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EXPLAINED

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Utter devastation: The search for surivors in a collapsed building after the earthquake in Kahramanmaras, Turkey on February 11, 2023. | Photo Credit: Reuters

The story so far: Two large earthquakes, one of magnitude 7.8 and closely followed by a magnitude 7.5, hit south-eastern Turkey, claiming at least 17,000 lives and counting, wreaking considerable damage in Turkey as well as Syria. Nearly 200 aftershocks have followed with earthquakes of magnitude 6 being reported in the region three days after the first tremblor.

The earth's crust is made up of roughly 15 massive segmented chunky slabs called tectonic plates which are constantly in motion. The land on which buildings are built rests on these plates. The plates continually collide, push and grate against each other and the meeting points of these plates are made up of a series of 'faults.'

The pent-up energy from the nestling plates, along faultlines, is often released when an imbalance in pressure causes rocks on either side of the fault to re-adjust. One set of rocks rising up relative to the other is a 'normal' fault, and one sliding down relative to the other is a 'reverse' fault. When they grate or move past one another, it's a 'strike-slip.' The energy released travels as waves that cause the ground to shake.

Turkey and Syria lie at the confluence of three plates — the Arabian Plate, the Anatolian Plate and the Eurasian Plate, making the region an extremely seismically active zone. The Arabian Plate is inching north into Europe, causing the Anatolian Plate (which Turkey sits on) to be pushed out west. The bulk of Turkey sits on the Anatolian Plate between two major faults: the North Anatolian Fault and the East Anatolian Fault.

Geologists say that the earthquakes were from a 'strike-slip' which is typical of the earthquakes in the region.

As this region hosts many fault systems, there are many earthquakes being recorded in the region. Only those that result in a release of energy above a certain threshold are captured by seismological instruments. At magnitude 7.8, the February 6 event is much bigger than the ones the area has experienced before. The fault system runs along nearly 190 km which is why the impact of the earthquakes was so far-ranging.

The second earthquake, of 7.5 magnitude, occurred further to the north on a different but adjacent fault system called the Sürgü Fault. The magnitudes of these earthquakes suggest that

there will be several aftershocks that can be registered in a wide radius and reports of shakes from as far away as Cairo (950 km) and Istanbul (815 km) away have been reported.

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The Indian Plate, colliding into the Eurasian plate and tilting upwards, created the Himalayas. The most common type of earthquake in the Himalayan region is due to reverse faults because of the compressive forces between the two plates, says Suvrat Kher, a Pune-based geologist. “However, whether it’s strike-slip or a thrust, the waves generated can be as powerful.” Scientists have longed warned of a massive, overdue earthquake in the Garhwal-Kumaon range here because of what is known about the pattern of quakes in the region.

Based on the amount of ‘slip’ (or movement) that is observed in an earthquake and measurements of the amount of ‘strain’ that accumulates every year, scientists can deduce the latent pressure that’s building up along a fault has been released. “We don’t have very accurate records that date back, say a thousand years, on 7+ magnitude earthquakes. The records of the last 300 or so years suggest that those that have occurred haven’t released all the pent-up energy and that’s why we think a major one — maybe even an 8 magnitude one — is overdue. However predicting the day it will occur is beyond our ken now,” said V.K. Gahlaut, seismologist and professor at the National Geophysical Research Institute (NGRI), Hyderabad.

In the Turkey-Syria earthquakes, energy from nearly 300 years of accumulated strain was released, he added.

It is only broadly true that the magnitude of earthquakes corresponds to death and devastation. Chile, a country with a long history of devastating earthquakes (over 9), is considered to be a model for earthquake preparedness.

Despite experiencing earthquakes with magnitudes over 8 in 2014 and 2015 casualties are extremely minimal due to years of strictly enforcing building codes. This despite being a much poorer country than Japan, also known for its experience in earthquake-proofing structures.

The 9-magnitude earthquake that caused a tsunami and a radiation leak in the nuclear power plant in the country’s Fukushima prefecture in 2011, didn’t damage the stability of the structure, said Mr. Gahlaut. “Just as the energy released exponentially rises in a single step of the scale (Moment Magnitude), the cost of earthquake-proofing too rises exponentially. On the other hand, if structures are built on a fault line, then no amount of engineering can save them.”

A lack of enforcement of building codes in Turkey and the timing of the earthquake in the early morning are believed to be major factors for the death and devastation inflicted. “It’s a bit like India where we have lots of rules (on building codes) but there is limited enforcement. The 1993 Latur earthquake for instance was a little over 6 magnitude but caused enormous damage because building codes are not enforceable there,” said Mr. Kher.

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