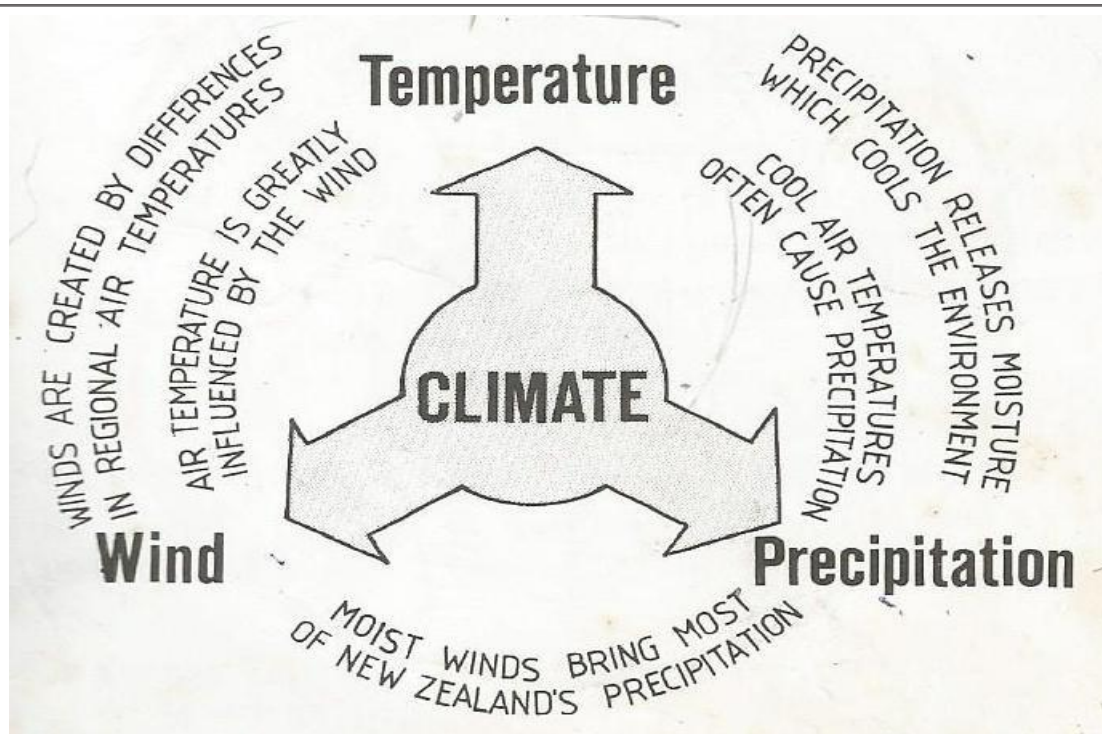


CHAPTER 1

CLIMATE – NEW ZEALAND

Climate refers to average weather condition of a place or region taken over a several decade. Weather on the other hand refers to daily atmospheric condition of a place. Although weather may change markedly from one hour to another, a relatively stable general pattern can usually be observed each season of the year. The longer our weather conditions are measured and recorded, the more accurately climate can be determined.

The Elements of Climate



Source: New Zealand; a new geography

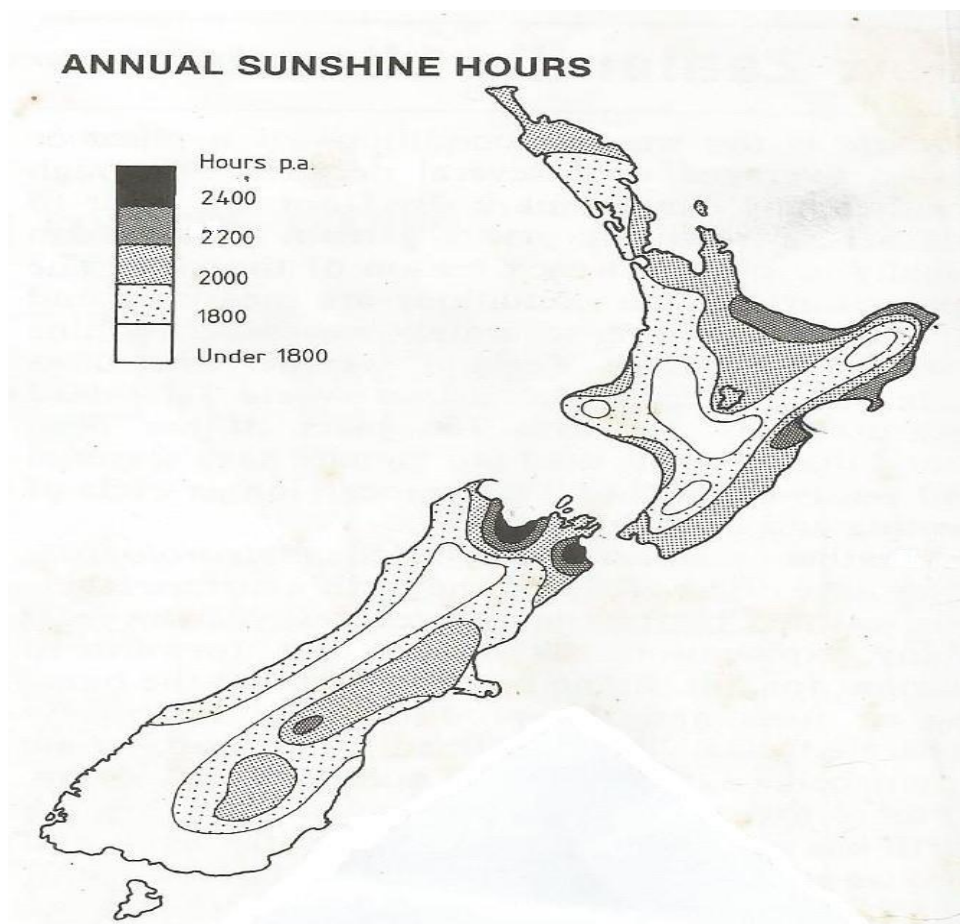
The long-term state of the atmosphere is a function of a variety of interacting elements.

Solar radiation

This is probably the most important element of climate. Solar radiation heats the earth's surface which in turn determines the temperature of the air above. The amount of solar radiation received by any place in New Zealand is determined by

- ⌘ The time of the day –in the 24 hour diurnal cycle
- ⌘ The time of the year – in the 12 month seasonal cycle
- ⌘ The atmospheric conditions – cloud or pollution cover
- ⌘ The height above sea level.

New Zealand stretches from 34 degrees South to 47 degrees South on the globe and is spread over a distance of some 1600 kilometers. It sits in the centre of the Southern Temperate zone. The northern parts of New Zealand are closer to the tropical zone and so they receive more concentrated solar radiation which produces a sub-tropical climate. The southern regions, on the other hand, are closer to the South Pole so they receive less solar radiation, and the temperatures are usually cooler.





Activity 1.0

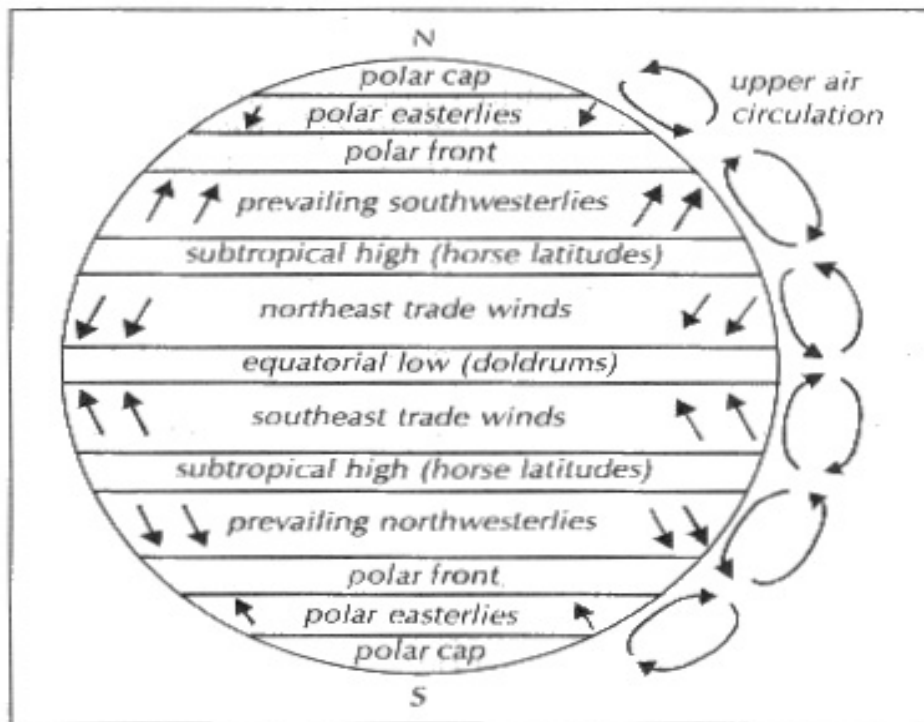
1. Why are summer temperatures warmer than winter?
2. Draw a diagram to show how summer and winter sun is received over New Zealand.
3. Approximately how many sunshine hours does Auckland receive each year?
4. Approximately how many sunshine hours does South Island High Country receive each year?
5. Why does Auckland receive more sunshine hours than the South of South Island?

Wind- is the moving air. It is expressed in kilometers per hour and measured with an anemometer.

Pressure System

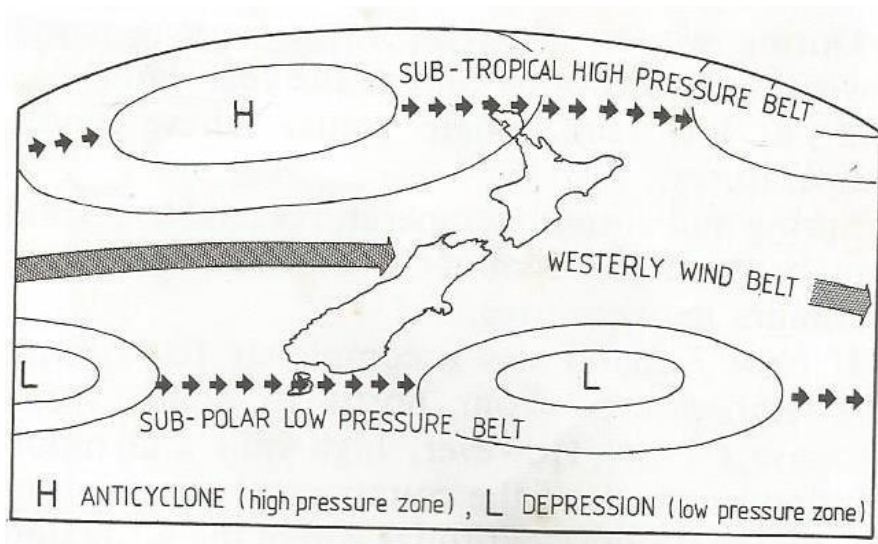
Air is made up of gases and when gases are heated up, they rise. Gases in the air have mass and weight. When air rises the particles that make up the air spreads out, and the weight, or pressure, of the air is lowered. Rising air brings low air pressure.

As cold air descends the air pressure increases. This is because the gravity draws the air particles downwards and the weight, or pressure of the air increases. Descending air pressure brings high air pressure.



Source: <https://www.google.com/search?q=Global+pressure+belts+images&client=firefox>

In the Southern Hemisphere the Sub-tropical High Pressure Belt encircles the earth to the north of New Zealand. This pressure belt produces high pressure cells, called anticyclones that drift eastward and cross New Zealand every six to ten days.

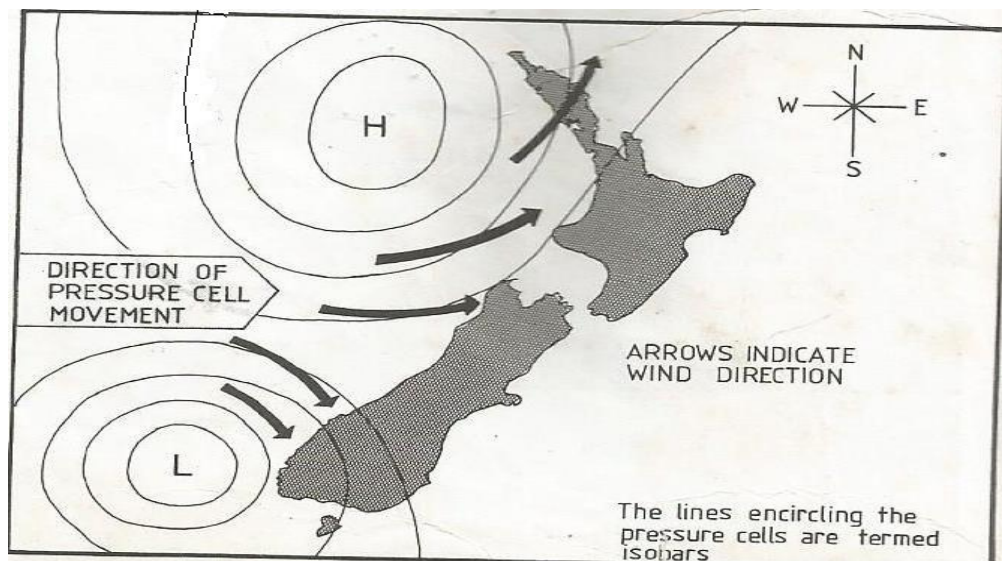


Source: *New Zealand; a new geography.*

A belt of low pressure circles the earth below New Zealand. The pressure belt produces low pressure cells, called depression, that drift eastward crossing New Zealand every 6 to 10 days in between anticyclones. A depression brings thick cloud cover and wet weather.

The regular passage of anticyclones and depressions over the country produces a very changeable climate that is described as New Zealand's 'six to ten day weather cycle'.

In summer the belt of anticyclones drift southwards, bringing finer weather to most parts of New Zealand. In winter the belt of depressions 'drift' northward bringing cloudier and wetter conditions to most part.



Source: *New Zealand Geography; a new geography.*



Activity 1.1

Mapping

On the outline map of New Zealand, locate and name the following:

- i. the high pressure cell during summer
- ii. the prevailing wind
- iii. an area on the South Island that experiences 'fohn winds'
- iv. the 'Roaring Forties'

CLIMATIC FACTORS/ CONTROLS AFFECTING CLIMATE

There are many different factors that affect climate around the world. New Zealand is also affected by the climatic controls. The most important natural factors are:

1. Distance from the sea.

The sea affects the climate of a place. Coastal areas are cooler and wetter than inland areas. The long narrow shape of New Zealand ensures that most places are close to sea. The sea influences New Zealand's climate in three main ways:

- The vast expanse of ocean and the warm currents to the west of New Zealand, ensure that the westerly winds that blow over the country are laden with moisture. The larger the expanse of warm water a wind moves across, the more moisture it evaporates and carries.
- Low land within fifty km of the coast kept a low moderate temperature throughout the year. This is because the ocean temperature remains more or less the same all year around. Breeze that blow onto the land warm the air over the land in the winter, and cools it in the summer.
- Winds that cross currents of warm sea water on their way to New Zealand are warmed and wind that cross cold currents are chilled.

2. Ocean Currents

Ocean moves in currents propelled by prevailing winds. The belt of westerly winds, around latitude 40 degrees south, drives the ocean currents in the westerly directions towards New Zealand. The main ocean current reaching New Zealand is West Wind Drift. It is a mixture of warm water that has flowed down the eastern seaboard of Australia (Warm Tasman Current), and cooler waters from the sub polar regions.

3. Direction of Prevailing Winds

Winds that blow from the sea often bring rain to the coast and dry weather to inland areas. The prevailing westerly's are an important feature of New Zealand's climate.

4. Relief

Climate can be affected by relief. The western slopes of New Zealand's mountains are the main areas where rain occurs. These areas have the highest rainfall recordings because the westerly winds that cross the Tasman Sea absorb water vapor and reach the coast laden with moisture. On reaching the mountains the warm, moist air is forced to rise, it cools and the water vapor condenses and falls as rain.

5. Latitude

Places on or near the equator are warmer than places far away from it. At the north and south poles, the sun's rays are scattered over a wide area which shades the heat.

6. Altitude

As altitude increases, the temperature decreases. For every 1000m increase in height there is a decrease of about 6 degrees Celsius of the temperature.

Activity 1.3

Essay

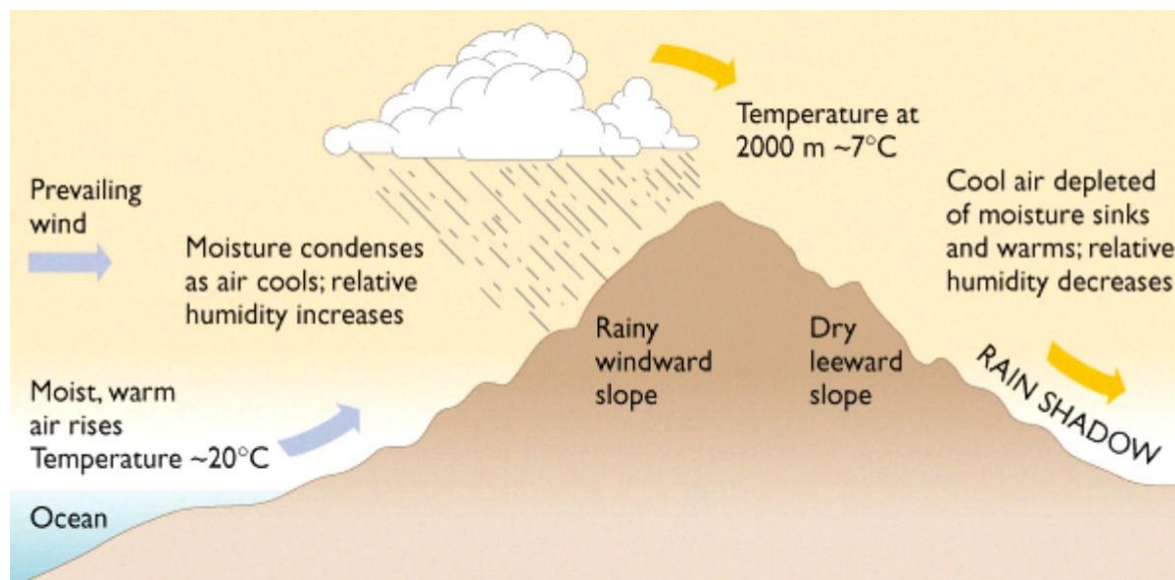
With reference to **climatic region** in New Zealand, discuss how the **climatic elements** interact with the **climatic controls** resulting in distinctive climatic features.

TYPES OF RAINFALL

There are three main types of rainfall:

Orographic rainfall

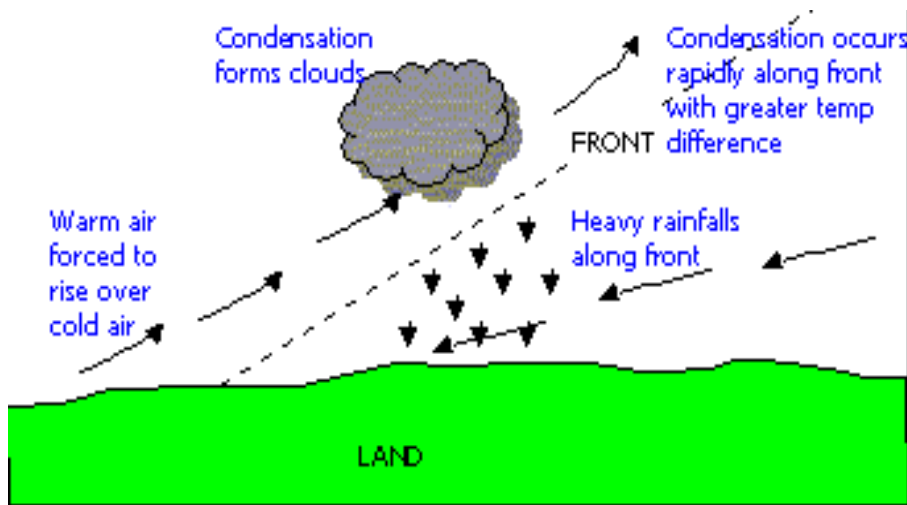
Commonly occurs on the windward slopes of mountain ranges. Warm, moist air meets the mountain barrier and tries to find a path around it. If there is none, the air is forced to rise up over the slope. In rising, the air will cool and release some of its moisture as rain.



Source :<https://www.google.com/search?q=types+of+rainfall&client>

Cyclonic (or frontal) rainfall

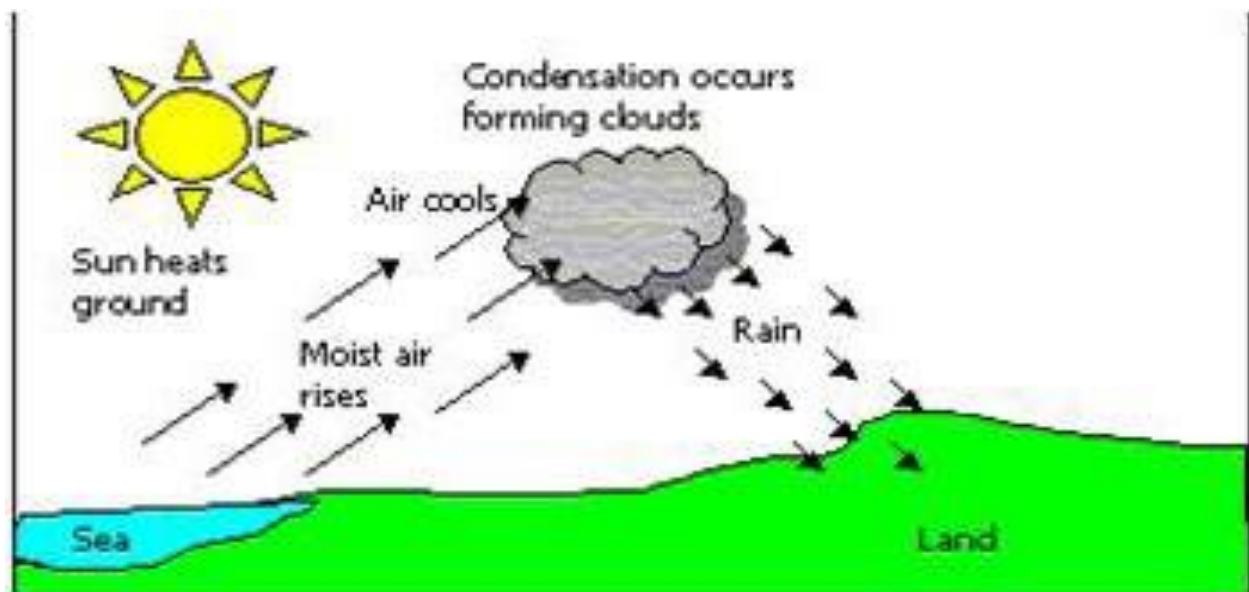
Occurs when warm, moist air comes into contact with cool air during the passage of a depression. The warm air rises up over the cooled air and as it does so it is cooled, clouds form and rain falls.



Source: <https://www.google.com/search?q=types+of+rainfall&client>

Convective rainfall

Often occurs in some parts of the country, at the end of a hot, still day. During the day, hot sunshine from a clear sky forces the warm surface air to expand, rise and carry moisture up into the sky. As the ground surface continues to warm, incoming air is also warmed and forced to rise. Eventually, the buildup of rising warm air forces the air that has already risen to reach a much colder temperature zone causing condensation, cloud formation and precipitation.



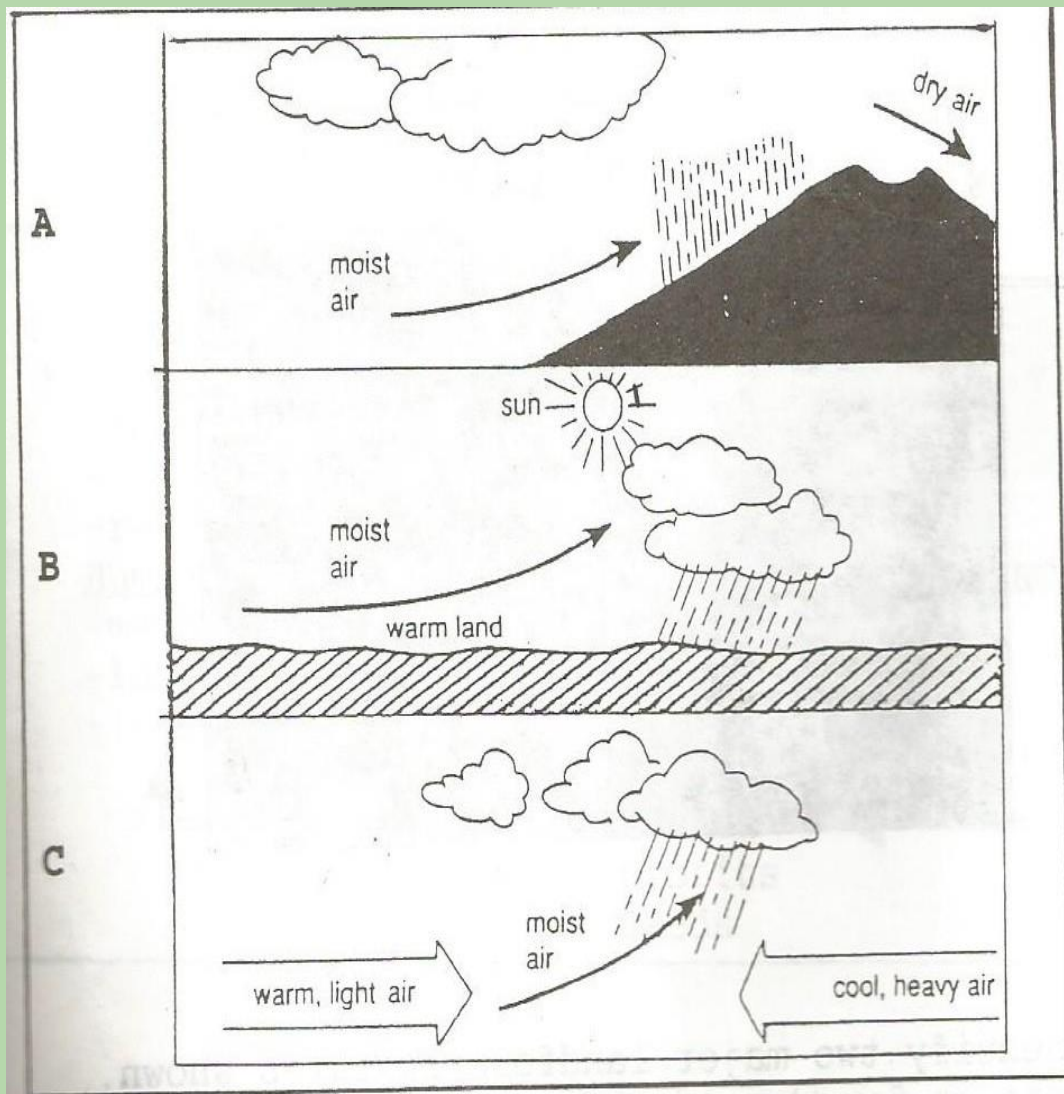
Source : <https://www.google.com/search?q=types+of+rainfall&client>



Activity 1.4

Resource Interpretation

Use the resource given below and you knowledge to answer the questions that follow.



Source: New Zealand; a new geography

- Name any two of the types of rainfall shown.
- State briefly how any one of these types of rainfall occurs.
- During which part of the day would rainfall type B frequently fall?
- After the rainfall in A, why would the wind be dry?

Global warming \ Greenhouse Effect

This refers to the warming up of the earth's atmosphere caused by emission of carbon dioxide and other poisonous gases into the atmosphere. These gases act like a blanket, preventing the natural escape of heat to the atmosphere and also damage the ozone layer making it ineffective to carry out its task of filtering the sun's rays. The situation has been developing in the world for over 150 years because of:

- i) Burning of fossil fuels which releases vast amount of carbon dioxide to the atmosphere.
- ii) Deforestation, which results in fewer trees being available to take in the carbon dioxide.

Effects of Global Warming

- i. Rise in temperature would cause the development of new areas of desert making food production difficult.
- ii. Huge ice sheets in the poles and in the higher mountainous region would half melt resulting in the side effects
 - flooding in low lying coastal areas
 - loss of life of men and other organisms that live in these areas
 - loss of productive coastal farmland, food supplies, housing and industry.

What is El Niño?

El Niño is a naturally occurring event in the equatorial region which causes temporary changes in the world climate. Originally, El Niño was the name used for warmer than normal sea surface temperatures in the Pacific Ocean off the coast of South America. Now, El Niño has come to refer to a whole complex of Pacific Ocean sea-surface temperature changes and global weather events. The ocean warming off South America is just one of these events.

What causes an El Niño?

In normal, non-El Niño conditions, trade winds blow in a westerly direction along the equator. These winds pile up warm surface water in the western Pacific, so the sea surface is as much as 18 inches higher in the western Pacific than in the eastern Pacific. These trade winds are one of the main sources of fuel for the Humboldt Current. The Humboldt Current is a cold ocean current which flows north along the coasts of Chile and Peru, then turns west and warms as it moves out into the Central Pacific. So, the normal situation is warmer water in the western Pacific, cooler in the eastern.

In an El Niño, the equatorial westerly winds diminish. As a result, the Humboldt Current weakens and this allows the waters along the coast of Chile and Peru to warm and creates warmer than usual conditions along the coast of South America.

What is ENSO?

ENSO is the “El Niño-Southern Oscillation,” the name scientists use for what is often called El Niño. The Southern Oscillation is a see-saw shift in surface air pressure between the eastern and western halves of the Pacific. When pressure rises in the east, it falls in the west and vice versa. In the 1950’s scientists realized that El Niño and the Southern Oscillation were parts of the same event.

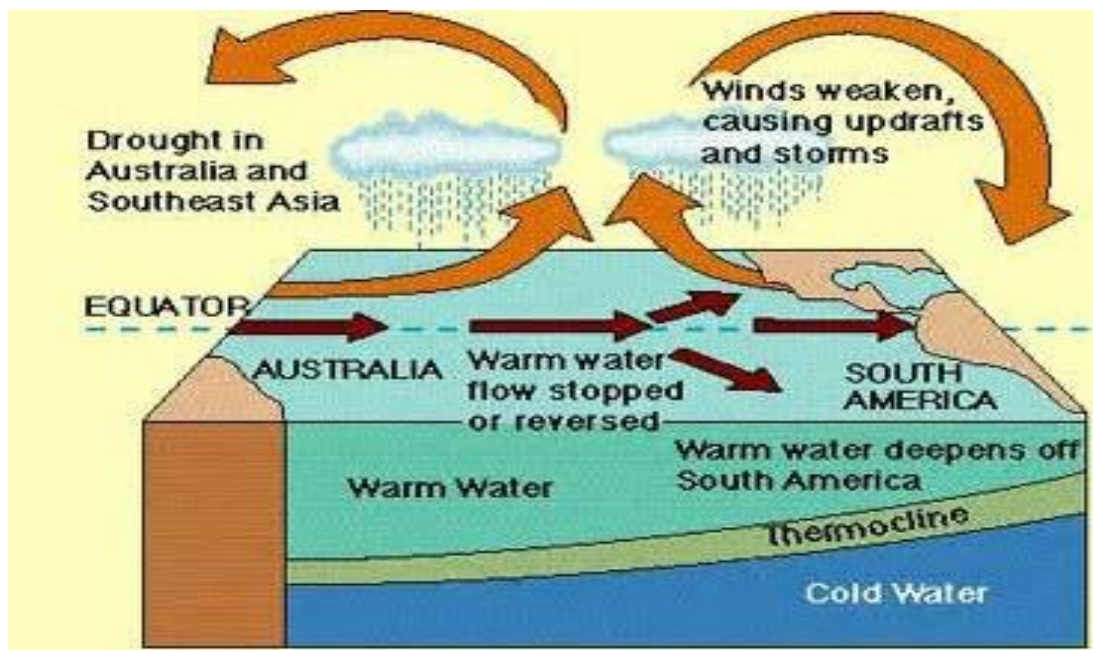
Source: http://www.dfg.ca.gov/marine/el_nino.asp

In New Zealand likely climate change impacts include:

- higher temperatures, more in the North Island than the South, (but still likely to be less than the global average)
- rising sea levels
- more frequent extreme weather events such as droughts (especially in the east of New Zealand) and floods
- a change in rainfall patterns - higher rainfall in the west and less in the east.

These changes will result in both positive and negative effects. For example:

- agricultural productivity is expected to increase in some areas but there is the risk of drought and spreading pests and diseases. It is likely that there would be costs associated with changing land-use activities to suit a new climate
- people are likely to enjoy the benefits of warmer winters with fewer frosts, but hotter summers will bring increased risks of heat stress and subtropical diseases
- forests and vegetation may grow faster, but native ecosystems could be invaded by exotic species
- drier conditions in some areas are likely to be coupled with the risk of more frequent extreme events such as floods, droughts and storms
- rising sea levels will increase the risk of erosion and saltwater intrusion, increasing the need for coastal protection
- snowlines and glaciers are expected to retreat and change water flows in major South Island Rivers.



Source: www.ocean.tamu.edu

IMPACTS OF EL NINO IN NEW ZEALAND



Source: www.agweb.com.

CLIMATE OF NEW ZEALAND

FEATURES OF NEW ZEALAND's CLIMATIC REGIONS

<u>Regions</u>	<u>Type of climate</u>
i) Winterless North Region	- warm in all seasons as it is nearer to the equator compared to the rest of NZ - maritime and latitude influence - few forests - ample or enough rainfall
ii) Central North island	- relief and interior location influences - cool temperature - in any frosts - ample rain and snow
iii) Wet West (North/ South Islands)	- affected by changing westerly winds - plenty of sunshine and rain - South Island has heavier rainfall controlled by westerly winds, warm Tasman and mountains
iv) Dry East (North and South Island)	- rain shadow areas - plenty of sunshine - South Island has cooler temperature and experiences fohn winds
v) South Island mountains	- relief is a major influence - Very cold in all seasons - heavy rainfall and snow - snow and ice covered peaks
vi) Inland South Island	- relief and interior location influence - great daily and annual temperature ranges - moderate rainfall - presence of frosts and fogs
vii) Southern New Zealand	- maritime and latitude influence - low temperature and sunshine - moderate rainfall

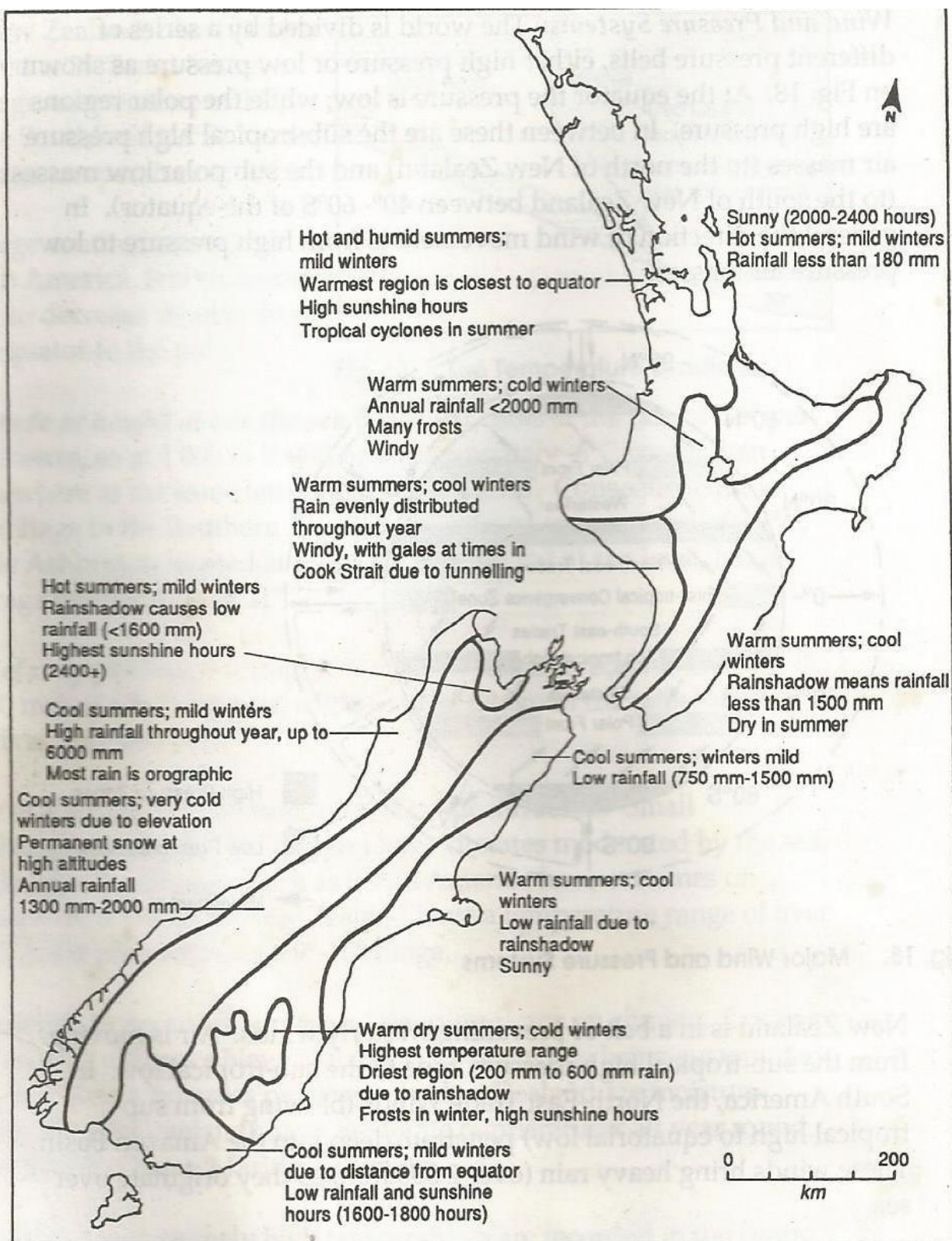


Fig. 19. New Zealand Climate Regions

Source: Form 6 Geography Revision

Economic Significance of Climate to New Zealand.

- Farming is the backbone of New Zealand. Approximately 50% of the country is suitable for farming. The interaction of relief, climate, vegetation and soils produce many different areas that can be used for farming. We will specifically look at how climate affects economic activities, specifically farming in New Zealand.

Farming types	Location	Climatic characteristic	Landscape	Output
Dairying	Northland Southland Manawatu Lowland	Hill/relief. Rainfall	Flat ,gentle slope or fertile soil	Milk & milk products
Mixed farming	Canterbury plains	Hot, dry summer, cool winter in South Island	Fertile soil	Crops such as wheat, peas, potatoes, barley, fat lambs, etc..
Horticulture (fruits, vegetables, flowers)	Nelson Bay of Plenty Hawkes Bay Northland Otago	Long warm summers Cool winter in the South Island	Flat land Fertile soil	Flowers, blue strawberry, vegetables such as kiwi fruit, lettuce, avocado, peas, etc.
Extensive sheep farming	East coast Hawkes Bay Wairarapa Hill Country South Is. Hill Country	Harsh climatic Extreme/ cool winters and dry summers	Rugged terrain in the South Island and lowlands in the North	Wool, mutton, lamb flaps, beef, etc.



Activity 1.5

Mapping

Draw an outline map of New Zealand, locate and name the following:

- (i) The windiest area in New Zealand waters.
- (ii) A large rain shadow region
- (iii) The position of warm ocean current
- (iv) The coldest lowland region in New Zealand
- (v) The cool ocean current
- (vi) An area with very high rainfall
- (vii) An area that receives more than 2400 hours of sunshine per year
- (x) The prevailing winds

Terms

Air pressure – the force exerted on to a surface by the weight of the air.

Climate –average conditions of the atmosphere over a long period of time.

Climatic elements - Any one of the properties or conditions of the atmosphere and ocean that together define the climate of a place (e.g., temperature, humidity, precipitation).

Convectional rain – rain which caused by the process of convection in the atmosphere. When the surface layers of the atmosphere are heated, the moisture laden air rises in a convection current, and in rising is cooled till the dew point is reached, and it's water vapour condenses to form clouds.

Cyclonic /frontal Rain – rain associated with a passage of cyclone or depression, and caused by warm, moist air moving upwards over colder, heavier air.

El nino – refers to abnormal conditions which might happen to prevailing winds and currents and results in their change or even reverse their directions.

Global warming - An increase in the average temperature of the earth's atmosphere, especially a sustained increase sufficient to cause climatic change.

Insolation – radiant energy received from the sun by the earth.

Orographic rain – rain which is caused by mountains standing in the path of moisture laden air; thus air is forced to rise, is hereby cooled, and if sufficient water vapor is present, rain is deposited on the higher ground.

Rainfall – the total amount of rain deposited on a given area during a given time, as measured by a rain gauge.

Solar radiation – is the heat energy that comes from the sun.

Temperature – how hot or cold an environment is.

Weather – is the day to day pattern of precipitation, temperature, winds and sunshine.

CHAPTER 2

CLIMATE: FIJI

Fiji enjoys a humid tropical maritime climate without great extremes of heat or cold. It is mainly dominated by the Southeast trade winds. Together with the topography, this controls the distribution of rainfall on the islands. Average annual precipitation ranges from 1500mm on the smaller islands to 4000mm on the larger islands. On the larger islands, topographic effects however cause a dry western climate suited for sugarcane and a similar distinctive wet and humid eastern climate where Suva (Viti Levu) is located.

The Elements of climate

1. Temperature

Temperatures at the lower level are fairly uniform. In the leeward side of the mountain, however on the western and northern sides of the main islands(including Taveuni) the day-time air temperatures often rise from 1degrees Celsius to 2 degrees Celsius above those on the windward sides or on the smaller islands. Also the humidity on the leeward side tends to be somewhat lower.

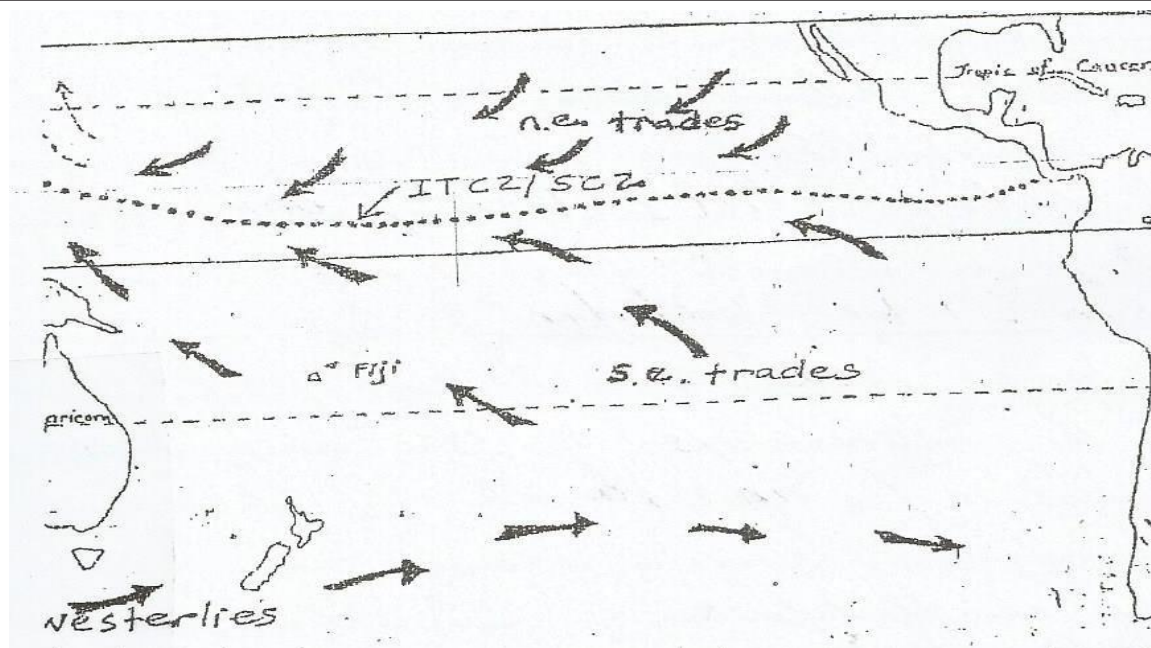
Due to the influence of the surrounding ocean, the changes in temperature from day to day and season to season are relatively small. The average temperatures change by only about two degrees Celsius to four degrees Celsius between the coolest months (July and August) and the warmest months (January and February). Around the coast the average night time temperatures can be as low as 18 degrees to 20 degrees Celsius and the average day-time temperatures can be as high as 30 -32 degrees Celsius. South Eastern coastal areas and the high interior often experience persistent cloudy humid weather.

2. Winds

The predominant winds over Fiji are the trade winds from the East to South East. On the coast of the two main islands day time sea breezes blow across with great regularity.

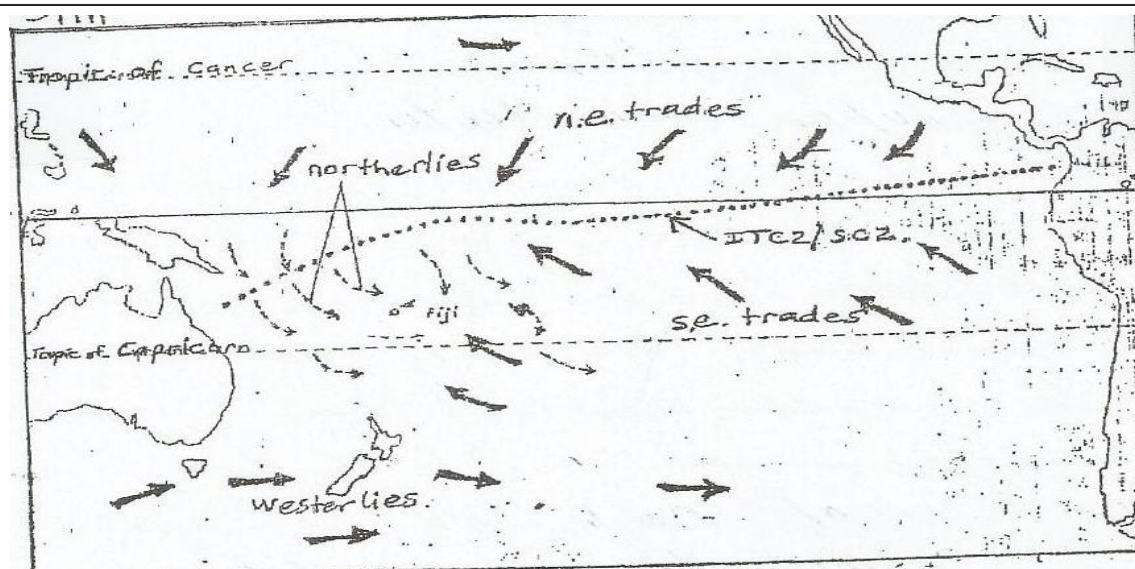
Generally, the winds in Fiji are light to moderate; strong winds are uncommon and are most likely to occur through channels and headlands in the period June to November when the winds are most persistent.

From May – October, when the overhead sun is north of Fiji, the group comes under the influence of the SE trade winds which blow from the high pressure belts(about 30 degrees latitude South) to the low pressure region. Also during the period, occasional depressions(low pressure) pass over Fiji bringing long steady periods of rain.



Main winds influencing Fiji in mid- winter- July

From November to April, winds are more variable, some easterlies, some westerlies and some northerlies. The northerlies in particular bring heavy rain to the northern and western sides of the larger islands. With more intense heat, there is a larger proportion of convectional rain. It is also a period of intense tropical storms.

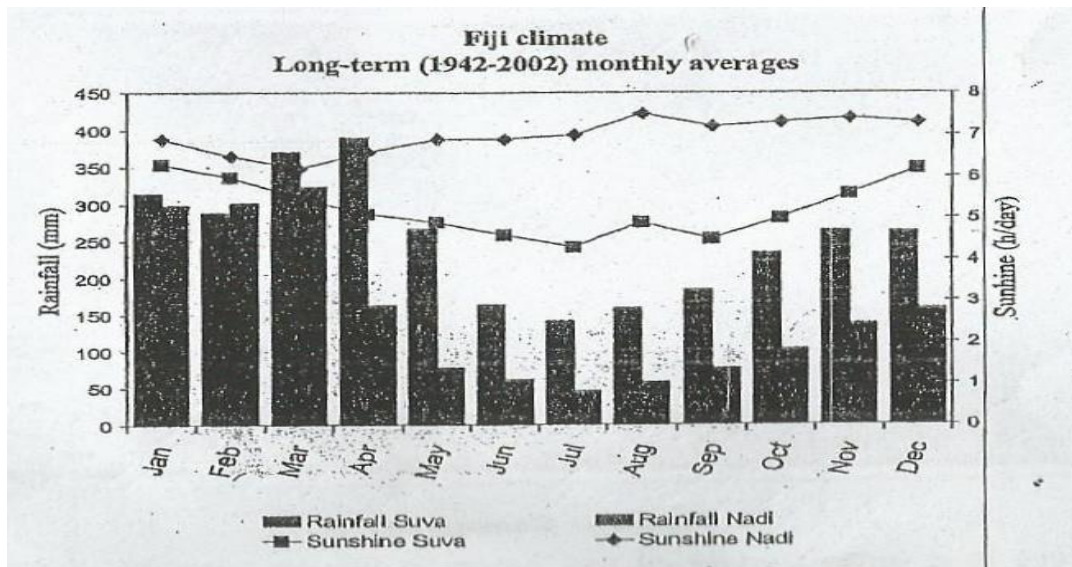


Main winds influencing Fiji in mid-summer (January)

The trade winds do not blow directly southwards towards the ITCZ but instead blow from southeast and northeast. This is because the earth spins on its axis once every 24 hours. The force of the earth's rotation that causes the deflection is called coriolis force.

3. Precipitation

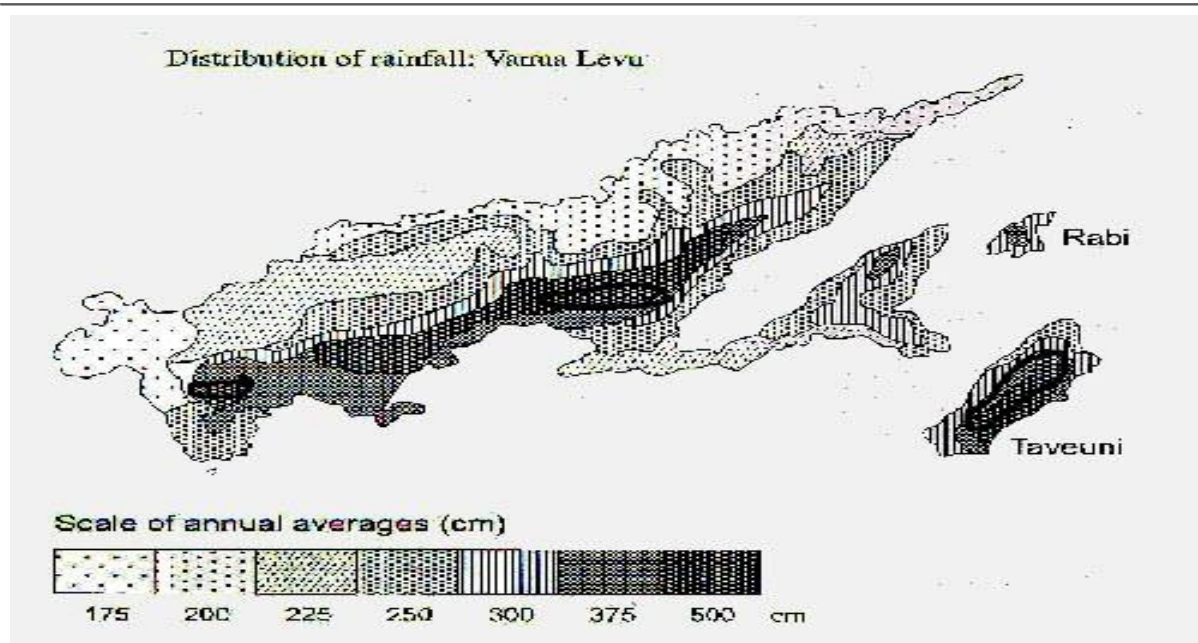
Rainfall is variable and mainly orographic (influenced by the island topography and the prevailing south east trades). The south –east trade winds are saturated with moisture, any high land mass lying in their path receives much of the precipitation.



Source: www.catalog.flatworldknowledge.com

Fiji experiences a distinct wet season (November to April) and dry season (May to October) that is largely controlled by the north and south movements of the South Pacific Convergence Zone which is the main rainfall producing system for the region.

Rainfall is usually abundant during the wet season especially over the larger islands and is often deficient during the rest of the year particularly in the dry zone in the northwestern sides of the main islands.

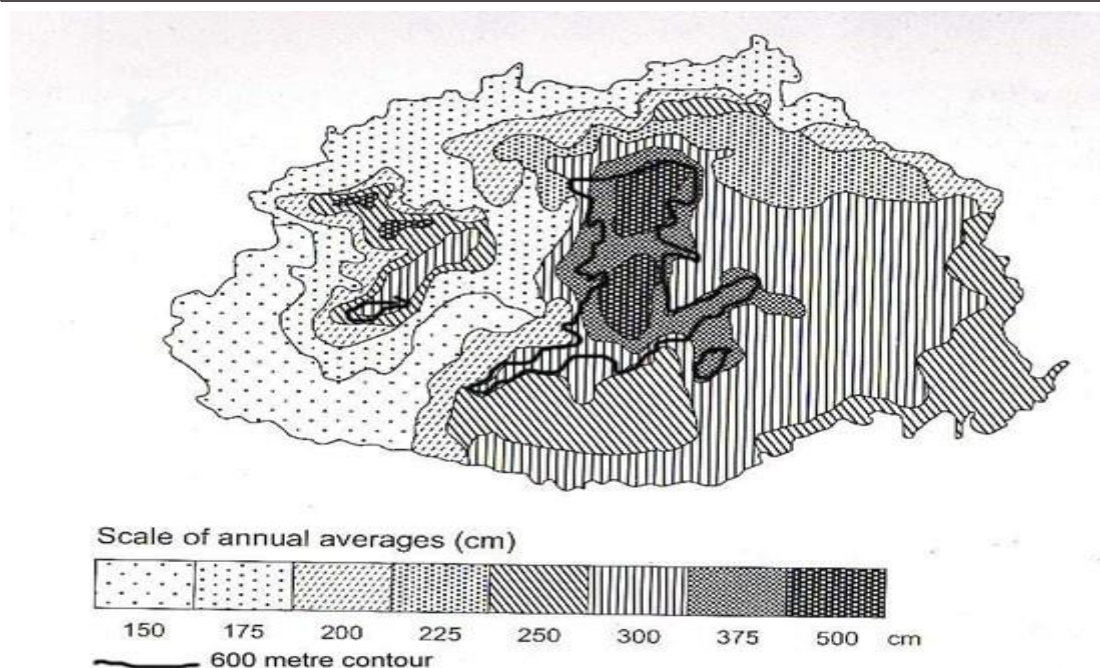


Source: www.fao.org

Wettest month is March and driest month is July,

During the warmer months, brief, heavy afternoon showers and thunderstorms are common known as convectional rainfall.

Fiji experiences prolonged dry spells quite often, usually for 3-4 months duration, when the north-western parts of the main islands, receive little or no rain.



Source: www.fao.org



Activity: 2.0

1. What are the three elements of climate?
2. What are the major seasons in Fiji and explain the causes ?
3. Briefly explain how winds influence the climate in Fiji.
4. Describe two factors that contribute to the formation of orographic rainfall in Fiji.

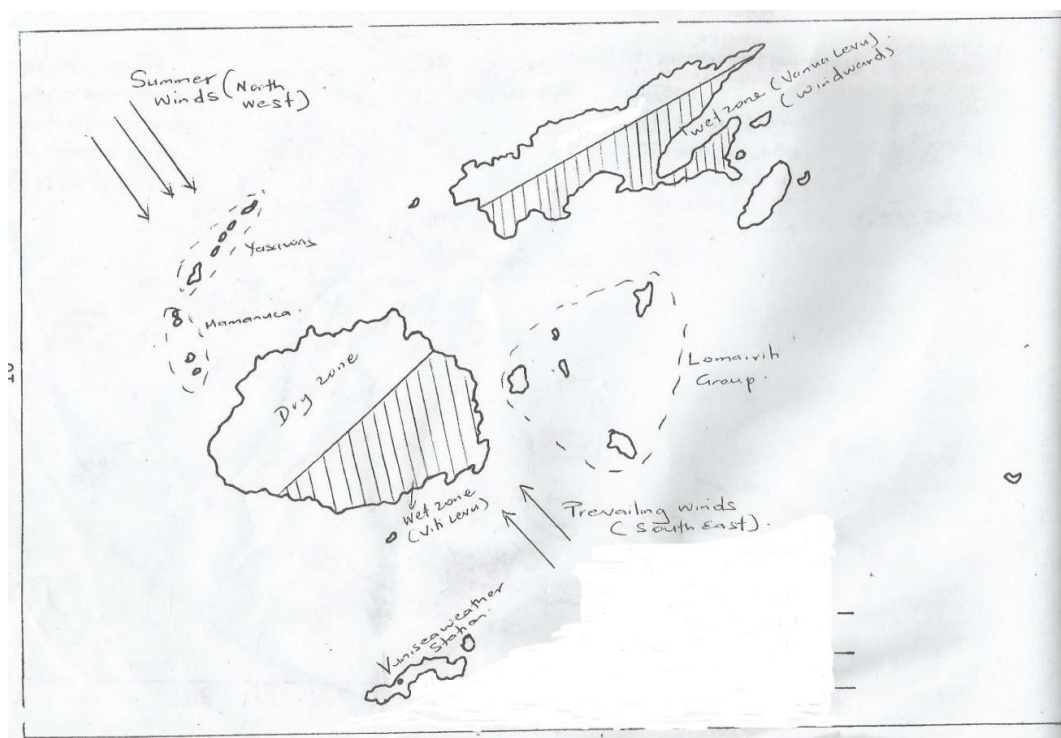
Climatic control factors/Factors affecting climate

Relief

The mountains on Viti Levu and Vanua Levu create wet climatic zones on their windward sides and dry climatic zones on their leeward sides; hence the main islands have pronounced dry and wet zones. Little climatic differentiation occurs on the smaller islands with low relief. Heaviest rainfall occurs on the windward parts of the larger islands.

The annual rainfall in dry zones – average – around 2000mm

Wet zones- ranges from 3000mm(coast) to 6000mm on the mountain sides.



Latitude

Does Latitude affect climate?

- Latitude exerts a large amount of control over any given area's climate.
- Latitude is probably the single most important determining factor in climate.

Fiji's position in the tropics (16 – 20 degrees south of the equator) gives it 'high sunshine' conditions all year round. Consequently, the temperature is uniformly high, averaging about 25 degrees Celsius.

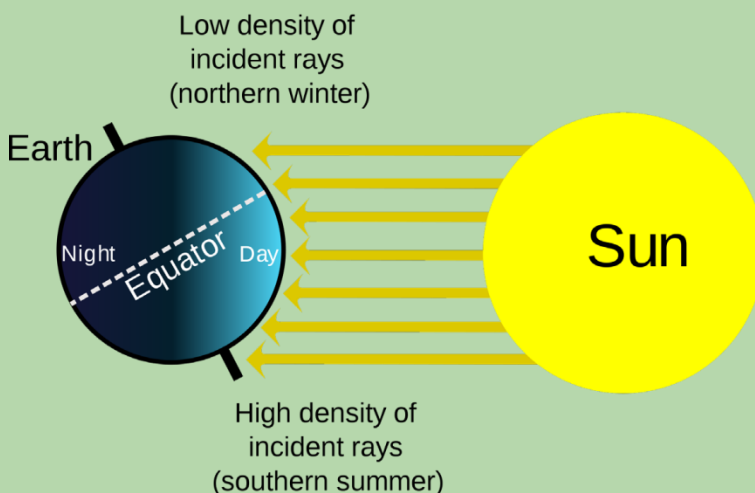
Proximity to the sea

The influence of the surrounding seas and oceans are the prominent factors behind the marine climate in Fiji. The flora and fauna is also according to the climatic condition.



Activity 2.1 Resource Study.

Use the resource given below and your own knowledge to answer the questions that follow.



Source: www.ei.leiighedu.com

- Describe the effects of solar radiation on Fiji's climate.*
- Distinguish between low angle of incidence and high angle of incidence.*
- How does latitude influence climate.*

INFLUENCE OF CLIMATE ON LANDUSE

- Difference in climate – reflected in distribution of main cash crops – sugarcane, coconut and rice.
- Cane grown on dry side of Viti Levu and Vanua Levu because it needs a lot of sunshine to increase its sugar content. Average annual rainfall in these areas is 2000 – 2400mm rain is needed in the early stages of plant growth and a lot of warmth and sunshine is required for the crop to mature or have high sugar content.
- Harvesting usually last from about June to November
- Copra – main producing areas are wet eastern regions where there is no distinct dry season. Average annual rainfall in these areas is 4000 – 4800mm
- Rice grown in both wet and dry season according to various types used
- -Dry rice grown on many cane farms
- -Wet Irrigated rice – mainly in Nausori and Navua because it needs plenty of rainfall average rainfall in these areas are 3600-4000mm
- Banana's, dalo, yaqona, cocoa, ginger grows in areas of high rainfall where there is no marked dry season eg in interior of Viti Levu Wainibuka and Waidina areas and Naitasiri



Activity 2.1

Mapping

Draw an outline map of Fiji, locate and name the following features;

- (iv) A water surplus region
- (v) A water deficit region
- (vi) A sugar cane growing area
- (vii) A rice production area

CHANGE IN CLIMATIC PATTERN

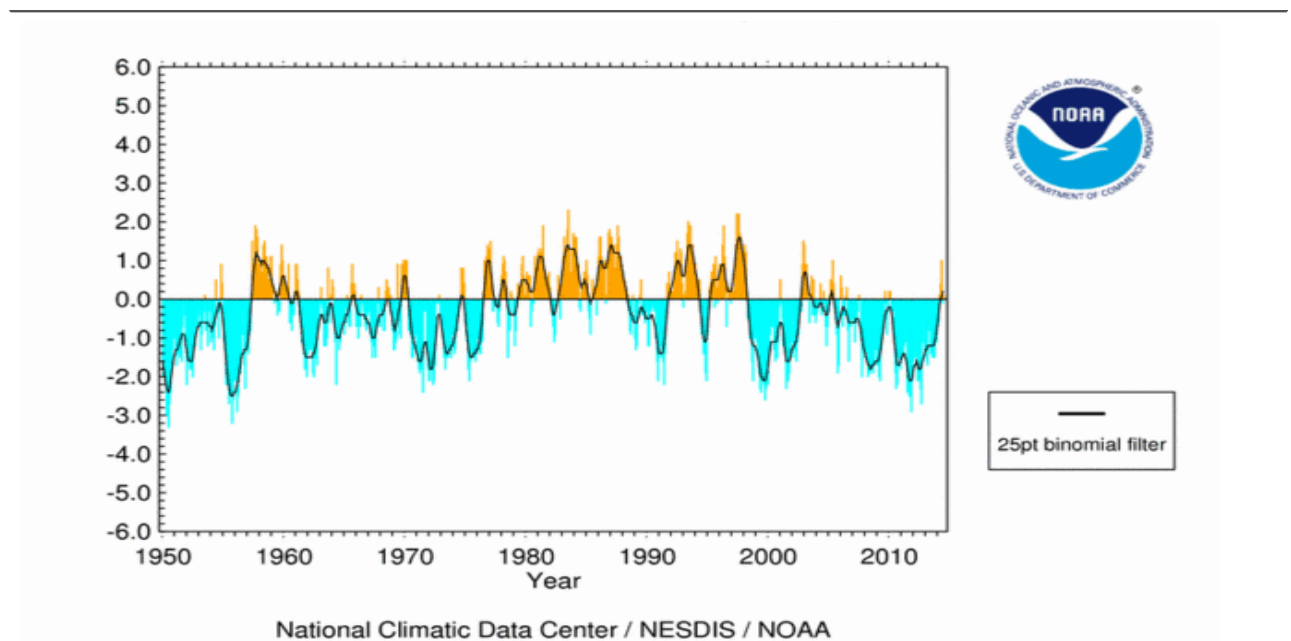
What causes change in climatic pattern?

Earth's climate is changing in the way it affects our weather, oceans, ecosystems and society. Human activities are contributing to climate change primarily by releasing billions of tons of carbon dioxide and other heat trapping gases known as greenhouse gases into the atmosphere every year. Manufacturing, driving, electricity generation and deforestation contribute to greenhouse gases which warms the planet.

Pacific decadal Oscillation (PDO)

The PDO is a long-lived El-Niño like pattern of Pacific climate variability. While the two climate oscillations have similar spatial climate fingerprints, they have very different behavior in time. The term PDO was coined by fisheries Scientist Steven Hare while researching connections between Alaska salmon productions and pacific climate.

The Pacific Decadal Oscillation (PDO) is a pattern of Pacific climate variability similar to ENSO in character, but which varies over a much longer time scale. The PDO can remain in the same phase for 20 to 30 years, while ENSO cycles typically only last 6 to 18 months. The PDO, like ENSO, consists of a warm and cool phase which alters upper level atmospheric winds. Shifts in the PDO phase can have significant implications for global climate, affecting Pacific and Atlantic hurricane activity, droughts and flooding around the Pacific basin, the productivity of marine ecosystems, and global land temperature patterns. Experts also believe the PDO can intensify or diminish the impacts of ENSO according to its phase. If both ENSO and the PDO are in the same phase, it is believed that El Niño/La Nina impacts may be magnified. Conversely, if ENSO and the PDO are out of phase, it has been proposed that they may offset one another, preventing “true” ENSO impacts from occurring.



Source: www.slate.com

Warm PDO

The broad area of above average water temperatures off the coast of North America from Alaska to the equator is a classic feature of the warm phase of the Pacific Decadal Oscillation (PDO). The warm waters wrap in a horseshoe shape around a core of cooler-than-average water. Impacts from the PDO depend in part on how it is aligned with the ENSO cycle; if the cycles are in opposite phases, then effects will be weakened. However, when both the PDO and ENSO are in the warm phase, meaning ENSO would be in the El Niño phase, expected impacts on the southeast include:

- Below average winter temperatures
- Above average winter precipitation

Cold PDO

Opposite of the warm PDO, the expansive area of below average water temperatures off the coast of North America from Alaska to the equator signals the cold phase of the PDO. The areas of warmer-than-average sea surface temperatures in the central Pacific are surrounded by below average temperatures near the North American continent. Expected impacts from a cold PDO and ENSO (La Nina) phase on the southeast include:

- Above average winter temperatures
- Below average winter precipitation

The ENSO

The ENSO (El Nino Southern Oscillation) phenomenon appears to be a major contribution to the fluctuations of climate, especially rainfall in the South Pacific. It has been seen that during the ENSO episode, the rainfalls are extremely low in the dry zones. El Nino(boy child) which is a warm phase and La Nina (girl child) is a cold phase are opposite phases of ENSO events are not always distinct.

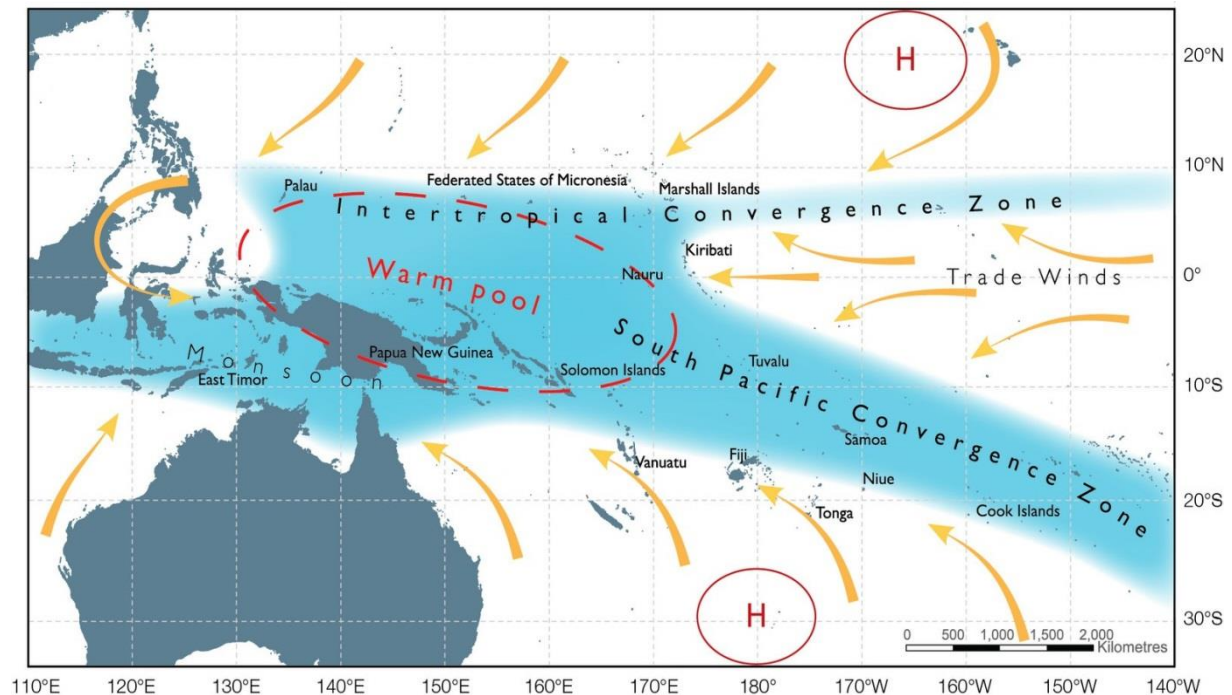
An El-Nino event usually results in drier and hotter conditions in Fiji during the wet and hot season, particularly from December to February and drier and cooler conditions in the cool and dry season , particularly between June and August. The most serious effect of strong El-Nino events in Fiji is the reduction in rainfall and increased likelihood of drought (e.g. in 1982 and 1997).However, El-Nino events beginning in the dry season may show up earlier in reduced rainfall (Kaloumaira,2002)

The opposite event –La-Nina can bring heavier rainfall in the wet season and occasionally above normal precipitation in the dry season. These events usually result in river flooding. The relationship between La-Nina and rainfall is strongest in the dry zones of the island.

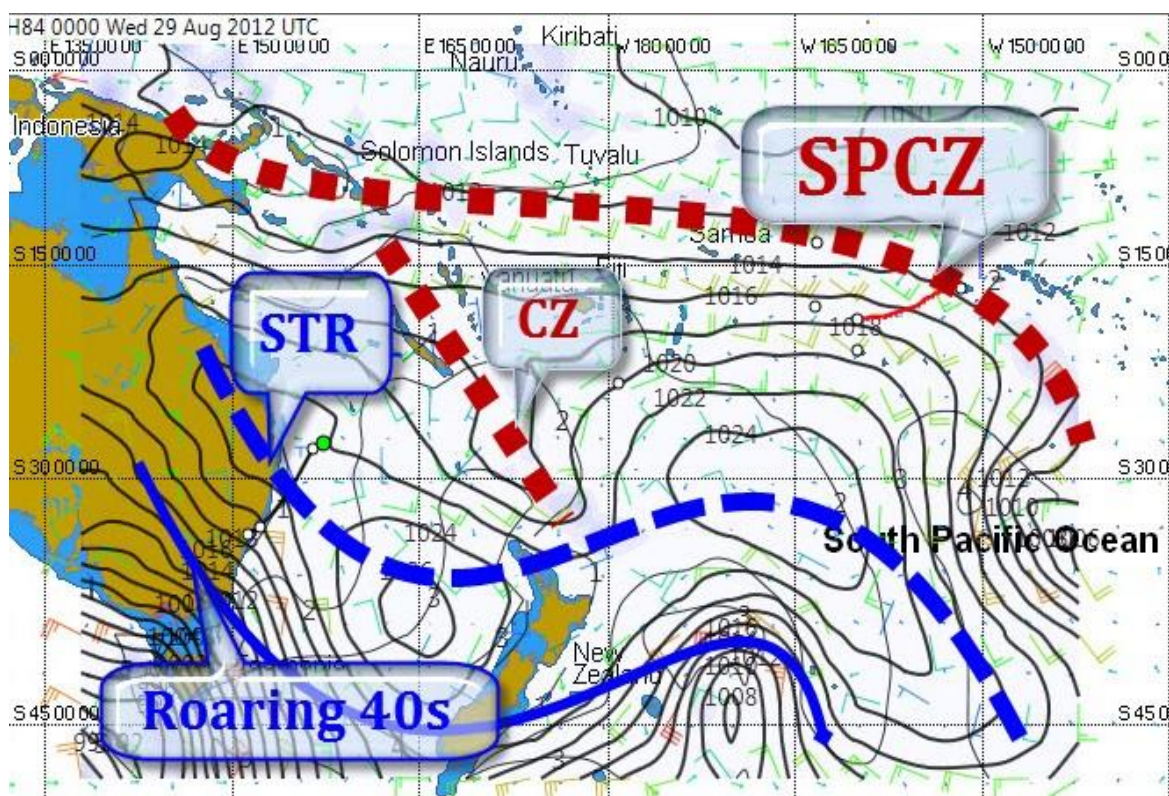
Historical data shows that the risk of Fiji being affected by tropical cyclones during an El-Nino event remains more or less the same as during a normal year, though the chances of high intensity tropical cyclones tend to increase. The data show more off-season tropical cyclones have occurred during El-Nino years. The chance of a tropical cyclone affecting Fiji during a La-Nina event has been shown to be low (Pahalad and McGree 2003).

South Pacific Convergence Zone and Inter- Tropical Convergence Zone.

The South Pacific Convergence Zone (SPCZ), a zone associated with high rainfall, fluctuates northeast and southwest of Fiji. During the southern hemisphere wet season, the heaviest rainfall occurs in the monsoon region and the Inter- Convergence .With Fiji in the SPCZ transition zone, there may be a delay between the onset of an ENSO event and the impact on the climate of Fiji, depending on when the SPCZ begins to shift eastward .



Source: www.takvera.blogspot.com



-it affects the population as a whole , a large degree of habitats.

- ⌘ extreme weather can cause disaster.

Global warming – Implications for Fiji

- ⌘ The average temperature has been proven an increase by one degree in the last century.
- ⌘ It is generally assumed that the current global warming is a result of rapid industrialization.

The sea level rise will produce

- Permanent coastal inundation
- Changes of coastline
- Coastal flooding
- Intrusion of seawater in freshwater lens
- Changes in coastal vegetation
- Increase in mud sediments in productive water.

Climate change impacts in Fiji

Climate change impacts in Fiji - what the IPCC 4th Assessment Report has found:

- Coastal erosion, water resources and human settlement on Pacific small islands will be at increasing risk with changes in temperature, rainfall and sea level rise. Accelerated coastal erosion, saline intrusion into freshwater sources and increased flooding from the sea may cause large effects on human settlements. Less rainfall coupled with accelerated sea level rise compound the threat on water resources .
- Beach erosion is prevalent due to sea level rise and human clearing of mangroves (1960s-1990s)
- It has been shown that port facilities would experience overtopping, damage to wharves and flooding of the hinterland if there were a 0.5 m rise in sea level combined with waves associated with a 1/50 year cyclone.

Small Islands

WWF Work

What WWF is doing on the ground in Fiji to protect against climate change:

WWF is testing its approach to build resilience in tropical mangroves and associate coral reefs including the Fiji Barrier Reef Eco region.

This project aims to build the capacity of nature resource managers to assess vulnerability and to adapt management strategies to respond to expected climate change impacts. Initial vulnerability assessments and adaptation planning point to the need for mangrove protection, reforestation with “climate-smart species,” integrated land-use and marine planning, as well as activities to improve resource use technology.

Coordinating the testing of adaptation methods in geographically diverse locations within a common habitat type aims to increase the replicability so that the project results can be transferred to other conservation efforts around the globe.

© WWF-Canon / Cat Holloway

Climate Witnesses

WWF runs the Climate Witness Programme to collect people's local observations of climate change that are then verified by scientists.

Example.

[Penina Moce](#) and her community have observed numerous changes because of global warming, such as sea-level rise and decreased and less predictable rain fall – a massive problem as drinking water is stored in tanks and water holding capacity is limited.



Activity 2.2

- (i) State two causes of global warming.
- (ii) Identify two impacts of global warming on the environment.
- (iii) Suggest two measures to minimize the impacts of global warming.

Terms

Coriolis force - an apparent force that as a result of the earth's rotation deflects moving objects (as projectiles or air currents) to the right in the northern hemisphere and to the left in the southern hemisphere.

Greenhouse gases - A greenhouse gas (sometimes abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range.

ITCZ – Inter-Tropical Convergence Zone is the boundary where the trade winds converge.

SPCZ – South Pacific Convergence Zone is a zone associated with high rainfall, fluctuates northeast and southwest of Fiji.

Trade winds- Any of a consistent system of prevailing winds occupying most of the tropics, constituting the major component of the general circulation of the atmosphere, and blowing northeasterly in the Northern Hemisphere and southeasterly in the Southern Hemisphere.

Maritime climate- Oceanicity is a measure of the degree to which the climate of a region is influenced by a maritime airflow from the oceans.

Latitude - is an angle (defined below) which ranges from 0° at the Equator to 90° (North or South) at the pole.

Pacific Decadal Oscillation - is a pattern of Pacific climate variability similar to ENSO in character, but which varies over a much longer time scale.

CHAPTER 3

RELIEF - NEW ZEALAND

Relief refers to the differences in height and shape of the land. It also refers to the many different kinds of landforms like; mountains, valleys, gentle slope, steep slope, cliffs, saddle etc.

Structure of the Earth

The earth's structure is made up of the:

1. crust - outer layer
2. mantle – middle layer
3. core – inner most layer

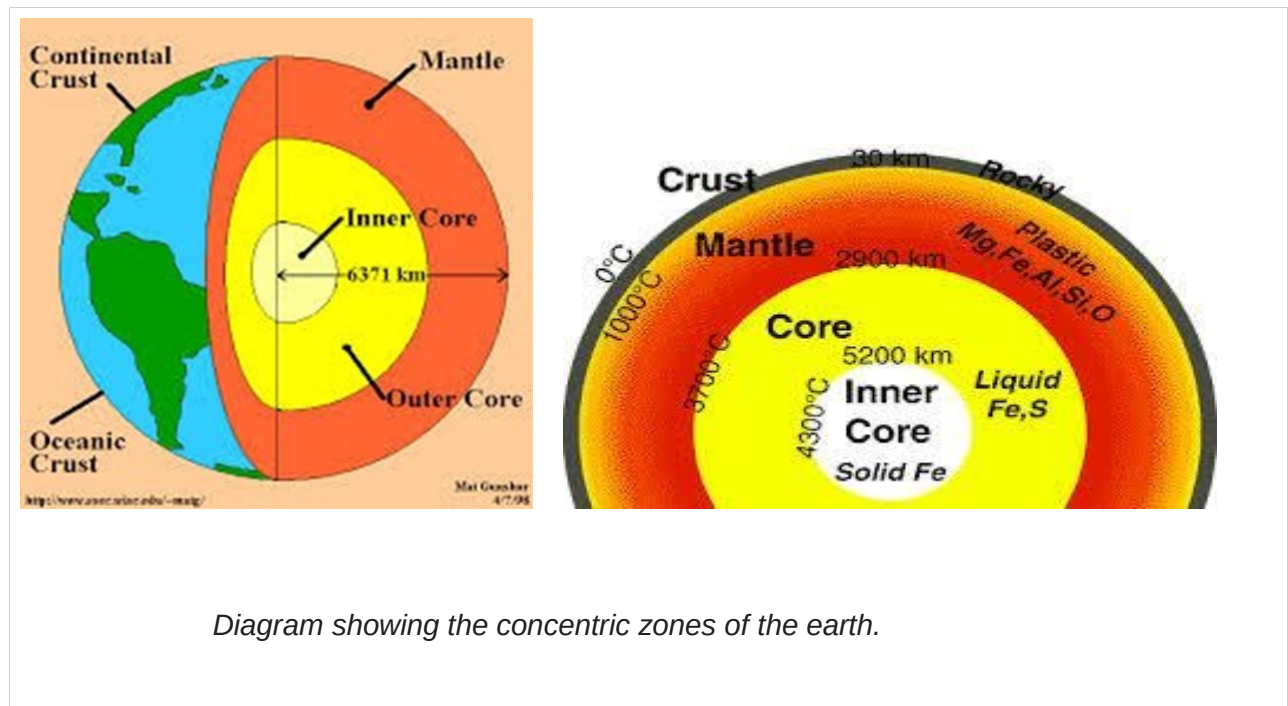


Diagram showing the concentric zones of the earth.

Source: <http://www.claseshistoria.com/bilingue/1eso/relief/relief-structure.html>

Crust

Refers to the outermost layer which is made up of a number of plates. On these plates are islands and continents sitting on them. The crust is called the lithosphere. The islands and continents sitting on the crust are made up mainly of granite rocks called SIAL, which means that the continents are made up mainly of Silica and aluminum rocks. Under the continents and the oceans there is a layer of basalt rock called SIMA which is rocks made from Silica and magnesium.

Mantle

Refers to the middle layer of the earth. It is the thickest of the 3 layers of the earth and is solid.

Core

Refers to inner most layer of the earth. There are 2 layers within the core.

1. Outer core - below the mantle and is liquid or contains hot molten rock known as magma
2. Inner core - inner most layer. It is solid.

Since the outer layer (crust) is lighter in density, the continents are said to be floating on the inner layers (mantle and core).

TECTONIC PLATES

Theory of Plate Tectonics

This theory states that the earth's crust is made up of a number of plates. Sitting on these plates, are continents and islands. These plates do move and the energy for plate movement comes from the liquid rock in the interior of the earth, which moves in massive convection currents.

15 Major Plates of the Earth

Plates	Continents/ Islands on them
Arctic plate	Landmasses of the North Pole
Antarctic plate	Landmasses of the South Pole
Eurasian plate	Europe
African	Africa
Indo-Australian	India/ Australia
Philippines	Philippine Islands
Pacific	Pacific Islands
Fiji	Fiji
Coco's plate	Panama Isthmus
North American	North America
South American	South America
Caribbean	Caribbean Islands
NAZCA	Between South America and Pacific plate
Bismarck	PNG/ Solomon's
Gorda	Off the coast of San Francisco

Plates Movement

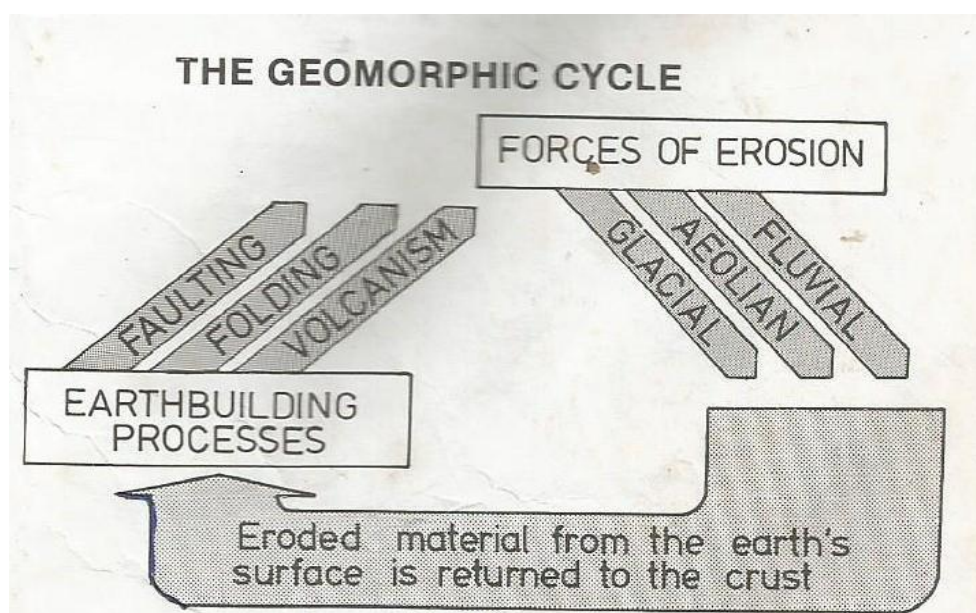
1. Divergent Zone

Type of Margin	Divergent	Convergent	Transform
Motion	Spreading	Subduction	Lateral sliding
Effect	Constructive (oceanic lithosphere created)	Destructive (oceanic lithosphere destroyed)	Conservative (lithosphere neither created or destroyed)
Topography	Ridge/Rift	Trench	No major effect
Volcanic activity?	Yes	Yes	No

Source: www.age-of-the-sage.org

THE GEOMORPHIC CYCLE

Geomorphic cycle refers to landforms that have been built up by earth building processes and slowly broken down by the processes of denudation.



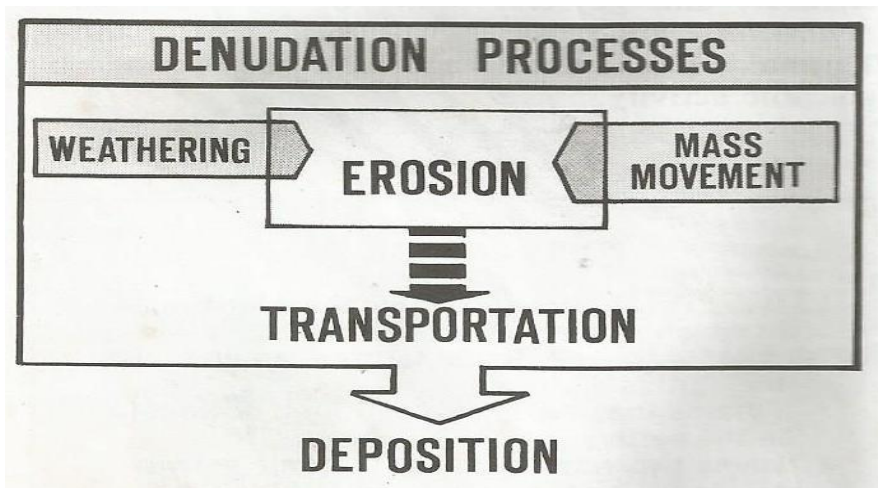
Source: *New Zealand : a new Geography*

Denudation is the stripping away of soil and rock from the landscape. Denudation process involves three main stages:

Stage 1 – wearing away of land surface by weathering, mass movement and erosion

Stage 2 – transporting the material by rivers, winds and glaciers

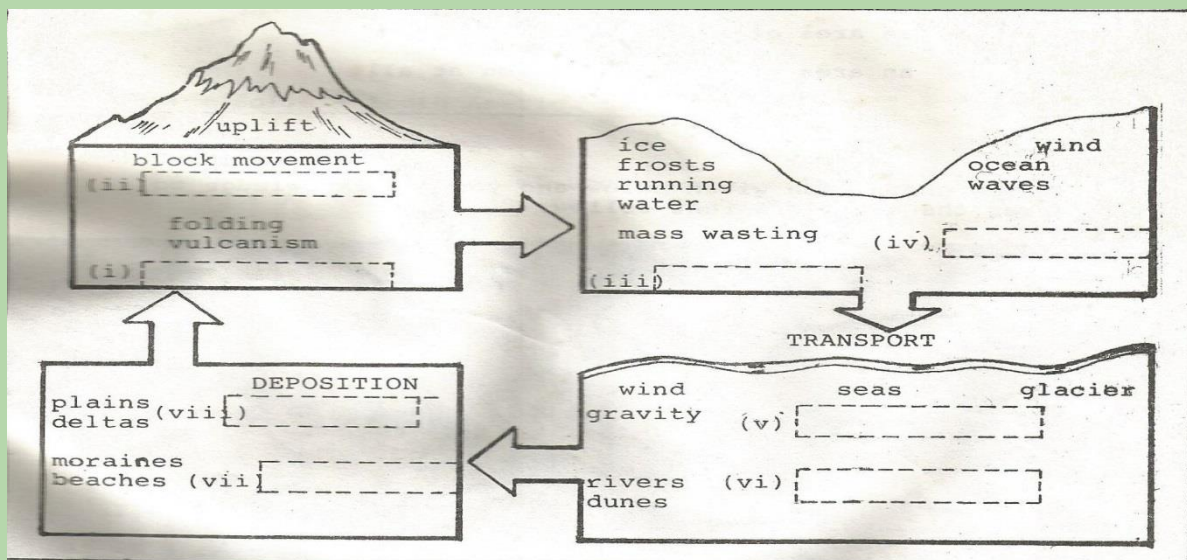
Stage 3 – deposition, which is the laying down of eroded material to form a new landform somewhere else.



Source: New Zealand; a new Geography



Activity 3.0 Fill In The Blanks



Beside each number write the number of the appropriate processes from the list given below. Some processes may have to be repeated.

Slips	floods	eruptions	coastal erosion	earthquakes
-------	--------	-----------	-----------------	-------------

Weathering

Refers to breaking down of rocks by physical, chemical and biological means.

1. Physical weathering- is the break down of rocks by continuous cycle of freezing and thawing known as frost shattering.
2. Chemical Weathering- when rainwater reaches the earth it is mildly acidic and can react with and weaken the structure of rock such as limestone thus wearing away and breaking down of rocks.
3. Biological Weathering- are the worms, roots of plants and trees and burrowing insects which loosen the soil.

Earth Building Processes

The various earth building processes which contribute to relief operate over millions of years ago and continue to the present day. They are namely:-

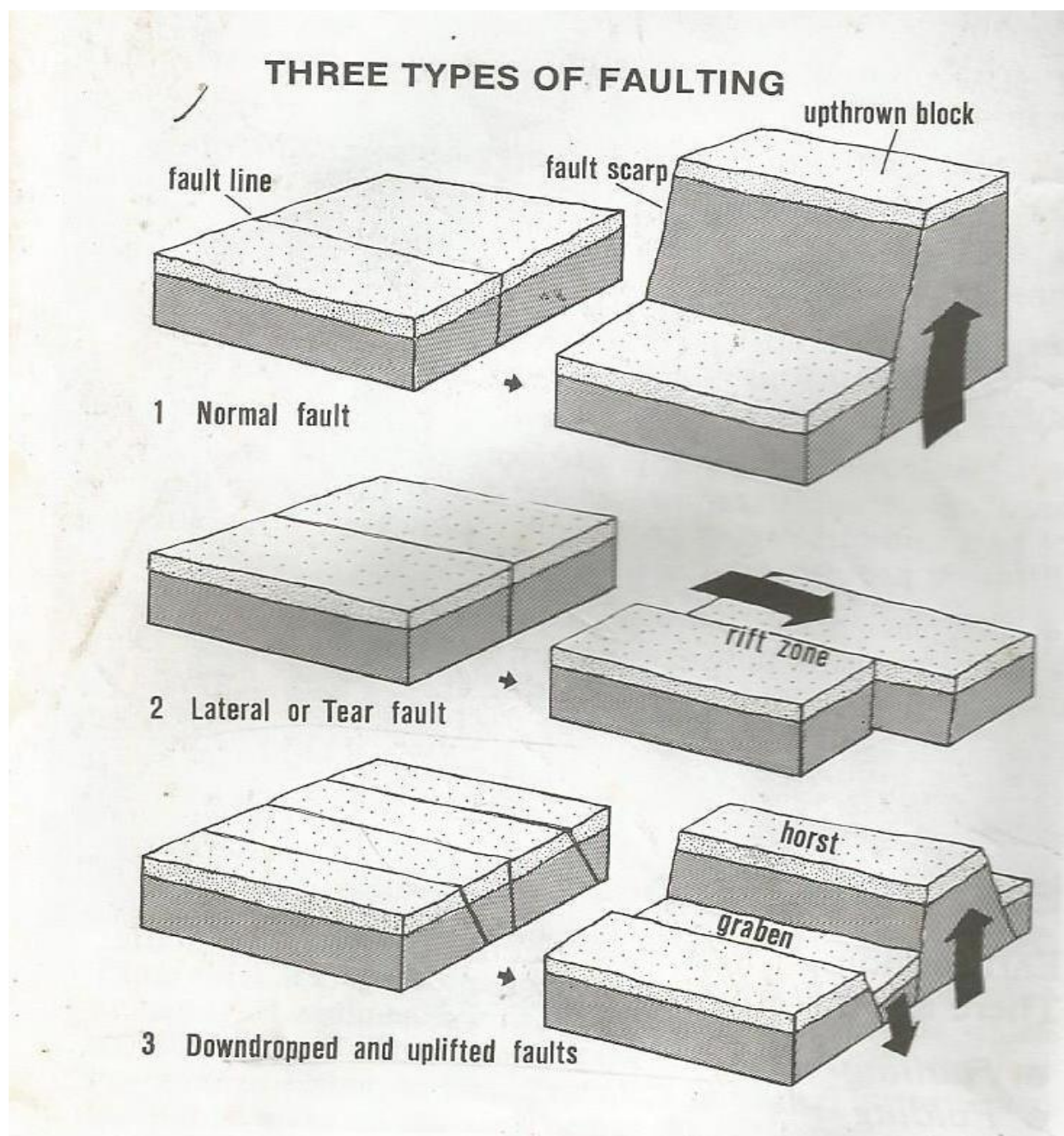
1. Folding
2. Faulting and
3. Volcanism.

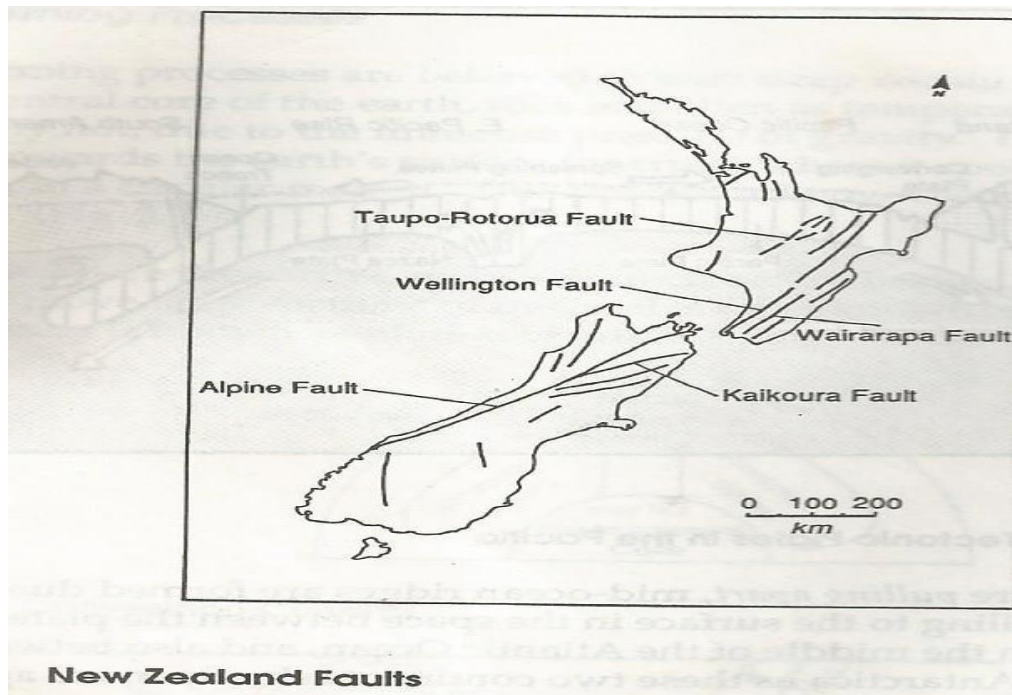
Faulting

Refers to the movement of the earth's plates along the zones of weakness. This is the result of the pressure building up causing the old brittle rocks to break and move in blocks. The land shifts in either an upward, downward or sideways direction. E.g. Alpine fault in NZ. Although movement along the fault line is slow, a sudden move results in an earthquake. E.g. Whakatane Earthquake (NZ) 1987.

Type of Faults

1. Normal fault
2. Reverse fault
3. Tear fault

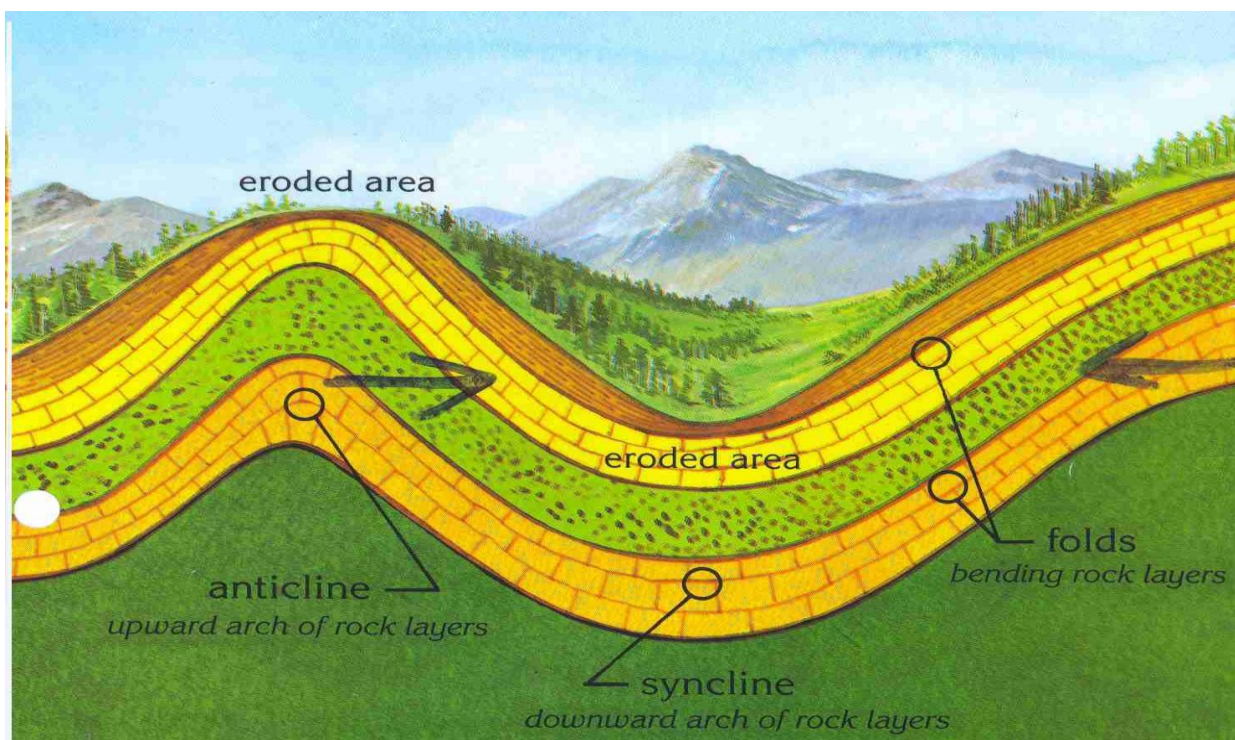




Source: New Zealand; a new geography.

Folding

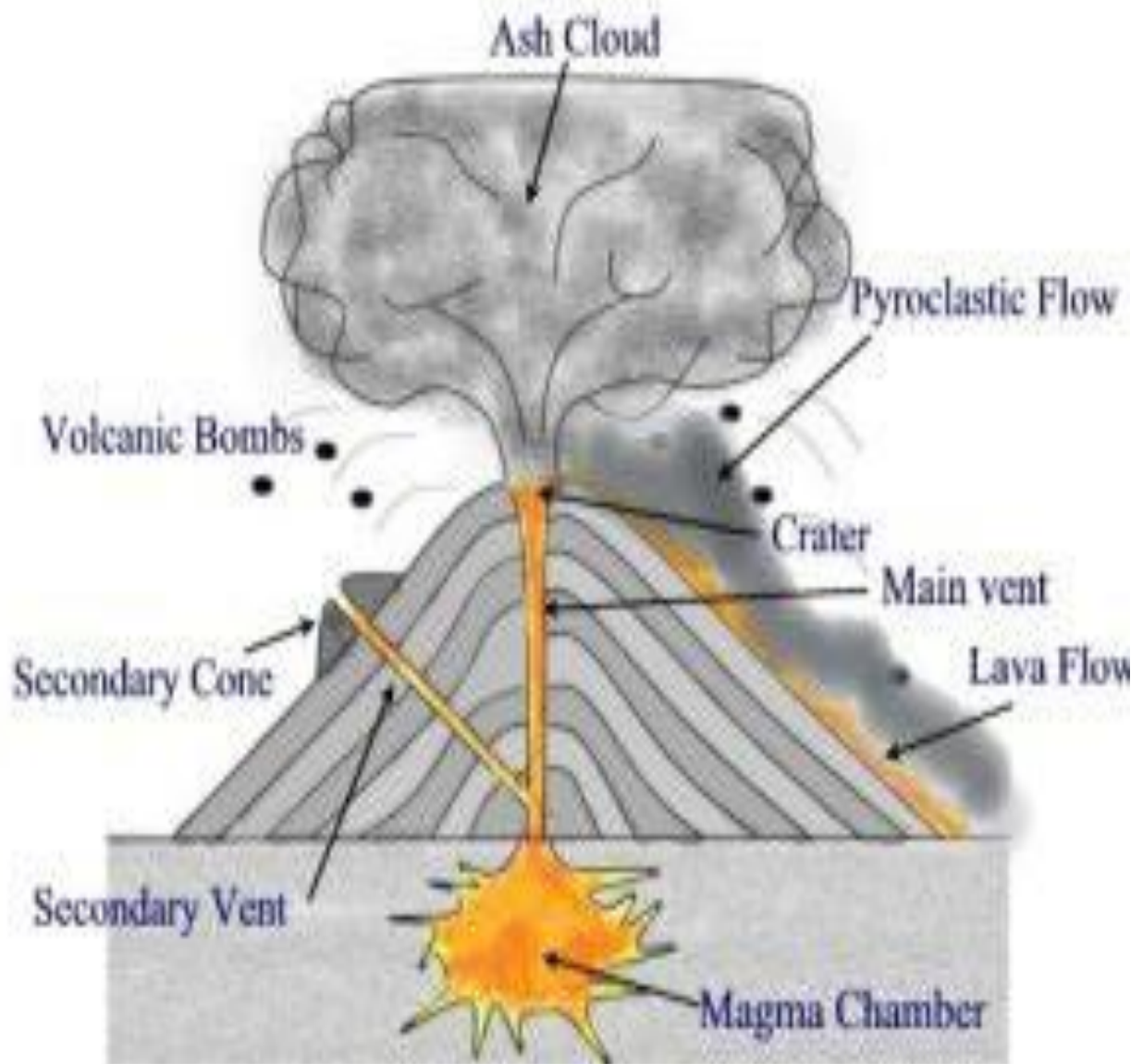
Refers to process in which soft rock is pushed and squeezed by hard rock that is moved by pressures from deep within the earth. Instead of cracking into smaller blocks, the soft rock twists and bends into folds.



Source: www.oocities.org

Volcanism

Refers to process whereby the earth's hot molten rocks called magma are able to force their way up to the surface through the cracks or weaker surfaces. Typical volcanic landforms include lava or ash erupted from volcanoes, large explosions craters such as Lake Taupo.



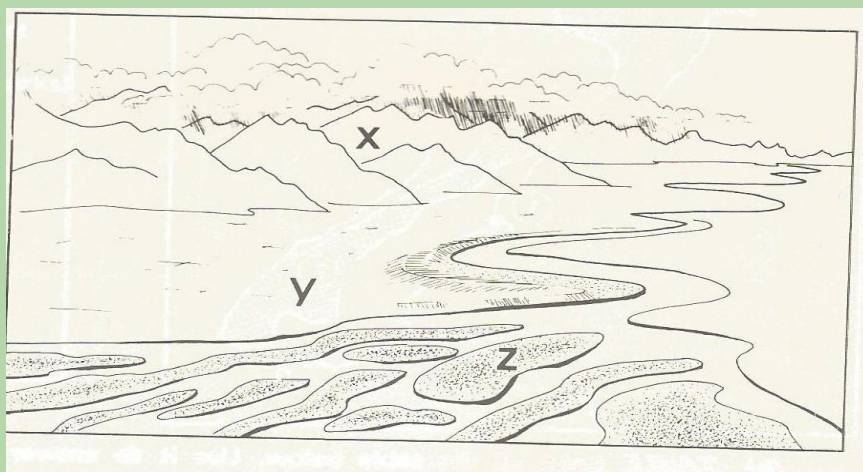
Source: www.library.fayschool.org



Activity 3.2

Sketch Interpretation

Use the picture below to answer the questions that follow:



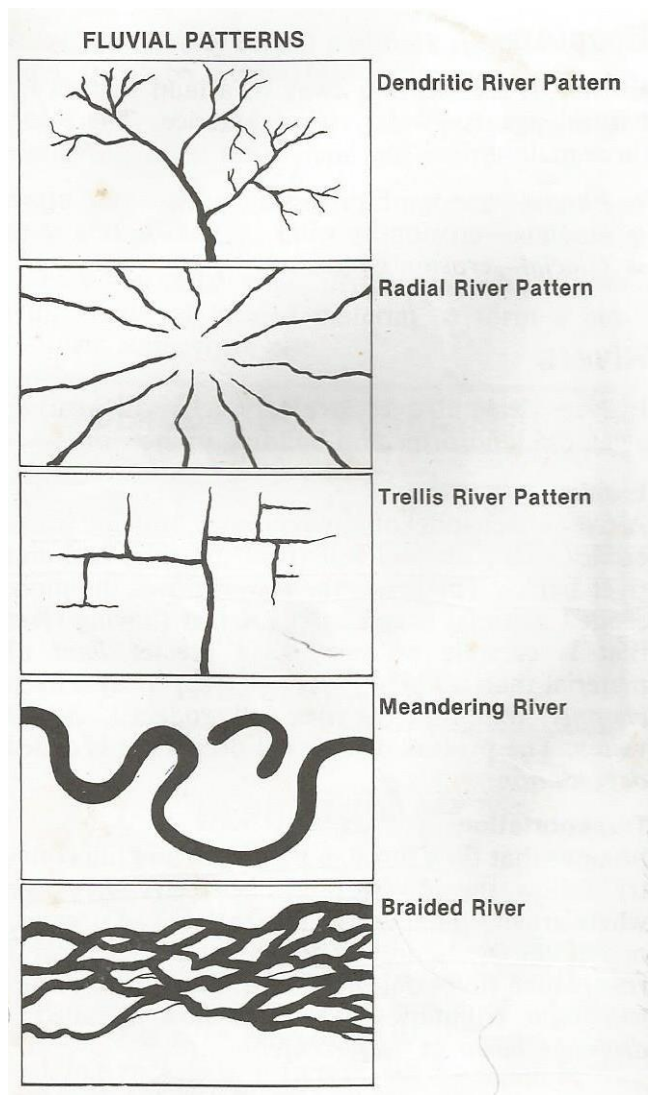
Source: FSLC 1987

1. Suggests what process raised the mountains at **X**.
2. Suggest why only the mountains are receiving precipitation.
3. Name the type of plain at **Y**.
4. Name the physical process which has built the island at **Z**.

Multiple Choice

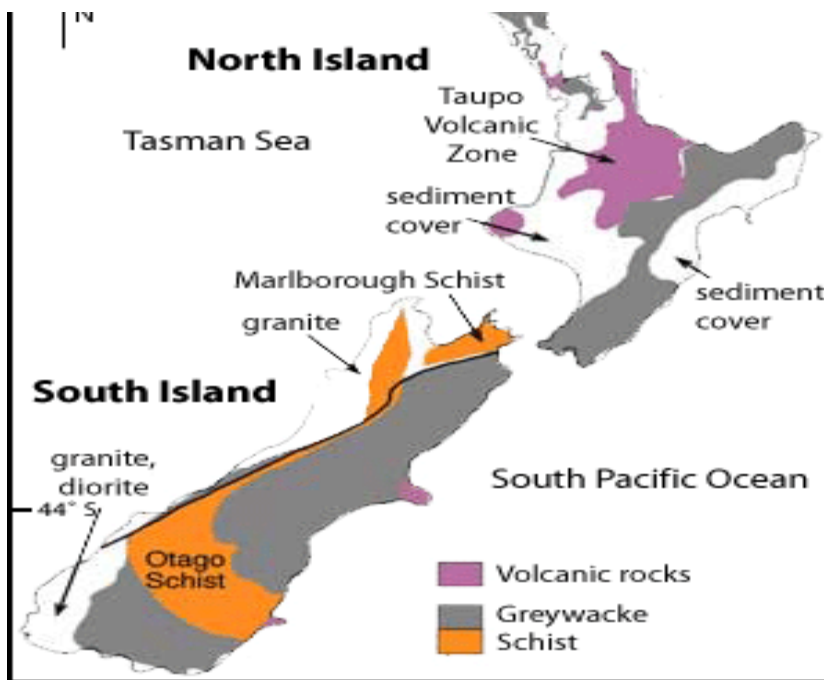
1. As the latitude over New Zealand gets higher then
 - A. Precipitation increases
 - B. Time zone changes
 - C. Racial diversity increases
 - D. Temperature decreases
2. Plate tectonic is a theory that describes
 - A. Movement of sections of the earth's crust
 - B. Uplift of mountains , valleys and hills
 - C. Movement of volcanoes, earthquake and faults
 - D. Down movement of valleys , river and coasts

Fluvial/ River Patterns



Tectonic location of New Zealand

New Zealand is sitting between the unstable Pacific Plate and the relatively stable Indo-Australian Plate. This means that it is sitting at a plate boundary at which enormous pressures are built up that causes the Earthquakes, volcanism and moving blocks of land which shape much of the NZ landscape. Huge blocks of land have been thrust upwards to form mountains while other blocks of land, while in other blocks of land have been squashed and folded to form ranges of hills. In some places earthquakes have raised great areas of land while in other places they have lowered or tilted them.



Source: www.geology.um.maine.edu

New Zealand Geology

NZ's landmass is largely made up of rocks that were originally formed from the ocean floor. This has been proved by geologists who found fossils of fish and other sea creatures embedded in rocks a long way from the sea.

The 'rock base' that forms NZ landmass continues below the sea to join the Pacific Plate.

This old and hard rock is called undermass. It is the foundation on which the landforms of the country are built upon. On top of some undermass are layers of softer, more recent rocks called core rocks. The most common rock in NZ's undermass is grey wacke. It is an old hard form of sandstone. Others found in the undermass are schist and gneiss. These rocks are mainly in the South Island where most of the large scale mountain building occurs. e.g. cover rocks (mudstones, limestone, basalt).

The rock that makes up NZ's under mass and cover are divided into 3 categories:

- i) Sedimentary rocks
- ii) Igneous rocks
- iii) Metamorphic rocks

i) Sedimentary Rocks

- are rocks that are formed when sand, mud, silt and marine plants and animal remains build up and cement together. These materials accumulate under water millions of years ago.

The pressure on them increased as layer upon layer build up and was gradually compressed to form rock.

- *sand deposits – formed grey wacke and sandstone
- *mud – formed mudstone
- * silt – formed siltstone
- *marine animals - formed limestone and other calcium rocks

ii) Igneous Rocks

- are rocks that are formed by volcanic eruptions. All igneous rocks have been heated to very high temperatures by the volcanic process that brings them up to the earth's surface.

iii) Metamorphic Rocks

- they are either sedimentary or igneous rocks that have been changed in their structure and appearance by enormous pressure which causes from earthquakes and other tectonic forces and is often accompanied by friction and heat..

Main Relief Patterns of New Zealand

Relief is the difference in slope and height if any areas of land. The main types of relief in NZ are:

- i) mountains
- ii) rough hill country
- iii) easy hill country and downland
- iv) plains
- v) plateaus



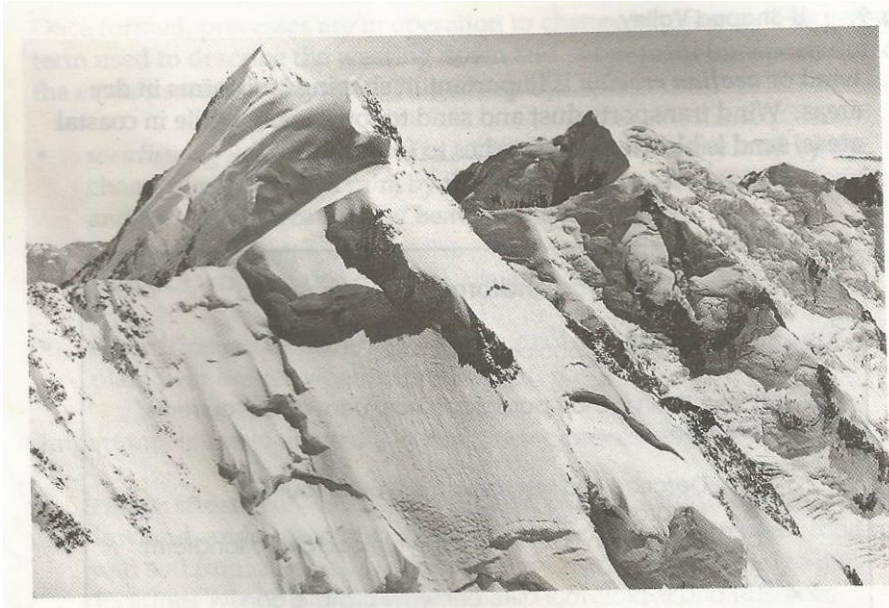
Lake Whakatipu



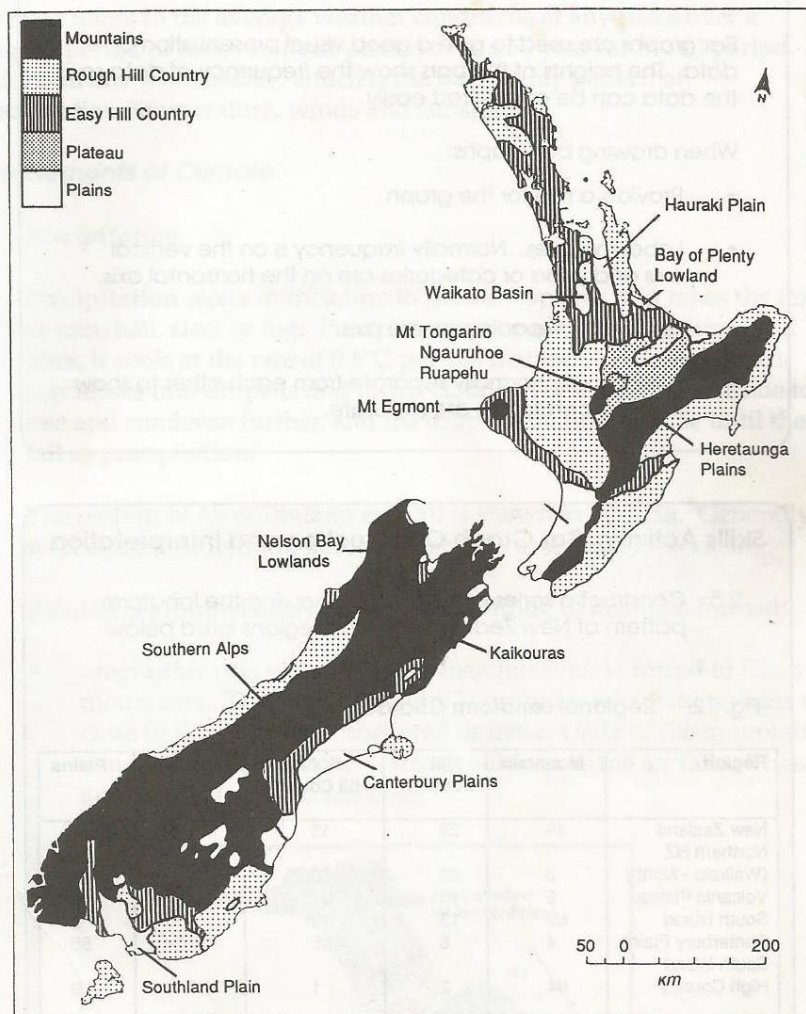
Canterbury Plains



Mt Ngauruhoe



Mt Cook – highest mountain in New Zealand



How Relief Affects Human Activities in New Zealand?

Relief plays a major role in determining what type of activities Humans will do –

i) e.g. NZ high country

cold/ steeply sloping mountainous districts like South Island High Country is used for Extensive Pastoralism.

- beef farming
- wool and sheep farming

ii) e.g. hill country (rolling to steep landform)

is used for semi-intensive agriculture

- wool and store sheep
- beef
- cattle
- forestry

iii) e.g. alluvial plain (flat to gently sloping land)

is used for arable crops, fattening, horticulture, dairying, forestry, urban development

How Human Activities have affected the Relief of New Zealand?

1. Extensive/ Intensive Pastoralism

E.g. in SIHC (Makaroa Station)

→ Soil erosion on steep slopes caused by overgrazing

→ results in occasional flooding → river bank erosion (siltation of rivers/ farmlands)

2. Town/ Urban Development

→ Removal of hill. E.g. the removal of a large hill in the middle of Hamilton to enable inner city development (1936)

* flat land makes building roads, drains, cables and other amenities and services of modern settlements easier to establish

3. Hydro Dams (construction)

Flooding/submerged of relief .e.g. small hills

- Tokaanu
- Aratiatia
- Ohakuri
- Atiamuri
- Whakamaru
- Maraetai
- Waipapa
- Arapuni
- Karapiro
- Matahina

4. Mining

e.g. Waikato (large reserve of sub-bituminous coal)

→ open cast mining , destroys relief

5. Logging

- landslides
- erosion

6. Excavation

Plains – human activity is very intensive

Hill country – human activity is semi-intensive

High country – human activity is very extensive

Case Study – The Canterbury Plain

Location

It is located on the east coast of the South island , boarded on the west by the high hill country.

Processes involved in the Formation

These plains were formed from the alluvial fans of large rivers. The rivers carry large amount of alluvium down their valleys where the rivers reach the lower land, they slowed down and deposited the alluvium in the sea. The sea was filled with gravel and mud and a as result plain was formed. Frequently, nor- wester wind blowing from west have spread even loess -fine yellowish dust. The soils vary in fertility according to the thickness of loess and the proportion of the coarse sand they contain.

Economic Activities

The Canterbury plain is the chief mixed faming area in New Zealand. It's fertile nature and the possibility of the use of the machines favor a wide variety of farming. Numerous rivers have potential for irrigation as these plains are on rainshadow region of the South Island.



Activity 3.3 Mapping

Draw an outline map of the New Zealand, locate and name the following:

- i. The highest mountain in New Zealand
- ii. Waikato River
- iii. Largest plain in South Island
- iv. The largest plateau
- v. Fiordland
- vi. The active volcanic mountain
- vii. Wellington fault
- viii. An Intermontaine basin
- ix. Hauraki Gulf
- x. An area of downland and gentle hill country

Terms

Crust – outer layer of the planet

Mantle - is the middle layer of the earth

Core- inner most layer of the earth.

Outer core- below the mantle and is liquid or contains hot molten rock known as magma.

Inner core- inner most layer of the earth. It is solid.

Plate - A tectonic plate (also called lithospheric plate) is a massive, irregularly shaped slab of solid rock, generally composed of both continental and oceanic lithosphere.

Convergent plate boundary - is an area on Earth where two or more lithospheric plates collide.

Divergent plate boundary - are where adjacent plates move apart and new crust is created.

Transform plate boundary- are where plates slide along each other in opposite directions and no new crust is created or destroyed.

Tectonic movement - movement resulting from or causing deformation of the earth's crust.

Mountains - is a large landform that rises above the surrounding land in a limited area, usually in the form of a peak.

Plains- is a flat land.

Plateaus- an area of high land usually consisting of relatively flat terrain, that is raised significantly above the surrounding area.

CHAPTER 4

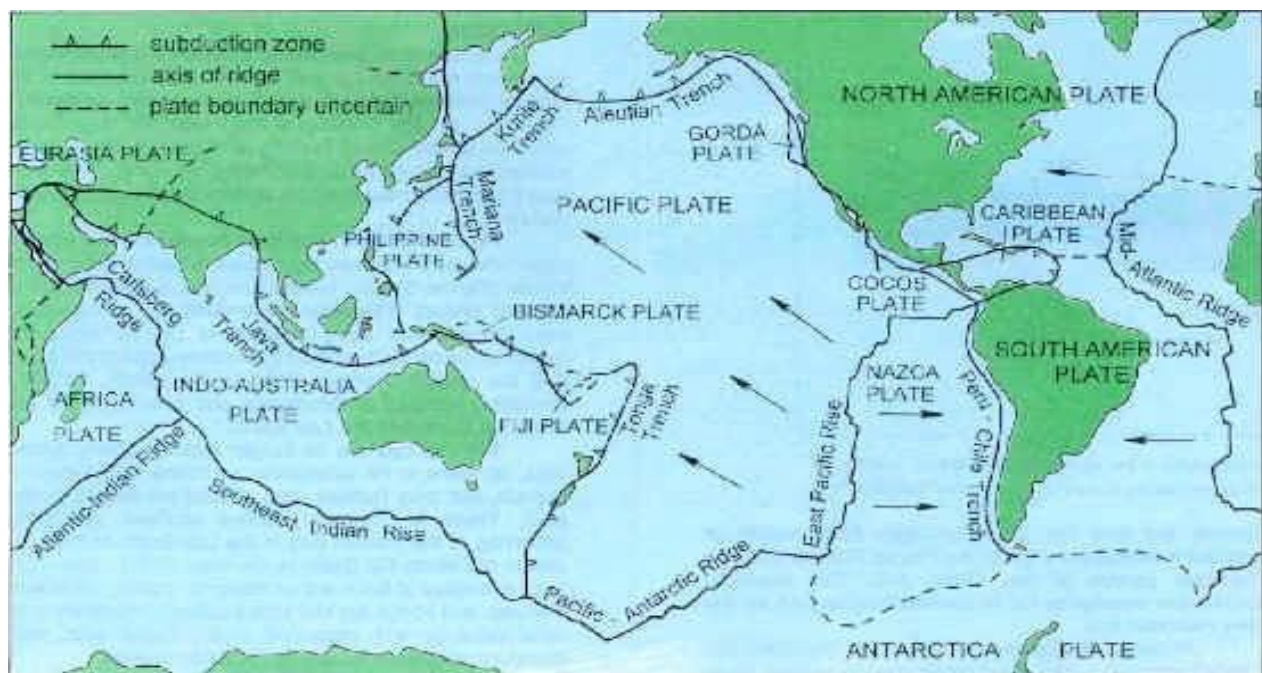
FIJI

RELIEF

Plate tectonics

Our planet earth is under constant change, and evidence that the earth is still active can be seen whenever a volcano erupts or an earthquake shakes the land. The lithosphere or outermost shell of the earth, which includes the crust and the upper mantle, is broken up like a cracked egg into a number of rigid plates which move around because of forces in the upper mantle (figure 3).

The Pacific lithospheric plates.



Source : <http://www.claseshistoria.com/bilingue/1eso/relief/relief-structure.html>

The boundaries of these plates are zones of intense activity and associated with them are many of the large-scale geological features produced by such processes as mountain building, volcanism, creation and destruction of sea floor and earthquake activity. The movement and deformation of the plate is known as plate tectonics. Tectonic movements which indicate instability of the earth's crust, produce faulting (fracture and displacement), folding, subsidence and uplift of rocks. Over millions of years plate tectonics has been responsible for the formation of many great mountain ranges and ocean basins.

Plate Boundaries are where plates meet and move against each other . They are usually the locations of many violent earthquakes and volcanoes. Earthquakes and volcanoes tend to occur in belts (for example, the “Ring of Fire” on which Fiji is located, surrounding the Pacific Ocean). These belts are the locations of plate boundaries. There are three types of plate boundaries- divergent, convergent and transform

- (a) Convergent
- (b) Divergent
- (c) Transform fault

Divergent boundaries (constructive boundaries) are where adjacent plates move apart and new crust is created. In the major oceans, there are long underwater mountain ranges called mid-ocean ridges. Mid-ocean ridges develop at edges of diverging plates and are the sites of volcanism and shallow earthquake activity. Along the centres of the ridges, new rock is forming from molten magma coming up from the upper mantle. The rocks produced are basaltic in composition. This process is also known as sea-floor spreading. An example of a mid-oceanic ridge is the Mid-Atlantic Ridge in the Atlantic Ocean.

Convergent boundaries (destructive boundaries) are where two adjacent plates Move towards each other and crust is destroyed. Along convergent boundaries are crumpled mountain ranges, deep sea trenches, shallow and deep earthquakes and volcanoes. The edge of the thin plate usually sinks under the other plate at an angle of between 30 degrees and 70degrees, usually forming deep trench. This process is called subduction and the movement of plates as they adjust produces earthquakes, as a plate edge sinks into the hot mantle, the rocks will be squeezed and heated and parts of it begin to melt. The rock melt, the magma thus formed would float upward, some of it reaching the surface as lava erupting from volcanic vents. The resultant volcanism often forms a chain of volcanoes along the plate boundary known as a volcanic island arc. The plate boundary can be seen at the earth’s surface as a deep ocean trench. The islands of Fiji, Vanuatu, Lau and Tonga were formed as volcanic island arcs by subduction-related processes; however Fiji and Lau are no longer active island arcs.

Transform boundaries are where plates slide along each other in opposite directions, and no new crust is created or destroyed. The famed San Andreas fault of California is such an example. There the Pacific plate slides past the American plate in a north westerly direction at rate of 10mm per year. When areas are stretched, they split, initially forming a rift and eventually a back-arc spreading centre. The weakest part of the upper plate is near the volcanic front (where volcanism is occurring), and the plate is both the hottest and has the thickest crust. Therefore the arc splits within about 50km of the volcanic front. the basin that usually opens up behind the volcanic island arc is known as a back-arc basin or a marginal basin and it usually becomes filled with lava and sediments. The North Fiji basin and the Lau basin are examples of back-arc basins.

The tectonic History of Fiji

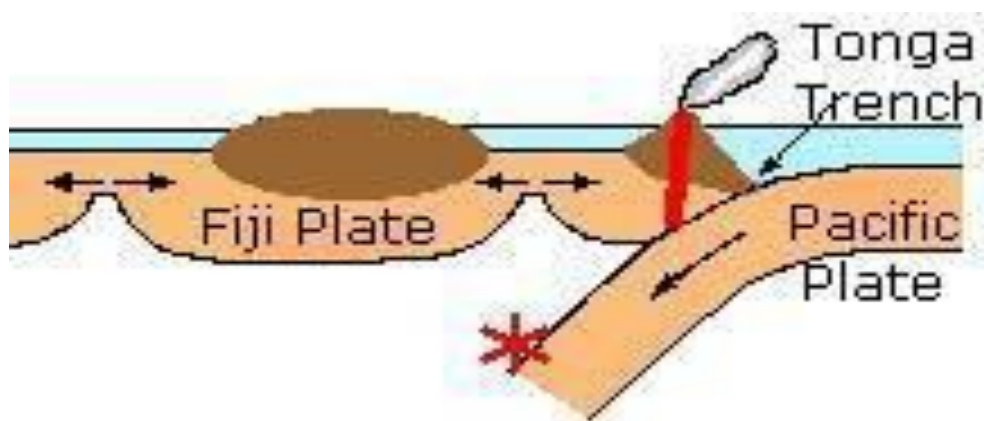
In the southwest Pacific two large plates, the Pacific Plate and the Indo-Fijian Australian Plate, are moving towards each other, that is, converging. This area of the south Pacific was formed in the last 65 million years of Earth's history by the growth of volcanic island arcs and associated marginal and oceanic basins. Fiji's tectonic history is very complex.

In Fiji, another island arc was formed, along with associated sedimentary basins that produced volcanic and sedimentary rocks of the Wainimala group which are exposed today in southern Viti Levu, and in the Yasawa and Mamanuca group of islands. There was continued volcanism on the Lau – Tonga Arc due to the northwestward subduction of the Pacific plate under the Indo-Australian plate along the Vityaz Trench. Fiji was caught in an area of increasing stresses during this period. Intrusions of plutonic rocks were common, and the earlier formed volcanic and sedimentary rocks were weakly folded, faulted and metamorphosed. Uplift near the end of this period may have produced the first significant landmasses of Fiji, mostly Viti Levu.

12- 7 million years ago

During this period the Pacific plate continued to obliquely subduct in a northwest direction under the Indo-Australian Plate south of Fiji, while the Indo-Australian plate probably moved north-east. The new stresses resulted in a major change in the nature of the plate boundary with the end result being splitting of the Vityaz Arc and the formation of a transform boundary north of Fiji called the Fiji Fracture Zone. At this boundary the two plates were moving past each other.

Fiji, therefore represents a portion of the old Vityaz Arc, which was split up, and rotated anti-clockwise to its present position. It forms a mini-plate, known as the Fiji Plate. This was also a period of great volcanic activity in Fiji and the whole region. Fiji is located at the Indo-Australian and Pacific Plate boundary between two opposite facing subduction zones and hence has had a very complex tectonic history.



Source: www.mrd.gov.fj

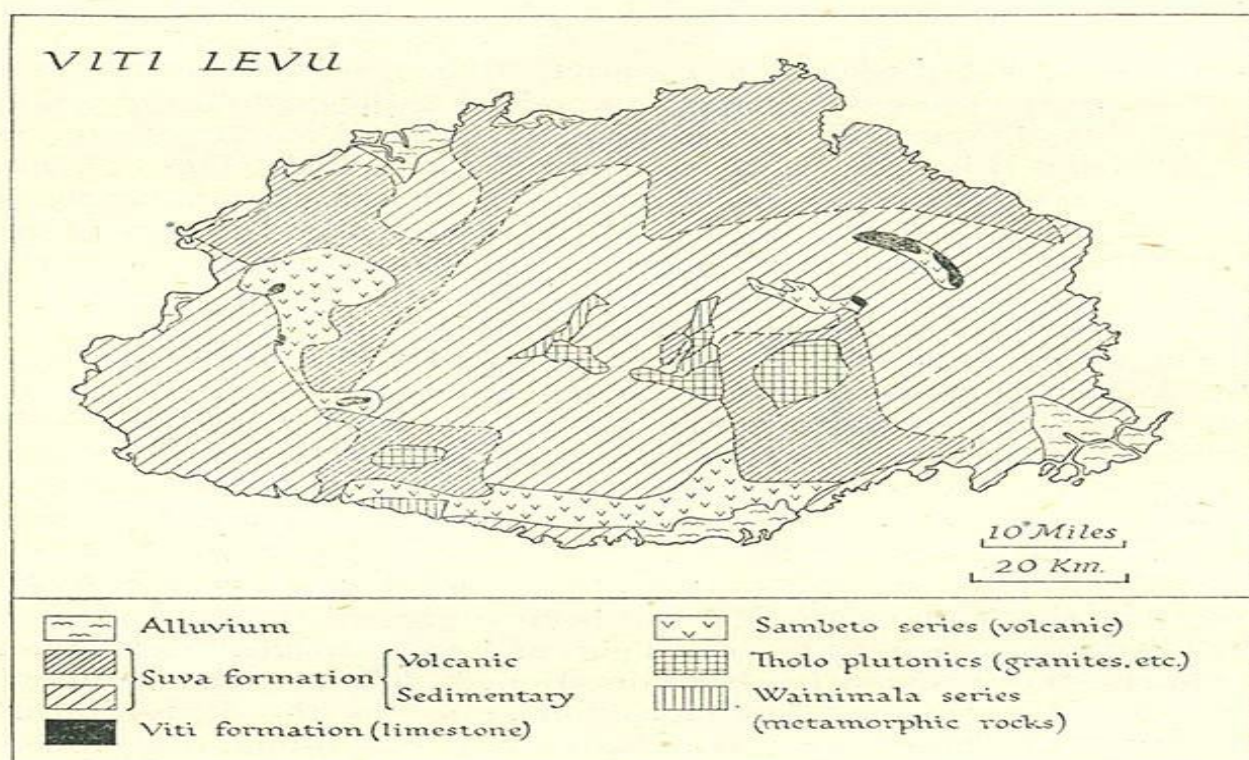


Fig. 35. Geological sketch map of Viti Levu

Based on H. S. Ladd, *Bernice P. Bishop Museum Bulletin*, no. 119, p. 16 (Honolulu, 1934).

Source: www.fijiearth.com



Activity 4.0

1. What happens at a divergent plate boundary?
2. What happens at convergent plate boundaries?
3. What happens at transform plate boundaries?
4. Explain why earthquakes and active volcanoes are found around the convergent plate boundaries in the Pacific Rim ("the Pacific Ring of Fire").
5. On an outline map of the Pacific, show the location of the divergent plate boundary in the Pacific. Name the plates on either side of it and show the directions in which they are moving.

Types of islands

Characteristic features of

1. Volcanic high islands

- high with rugged relief
- deep interior valleys
- jagged peaks and ranges
- lower coastal fringe

Examples – Viti levu, Vanua Levu, Taveuni, Lomaiviti group, Kadavu.

Explorers generally speak of 'high' and 'low' islands in relation to the structure, appearance, and size of islands themselves, their flora and fauna, and the lives and customs of their people. There are three types of islands in the archipelago. The majority are high islands of volcanic origin and low islands which include coral and limestone varieties. The volcanic islands, of which Viti Levu is an example, have sharply defined, mountainous landscapes, ancient volcanoes and rocky outcrops and shores inland, broken terrain with few stretches of flat except in river valleys.

In the windward areas where rain is frequent, the hills are covered with thick vegetation and are smothered almost incessantly with rain. In the leeward, growth is sparse and hills are brown. Lively traces of the active volcanic period are hot springs, which are always found at low elevations. The best known in Fiji are the springs at Nakama, in the old coconut-plantation town of Savusavu on Vanua Levu.

The larger islands of the Fiji group of islands are the results of the volcanic activities of the past. The solidification of the molten lava and rocks erupting from the volcanoes is responsible for the formation of the islands. The mountainous relief still bears many dormant volcanoes that prove the activities of the past.



Source: www.go-fiji.com

2. Raised limestone islands

Features of limestone islands

- Uplifted limestone deposits fractured by volcanic action
- Rise up to 300m but generally at low relief.
- Examples- Kabara, Lakeba, Fulaga

Limestone islands may also appear to be low and flat topped, but have steep, sharp sides suggesting that they are huge masses of rock heaved up from the sea. This is exactly what they are- often surrounded by a succession of precipitous cliffs, undercut by the surf. Because the limestone erodes easily, the rock may be pitted and bristling with sharp pinnacles or cut by ravines or narrow canyons, inland, central depressions gives the islands a basin-like appearance. The depression floors are commonly cut up into rolling hills, fertile and well wooded. A good example of a typical limestone island is Vanua Balavu in the Lau group.



Fulaga island Lagoon

Source: www.ezt.com.my

3. Coral islands or islets

Features of coral islands or islets

- very low relief
- soil generally sand

Examples – Nukulau, Wailagilala

The smaller of the Fiji islands are made of coral. Thus human habitation is impossible on most of them. They however are home to a large number of sea creatures who have taken shelter in and around the reefs.

Coral islands although low and small, have their own peculiarly Robinson Crusoe charm. Generally located near the inner margin of a broad reef, they are usually only a few metres above sea level, are flat as a table and have beautiful white sandy beaches. Despite limited soil, they often support luxuriant vegetation including vines, grasses, broad leaved trees and of course, the coconut palm. A classic example is the resort on beachcomber island off Lautoka.

Of the hundreds of islands in the Fiji group, only a few may be classed as true atolls. The typical atoll, of which so much has been written in the romantic literature of the South Seas, is basically long strips of broken coral and sand ranging from a few metres to half a km forming a circular or ring-like structure that surrounds a lagoon. Perhaps the best-known example of an atoll in Fiji is Wailagilala, on the eastern side of the Nanuku Passage, the main shipping path through the islands.



Wailagilala island –an uninhabited island in northern Lau

Source: www.cruiseguide.com.au

Reefs surround most islands.

Two types

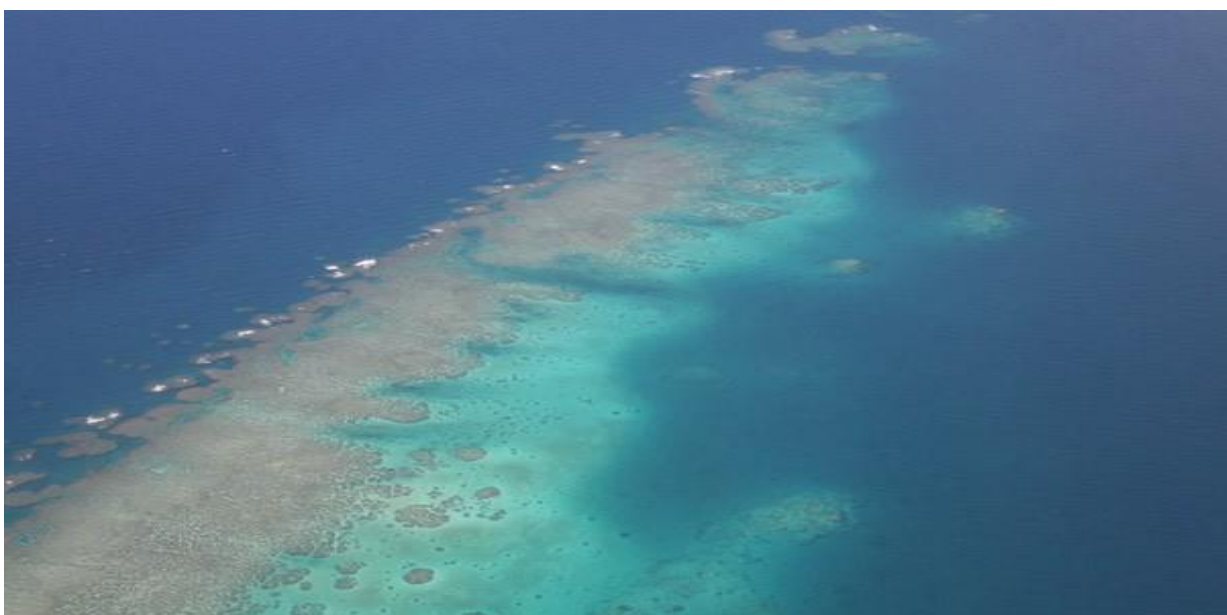
1. Fringing reefs – these cover the surface of off-shore platforms and have little water over them.



Fringing reefs in Fiji

Source: www.britanica.com

2. Barrier reefs – are found at the edge of the underwater platform are separate from the land. Beyond the barrier reef the sea-floor drops sharply into the ocean floor depths



The Great Astrolabe Reef in Kadavu

Source : www.paddlefiji.com

Volcanic Islands

The islands of the Fiji archipelago are formed of volcanic materials and sediments, deposited towards the eastern margin of a massive platform of great age, and complicated series of events that built and shaped them to their present form and over an enormous period of time

The features of volcanic high islands are

Jagged peaks and ranges

Lower coastal fringe

Mountains on Viti Levu have a north to south trend and at both ends, they swing eastward to form two coastal ranges

- East and the west of the high ridges are the plateau which form the basins of the main rivers.
- In these uplands are 29 peaks of over 3000 ft.
- Highest mountain peak – Mt Victoria
- These uplands form a broken pattern of ridges and valleys, volcanic plugs, cones and almost vertical thumbs and spikes.



Nadrau Plateau

Source: www.fijibure.com

Lowlands – of the main islands are found along the coasts and along the river valleys leading back into the hills and interior.

Lowlands on Viti levu

- Found on broad, flat flood plains and deltas near the mouths of the larger rivers and the narrow flats along the coasts
- They form only a small part of the total land area, but they support the bulk of Fiji's population.
- Western lowlands are chief sugarcane growing areas
- East and south east lowlands grow coconuts and market garden crops.

Lowlands on Vanua Levu

-lowlands are restricted

-found on the northern side of the island where they are broken in to pockets by ranges of low hills running out to sea.

-Ranges of low hills are spurs

-these lowlands are known as Talasiga plains – as they are hot and dry throughout most of the year.

- Only Labasa lowlands has been greatly developed.

- southern side of Vanua Levu- coastal flats are interrupted by steep bluffs and headlands or by patches of mangroves near the mouths of the streams.

DRAINAGE PATTERNS

- Viti Levu- drainage pattern is radial
- Rivers flow from central plateau in all directions to the coast
- Largest rivers- have dendritic (fanshaped) drainage pattern. Their main tributaries from the plateau join together in the main stream which meanders across the lowland to the sea.
- Example- the Rewa River drains almost 1/3 of Viti levu.
- The tributaries- Wainibuka, Wainimala, Waidina and Waimanu
- Example – the Sigatoka River, Ba River, and Nadi River – all reach into the interior and drain the western side of Viti Levu.

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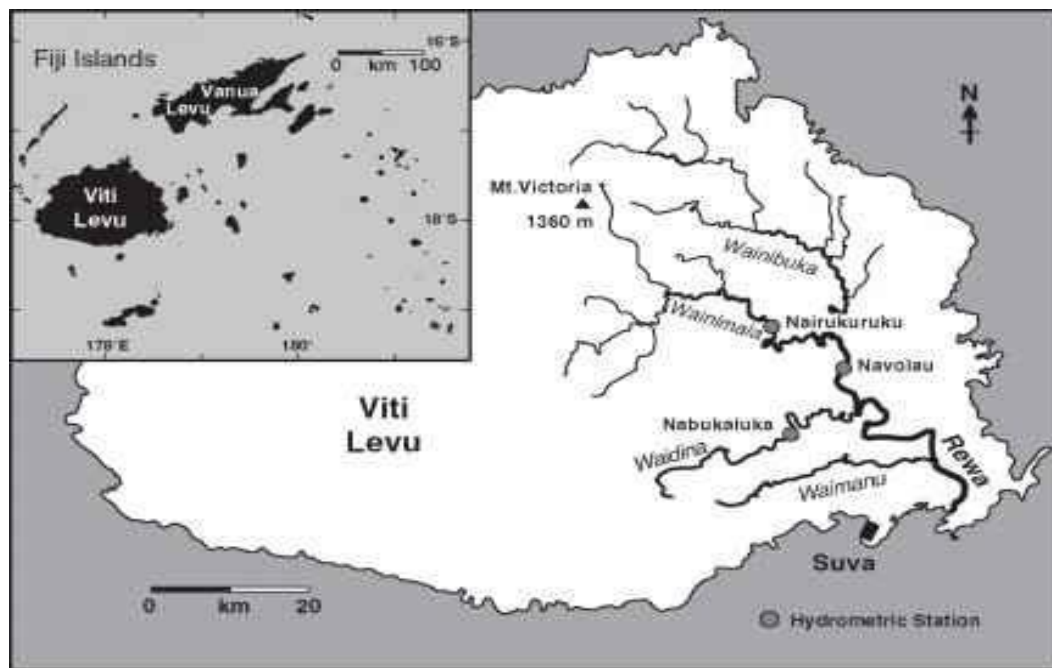
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Rewa River tributaries

Source: www.briangwilliams.us



Nadi River

Source: www.autostylized.com

Vanua Levu

- Main rivers – Dreketi, Nasikawa, Yanawai and Wainunu – all flow from the long central upland area down to the coast

Old Volcanic Landforms

- No active volcanoes in Fiji, but there is evidence of early volcanic activity.
- Joske's Thumb- formed when lava from a volcano solidified in the neck, then the sides of the peak weathered away leaving hardened cone to be exposed.

Caldera

Example – Ovalau Island is the remains of the caldera.

- Caldera is formed when the centre of a mountain is blown off during an eruption

Hot Springs

- Major feature of past volcanic activity
- Many hot springs and mud pool in Fiji
- Most prominent – in Savusavu in Vanua Levu, Nawaikama in Gau and in Kadavu and Vanua Balavu



Hot Spring in Savusavu

INFLUENCE OF RELIEF ON LANDUSE

- Except where they are cut by large rivers, the inland areas are high with steep slopes and broken with rugged hills.
- 1/3 of Fiji – too steep, too rocky or too poor to be used for farming
- It is only a small area of gentle relief that is intensively farmed, except where there are mangrove and swamp areas.
- Most cash cropping – done on coastal plains and the valleys
- High relief – increases cost of building roads which could enable farmers to transport cash crops to the ports and markets.
- Interior highlands – could be developed as planted forests or for extensive cattle grazing on grassland.

How relief affects human activities and vice versa

Case Study: Sigatoka Valley (known as the Salad Bowl of Fiji)

Location

Inland Sigatoka, along the west bank of the meandering river, flanked on both sides by a patchwork of flat green fields of vegetables that give the Sigatoka Valley its nickname: “Fiji’s Salad Bowl”.

Processes involved in the Formation

Valleys are one of the most common landforms on the Earth and they are formed through erosion or the gradual wearing down of the land by wind and water. In river valleys for example, the river acts as an erosional agent by grinding down the rock or soil and creating a valley. The shape of valleys varies but they are typically steep-sided canyons or broad plains, however their form depends on what is eroding it, the slope of the land, the type of rock or soil and the amount of time the land has been eroded.

Economic Activities

The Sigatoka Valley is known for its high production of vegetables, and thus referred to as Fiji’s “Salad Bowl”. Sigatoka’s economy is largely dictated by the flow-on effects of the broader Nadroga/ Navosa economy. Nadroga contains a high concentration of Hotels and Resorts outside of Nadi. There are several resorts in Sigatoka, for example, Shangri-La’s Fijian Resort & Spa, Outrigger on the Lagoon Fiji, Warwick Fiji Resort & Spa, Hideaway Hotel, Naviti Hotel. Recently, there has also been major growth in international residential developments.

Tourism accounts for a large number of employees and provincial development. Nadroga is also regarded and nicknamed the ‘Salad Bowl of Fiji’, specifically the Sigatoka Valley, which produces a high volume of the nation’s fruits, spices and vegetables, both for local consumption and export. Dalo (or Taro), often the domain of Eastern Fiji, is not so widely produced in Nadroga, however, cassava (tapioca) is produced for consumption and export. The province is one of Fiji’s sugar producing areas, however the number of farms and production have declined in the past 10 years as farmers seek to diversify their crops and move to more lucrative crop options. Expiring native land leases have also contributed to a decline in sugar production. Cattle (beef) farming used to be a major economic activity

led by the government-supported Yalavou Cattle Scheme, however this has also declined in recent years. Sigatoka's economy has benefited from the flow-on effect of tourists and agriculture in the greater Nadroga/Navosa province. The town provides an essential service point for hotel industry, hotel workers, farmers and so forth, in terms of provision of wholesale/retail goods, government services, police, utilities and administration. The international headquarters of Pacific Green Industries (Fiji) Limited is located in Sigatoka.

Source: http://en.wikipedia.org/wiki/Sigatoka,_Fiji

INFLUENCE OF HUMANS ON RELIEF

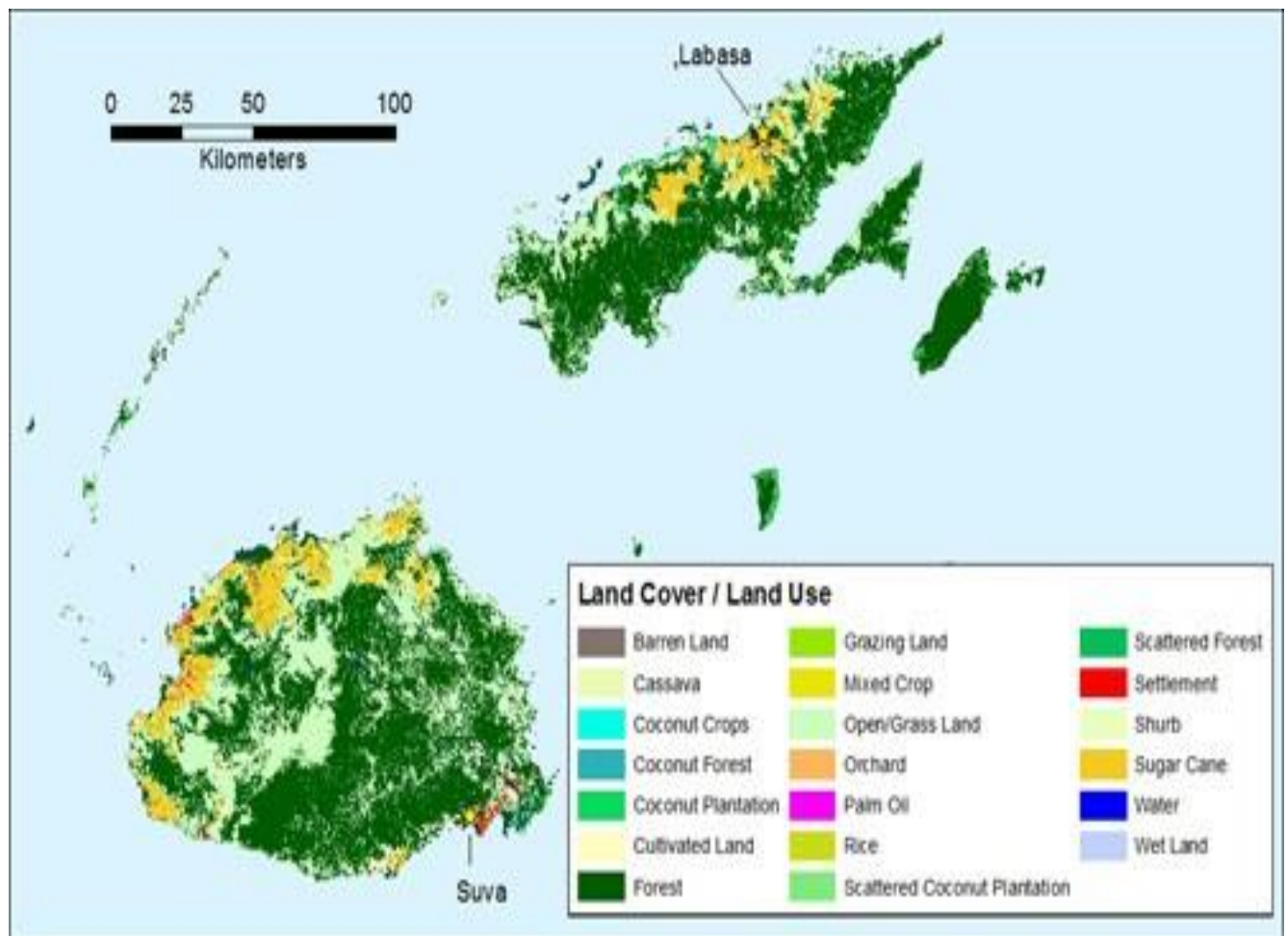
Since the beginning of human development, valleys have been an important place for people because of their presence close to rivers. Rivers enabled easier movement and also provided resources like water, good soils and food such as fish. The valleys themselves were also helpful in that valley walls often blocked winds and other severe weather if the settlement patterns were positioned correctly. In areas with rugged terrain, valleys also provided a safe place for settlement and made invasions difficult.

Source: <http://.about.com/education>



Eco-tourism up Luva River

Source : www.riversfiji.com



Source: www.air-worldwide.com