

MOROCCO

8TH SEPTEMBER 2023

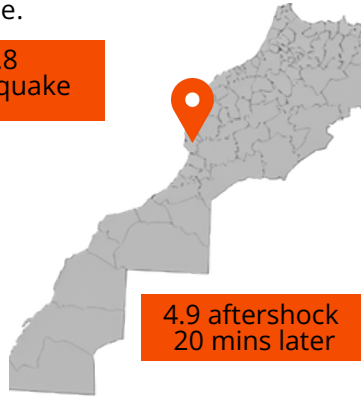
What? Where?

The earthquake struck at 11:11pm local time 75 km SW of the country's capital, Marrakesh within the Atlas Mountain range. The focus of the quake was shallow, only 18 km below the surface.

6.8
earthquake

Country Data

Morocco is classed as a Lower-Middle Income Economy with a GDP per capita of \$3,570 (2022, Lloyds Bank). 54.5% of the country's GDP is generated through the tertiary sector. Specifically, tourism and real estate. 43% of the working population is employed in this sector alone. 34% of the working population is employed in agriculture contributing to approximately 11% of the country's GDP.



4.9 aftershock
20 mins later

23% of the working population are employed in (secondary) industry in which textiles is a major contributor. This generates approximately 26% of Morocco's GDP. Of a population of 37 million people, 380,662 people lived within 50km of the epicentre.

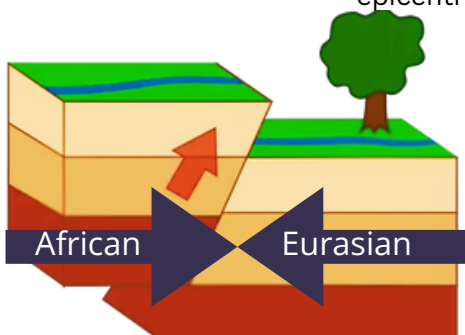


Diagram of a thrust fault. Source RGS (with IBG)

Plate margin

The Atlas Mountains formed due to being on a collision plate boundary, at which convergence is a rate of 4-10 mm per year forming a network of fault lines. Composed mainly of sandstone, a soft rock, the mountains fracture easily. Their slower movement results in less frequent earthquakes. The fault line itself is a reverse fault - a type of thrust fault which dips at an angle of more than 30 degrees.

After the earthquake, the land on the upward block rose by 20cm whereas the downward block sunk by 7cm.

Impacts

The earthquake claimed 2,946 lives and injured over 5,500 people. Some of the worst affected areas were the remote valleys of the Al Haouz region.



Building in rural Morocco. CREDIT: Moroccan Red Crescent

In this region, many of the buildings were made of local stone and masonry and were not earthquake resistant. In Tikhit village, 95% of buildings were destroyed. Although many modern buildings in Marrakesh are quake-proof, the C11th medina district experienced building collapse and damage sending vast amounts of dust into the air. The earthquake impacted 100,000 pupils by damaging over 530 schools. 380,000 people were made temporarily or permanently homeless. Those in temporary mountain shelters also endured flooding, landslides, and freezing winter conditions. The earthquake also broke water pipes and electric cables which cut off many towns and villages.

Responses

Moroccan officials did not announce the earthquake formally until 18-hours after the event. Aid came from the UK, Spain, UAE and Qatar, while offers from France, Germany, US and Canada were declined. Access to remote mountain regions was hindered by blocked roads. Since late 2023, around 800 shelters in 20 mountain villages have replaced tents.

These shelters, constructed with local materials and featuring tinplate outer layers and polystyrene insulation, have an expected lifespan of two years which should give people time to rebuild their homes.



A valley in the Atlas Mountains. CREDIT: Gilbert Sopakuwa, Flickr

TAIWAN

3RD APRIL 2024

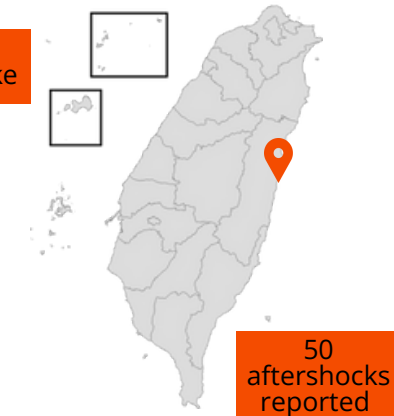
What? Where?

The earthquake struck at 07:58 am local time. The epicentre was 30 km south of Hualien City in the region of Hualien. It was reported that this was Taiwan's strongest earthquake in 25 years.

7.4
earthquake

Country Data

Taiwan is classified as a High-Income Economy with a GDP per capita in 2023 of \$32,460 ([focuseconomics](#)). The majority of Taiwan's GDP (98.2%) comes from the service and industrial sectors at 36% and 62.2% respectively. Almost \$200 billion worth of Taiwan's exports in 2023 were derived from parts of electronic products ([statista.com](#)). Most of this were electronic chips for Apple and Nvidia.



Taiwan's population as of 2023 stood at 23.94 million people. Of which 15 million make up the country's labour force. In 2022, 5% of the working population were employed in agriculture, 30% in industry and 65% in services.

Impacts

Due to Taiwan's investment in infrastructure over the past few decades, the damage in the city of Hualien was limited and normality resumed quickly.



The 'Uranus' building in Hualien City. One of the few buildings to be destroyed from the earthquake. CREDIT: Shufu Liu / Office of the President Flickr

It is thought that at least 12 people were killed and 1,100 injured from the initial earthquake. Remote mountainous regions to the north of the city experienced landslides and rockfalls, cutting off roads and bridges leaving 600 people stranded of which 450 were in a hotel in the Takoro National Park, 23km NW of Hualien City. The national park was closed to visitors to ensure that all routes are checked for safety. Since the devastating Chi-Chi earthquake of 1999, the Taiwanese government have set about reinforcing older buildings and ensuring most new buildings meet strict regulations to limit the damage done by earthquakes.

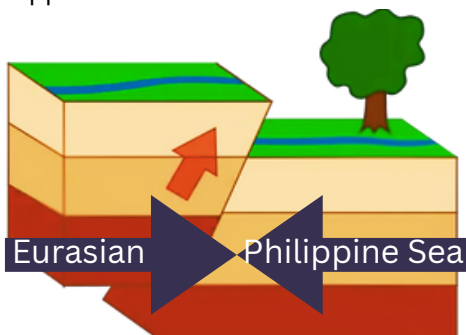


Diagram of a thrust fault. Source RGS (with IBG)

Plate margin

The tectonic plate network in and around Taiwan is complex. The two major plates in the region: the Eurasian to the west and Philippine Sea Plate to the east are converging. However, depending on where you are along this margin, the plates behave in different ways. For example, in the north, the Philippine Sea Plate is subducting under the Eurasian at the East China Sea at a rate of 7.1 cm/year. In the south, it is the South China Sea which is subducting under the Philippine Sea Plate at a rate of 9.6cm/year. The Hualien region is part of a collision zone at a rate of 8.2 cm/year creating a thrust fault.

Responses

The Taiwanese are no strangers to earthquakes and experience on average, over 150 each year. Therefore, their level of preparedness is high. Earthquake warning systems interrupting news broadcasts providing essential seconds warning before buildings started to shake. Emergency workers in Hualien were quick to get to work repairing damaged buildings, only deeming four to be demolished.

Rescue workers used helicopters, drones and small search and rescue parties with dogs to look for and monitor those who were stranded in more remote regions.



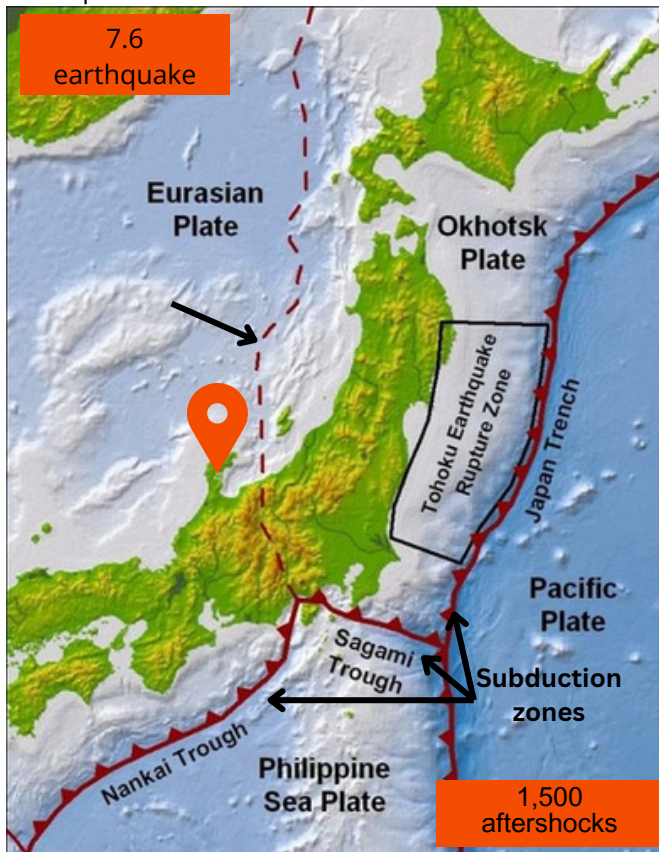
Steep sides of a gorge in Takoro National Park. CREDIT: Benjamin Ho Flickr

JAPAN

1ST JANUARY 2024

What? Where?

The earthquake hit on New Year's Day at 16:10 local time in the Noto Peninsular, Ishikawa Prefecture (similar to a county), 6km north of the city of Suzu. The focus was shallow at a depth of 10km. For the 3 years before the earthquake, this area had experienced tens of thousands of smaller earthquakes known as an earthquake swarm.



Country Data

Japan is classed as a High-Income Economy with a GDP per capita of \$39,000 (2021, World Bank) and has the third largest economy in the world. 3% of Japan's workforce are employed in agriculture, 24% in industry and 73% in services.

Responses

Initial responses to the area were hindered by bad weather, landslides and damage to roads making them hard to pass and cutting off 2,000 from aid. The Japanese government sent almost 6,000 of its troops to help with the relief effort. 14,000 housing units were made available across the Ishikawa Prefecture.

In hard hit Wajima, many people relocated to emergency shelters, where poor sanitation and a higher COVID-19 risk were reported. 4,000 applications were made for temporary housing however, only 550 had been built by February 2024 (The Guardian, February 2024).

Impacts

Settlements close to the epicentre were worst hit by the quake particularly in the cities of Suzu and Wajima. In total, 241 people were killed and 1,296 people injured. The older buildings (pre-1981) in the region were majorly affected contributing to the 60,614 homes that were destroyed or damaged. In total, over 14,000 people were impacted by the earthquake. As of February 2024, 12,929 people were still living in emergency accommodation. Due to the proximity to the coast, the earthquake triggered a small tsunami flooding around 296 acres of land. Snow and heavy rainfall, typical for the time of year created landslides to the already unstable surface.

It is estimated that the earthquake will cost approximately £14 million in repairs and reconstruction.



Damage from the earthquake swarm. Source: wikimedia

Plate margin

The islands of Japan lie on a complex section of tectonic plates involving subduction of the Philippine Sea Plate - moving on average 6.5cm/year and the (slightly) faster Pacific Plate moving at an average speed of 7cm/year, being subducted under the North American and Eurasian plates. The Noto Peninsular is at the intersection between these plates on the side of the Sea of Japan (East Sea). Although it is a hard area to pinpoint the exact cause of the earthquake, the main consensus is that it was as a result of a convergent, subduction zone.



AI generated image of an emergency shelter in Japan CREDIT: RGS

ICELAND

19TH DECEMBER 2023

What? Where?

The volcanic eruptions started in December 2023 and has been intermittently erupting since. Most of the activity is around the Reykjanes peninsula in the south-west of the country approximately 40km from the capital, Reykjavik.

Country Data

Iceland is classed as a High-Income Economy. As of 2022, Iceland's GDP per capita is \$73,466 (World Bank). Most people (78%) work in the service sector, 18% are employed in industry and 4% in agriculture. The population of Iceland is just over 382,000 (World Bank, 2022) and over 1/3 of that population live in its capital - Reykjavik.



Due to its geological location, Iceland and its people are used to tectonic events and have a lot of infrastructure to support typical volcanic events and the hazards associated with them.

Event timeline

25th October: seismic swarm starts resulting in over 20,000 earthquakes. The town of Grindavík (4,000 people) evacuated.

18th - 21st December: eruption episode 1 - lava fountains and flows from fissures.

14th - 16th January: eruption episode 2 - lava flows into the town of Grindavík setting 3 houses on fire.

8th - 9th February: eruption episode 3 - dark plumes rise 2.5km into the air.

16th - 24th March: eruption episode 4 - lava fountains. 23rd - 24th March lava flows into and fills the Melhólsnáma mine.

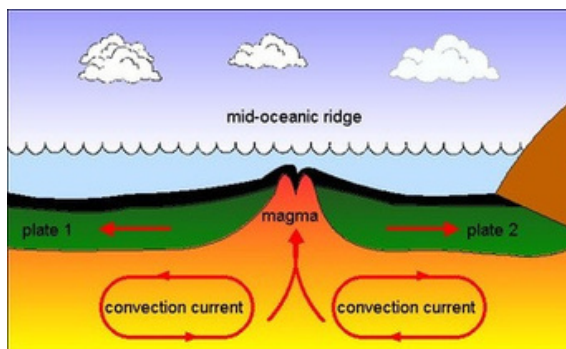


Diagram of sea floor spread adapted from Ramona Benson Flickr

Plate margin

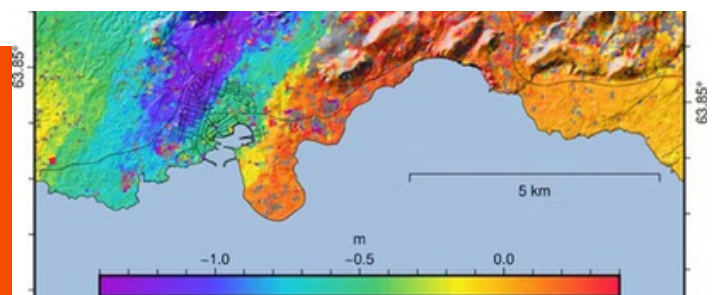
The whole of Iceland sits on the junction between two plates: the Eurasian to the east and North American to the west, both of which are moving away from each other at a rate of approximately 3cm per year on a divergent (or constructive) plate boundary.

Magma rises to the surface at the point where the plates are moving apart and finding areas of lower pressure generating volcanic activity and ground deformation. Basalt, the main rock type rising to the surface when cooled will form vertical wall like structures called dikes.

Responses

The town of Grindavík was evacuated and there were closures to certain places (i.e. the Blue Lagoon) as a precaution. Bulwarks (a type of dam made of earth) were constructed in the Svartsengi power plant to help redirect any potential lava flows from the area.

As the country is used to such activity, there are many institutions monitoring the events which help to ensure that people are as prepared and can manage the event as much as possible. With ongoing the volcanic activity being so close to Grindavík, it is uncertain whether the population will be able to return.



Satellite image of ground deformation in the Grindavík region. Adapted from Icelandic Met Office