

Japanese Earthquake & Tsunami

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By

Kit Walker

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Introduction

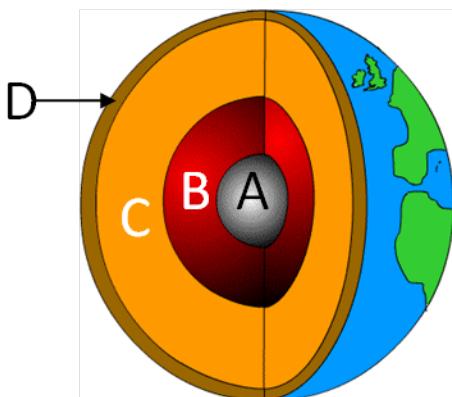
On March 11th 2011 a massive earthquake recording magnitude 9 on the Richter scale stuck in the ocean on the east coast of Japan, causing devastation and havoc in Japan. I will be taking a look at the earthquake itself and how the Japanese prepared for it.

What are Earthquakes?

Earthquakes are completely natural events that bring havoc to thousands of people around the globe, however rather interestingly earthquakes on their own are not a danger to humans; it is only when human change is present that they become a danger.

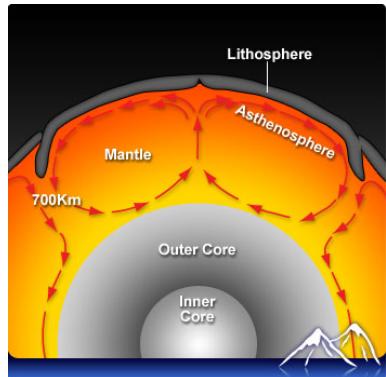
The definition of the word earthquake is “A sudden movement of the earth’s crust caused by the release of stress accumulated along geological faults”

To fully understand what an earthquake is you have to understand the theory of plate tectonics. The earth is split up into four sections, below is an image to show these sections:



- A- This is the inner core, it is the very centre of the earth and it is solid iron despite the high temperature it is still solid because of the extreme pressure.
- B- This is the outer core and is a hot liquid substance
- C- This is the Mantle, it is a semi liquid substance made from silicon.
- D- This is the Crust it is the thinnest of all of the layers.

The crust is extremely thin compared to the other layers, think of it like the edge of a bubble it is that thin compared to the other layers of the earth’s composition. The crust is split up in 15 main plates, these are called tectonic plates and they float on the mantle. Think of it like lilo in a swimming pool where the Tectonic plates are the lilos and the mantle is the water. The outer core is very hot and the mantle closest to the outer core heats up and then rise to the crust then they curve round and form a circle that pulls the plates apart, pushes them together and then slides them past each other.



See image on the right

This shows the hot mantle rising moving the plates. As mentioned before there are 15 major plates, the border of these plates is called the margin; the margins of plates are jagged. They are like saw blades. This means that when they collide they catch and great pressure builds up until one buckles and goes under the other and the great build up of pressure is released.

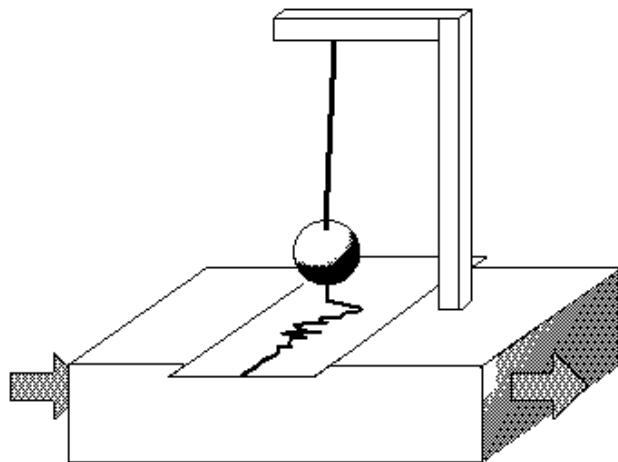
In the case of the Japanese Earthquake the two plates that collided were the Pacific Plate and the Eurasian Plate, they came together due to the convection currents the after around a hundred years of build up in pressure it finally snapped and a huge waves of pressure were released. These waves are called seismic waves and cause great tremors in the surface of the earth.

There is specific terminology used when describing an earthquake, the first is the Focus, this is the location under the ground where the energy originated. Then there is the epicentre, this is the land above the focus.

How are Earthquakes measured?

The most common way to measure an earthquake would be to use the Richter scale, the Richter scale was invented by a man called Charles Francis Richter. He was an American seismologist who lived in the 20th century. The scale assigns a number to quantify the energy released in an earthquake. The scale is a base-10 logarithmic scale meaning that a magnitude two earthquake is ten times more powerful than magnitude one earthquake meaning that a magnitude nine earthquake is nothing like a magnitude eight earthquake. Earthquakes are measured using something called a seismologist, it is essentially a pen on the end of piece of string and that draws lines on a piece of paper, then when the earth shakes it causes pen to draw a graph and

seismologists then use this graph to work out what magnitude it is on the Richter scale.



Another scale used to measure earthquakes is the Mercalli scale, it is less popular due to its inferior accuracy. The Mercalli scale goes from 1-12 and it is not measured using a seismograph it is measured based on its affects. Meaning that if an earthquake hit a town and it was filled with completely earthquake proof buildings then it would measure very low on the Mercalli

scale because it had no affect. When it could measure very highly on the Richter scale.

What are Tsunamis?

Tsunamis are not a feature of earthquakes but they are often paired together, when the plates snap if this takes place in the sea a large body of water is displaced by the sudden movement of the plates and then the water travels to the oceans and when it releases land it can be very destructive, sometimes much more than the earthquake its self. That was a huge problem in Japan, they were very prepared for an earthquake and it caused lots of damage but it wasn't too bad but then the tsunami was completely destructive and the earthquake defences became useless. In some places they had built walls 10 meters high and although the tsunami was only ten metres the movement in the plate caused the whole country to drop one metre deeming the walls useless.

Here is a picture of the Japanese earthquake breaking over the ten metre high wall.

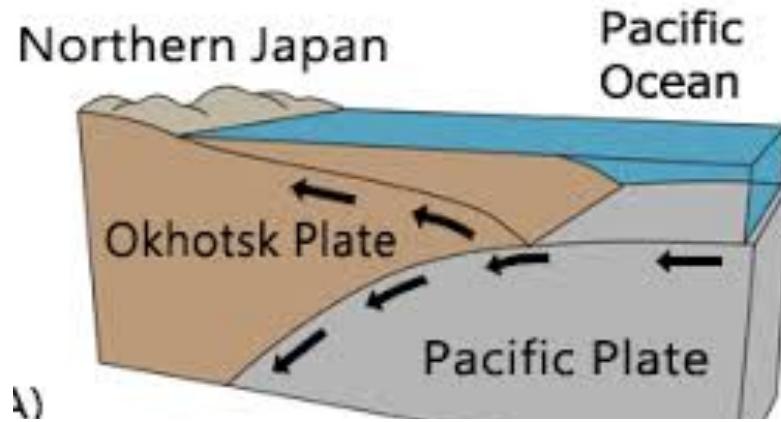


The Tsunami caused great worries at the Nuclear power station as soon as the warnings were announced they shutdown the plant and began the cooling process. When the tsunami reached the power plant it caused an explosion, there was later an evacuation announcement as the radiation levels near the gate were too high. Two years later on the 28th August the Nuclear Regulation Authority declares the toxic water leak a level 3 on the eight point International Nuclear Event Scale.

What caused the Earthquake & Tsunami?

As mentioned earlier earthquakes are caused by tectonic action, in this case it was two plates off the eastern coast of Japan that caused the earthquake, the two plates involved, these plates were the Okhotsk plate and the Pacific plate. The two plates came together and the pressure slowly built up over about a century and then in 2011 the pressure was too high and the two plates snapped releasing seismic waves that rushed towards the coast of Japan. Fortunately Japan's preparation for earthquakes is top notch as it is very near the fault line and so earthquakes can occur quite frequently, within less than a minute the whole country was aware and people started evacuating the closest areas and the defences were put in place. This quick reaction time meant that there were fewer injuries than may be expected of such a large disaster.

Earthquakes normally last about 2 minutes maximum but the Japanese earthquake lasted an unprecedented 5 minutes. After the earthquake was over the disaster had only just begun, the concerns were now focussed on the tsunami that would inevitably be arriving.

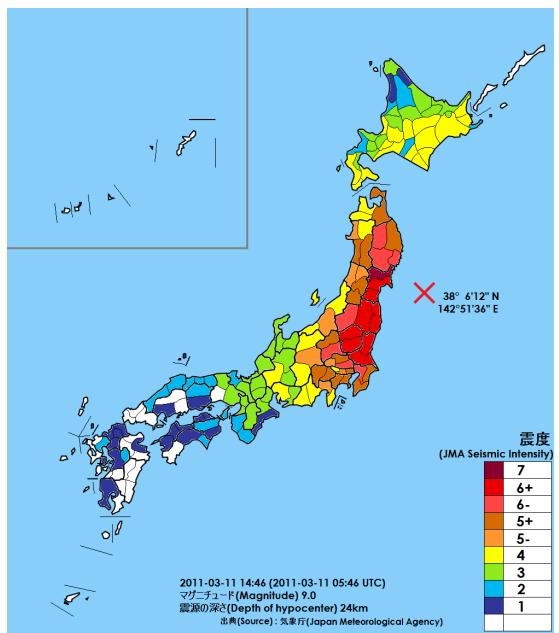


Japan.

Here is an image of the two plates that caused the earthquake and you can see that the Pacific plate was forced under the Okhotsk plate they came together at roughly 8.9cm a year, this is roughly the speed your fingernail grows. Then when the pressure was too high they flipped the Okhotsk plate suddenly lifted sending seismic waves through ground towards

As mentioned before the Richter scale is the most commonly used scale for measuring earthquakes and the Japanese Earthquake was measured at 8.9. This was a huge earthquake, the largest ever recorded in Japan. The magnitude 8.9 was later upgraded to a magnitude nine.

Here is a diagram showing the focus of the Earthquake and the places that were most affected.



The sudden movement out at sea caused a large body of water to move out in all directions. This water then rushed towards the coast of Japan at a staggering 800 km/h. The water rushed to the coast in wave that crashed over all of the Japanese defences. The Tsunami on average was ten metres high but in places reached a mind-blowing 40 meters tall.

A Comparison of the affects of the Tsunami and the Earthquake

As there was very little time between the Tsunami and the earthquake it was hard to really gather any data about death toll or the like however now three years on they have had plenty of time to gather data and release some of the affects of the Tsunami and Earthquake there were around sixteen thousand deaths with around six thousand injured. As of the 6th April 2011 It was estimated that around one hundred and sixty thousand homes were without water and the around fifty thousand were damaged. The government estimated a damage of around 16-25 Trillion Yen. The top estimate would make it the world's most expensive disaster. This estimate covers everything from roads, to homes. In a recovery attempt there have been one hundred and thirty four countries and

thirty nine countries offering their assistance.



Here you can see an image of a house on fire surrounded by water, this is most likely caused by gas mains leaking and then catching alight. This is a huge problem with disasters like this, it is not just the event itself that causes the damage, its what follows in the aftermath.

This is an image of a collapsed road, this is especially problematic because it prevents the emergency services from getting out and helping people.

The Tsunami as mentioned earlier caused great worries for the Nuclear Power plant and as soon as there was a warning released of an earthquake they were shutdown and the cooling process begun. But the earthquake damaged the towers. Then the Tsunami

washed over the six-meter high water breaks and it caused an explosion in the plant that lead to the leaking over Nuclear Radiation. The government then ordered the surrounding area to evacuate. In this instance the Earthquake did not cause as much damage as the tsunami.



In order to understand the devastation you need to see images, here is a selection of images of the havoc caused in two of the worst hit cities in Japan, Tokyo and Sendai. Tokyo being the most populous city in Japan is a very interesting location to look at. These are images taken before the Tsunami.



Here you can see another burning building, this was taken just by Sendai airport and as mentioned before the flames would have been caused by the gas mains bursting and leaking.

Below you can see a man who runs and ceramic shop assessing the damage to his wares. This shows how not only did it cause a lot of physical damage it also caused huge amounts of economical damage.

Below you can see some broken windows, another image showing the devastation to the building caused by the earthquakes, this is in Tokyo.



Below you can see commuters in Tokyo wrapped up in blankets preparing for a cold night. This shows that the dangers are present not only before the earthquake but also in the aftermath.



These are now photos showing the devastation caused by the Tsunami as well.

Here you can see Sendai Airport surrounded by water. This shows how the Earthquake and Tsunami completely destroyed all transport links to other countries as well as internal transport links.

Below are houses that have been swept away but the Tsunami again near Sendai Airport.



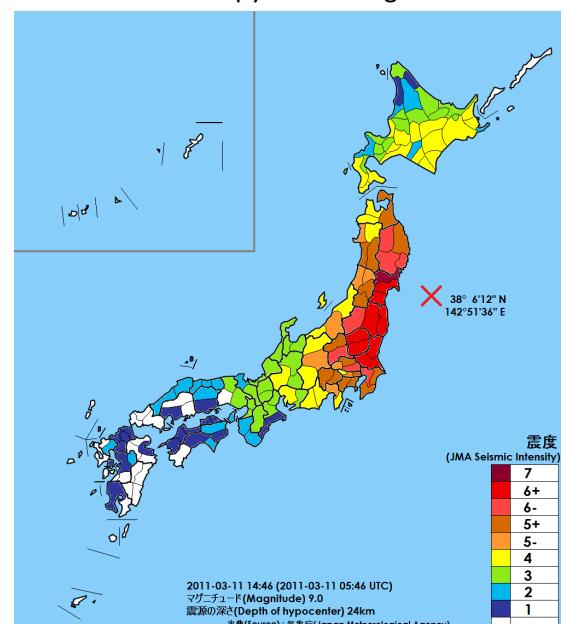
You can see that the Earthquake caused lots of damage, but the Tsunami that followed only 10 minutes later caused even more devastation.

You can see from these images in large cities like Tokyo the destruction is much worse because the buildings are larger and there are more people to evacuate.

The east coast being the closest to the epicentre were obviously the worst hit and below is another copy of the diagram

showing which locations were worst hit:

As mentioned above Tokyo was very badly hit but there were many other countries that were affected, this includes Fukushima and as mentioned there was a nuclear disaster caused by the Earthquake and Tsunami as well as a minor amount of leaked radioactive waste. From the map you can see the worst hit location (darkest red) is Miyagi, it is the closest to the epicentre and that is where the Seismologist recorded the highest on land magnitude. Here is an aerial image of the Tsunami coming on to the shore in the Miyagi area.



Japanese earthquake and tsunami preparation strategies

Obviously the Japanese were aware of the danger because large earthquakes had happened in the past and so they had defence strategies. They had lots of seismometers setup and within seconds of the earthquake starting the whole country was aware, computer generated messages appeared on screens around the country and an announcement even interrupted the Japanese parliament. The quick response allowed everyone to get ready. They could evacuate homes and buildings. This quick broadcast really helped Japan. After the earthquake the Tsunami would imminently be arriving. In many towns they had practiced before, they had drills and now the practice paid off, many people were able to find high ground and get safe. Unfortunately in the more built up areas evacuating was much harder and many people were not able to. In many coastal towns they had built ten meter high walls, these were meant to protect against a tsunami and although the wave was measured at ten meters the walls didn't stop it because the earthquake had dropped the whole of Japan one meter rendering the walls useless. In Fukushima as mentioned earlier the nuclear power plant was at huge risk. The plant began cooling as soon as the earthquake was detected but it still suffered an explosion and then later a major nuclear waste leak.

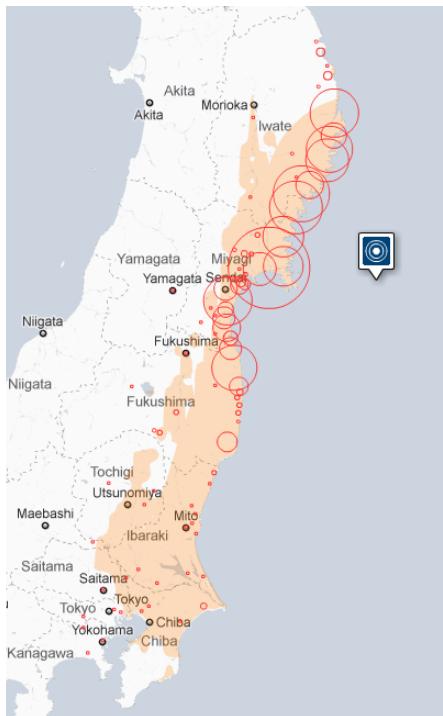
In conclusion I think that the Japanese defence strategies were very good, I think that the quick reaction time was very impressive and I think that the Tsunami evacuation practice was well worth it. I think it is unfortunate that the walls didn't stop the Tsunami but the earthquake was so much larger than the previous one that it is not surprising ten meter high walls seemed adequate.

Here is an image of the tsunami breaking over the sea walls.



Effects of the Tsunami

The Tsunami had many effects on Japan and here is a sections on some of the figures and details regarding the aftermath of the earthquake.



Firstly the death toll has now been totalled at around sixteen thousand. Here on the right you can see a map, this map shows the number of deaths, the larger the circles and as said before the worst hit area was around Sendai and rather unsurprisingly Sendai is circled by one of the largest circles.

Not only did the earthquake have a huge physical impact, it had a large economic and social impact as said before the overall destruction is estimated to be around 16 – 25 trillion yen (£129.6 billion to £202.5 billion), this will obviously take huge time to recover from and this is an example of a long term affect. The Bank of Japan had to invest billions of Yen into the economy to stop the whole country going into Recession.

Of course not only Japan was affected, the earth quake shifted the whole planted of its access and NASA have made calculations and have worked out that the days are now 1.8 microseconds shorter than they originally were before the earthquake.

The Earthquake also had some environmental impacts, obviously and as previously mentioned the Radiations leak in Fukushima. Also there has been a huge amount of debris dispersed into the oceans. The debris could be a problem for Japan as one of its main exports is marine life and with the debris in the water fishing could become very difficult.

Conclusion

In conclusion I think that the Tōhoku earthquake that occurred in Japan was a huge devastation. I think that the country and its people however did very well to cope and the death toll is astoundingly low, I think over the years to come Japan will fully recover from the incident and return to the powerful hit tech country it once was.