Review of “Seismostratigraphy and Thermal Structure of Earth's Core-Mantle Boundary Region ”

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Summary

- Positive and negative reflections of ScS corresponds to boundary from pv to ppv and from ppv to pv, respectively.
- There is a ppv lens beneath North America indicating that D'' is cold because of slab.
- Combining with phase boundary between perovskite (pv) and post-pv of $MgSiO_3$, temperature at CMB is estimated 3950 ± 200K.

Technique

- Inverse scattering and generalized Radon transformation (GRT) with ScS wave (Fig. 1A)

  Radon transformation: Projection from a arbitrary position (line integral)

Reflection interface (Fig. 3)

- L1: presumed top of D'' (transition from pv to ppv with depth)
- L2: transition from ppv to pv with depth
- L3: ??? (slab folding? multipul crossing?)

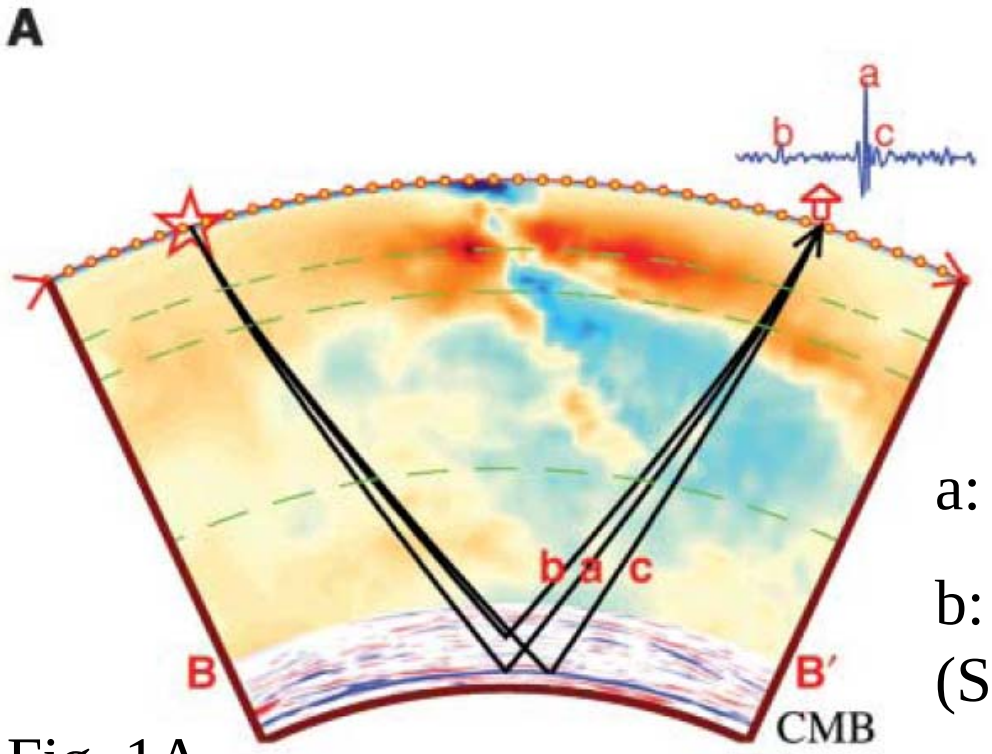


Fig. 1A

a: symmetric ScS reflection

b: S wave reflected in D'' (SdS)

c: asymmetric ScS reflection

ref. seismic wave naming

P:	P wave propagating in crust or mantle	p	P wave injected upward from the source
S:	S wave propagating in crust or mantle	$\dot{s}$	s wave injected upward from the source
K	P wave through the outer core	$\dot{c}$	Reflection at core mantle boundary
I:	P wave through the inner core	$\dot{i}$:	Reflection at inner core boundary

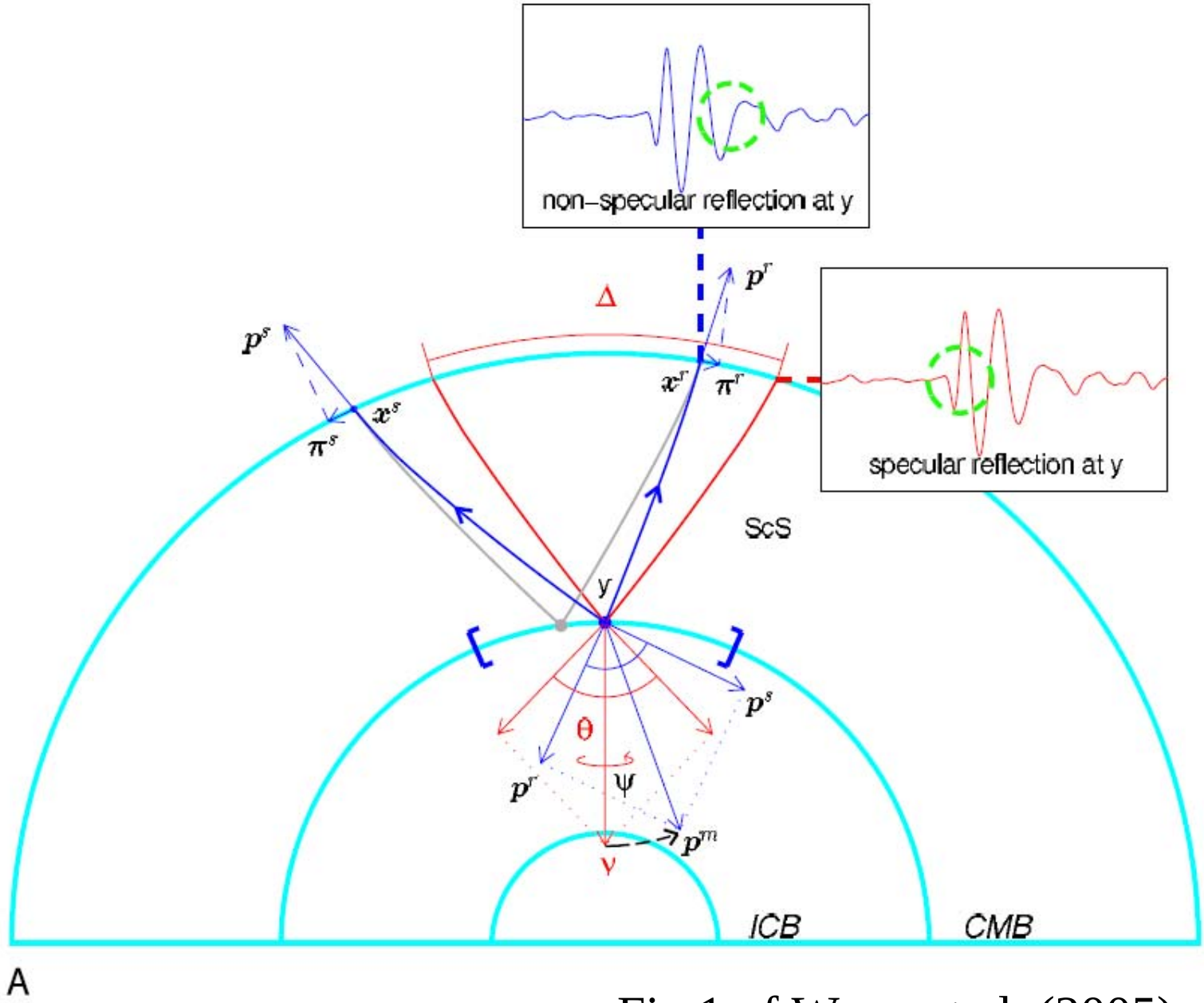


Fig.1 of Wang et al. (2005)

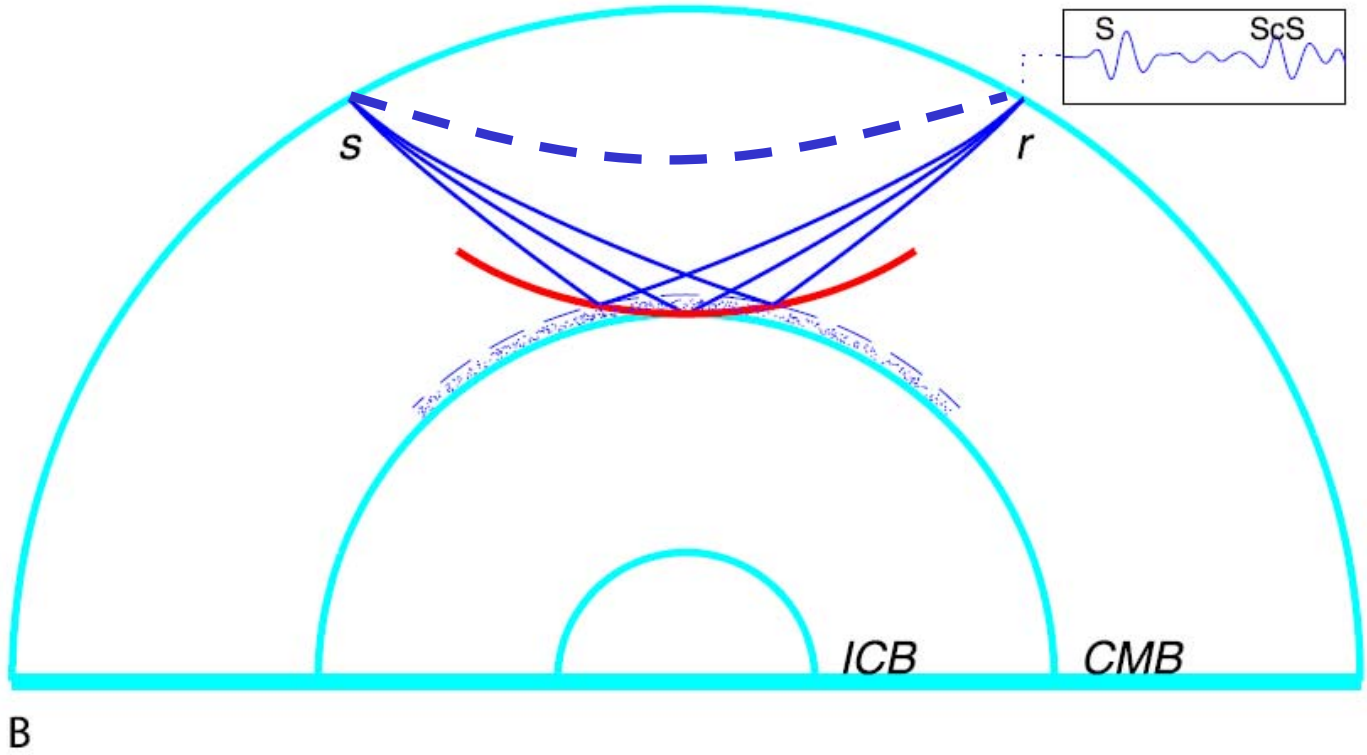


Fig.1 of Wang et al. (2005)


Google Earth

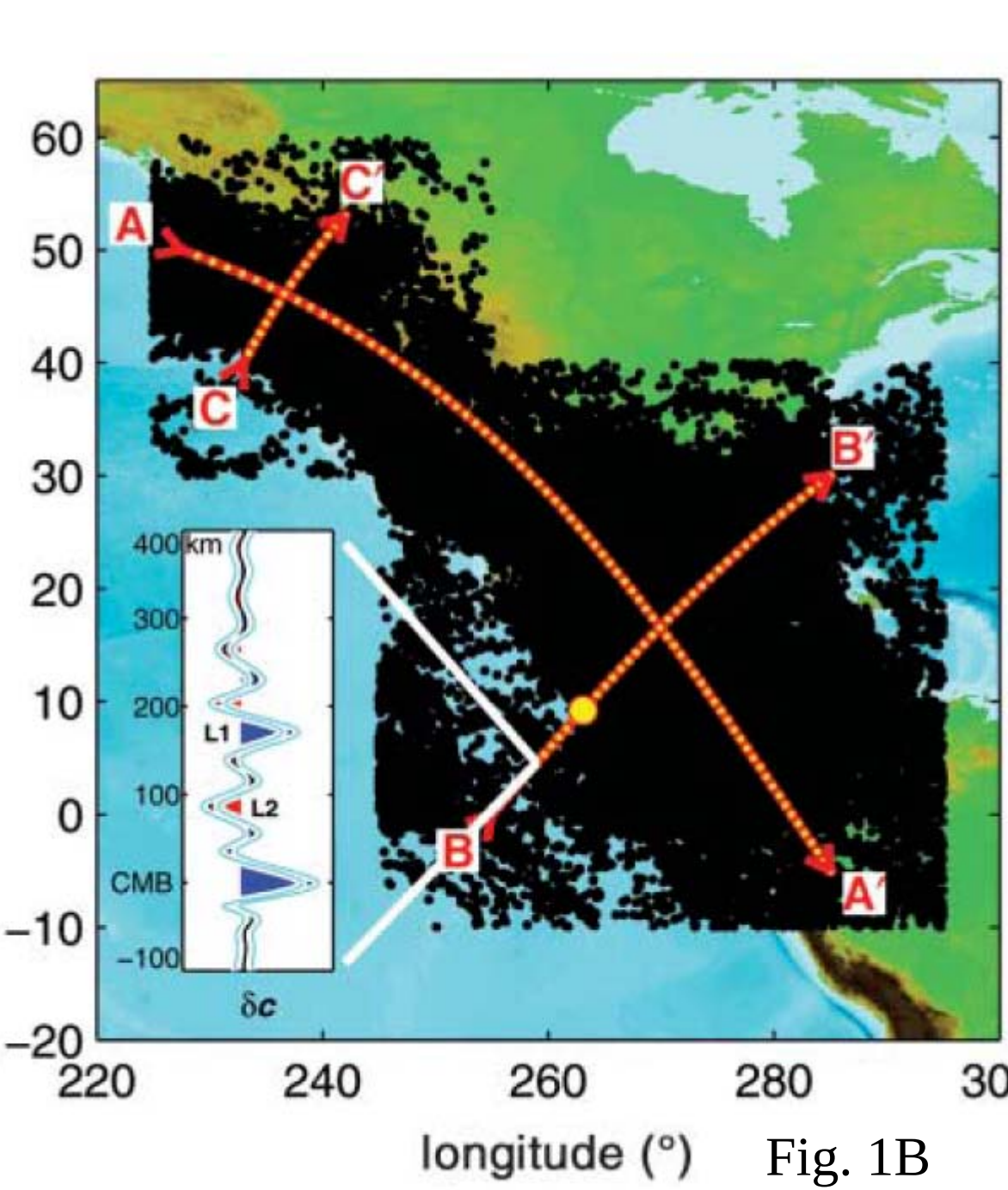

B
60
50
40
30
20
10
0
−10
−20
220
240
260
280
30
atitude (°)
longitude (°)
A
A′
B
B′
C
C′
400
km
300
200
L1
100
L2
CMB
−100
δc

Fig. 1B

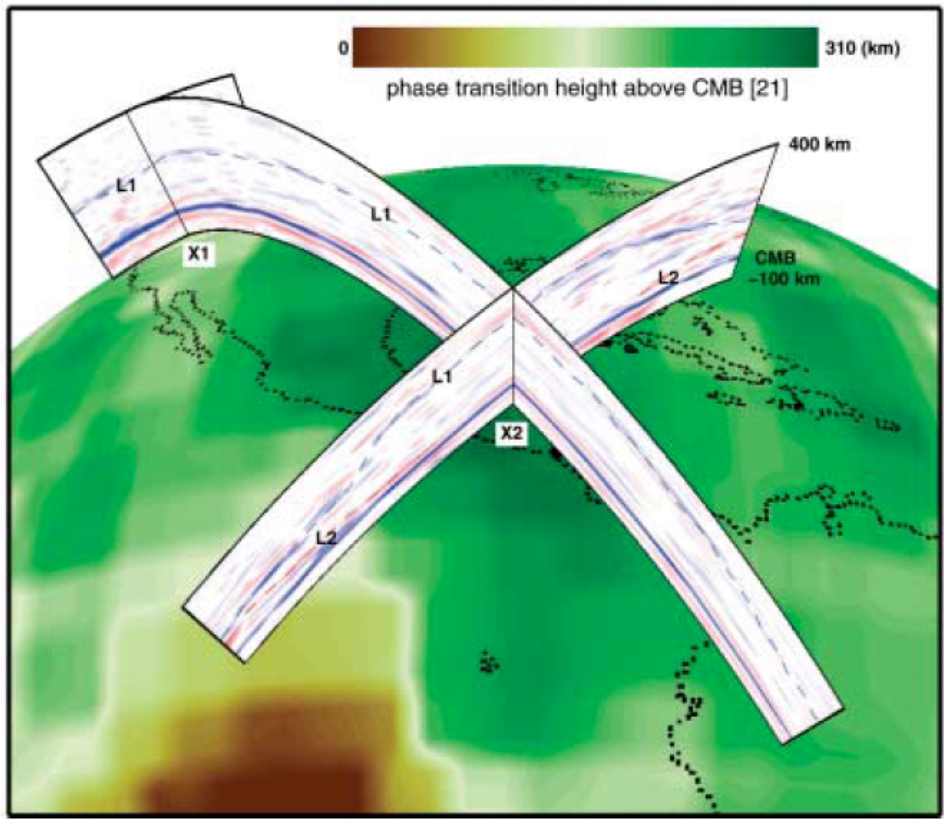


Fig. 2. Three-dimensional exploration seismology of the lowermost mantle. Seismic images of the lowermost mantle (CMB to 400 km above it) are produced by lateral juxtaposition of radial general Radon transform profiles (fig. S2) calculated at image points along the section lines shown in Fig. 1. Structure outside 75% confidence bands (*18*) includes the CMB (at 0 km) and several scatter interfaces above it. Thinly dashed lines indicate scatter interfaces (L1, L2) highlighted in Fig. 3. This 3D rendition illustrates the large spatial scales over which inverse scattering with the *ScS* wave field can be used to explore the lowermost mantle. Points X1 and X2 indicate the section intersections. The background color depicts the prediction of the height above the CMB of a presumed phase transformation with a Clapeyron slope of 6 MPa/K (*21*). In most of this region, the correlation between L1 and the predicted values is very good

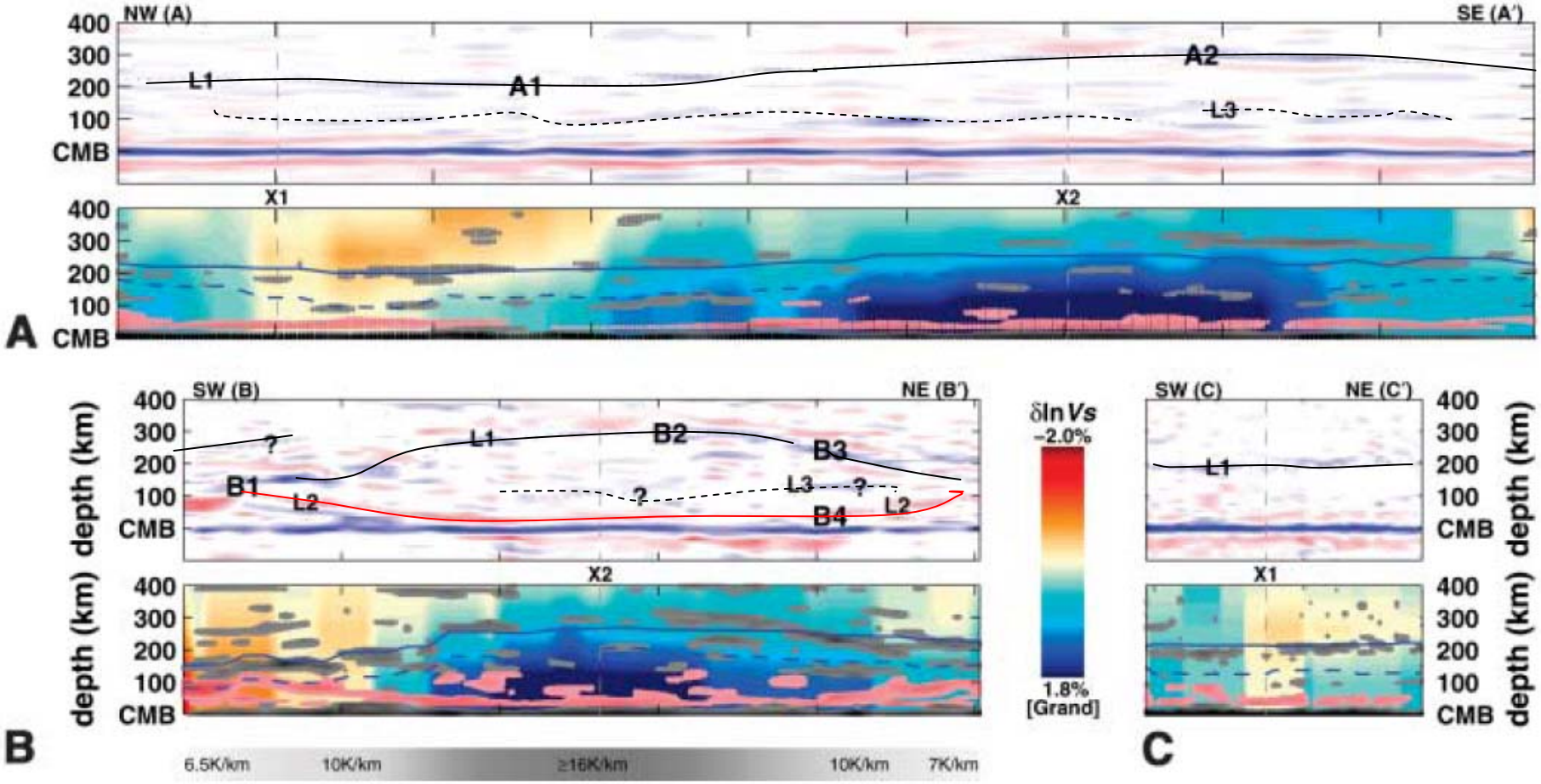

A
NW (A)
SE (A')
400
300
200
100
CMB
L1
A1
A2
L3
X1
X2
B
SW (B)
NE (B')
depth (km)
?
L1
B2
B3
B1
L2
L3
B4
δln Vs
−2.0%
1.8%
[Grand]
6.5K/km
10K/km
≥16K/km
10K/km
7K/km
C
SW (C)
NE (C')

Fig. 3

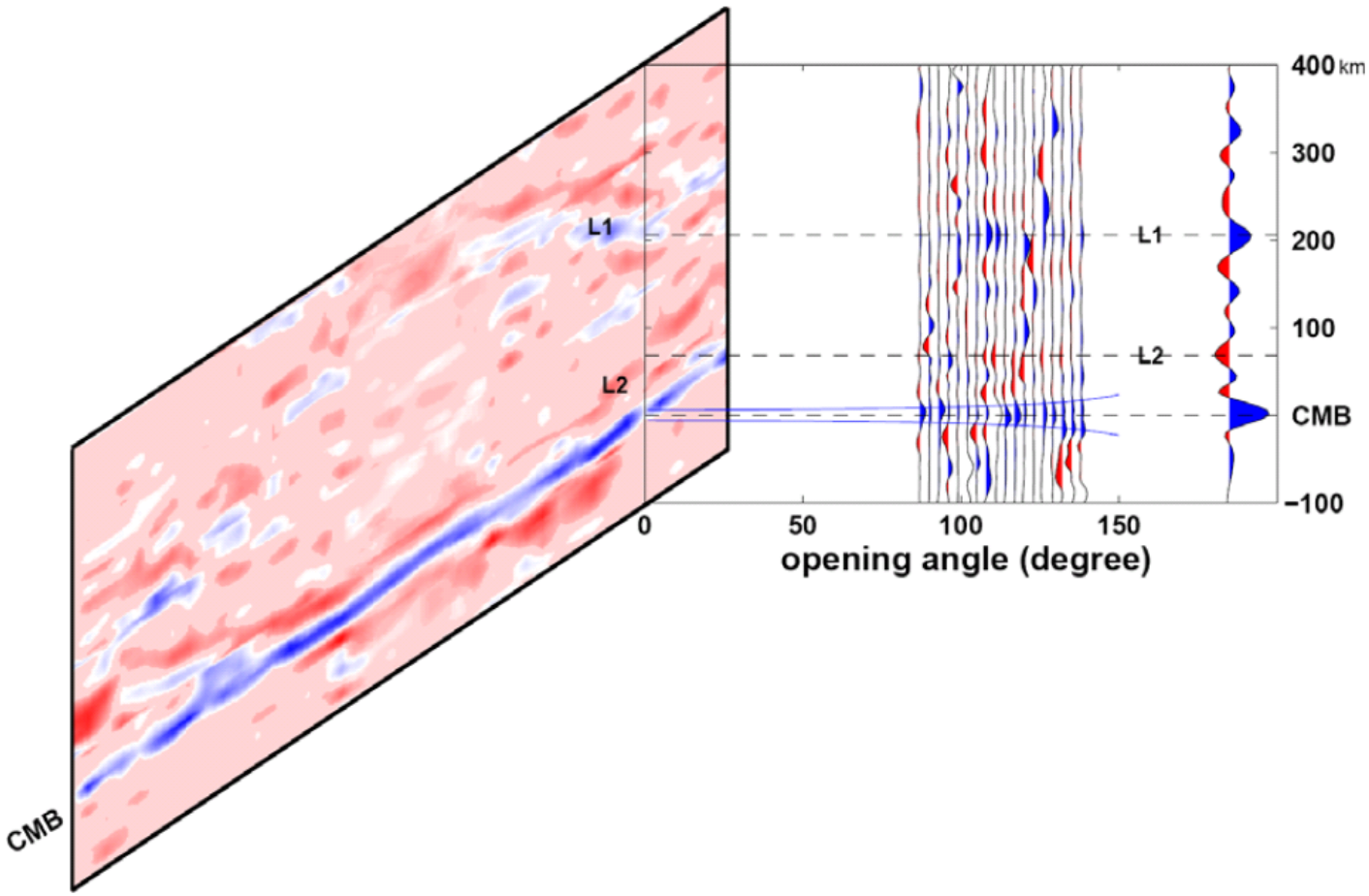

L1
L2
CMB
0
50
100
150
opening angle (degree)
L1
L2
CMB
400 km
300
200
100
−100

Fig. S2

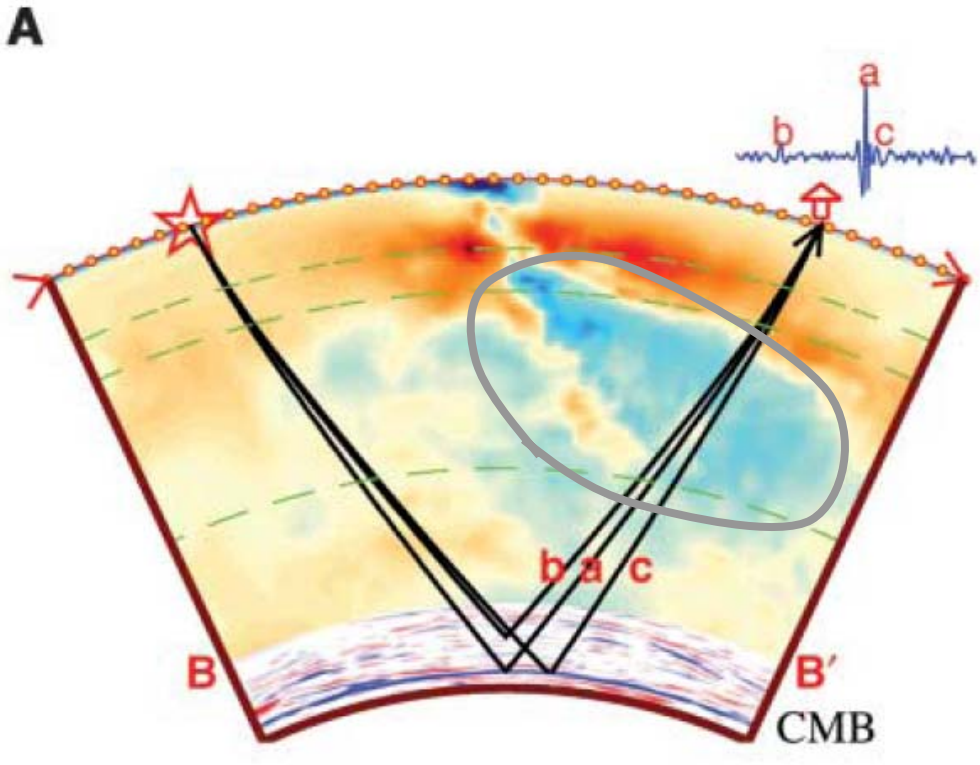
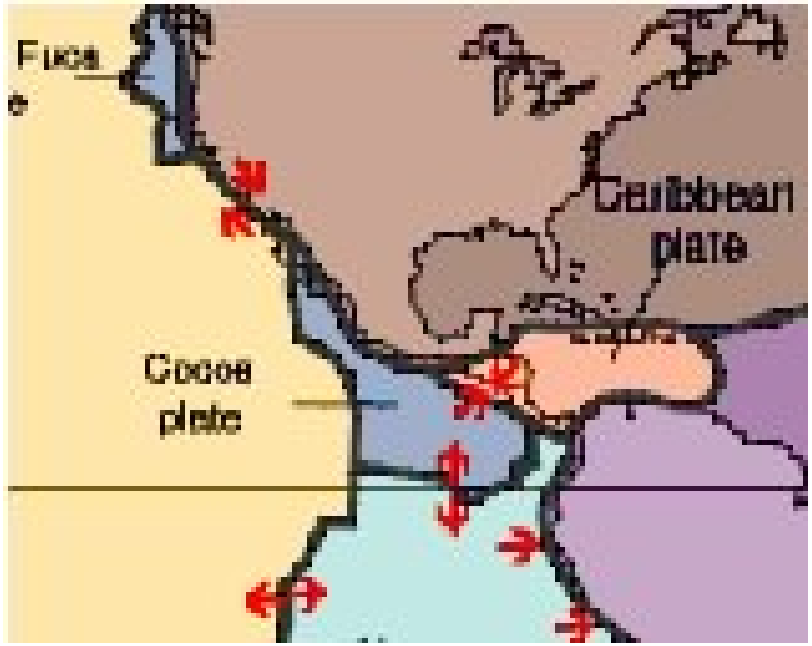


Fig. 1A



from Wikipedia

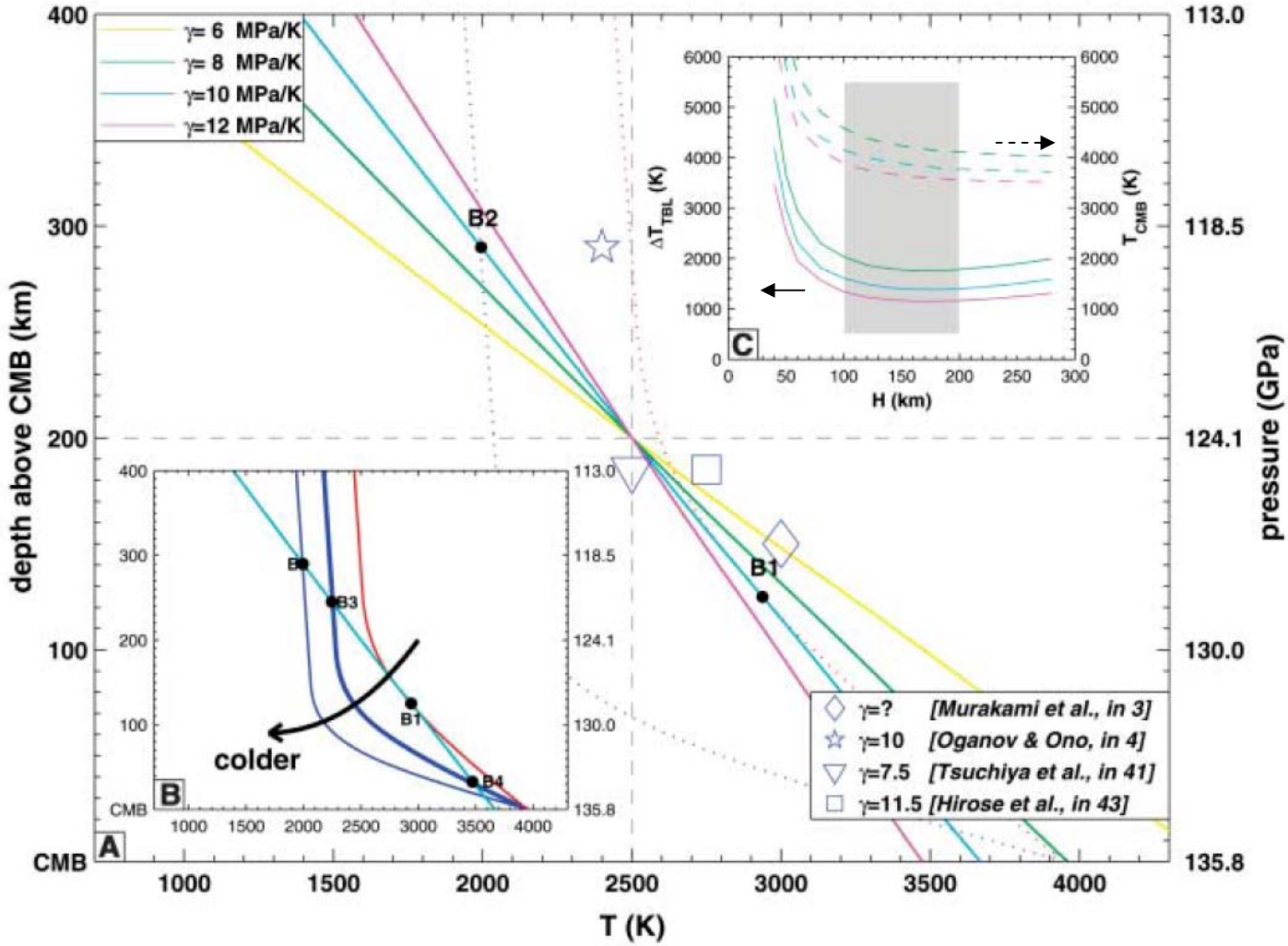

γ= 6 MPa/K
γ= 8 MPa/K
γ=10 MPa/K
γ=12 MPa/K
B2
B1
B0
B3
B4
colder
A
B
C
CMB
depth above CMB (km)
pressure (GPa)
T (K)
H (km)
ΔT_TBL (K)
T_CMB (K)
γ=? [Murakami et al., in 3]
γ=10 [Oganov & Ono, in 4]
γ=7.5 [Tsuchiya et al., in 41]
γ=11.5 [Hirose et al., in 43]

Fig. 4

Further issue

- More resolved image
- Other region

(to estimate the core heat flux)

Thermal conductivity