Chapter 1

EXTRA RESOURCE

Plate tectonics and associated hazards

Management of hazards

Chapter 1 of your *AQA A2 Geography* textbook includes case studies of particular volcanoes and earthquakes (pages 18–23 and 30–34). This additional resource provides a more general overview of how earthquake and volcano hazards can be managed.

Hazard management: volcanoes

Prediction

It is easy to locate volcanoes, but it is very difficult to predict exactly when activity will take place, particularly a major eruption. The Colombian volcano, Nevado del Ruiz, came to life in late 1984 with small-scale activity. Vulcanologists knew the danger a major eruption could pose to the surrounding area, but were unable to predict when the major event would take place. Small-scale volcanic activity continued for several months and people were not prepared to evacuate their homes on the basis of this threat. When the violent eruption came on 13 November 1985, almost all the population had remained in the area. Devastating lahars, resulting from melting snow and ice, swept down the valleys, killing over 20,000 people.

A study of the previous eruption history of a volcano is important in prediction, along with an understanding of the type of activity produced. At present, research is being conducted to see if it is possible to predict the time of an eruption accurately using the shock waves that are produced as magma approaches the surface, expanding cracks and breaking through other areas of rock. There was some success in predicting the recent eruption (2000) of Popacatapetl in Mexico, but it remains to be seen if such techniques can be applied to all volcanoes.

Protection

With volcanic activity, protection means preparing for the event. Monitoring of the volcano may suggest a time when the area under threat should be evacuated. Such monitoring includes observations of land swelling, earthquake activity, changes in groundwater level and chemical composition, emission of gases, magnetic field studies and the shock wave analysis mentioned above. Several governments of countries in volcanic areas have made risk assessments and from them produced a

series of alert levels to warn the public. In New Zealand the government has produced a five-stage table that includes the following:

1 Signs of volcanic activity. No significant volcanic threat.
2 Indications of intrusive processes. Local eruption threat.
3 Increasing intrusive trends indicate real possibility of hazardous eruption.
4 Large-scale eruption now appears imminent.
5 Destruction within the permanent danger zone (as identified). Significant risk over a wider area.

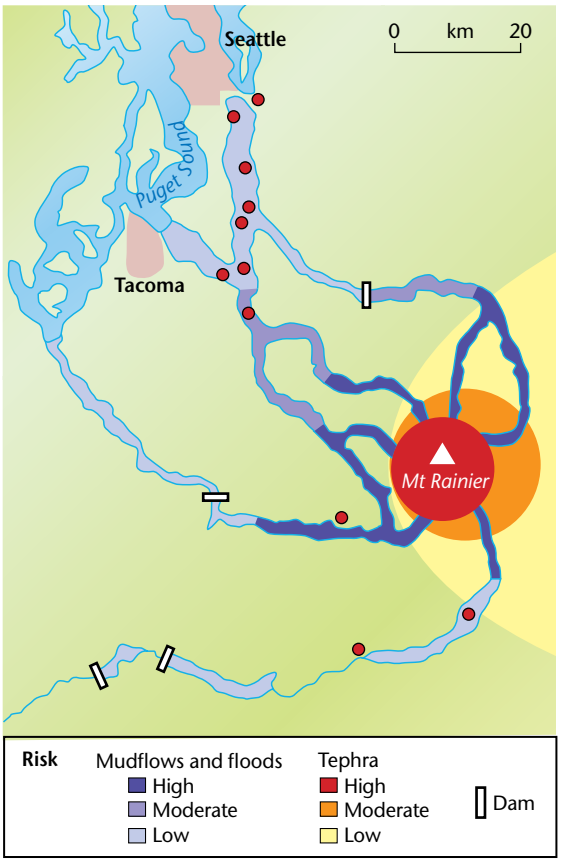

Figure 1
Risk assessment of the Mt Rainier area

Geological studies of the nature and extent of deposits from former eruptions and associated ashfalls, lahars and floods may also provide evidence for hazard assessment. Figure 1 shows the hazards posed by Mt Rainier (Cascade Range, USA), one of the most studied volcanoes in North America.

Following assessments, it is possible to identify the areas at greatest risk, and land use planning can be applied to avoid building in such places.

Once the lava has started to flow, it is possible, in certain circumstances, to divert it from the built environment by:

- digging trenches (Mt Etna, Sicily)
- explosive activity (Mt Etna, 1983)
- artificial barriers, which also protect against lahars (Hawaiian islands)
- pouring water on the lava front (Haeimaey, Iceland, 1973)

Foreign aid to developing countries suffering volcanic eruptions may be required for considerable periods of time as volcanic events can be prolonged and devastating to the local economy. Such aid is needed for monitoring, evacuation, emergency shelters and food, long-term resettlement of the population and restoration of the economic base and the area's infrastructure.

Hazard management: earthquakes

Prediction

The prediction of earthquakes is very difficult. Regions at risk can be identified through plate tectonics, but attempts to predict earthquakes a few hours before the event are unreliable. Such prediction is based upon monitoring groundwater levels, release of radon gas and unusual animal behaviour. Fault lines such as the San Andreas can be monitored and local magnetic fields can be measured. Areas can also be mapped on the basis of geological information and studies of ground stability. These can help to predict the impact of earthquakes and can be used to produce a hazard zone map that can be acted upon by local and even national planners.

Close studies of fault lines can sometimes indicate the point along the fault where the next earthquake might be due. A study of the pattern of events along the San Andreas fault between 1969 and 1989 revealed the existence of a 'seismic gap' in the area of Loma Prieta. This area suffered an earthquake in October 1989 which measured 7.1 on the Richter scale and was the worst to hit the San Francisco region since 1906. In total, 63 people died and more than 3,700 were seriously injured. Because of the seismic survey, this event was not entirely unexpected, but, like all earthquakes, it was not possible to predict it precisely. Such a system, however, would not work for events such as the one at Northridge, which took place on an unknown fault line.

Prevention

Trying to prevent an earthquake is thought by most people to be impossible. This, however, has not stopped studies into the feasibility of schemes to keep the plates sliding past each other, rather than 'sticking' and then releasing, which is the main cause of earthquakes. Suggestions so far for lubricating this movement have focused on water and oil. Some people have even gone as far as to suggest nuclear explosions at depth!

Protection

Since earthquakes strike suddenly, violently and without warning, preparation cannot be put off until the event. Being prepared for an earthquake involves everyone from civil authorities to individuals. In the USA, the Federal Emergency Management Agency's earthquake program has the following objectives:

- to promote understanding of earthquakes and their effects
- to work better to identify earthquake risk
- to improve earthquake-resistant design and construction techniques
- to encourage the use of earthquake-safe policies and planning practices

Protection therefore means preparing for the event by modifying the human and built environments to decrease vulnerability. It also includes attempts to modify the loss by insurance and aid. Some of the means of protection are described below.

Hazard-resistant structures

Buildings can be designed to be aseismic or earthquake-resistant. There are three main ways of doing this:

- putting a large concrete weight on the top of a building which will move, with the aid of a computer program, in the opposite direction to the force of the earthquake to counteract stress
- building large rubber shock absorbers into the foundations to allow some movement in the building
- adding cross-bracing to the structure to hold it together when it shakes

Older buildings and structures such as elevated motorways can be **retro-fitted** with such devices to make them more earthquake-proof. A comparison between the 1989 Loma Prieta earthquake in California (7.1 Richter) and the 1988 event in

Armenia (6.9 Richter) shows the effects of different types of building structures. In California, with its earthquake-proof buildings, there were only 63 deaths, whereas in Armenia more than 25,000 people died, many inside buildings that collapsed as a result of soft foundations and no earthquake-proofing features. In the town of Leninakan, for example, over 90% of the modern 9–12 storey buildings with precast concrete frames were destroyed.

Education

Education is a major way of minimising loss of life in the event of an earthquake. Instructions issued by the authorities explain how to prepare for an earthquake by securing homes, appliances and heavy furniture, and getting together earthquake kits. Schools, offices and factories may have earthquake 'drills'. Government offices and many companies in Japan observe Disaster Prevention Day (1 September) which marks the anniversary of the Tokyo earthquake.

Following the Loma Prieta earthquake (1989), the American Red Cross issued a list of supplies that people should keep at hand in case of an earthquake. These included:

- water: at least 3 days' supply for all persons and pets in the house
- a whole range of foodstuffs, particularly canned and high-energy foods
- clothing and bedding
- first-aid kit
- tools and supplies, to include radio, torch, batteries, can opener, matches, toilet paper, small fire extinguisher, pliers, aluminium foil

Figure 2 shows the instructions issued by the metropolitan government of Tokyo advising people what to do if an earthquake occurs in the city.

Figure 2

Tokyo Metropolitan Government

What to do if a big earthquake hits

The worst shake is over in about a minute, so keep calm and do the following:

1 Quickly turn off all stoves and heaters. Put out fires that may break out. Do not become flustered by the sight of flames, and act quickly to put out the fire.

2 Get under a table or desk to protect yourself.

3 Do not run outdoors where you are liable to be hit by falling objects.

4 Open the door for an emergency exit. Door frames are liable to spring in a big quake and hold the door so tight it cannot be opened.

5 If you are outdoors keep away from narrow alleys, concrete block walls and embankments, and take temporary refuge in an open area.

6 During evacuation from department stores or theatres do not panic. Do as directed by the attendant in charge.

7 If driving in the street, move the car to the left and stop. Driving will be banned in restricted areas.

8 Evacuate to a designated safety evacuation area if a big fire or other danger approaches.

9 Walk to emergency evacuation areas. Take the minimum of personal belongings.

10 Do not be moved by rumours. Listen to local news over the radio.

Fire prevention

'Smart meters' have been developed which can cut off the gas if an earthquake of sufficient magnitude occurs. In Tokyo, the gas company has a network transmitting seismic information to a computer which informs employees where to switch off major pipelines, reducing the number of fires.

Emergency services

Use of the emergency services in the event of an earthquake needs careful organisation and planning. Heavy lifting gear needs to be available. Civilians must be given first-aid training as trained medical personnel can take some time to arrive. Much of the preparation in California involves the establishment of computer programs that will identify which areas the emergency services should be sent to first.

Land-use planning

The most hazardous areas in the event of an earthquake can be identified and then regulated. Certain types of buildings such as schools and hospitals should be built in areas of low risk. It is also important to have sufficient open space, as this forms a safe area away from fires and aftershock damage to buildings.

Insurance and aid

In MEDCs, people are urged to take out insurance to cover their losses. This can be very expensive for individuals. Only 7% of the people affected by the Kobe earthquake in Japan (1995) were covered by earthquake insurance.

Most aid to LEDCs has been emergency aid in the few days after the event — providing medical services, tents, water purification equipment, and search and rescue equipment. Aid over the longer term, to reconstruct the built environment and redevelop the economy, is much less readily available.