Global Characterization of Double Seismic Zones

Manuel Florez

Graduate Student,
Department of Earth, Atmospheric and Planetary Sciences
In collaboration with German Prieto

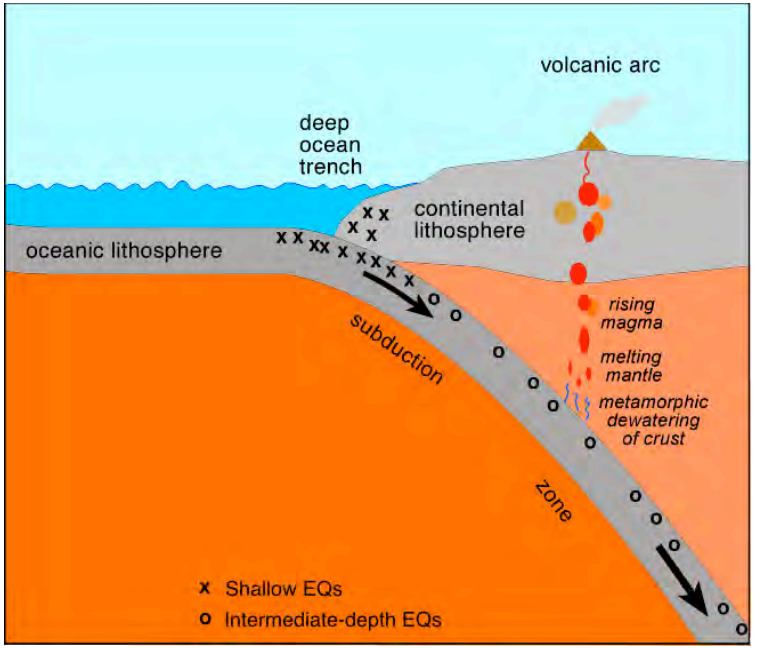
MIT Earth Resources Laboratory
2017 Annual Founding Members Meeting
June 1, 2017

Massachusetts Institute of Technology

Earth Resources Laboratory

Subduction zones

What is the structure of intermediate depth seismicity in subduction zones?



Subduction Zone Structure

Maximum depth of seismicity

Geometrical Structure of Seismicity

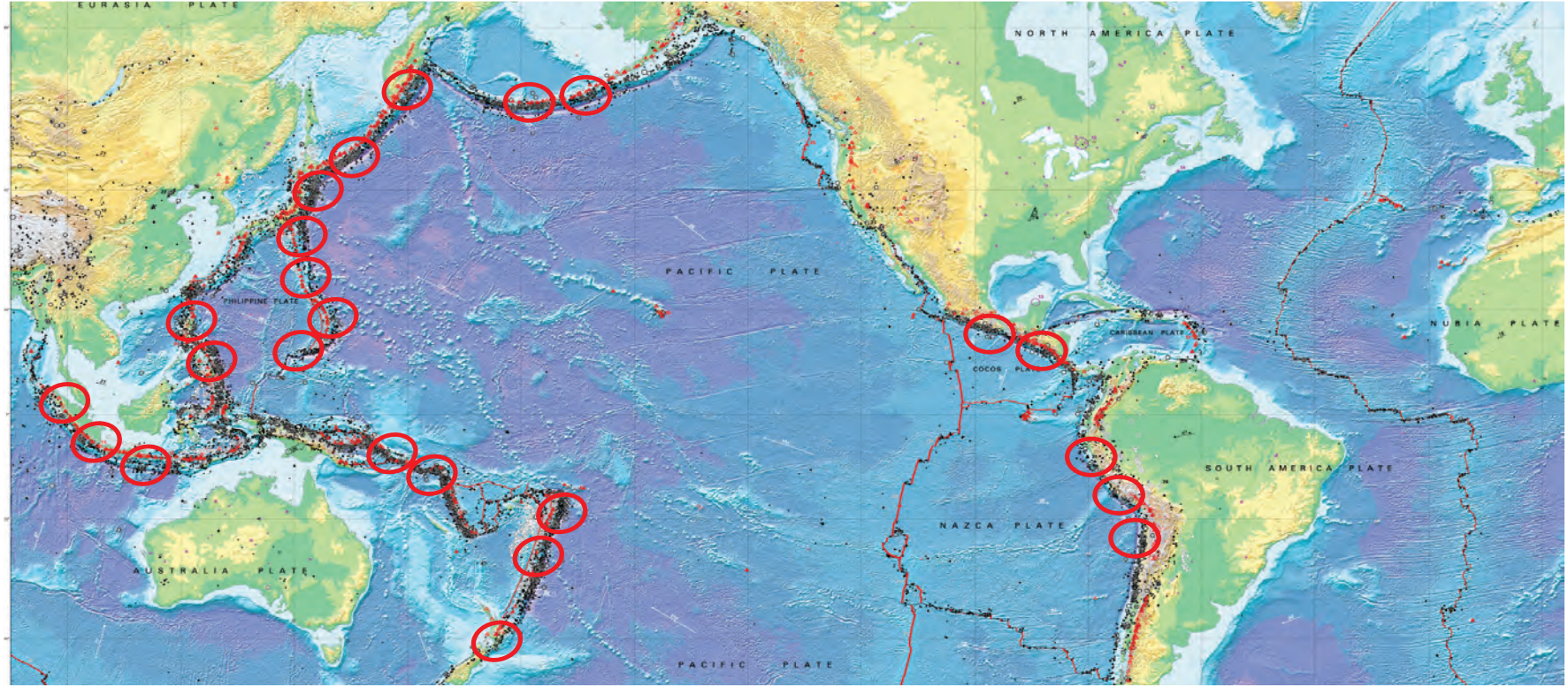
Intermediate Depth Earthquakes

Mechanism is not well constrained

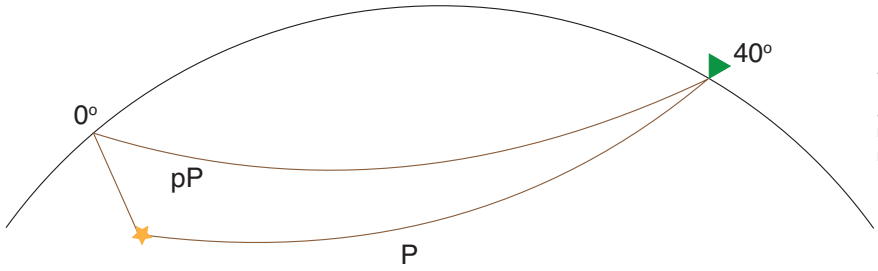
Earthquake Locations

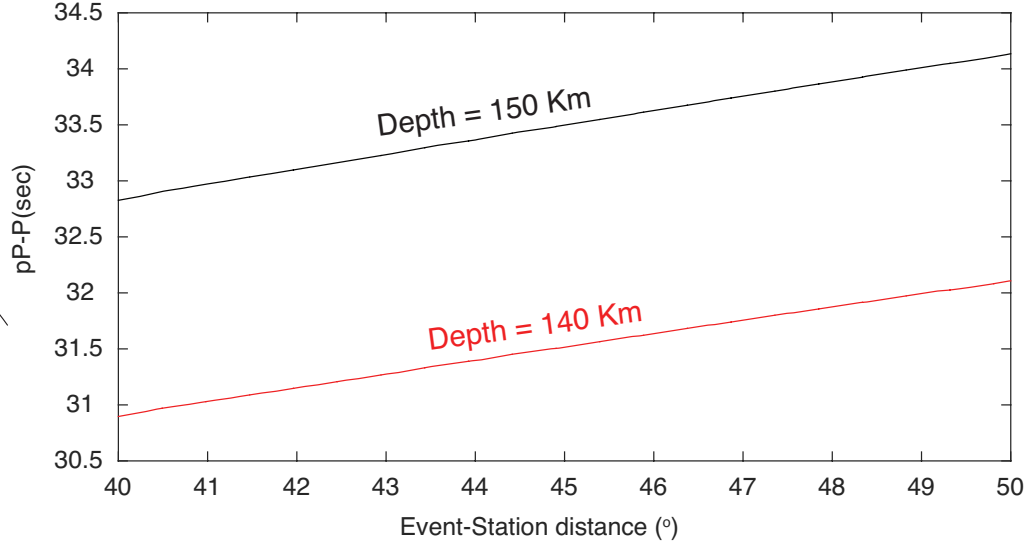
Accurate EQ relocation is ***key*** to understanding subduction zone process

Global Distribution of Seismicity



Depth Phases



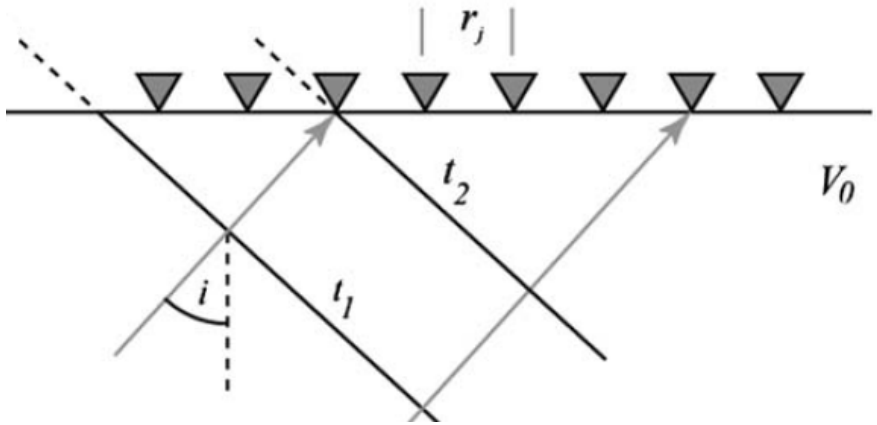


- Sensitive to and better for constraining hypocenter depth.
- However, it is challenging to routinely identify them.

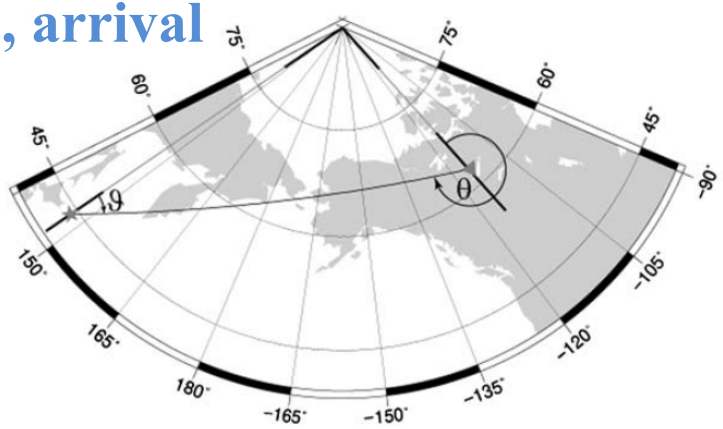
Array Processing Techniques

Beam

$$b(t) = \frac{1}{M}\sum_{j=1}^{M} x_j(t + t_j)$$



Parameters: Backazimuth, slowness, arrival time

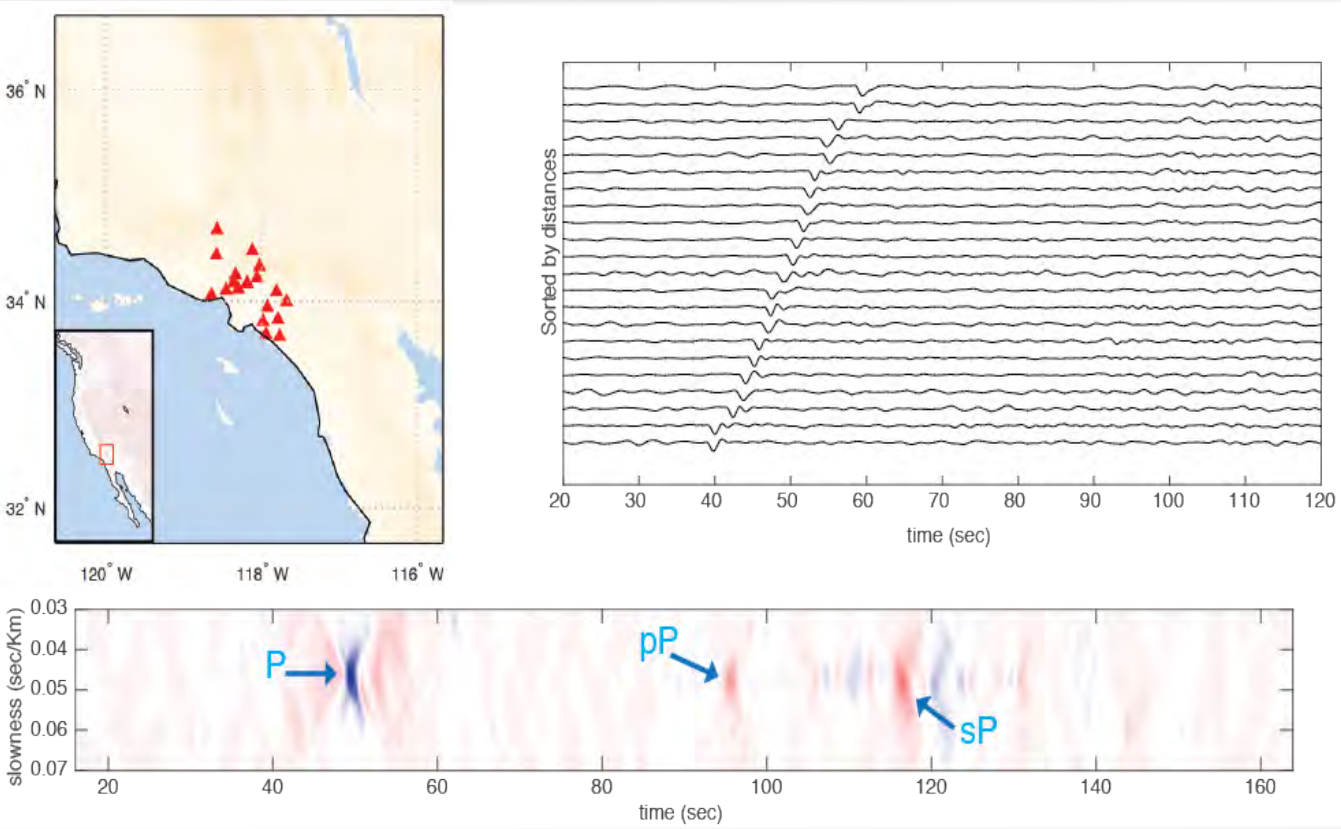


Ambient Noise (Gerstoft et al., 2012)

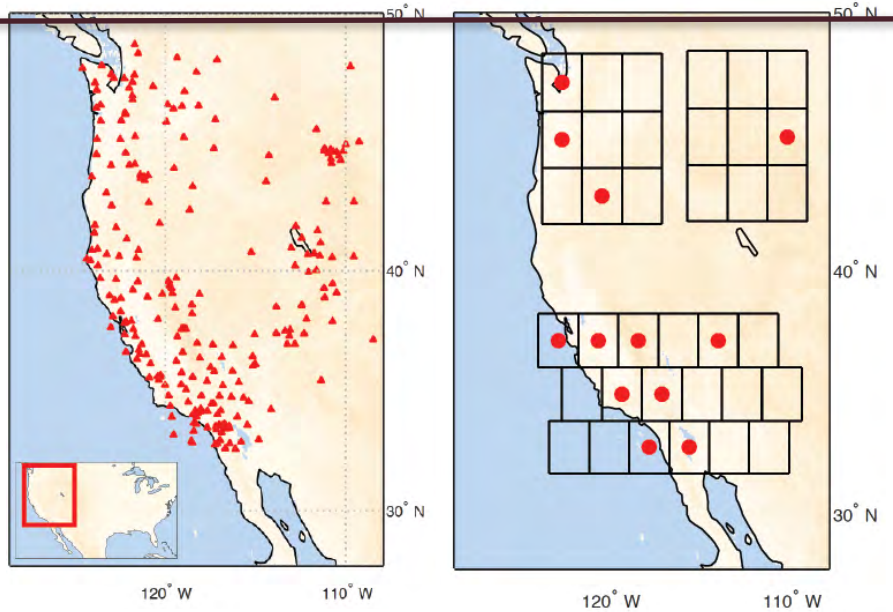
Backprojection (Ishii et al., 2005).

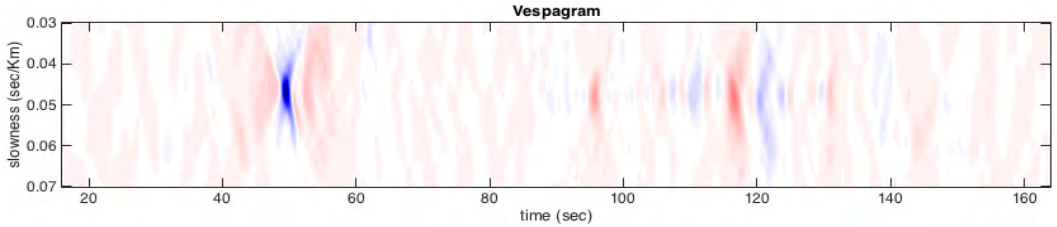
Deep Interface Imaging (Rost and Thomas, 2013)

Vespagram Analysis



Subarrays in Western USA

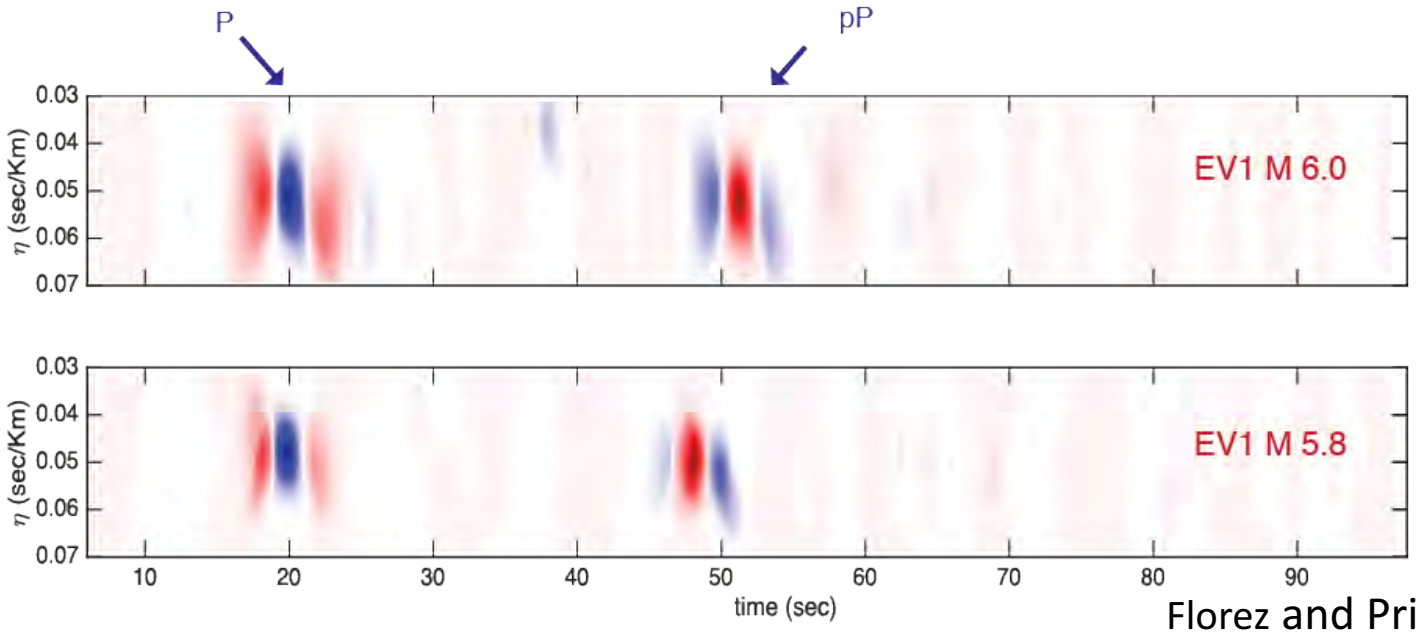




Florez and Prieto, 2017

Relocation

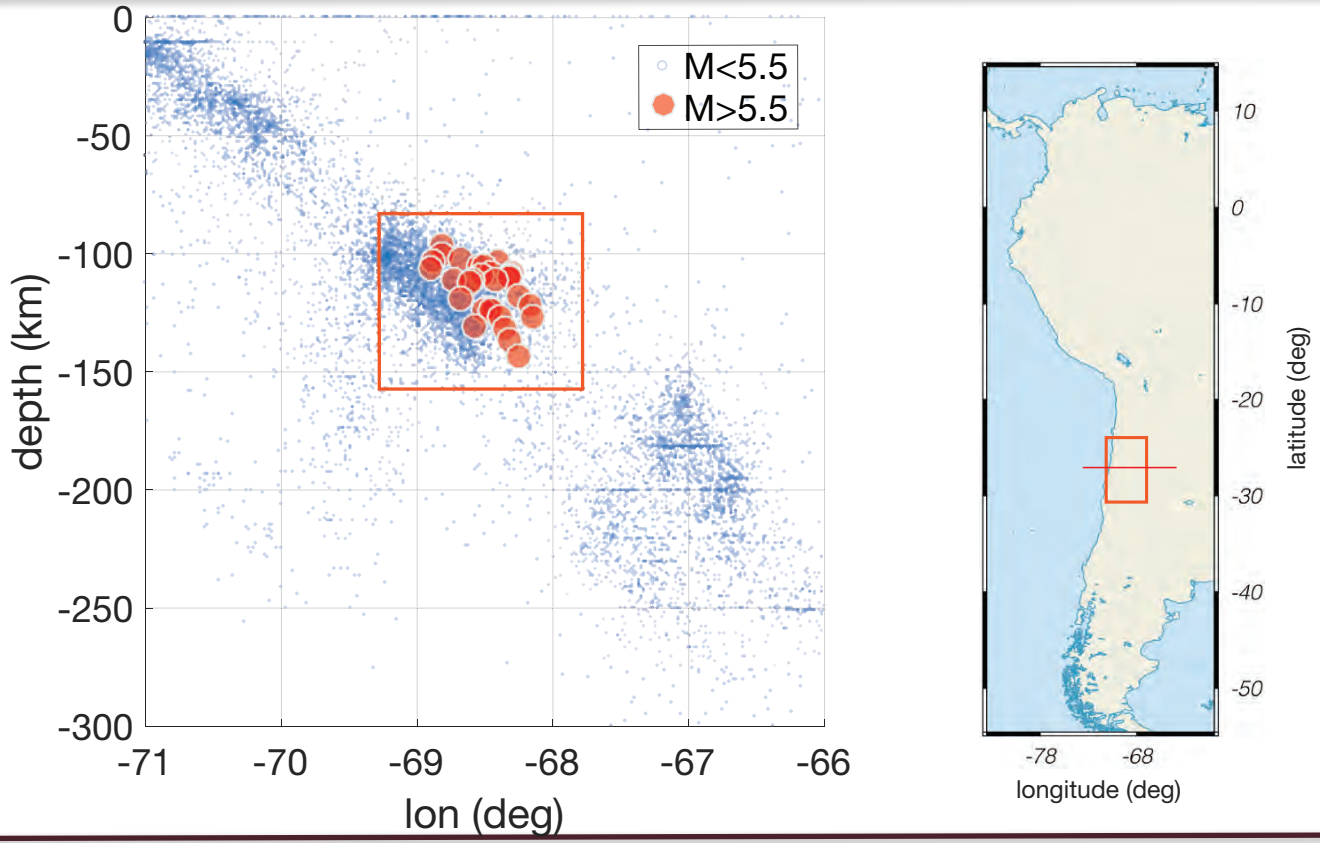
pP-P times at the same Subarray



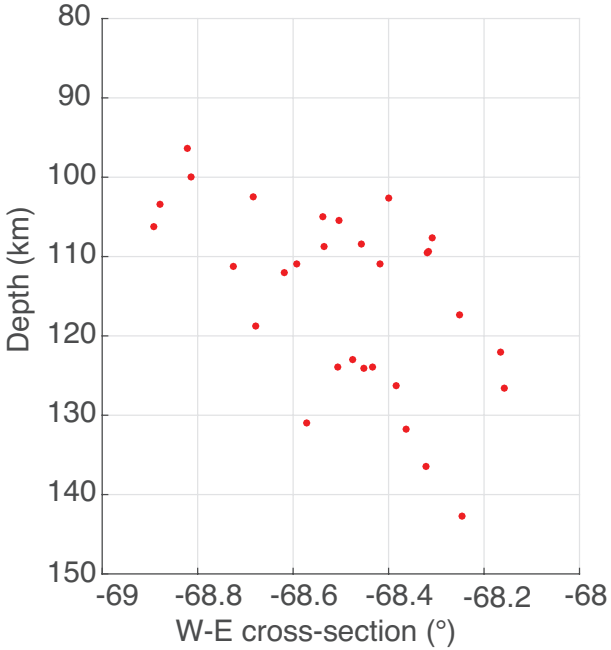
Florez and Prieto, 2017

$$t_{obs} = (pP - P)_1 - (pP - P)_2$$

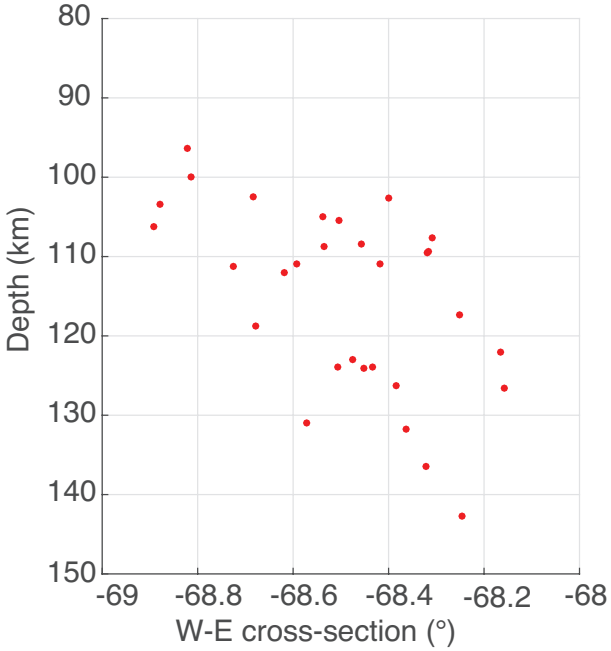
DSZ: Northern Chile

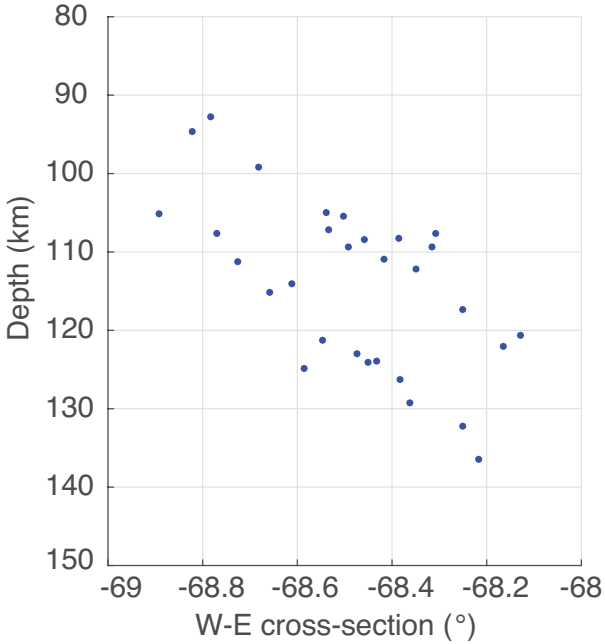


DSZ: Northern Chile

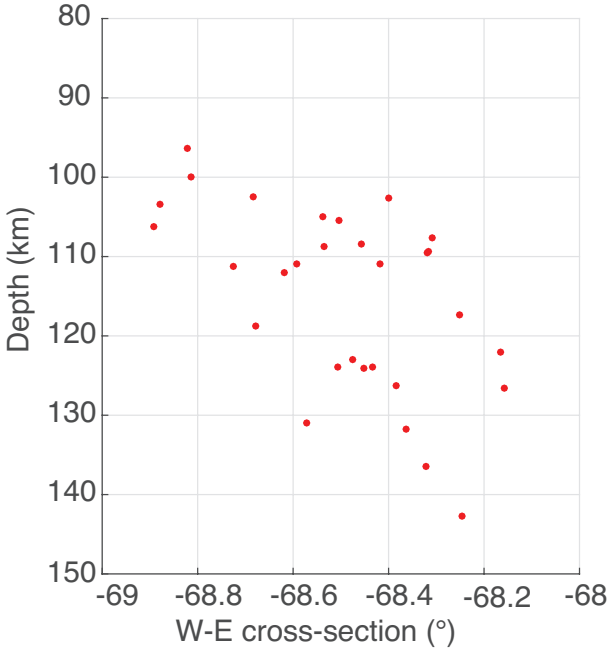


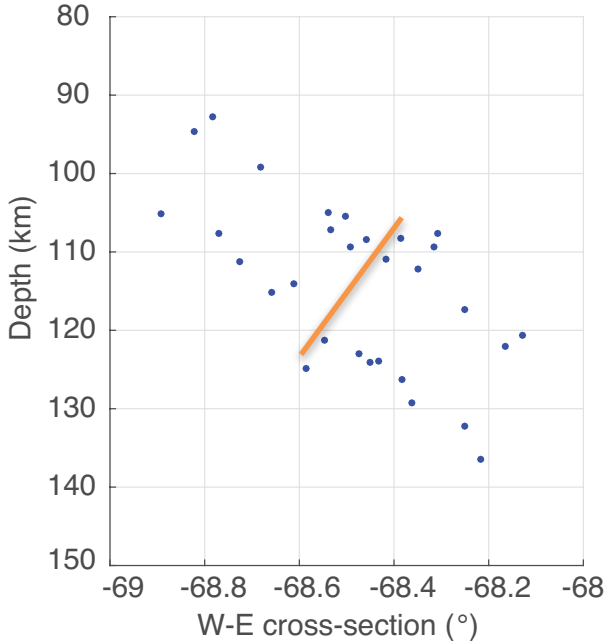
DSZ: Northern Chile

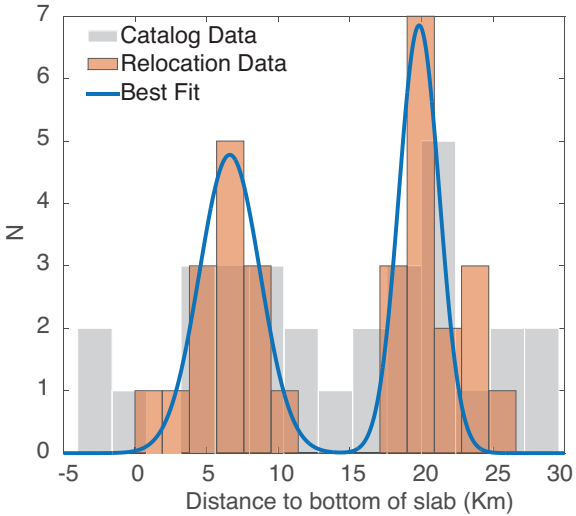




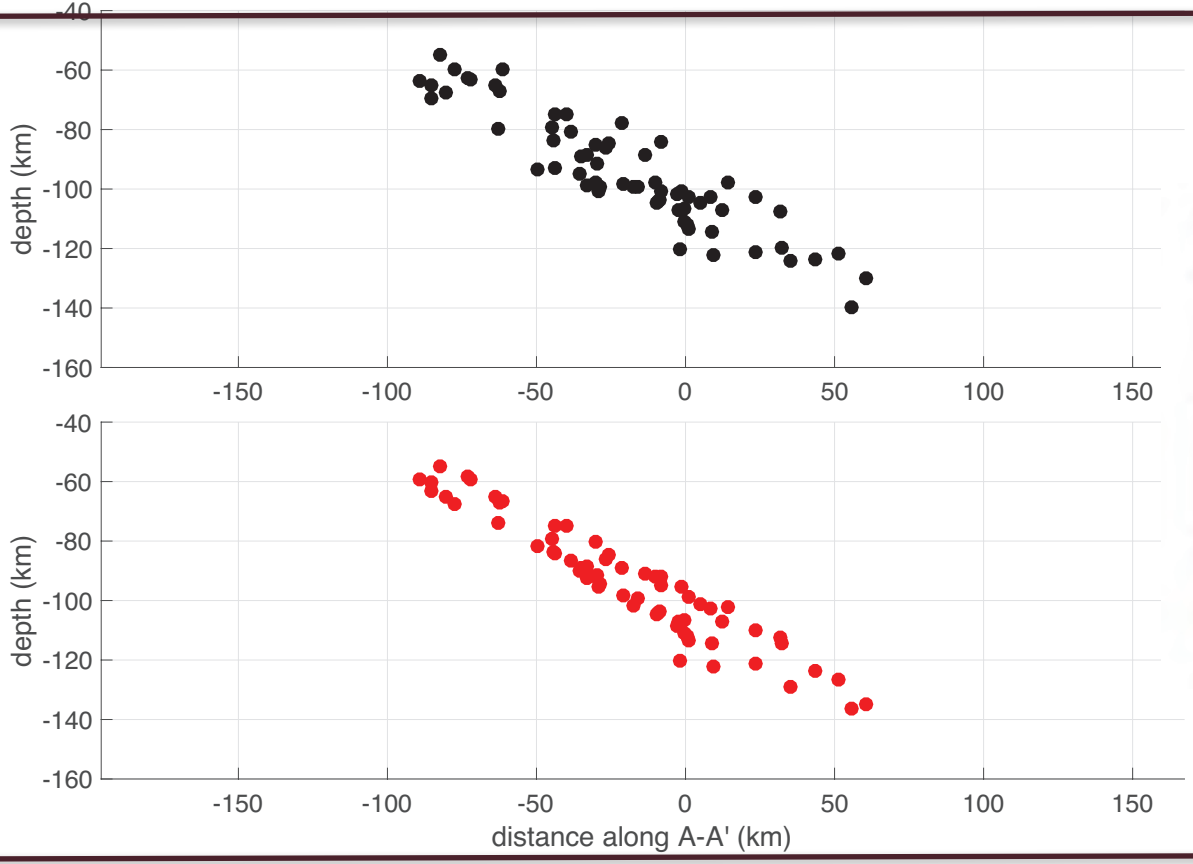
DSZ: Northern Chile

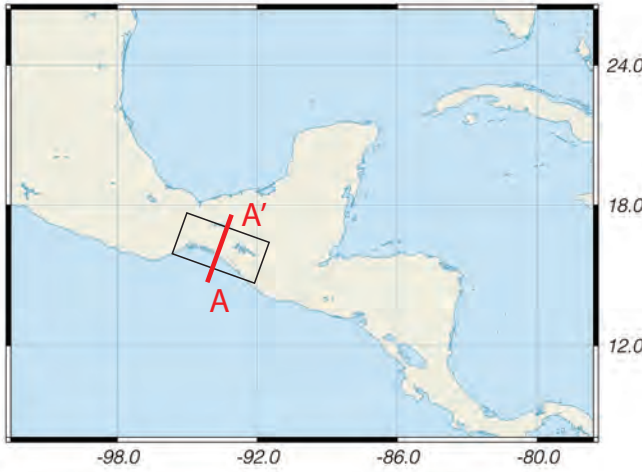




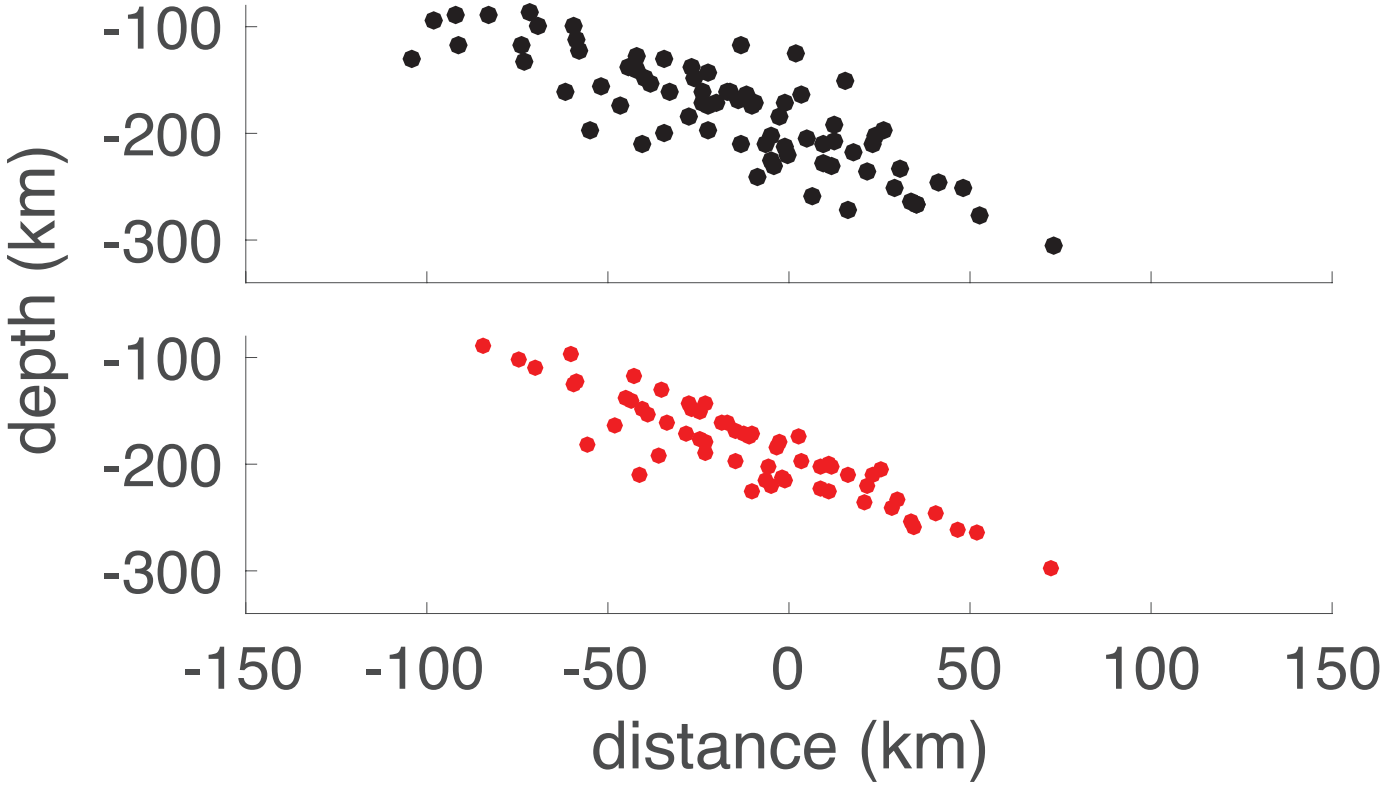


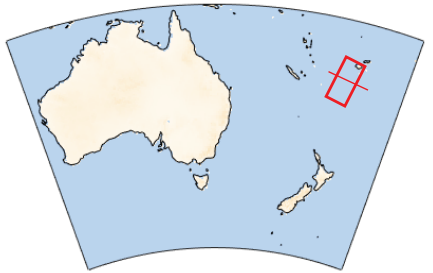
DSZ: Central America



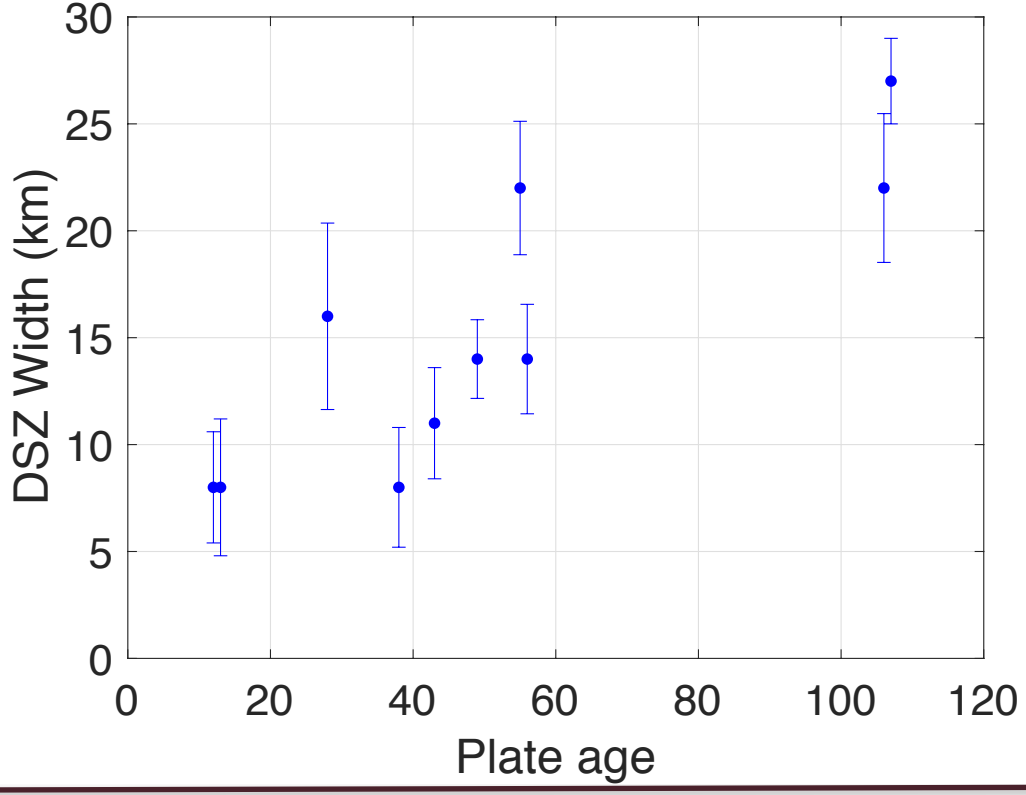


DSZ: Tonga

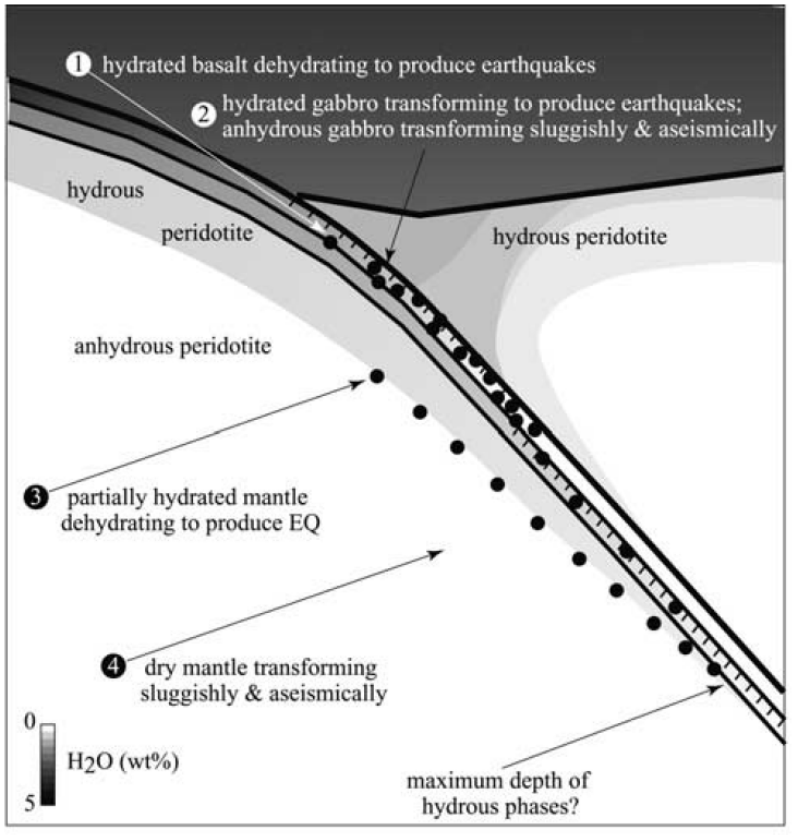

-100
-200
-300
depth (km)
-100
-200
-300
-150
-100
-50
0
50
100
150
distance (km)



DSZ: Global



Possible Model



Hacker et al., 2003

Conclusion

- **Double Seismic Zones appear to be a defining characteristic of subduction zones.**
- **Seismicity clusters into two planes in every subduction segment studied.**
- **Until this study it was not possible to clearly define DSZs due to the large errors present in global EQ catalogs.**
- **The separation between the planes of seismicity correlates with age of the plate.**