Earthquakes and Tsunami

In this video, I will discuss earthquakes and tsunamis,

outlining what are they, and what causes them.

I will also explain how earthquakes are recorded,

where earthquakes and tsunami occur

in Australia, how earthquakes are compared, in terms of severity

as well as the effects of earthquakes and tsunamis.

I will mention who are responsible for monitoring

earthquakes and tsunami.

I will suggest what you can do to prepare for, and what

to do in the event of an earthquake, and tsunami.

**Earthquakes**

I will now talk about earthquakes.

Earth’s outer layer is made up of separate pieces

called tectonic plates. There are seven large plates

and numerous smaller plates around the world.

Each of those plates is constantly moving towards,

away, or past each other.

Movement is not usually smooth and gradual, instead

it occurs in a series of jerks because of friction between

the plates.

**What causes earthquakes?**

When stress caused by moving plates gets too large,

the rocks break and slip past each other releasing energy

into the crust in the form of vibrations, which we feel as earthquakes.

volcanic activity can occur where plates meet.

Molten rock (magma) is stored in reservoirs under volcanoes

can fracture the rock through which it squeezes, causing earthquakes.

**Human-induced earthquakes**

There are several ways, which earthquakes can occur as a result of

human activity, such as:

Explosions used to tunnel rocks, which can cause seismic waves.

Removing material during some mining processes leaves voids

behind, which may unbalance existing stress in the surrounding rocks,

causing small earthquakes as the rocks settle into a new equilibrium.

Reservoir-related earthquakes occur when a new dam is filled after

construction, or there's a major change in water level.

Added water can put pressure on underlying and surrounding rocks

which alters pressure on the rock, and causes them to break.

Aside from natural causes, and human activity, objects from outer space can play

a part in earthquakes.

Meteorites can cause seismic waves to radiate from point of impact,

which may be recorded or felt as a small earthquake.

**Types of Earthquakes**

There are two types of earthquakes, interplate earthquakes occur

along the tectonic plates, and intraplate earthquakes

occur away from the plate margins.

Most earthquakes in Australia are caused by rocks being squeezed or

compressed by horizontal forces due to the collision between the

Indo-Australian plate, and the Pacific Plate to the east and the

Eurasion plate to the north.

**Foreshocks and aftershocks**

Foreshocks are smaller earthquakes that may occur before large earthquakes. Foreshocks are caused by fracturing of rocks under stress

Aftershocks are smaller earthquakes that may occur after the main shock

(known as the larger earthquake). Aftershocks are caused by the rocks

in the area readjusting to the fault movement.

**How are earthquakes recorded?**

Earthquakes are detected by scientific instrument called 'seismometers'

which are sensors that detect and covert any small movement in the

earth into an electrical signal.

**Where do earthquakes occur in Australia?**

Earthquakes in Australia occur as a result of forces acting on the

boundaries of the Indo-Australian plate.

There are on average of 80 earthquakes of magnitude 3.0 or more in

Australia each year.

Earthquakes above magnitude 5.5 occur on average every two years.

About every five years, there's a potentially disastrous earthquake of

above 6.0 or more.

**How do we compare earthquakes?**

Earthquakes are compared by its magnitude (the energy released),

and its effects, described by an intensity scale, using observations

made by people who have experienced the earthquake

or observed structural damage to buildings.

**The effects of an earthquake**

Magnitude is not the sole factor in determining how much

damage will be caused.

For example, in Newcastle in 1989, an earthquake with a magnitude

of 5.6 resulted in 160 injuries, 13 fatalities, and damage costs of $4 billion.

Newcastle is a highly populated city, and falling buildings were the main

factor in the fatalities.

Whereas an earthquake in Meckering, WA in 1968 had a magnitude of 6.9 that resulted in 20 injuries, no fatalities, and damage costs of $5 million.

The low rate of injuries and lack of fatalities was due to Meckering’s

small population of 240 people at that time.

**Who is responsible for monitoring Earthquakes?**

Geoscience Australia operates 24/7 earthquake monitoring centre which detects, analyses, reports and records earthquakes within Australia and internationally.

This centre is part of the Joint Australian Tsunami Warning System

which provides a warning if an earthquake has the potential to cause a tsunami.

Earthquakes located in Australia, and earthquakes with a magnitude of 5

or greater outside Australia but within our region, are catalogued

and published on the Geoscience Australia website.

Earthquakes occurring anywhere in the world with a magnitude of 6 or

greater are also catalogued and published on the Geoscience Australia website.

Geoscience Australia operates the Australian National Seismic Network which monitors seismic data from over 60 stations in Australia.

The data are sent to the processing centre in Canberra in near-real time; that is,

they arrive within about 10 seconds of being recorded at the seismometer.

Data are also obtained in near-real time from over 130 stations belonging to overseas national seismic networks.

The data are analysed automatically and reviewed by a seismologist.

**What to do to prepare for, and in the event of an earthquake?**

I will use the example of South Australia’s SES guidelines.

Preparing your home

Check that your insurance policy covers earthquake damage and that you are fully insured.

If buying a house, consider brick veneer as it is more flexible in the event of an earthquake than double brick and stone.

In existing buildings, check for unsupported masonry parapets, gables and chimneys, and repair loose roof tiles and cracks in walls.

Brace tall, freestanding bookshelves and water heaters to stop them falling over.

When furnishing your home keep chairs, lounges or beds clear of hanging items such as hanging pictures or mirrors and hanging plants.

Store breakables and heavy items on bottom shelves.

Secure suspended cupboard doors with sturdy latches.

Hazardous materials should be kept in waterproof containers and stored in a secure cupboard to prevent leakage.

Essentials

Keep a battery powered torch by your bed.

Talk to your family about the safest areas for you to shelter during earthquakes. Also decide on a place where you would meet in the event that you become separated.

Keep a list of emergency numbers readily available, such as police, State Emergency Service, fire, ambulance, and gas, power and water supplies.

Maintain a store of at least three days’ worth of emergency non-perishable foods and water supply, as store stocks may run low, or be inaccessible in the event of an earthquake.

**During an earthquake**

Should an earthquake happen, it’s important to remember three things:

Drop, cover, and hold on.

If indoors, stay there (keep clear of falling debris outside).

Shelter under (and hold onto) a sturdy table, bench, or interior doorframe

Keep clear of windows, chimneys, and overhead fittings such as hanging items on ceilings and walls.

In high-rise buildings, stay clear of windows, and outer walls. Get under a desk or table to stay safe.

Don't use lifts. You may become trapped.

In crowded areas or buildings, don't rush for the doors. Move clear of overhead fittings and shelves.

If outside, keep well clear of buildings, overhead structures, awnings, walls, bridges, power lines and trees.

In a city street, shelter from falling debris under sturdy structures or doorways of buildings. Do not stand under awnings or parapets because they may collapse.

If you are in a vehicle, stop in an open area until the shaking stops.

Beware of fallen power lines, damaged roads, including overpasses and bridges;

and landslides.

**After an earthquake**

Watch the news and heed warnings or advice on damage, service disruptions and evacuation.

Expect aftershocks, so evacuate if the building is damaged.

Check for broken water, sewerage or electrical mains.

Watch for hazards and tend to injuries.

Turn off electricity and water. Don't light matches. Check for fuel leaks and damaged wiring.

Check for injuries. Apply first-aid. Don't move the seriously injured unless in immediate danger.

Don't use the phone immediately (to avoid congestion) unless there is a serious injury or fire.

Check for cracks and damage in the roof, walls and chimneys.

Don't waste food or water because the supply may be interrupted.

Avoid driving unless for an emergency (keep the streets clear for emergency services).

Don't go sightseeing or enter damaged buildings.

Stay calm and help others if possible.

**Tsunami**

I will now discuss tsunamis.

**What causes a tsunami?**

A tsunami is a series of waves generated by a number of causes including:

Vertical movement of the sea floor as the result of a large earthquake

Submarine or coastal volcanic eruptions

Meteor impacts

Coastal landslides and slumps, either land-based or submarine

Earthquakes from subduction zones are the most common source

of destructive tsunami.

These earthquakes are generated when two tectonic plates meet

and one goes under the other.

The sinking (subducting) plate drags against the upper plate,

causing flexing.

Continued stress on the plate boundary results in the upper plate

rebounding to its original position, displacing the sea water above.

This can lead to the generation of tsunami waves.

**Where do tsunami occur in Australia?**

Minor tsunami are recorded about once every two years in Australia,

but most are small and present little threat to our coastal communities.

The tsunami threat to Australia varies from ‘relatively low’, for most of

our coastline, to ‘moderate’ on the north-west coast of WA due to its

proximity to Indonesia and other countries in that region prone

to large earthquakes and volcanic activity.

Most tsunami occurs in the Pacific and Indian Oceans. The boundary of the Pacific Ocean experiences frequent earthquakes. This boundary is commonly known as the Ring of Fire.

There are two major subduction zones in the Indian Ocean that can also generate tsunami.

**History**

Australia has been affected by over fifty tsunamis in the past two hundred years.

The largest tsunami to have affected the NSW coast in recent times

occurred in May 1960 after a 9.5 magnitude earthquake in Chile

resulted in a one metre tidal fluctuation in Sydney Harbour.

This caused widespread damage to marine infrastructure along the NSW Coast including damage to boats, wharves, jetties and beaches.

**How will I receive a tsunami warning?**

How could I receive an official warning? Warnings come in various

forms. You should act early based on the first warning you receive.

Warnings may come through television and radio broadcast

If you are at or near a beach, a siren like warning may be activated

by surf lifeguards.

People in the water, or the immediate foreshore area may be instructed

to evacuate and move away from the area.

A text or recorded voice message may be sent to people in the affected area.

Once this message has been received, it is then advised that people

follow the steps to safety. People should not wait for this message if

they have heard it via other sources.

You may be alerted via low flying aircraft equipped with public address systems

Aircraft with the ability to fly lower than normal may be tasked to disseminate warnings.

Advice may come from other government agencies, emergency services and authorised persons.

You should also continue to monitor the radio for further advice and do not return to the evacuation zones until authorities have given the all clear.

All warnings issued by the Joint Australian Tsunami Warning Centre

will be placed on the Bureau of Meteorology website.

Tsunami Warnings may also appear on local SES websites.

Warnings issued by the Joint Australian Tsunami Warning Centre (JATWC)

will also be shared via SES social media including Facebook and Twitter.

Other agencies and local community organisations may also

share warnings with their audience as well.

JATWC issue several types of warnings;

Official Tsunami Watches

Tsunami Warnings

No Threat Bulletins

Tsunami Cancellations

Tsunami Warning Summaries

It is worth familiarizing yourself with the different warnings

to be aware of the threat levels of a tsunami.

The Joint Australian Tsunami Warning Centre (JATWC)

is operated by the Bureau of Meteorology, and Geoscience Australia.

Using seismic and sea level monitoring and warning systems the JATWC provides a 24-hour tsunami monitoring and analysis capacity for Australia.

The main aim is to provide Australian emergency managers with a

adequate warning of a likely tsunami impact

generated from subduction zone earthquakes.

**What to do?**

In the event of a tsunami, know where to go.

Find the safest route to travel in the event that you might need to

evacuate and identify the point at which your evacuation route may be cut

In many locations, it is likely that you will need to evacuate by foot

due to congestion on roads

Find out where any evacuation centres could be set up in your area.

If you prefer, check with friends and relatives outside the affected area

to organise a place to go.

Know who to call

For emergency help in tsunami, call the SES

Keep local emergency numbers handy (in your wallet or phone)

In a life‐threatening emergency, call 000 (triple zero) or TTY 106

Know your plan

To help households and businesses plan for tsunami,

Information is available online in each state.

For example, there is the SES’ Home Emergency Plan

Download and review your plan annually to keep it up‐to‐date

**What are the warning signs?**

If you are unaware or missed a tsunami warning, there are sometimes warning

signs of an impending tsunami.

These signs can be remembered as: shake, drop, and roar.

Shake refers to a large undersea earthquake that may be felt prior to a tsunami by an on-going shaking of the ground in coastal regions,

Drop refers to sea levels that may drop dramatically before the arrival of the tsunami, and

Roar is where a roaring sound may precede the arrival of the tsunami.

**What to do if there is a tsunami?**

If you are aware of the warning signals of shake, drop and roar, then run and wait.

Evacuate/run immediately to higher ground or well away from the water’s edge.

Do not go towards shore to watch a tsunami.

Wait at the safe place for several hours. The tsunami may arrive within thirty minutes of the earthquake or other warning signs.

The backwash of the tsunami is also dangerous. As the large volume of

water pushed onto land recedes back towards the ocean,

it may carry debris and people to sea with it.

**What to do after a tsunami?**

Continue to watch the news, and internet for advice and do not leave the evacuation zones until authorities have given the all-clear.

Be aware that there may be more than one wave and it may not be

safe for up to 24 hours, or longer.

The waves that follow the first one may also be bigger.

Check yourself for injuries and get first aid if needed. Help others if you can.

Do not go sightseeing.

When re-entering homes or buildings, use extreme caution as water may have damaged buildings. If your property is damaged, call the local SES.

Look for, and report, damaged/fallen power lines or other utilities to the relevant authority.

If your property is damaged, take notes and photographs for insurance

purposes. If you rent your property, contact your landlord and your contents

insurance company as soon as possible.

**Summary**

While the past can be used as an indicator of what may happen

in the future, disasters will happen in areas where the hazard has never

arisen in the area previously.

While there are records of earthquakes and tsunami in Australia, they

are relatively rare and therefore not always completely understood.

Earthquakes cannot be forecast therefore individuals, families,

businesses and communities must develop and practice emergency plans.

The Federal Government monitors earthquakes and tsunami, and

warning information is provided to the public.

State Emergency Service organisations are the lead combat agencies

for issuing local instructions.