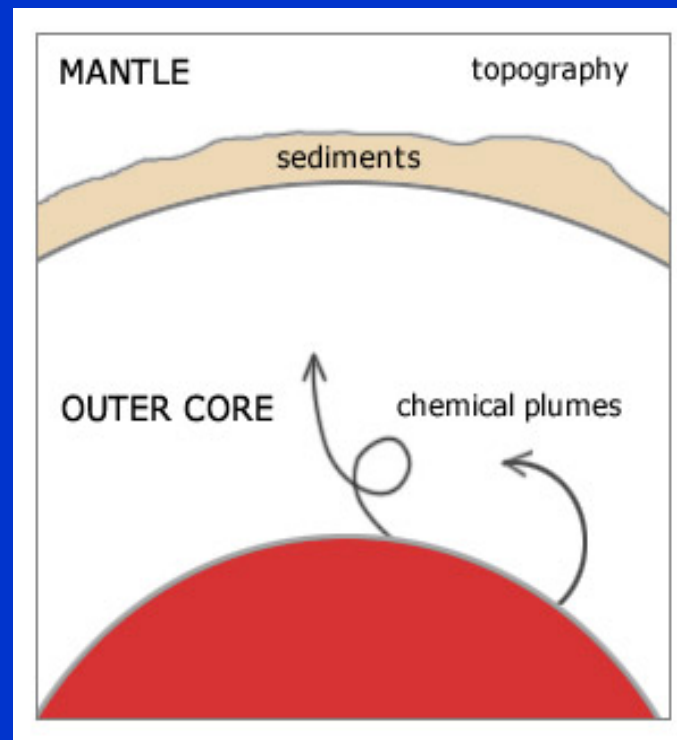


Seismic detection of rigid zones at the top of the core

Rost & Revenaugh, Science 2001

"Continents
of the core"

[Wyssession,
Nature 1996]



← CRZ

(Core Rigidity Zone)

[Buffett et al., 2000]

Previous studies indicating a CRZ:

Buffett et al, Science 2000

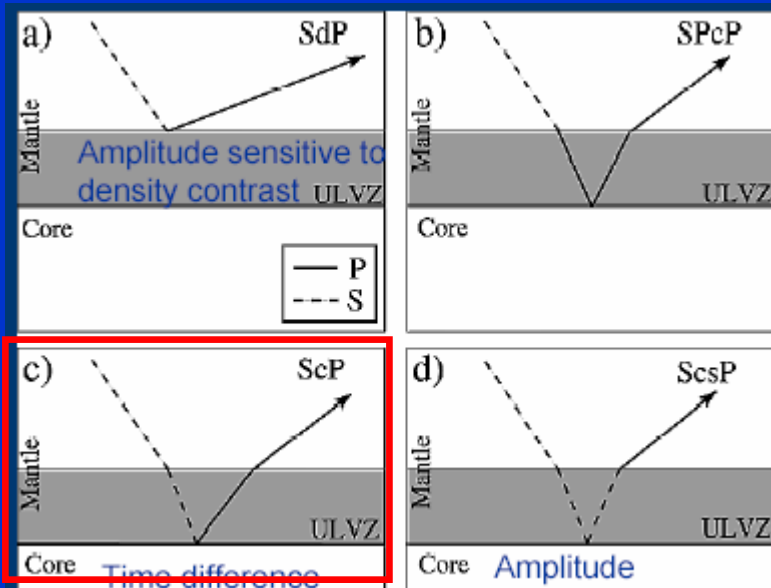
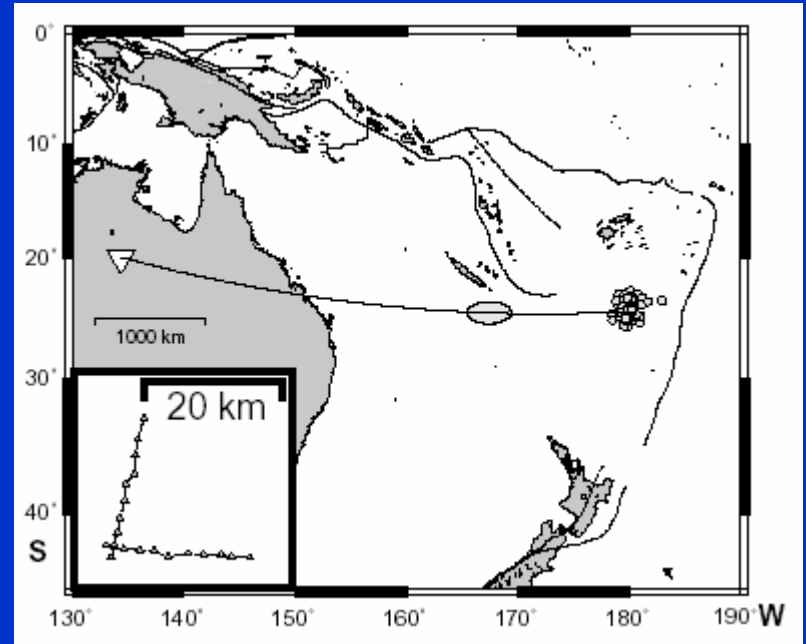
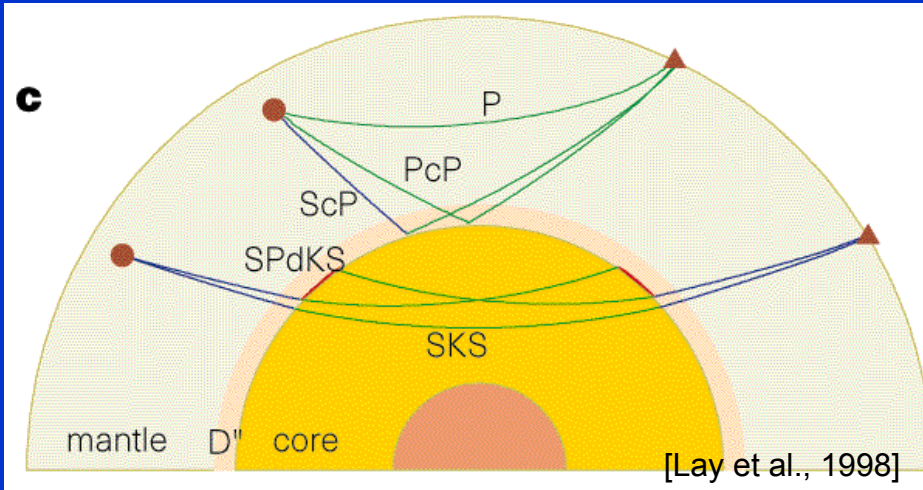
Nutation data to be fit by a conducting layer

Garnero & Jeanloz, GRL 2000

Similarity in SP_dKS waveforms by both ULVZ & CRZ

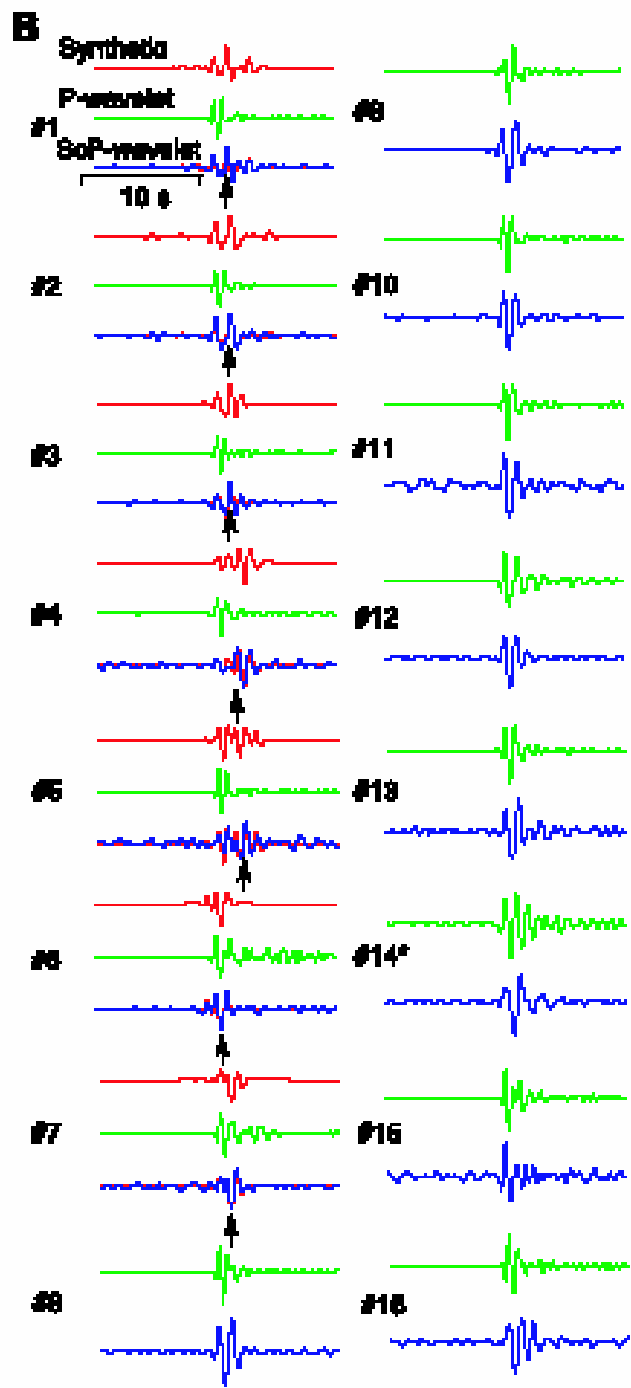
Seismic probe: *ScP*

Data



$$\Delta = 40^\circ \sim 44^\circ$$

[Courtesy of Emily van Ark, originally from Rost & Revenaugh, 2003]



Complex waveforms:

Large postcursors

(Unlikely to be produced by ULVZ)

Model space

ULVZ

CRZ

$\delta V_p = 0 \sim -15\%$

$\delta V_s = 0 \sim -30\%$

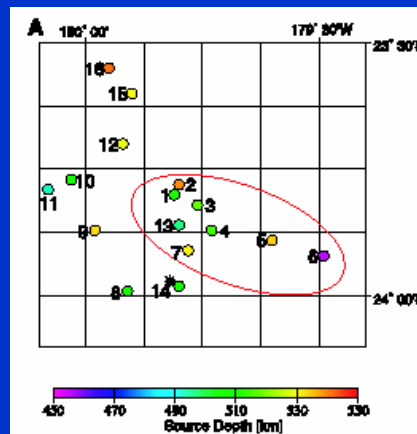
$\delta \rho = 0 \sim 50\%$

$H = \sim < 10 \text{ km}$

$V_s = \text{up to } 5.5 \text{ km/s}$

$\delta \rho = 0 \sim -40\%$

$H = \text{up to } 2 \text{ km}$



Intermezzo

Gaussian Beam Method (GBM)

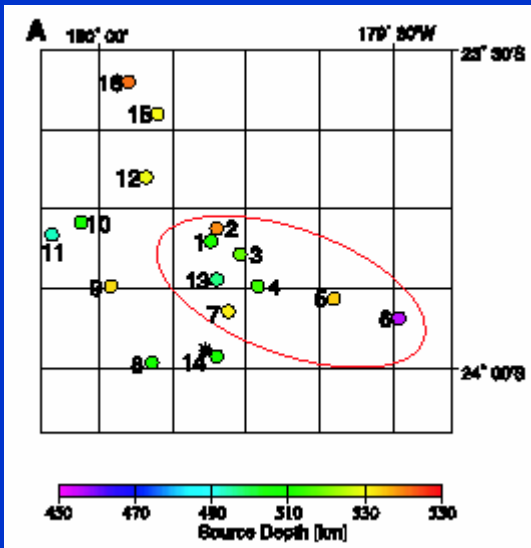
Ray concept + wave theory; high-frequency seismogram in inhomogeneous media; time-economic & avoids singularity

Reflectivity

Layered half-space model;
reflection/transmission coefficients

fk-analysis

Standard array-analysis method to detect weak phases by constraining slowness & backazimuth through a grid search in spectral domain to find a power maximum indicative of coherent wave energy [e.g., Rost, 2000]



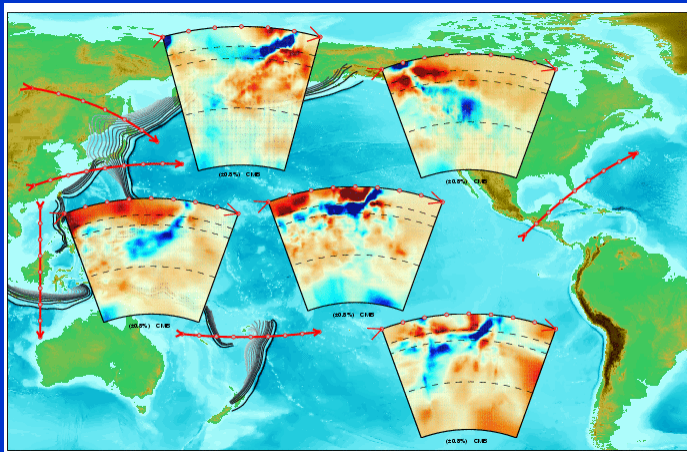
More Considerations:

1-D modeling appropriate?

3-D structure exists, but good matches between synthetic and obs. justify the simplification.

Could "Sc*spP" be just a scattered phase?

Similar waveforms and travel time difference from different events argue against the possibility.



[Karason & van der Hilst, 2000]

P phase travels further within the slab and would have been more complicated.

Possible CRZ models

Chemical reaction zone



→ Unlikely to produce a layer > ~ a few meters

Sediments at the top of the core:

Lighter Elements:

Saturated due to exchange within the mantle;
enriched in outer core by cooling & solidification of inner core

Chemical equilibrium maintained by a mushy layer of lighter
element-bearing solid phases + liquid Fe, situated within CMB
topographic heights (~350 m).