Turkey Earthquake-the country's worst disaster since 1939

February 7, 2023

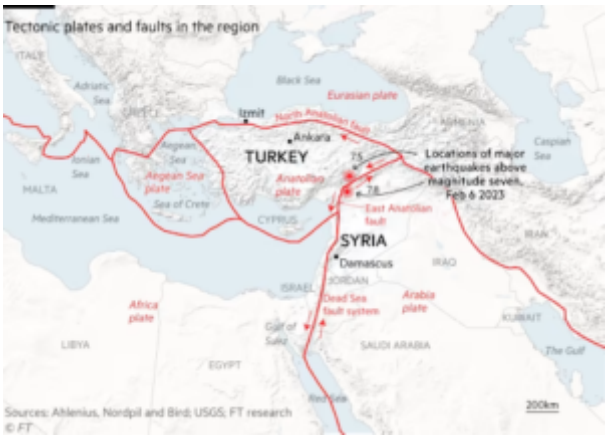
In news– Turkey was recently hammered by a series of powerful earthquakes with a magnitude of 7.8.

Causes for recent earthquakes-

- **The region where the earthquake has struck lies along a well known seismic fault line called the Anatolia tectonic block** that runs through northern, central, and eastern Turkey.
- It is a **seismically active zone** – though not as active as, say, the Himalayan region which is one of the most dangerous regions in the world from the perspective of earthquakes.
- **The seismicity in this region is a result of interactions between the African, Eurasian, and Arabian plates.**
- The Arabian plate is known to be pushing northward, which results in a slight westward movement for the Anatolian plate, where Turkey is located.
- Latest earthquake happened around the **near-vertical fault line on the eastern Anatolian block,** close to the Syrian border.
- The mechanism and location of the earthquake are consistent with the earthquake having occurred on either the **East Anatolia fault zone or the Dead Sea transform fault zone.**
- The **East Anatolia fault accommodates the westward extrusion of Turkey in the Aegean Sea,** while the Dead Sea Transform accommodates the northward motion of the Arabian peninsula relative to the Africa and Eurasia

plates

- **In the Eastern Mediterranean Region comprising Turkey, Syria and Jordan, tectonics are dominated by complex interactions** between the African, Arabian, and Eurasian tectonic plates, and the Anatolian tectonic block.
- **Dominant Structures here are**
    - **Red Sea Rift**, the spreading centre between the African and Arabian plates;
    - **Dead Sea Transform**, a major strike-slip fault that also accommodates Africa-Arabia relative motions;
    - **North Anatolia Fault**, a right-lateral strike-slip structure in northern Turkey accommodating much of the translational motion of the Anatolia block westwards with respect to Eurasia and Africa;
    - **Cyprian Arc,** a convergent boundary between the Africa plate and the Anatolia block.
- **Turkey's earthquakes emerged from relatively shallow depths** which **made them devastating.**
- The first earthquake, of magnitude 7.8, originated 17.9 km below the Earth's surface. All the subsequent ones, including the one of 7.5 magnitude, emerged from even closer to the surface.
- Shallow earthquakes are generally more devastating because they carry greater energy when they emerge on the surface.
- **Deeper earthquakes lose much of their energy by the time they come to the surface.**
- The deeper quakes spread farther though – the seismic waves move conically upwards to the surface – even as they lose energy while travelling greater distances, and hence cause less damage.
- Large earthquakes, of magnitude 5 or higher, have not been very frequent in recent years.
- Only three earthquakes of magnitude 6 or more have happened in the region since 1970. The last major quake in this area came in January 2020.



What is Magnitude?

- Magnitude is a measure of how big the waves are, while the strength refers to the energy it carries.
- Magnitude is measured on a logarithmic scale, which means the seismic waves produced by a magnitude 6 earthquake have 10 times higher amplitude than the ones produced by a magnitude 5 earthquake.
- The energy differential is even higher, 32 times for every change of 1 in magnitude.

What are aftershocks?

- Aftershocks are a sequence of earthquakes that happen after a larger mainshock on a fault.
- Aftershocks occur near the fault zone where the mainshock rupture occurred and are part of the "readjustment process" after the main slip on the fault.
- While they become less frequent with time, they can continue for days, weeks, months, or even years for a very large mainshock.
- Hours after a massive earthquake hit south-central Turkey and northern Syria, aftershocks have continued to cause damage and spread chaos.
- Massive earthquakes are often followed by multiple aftershocks, which can last for hours or even days.

The Erzincan earthquake-

- The 1939 earthquake that Erdogan referred to is the

Erzincan earthquake, in which about 33,000 people are thought to have been killed.

- It took place on December 26, 1939, and caused extreme damage in the Erzincan Plain and the Kelkit River Valley.
- The earthquake measured 7.8 on the Richter scale, occurred on the North Anatolian Fault Zone (NAFZ), and created a 360-km-long surface rupture, traces of which are still visible.
- Erzincan, historically Yerznka, is the capital of Erzincan Province in Eastern Turkey.

What is an earthquake?

- An earthquake is an intense shaking of the ground caused by movement under the earth's surface.
- It happens when two blocks of the earth suddenly slip past one another.
- This releases stored-up 'elastic strain' energy in the form of seismic waves, which spreads through the earth and cause the shaking of the ground.
- The location below the earth's surface where the earthquake starts is called the hypocenter, and the location directly above it on the surface of the earth is called the epicentre.

What exactly causes earthquakes?

- As we know, the earth's outermost surface, crust, is fragmented into tectonic plates.
- The edges of the plates are called plate boundaries, which are made up of faults.
- The tectonic plates constantly move at a slow pace, sliding past one another and bumping into each other.
- As the edges of the plates are quite rough, they get stuck with one another while the rest of the plate keeps moving.
- Earthquake occurs when the plate has moved far enough

and the edges unstick on one of the faults.

Why earthquakes remain unpredictable?

- Earthquakes continue to remain the most common natural hazard that cannot be predicted. As such, no early warning systems can be developed.
- **Theoretically, it is possible to offer a lead time of a few seconds between the time of the origin** of the earthquake and the time it reaches the Earth's surface.
- Seismic waves travel significantly slower than the speed of light – between 5 and 13 km per second.
- So if the earthquake is detected as soon as it is triggered, information about it can be related a few seconds ahead of it reaching the ground.
- Such systems are already in use in some locations to issue alerts about earthquakes. However, these are not predictions. The alerts are issued post-event.
- **Attempts to find reliable predictors to earthquakes have not been fruitful so far.**
- Scientists have been able to map the areas that are earthquake prone, and are likely to generate earthquakes in future, but **there is no way to predict when.**
- For example, scientists say the Himalayan region has so much accumulated stress beneath the surface that it could result in multiple 7 or 8 magnitude earthquakes. But it cannot be predicted when that would happen.
- Between one and three earthquakes of magnitude 8 or above are recorded every year on average, while 10-15 earthquakes of magnitude between 7 and 8 occur.