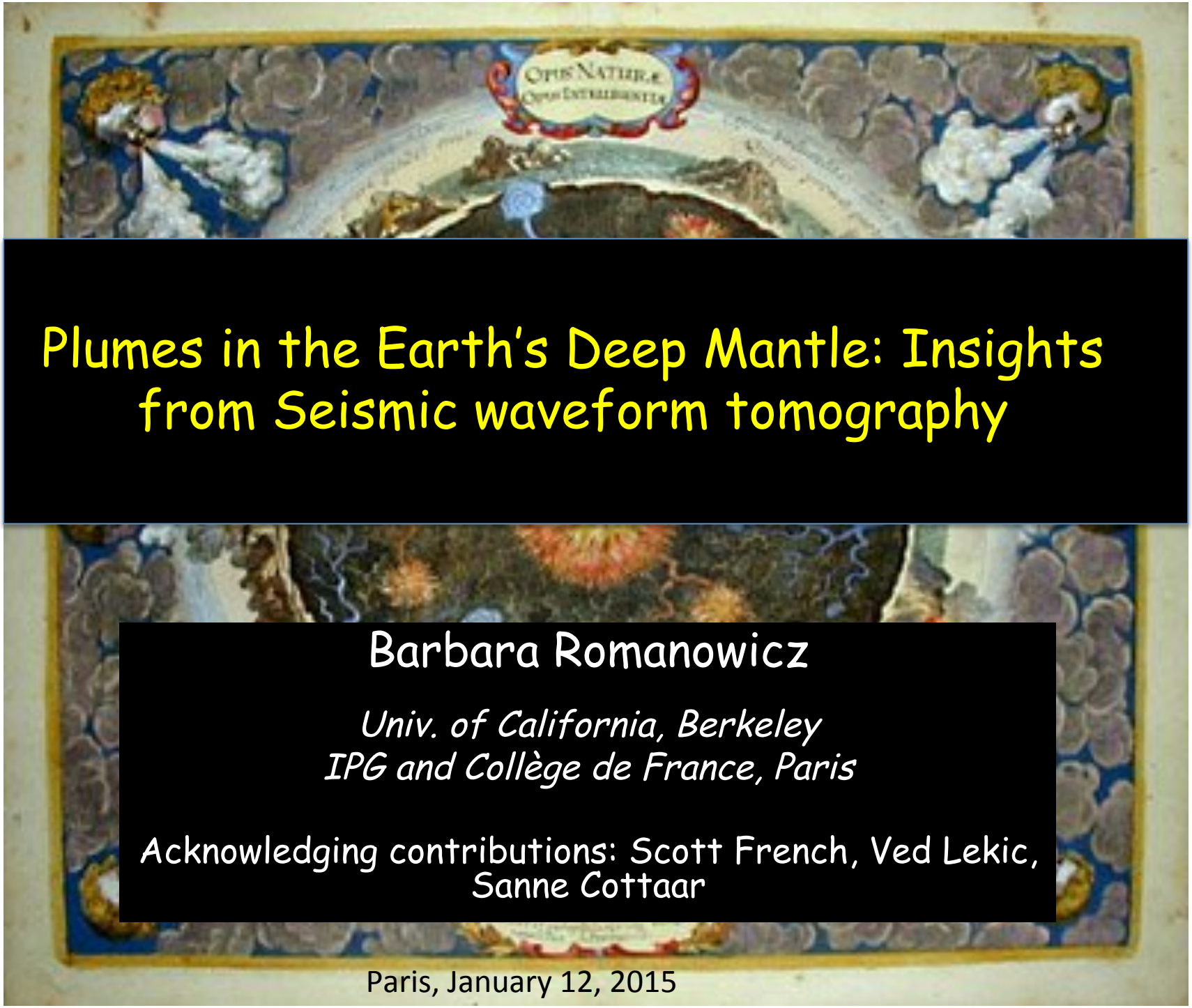

Plumes in the Earth's Deep Mantle: Insights from Seismic waveform tomography

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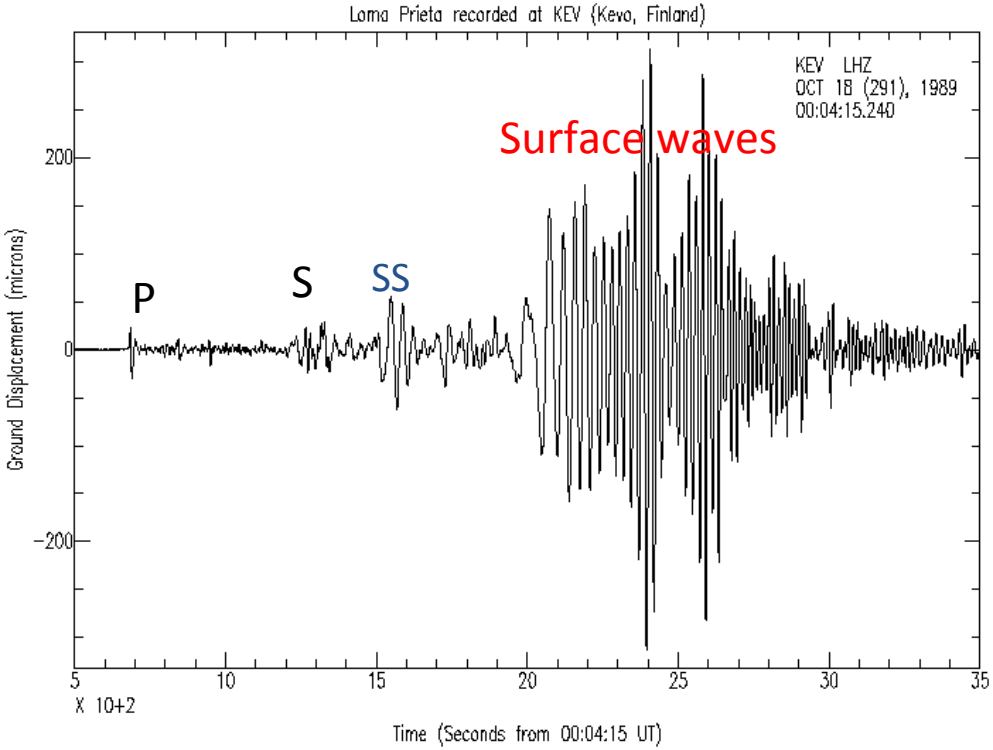
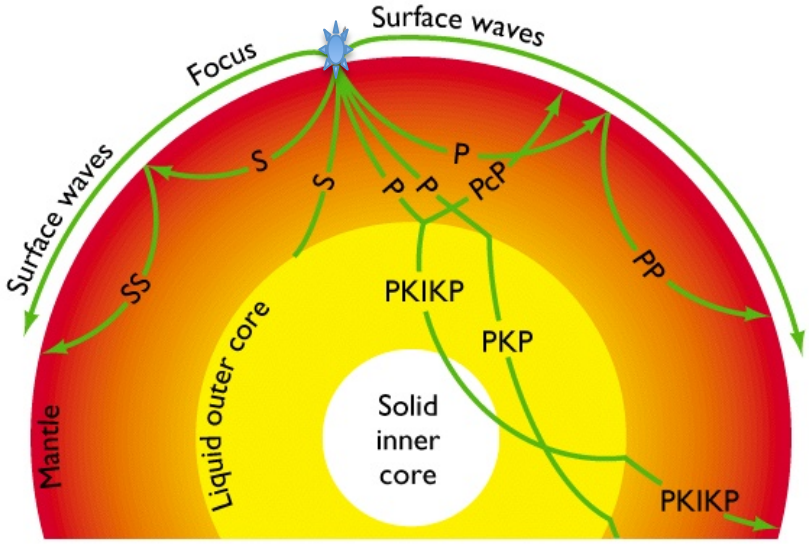
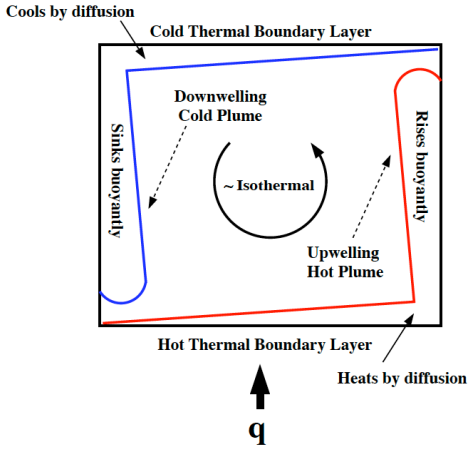
Acknowledging contributions: Scott French, Ved Lekic, Sanne Cottaar

Paris, January 12, 2015

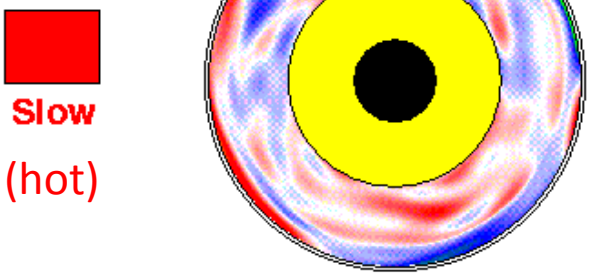
Loma Prieta (CA) 1989 M 7 earthquake observed at KEV, Finland





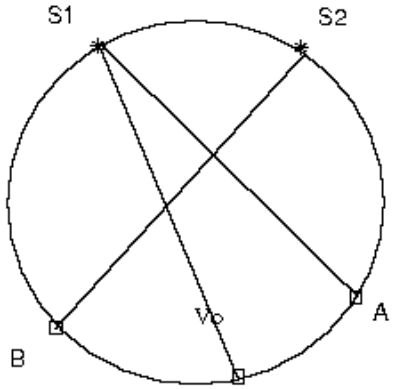


Medical Imagery

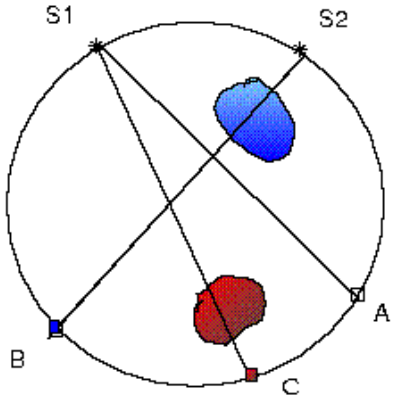


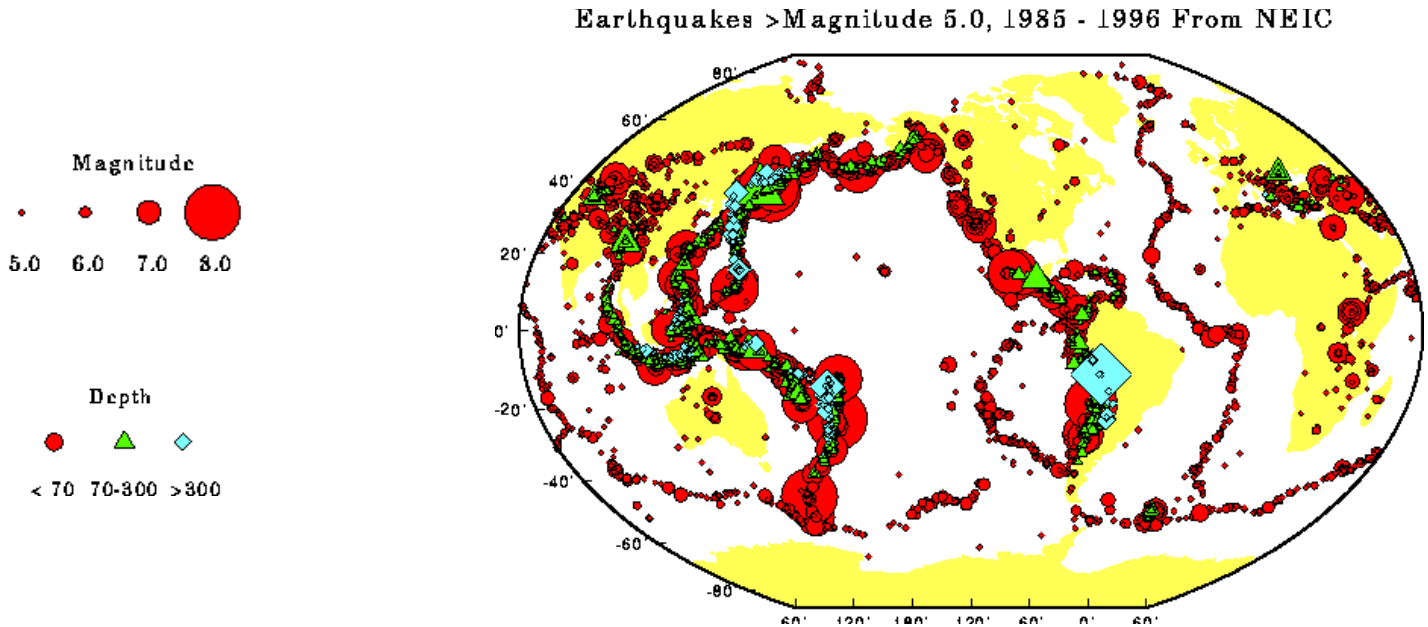
Seismic Tomography

Homogeneous Body

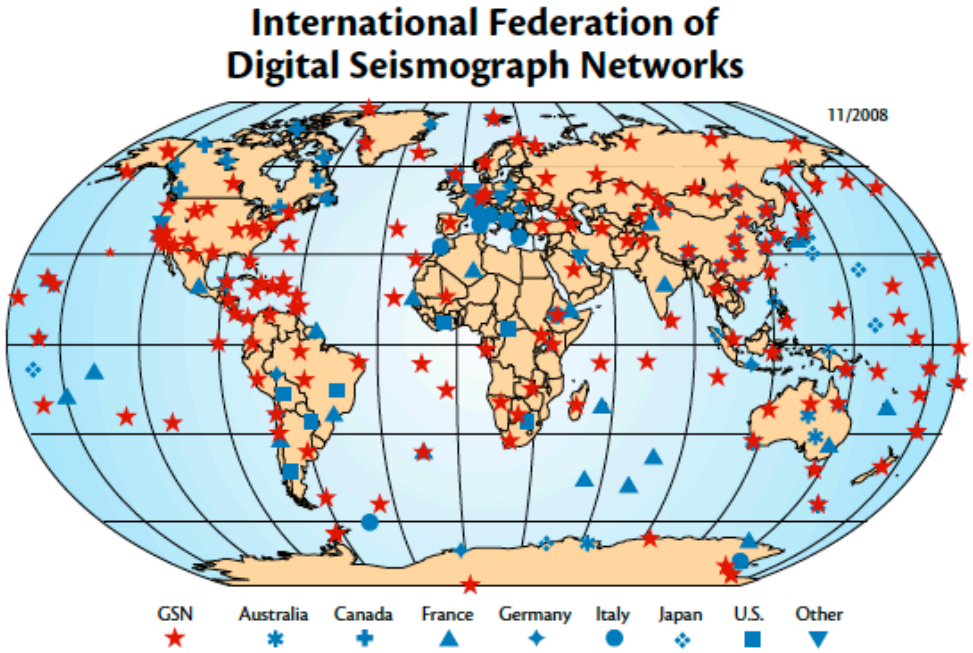


Body with in homogeneities

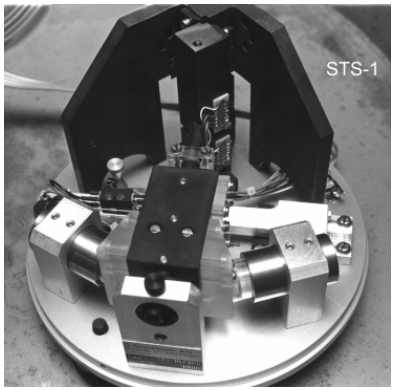




Sources of vibration

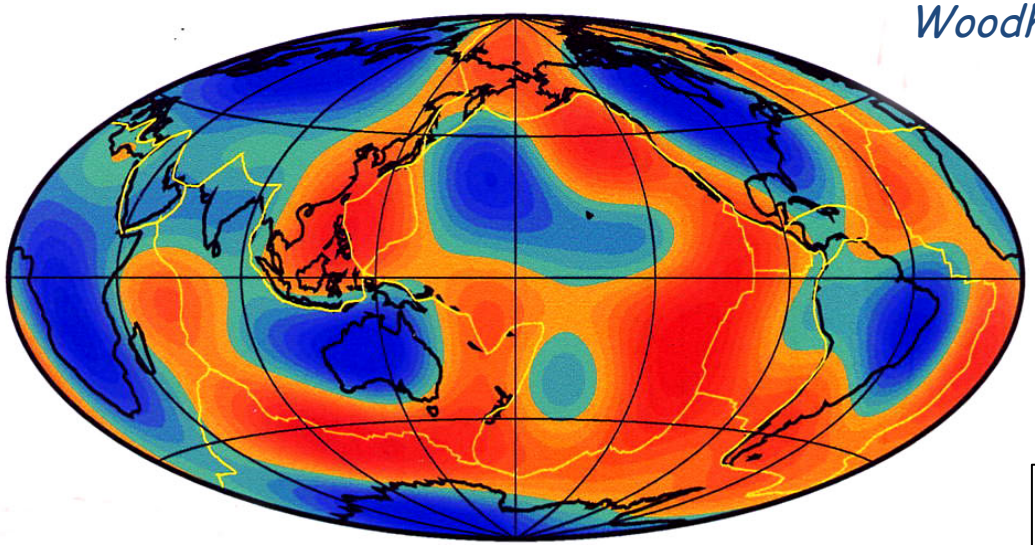


Receivers



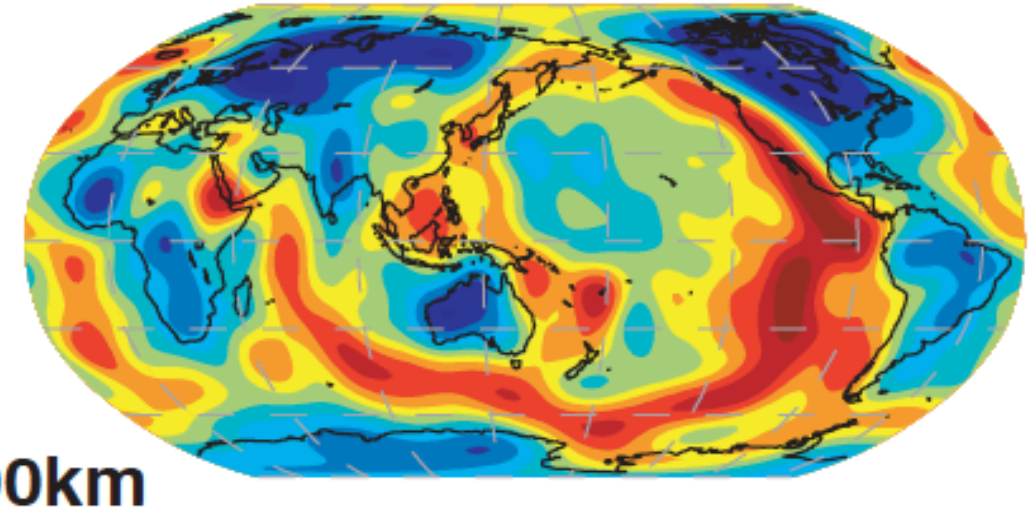
Model M84C (100 km)

Woodhouse and Dziewonski, 1984



-5% +5%

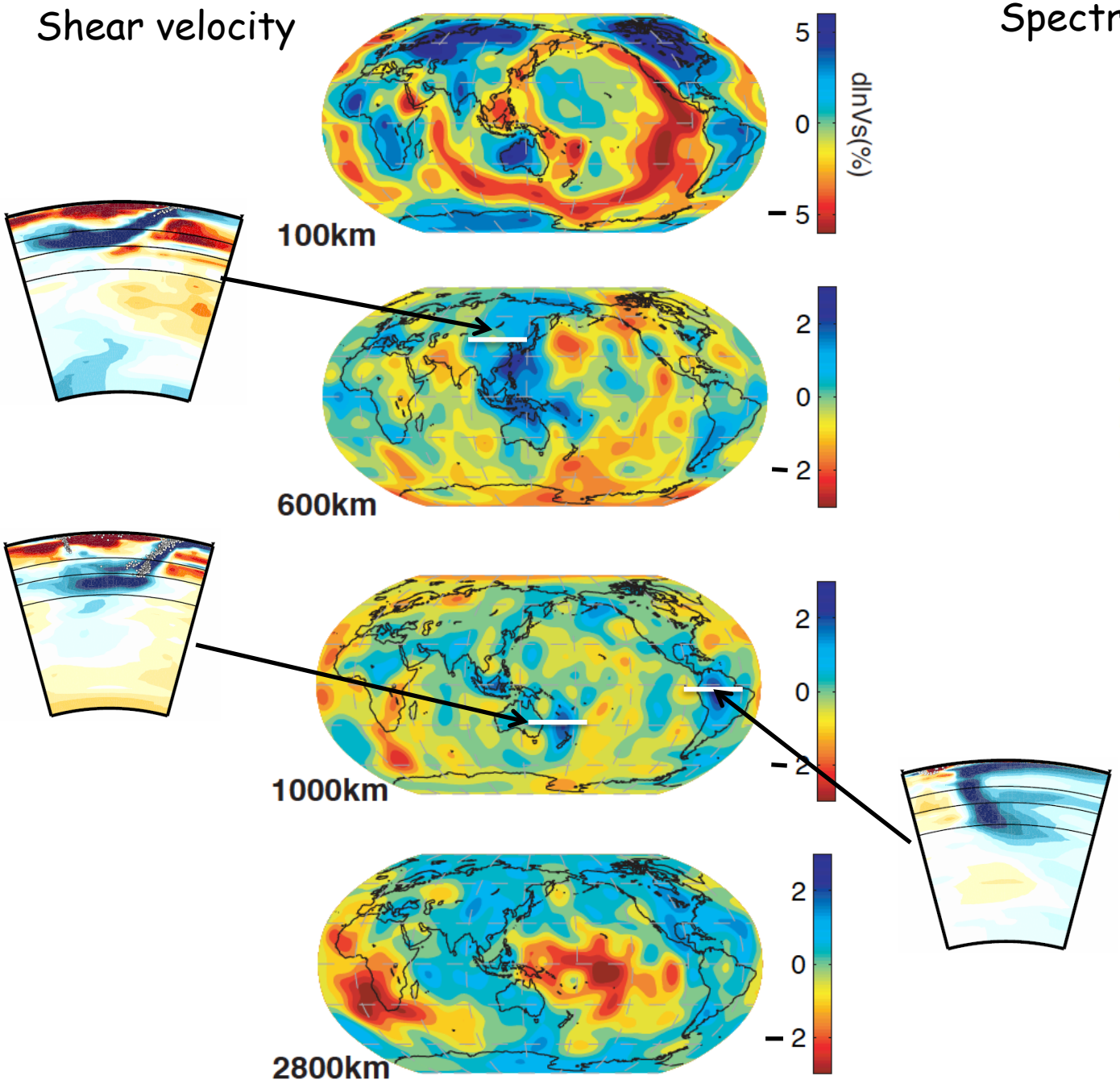
Depth = 100 km



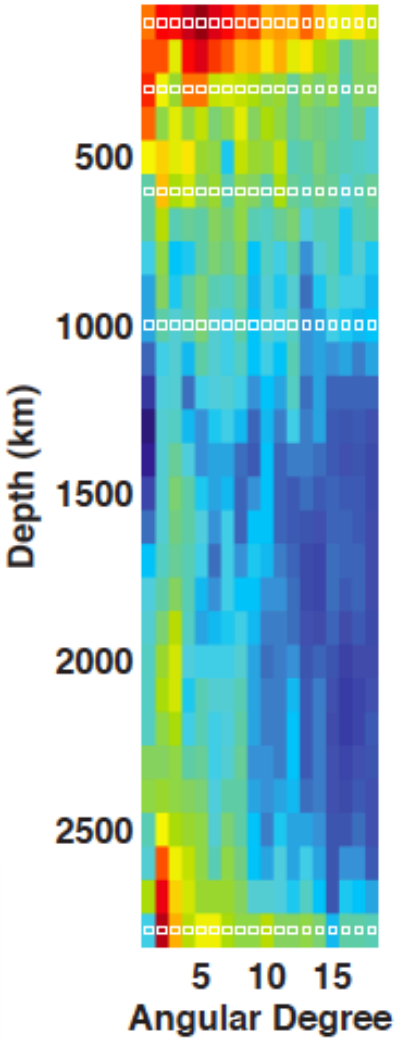
100km

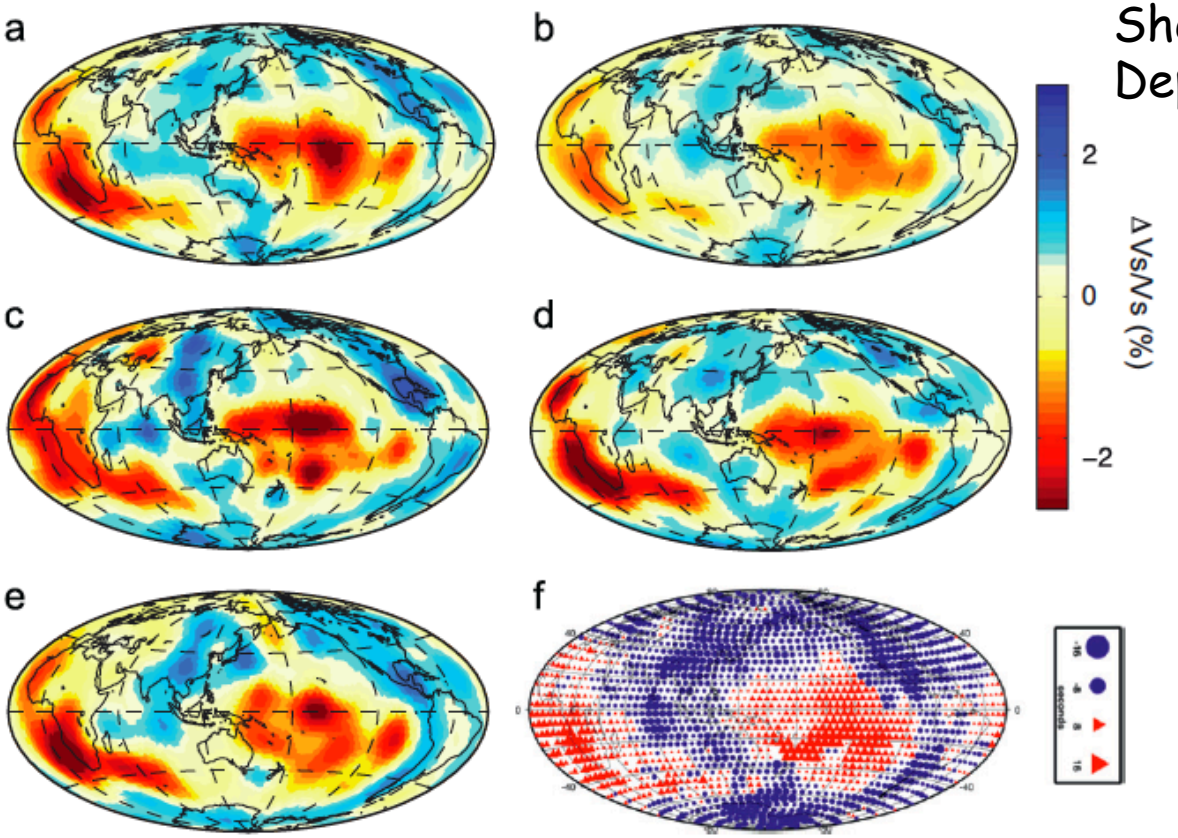
Kustowski et al., 2008

Shear velocity



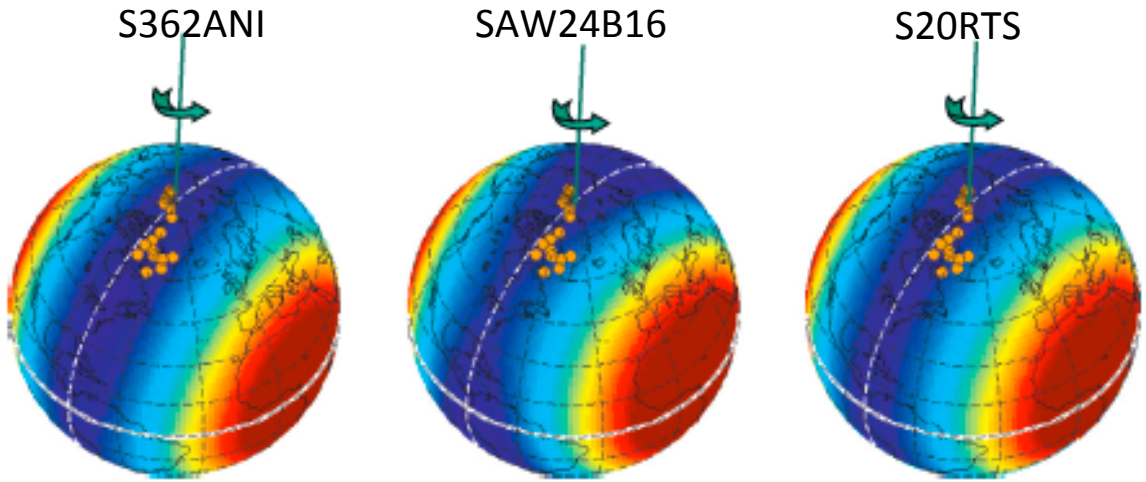
Spectrum of heterogeneity





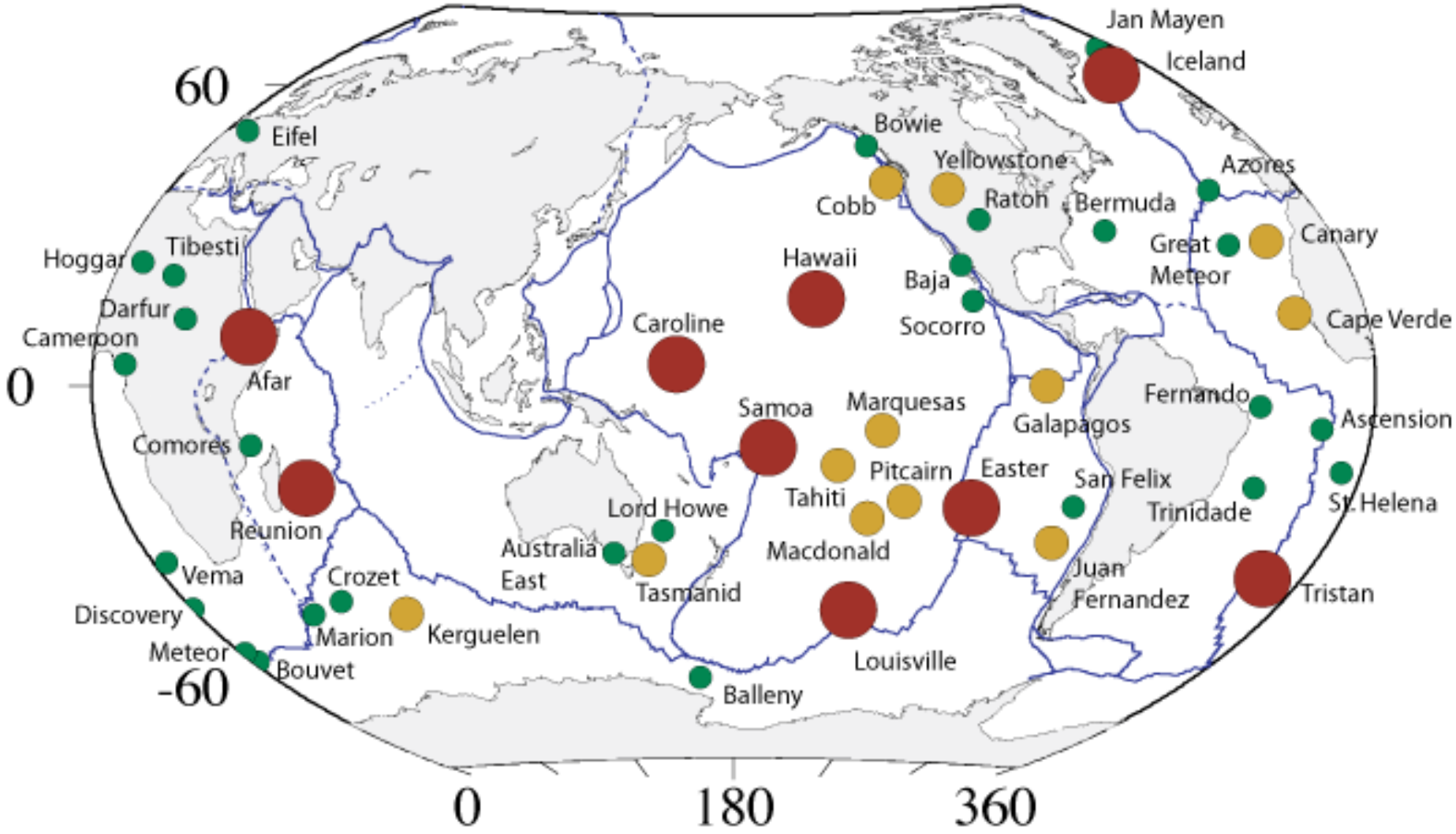
Shear velocity
Depth = 2800 km

"LLSVP", or…
"Superplumes"

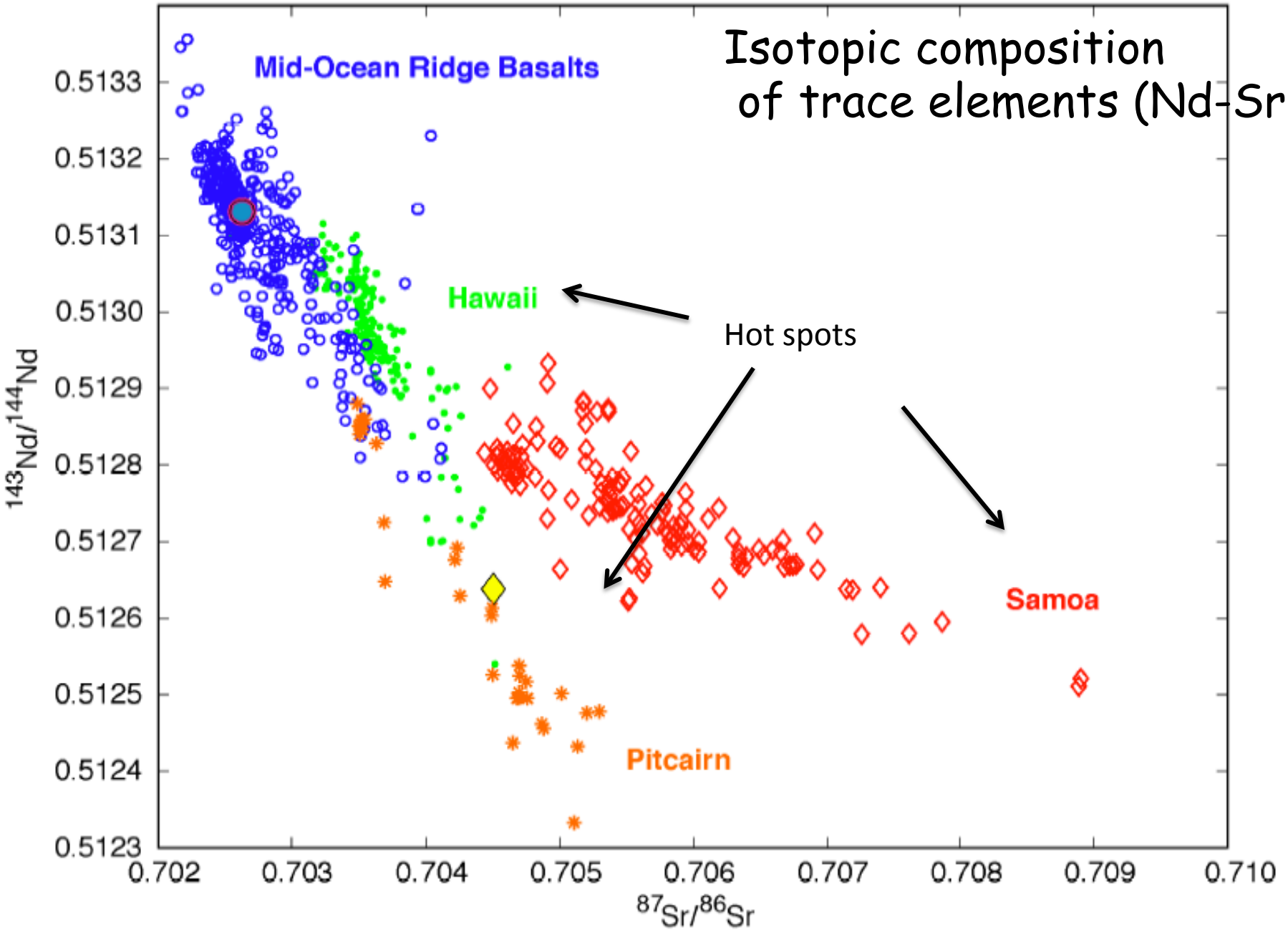


- Paleo-pole locations
  (Besse and Courtillot, 2002)

Catalogued hotspots

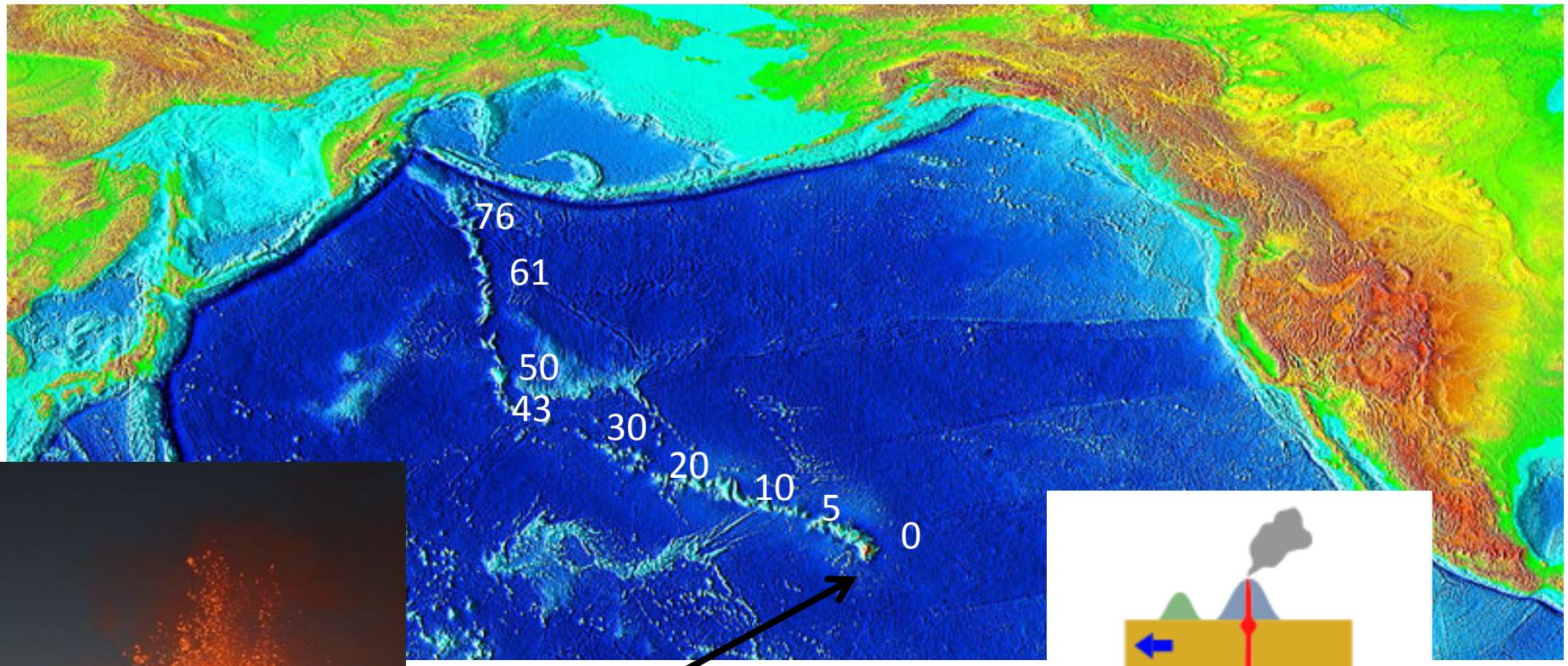


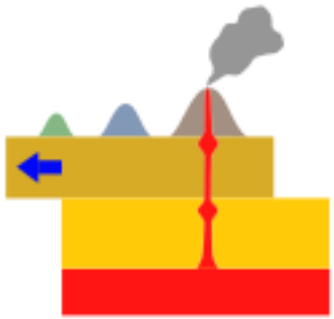
source: mantleplumes.org



Workman, 2005

Hotspots and plumes

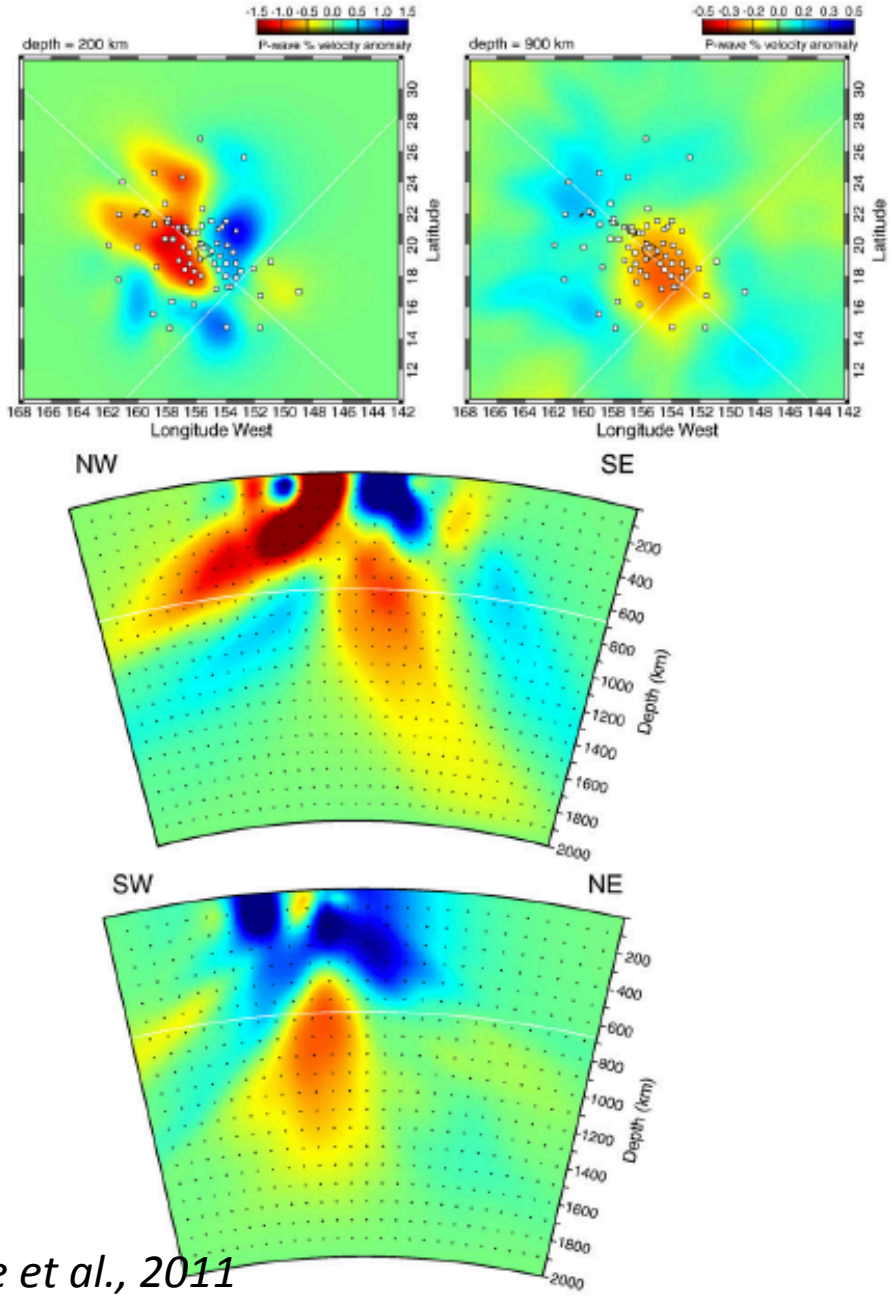


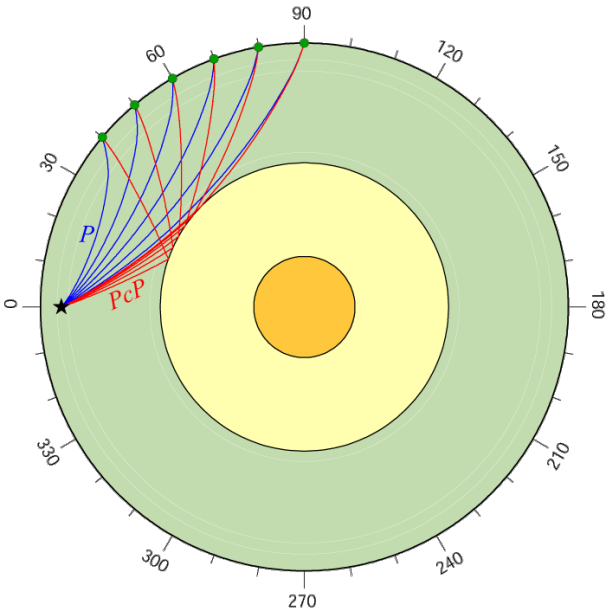


Morgan, 1971

P wave travel time tomography

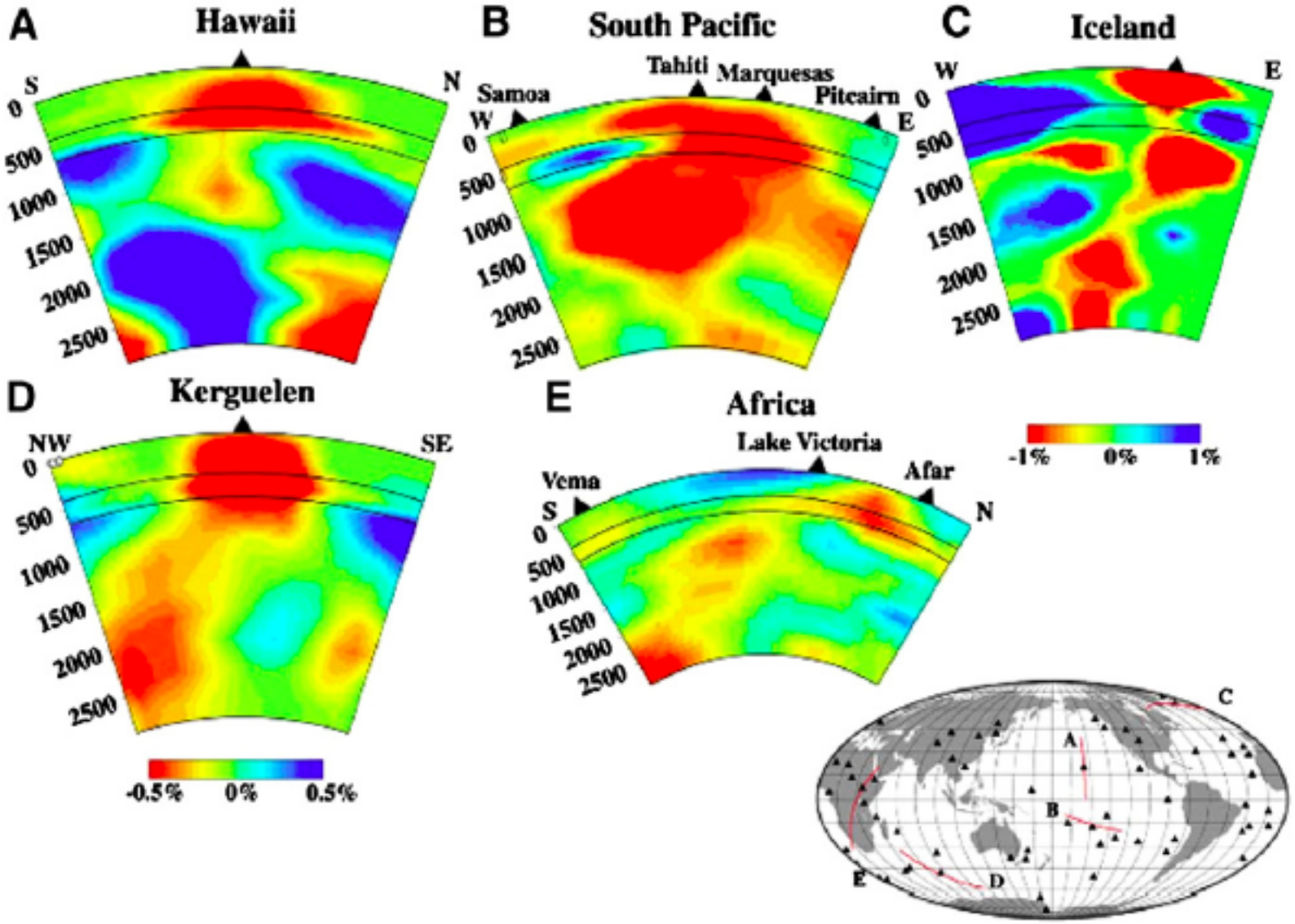
Hawaiian "plume"





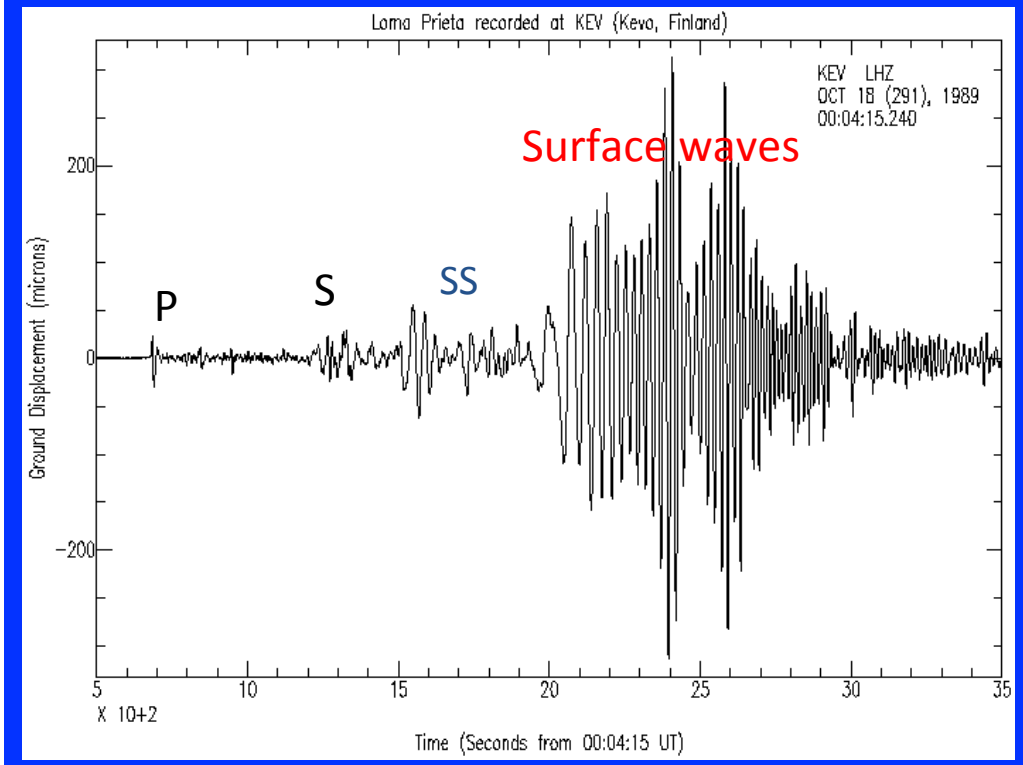
Wolfe et al., 2011

P wave travel time tomography



Nolet et al., 2005

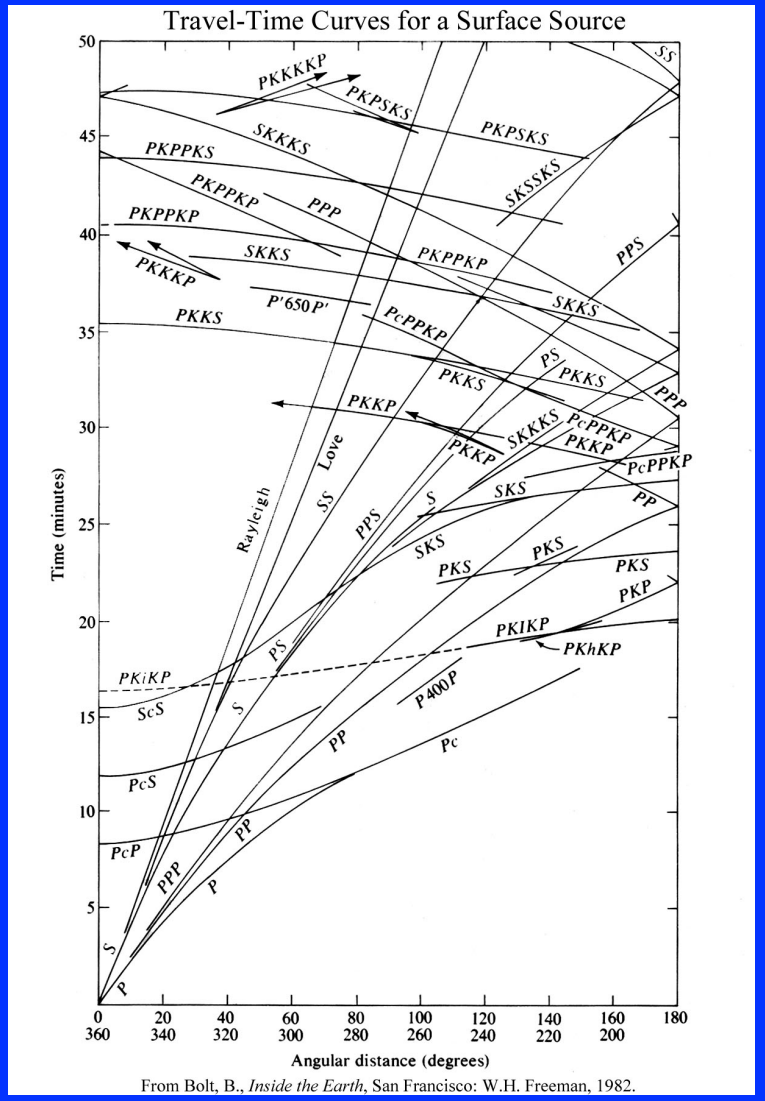
Richness of the teleseismic wavefield:



50 mn

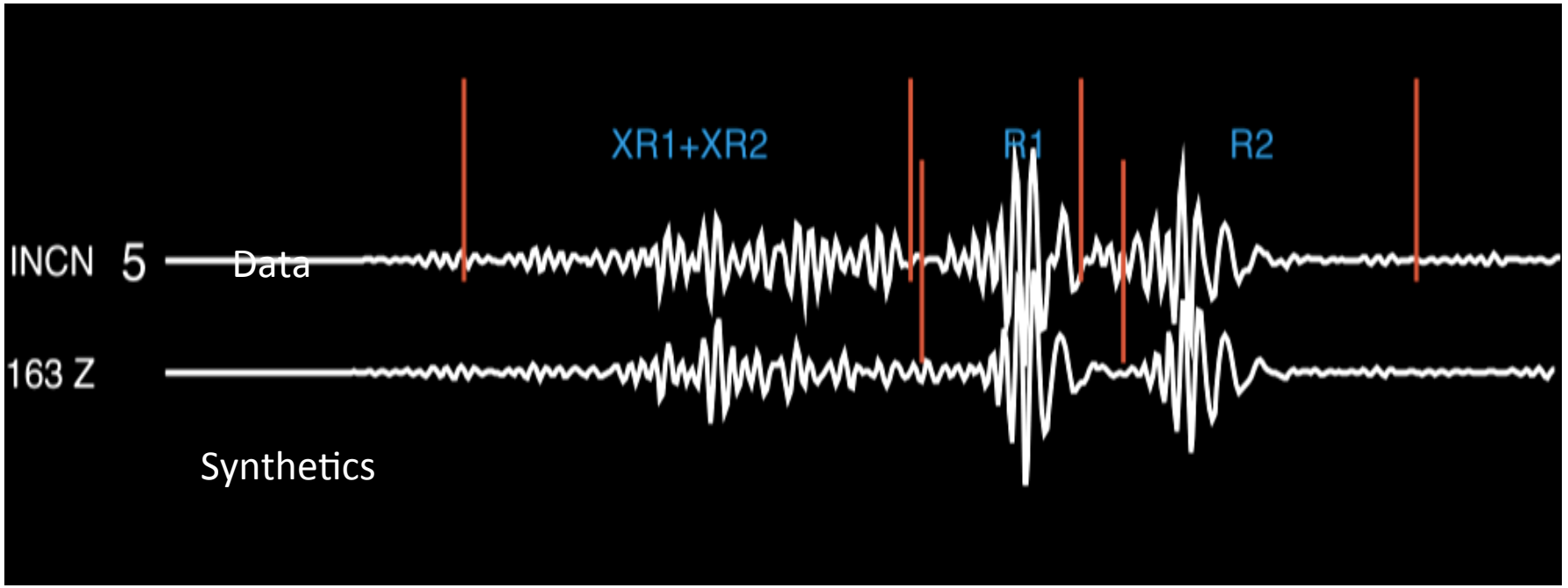
Most tomographic studies rely primarily on travel times of phases well separated on the seismogram:

P, PP, S, SS, fundamental mode surface waves.



From Bolt, B., *Inside the Earth*, San Francisco: W.H. Freeman, 1982.

Full Waveform Tomography using SEM:



Replace mode synthetics by numerical synthetics computed using the Spectral Element Method (SEM)

- Challenges: computational time increases as ω^3
- Several hundred of events, iterations
- Thin slow layers in crust

UC Berkeley
Global Seismology Group