■ Up to 100 000 lives could be at risk. ■ Property damage of at least $3600 million.
	Small eruption (eg. from a scoria cone)	■ Up to 4000 lives at risk. ■ An area up to 2 km from the vent destroyed by hot scoria lava or ash.
White Island	Tsunami	■ Would affect a 100 km stretch of low lying coastal land. ■ About 6000 lives could be at risk. ■ Property damage of at least $25 million. ■ Damage to port facilities.
Okataina (Rotorua area)	Intermediate-sized eruption	■ Complete devastation within 10 km of the vent. ■ Large areas of exotic forest and farmland covered in 30 cm of ash and pumice. ■ Much loss of life.

AREA	TYPE OF VOLCANIC HAZARD	LIKELY EFFECT OF HAZARD
Okataina (Rotorua area) (continued)	Violent **ignimbrite** eruption	■ Catastrophic effect on the Rotorua-Bay o Plenty region. ■ Enormous loss of life. ■ Property damage to Rotorua City, tourist facilities, power stations, exotic forests a Kawerau Pulp and Paper Mill.
Taupo Area	Violent eruption ejecting enormous quantities of material	■ Substantial areas of the North Island cou be sprayed with volcanic material. ■ Enormous loss of life. ■ Destruction of exotic forests, farmland, residential and industrial areas and hydroelectric power stations on the Waik river.
Tongariro National Park Area	Eruptions from Tongariro, Ruapehu or Ngauruhoe	■ Apart from the winter ski season, low population at risk. ■ Likely to only affect a small area around volcano. ■ Damage to communication and energy networks.
	Lahar from Ruapehu (a major hazard)	■ Up to 1500 lives are at risk during the sk season. There is a 20% chance of a laha on a weekend skiing day this century. ■ Could cause damage to Tongariro powe scheme.
Taranaki Area	Tephra eruption	■ Contaminated water supplies. ■ Damage to pasture and crops. ■ Damage due to ashfall.
	Lahar	■ Could affect areas up to 35 km from the summit. ■ Flooding. ■ Loss of life.

ACTIVI

1a Using the model below and the information in resource **13.5**, rank each of the regions in resource **13.5** from **most hazardous** to **least hazardous**.

b In a paragraph explain your ranking.



People living in volcanic areas

2 Why is a lahar from Mt. Ruapehu a major volcanic hazard? (Resource **13.5**.)

3 What could the long term effect be of a violent ignimbrite eruption in the Okataina area? (Resource **13.5**.)

4a Identify the volcanic hazards in your area.

b Rank these hazards from those likely to have a **major impact** to those likely to have a **minimal impact**.

5a Rank the following volcanic hazards from those **most likely to cause loss of life** to those **least likely to cause loss of life.**

Lahar, Lava flow, Ashfall, Volcanic blocks, Pyroclastic flow

b In a paragraph explain your ranking.

6 Construct a 'Volcanic Hazard Poster' for New Zealand. Your poster should contain information on the main hazards, their likely effect, and the volcanic hazard areas.

14 Volcanic Eruptions in New Zealand

INFLUENCE OF PEOPLE

How can people increase or decrease the likelihood or effects of volcanic eruption hazards?

THE LIKELIHOOD

Resources **10.4-10.7** show clearly why people cannot influence volcanic eruptions. The processes that cause them operate beneath the earth's surface and are therefore completely beyond human control.

The definition of a natural hazard on page 4 makes it clear that a natural hazard is more than a natural event. People must be in danger for it to be a hazard. The likelihood of a natural event being a natural hazard (in this case volcanic eruptions) can therefore be increased by cultural processes (see resource **14.1**).

14.1 INCREASING THE LIKELIHOOD OF A HAZARD

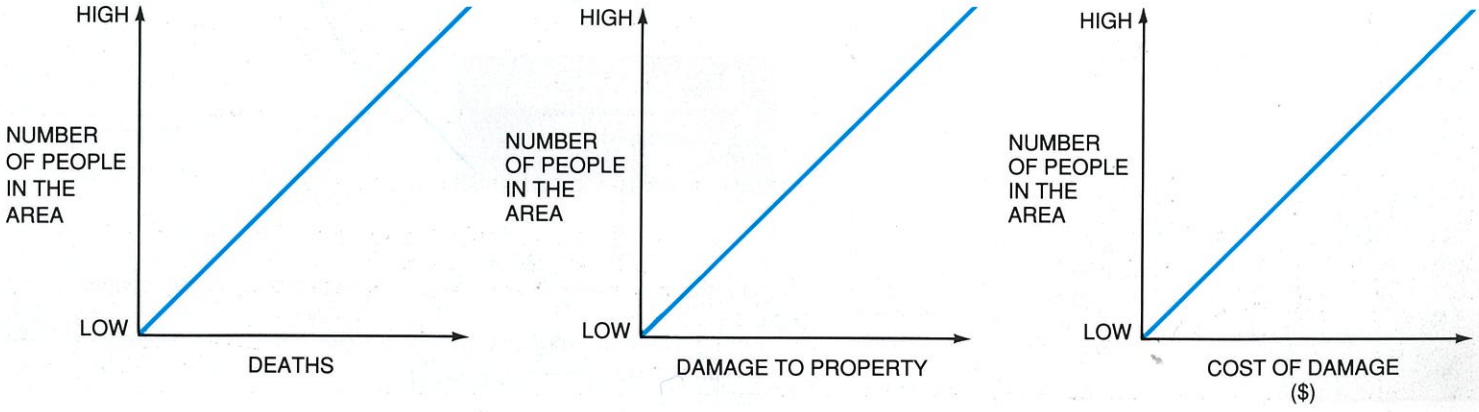
MAIN VOLCANIC 'AT RISK' LOCATIONS	LIKELIHOOD OF THE EVENT BEING HAZARDOUS IS INCREASED BY:
Mountains eg. Ruapehu	People being at the mountains in winter for skiing and summer for tramping.
Lakes eg. Taupo	People at the lakes for fishing, water sports and scenic views.
Geothermal activities eg. Rotorua	People attracted by hot springs, geysers, and boiling mud pools.
Urban areas eg. Rotorua	Many people live in a concentrated area in close **proximity** to volcanic activity.
Roads eg. Highway 1	Highway 1, the major road link between the northern half of the North Island and the rest of New Zealand, runs through the most volcanically active area in New Zealand.

People make the natural process of volcanic eruptions *more likely* to be hazardous simply by being there. The likelihood of volcanic eruptions being hazardous is decreased if people are not in the hazardous area and if good warning systems are in place.

INCREASING THE EFFECTS

In the same way that the likelihood of a natural event being hazardous is increased by the presence of people, so too are the effects of an eruption likely to be increased the more people there are in the vicinity (see resource **14.2**).

14.2 THE RELATIONSHIP BETWEEN THE NUMBER OF PEOPLE AND THE EFFECTS OF A VOLCANIC ERUPTION



1 Read resource **14.3**. Where would you place the effects of the White Island eruption on each graph in resource **14.2**?

2 After reading resource **14.3**, complete the following table:

Increasing the effects of volcanic eruptions	Decreasing the effects of volcanic eruptions
allowing reporters into the area	

3 How could the 11 deaths described in resource **14.3** have been avoided?

14.3 NEWSPAPER CLIPPING

White Island

Two scientists and two Ministry of Civil Defence staff were on the island during the eruption on February 20, 1992.

DSIR vulcanologist in Rotorua, Bruce Houghton, explained what happened: "We were checking on the amount of new ash when there was a small eruption from an active crater about 250 metres away."

There had been no visible signs the crater would blow, only an uprush of sound.

The party was clear of the falling lava "bombs" but ran to shelter in a crater side wall where they watched the ash clouds being blown overhead. It was not a large eruption nor unusual for White Island which is an active volcano.

However, it was a treat for the scientists to be present during an eruption. And for the Civil Defence people who visited the island shortly afterwards it was a chance to see the immediate effects of an eruption.

In 1914, however, 11 sulphur miners who were living on the island were killed in an eruption.

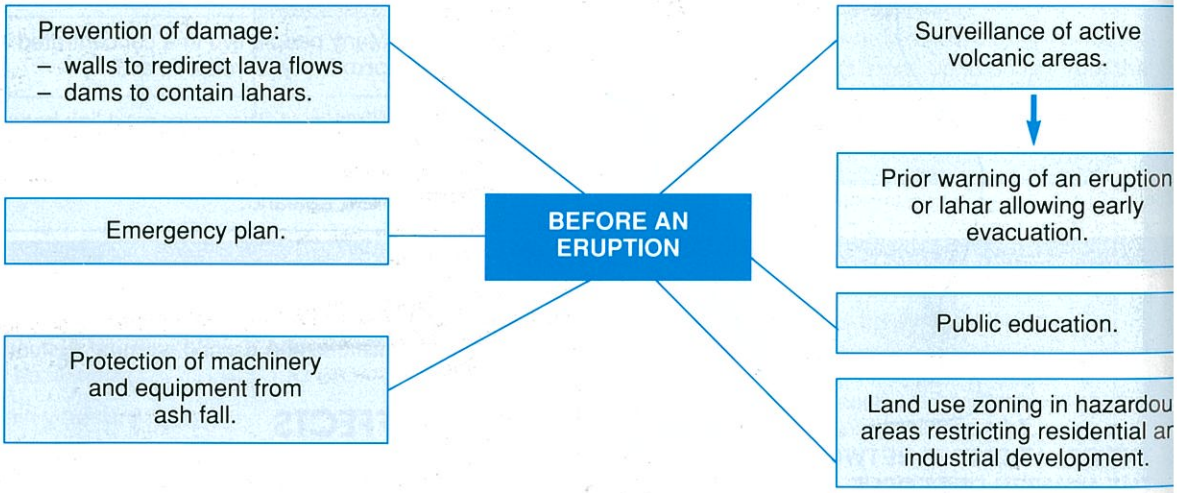
Sulphur mining for fertiliser was attempted again in the 1930s. This time the miners lived on the other side of the island — well aware of the untimely end of their forebears — and made the daily trek to the other side to gather the raw sulphur. It was a hostile environment and the business eventually failed a few years after it began.

White Island was undisturbed by man for several decades. Scientific monitoring began in the 1960s and the DSIR installed a seismograph in 1976, three days before intense volcanic activity began on the island again.

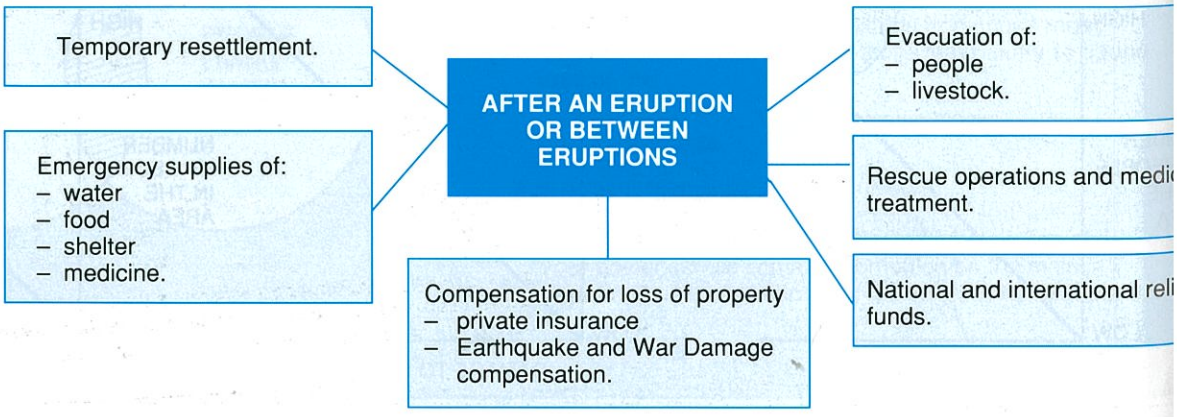
DECREASING THE EFFECTS

People can do a lot to decrease the effects of volcanic eruptions (see resources **14.4** & **14.5**).

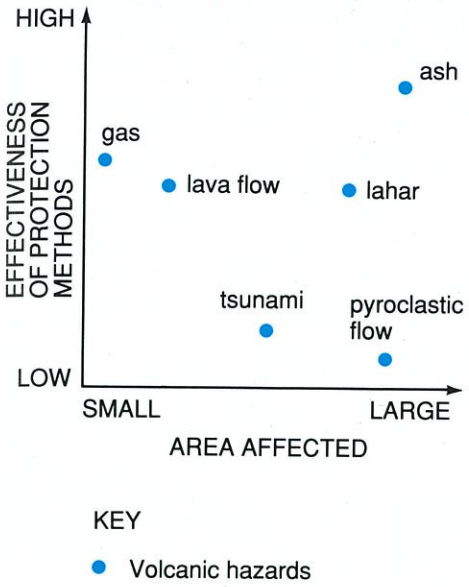
14.4 DECREASING THE EFFECTS BEFORE AN ERUPTION



14.5 DECREASING THE EFFECTS AFTER AN ERUPTION



14.6 PREPARATION EFFECTIVENESS



- **Emergency plans** – organisations such as Civil Defence can help decrease the effects by having plans and practices for such an event (see resource **14.6**).

- **Warning** – warning systems give people the opportunity to evacuate. Instruments can monitor changes in volcanic activity that suggest an eruption may occur. Instruments may measure changes in cone shape, changes in water temperature, earthquakes and changes in gas temperatures.
  - Mt. Ruapehu has a lahar warning system based on instruments at the top of the mountain. If the instruments were triggered, people on the mountain would have 5–10 minutes warning to get out of the valleys and on to the ridges. There is also a flood gauge on the Whangaehu River, upstream from the Tangiwai rail bridge. If a lahar were to flow from Ruapehu into the river a resulting rise in water level would trigger the gauge to warn approaching trains.

- **Compensation** – the effects of volcanic eruptions on property are decreased *after* the event by compensation paid out to people with Earthquake and War Damage Commission insurance on their properties.
  - since 1944 only one major claim has been paid out. This was in 1969 when $40,000 was paid for damage caused by a lahar to a building on Mt. Ruapehu.
  - this fund has a limited ability to decrease the effects of a volcanic eruption. It is not able to pay out on a standing forest, bridge or viaduct, tunnel or cutting, retaining wall or dam, drain or channel, reservoir or swimming pool, water tank or septic tank and livestock or growing crop. These require a special insurance cover.

ACTIVITIES

1 Look at resources **14.4–14.6**. Which types of volcanic hazard can people most effectively decrease?

2 Are National Parks a sensible landuse for an area with volcanic hazards? Why?

3 What groups of people cannot claim compensation for volcanic eruption damage through the Earthquake and War Damage Commission?

4 The Civil Defence resource '*Be Ready to Survive*' lists six ways you can be prepared. Find out:
- **a** What your local Civil Defence warning signal is.
- **b** How to turn off your electricity, water and gas.
- **c** What your family would do if you got separated.
- **d** Where you would get help.