The Impact of the M7.7 Mandalay / Myanmar Earthquake on Southern Thailand and What Holds the South

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1. INTRODUCTION

Earthquakes are a common phenomenon in Thailand, with the majority of epicenters located in the northern and western regions. The largest recorded earthquake, measuring M6.1, occurred southwest of Chiang Rai on May 5, 2014. However, earthquakes frequently occur outside of Thailand but close enough to affect it. For example, on August 24, 2016, a magnitude 6.8 earthquake occurred west of Chauk in Myanmar. The shaking was felt in high-rise buildings in Bangkok's Silom, Ratchadaphisek, Khlong Tan, and Khlong Toey areas. People in buildings in Chiang Mai also reported shaking [1]. This earthquake occurred farther away than the M7.7 earthquake in 2025. Notably, on December 26, 2004, an M9.2 earthquake occurred off the western coast of Sumatra, Indonesia, causing an Indian Ocean-wide tsunami. During this event, buildings shook in many locations in Thailand, not only in southern Thailand but also in Bangkok. The recent M7.7 Mandalay, Myanmar, earthquake on March 28, 2025, (22.01°N, 95.92°E) was severely felt in Bangkok, Hat Yai (further south), and even Northern Malaysia.

2. M7.7 MANDALAY/MYANMAR EARTHQUAKE

The M7.7 Mandalay/Myanmar earthquake was significant for Thailand, not only because of the collapsed building in Bangkok with a high preventable death toll, but also because of its impact on southern Thailand. The earthquake was severely felt in Bangkok, located around 1,000 km from the epicenter, and also in Hat Yai (7 °N, 100.5 °E), which is located 1,700 km from the epicenter [2]. High-rise buildings on rock foundations shook severely, causing people to panic and leave the buildings. Similar experiences were made during the 2004 earthquake, although there were much fewer high-rise buildings in the city at that time. However, the distance to the epicenter of the M9.2 earthquake was about 660 km. The intensity in Hat Yai for that earthquake was around 6. For the M7.7 the intensity is shown in Figure 1. As expected the intensity is logarithmically decreasing with hyphocentral distance. Many felt reports at around 1,000 km are related to Bangkok locations. However, there are a few reports beyond this distance.

Further, the earthquake types of the M9.2 and M7.7 are quite different. The first one is a thrust earthquake at an active subduction zone (Sunda Subduction Zone). It is well documented that such events can produce high magnitude earthquakes. The second and recent earthquake is on land along a well-developed strike-slip fault, which is also part of the same plate boundary where the first earthquake was located.

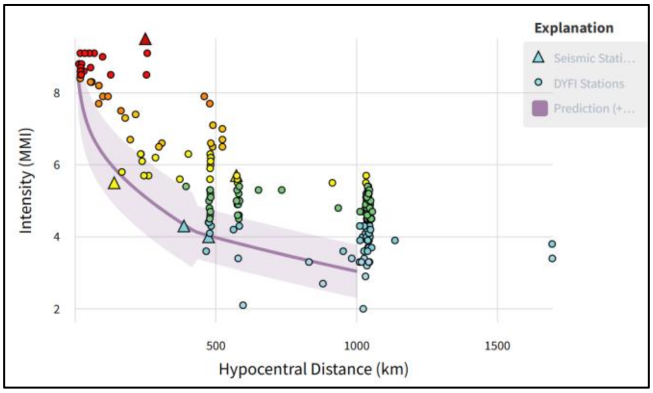

Figure 1. Intensity (Modified Mercalli Intensity Scale) versus hypocentral distance (in km) for the M7.7 Mandalay/ Myanmar earthquake. Prediction (solid line, ±1 standard deviation, using soil) and observations: Triangles - seismic stations, circles- felt reports; from [2].

Recent investigations revealed that for the M7.7 the rupture extended over ~450 km with an average slip of 3-5 m, predominantly within the upper 10 km of the crust. Inferred from near-field waveform observations a maximum rupture speed of ~4.8 km/s was determined, which is, consistent with supershear propagation [3].

Supershear, or intersonic, earthquakes are those type of earthquakes where the rupture velocity is higher than the shear wave (S) velocity of the rocks through which they break. Usually, the S-wave velocity of related host rocks is around 3.5 km/s. Such types of earthquakes occur rarely, but then often found with strike slip faults. They can be highly destructive as they are often associated with strong ground shaking. Another example for such an earthquake can be found at the far eastern side of the Sunda Subduction Zone, the 2018 M7.5 Palu (Indonesia) earthquake, which also indirectly triggered a tsunami.

3. ACTIVE FAULTS IN SOUTHERN THAILAND

In southern Thailand, a series of faults, including the Ranong (RFZ) and Khlong Marui (KMFZ) fault zones, were identified as inactive before 2004 by the Department of Mineral Resources (DMR) of Thailand. However, no seismicity studies have been carried out. The KMFZ and RFZ are major NNE-SSW trending strike-slip faults with diachronous reversal in shear sense that originated before the India–Eurasia plate collision but were activated during it. Seismological observations in early 2005 have confirmed low-magnitude (M<4.5) seismicity along the faults and in southern Thailand. Both fault zones are around 500–600 km from Bangkok.

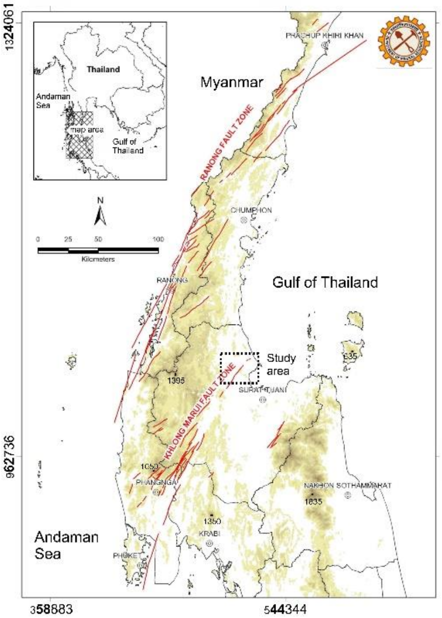

Figure 2: Topographic map of southern Thailand with the major fault zones, after [4], and study area; base map in UTM WGS-84, numbers are elevations in meters

In 2006/07, the DMR conducted a preliminary study on the recurrence interval of the RFZ and the southwestern and middle parts of the KMFZ. The study concluded that the KMFZ last moved 1,200 years ago and the RFZ 2,000 years ago. Furthermore, the recurrence intervals of the KMFZ and RFZ are 1,000 and 2,000 years, respectively [4].

As part of a larger study, which was supported by EGAT, extensive geological and geophysical fieldwork was carried out in 2010/11 with the objective of locating the KMFZ in the western part, identifying locations with evidence of paleoearthquakes, and dating sediments related to these events. Paleoseismological investigations in this area have shown that conjugate faults related to the main Khlong Marui Fault Zone have been active for at least the last 10,000 years, with two identifiable events occurring between 2.53 and 6.89 thousand years ago (ka) and between 0.59 and 2.17 ka. The maximum magnitude of these paleoearthquakes was found to be M 7.0 [5].

Therefore, it can be concluded that the Khlong Marui Fault Zone is located further south than previously mapped [4], as shown in Figure 3. Additionally, it can be established that the fault was active before 2004, contrary to previous findings [4]. Higher magnitude earthquakes therefore can be expected along this fault.

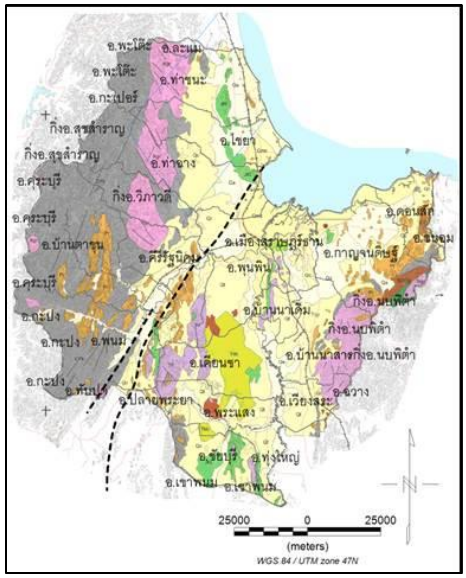

Figure 3: Geological map (after DMR) with the main fault line of the KMFZ (black dashed line), [5].

Clearly categorizing the KMFZ as an active fault has implications for seismic hazard assessments and related mitigation efforts. For instance, it affects the engineering requirements for buildings and infrastructure in the region. It may also affect Bangkok.

4. REFERENCES

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