Preliminary Report on the March 28, 2025 Myanmar Earthquake with a Magnitude of 7.7 (Version 2)

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1- Introduction

At 9:54 AM local time on March 28, 2025, a 7.7-magnitude earthquake struck central Myanmar at a shallow depth of 10 km, affecting neighboring countries up to 1500 km away. Bangkok, 1000 km away, experienced unexpected damage and casualties. The nearest city, Mandalay, with 2 million residents, suffered severe destruction, including ancient monuments, tall buildings, infrastructure, and utilities. Death toll estimates reach thousands, with economic losses in the billions. The quake resulted from the north-south Sagaing Fault, marking the India-Eurasia plate boundary. Since 1900, six quakes over magnitude 7 have occurred within 250 km of this area. Chinese seismic centers recorded a magnitude of 7.9, also felt in southwestern China. The information about the event is summarized in Fig. 1.

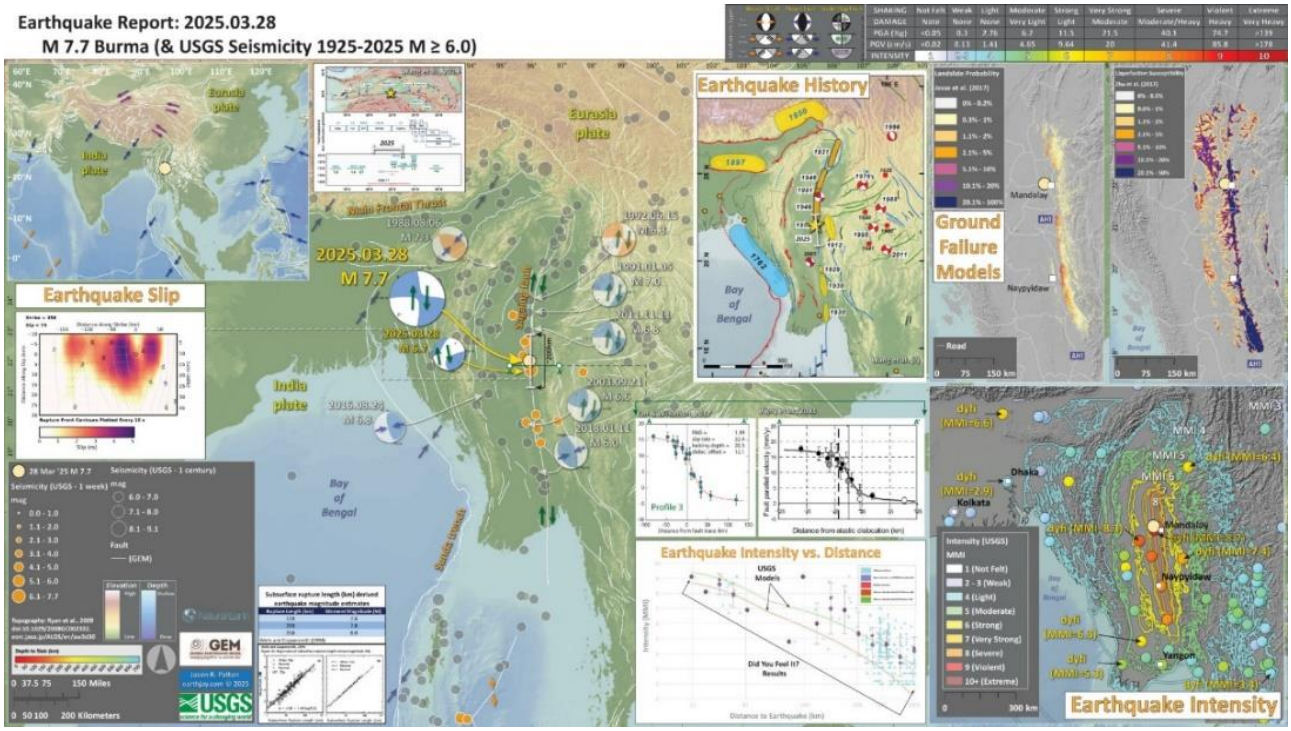

Figure (1): Some information about the March 28, 2025 Myanmar Earthquake (USGS)

The seismic waveforms recorded by the National Center of the Broadband Seismic Network of the International Institute of Earthquake Engineering and Seismology are shown in Fig. 2.

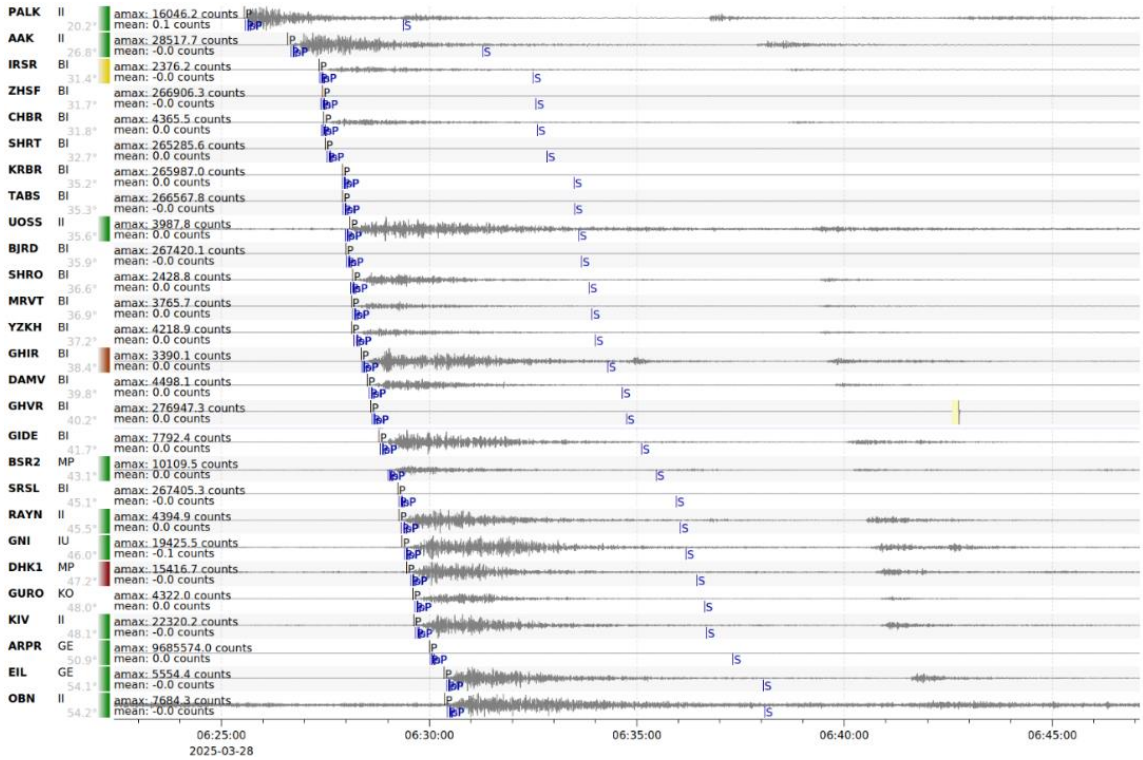

Figure (2): Vertical components of seismograms recorded from the Myanmar earthquake at the National Center of the Broadband Seismograph Network of the International Institute of Earthquake Engineering and Seismology

2- Tectonic Structure of the Earthquake-Affected Area

The March 28, 2025, Myanmar earthquake occurred at the intersection of four tectonic plates: India, Eurasia, Sunda, and Burma, where intense tectonic activity leads to seismic hazards. The Sunda Megathrust defines the boundary between the Indian and Burma plates, while the 1400-km Sagaing Fault, is the region's most active seismic source, causing earthquakes near major cities like Yangon, Naypyidaw, and Mandalay. Significant quakes occurred in 1931, 1946, 1956, 1991, and 2012, with magnitudes ranging from 7 to 8. The N10°E convergence of 35 mm/year is distributed across the Sagaing Fault (20 mm/year), Kabaw Thrust (9 mm/year), and Andaman Trench subduction (14 mm/year) (Socquet et al., 2006). Shear-wave splitting studies show north-south tectonic stress consistent with the observed faulting mechanism which. is right lateral strike-slip, with respect to the north-south trend of the Sagaing fault (Fan et al., 2024).

3- Radar Interferometry Studies

Radar interferometry (InSAR) is valuable for mapping earthquake-induced ground deformation over large areas. For the March 28, 2025, Myanmar earthquake, co-seismic displacement was estimated using the Pixel Offset Tracking (POT) method on Sentinel-1 radar images from March 19 and 31, 2025. POT is effective for detecting large displacements where conventional methods fail due to loss of image coherence and phase ambiguity. To extend coverage along the Sagaing Fault, Sentinel-1 radar and Sentinel-2 optical data were combined, revealing displacement fields over ~500 km. Results show the rupture spans ~503 km from Kyauk-Myaung in the north to Myo-Chaung in the south (Fig. 3).

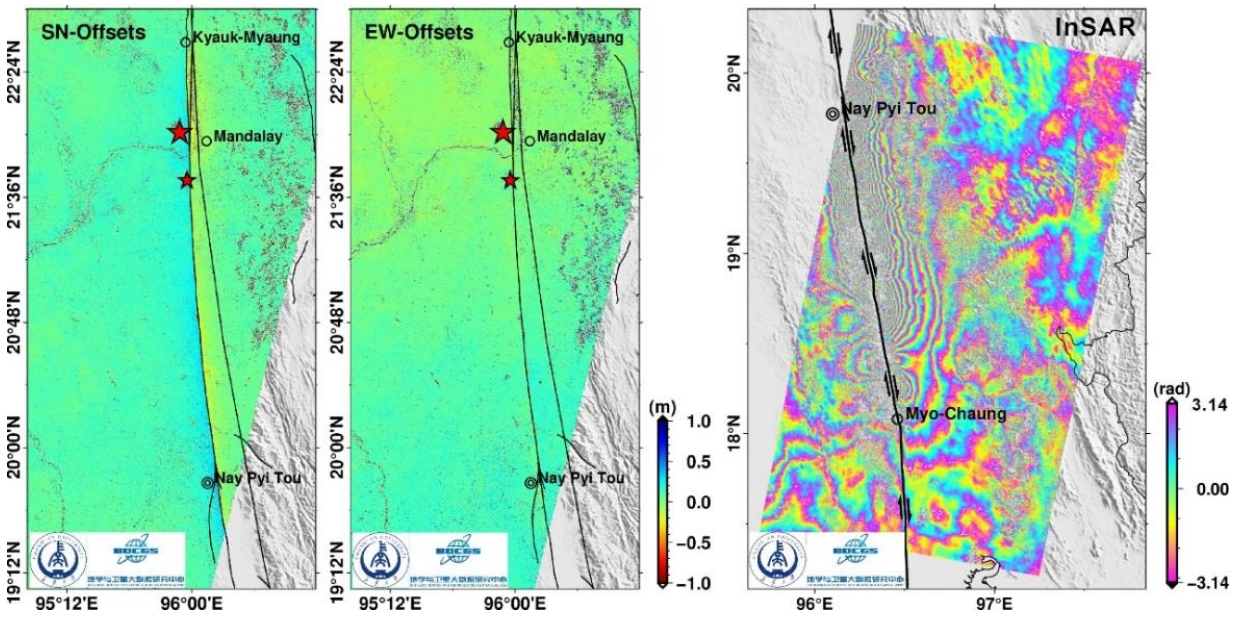

Figure (3): The results of radar interferometry studies using Sentinel-1 and 2 images (x.com)

4- Coulomb Stress Studies

Coulomb stress analysis for the March 28, 2025, M7.7 Myanmar earthquake shows significant stress changes on nearby faults, particularly the Sagaing Fault, which has a 24 mm/year slip rate. An M6.4 aftershock occurred 11 minutes later in the south, likely due to stress transfer or reduced shear resistance from fault rupture. Calculations indicate increased stress in both the northern and southern segments of the Sagaing Fault, raising the likelihood of future earthquakes, especially near Naypyidaw, a high-stress zone and potential future epicenter (Fig. 4).

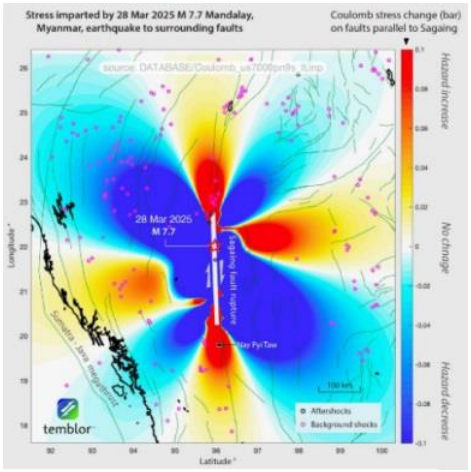

Figure (4): Coulomb stress study calculated for the recent Myanmar earthquake (Temblor, 2025).

5- Supershear Earthquake

A supershear earthquake occurs when fault rupture speed exceeds shear wave velocity, creating a shock front that intensifies ground shaking. The M 7.7 Myanmar earthquake on March 28, 2025, showed clear signs of supershear rupture along the Sagaing Fault, with southward propagation at ~5 km/s—faster than regional shear wave speed—resulting in a 500 km surface rupture and displacements up to 5 meters. This led to amplified destruction even in distant areas like Bangkok, over 1000 km from the epicenter. Seismic and satellite data confirm its rare supershear nature and significant impact on Myanmar's tectonic structures.

6- Conclusion

The M7.7 March 28, 2025, Myanmar earthquake, with a shallow 10 km depth, strike-slip mechanism, 500 km rupture, and 5 m vertical displacement, exemplifies a major seismic event. Its severe human and economic impacts highlight the need for further study, which will enhance seismology, earthquake-resistant design, and crisis management. Given the presence of similar active faults in Turkey, Iran, Afghanistan, Uzbekistan, and Tajikistan, this event offers critical insights for both theoretical and practical applications in seismic risk reduction across West and Central Asia.

References

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