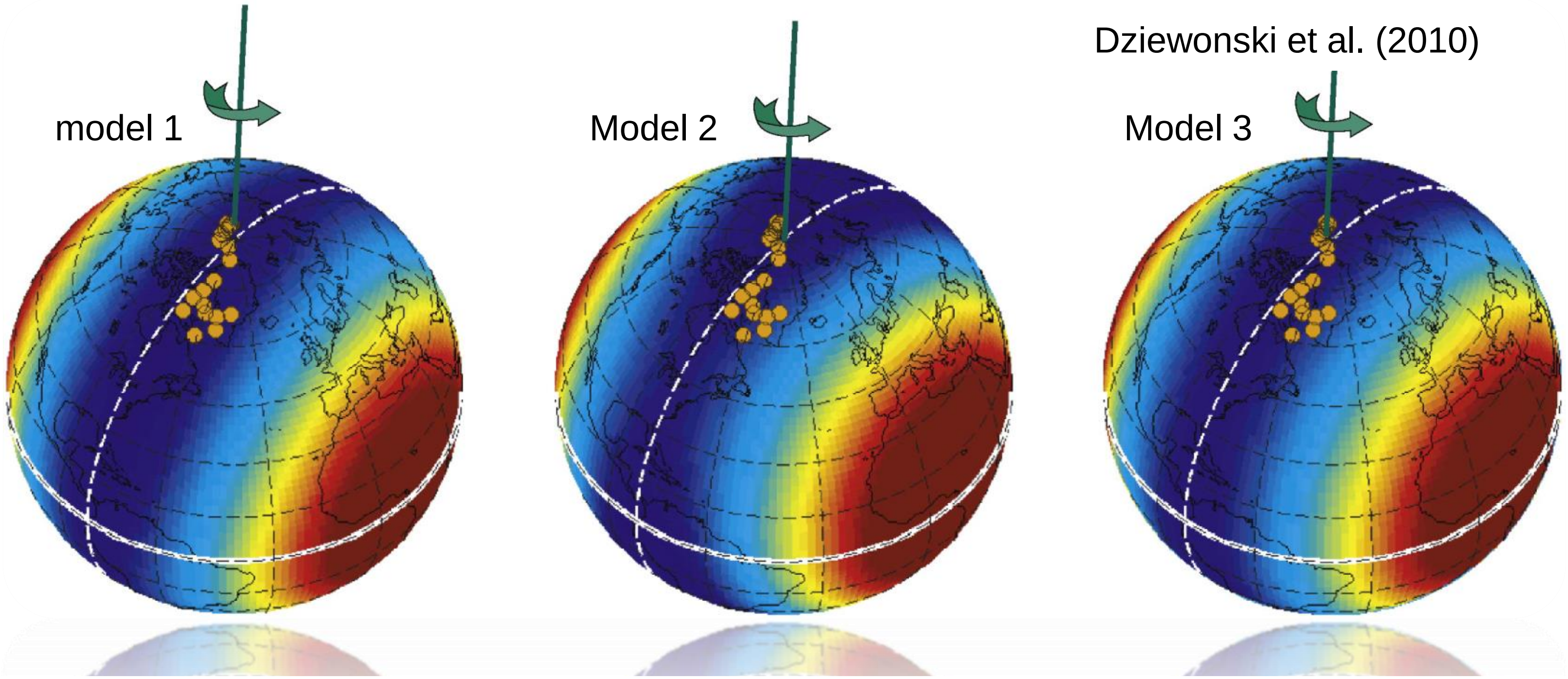

Seismic Structure of the Lowermost Mantle (LLSVPs)

A Simple consideration from mineral physics aspect

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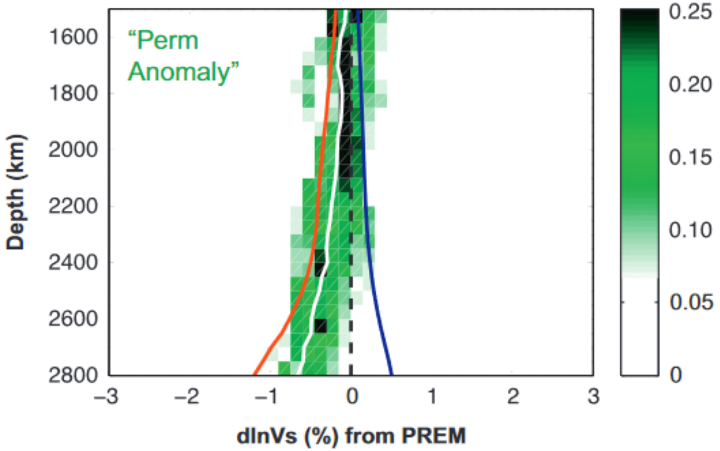
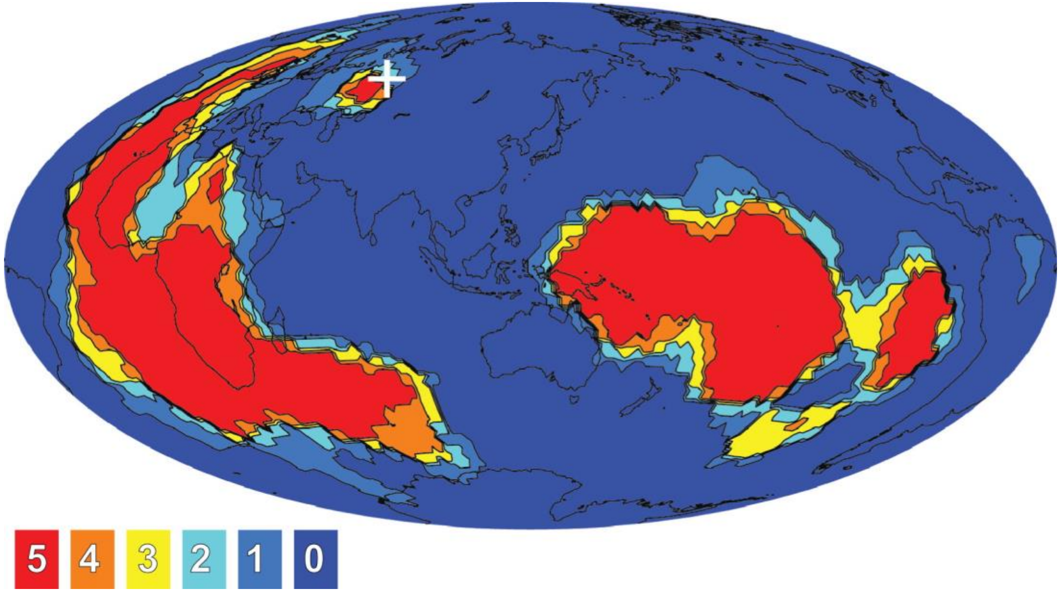
Large Low Shear Velocity Provinces (LLSVPs)

$v_s^2 = G/\rho$ $v_s \downarrow$



Lekic et al., 2012



Vote map, LLSVPs consistency between shear-wave tomography models (Lekic et al., 2012)

seismic wave velocity <=> mineral physical prosperities

$v_s^2 = G/\rho$ $v_s \downarrow$

H1: G ↓ only

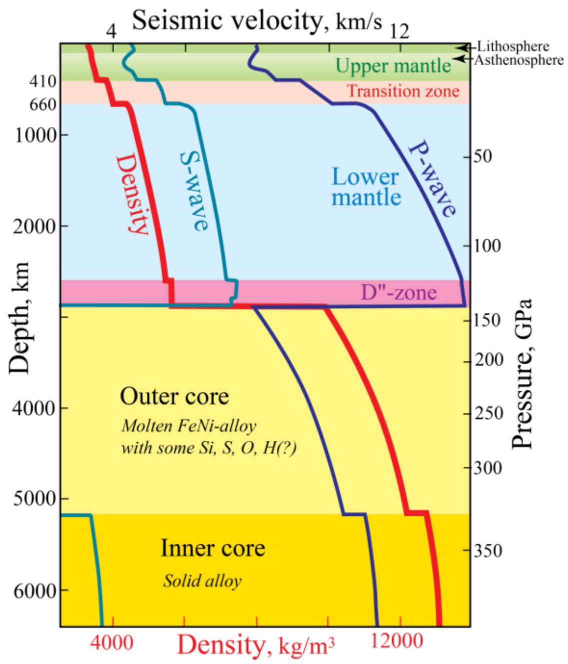
H2: ρ ↑ only

H3: G ↓ + ρ ↑

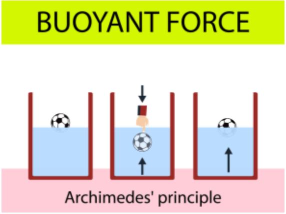
H4: G ↓ + ρ ↓, but G ↓ dominate

H5: G ↑ + ρ ↑, but ρ ↑ dominate

seismic wave velocity <=> mineral physical prosperities

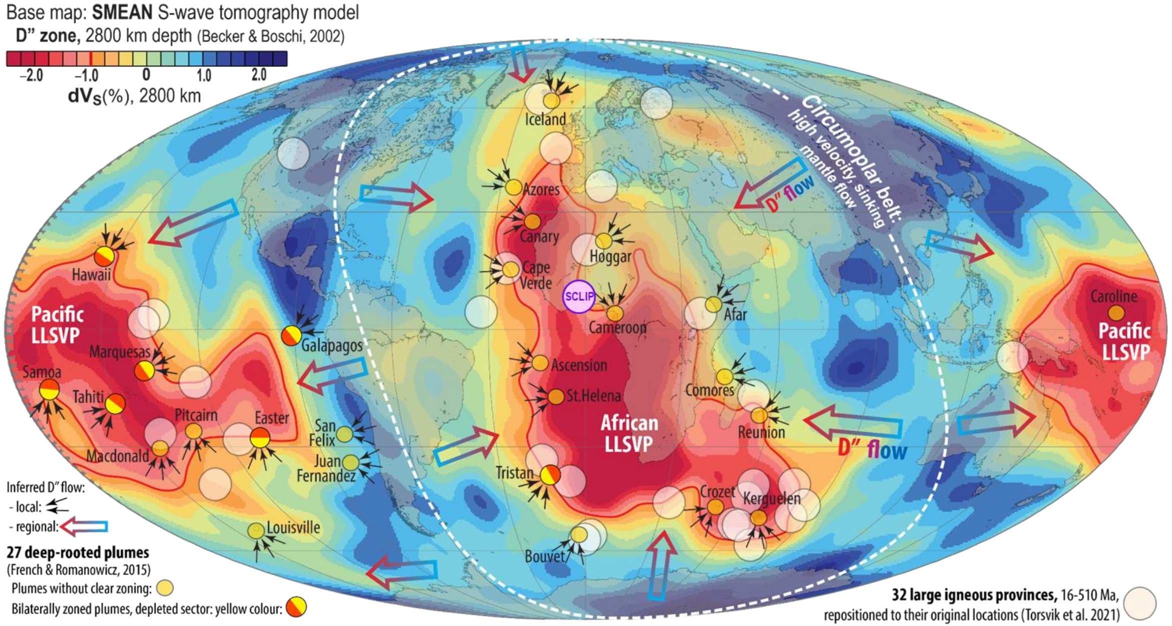


credit: R.G. Trønnes



Clustering of reconstructed LIPs along the LLSVP-margins

1. LLSVPs have long-term stability (> 300-500 Ma)
2. The LLSVPs are likely to have **(hot) base layers** with a **density excess** sufficient to counteract destruction by thermal buoyancy



seismic wave velocity <=> mineral physical prosperities

$v_s^2 = G/\rho$ $v_s \downarrow$

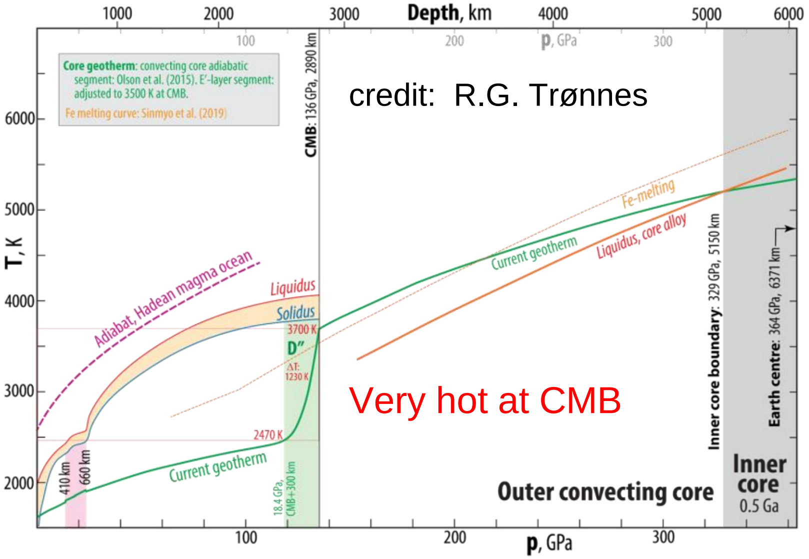
~~H1: G ↓ only~~

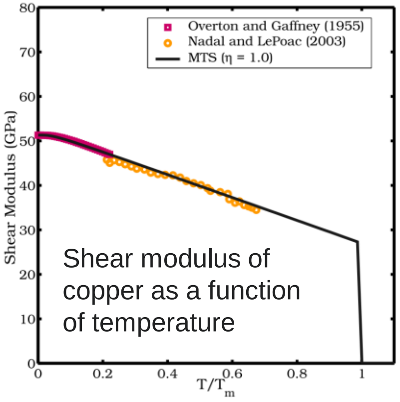
H2: ρ ↑ only

H3: G ↓ + ρ ↑

~~H4: G ↓ + ρ ↓, but G ↓ dominate~~

~~H5: G ↑ + ρ ↑, but ρ ↑ dominate~~





Shear modulus usually decrease with temperature!

seismic wave velocity <=> mineral physical prosperities

$v_s^2 = G/\rho$ $v_s \downarrow$

$v_p^2 = (K + 4/3G)/\rho$

~~H1: G ↓ only~~

H2: ρ ↑ only

H3: G ↓ + ρ ↑

~~H4: G ↓ + ρ ↓, but G ↓ dominate~~

~~H5: G ↑ + ρ ↑, but ρ ↑ dominate~~

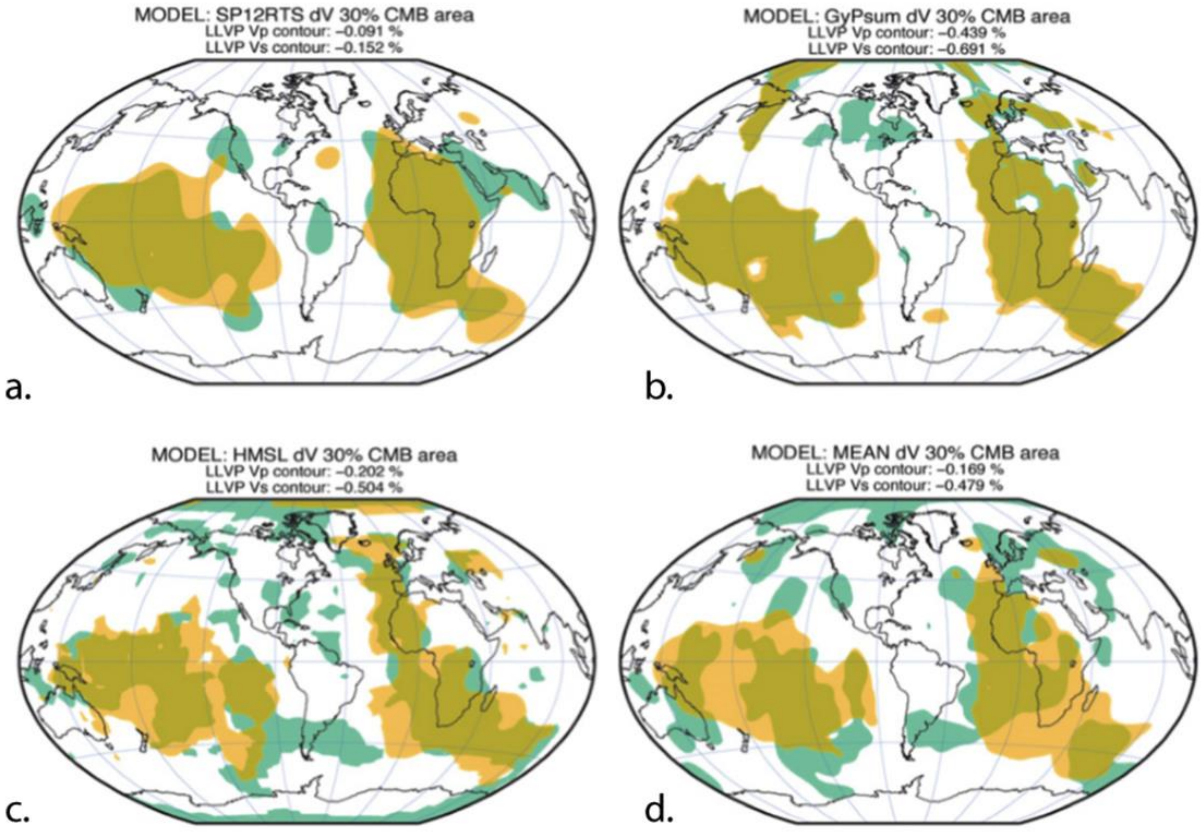
If Hypothesis 2 is true, we should see the same degree of low v_p as v_s

if we assume that v_s decrease by x because ρ increase by y (x and y are positive value):

$[(1-x)v_s]^2 = G/[\rho(1+y)]$ => $(1-x)^2 v_s^2 = 1/(1+y) G/\rho$ => $(1-x)^2 = 1/(1+y)$

If ρ increase by y, according to $v_p^2 = (K + 4/3G)/\rho$, v_p should decrease by x, same magnitude decrease as v_s

seismic wave velocity <=> mineral physical prosperities



Garnero et al., 2016

comparison of low velocity regions in P-wave (green) and S-wave (orange) joint tomography models

model a: v_p -0.091%, v_s -0.152%

model b: v_p -0.439%, v_s -0.691%

model c: v_p -0.202%, v_s -0.504%

model d: v_p -0.169%, v_s -0.479%

more decrease in v_s than v_p was observed!

seismic wave velocity <=> mineral physical prosperities

$v_s^2 = G/\rho$ $v_s \downarrow$

$v_p^2 = (K + 4/3G)/\rho$

~~H1: G ↓ only~~

~~H2: ρ ↑ only~~

H3: G ↓ + ρ ↑

~~H4: G ↓ + ρ ↓, but G ↓ dominate~~

~~H5: G ↑ + ρ ↑, but ρ ↑ dominate~~

A proper model to describe LLSVPs should include a decrease in shear modulus and an increase in density

Bulk sound velocity should be considers as an important constrain: $v_\phi^2 = K/\rho$