Dedicated to the memory of the people died and suffered from this earthquake.

A Quick Report
on
2025 Mandalay-Sagaing (Myanmar) Earthquake

Prepared

by

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University of the Ryukyus, Okinawa, Japan

1st Draft: 2025 April 1
2nd Draft: 2025 April 6
3rd Draft April 10

ATTENTION

Please note that this document is prepared with a sole purpose to provide an overview of various aspects of the earthquake for researchers, who would be involved with this earthquake.

The major source of pictures relevant to the aspects of this document are obtained from the web-sites of various institutes and major mass media, and they are gratefully acknowledged for the information through images of the earthquake, which it will probably pave the ways for further improvement of earthquake resistances of various structures essential to the societies worldwide.

Many relevant pictures were shared by the people of Myanmar and they are accessible from the following web-site and the author gratefully acknowledges their efforts and generosity:
https://themimu.info/webmap-sagaing-earthquake-2025

CONTENT

1) Location
2) Geology and Tectonics
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8) Building Damage
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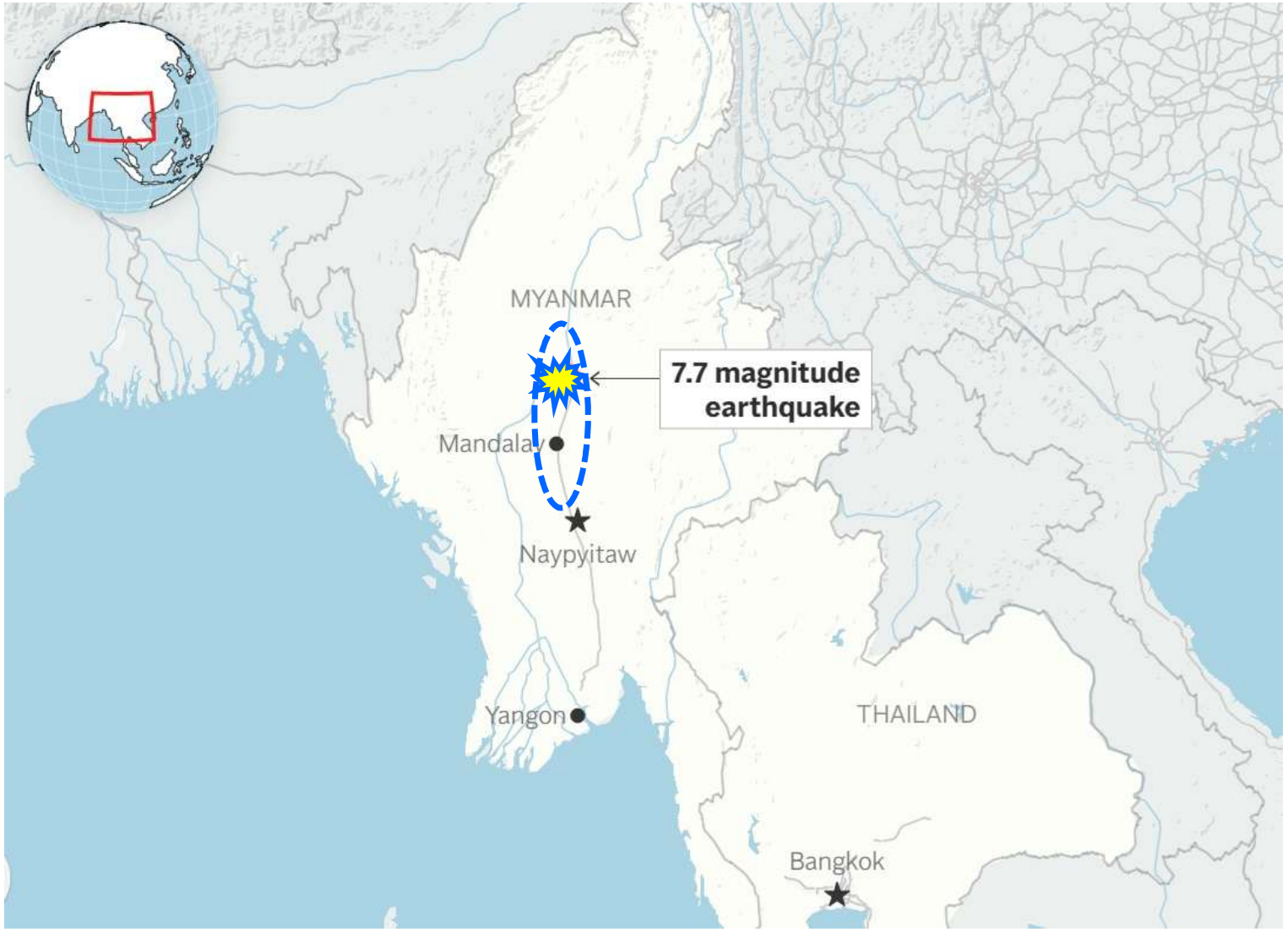
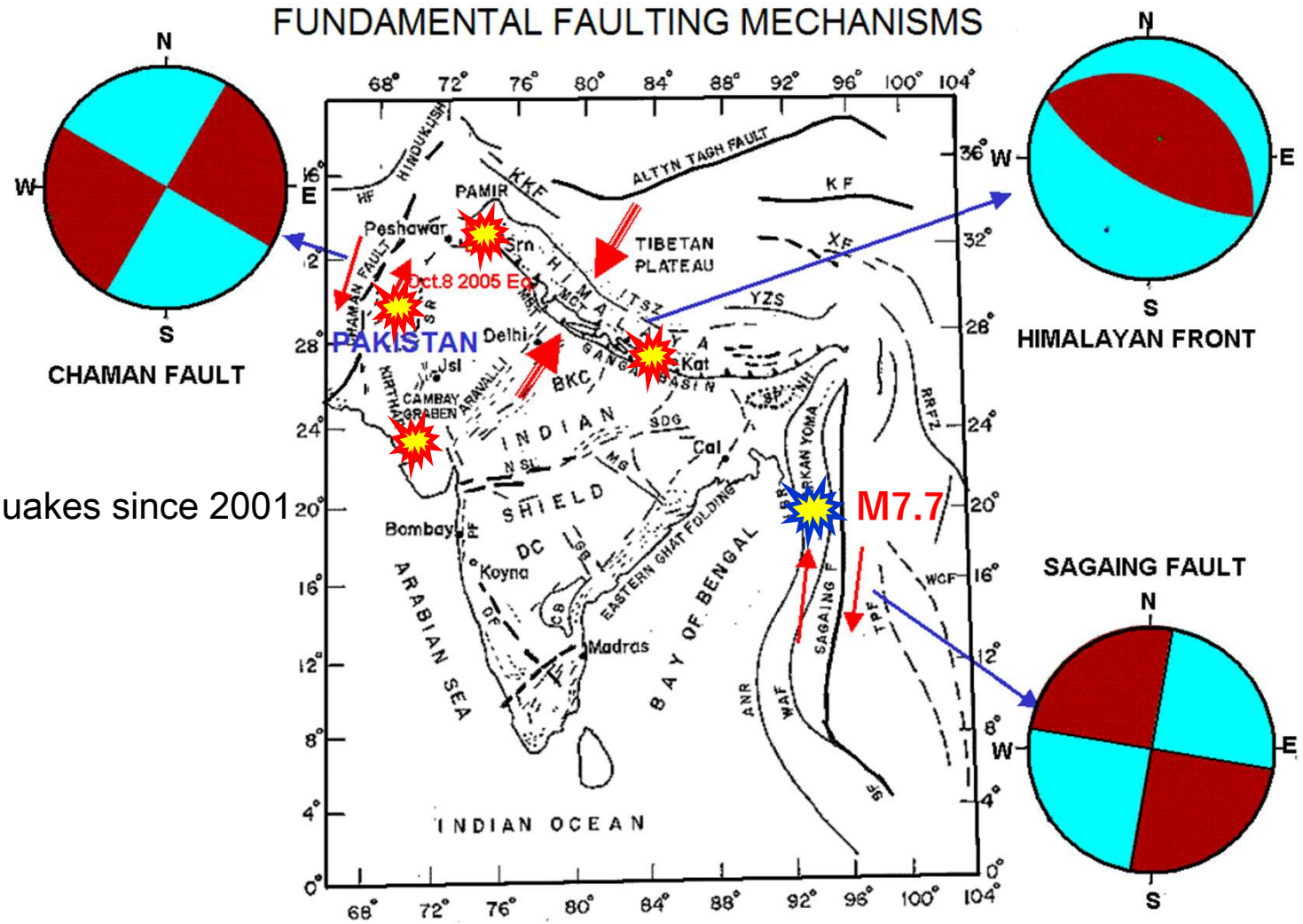
References

Location



Modified from OpenStreetMap

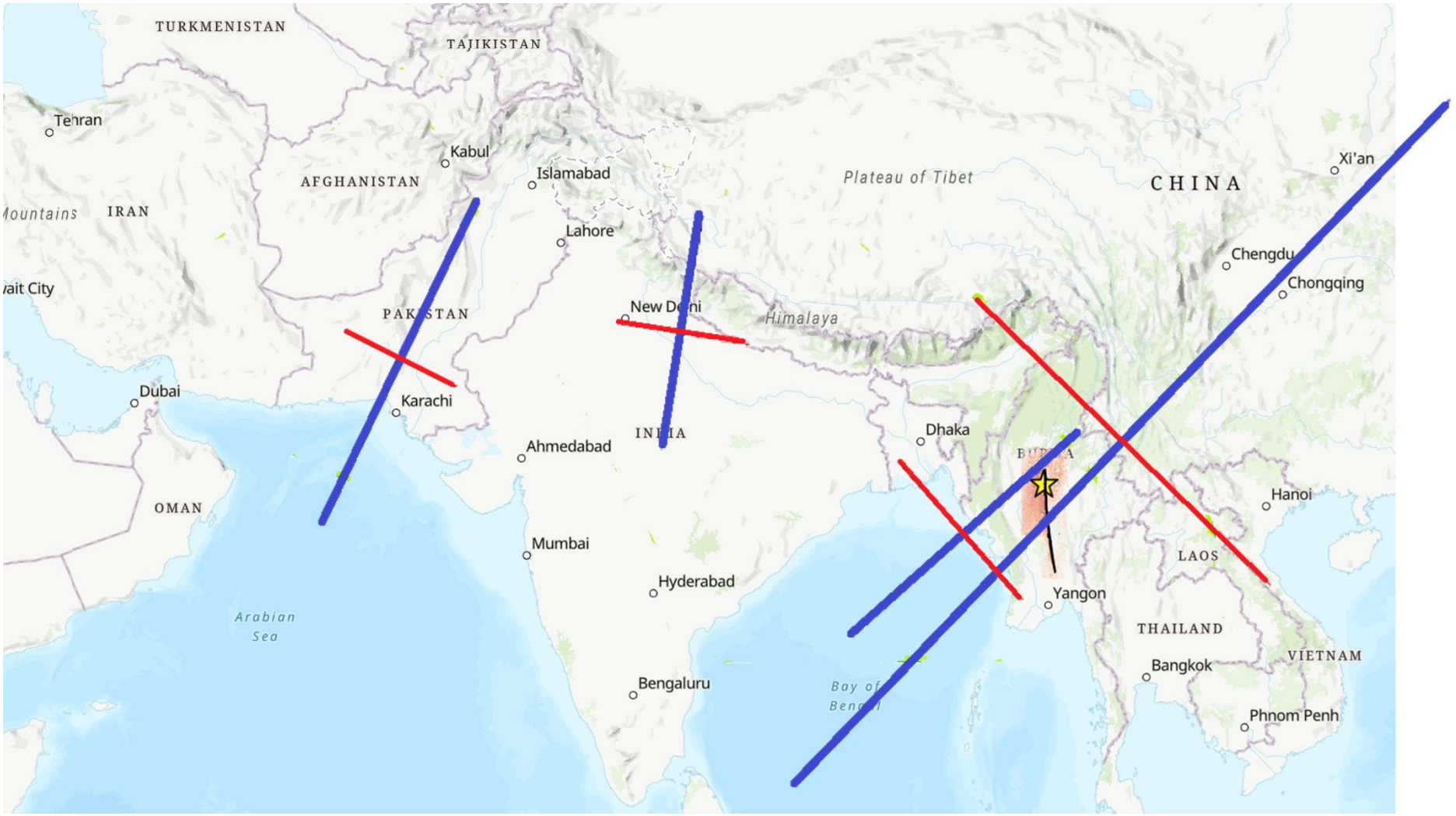
Regional tectonics



Major earhquakes since 2001

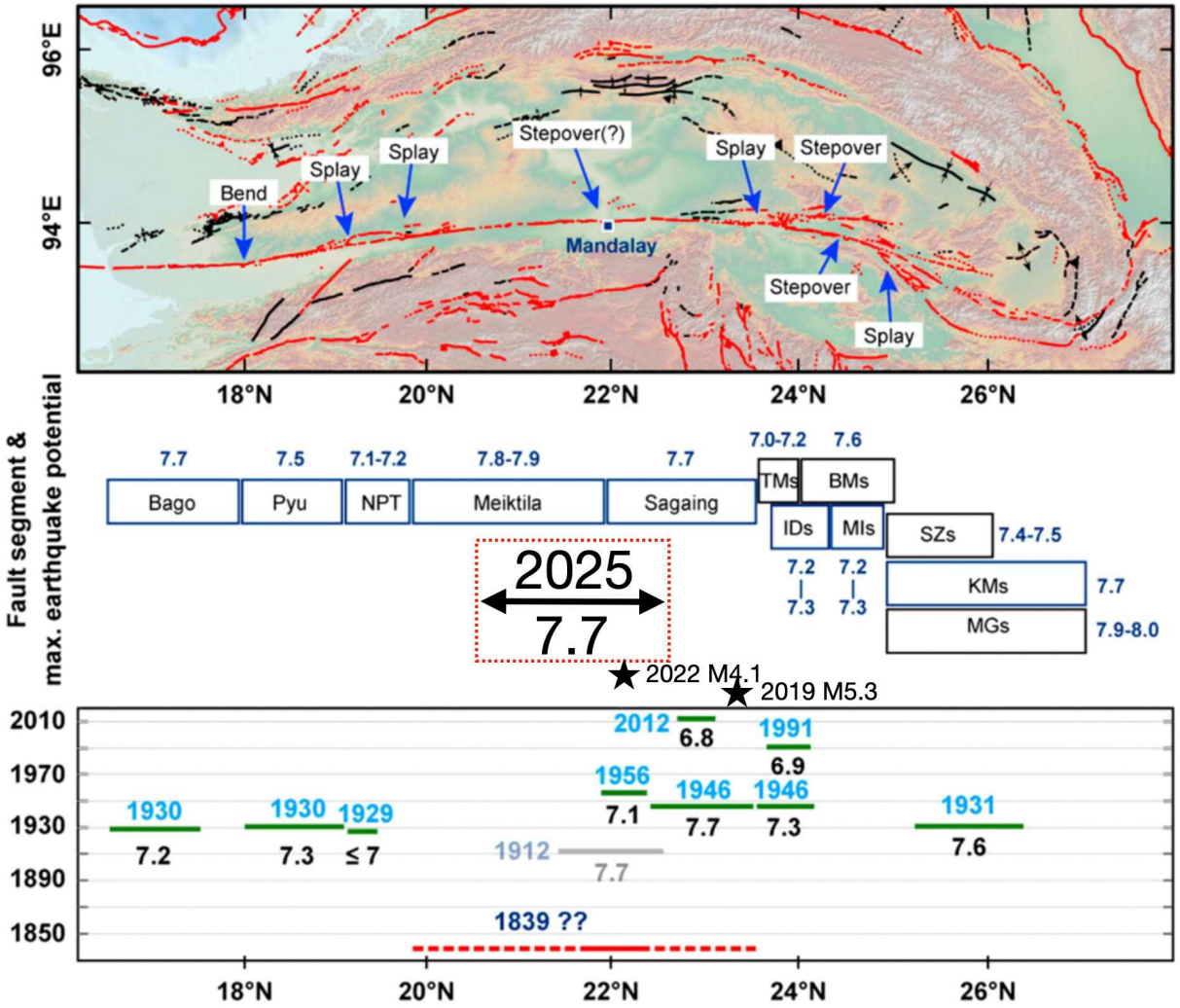
Tectonic features of Indian plate and its close vicinity modified from Aydan (2006)

Annual Crustal Straining



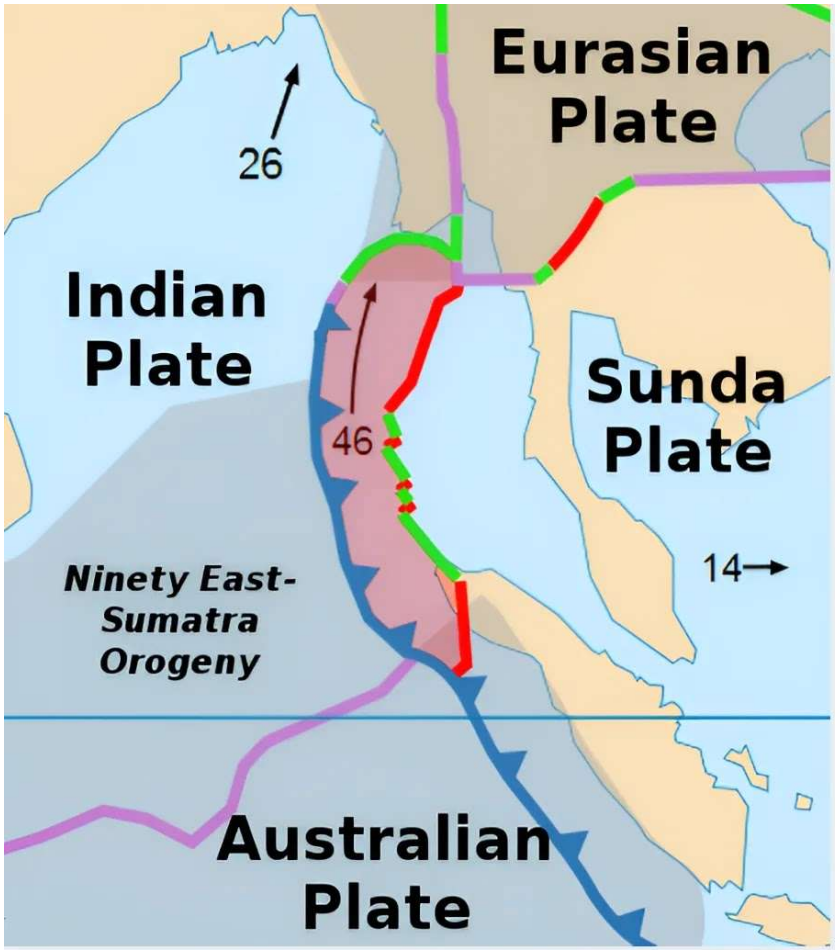
modified from Aydan (2006)

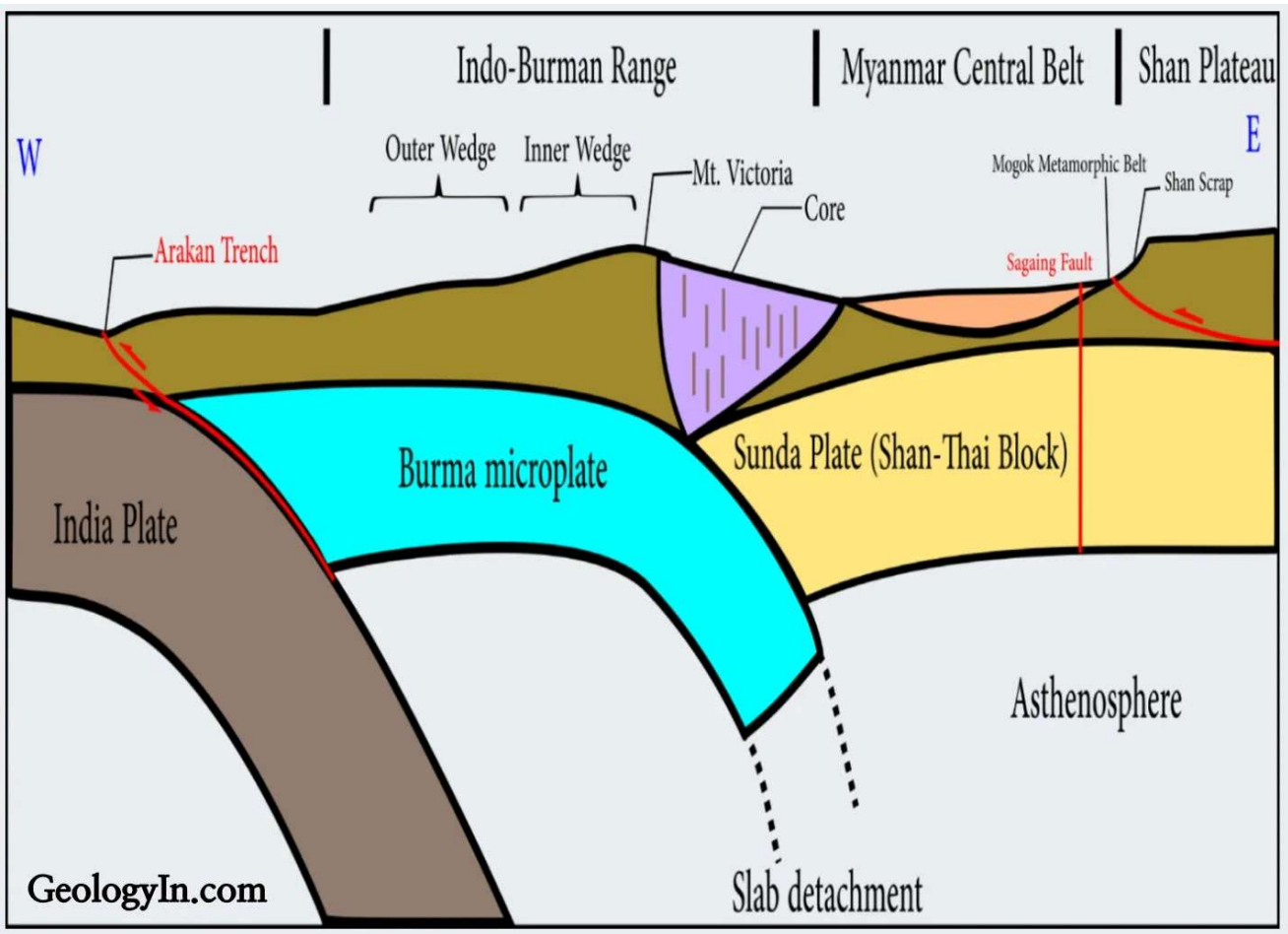
Major earthquakes along Sagaing Fault Zone since 1930



from Hubbard and Bradley, K., 2025

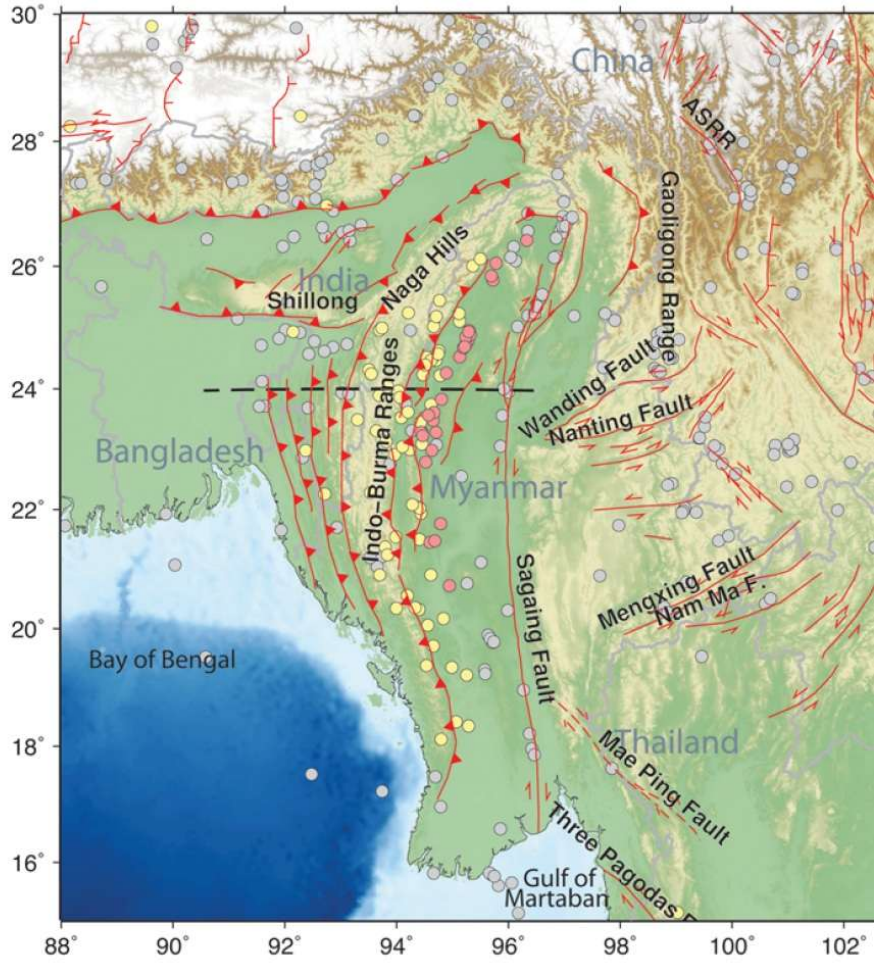
Regional Plate Tectonics

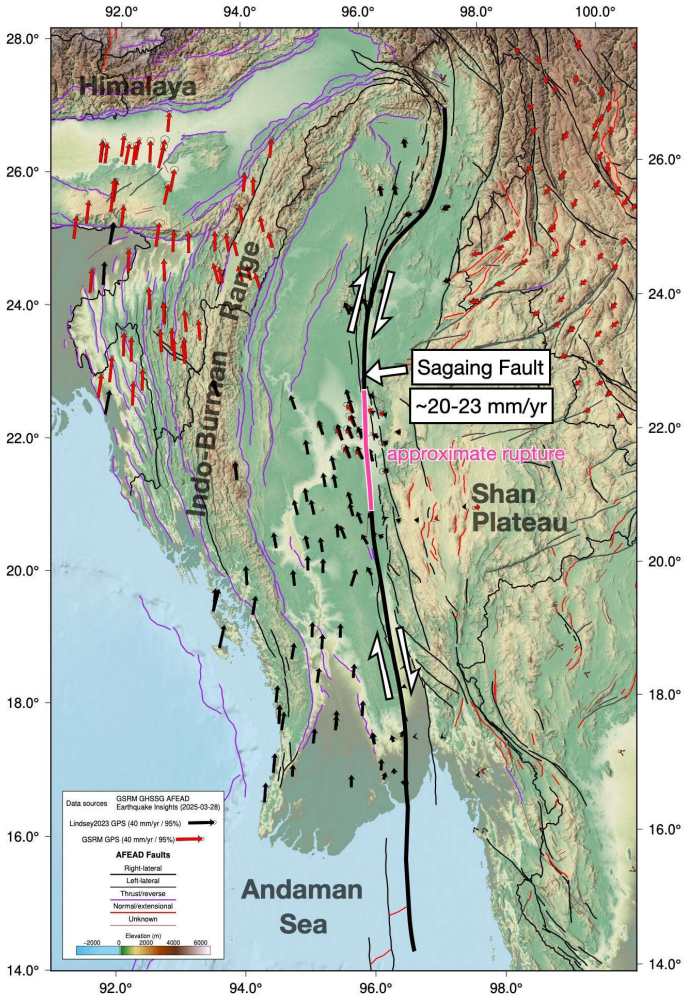


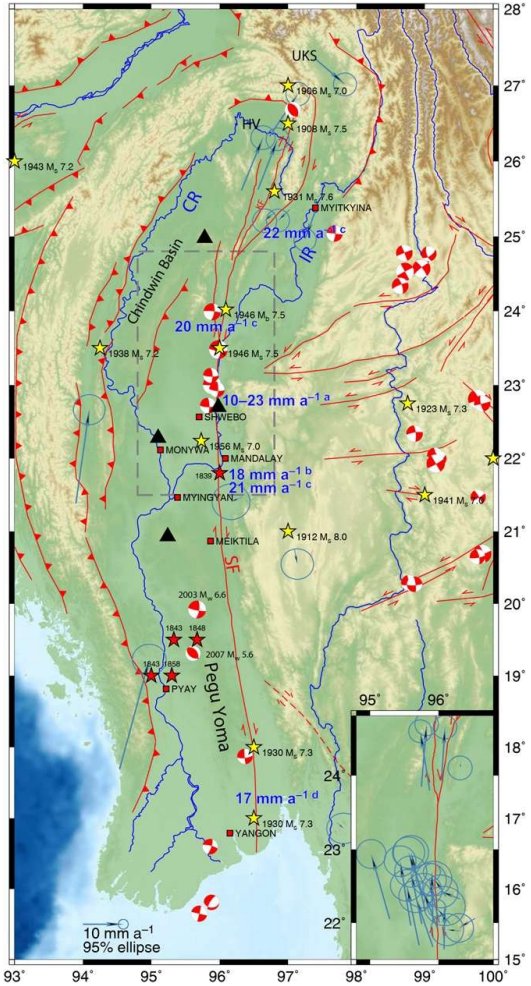


from https://www.geologyin.com/2025/03/myanmar-earthquake-causes.html

Faults, Crustal Deformation and Focal Mechanism of Past Earthquakes

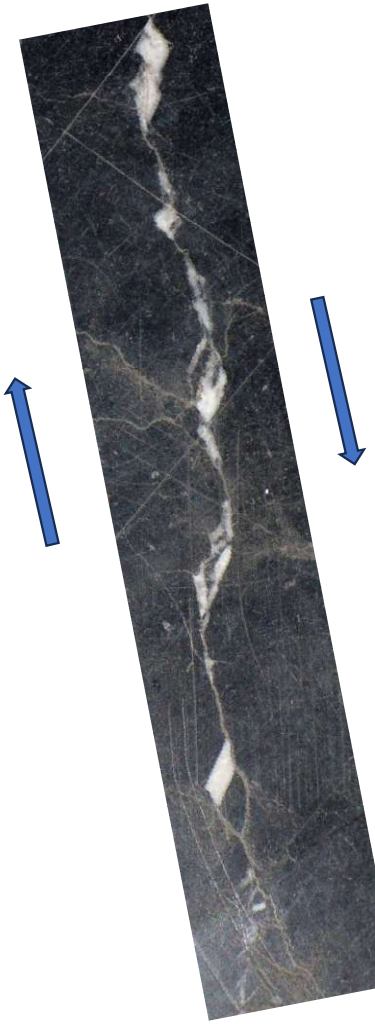




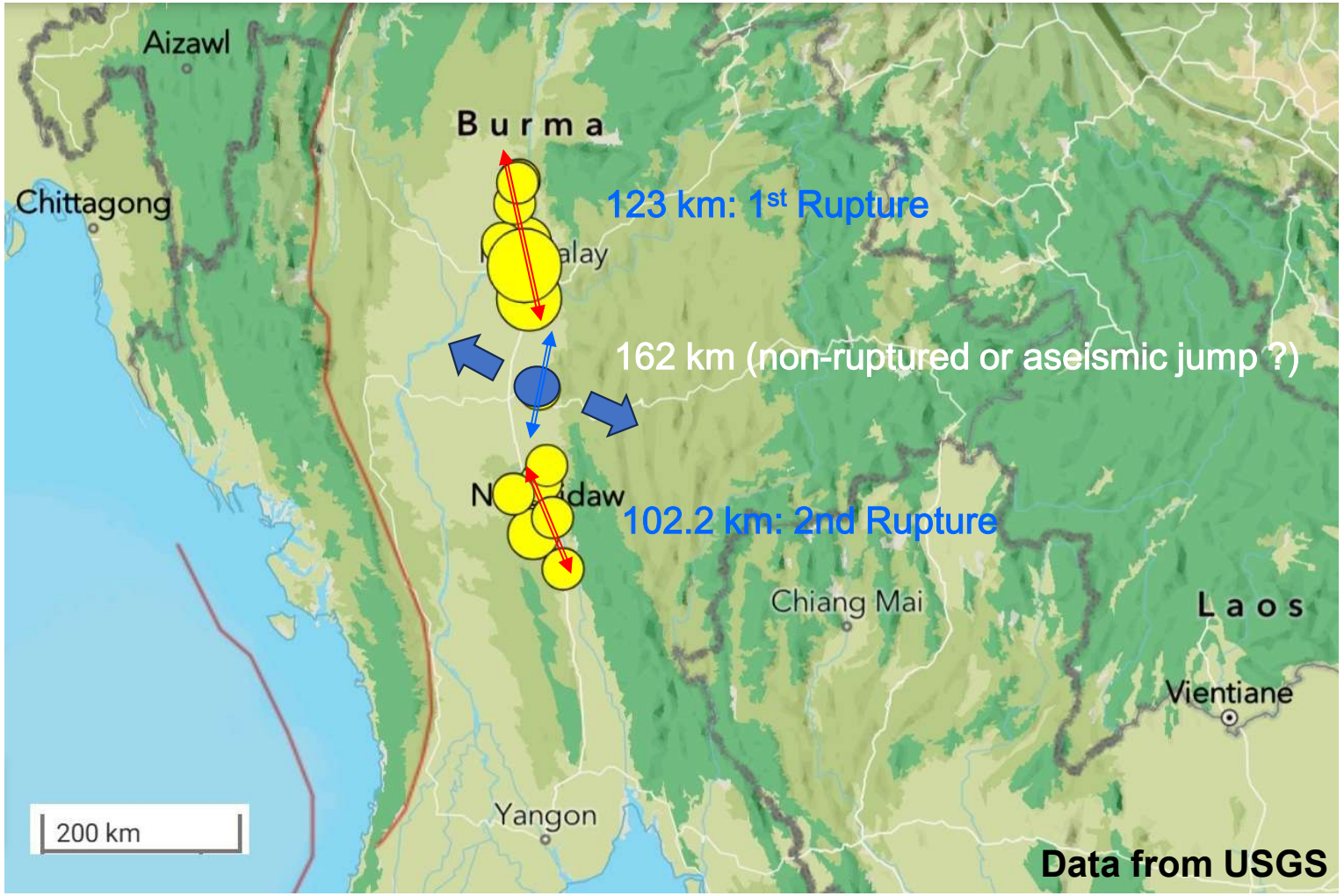


Compiled from Sloan et al. 2017 and **Hubbard and** Bradley, 2025 .

Physical Example



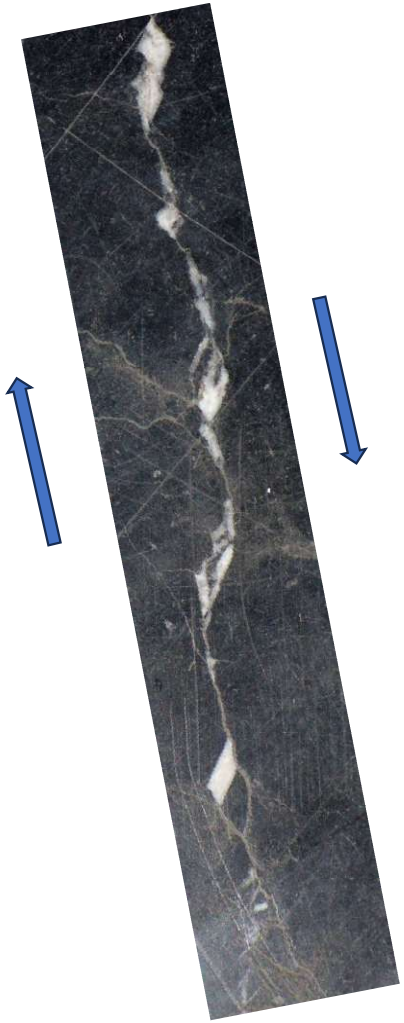
Seismicity: aftershocks for first 72 hrs - main shock

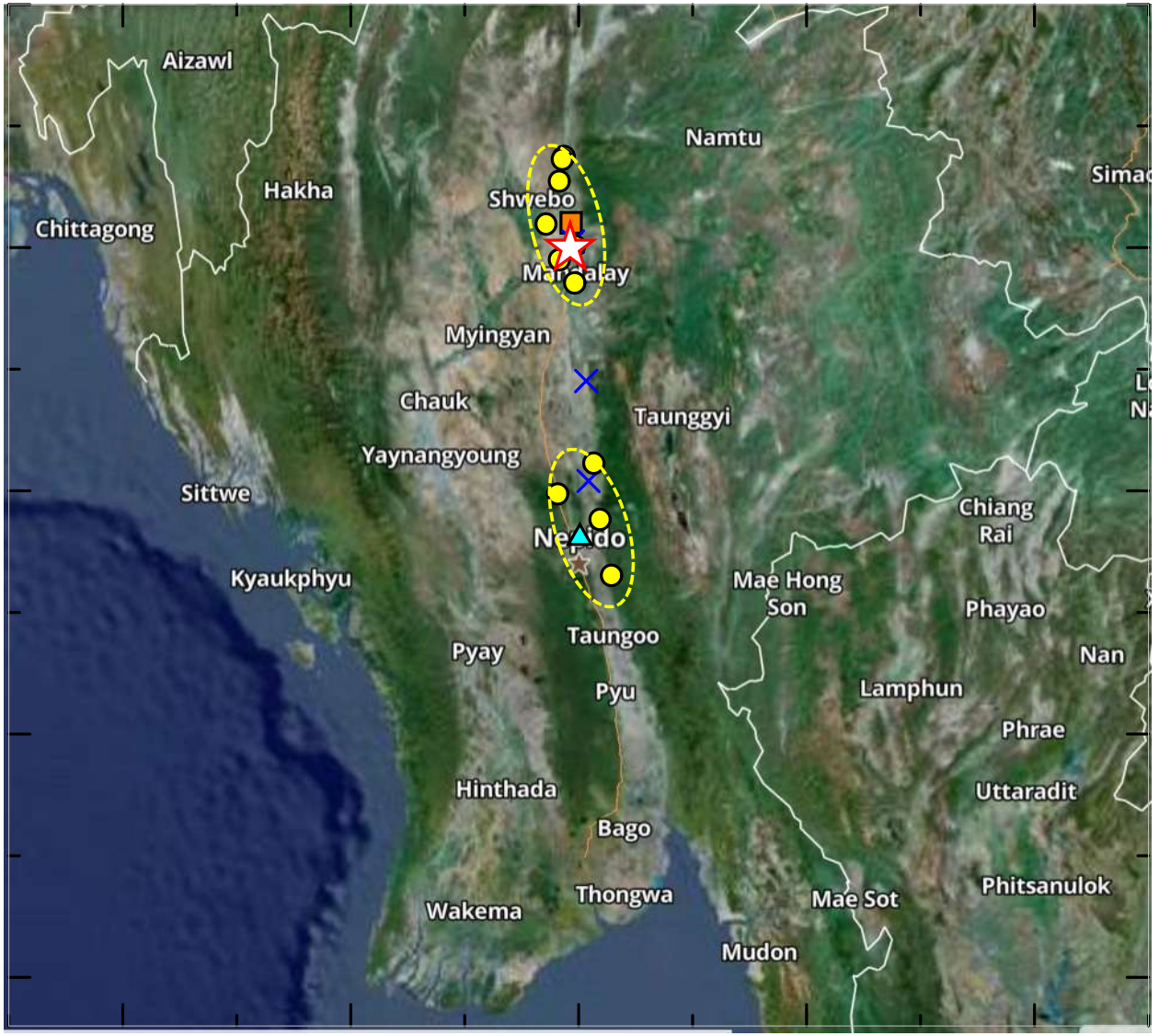


If rupturing involves two segments separated by a 163 km long step-over, maximum slips are 405 cm for north segment and 321 cm for south segment, respectively.

2nd Interpretation: Main & Aftershocks on March28-April3(data from USGS)

Physical Example

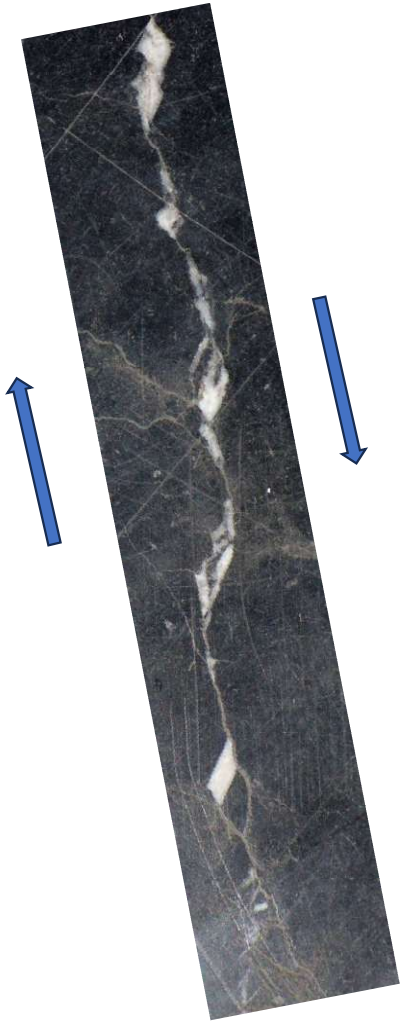


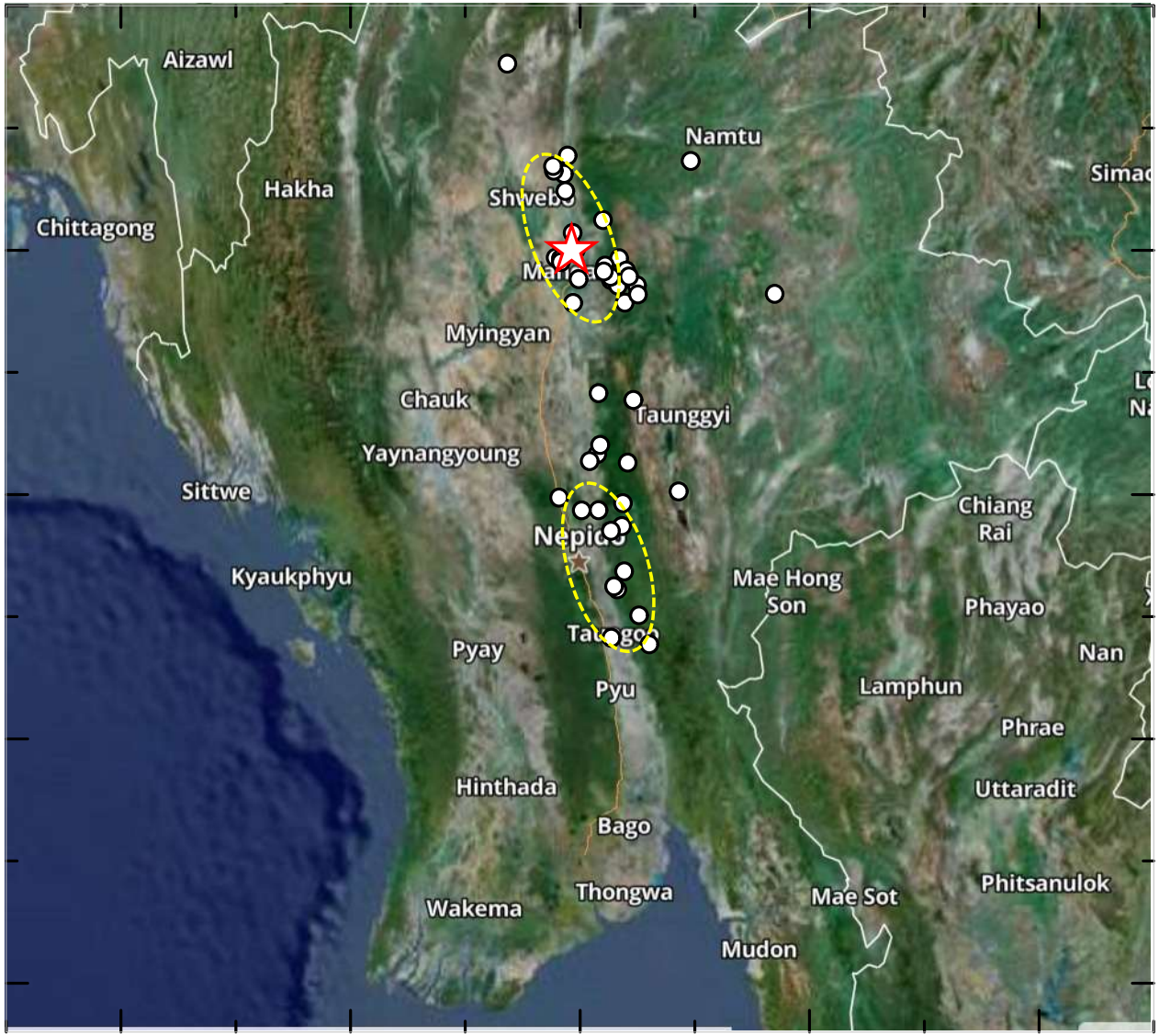


If rupturing involves two segments separated by a 163 km long step-over,

3rd Interpretation based on EMSC data: Main & Aftershocks on March

Physical Example

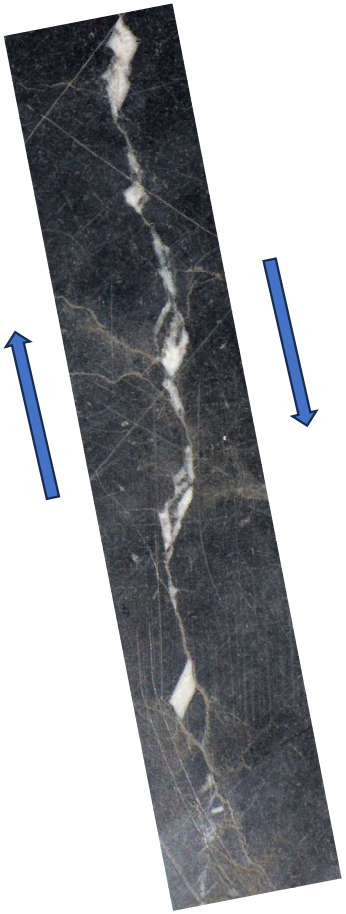




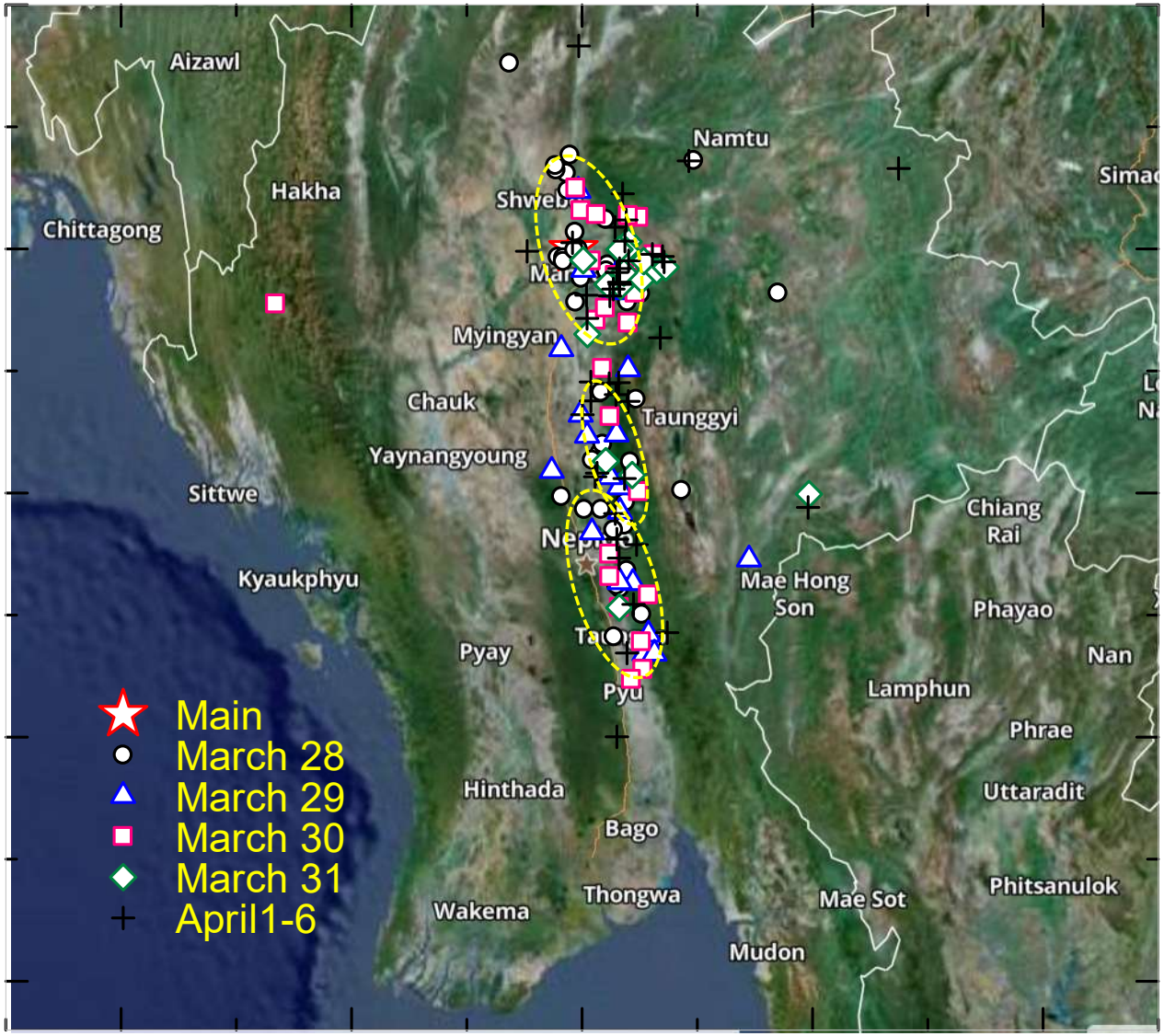
The interpretation is the same with more detailed data.

Main & Aftershocks on March 28-April 6(data from EMSC)

Physical Example



INSAR analyses implied that the rupture is about 450 km.



The seismic activity confirms that interpretation. But Mw 7.7 is not compatible with the estimated fault length

Focal Mechanism

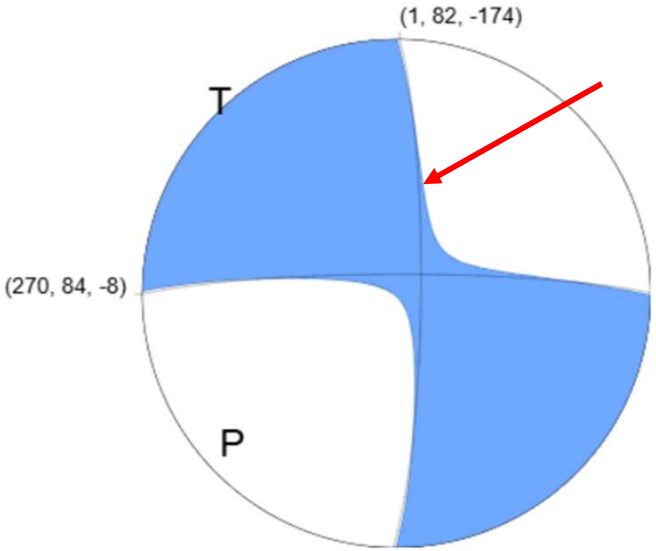
USGS

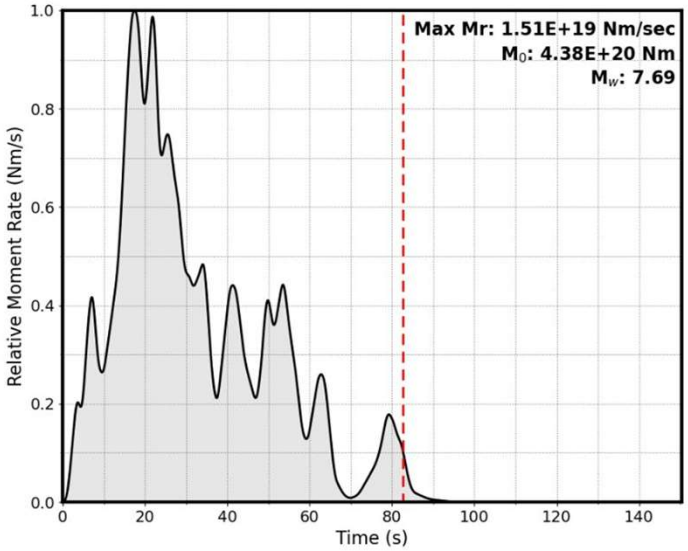
W-phase Moment Tensor (Mww)

Moment	4.634e+20 N-m
Magnitude	7.71 Mww
Depth	40.5 km
Percent DC	93%
Half Duration	38.50 s
Catalog	US
Data Source	US
Contributor	US

Nodal Planes

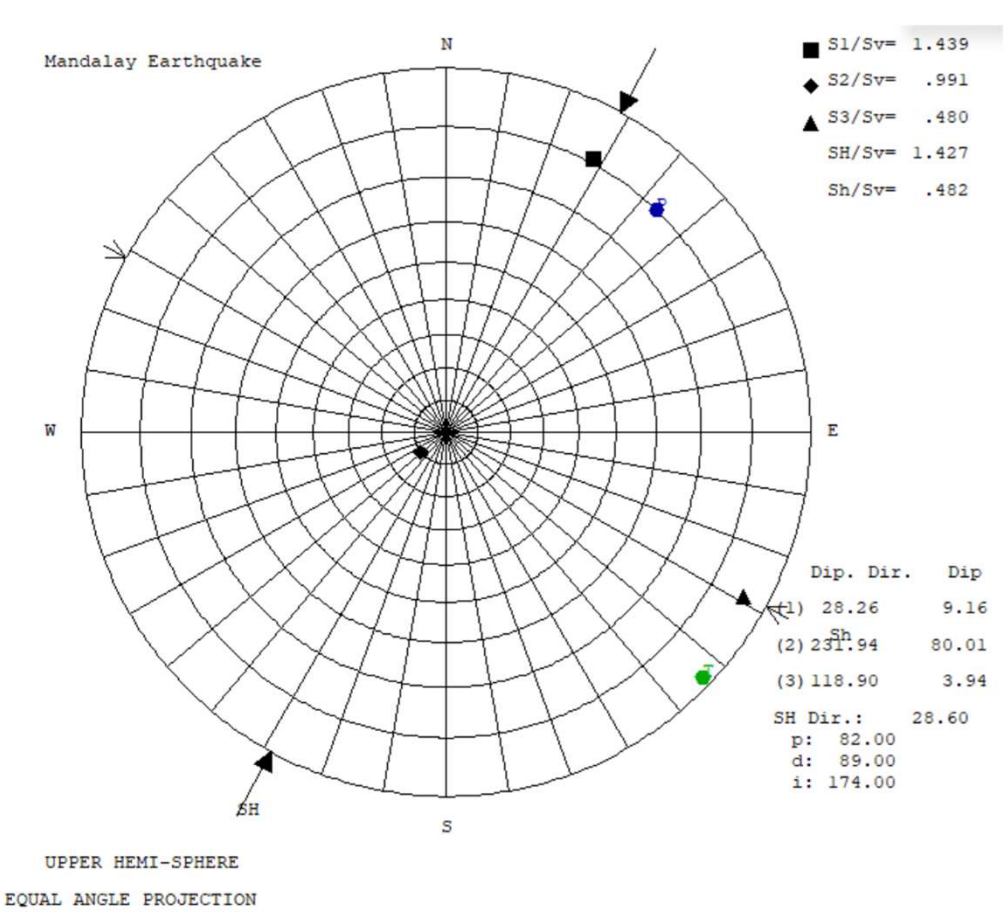
Plane	Strike	Dip	Rake
NP1	1°	82°	-174°
NP2	270°	84°	-8°





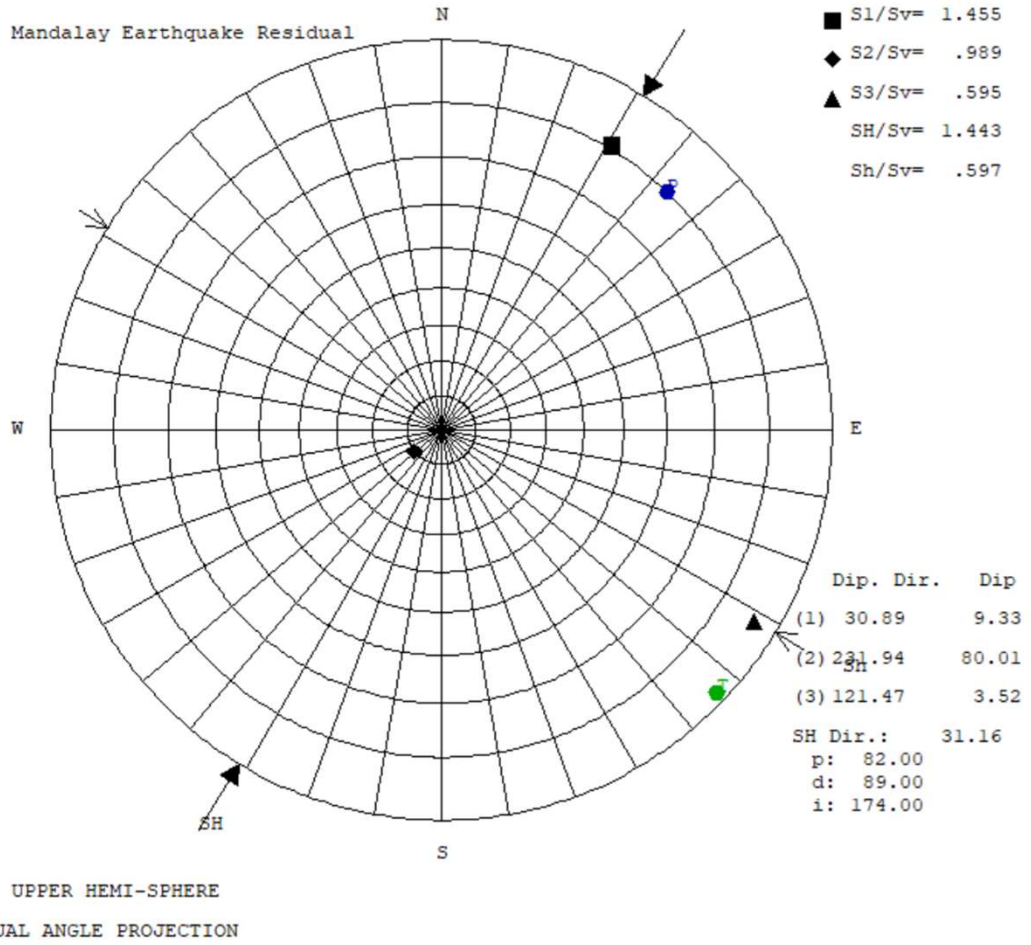
Main Fault dips towards South-East

Crustal Stress State



Peak Friction

$\phi_p = 30^o$



Residual Friction

$\phi_r = 24.8^o$

Surface Ruptures near Sagaing

Compiled from various internet sources

Compiled from various internet sources

Empirical Estimation of Main Earthquake Parameters by Aydan's Method

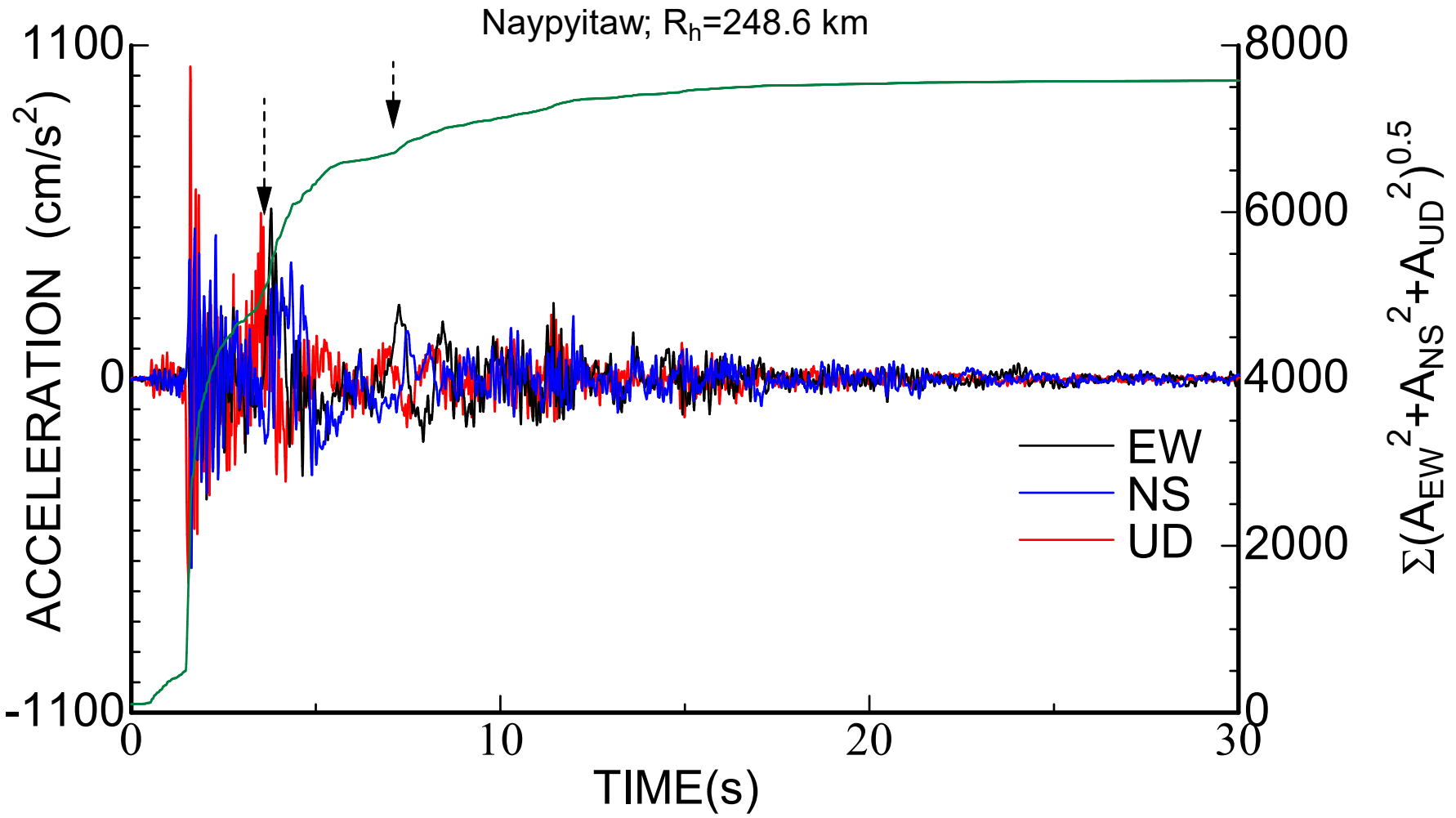
Length (km)	Magnitude	UMAX (cm)	AMAX (gals)	VMAX (cm/s)	Rupture Duration (s)
170	7.7	607	1117	80	40.5
225	7.9	863	1332	95	52

Estimation of Main Earthquake Parameters by several institutes

Institute	Magnitude	Amax	Vmax	Slip(cm)	Duration	Moment
USGS	7.7	1225	93.24	430	77.0	4.634e+20 N-m
IPGP	7.9					9.36e+20 N-m

Attention: The estimated magnitude by several institutes (GCMT, USGS etc.) is 7.7 and it implies 170±20 km rupture on the basis of available data. If the INSAR inferred fault length is about 450 km. Probably INSAR is very much influenced by permanent ground movements related to not only fault but also ground liquefaction, lateral spreading and local slope failures. Therefore, the inferred fault length can not be taken granted unless the field observations confirm. Furthermore, the total length will involve many segments with some over-steps as the author observed this issue in the interpretation of fault ruptures in the 2023 Kahramanmaraş earthquakes in Türkiye and there are many mistaken inferences in the publications from Turkish authors as well as ovserseas authors.

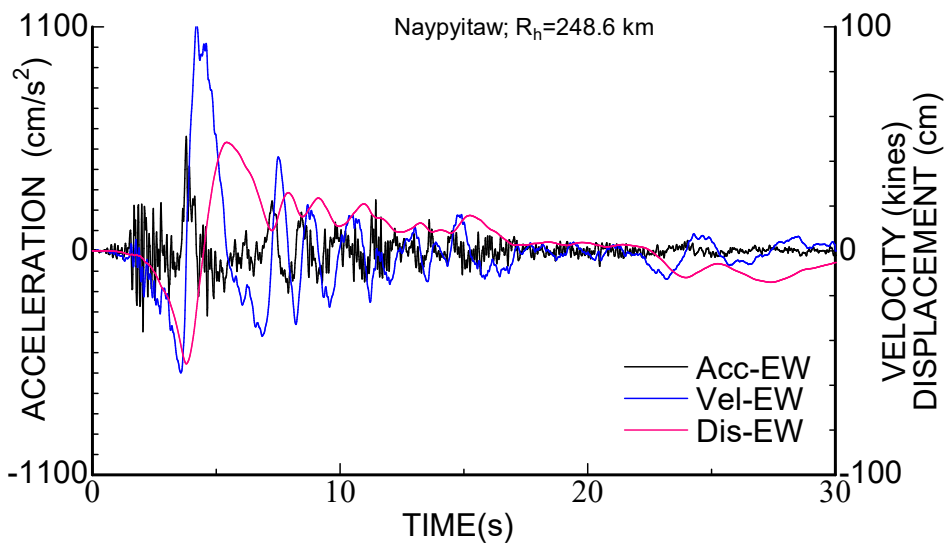
Strong Motions

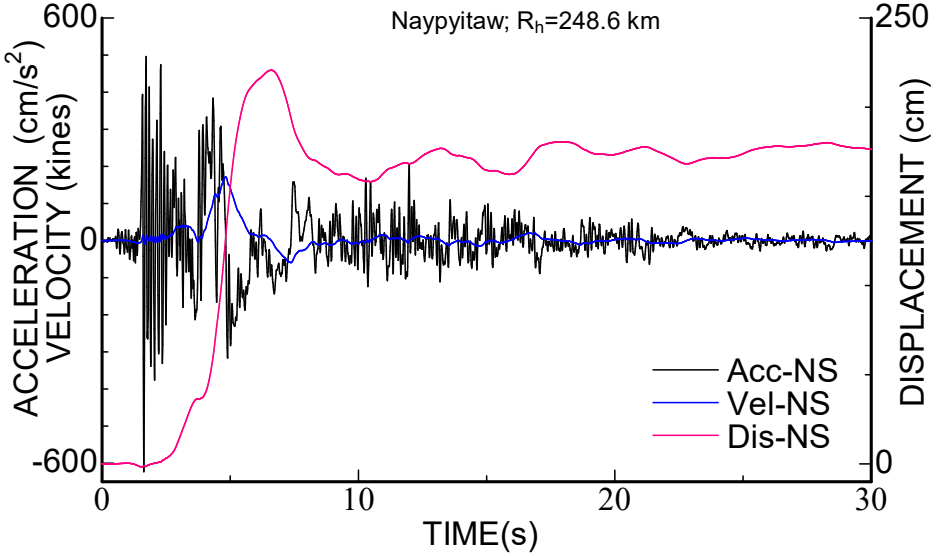


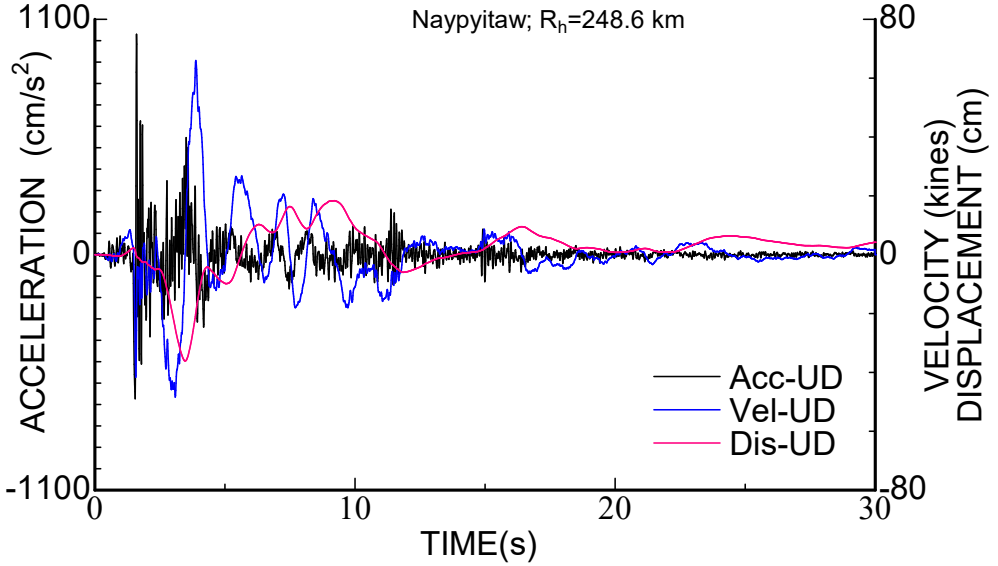
Data from CESMD, 2025

Rupture duration at Naypyitaw about 16 s

Naypyitaw Velocity and Displacement Response by EPS Method

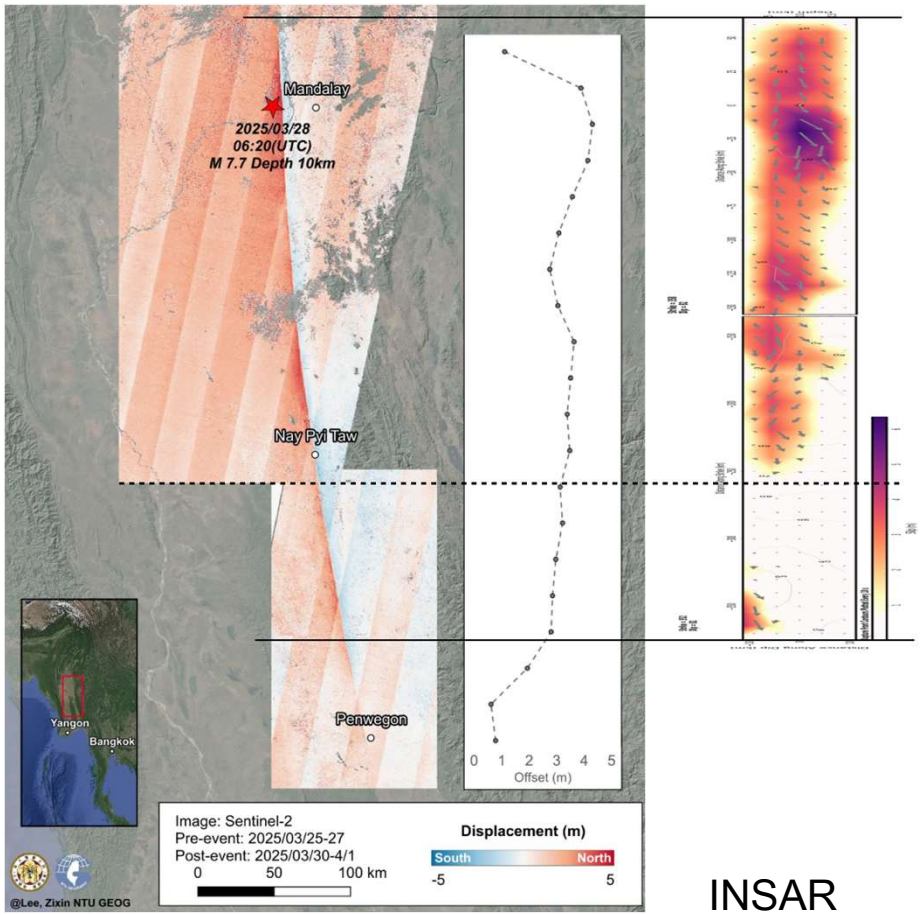




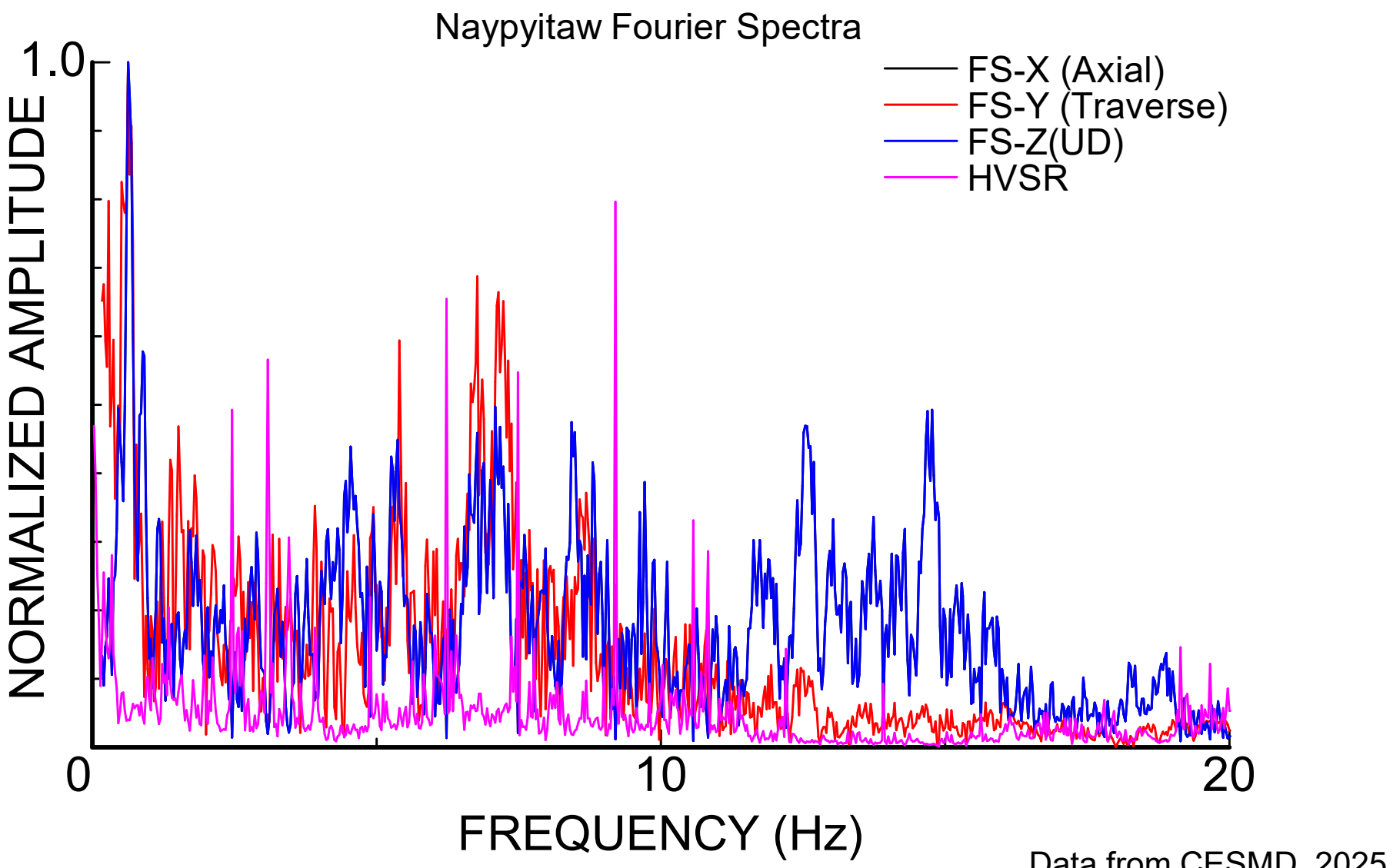


Data from CESMD, 2025

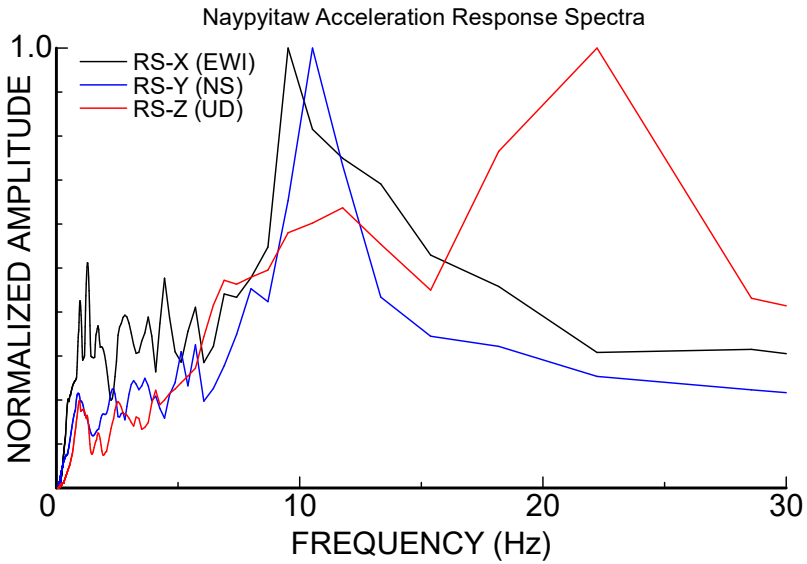
Permanent Ground Displacement Estimation by INSAR and EPS Method

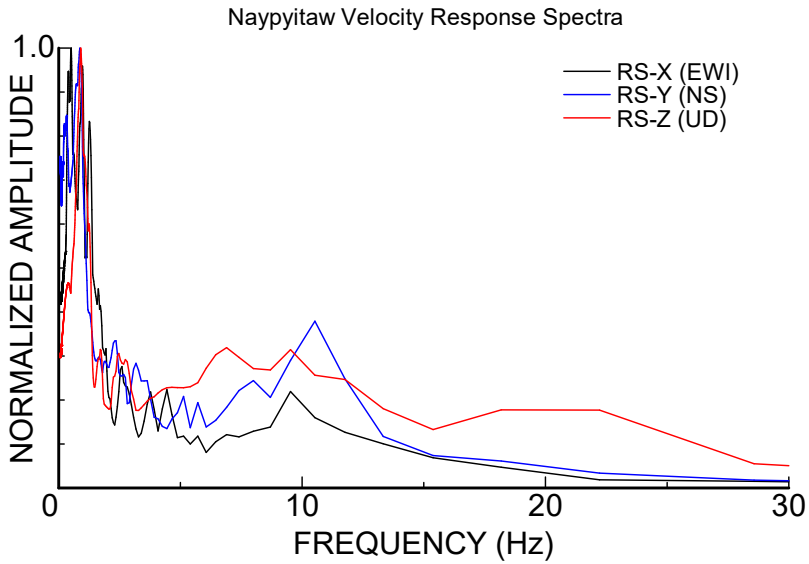


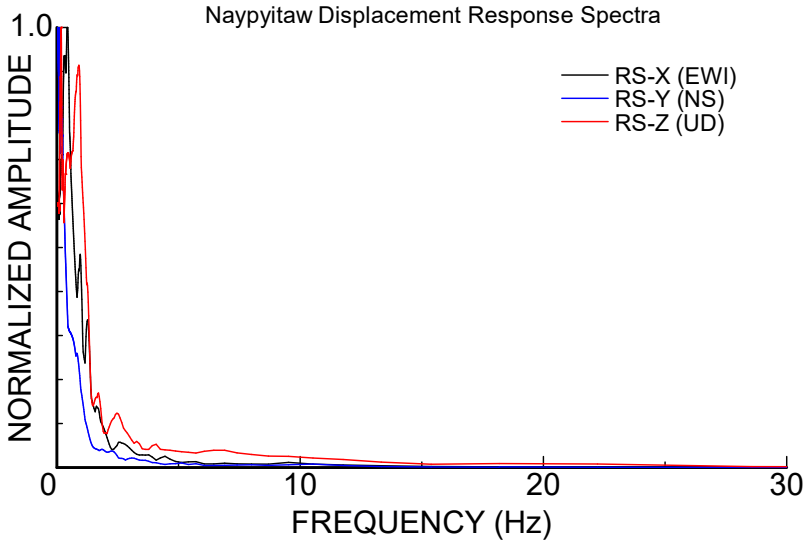
INSAR


Naypyitaw Fourier Spectra
FS-X (Axial)
FS-Y (Traverse)
FS-Z(UD)
HVSR
NORMALIZED AMPLITUDE
1.0
0
10
20
FREQUENCY (Hz)
Data from CESMD, 2025

Naypyitaw Acceleration, Velocity and Displacement Response

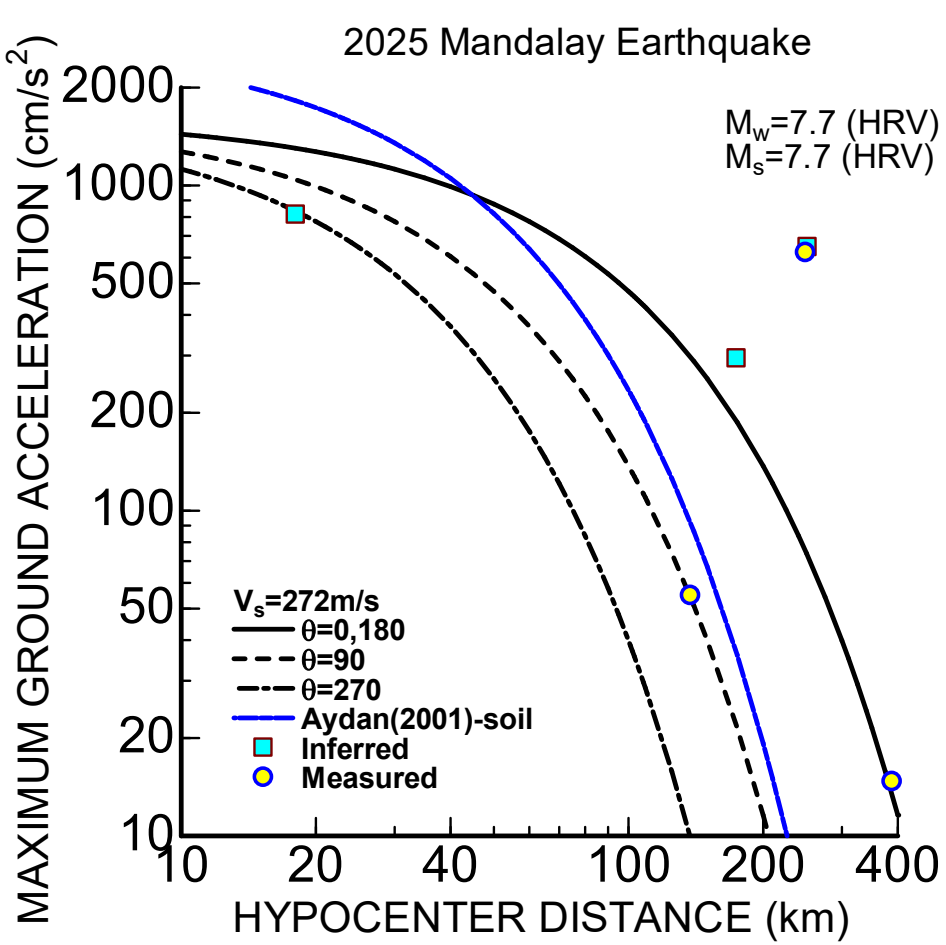


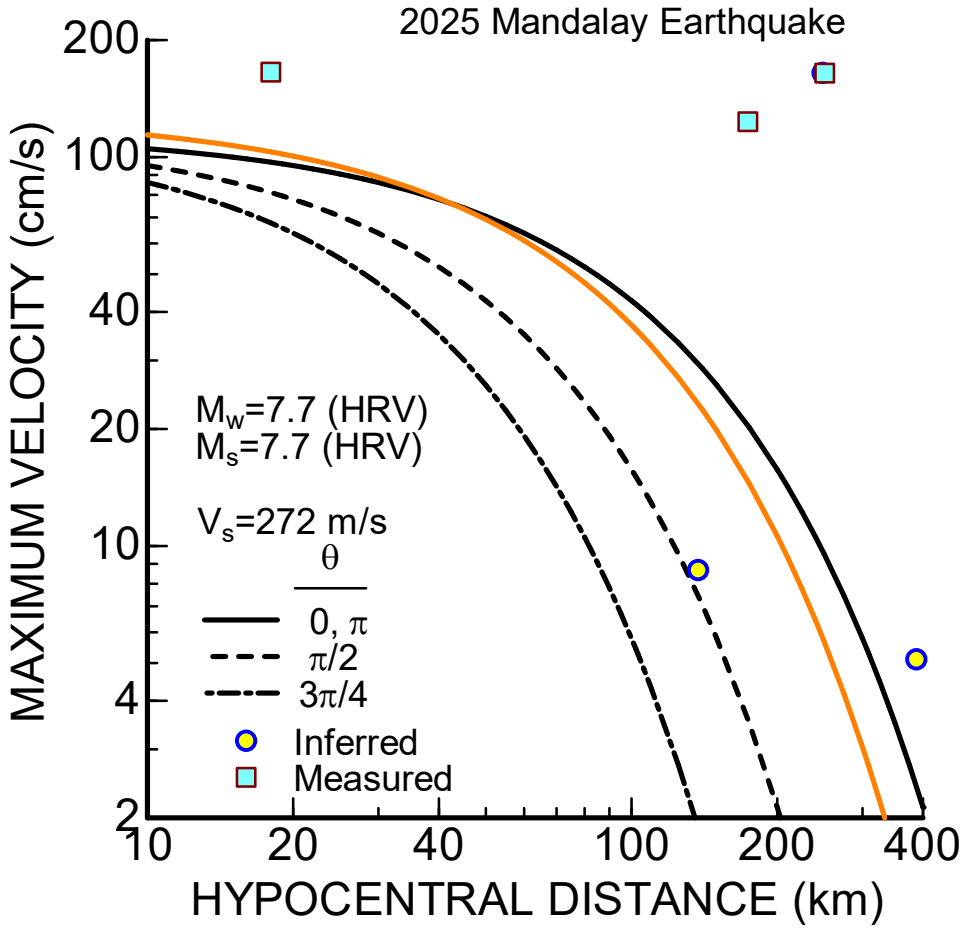




Data from CESMD, 2025

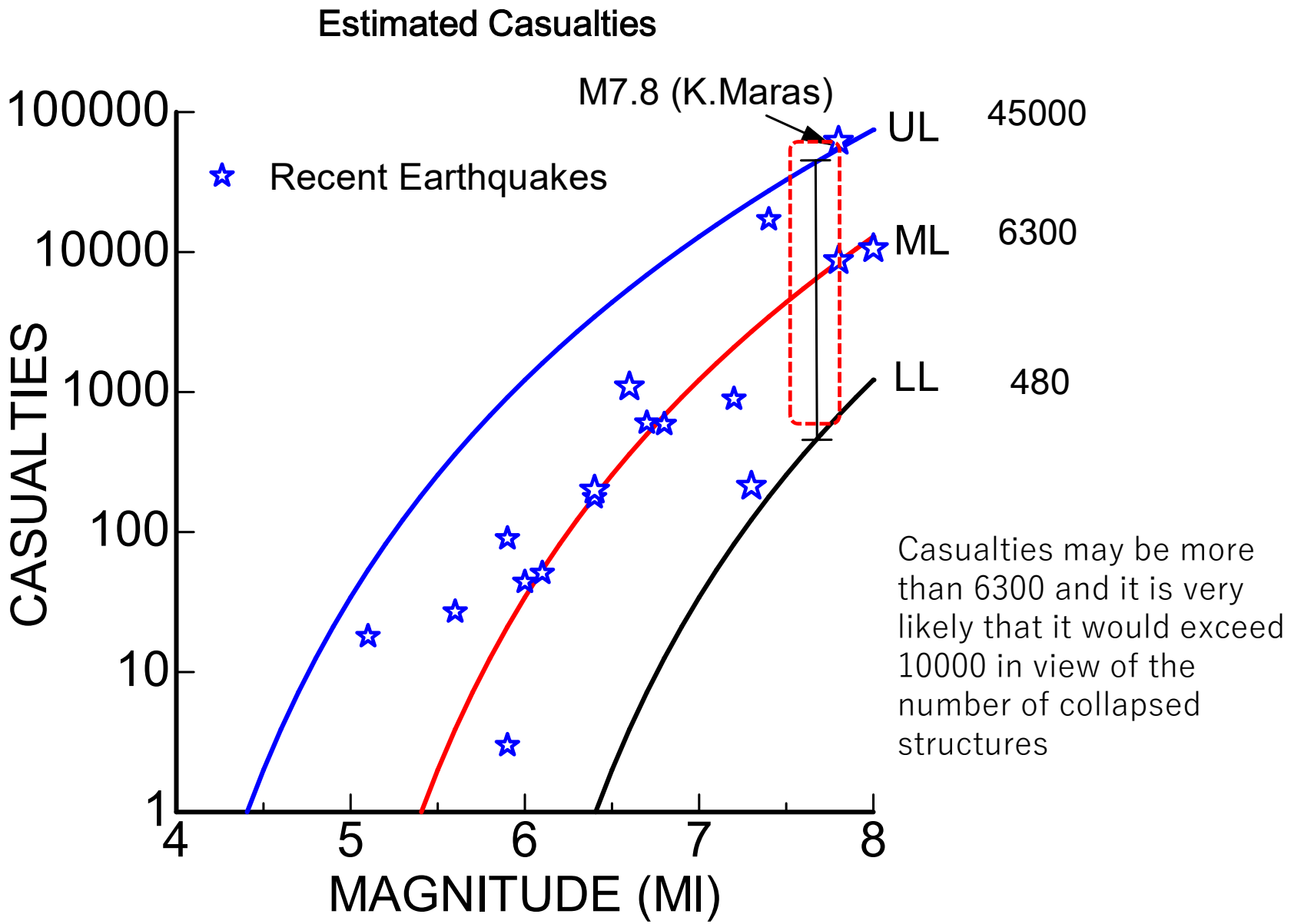
Attenuation of Maximum Ground Acceleration and Velocity





Attenuation of accelerations and velocities are not compatible for Mw 7.7 earthquake and several segmented estimations may be necessary as shown for 2008 Wenchuan earthquake (Aydan 2023).

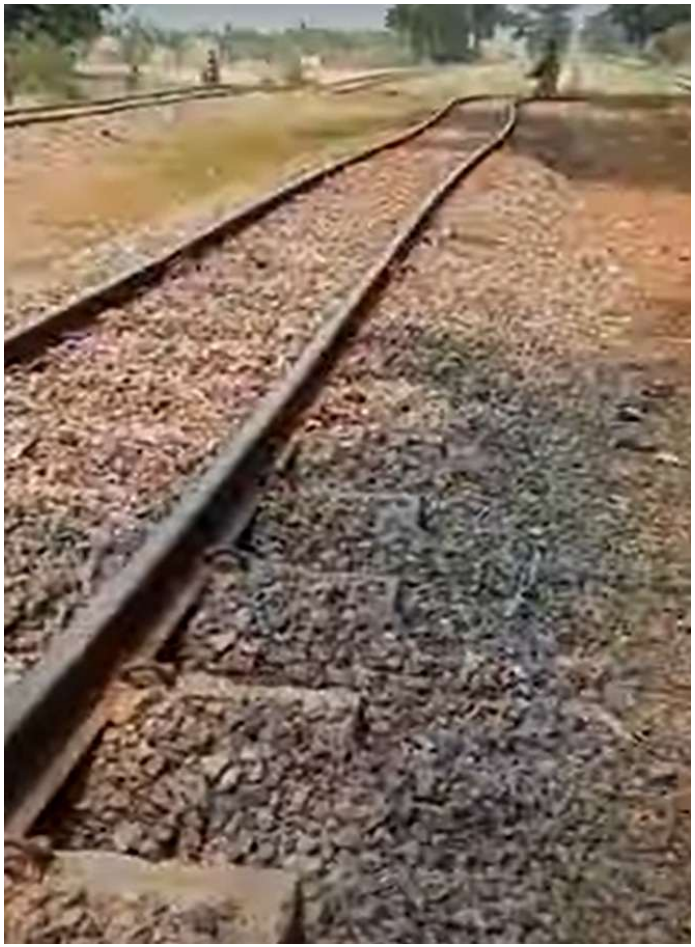
Attenuation relations from Aydan (2001, 2012)


Estimated Casualties
M7.8 (K.Maras)
UL
45000
ML
6300
LL
480
Recent Earthquakes
100000
10000
1000
100
10
1
CASUALTIES
4
5
6
7
8
MAGNITUDE (MI)
Casualties may be more than 6300 and it is very likely that it would exceed 10000 in view of the number of collapsed structures

Bridge Damage and possible causes

Pictures from Internet

Railway Damage in Pyinmana



Damage is due to faulting

Pictures from Internet

Naypyitaw Airport

Pictures from Internet

Liquefaction Sites

Pictures from Internet

Pictures from Internet

Lateral Spreading Sites

Pictures from Internet

Reported Liquefaction Sites

Rockfalls and slope failures

Taungyi

Slope and retaining-wall failures next to fault rupture

Pictures from Internet

Building Damage (RC structures)

Pictures from Internet

Soft-floor and pancake modes

Mandalay

Mandalay

Syriam (577 km)

Timber Buildings

Pictures from Internet

Interior Damage

Suspended ceiling panles are easily fallen and and it was even observed in 2007 Kameyama earthquake (Mw<6)

Pictures from Internet

Brick Masonry Budist Temples

Pictures from Internet

Interblock sliding and toppling failure

Pictures from Internet

Damage to Mosques and Minarets

Timber Buildings along Lake Shore (Inle Lake)

Pictures from Internet

Bearing capacity issues on soft ground along lake shores

Long-distance Effects

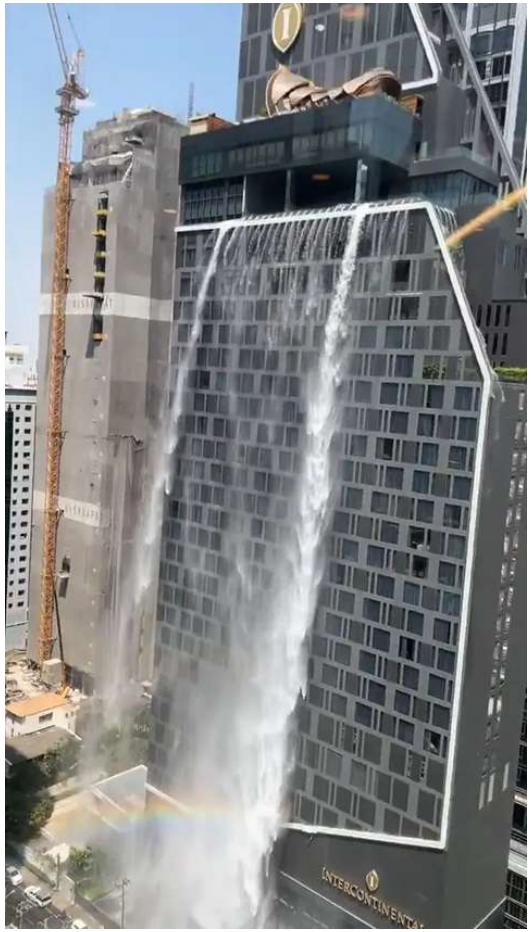
A hijg-rise building of 30 floor under construction failed during the earthquake. Furthermore, the high-rise hotels with pools on top subjected to heavy shaking due to long-period components of induced ground motions.

High-rise buildings with connection bridges damaged

Collapsing 30 floor high-rise building in Bangkok

Pictures from Internet

waterfall from the high-rise hotels with pools, Bangkok



Collapsing construction Crain, Bangkok

Pictures from Internet

Sloshing in pools on top of the high-rise hotels

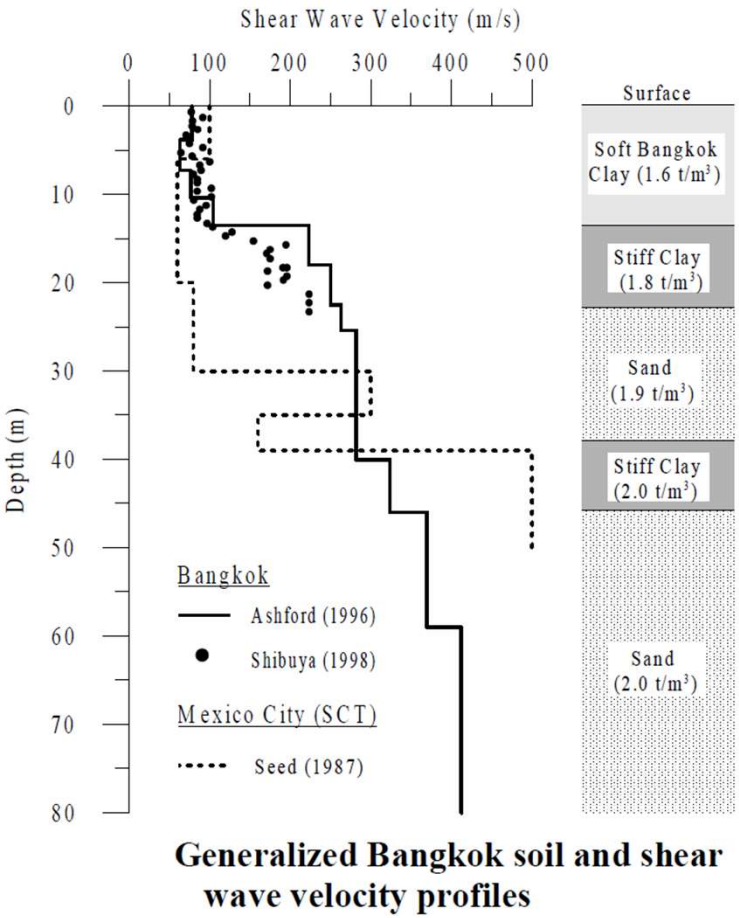
Bangkok

Pictures from Internet

Sloshing in pools and aquarium, Bangkok

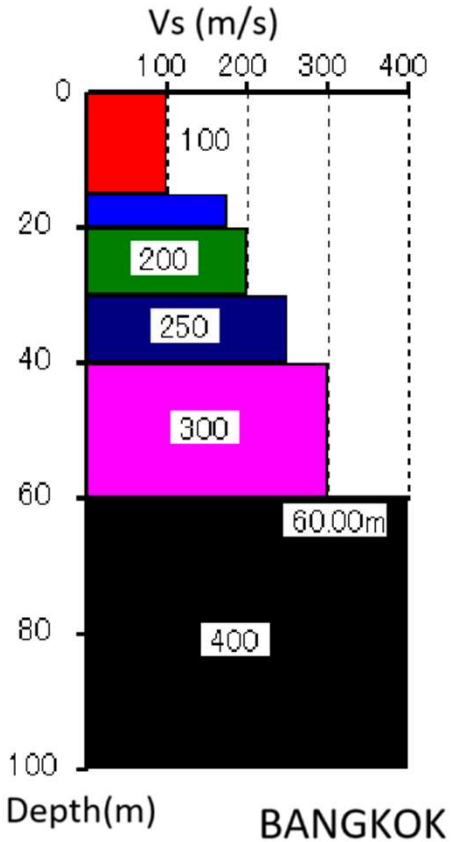
Pictures from Internet

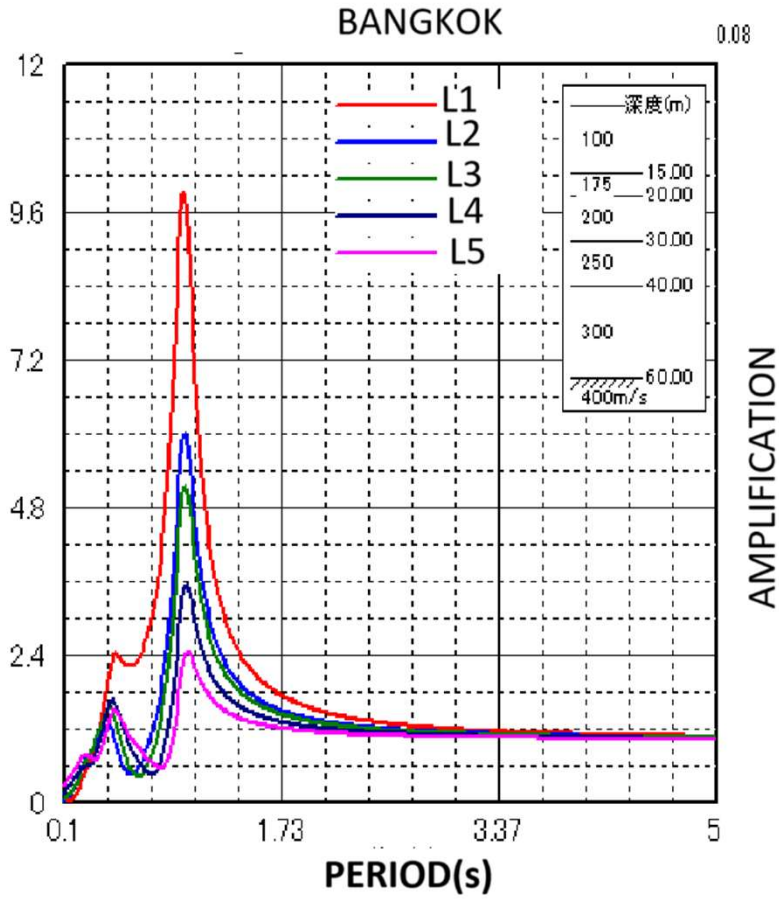
Soil Profile in Bangkok



Generalized Bangkok soil and shear wave velocity profiles

Computed ground motion amplification in Bangkok





From Varnitchai et al. (2000)

Damage at Energy Transformation Lines and Utility Poles

Conclusions

1) The initial rupture length of the earthquake fault is likely to be 170 km, which is compatible with empirical equations based on past experiences. Nevertheless, there is a discussion that the fault length can be up to 450 km. If such a reasoning is true than the magnitude of the earthquake must be much greater than 7.7. If the inference based on INSAR is true, it is very likely that there should be a 163 km long step-over of without transferring any stress.
2) The estimated slip is about 600 cm. If rupturing involves two segment separated by a 163 km long step-over, maximum slips are 405 cm for north segment and 321 cm for south segment, respectively. These values are close to those inferred from INSAR
3) Widespread ground liquefaction occurred for a total length of 500 km. The ground liquefaction may be involved in the collapse of 91 years old colonial Ava Bridge in Mandalay
4) Strong motion data is very scarce. Nevertheless, the record at Naypyitaw strong motion records could provide very valuable data for structural damage. However, the record also involve the effect of ground liquefaction. The permanent ground deformation at Naypyitaw is about 172 cm northward, which is compatible with the overall tectonics.
5) The crustal stress direction is similar to those obtained from the inference from focal plane solutions.
6) Many RC structures collapsed due to soft-floor effect at the ground level and poor construction of beam-column connections.
7) Casualties may be more than 6300 and it is very likely that it would exceed 10000 in view of the number of collapsed RC structures.
8) Highways and railways are damaged due to permanent ground deformations resulting from faulting as well as ground liquefaction

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Harvard GCMT. https://www.globalcmt.org/CMTcite.html

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