Unit 3 Living On Earth – Extracting, Using and Managing Earth Resources

Unit 4 The Changing Earth – The Cause and Impact Of Earth Hazards

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3.1.1.6

(a) Identify three non-metallic resources found in mineral sand deposits.

(b) Describe features of mineral sand deposits which determine that they fall into the category of non-renewable.

3.1.1.7

(a) What is coal seam gas?

(b) Why is coal seam gas classified as a non-renewable resource?

3.1.1.8 Explain how the mode of formation of fossil fuels results in their classification as a non-renewable resource.

3.1.1.9 Use a named example of a non-metallic resource studied during this course to explain why this resource cannot be replaced during our lifetime.

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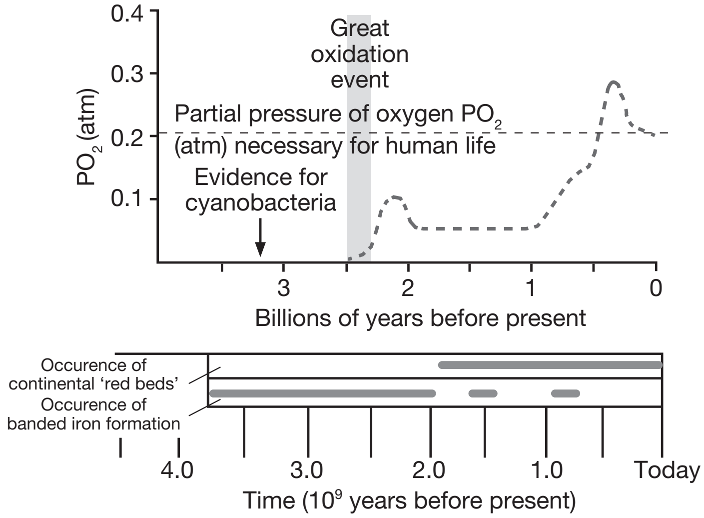
3.1.1.10 The major iron ore deposits in Australia are located in 2.5 Ga banded iron formations located in the Hamersley Range of Western Australia. They formed as a result of the introduction of oxygen into the oceans. Dissolved iron in the oceans reacted with the oxygen to form insoluble iron oxide minerals which precipitated in bands on the ocean floor.



(a) What was the likely source of oxygen in ocean water before 2.5 Ga?

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(b) Compare the oxygen concentration of the atmosphere before and after the great oxidation event.

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(c) Suggest a reason for red bed deposits becoming the major source of iron ore deposits from 2.0 Ga.

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3.1.1.11 Complete the table to identify two mineral resources produced in each of the different geological settings identified.

Geological setting	Mineral resources
Hydrothermal	
Alluvial	
Stratigraphic traps	

3.1.1.12 The Mount Isa Pb-Zn-Ag and Cu deposits are located in the north-western regions of Queensland where extensive faulting and the presence of super basins provide evidence of continental rifting.

Suggest a likely mode of formation for the Pb-Zn-Silver and Cu deposits in the Mount Isa region.

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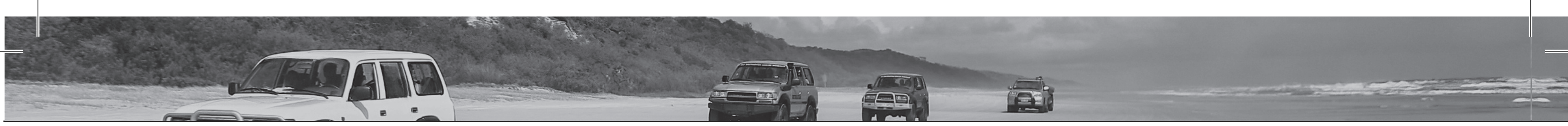
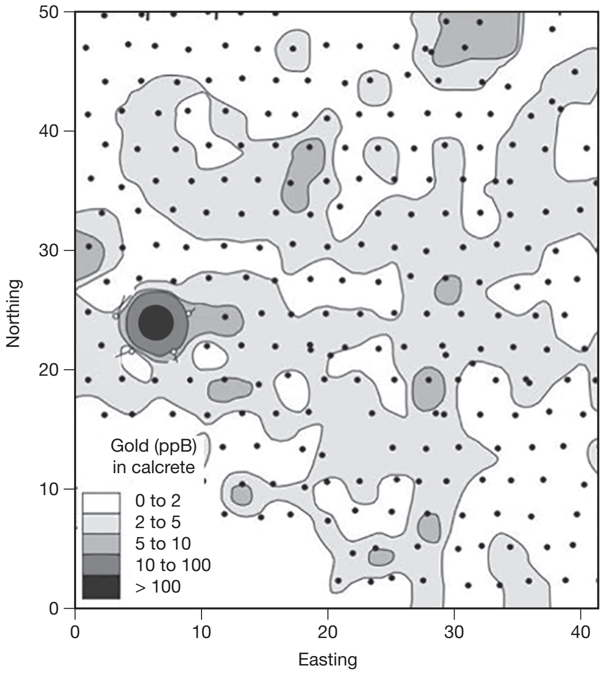


3.1.2.9 Sampling of calcrete from the top 2 metres of soil in a 200 square kilometre region provided geochemical data on the potential location of a gold deposit in the region.



(a) Identify the most likely location of a gold ore body in the region using its northerly and easterly position. Justify your selection.

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(b) Suggest reasons for conducting geochemical analysis in this region.

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(c) What further type of exploration would be required to determine the extent of the ore body?

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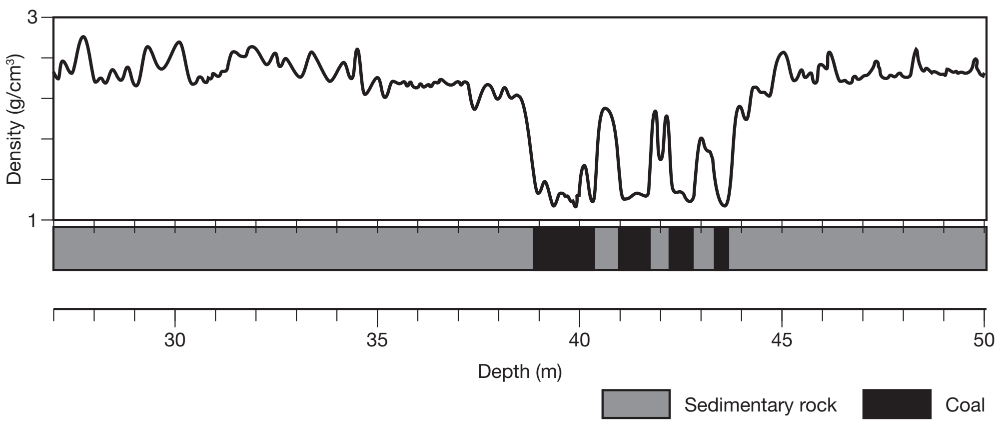
3.1.2.10 Geophysical data is routinely collected from the analysis of drill cores collected during coal exploration, however, the process is expensive and cores are often damaged or incomplete. Borehole logging is cheaper and provides a rich source of geophysical data and is particularly useful in determining the quality of coal seams and the strength of the surrounding rock.

The image shows a typical density log collected from borehole logging.



(a) Identify the trend observed in this image.

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(b) Explain how this type of data can be used by the resource industry.

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3.1.4.12

(a) Identify three environmental factors that require monitoring.

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(b) What is the purpose of monitoring environmental factors?

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(c) Why is it important to measure the effectiveness of environmental monitoring strategies?

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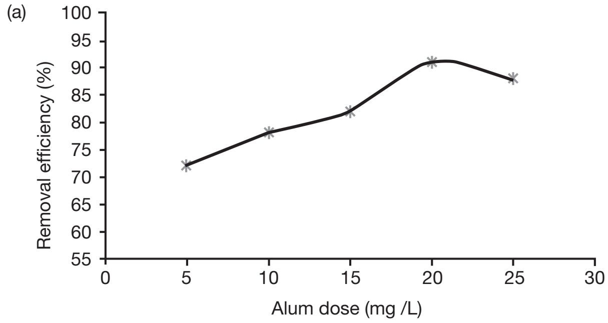
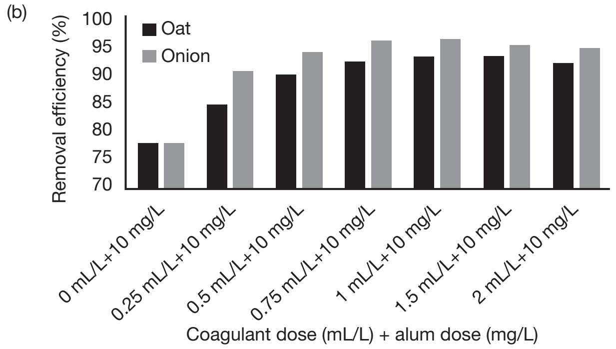
3.1.4.13 Coagulants such as alum are used to increase the rate at which suspended solids are able to settle to the bottom of a settling pond. Natural coagulants such as oat and onion extracts are often added to chemical coagulants.

Graph (a) shows the effect of different doses of alum on removal efficiency and graph (b) shows the effect of using natural coagulants such as oat and onion extracts in addition to alum.





(a) Describe the relationship between alum dose and removal efficiency in a settling pond.

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(b) Describe how the addition of oat and onion extracts to 10 mg/L of alum affects removal efficiency.

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(c) Suggest reasons for selecting 10 mg/L alum as the standard test dose used for adding the oat and onion extracts.

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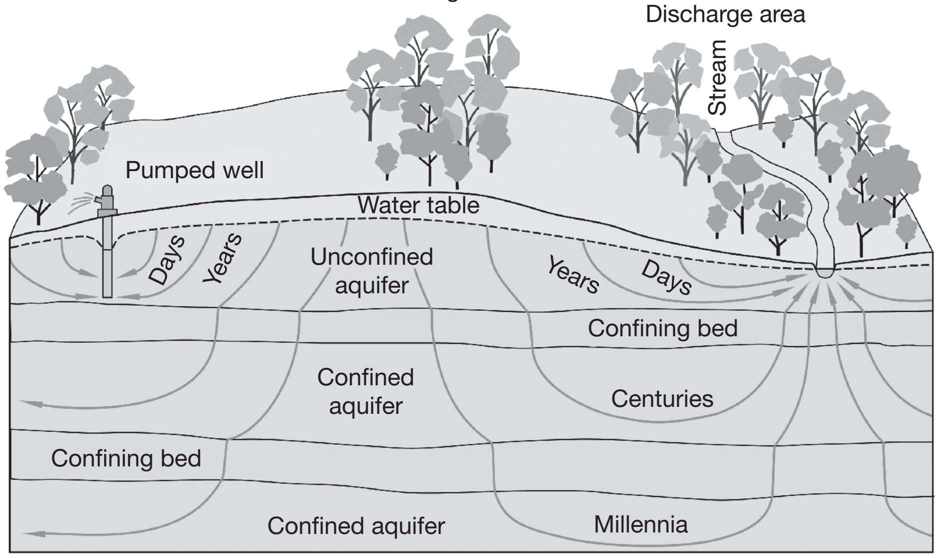
3.2.1.9 Groundwater systems interact with surface water systems to create dynamic stores of high quality water with variable flow rates and storage times.



(a) Compare the recharge of ground water on a local and regional scale.

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(b) Suggest reasons why deep artesian water supplies are more difficult to manage sustainably than shallow groundwater sources.

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3.2.1.10 Explain why hydroelectric energy is considered to be a sustainable source of energy.

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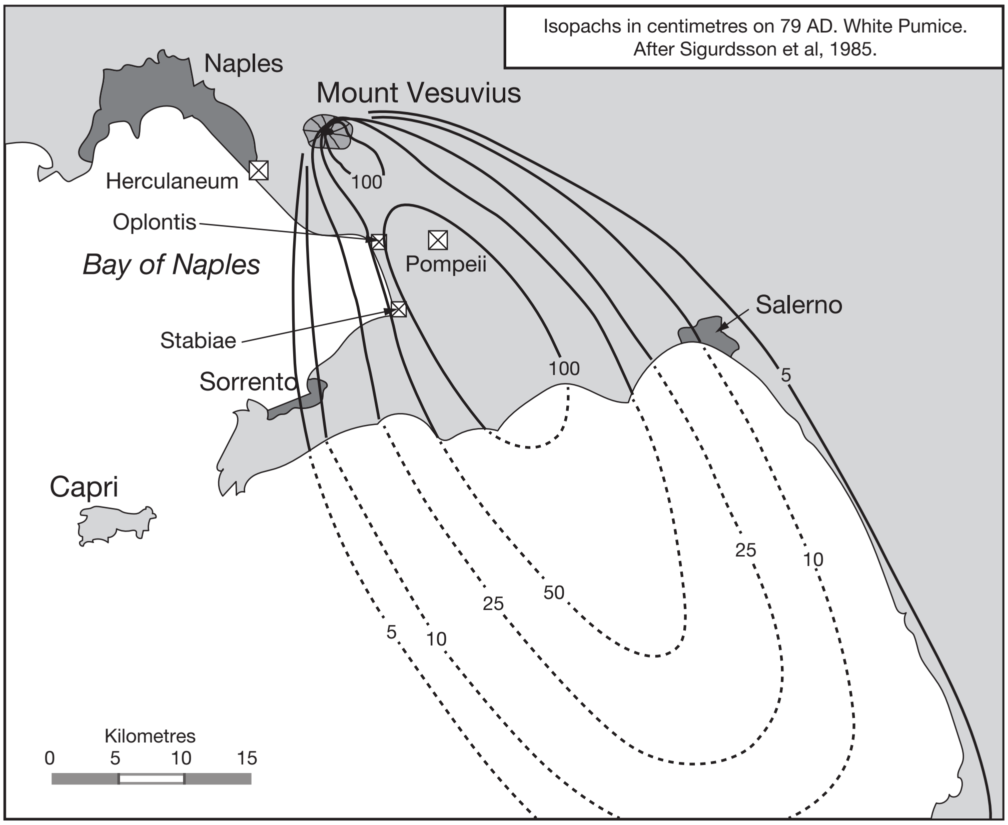
4.1.1.15 Isopach maps show the distribution and depth of ash deposited during a volcanic eruption. Such maps provide historical data about past eruptions which help civil authorities develop hazard management plans for future events.



Mount Vesuvius has erupted 30 times since its cataclysmic eruption in 79 AD. It has not erupted since 1944 and currently appears to be in a quiet phase, however, it will erupt again but no one can predict when. It is essential for authorities to plan for an eruption which could happen at any time.

Evaluate the usefulness of information such as isopach maps in developing hazard management plans for regions situated near active volcanoes.

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4.1.1.16 The image below shows the damage caused by a 7.9 magnitude earthquake which hit Sichuan, China in 2008 killing nearly 70 000 people and injuring nearly 400 000.

(a) Outline design features of buildings which help prevent structural damage during an earthquake.

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(b) Explain how one of these features can prevent damage to the structure during an earthquake.

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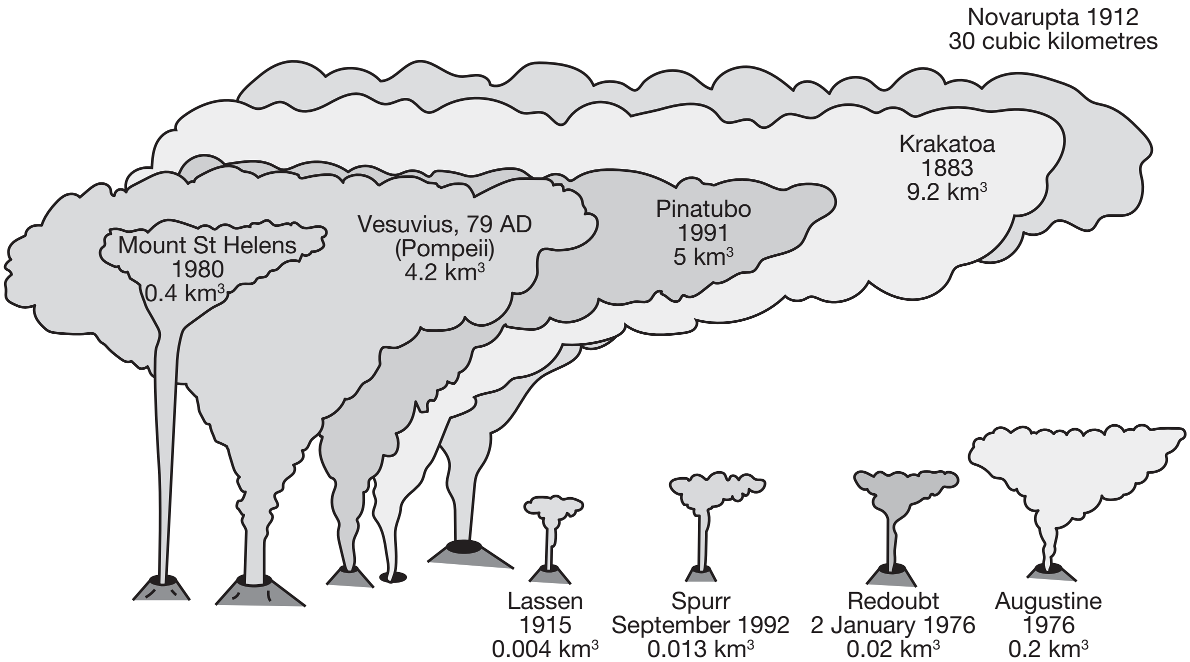
4.1.1.19 The eruption of the Alaskan volcano Novarupta was the largest eruption of the 20th century. It is estimated that this eruption emitted about 30 km^3 of ejecta into the atmosphere.

The image below shows a comparison of the ejecta released in several major eruptions of the 20th century.



Based on your understanding of explosive eruptions and their impact on climate, suggest the most likely impact of the eruption of Novarupta on global climate in 1912.

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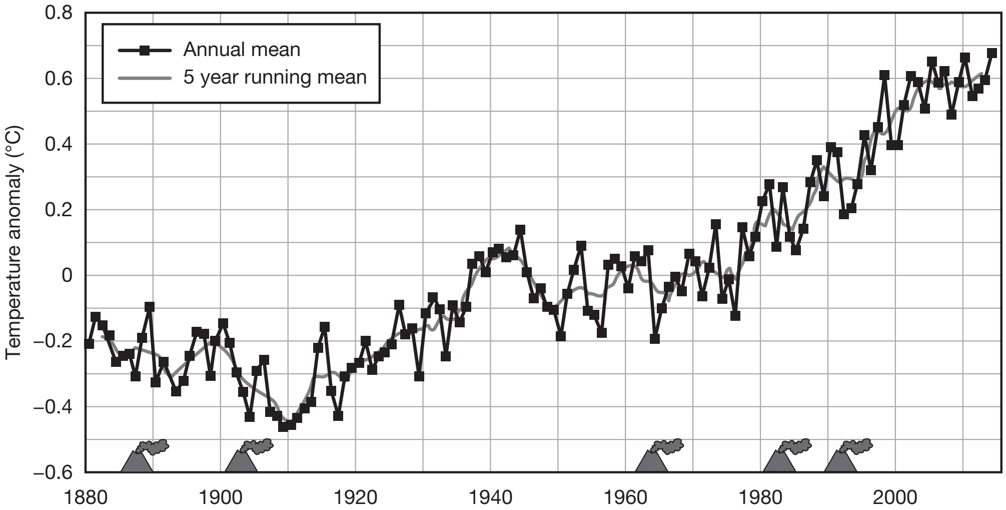
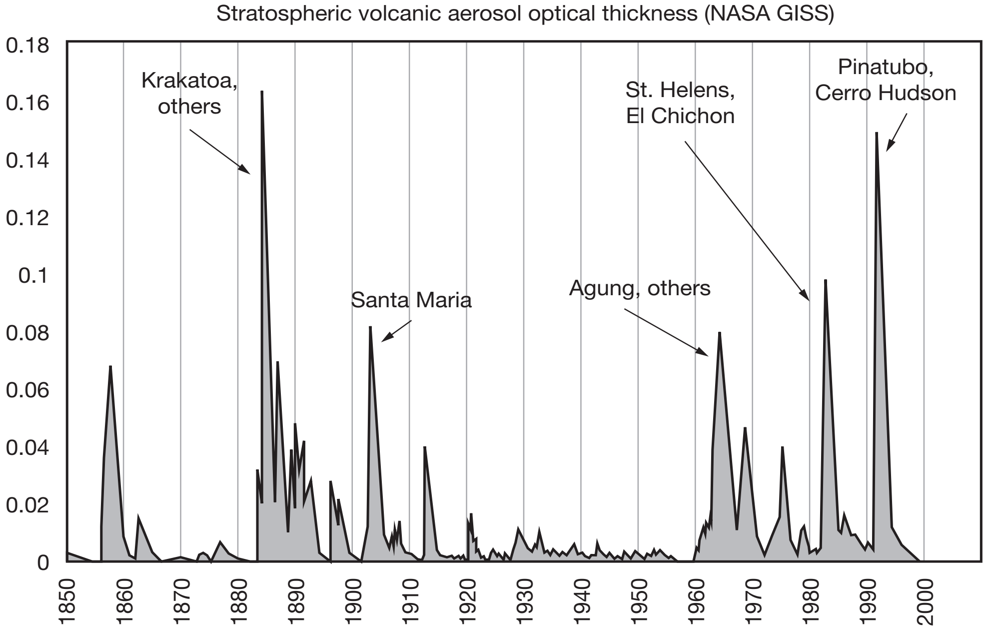
4.1.1.20 Examine the data provided in the two graphs below.

Graph 1 Global surface temperatures from 1880 to 2014 compared to the 1950 to 1970 mean.



Graph 2 The relative volcanic aerosol thickness in the stratosphere from 1850 to 2000.



(a) What conclusion can be drawn about the relationship between volcanic eruptions and average global temperatures?

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(b) Use data from the graphs to explain this relationship.

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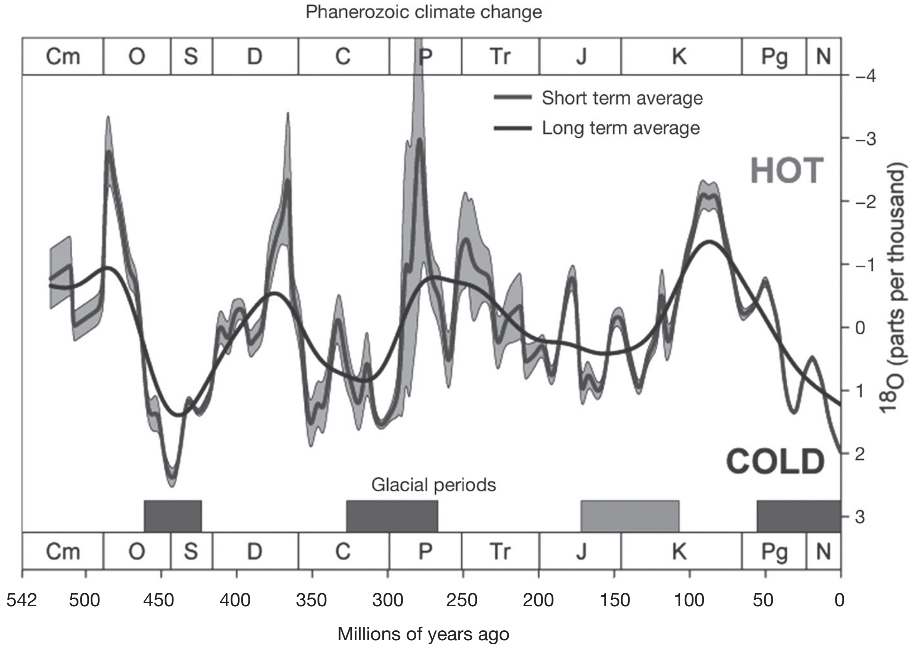
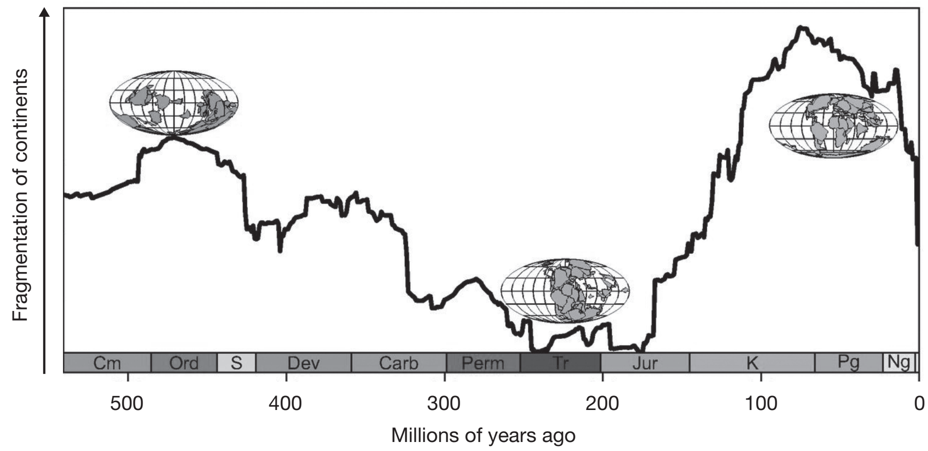
4.2.1.7 The following graphs show global climate variation and the plate tectonic supercycle (PTS) throughout the Phanerozoic.

Graph 1



Graph 2



(a) Identify any relationship that might exist between global temperatures and the distribution of continents observed in these graphs.

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(b) Explain this relationship.

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(c) Explain how the impact of other climate drivers could be responsible for the data in graph 1.

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4.2.1.8 Explain how each of the three Milankovitch cycles can alter the radiative forcing influence of the Sun.

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4.2.1.9 The role played by changes in the position of the Earth in relation to the Sun on global climate change was first proposed by Serbian scientist Milutin Milankovitch.

(a) Complete the table to identify how features of each component of the Earth's orbits influence climate.

Feature	Influence
Eccentricity	
Obliquity	
Precession	

(b) What evidence is there to support Milankovitch's proposal?

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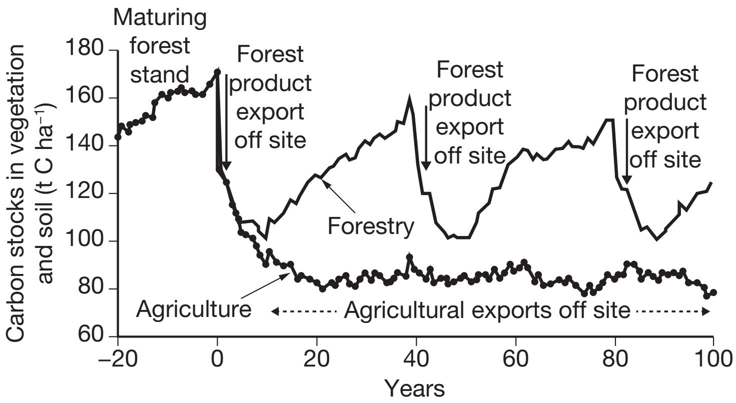
4.2.2.3 The graph below models the amount of carbon that would be held in vegetation in land used for forestry compared with land used for agriculture over a projected period of 100 years.



Explain the impact of land clearing for agriculture on rising levels of carbon dioxide in the atmosphere and the greenhouse effect.

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4.2.2.4 The concentration of oxygen and nitrogen in the atmosphere has remained stable for the past 2 billion years. The concentration of the remaining atmospheric gases, however, are much more susceptible to change in response to climatic conditions. Carbon dioxide, methane and sulfur dioxide in particular play a significant role in climate variation.

The table identifies the volume of each gas entering the atmosphere each year in million tonnes from natural and human sources.

Atmospheric gas	Natural sources (million tonnes)	Human sources (million tonnes)
Carbon dioxide	750 000	32 500
Methane	240	350
Sulfur dioxide	20 to 25	100

(a) Compare the contribution of natural and human sources of carbon dioxide, methane and sulfur dioxide.

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(b) Explain the impact of carbon dioxide, methane and sulfur dioxide from human and natural sources on the concentration of these gases on the atmosphere.

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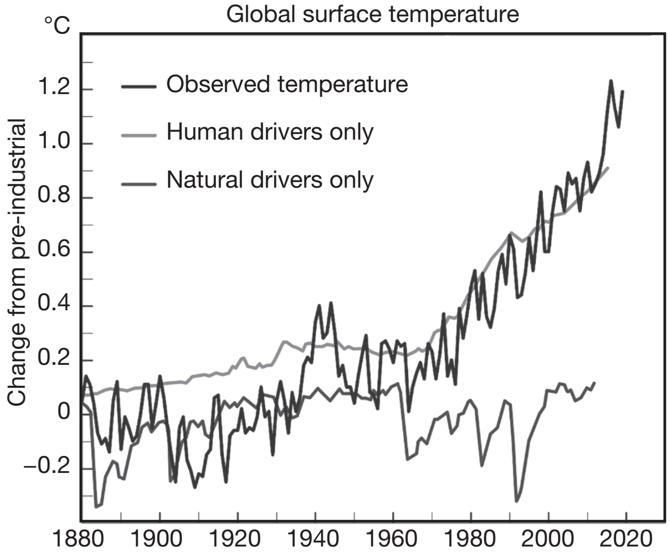
4.2.2.5 The graph shows the observed changes in global surface temperature measured against the pre-industrial baseline average of temperatures from between 1850 to 1900 as reported by the IPCC.



(a) Compare the trends in observed changes in global temperature with temperature changes caused by natural climate drivers only.

(b) Suggest a reason for the strong dips in temperature due to natural climate drivers.

(c) Explain why most of the observed increase in global temperatures have been attributed to human causes.

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4.2.2.9 Changes in land use as shown in the images below have contributed to climate change through its contribution to the enhanced greenhouse effect.

Explain how changes in land use contribute to the enhanced greenhouse effect.

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4.2.2.10 Greenhouse gas (GHG) emissions have risen drastically since the Industrial Revolution as a result of our increased dependence on energy and the production of goods and services which are fundamental to the global economy and our daily lives. These activities consume fossil fuels and produce GHGs which contribute to the enhanced greenhouse effect.

The following data shows Australia's GHG emissions by sector for 2008.

Economic sector	Agriculture	Transport	Stationary energy	Industrial	Land use/change and forestry	Fugitive	Waste
Percentage (%)	15	14	51	5	5	7	3

(a) Graph this data on the grid below.

(b) Suggest the two main uses of energy included in the stationary energy column.

(c) Account for claims by the International Governmental Panel on Climate Change that the agricultural sector is responsible for 31% of total global GHG emissions.

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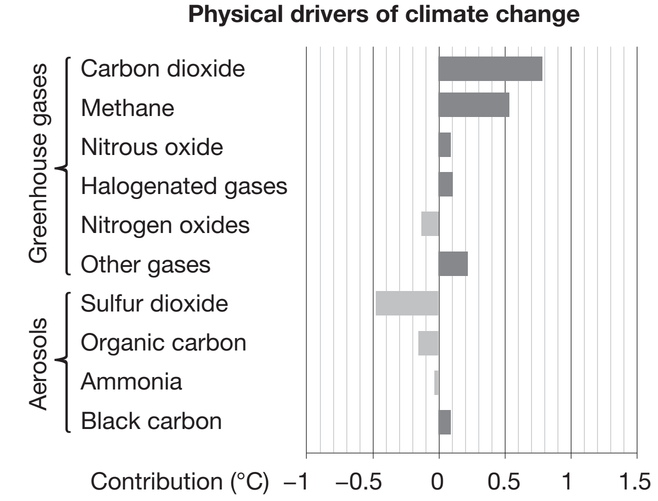
4.2.2.13 This image compares the radiative forcing of greenhouse gases and aerosols on climate.



(a) What is the combined radiative forcing of carbon dioxide and methane on global temperatures?

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(b) Recent studies have shown that nitrogen used in fertilisers has an overall negative impact on climate. Suggest a reason for this finding.

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(c) Explain how efforts to reduce pollution could increase the radiative forcing of carbon dioxide and methane.

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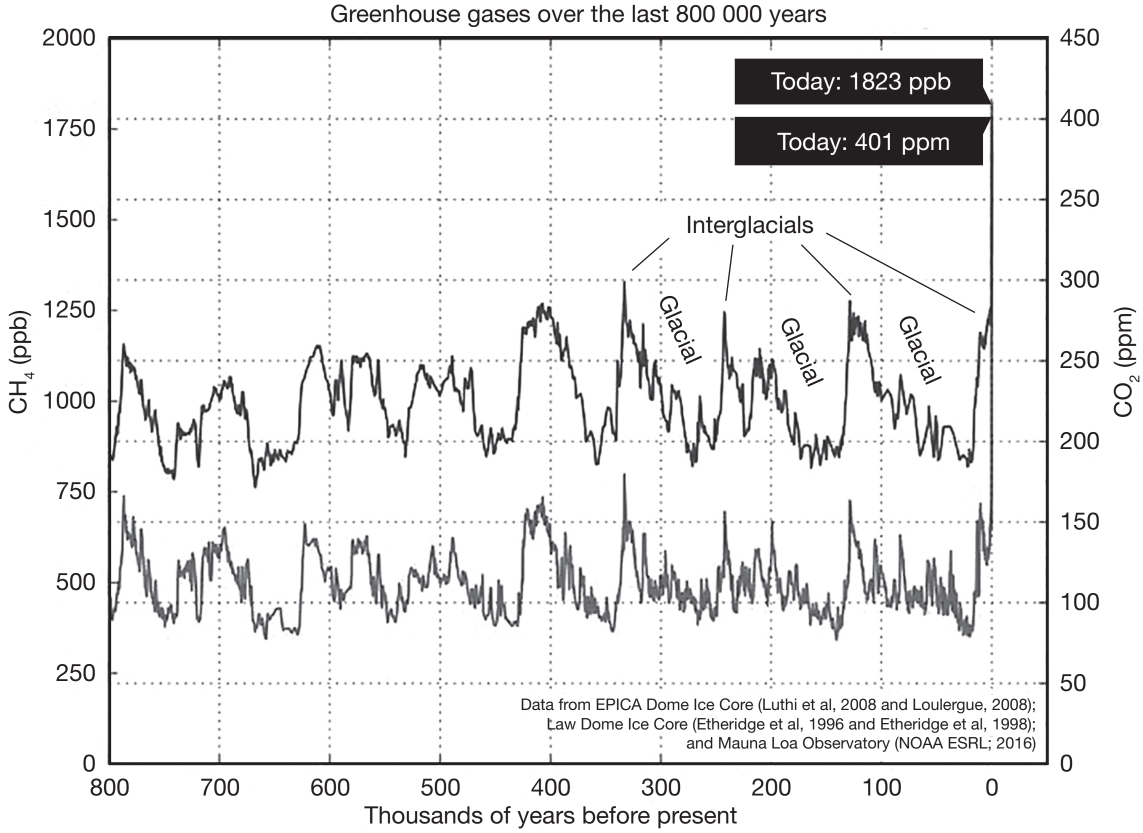
4.2.2.14 Small bubbles of air trapped in glacial ice provides a sample of the atmosphere at the time the ice was formed. It is possible to directly measure the exact concentrations of gases including carbon dioxide and methane in the atmosphere at that time. The data collected is then presented in graphs which identify the nature of variations in these concentrations.



(a) Describe any trends, patterns or relationships apparent in this data.

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(b) What conclusion can be drawn about recent changes in carbon dioxide and methane gas concentrations? Justify your conclusion.

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4.2.3.6 The table provides population and distribution data about birds endemic to low lying coastal habitats of Oceania.

Bird species	Population	Distribution
Polynesian ground dove	150	Volcanic islands and coral atolls in the South Pacific
Christmas shearwater	150 000	Widespread in northern Oceania
Great frigatebird	>10 000	Widespread in northern Oceania
Kiritimati reed warbler	<10 000	Limited to two low lying coral atolls
Tuamotu kingfisher	90	Only found on the island of Niau in the South Pacific
Tuamotu sandpiper	900	Few islands in South Pacific

(a) All of the bird species in this table are at risk from loss of habitat due to rising sea levels.

Identify the two species most likely to be at risk from rising sea levels.

(b) Explain why these two species are at such great risk.

4.2.3.7 Use an example to demonstrate the impact of climate change on the distribution of terrestrial organisms.

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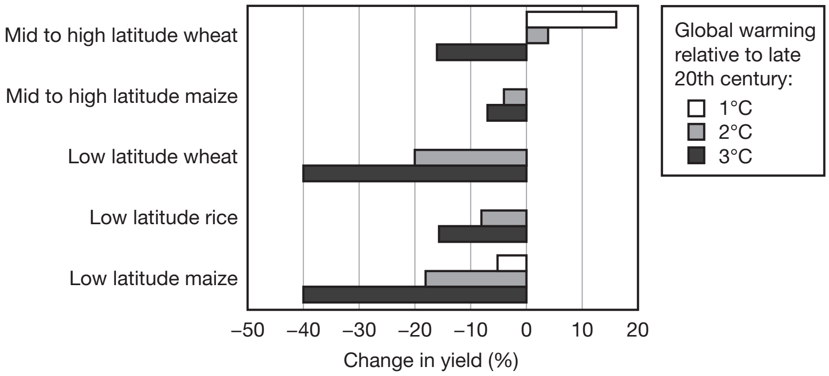
4.2.3.8 The graph provides estimates of projected yield for a variety of crops grown in different latitudes for a range of likely temperature changes expected from ongoing climate change. The projections are based on data from the US National Research Council for foods grown under the expected atmospheric carbon dioxide levels for 2050.



(a) Discuss the likely impact of climate change on crop productivity on a global scale.

(b) Confidence in the projections made in this graph is rated at low to moderate.

Suggest reasons why there is not greater confidence in these projections.

4.2.3.9 Measurements from core samples, tide gauges and satellite measurements indicate that the sea level has risen 10 to 20 cm over the past century. However, sea level has risen 6 cm over the past 20 years, twice as fast as in the preceding 80 years. The IPCC says that sea levels are expected to rise 32 cm by 2050.

(a) Identify the types of ecosystems which are at risk from rising sea levels.

(b) Outline changes to the physical environment in these ecosystems caused by rising sea levels.

(c) Describe the impact of these changes on species living within these ecosystems.

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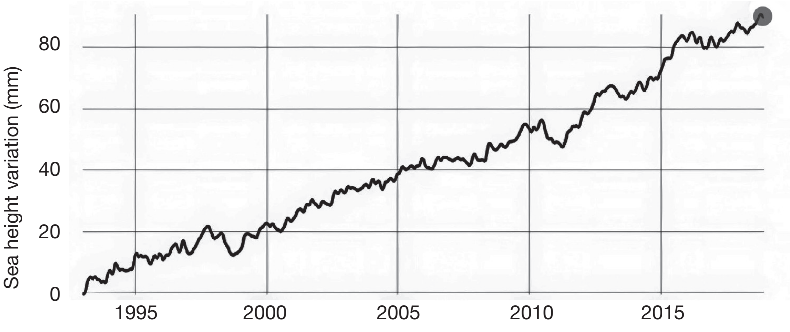
4.2.3.10 The graph shows sea level observations gathered from satellite radar measurements between 1993 and 2018.



(a) Use data provided in the graph to calculate the average rise in sea levels between 1995 and 2018.

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(b) Explain why sea levels are rising.

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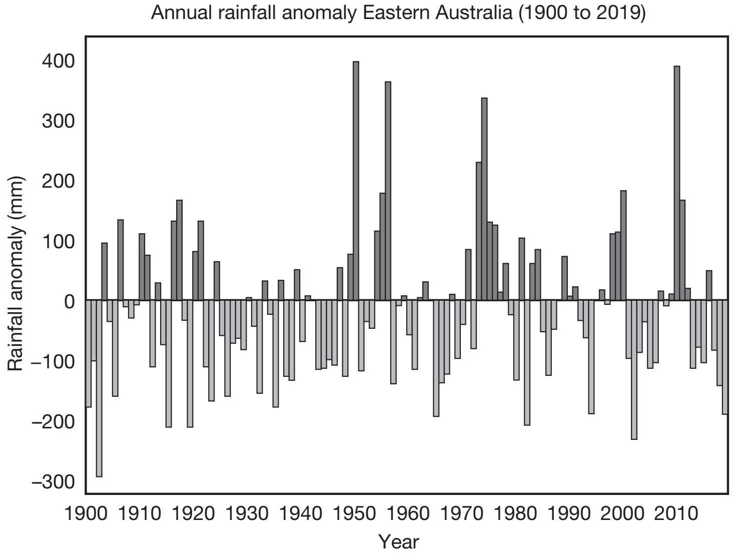
4.2.3.11 Climate change is causing changes in rainfall patterns around the world. The graph shows how rainfall in Eastern Australia has changed from 1900 to 2019. The baseline for comparison at 0 mm represents average rainfall between 1961 to 1990.



(a) Describe changes in rainfall across Eastern Australia since 1900.

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(b) Explain why this graph does not provide a clear indication of the impact of climate change on rainfall in Australia.

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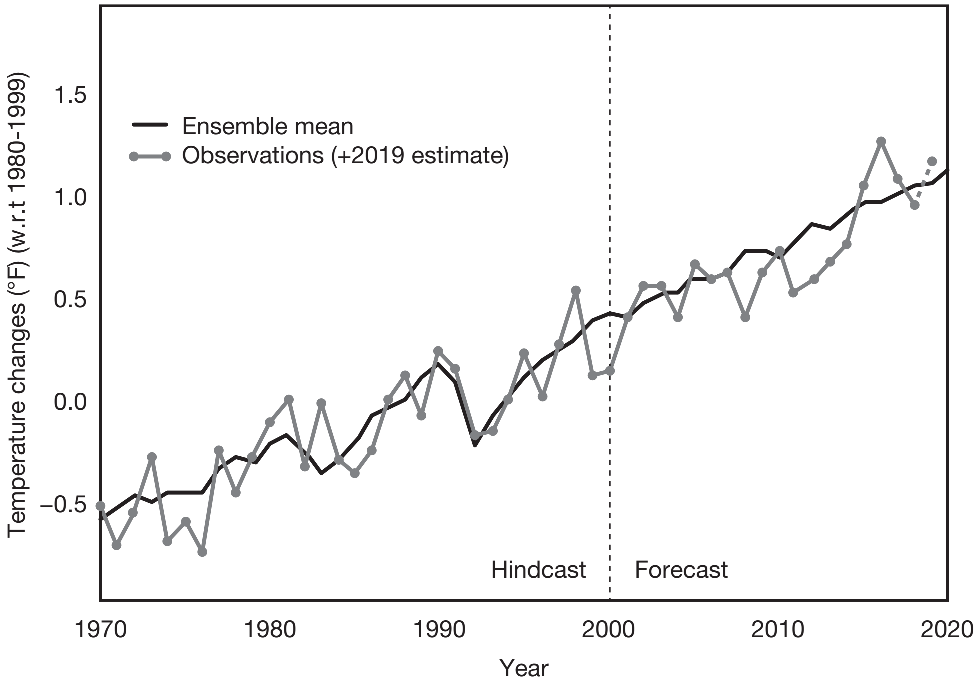
4.2.5.15 The graph provides a comparison of the change in temperature from a 1980 to 1999 baseline average, obtained from 17 climate model projections with observational data from multiple government sponsored sources such as NASA.

Forecast evaluation for models run in 2004



Hindcast data is used to establish the validity of the models, while forecast data is used to make predictions of future.

(a) In what year was this climate model applied? Justify your response.

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(b) Explain the importance of hindcast data.

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(c) What conclusion can be drawn about the accuracy of the climate models used for this data and whether they require further adjustment?

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4.2.5.16 Climate outlooks are a valuable tool for communities making decisions about weather dependent activities and preparing for severe weather events.

(a) What sort of information do climate outlooks provide?

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(b) Describe the type of data used for producing climate outlooks.

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4.2.5.17 The tables provide climate outlooks for mean temperature and rainfall for South East Queensland, Central West Queensland and North Queensland for 2030, 2050 and 2070. Data is provided for outlooks based on low and high emissions futures.

Mean temperature (°C)	**2030**		**2050**		**2070**	
	Low emissions	**High emissions**	**Low emissions**	**High emissions**	**Low emissions**	**High emissions**
South East Queensland	+0.8	+0.9	+1.2	+1.7	+1.5	+2.6
Central West Queensland	+1.1	+1.2	+1.5	+2.0	+2.0	+3.3
North Queensland	+0.9	+1.0	+1.3	+1.7	+1.6	+2.6

Rainfall change (%)	**2030**		**2050**		**2070**	
	Low emissions	**High emissions**	**Low emissions**	**High emissions**	**Low emissions**	**High emissions**
South East Queensland	–3	–5	–1	–1	–3	–9
Central West Queensland	–3	–5	–5	–7	–3	–9
North Queensland	–5	–8	–1	–7	–6	–9

What conclusions can be drawn about future temperatures and rainfall in these areas of Queensland?

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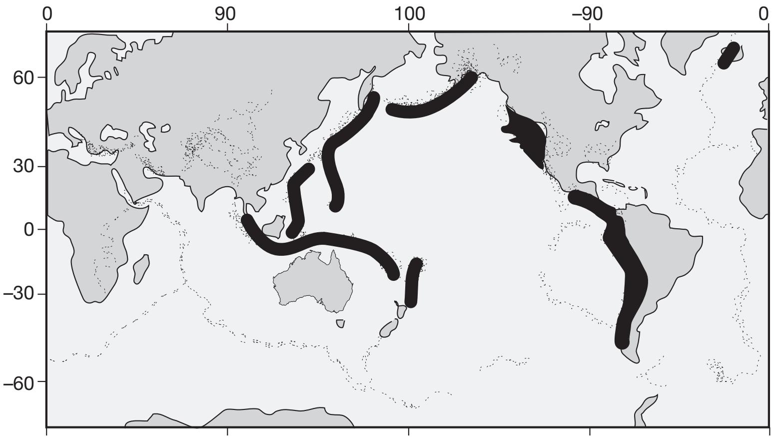
4.1.2.6 (a)



(b) All but one of the shaded regions are subduction zones where the high frequency of earthquakes is due to the descending oceanic plates as earthquakes occur along the subducted plates. This produces a wide band of earthquakes along subduction zones. Volcanoes are prominent along subduction zones, therefore, the high frequency of earthquakes across a wide linear zone identifies the region as a subduction zone and consequently a high risk of volcanic activity. Volcanic activity is also particularly hazardous in Iceland where volcanic activity is due to the active rifting through the middle of the island.

(c) The west coast of South America borders the Pacific Ocean which is ringed by subduction zones. This exposes the west coast to tsunamis generated by large magnitude undersea earthquakes common along these zones. The east coast of South America is exposed to less frequent intense earthquake activity as there are no subduction zones along the Atlantic coasts and therefore at lower risk of tsunamis.

4.1.3.1

Phenomenon	Main features
Cyclone	Intense tropical lows which rotate around an eye. Sustained winds in excess of 90 km/h.
Floods	Excessive inundation of water over land that is normally dry. Occur when water cannot drain away quickly enough.
Drought	Abnormally long periods of dry weather. Evaporation of water exceeds precipitation and infiltration.

4.1.3.2 Cyclones are large revolving tropical storms that bring destructive gale force winds, heavy rainfall and storm surges to coastal communities. Floods can result from the rain and storm surges that accompany cyclones, but can also result from any weather system such as monsoons and east coast lows, that brings excessive rainfall. Floods frequently affect riverine systems, but can also move across vast expanses of low lying areas of the continent. Droughts are prolonged periods of dry weather, where rainfall is significantly lower than normal and evaporation rates exceed precipitation.

4.1.3.3 (a) Cyclones are classified according to maximum wind speed lasting a minimum of 10 minutes. Category 1 cyclones are the weakest and must sustain wind speeds of at least 90 km/h. Category 5 cyclones must have sustained maximum wind speeds in excess of 200 km/h.

(b) The speed at which the cyclone crosses the coast and the type of communities in the path of the cyclone. If the cyclone passes through rural or non-inhabited regions, then the cyclone will cause less damage than if it passes through highly populated areas, with a high proportion of built structures. The amount of rainfall and the size and timing of the storm surge are also critical factors.

(c) The rising warm moist air above tropical oceans fuels a cyclone by the release of energy as it condenses to form the clouds. As the cyclone passes over land there is insufficient moisture in the air to maintain the rotational energy of the cyclone.

4.1.3.4 (a) Category 5.

(b) Cyclones usually change direction as they approach land, but Yasi took an almost direct path in its approach to the Queensland coast.

(c) The cyclone continued on its path of destruction, maintaining its status as a cyclone for close to 1000 km finally degrading into a tropical low at Cloncurry near Mount Isa. The impact from the resultant tropical low would also have been felt for many more hundreds of kilometres further inland.

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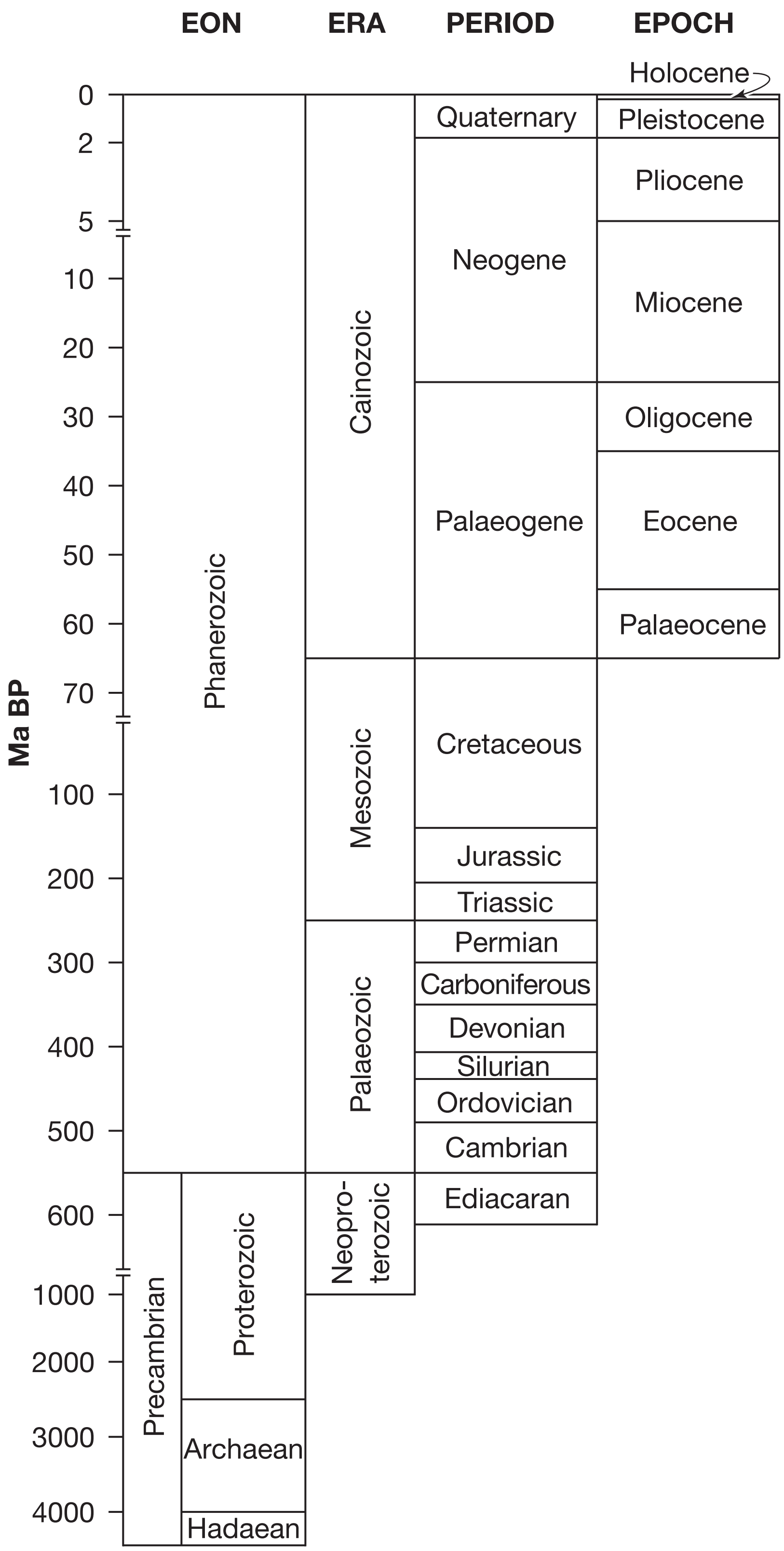
Geological Time Scale



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