EOS's broadband seismic network in Myanmar: installation, site classification, Local seismicity reports and velocity structure studies

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POSTER

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Abstract

To study the earthquakes and better understanding the tectonic in Myanmar, EOS-Earth Observatory of Singapore has been collaborating with local seismic monitoring authority to install (30) broadband seismic stations. With the broadband collected data, we have used them to study the site classification, earthquakes relocation and constrain the velocity structure.

We defined our EOS's broadband seismic stations site classes by using the H/V spectral ration (HVSR) method from ambient seismic noise. We clearly identified some of our stations on the rock site (EW01, M27) which have resonance frequency larger than 5.0 Hz and less than 1.6 Hz are defined as soft soil (EW05, M022). This classification is based on the NEHRP – National Earthquake Hazards Reduction Program (NEHRP) site classes.

From the initial automatic location that we have selected and relocated ~1000 earthquakes which we found that all these local earthquakes well defined the Indian slab beneath Myanmar region. Moreover, use selected teleseismic events located between 30-90 degree to image Moho beneath seismic stations using P-receiver function and H-K stacking technique to get crustal thickness and Vp/Vs ratio.

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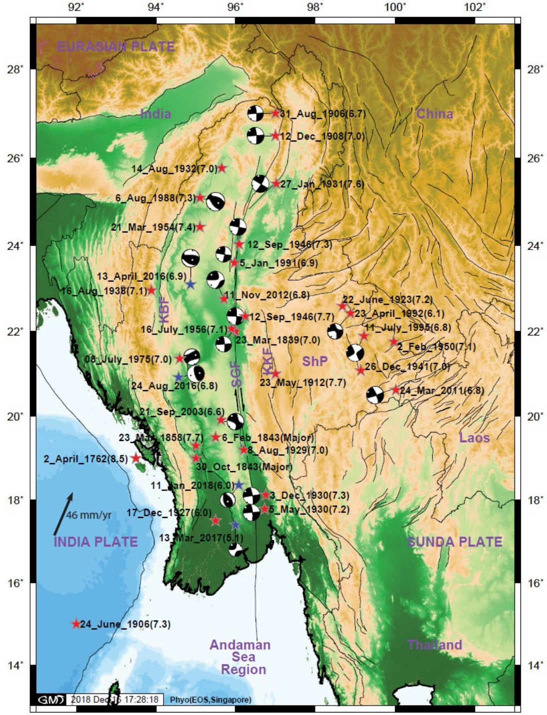
INTRODUCTION

Seismotectonic of Myanmar



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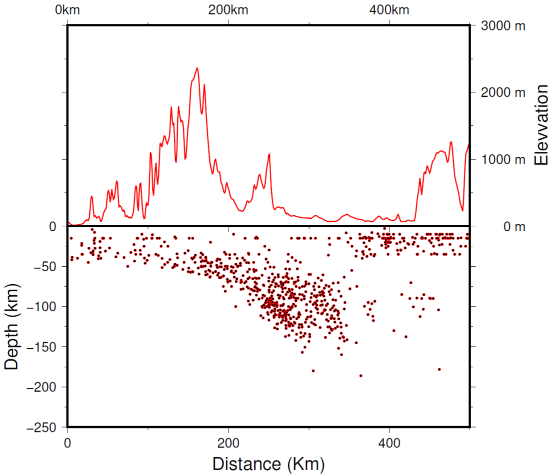
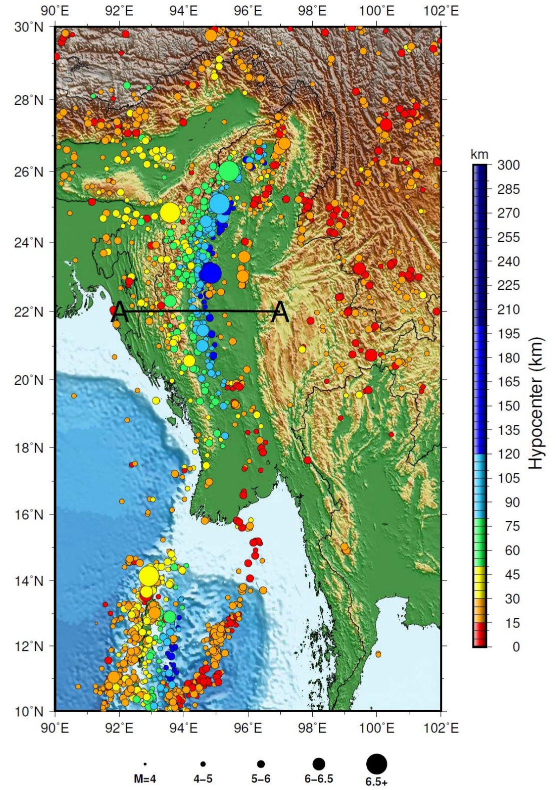


In seismotectonic map, Blue stars indicate epicenters of recent widely felt intensity earthquakes from 2016 to 2018 and red are historical destructive earthquakes and significant earthquakes epicenter since 18th century.

We can see clearly the subducted slab in the cross section of ISC-GEM seismicity which goes to 150 km depth deep. There are no deep earthquakes in the area of between Latitude 18 to 14 degree North.

Myanmar_Seismicity (ISC−EHB (2317 events), 1964−2017)



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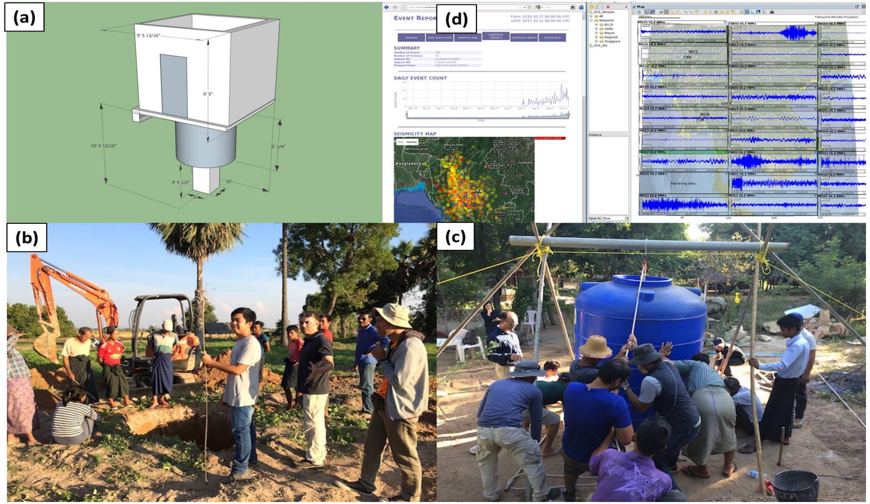
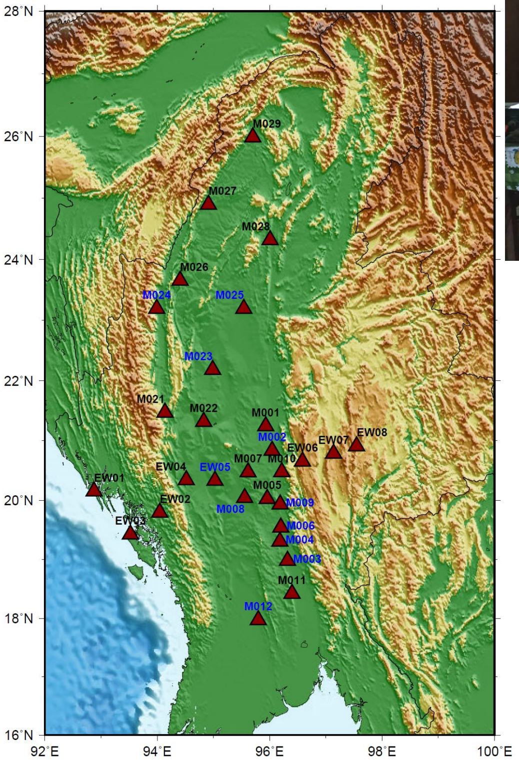
EOS's broadband seismic network in Myanmar



(a) Vault design for our broadband seismic stations by director of technical office
(b) and (c) are site installations photo by EOS, DMH and MEC
(d) Screen view of real time Earthworm monitoring software in EOS, Singapore.

EOS_Seismic Network in Myanmar (2017 – 2021)



Katsujima analog seismographs in Yangon seismic station

All the EOS's broadband seismometers used Quantera Q330S seismic recorder with 100 sampling rates per second.

20-stations are Streckeisen STS2.5 (Kinematric product) and another 10-stations are Nanometrics Trillium 120P sensor provided by Academia Sinica,, Taiwan.

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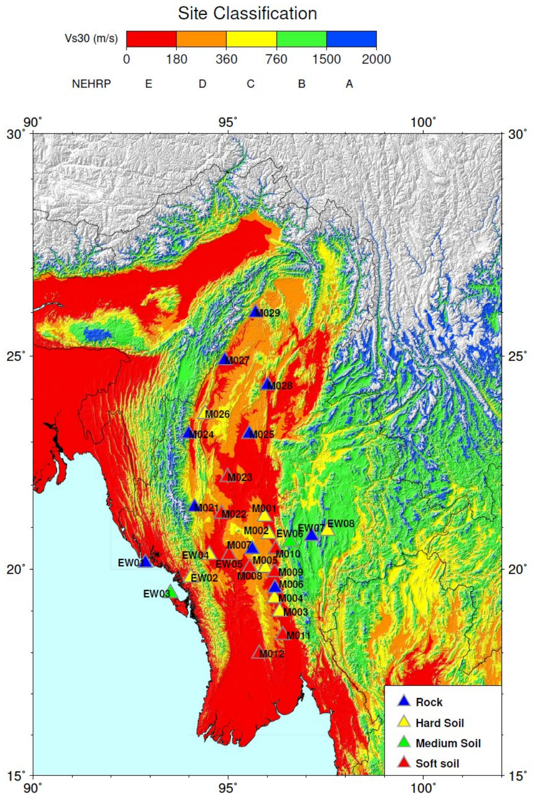
METHODS & RESULTS

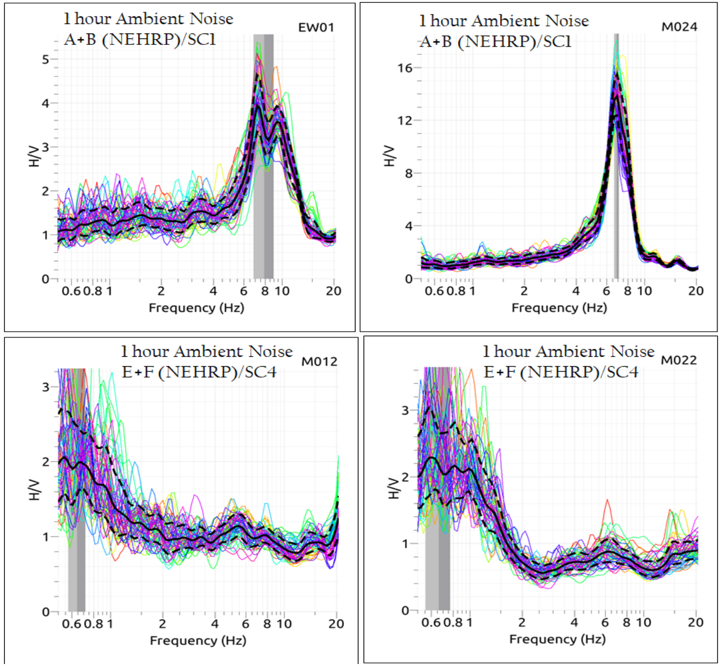
Sites classification of our EOS seismic stations



Empirical Vs30 Map from gloabl topography [Wald and Allen, 2007: Allen and Wald, 2009] is available for Myanmar region and superimposed with our HVSR study results which is the horizontal to vertical spectral ration (HVSR) method from ambient seismic noise of each EOS seismic station.

EOS broadband seismic stations EW01, M024 (rock site class SC1, A+B(NEHRP)) and M012, M022 with soft soil class SC4, E+F(NEHRP) by using 1-hour ambient noise from three-component broadband seismometer.

Each (60) seconds single trace of the resonance frequency and corresponding HVSR amplitude value can see in different random color pattern and thick solid line and dash lines are average HVSR and its 95% confidence level, respectively.



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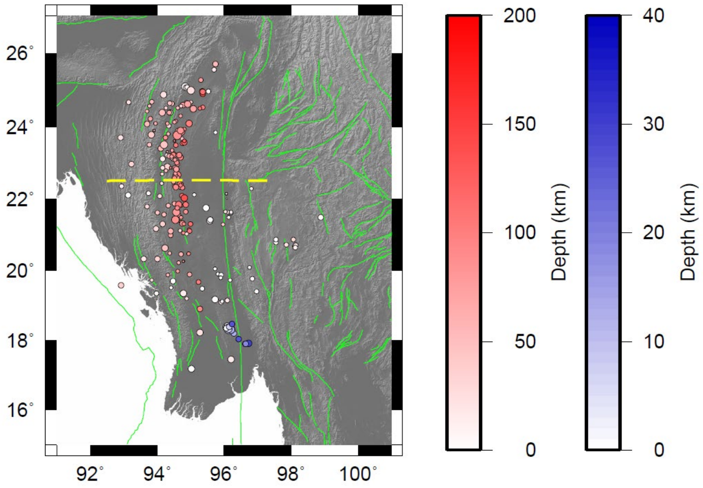
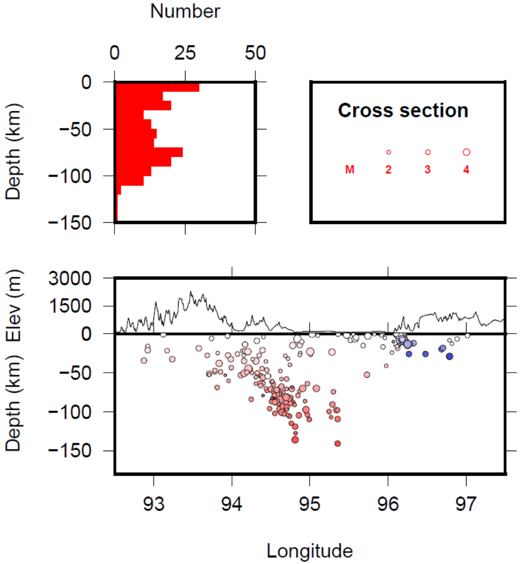
Hypocenter relocation (local seismicity)



All the selected earthquakes (~ 1000 events) which detected from EOS broadband seismic network in Myanmar and each event has detected from at least minimum 10-seismic stations to do (**HypoDD**) double different earthquakes relocation.



Relocated events hypocenters from local seismicity are clearly show smaller size of magnitude earthquakes which detected from EOS networks are correspond to India slab pull in Myanmar region.

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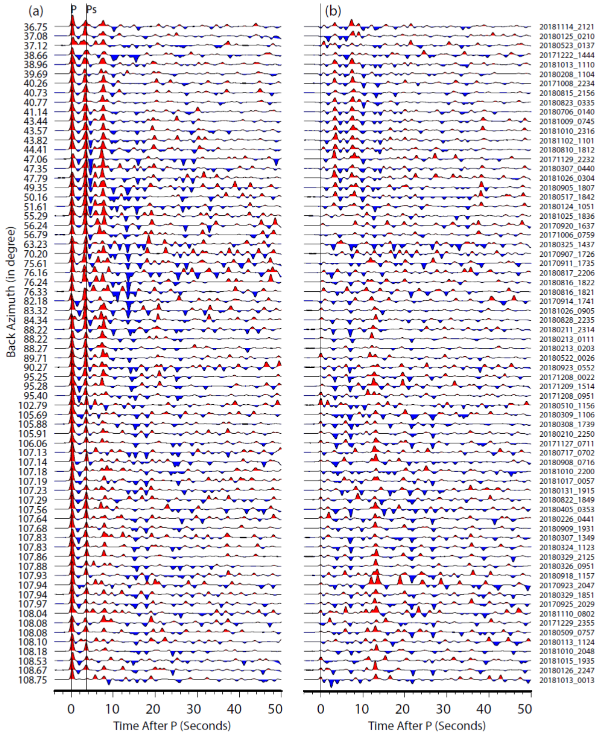
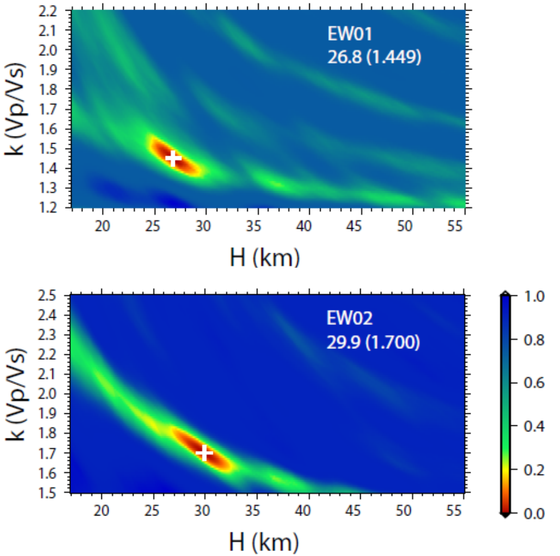


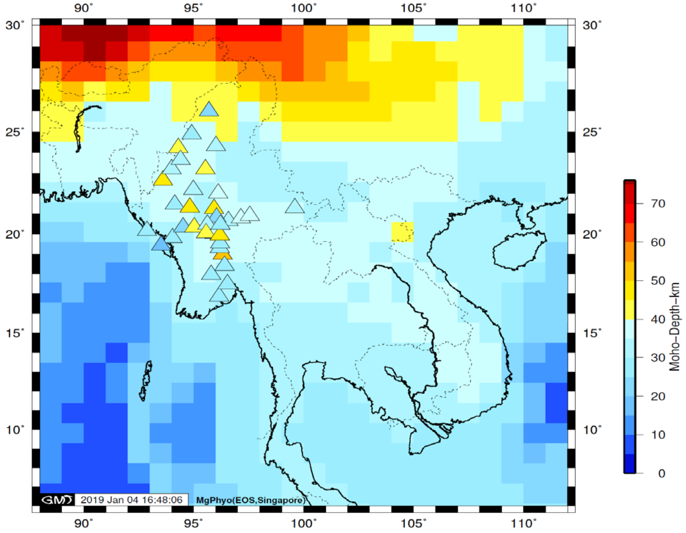
(a) Moho converted (Ps) phases on the radial receiver functions (RFs)

(b) transverse receiver function with increasing ray back-azimuths for our broadband seismic station EW02.

Crustal thickness beneath our EOS stations



HK stacking results of EW01 and EW02 (western coast of Myanmar [Zhu and Kanamori, 2000].



Preliminary crustal thickness (Moho depth) beneath the EOS's broadband seismic stations in Myanmar and plotted together with Crust 1.0 global model in background.

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CONCLUSIONS

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10.1029/2018JB016622

Key Points:
- We applied joint inversion of multiple seismic data sets to constrain the crustal-scale *S* wave velocity structure in Myanmar region
- We found highly variable crustal structure, including a thick sedimentary basin and ~5-km Moho offset across the Sagaing-Shan Scarp fault system
- Regional 3-D waveform simulations verify the accuracy of the proposed 3-D velocity model

Supporting Information:
- Supporting Information S1
- Data Set S1

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A 3-D Shear Wave Velocity Model for Myanmar Region

Xin Wang[1], Shengji Wei[1,2], Yu Wang[1,3], Phyo Maung Maung[1], Judith Hubbard[1,2], Paramesh Banerjee[1], Bor-Shouh Huang[4], Kyaw Moe Oo[5], Thomas Bodin[6], Anna Foster[7], and Rafael Almeida[7]

[1]Earth Observatory of Singapore, Nanyang Technological University, Singapore, Singapore, [2]Asian School of the Environment, Nanyang Technological University, Singapore, Singapore, [3]Department of Geosciences, National Taiwan University, Taipei, Taiwan, [4]Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan, [5]Department of Meteorology and Hydrology, Yangon, Myanmar, [6]Laboratoire de Géologie de Lyon: Terre, Planète, Environnemen, Université Lyon 1, CNRS, Villeurbanne, France, [7]School of Earth Science Energy and Environment, Yachay Tech University, Urcuquí, Ecuador

Abstract Myanmar is located at the eastern margin of the ongoing Indo-Eurasian collision system, has experienced a complex tectonic history and is threatened by a high level of seismic hazard. Here we develop a crustal scale 3-D seismic velocity model of Myanmar, which is not only critical for understanding the regional tectonic setting and its evolution but can also provide the foundation for a variety of seismological studies, including earthquake location determinations, earthquake focal mechanism inversions, and ground motion simulations. We use the newly deployed Earth Observatory of Singapore-Myanmar broadband seismic network and other seismic stations in and around Myanmar to study the station-based 1-D velocity structure through a joint inversion of receiver functions, H/V amplitude ratio of Rayleigh waves, and surface wave dispersion measurements. Our results reveal a highly variable crustal structure across Myanmar region, characterized by a series of N-S trending sedimentary basins, with thicknesses up to ~15 km in central Myanmar and an ~5-km step in the depth of the Moho across the Sagaing-Shan Scarp fault system. We interpolate our station-based 1-D velocity profiles to obtain an integrated 3-D velocity model from southern Bangladesh to Myanmar. Using three regional earthquakes located to the south, within, and north of the seismic network, we show that our proposed model performs systematically better than the CRUST 1.0 model for both Pnl waves and surface waves. Our study provides a preliminary community velocity model for the region, with further refinements and interpretations anticipated in the near future.