REPORT
doi:10.26443/seismica.v4i2.1914
SEISMICA

Fast Reports of the 2025 Mw 7.8 Mandalay, Myanmar Earthquake: unraveling the rupture characteristics

Kiran K.S. Thingbaijam * [1], **Ryo Okuwaki** [2], **Tiegan E. Hobbs** [3,4,5]

[1]Earth Sciences New Zealand, 1 Fairway Drive, Avalon 5011, New Zealand, [2]Institute of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Ibaraki, Japan, [3]Geological Survey of Canada, Vancouver, BC, Canada, [4]Dept. of Earth, Ocean, and Atmospheric Sciences, University of British Columbia, Vancouver, BC, Canada, [5]School of Earth and Ocean Sciences, University of Victoria, Victoria, BC, Canada

Abstract The Seismica Fast Reports of the 2025 Mandalay, Myanmar Earthquake unraveled distinct facets of the source. We envisage that further studies will reconcile these different findings.

Production Editor:
Andrea Llenos
Handling Editor:
Andrea Llenos
Copy & Layout Editor:
Théa Ragon

Received:
August 28, 2025
Accepted:
October 1, 2025
Published:
October 13, 2025

1 An overview

On 28 March 2025, Myanmar was struck by a massive Mw 7.8 earthquake — one of the most powerful seismic events in the nation's recorded history. The earthquake unleashed extreme shaking, registering a Modified Mercalli Intensity of X in the near-source region, and left a trail of destruction that reached parts of Thailand, China, and Vietnam. Early online information confirmed that the strike-slip event occurred on the north-south trending Sagaing Fault, and had a very long rupture on the order of 400 km (USGS, 2025).

Seismica Fast Reports allow researchers to publish preliminary assessments of noteworthy events, which are more involved than automated processing (e.g., moment tensor solutions) but less detailed than standard scientific studies that tend to be published months and years afterward. At the time of writing, three such reports have examined the rupture characteristics of the event (Inoue et al., 2025; Melgar et al., 2025; Hirano et al., 2025). Notably, each study used different datasets—seismograph records, satellite imagery, trench observations, and CCTV footage. Together, they offered broad-ranging perspectives on the complex rupture behavior of the event, addressing key questions: How did the rupture propagate? What was its overall geometry? How was the slip distributed? And how does it relate to past events?

Inoue et al. (2025) analyzed vertical components (P-wave) of teleseismic recordings using a potency density tensor inversion technique. This technique aims at recovering the rupture geometry (Shimizu et al., 2020). Their findings suggested that the event nucleated and propagated with a supershear rupture velocity (i.e., faster than the S-wave can travel). More intricately, the event was associated with multiple (at least three) asymmetric, bilateral ruptures or subevents, although the overall rupture was unilateral, traveling from north to south.

Melgar et al. (2025) carried out joint inversion of regional strong motion waveforms and Sentinel-1 SAR pixel offsets to infer a detailed kinematic rupture model of the event. They applied a multi-time window method that allows flexible rupture timing (Melgar and Bock, 2015). Their model suggests that the total rupture extended 450 km with depth-averaged slip in the range of 3 to 5 m.

Hirano et al. (2025) conducted an innovative analysis of the CCTV footage to track surface rupture. Their results suggest that the rupture may have nucleated at supershear speed, decelerated to subshear speed (~3.0 km/s) between 60 km and 120 km south of the epicenter, and then returned to supershear speed. This pattern aligns with evidence from strong-motion recordings and waveform simulations. They also note that the rupture deceleration occurred in a low stress drop region, as identified through satellite imagery, suggesting a positive correlation between the rupture speed and the stress drop.

All of these studies agree on the supershear characteristics of the rupture. They also agree that large slip patches are located in the nucleation or hypocentral region. However, there are significant differences in the resolved features of the rupture. The moment rate function inferred by Melgar et al. does not exhibit multiple peaks, whereas that inferred by Inoue et al. does. There are also differences in inferring rupture behavior

*Corresponding author: k.thingbaijam@gns.cri.nz

at the intersection between the Sagaing segment (where the hypocenter is located) and the Meiktila segment (located south of the first segment). Inoue et al. and Hirano et al. argued that the intersection may act as a barrier to rupture. In contrast, Melgar et al. suggested it is rather diffusive, i.e., not a strong barrier. Another difference lies in the maximum rupture speed, which is approximately 6.0 km/s in the case of Inoue et al., compared to 4.8 km/s in the case of Melgar et al. An ultimate question thus arises as to how these different observations can be reconciled.

We find that the different reports consistently describe this event as having an unusually long rupture. Based on the reported findings, we speculate on two possible contributing factors: (1) supershear rupture speed, and (2) the occurrence of multiple distinct subevents within the overall rupture. Supershear rupture may have contributed to sustaining the extensive rupture propagation, assuming favorable conditions such as high pre-stress, a long and straight fault geometry, and conducive crustal properties. As for the distinct sub-events, they reportedly spanned approximately 120 km, 150 km, and 200 km (Inoue et al., 2025), with varying degrees of spatial overlap. Their sequence and interaction may have collectively produced the exceptionally long rupture.

Last but not least, Myanmar has a long history of large earthquakes, particularly on the Saingang Fault. Melgar et al. (2025) uncovered paleoseismic evidence of five surface-rupturing earthquakes that possibly occurred over the past millennium, implying that an average recurrence period of similarly sized events is less than 200 years for the Saingang fault. There is a need to further corroborate this early finding with a more rigorous study.

We note that other equally important studies have been reported elsewhere (e.g., Ye et al. 2025; Antoine et al. 2025; Vera et al. 2025; Kearse and Kaneko 2025; Xiwei et al. 2025). However, a discussion of them lies beyond the scope of this editorial.

Acknowledgements

We appreciate the careful reading and helpful suggestions by Andrea Llenos and two anonymous reviewers.

References

Antoine, S. L., Shrestha, R., Milliner, C., Im, K., Rollins, C., Wang, K., Chen, K., and Avouac, J.-P. The 2025 Mw 7.7 Mandalay, Myanmar, earthquake reveals a complex earthquake cycle with clustering and variable segmentation on the Sagaing Fault. *Proceedings of the National Academy of Sciences*, 122(33):e2514378122, 2025. doi: 10.1073/pnas.2514378122.

Hirano, S., Doke, R., and Maeda, T. Supershear-subshear-supershear rupture sequence during the 2025 Mandalay Earthquake in Myanmar. *Seismica*, 4(2), Aug. 2025. doi: 10.26443/seismica.v4i2.1785.

Inoue, N., Yamaguchi, R., Yagi, Y., Okuwaki, R., Enescu, B., and Tadapansawut, T. A multiple asymmetric bilateral rupture sequence derived from the peculiar tele-seismic P-waves of the 2025 Mandalay, Myanmar earthquake. *Seismica*, 4(1), May 2025. doi: 10.26443/seismica.v4i1.1691.

Kearse, J. and Kaneko, Y. Curved Fault Slip Captured by CCTV Video During the 2025 Mw 7.7 Myanmar Earthquake. *The Seismic Record*, 5(3):281–288, 2025. doi: 10.1785/0320250024.

Melgar, D. and Bock, Y. Kinematic earthquake source inversion and tsunami runup prediction with regional geophysical data. *Journal of Geophysical Research: Solid Earth*, 120(5):3324–3349, 2015. doi: 10.1002/2014JB011832.

Melgar, D., Weldon, R., Wang, Y., Bato, M. G., Aung, L. T., Shi, X., Wiwegwing, W., Khaing, S. N., Min, S., Thant, M., Speed, C., Zinke, R., Fielding, E., Meltzner, A., and Dawson, T. Supershear source model of the 2025 M7.8 Myanmar earthquake and paleoseismology of the Sagaing Fault: regions of significant overlap with past earthquakes. *Seismica*, 4(2), Jul. 2025. doi: 10.26443/seismica.v4i2.1771.

Shimizu, K., Yagi, Y., Okuwaki, R., and Fukahata, Y. Development of an inversion method to extract information on fault geometry from teleseismic data. *Geophysical Journal International*, 220 (2):1055–1065, 2020. doi: /10.1093/gji/ggz496.

USGS. United States Geological Survey, M 7.7 - 2025 Mandalay, Burma (Myanmar) Earthquake, https://earthquake.usgs.gov-/earthquakes/eventpage/us7000pn9s/executive (Last Accessed August 2025). 2025.

Vera, F., Carrillo-Ponce, A., Crosetto, S., Kosari, E., Metzger, S., Motagh, M., Liang, Y., Lyu, S., Petersen, G., Saul, J., et al. Supershear Rupture Along the Sagaing Fault Seismic Gap: The 2025 Myanmar Earthquake. *The Seismic Record*, 5(3):289–299, 2025. doi: 10.1785/0320250025.

Xiwei, X., Wenjun, K., Tao, W., Xianbing, Z., Yuzhuo, L., Yuxuan, Z., Jizhen, Z., Kang, L., Qixin, W., Jia, C., et al. The Mw 7.7 Myanmar earthquake: a continental longest surface-rupturing supershear cascading event. *npj Natural Hazards*, 2(1):73, 2025. doi: 10.1038/s44304-025-00125-z.

Ye, L., Lay, T., and Kanamori, H. The 28 March 2025 Mw 7.8 Myanmar Earthquake: Preliminary Analysis of an 480 km Long Intermittent Supershear Rupture. *The Seismic Record*, 5(3):260–269, 2025. doi: 10.1785/0320250021.