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Seismic Velocity Contrast Along the Longitudinal Valley Fault System, Taiwan, from Analysis of Fault Zone Head Waves and Direct P Arrivals

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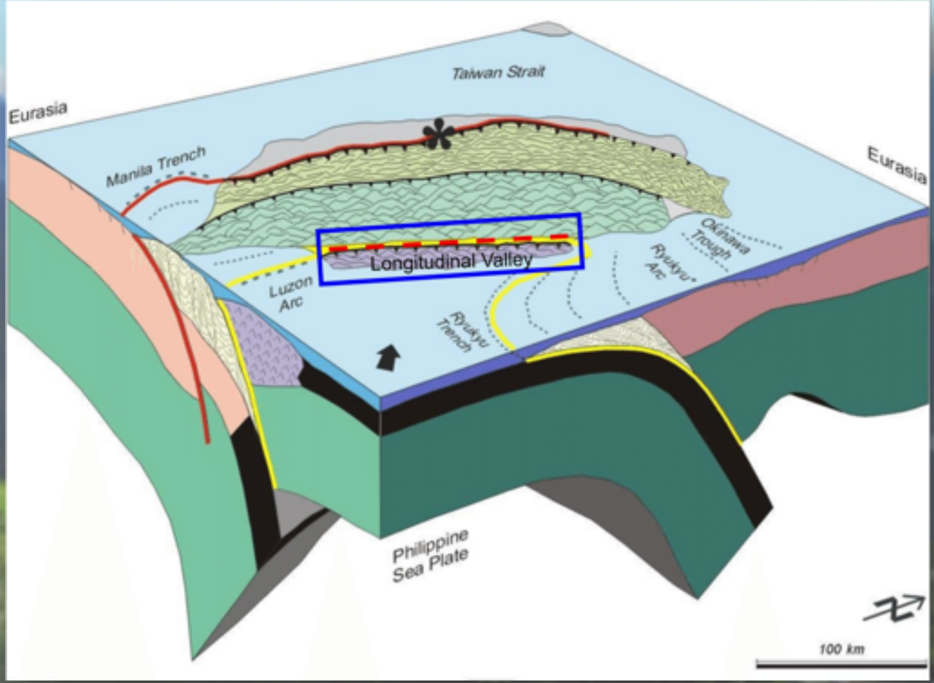
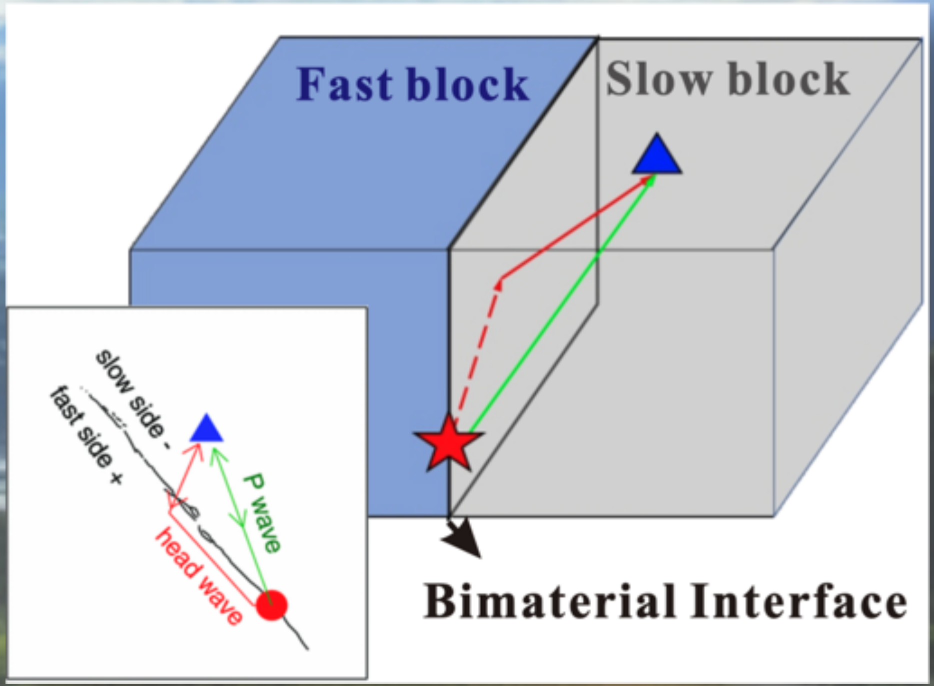
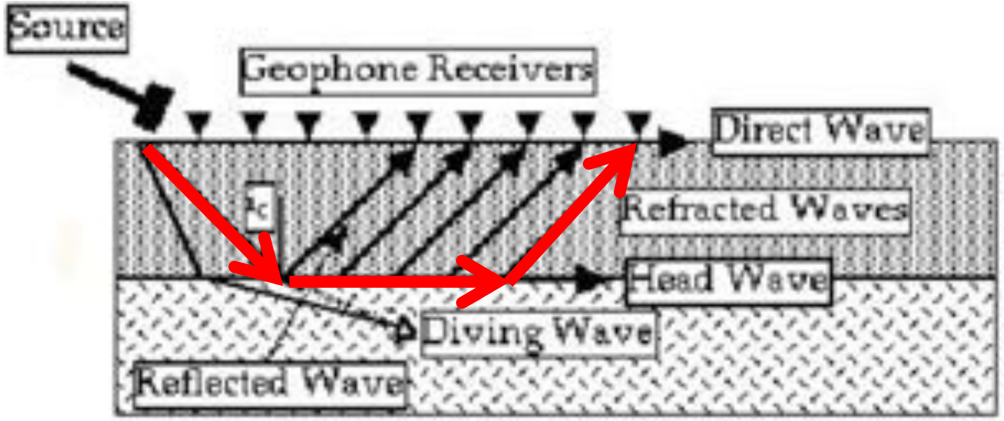


Angelier et al. (1986)

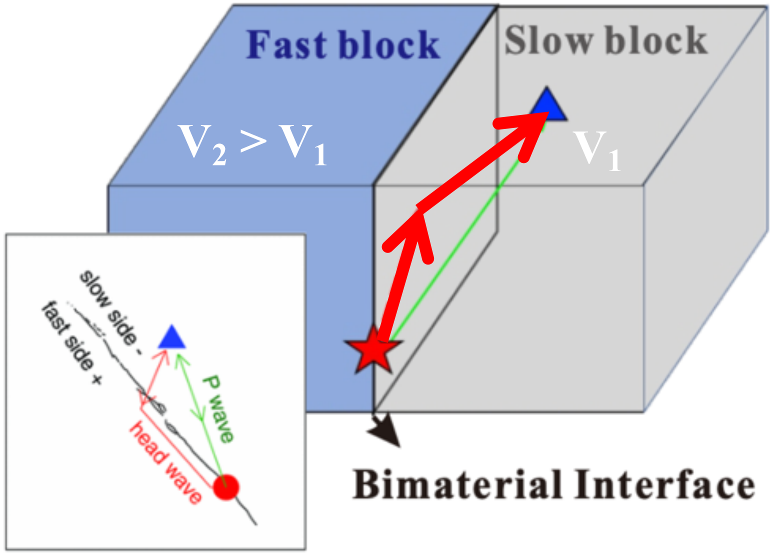


Allam et al. (2014)

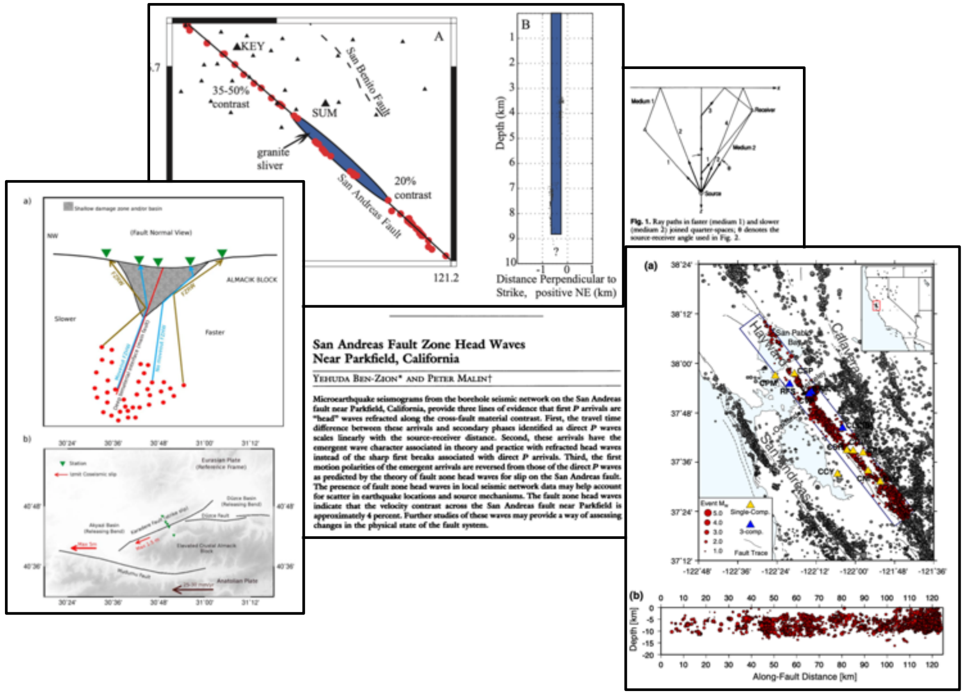
Fault zone head waves



https://www.ucl.ac.uk/EarthSci/people/lidunka/GEOL2014/Geophysics4%20-%20Seismic%20waves/SEISMOLOGY%20.htm



- Characteristics of fault zone head wave
  - ✓ Generated by earthquakes on faults that **separate different lithologies**
  - ✓ **Recorded by local seismic networks**
  - ✓ **On the slower side** of the lithology interface
  - ✓ **Opposite first motion polarity** from following direct P arrivals
- Previous studies:
  - ✓ The **Parkfield** section of the central San Andreas fault in California (Ben-Zion & Malin, 1991)
  - ✓ The **Bear Valley** region of the San Andreas fault (McGuire & Ben-Zion, 2005)
  - ✓ The Hayward fault in Northern California (Allam et al., 2014)
  - ✓ The North Anatolian Fault, **Turkey** (Najdahmadi et al., 2016)
  - ✓ Along the Southern San Andreas fault (Share & Ben-Zion, 2016; Share & Ben-Zion, 2018)
  - ✓ The Denali fault in **Alaska** (Allam et al., 2017)
  - ✓ The San Jacinto fault in Southern **California** (Share et al., 2019)



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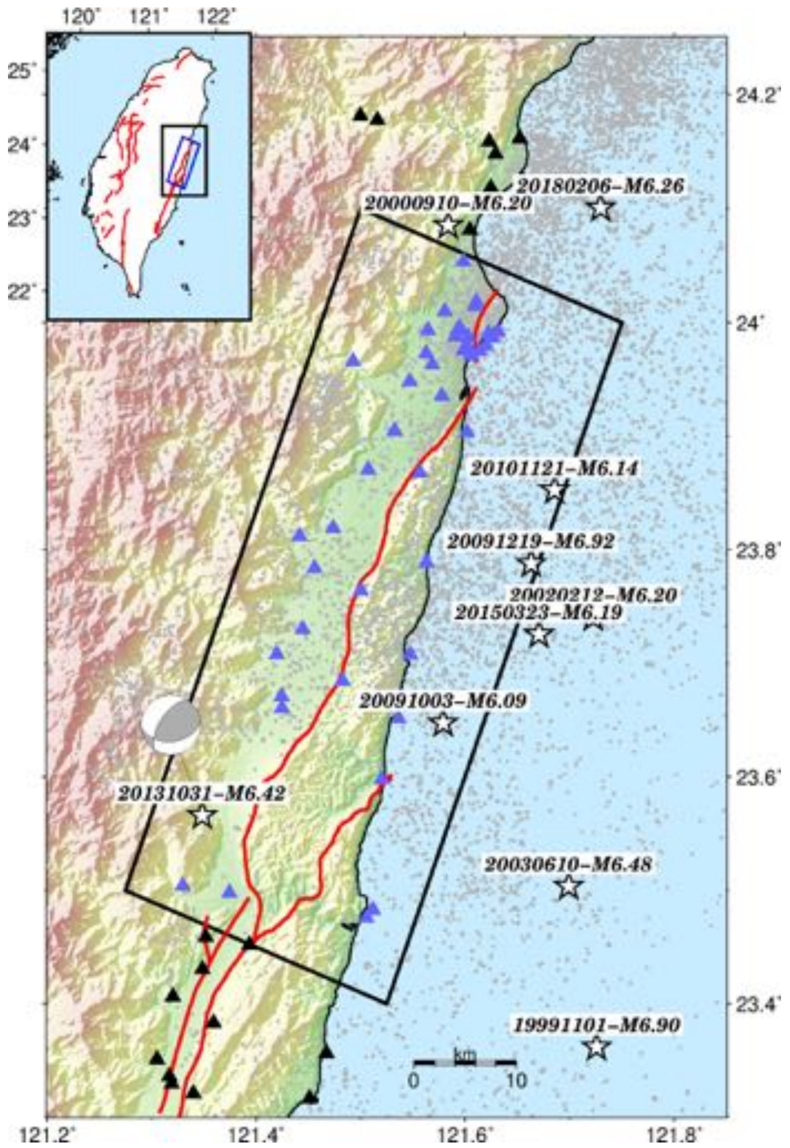
Data and Method



✓ **Data**

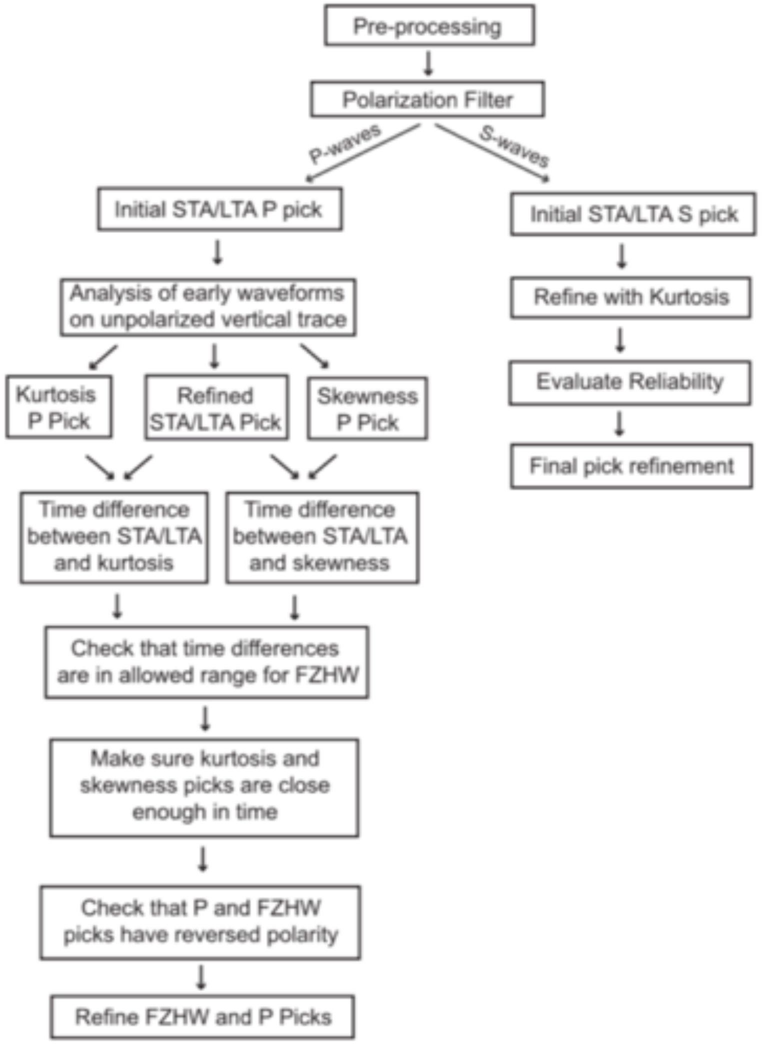
- Seismic data from Taiwan Strong Motion Instrumentation Program (**TSMIP**, Kuo et al., 1995)
- The strong-motion seismographs
  - ✓ Force Balance Accelerometer
  - ✓ **The trigger mode**
- **44** stations
- Within a **70 km by 28 km** box
- Along the **northern segment** of the LV fault system
- **13,000** small-to-moderate earthquake seismograms
- Between **2012 to 2018**
- Downloaded from the Central Weather Bureau

✓ **Data pre-processing**

- Removing the mean and trend
- A high-pass filter with a corner frequency of **4 Hz**
- Each acceleration record was integrated to **velocity time series**

✓ **Method**

- Apply the algorithm (Ross & Ben-Zion, 2014) to automatically detect FZHWs



Reprinted from Figure 6 of Ross & Ben-Zion (2014)

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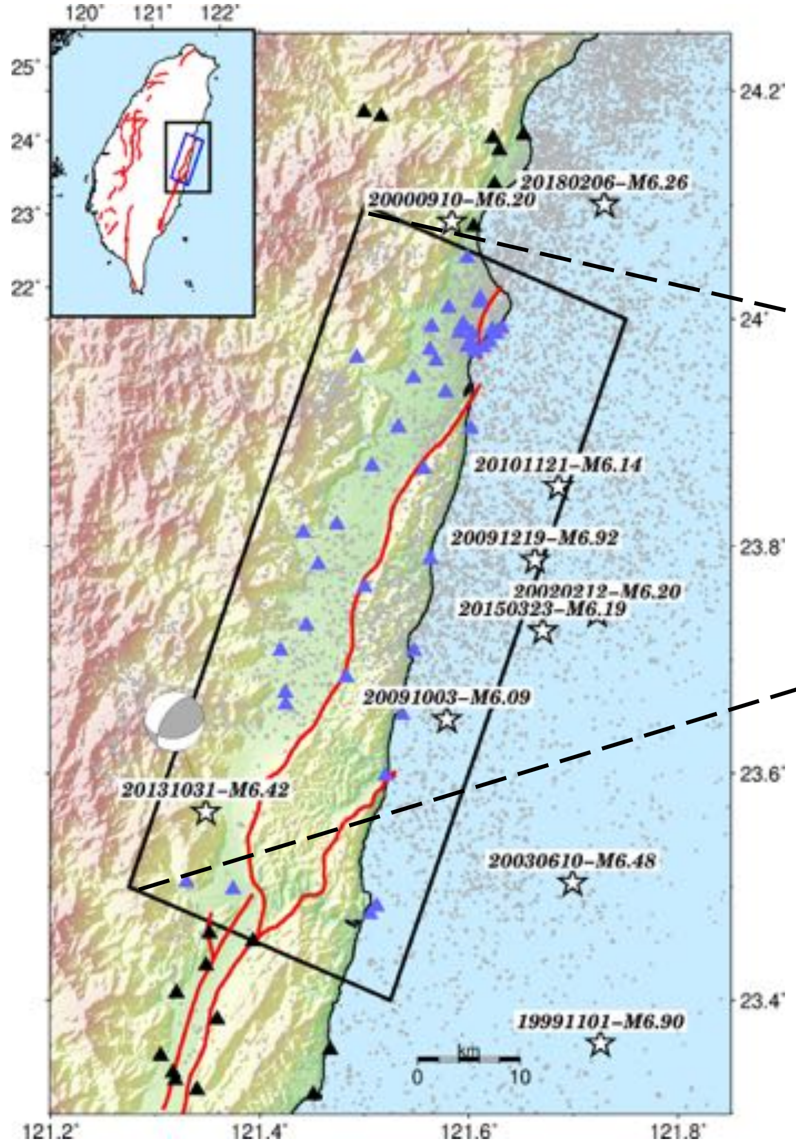
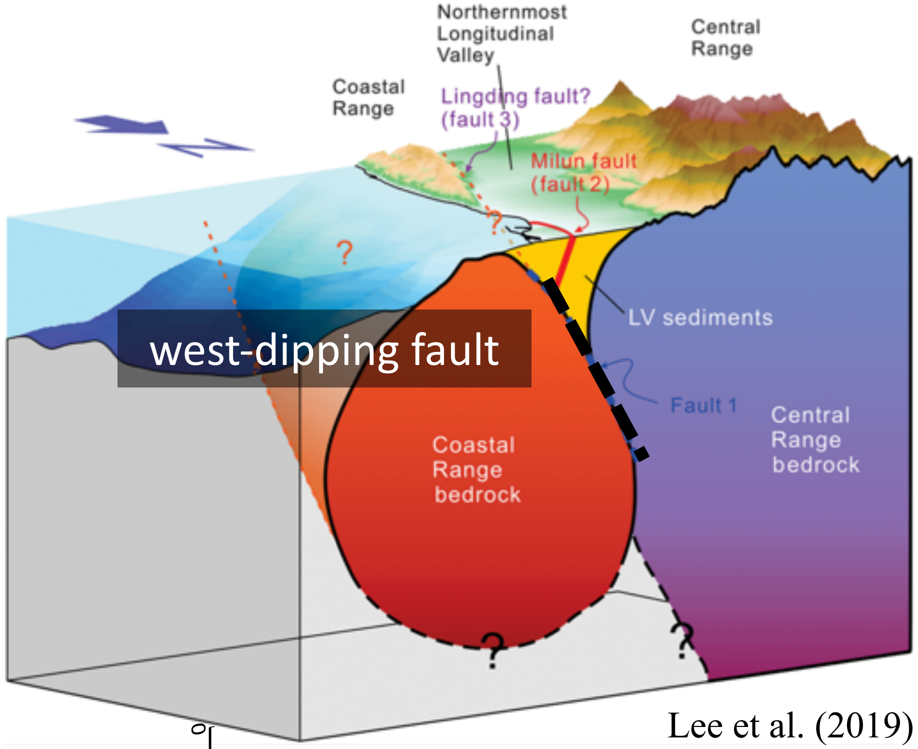
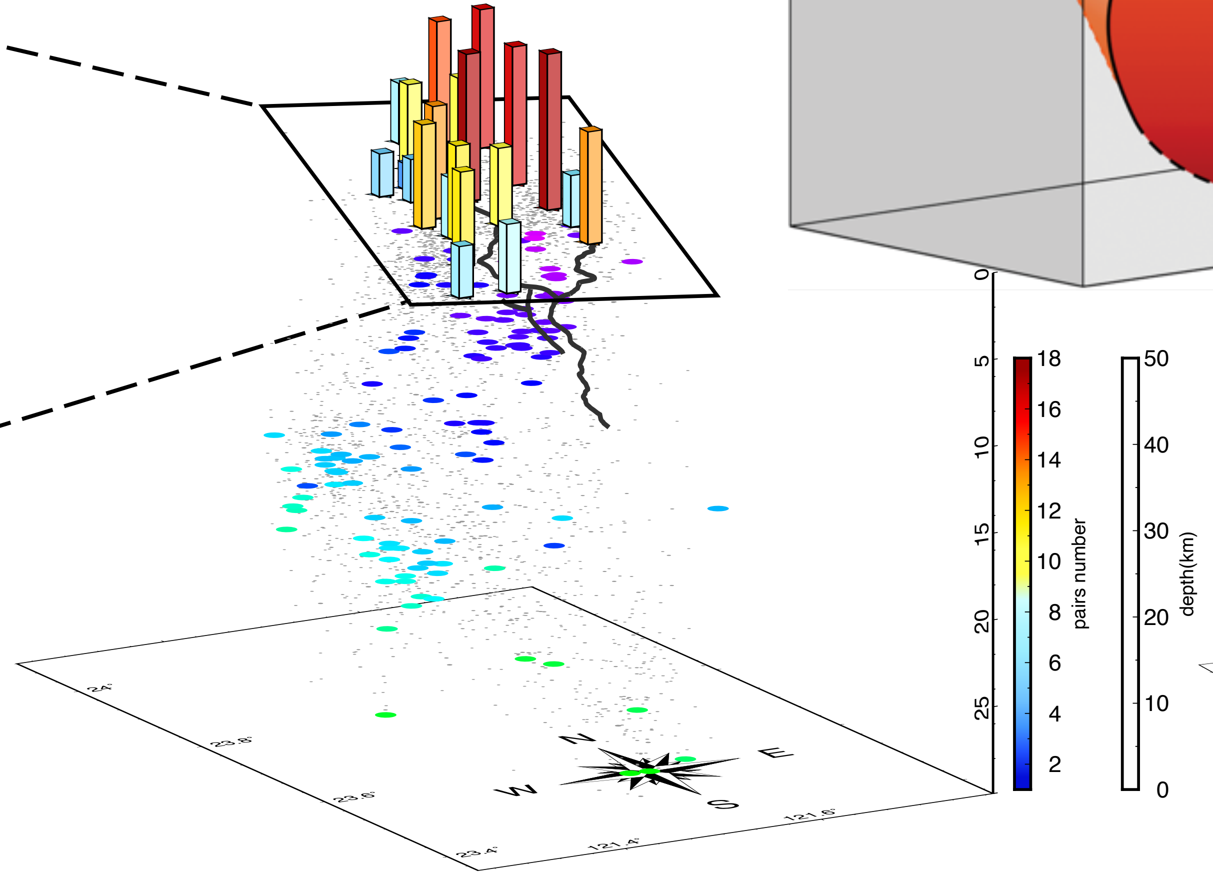
Results - Summary of automatic [FZ]HW detections

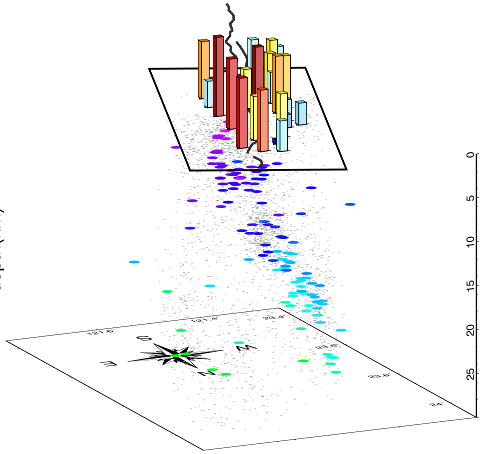


414 robustly detected head waves excited by **204 events** that are located within a thin volume along the **west-dipping Central Range fault**.



Lee et al. (2019)





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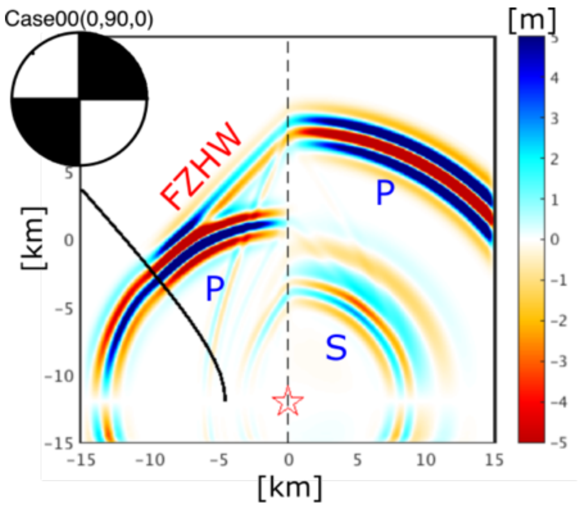
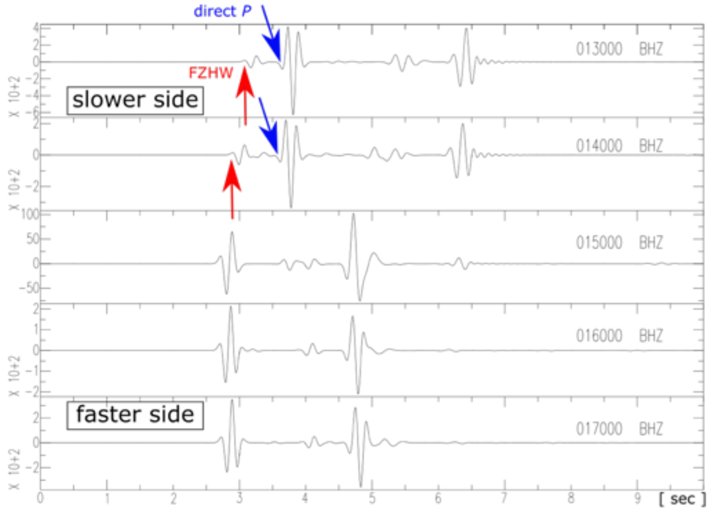
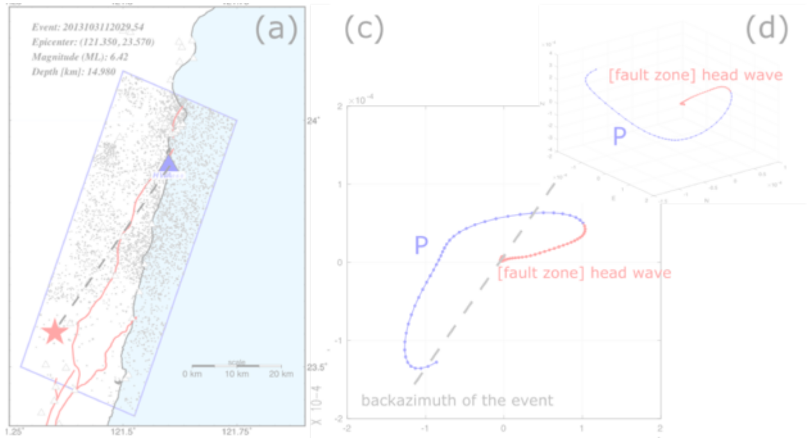
Analysis Procedure

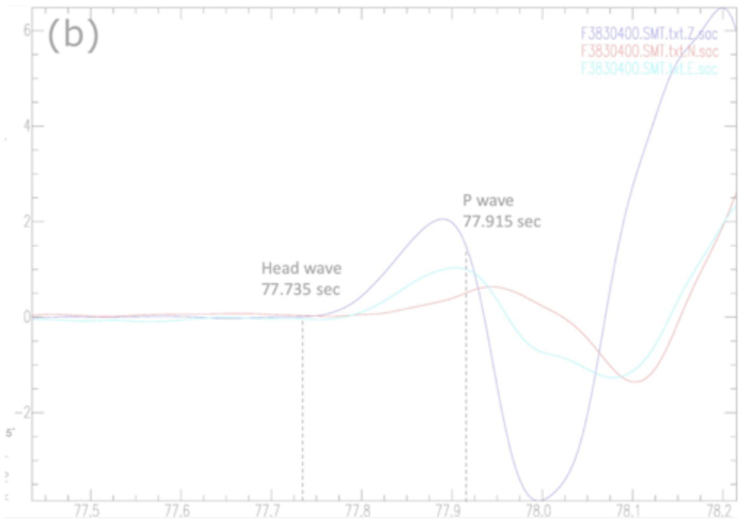
✓ First motion polarity



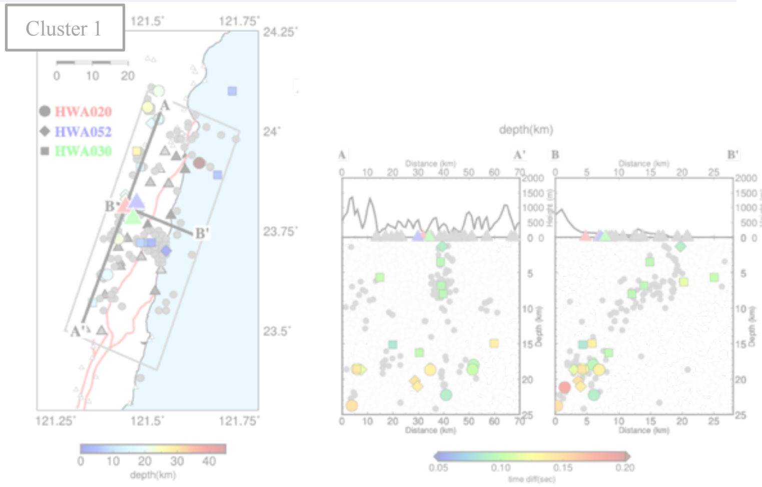


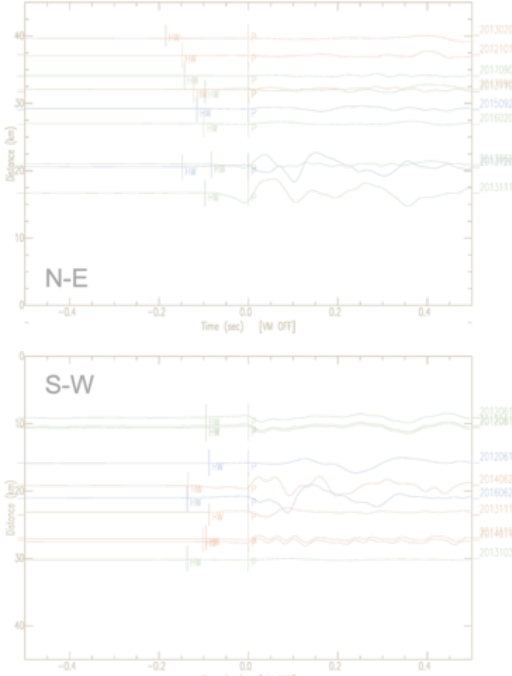
✓ Particle motion





✓ Move-out pattern





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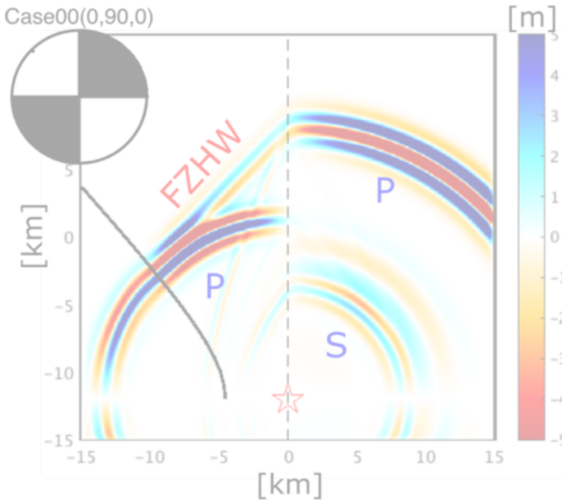

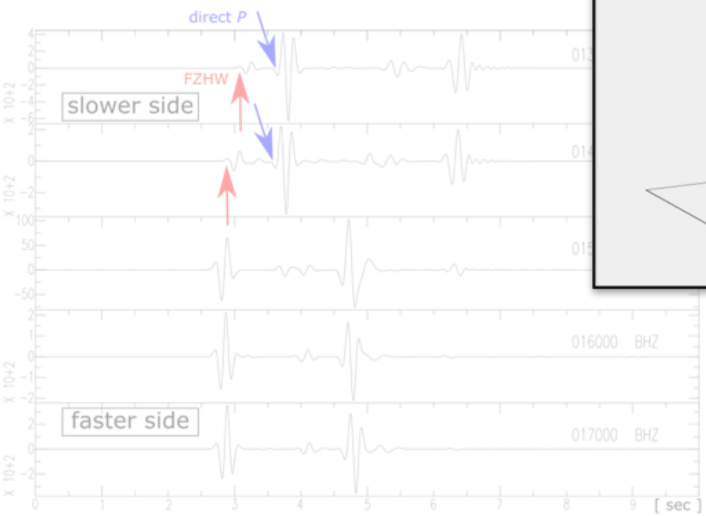

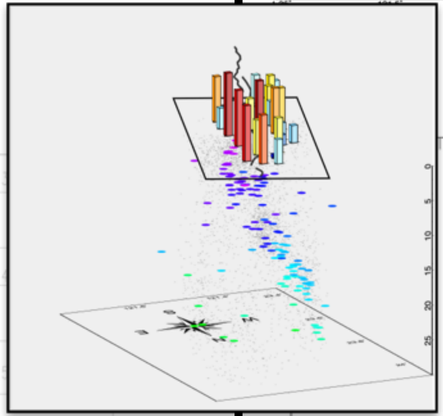

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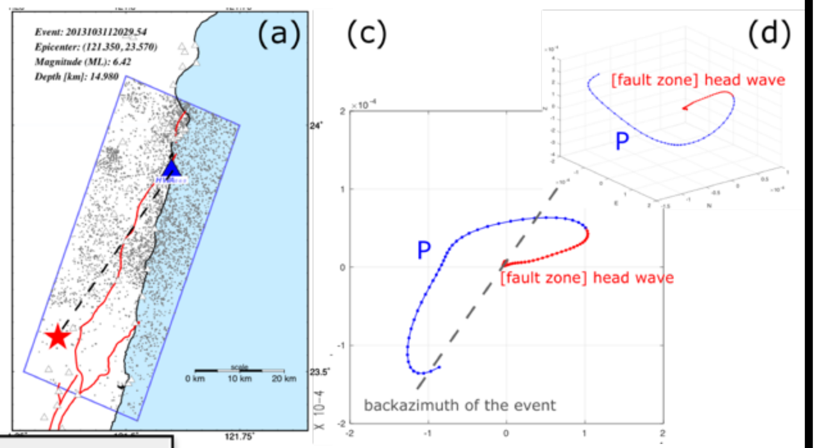

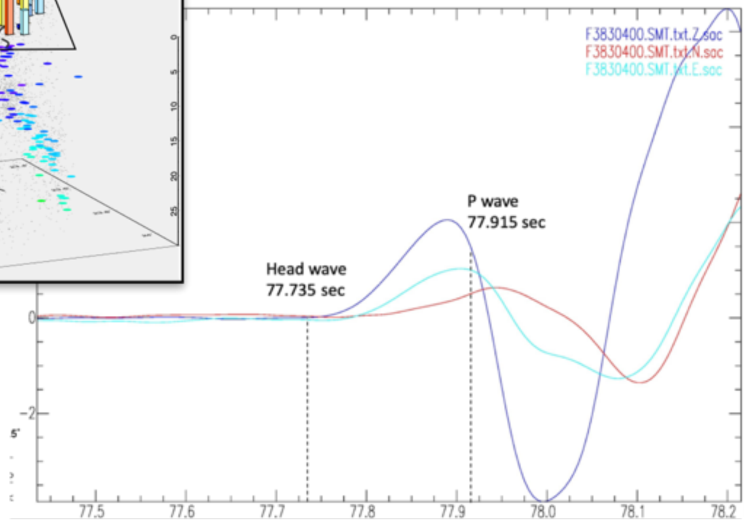

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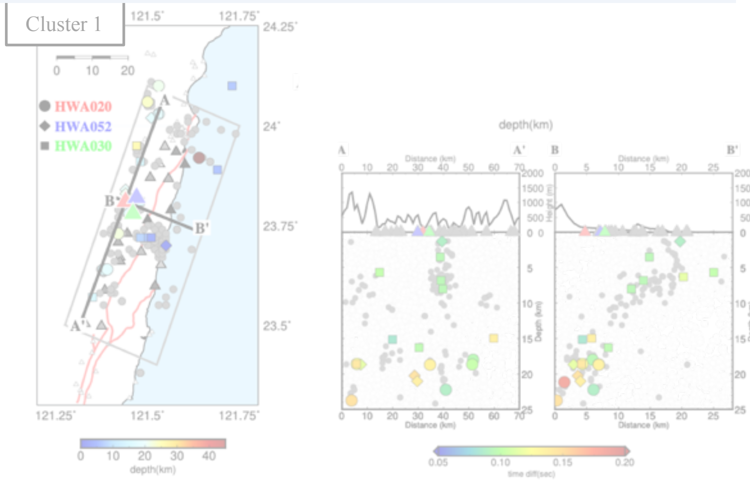

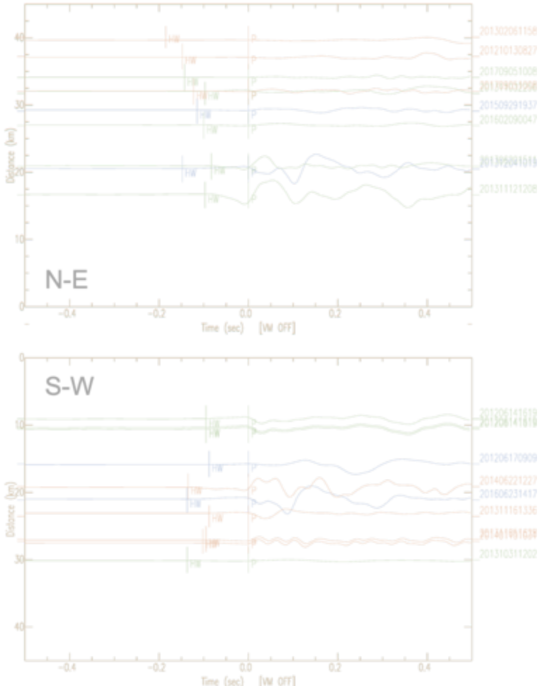

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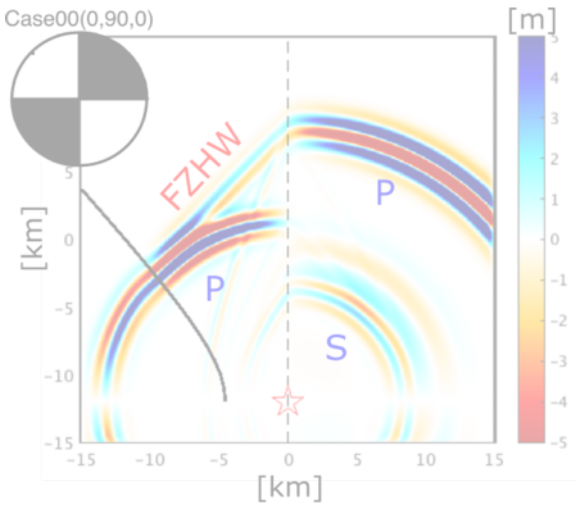

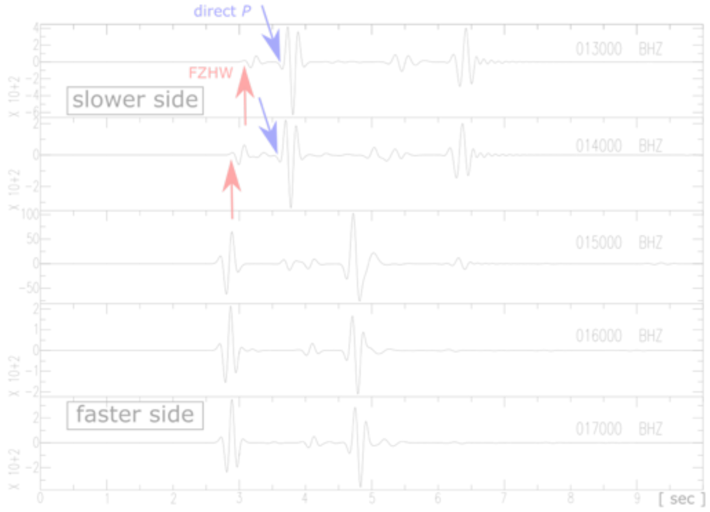

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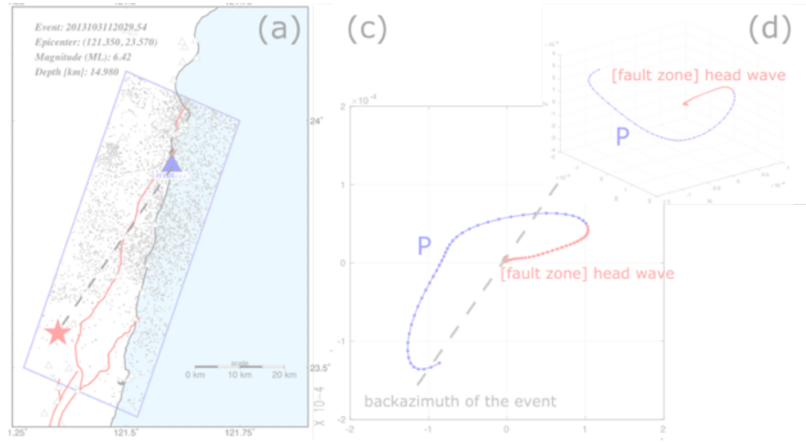

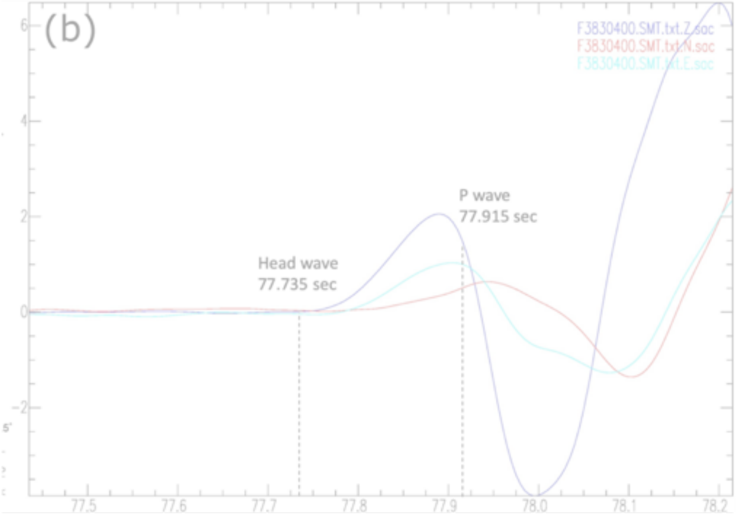

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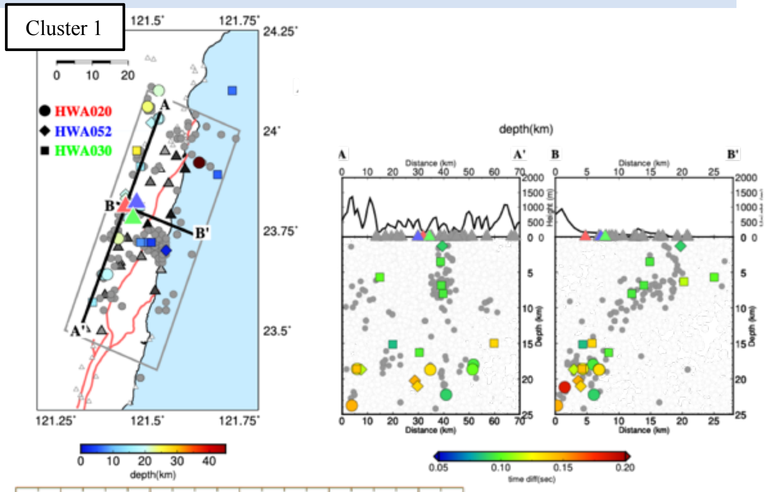

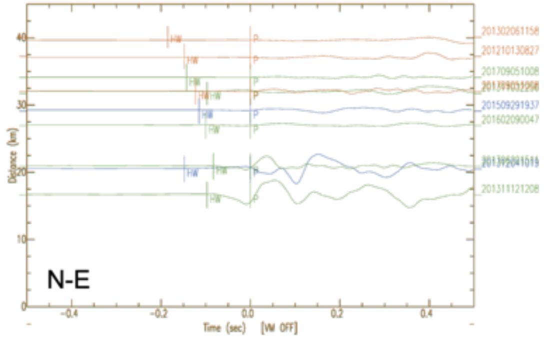

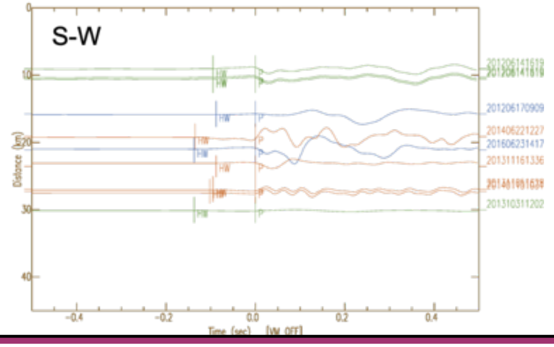

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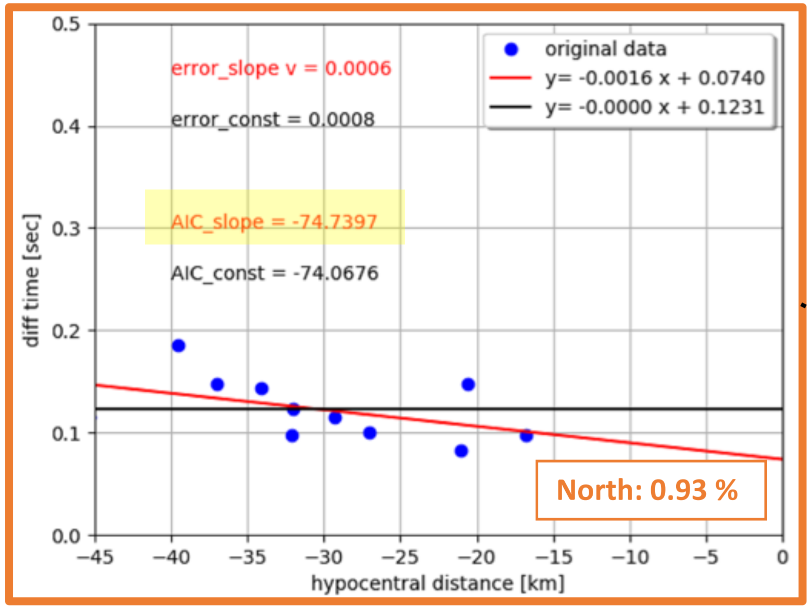
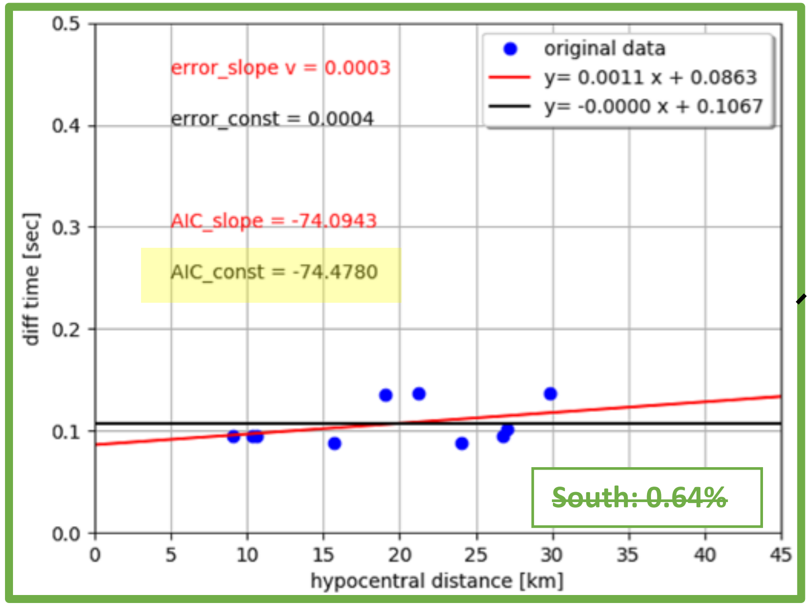
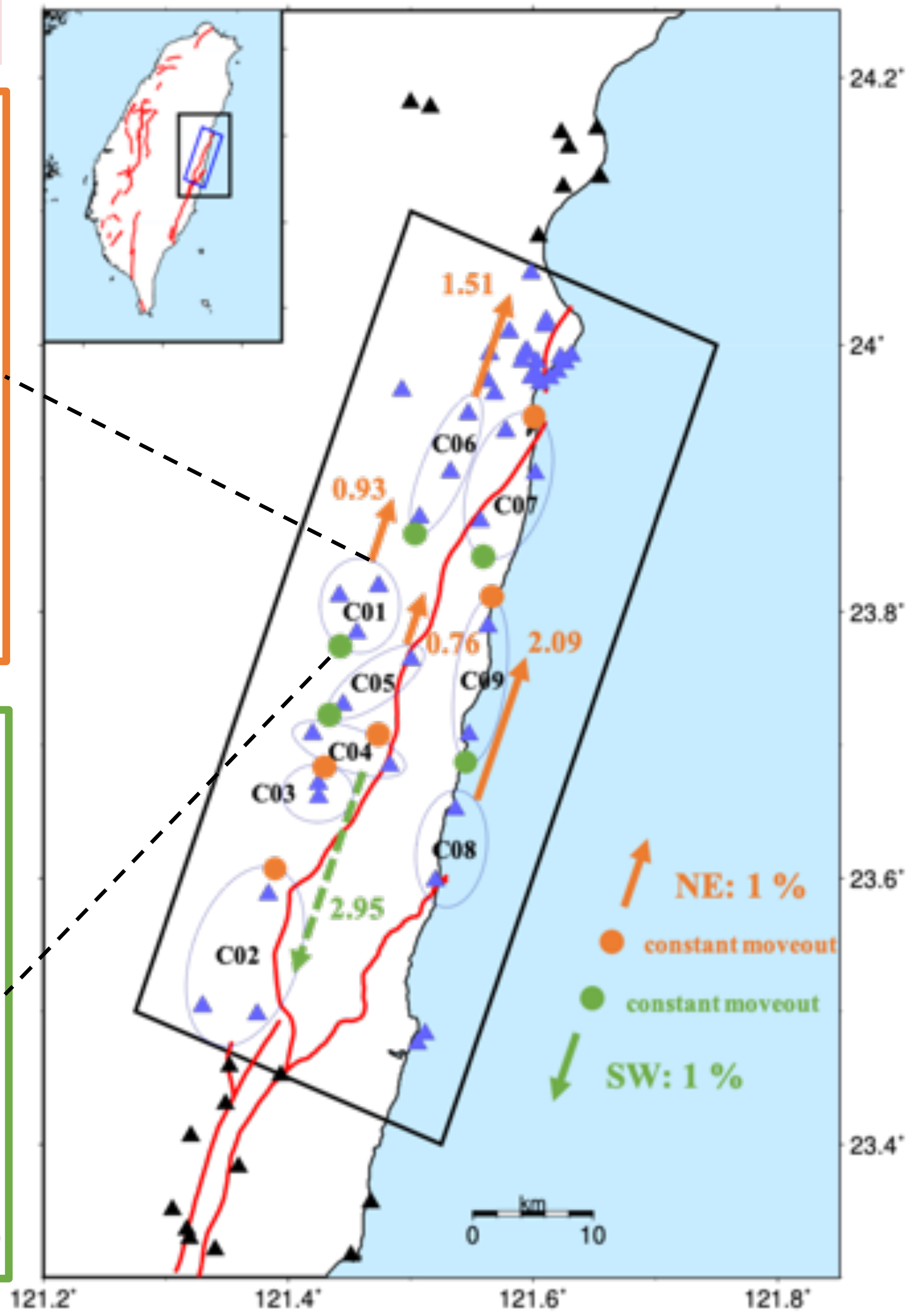
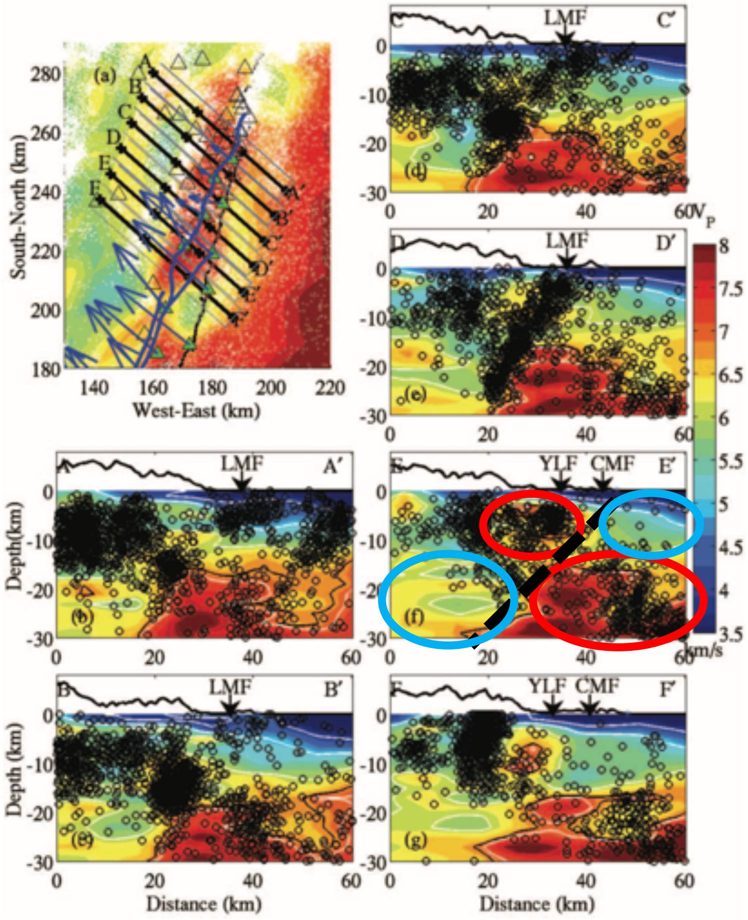
Velocity contrast







- The existence of a bimaterial interface **at a crustal depth level**.
- Constant moveout can be produced by **a shallow local structure**.
- The obtained average velocity contrast in the chosen clusters ranges from **1 to 3 per cent.**

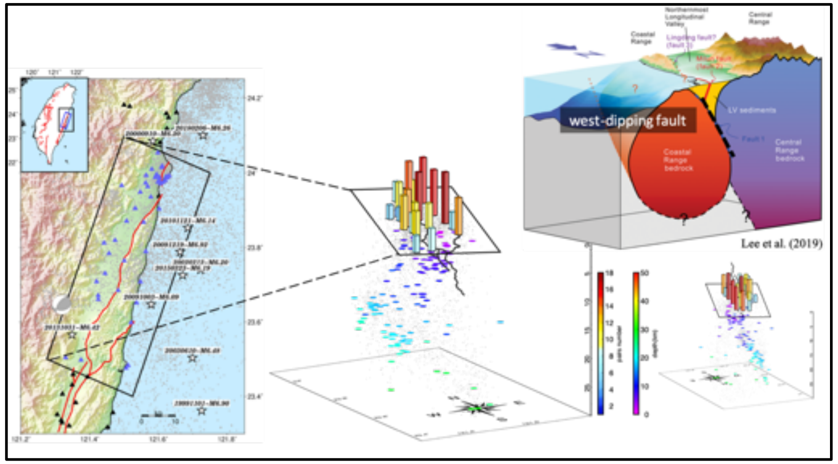


Kim et al. (2006)

Summary

- **414 robustly detected head waves** excited by **204 events** that are located within a thin volume along the **west-dipping Central Range fault**.

- Several characteristics can be used to identify FZHW:
  - Opposite first-motion polarity
  - Particle motion
  - Moveout pattern



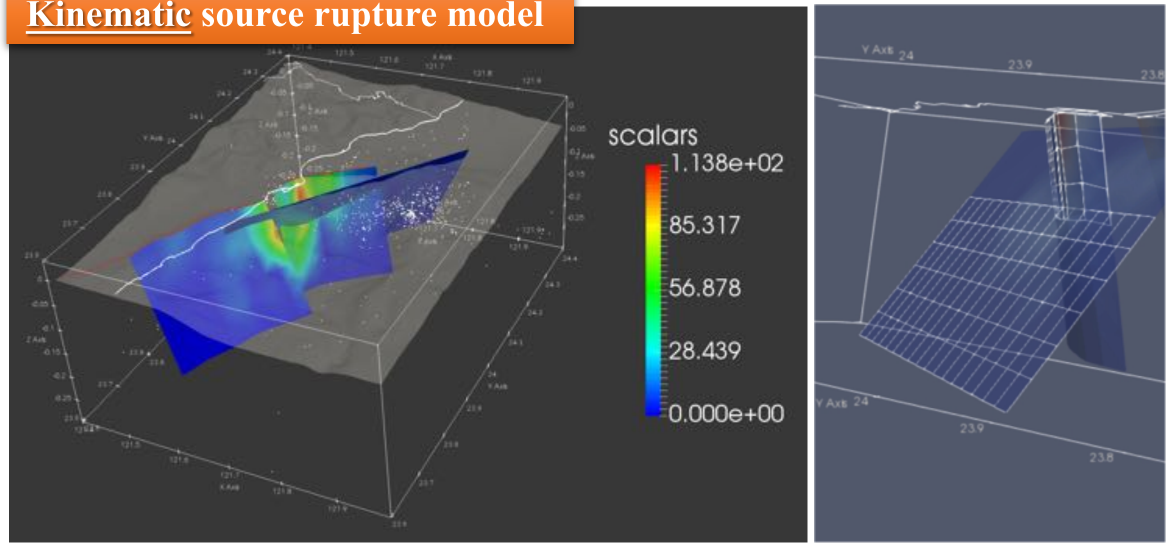
- The existence of a bimaterial interface **at a crustal depth level**.

- Constant moveout can be produced by **a shallow local structure**.

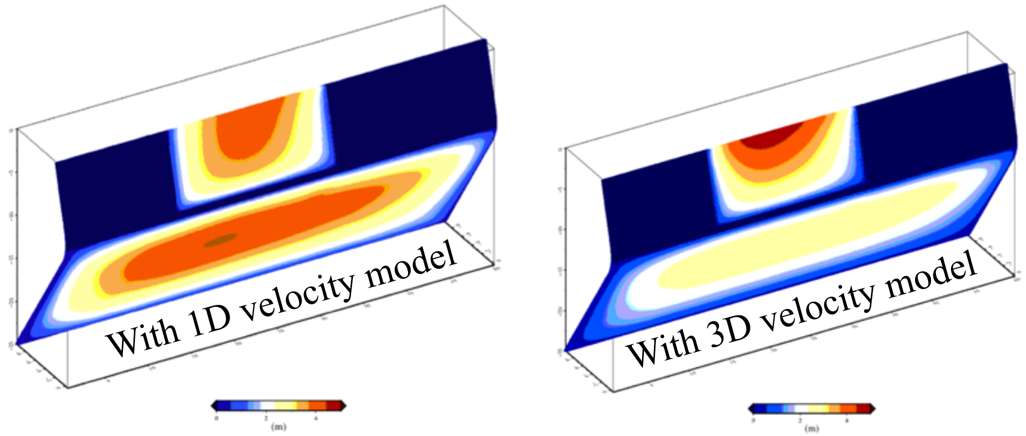
- The obtained average velocity contrast in the chosen clusters ranges from **1 to 3 per cent.**

- **Fault zone head waves** provide high-resolution information on fault structure at seismogenic depths.

Kinematic source rupture model



Dynamic source rupture model



Longitudinal Valley in eastern Taiwan. photo by Tzu-Chi, Aug 1st 2015

EGU General Assembly 2022

More detail on YouTube

OSPP judging form

Discuss with me via Zoom

Thanks for listening. ☺
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