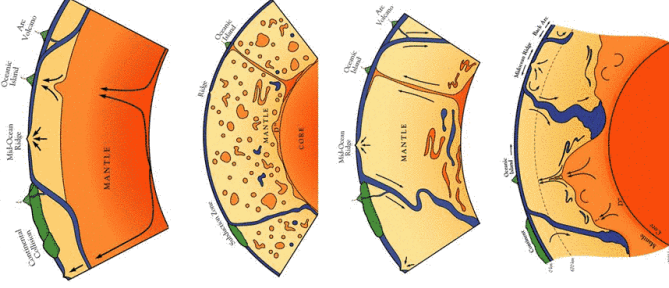


What do we NOT understand about the transition zone?

- Open questions especially concerning the role of the transition zone on geodynamics
- Goals of the workshop and short course:
 - Develop a knowledge-base
 - Develop a toolkit for addressing the open questions
 - Where possible, come up with concrete progress towards some of these questions.



Transition Zone Dynamics and Fate of Slabs

- At what rate does material move through the transition zone?
- How does this compare to the rate at which material rises from a hot thermal boundary layer near the CMB?
- What, and where, are the **maximum** rates of transfer of mass across the transition zone?

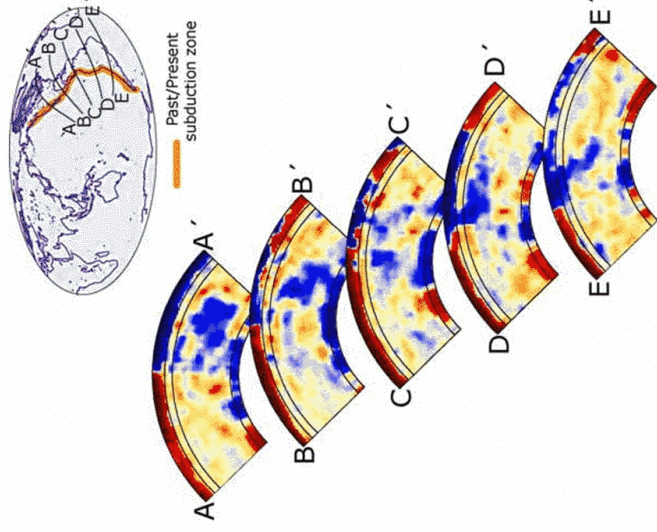
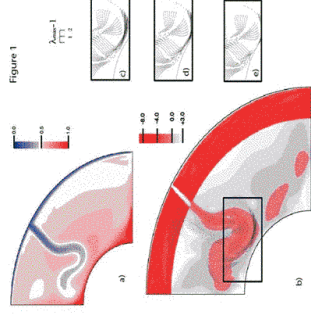
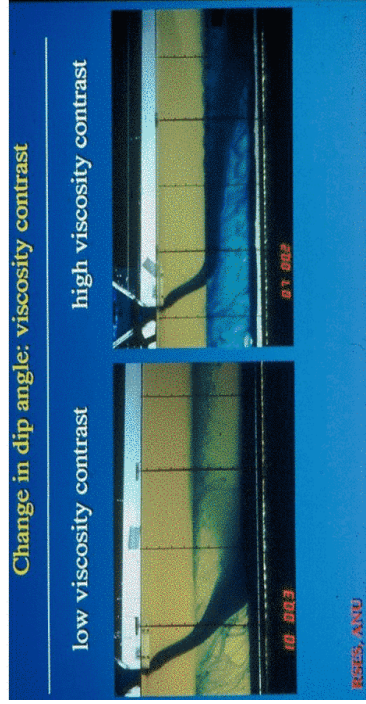


Image by Garnero from Grand JGR (1997) model

Transition Zone Dynamics and Fate of Slabs

- How much do slabs “pond” in the transition zone?
- What do seismic tomography and the location of earthquakes tell us?
- What is the effect of phase changes in the lower mantle on the strength of slabs and their entrainment into mantle convection?



McNamara et al. 2002

Transition Zone Dynamics and Fate of Slabs

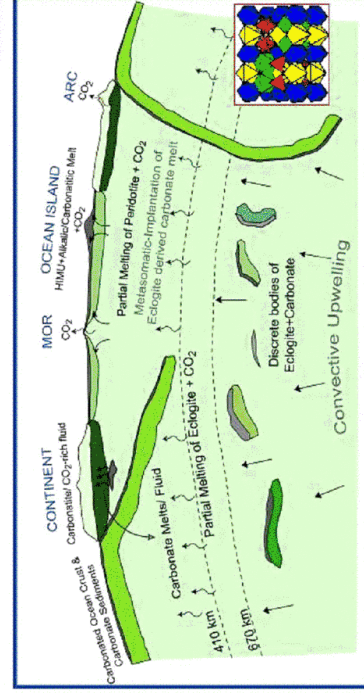
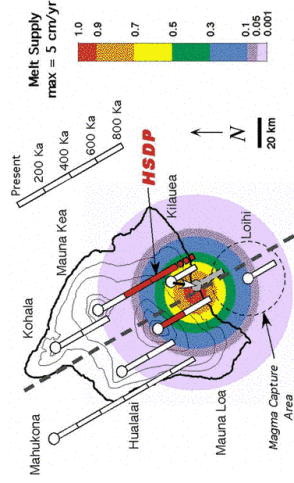
- Do subducted crust and subducted lithosphere (residue of melting) travel as single package through the mantle?
- Can this be tracked geochemically?
- What are the dynamical predictions (based on what assumptions)?

Transition Zone Boundary Topography

- What mechanism(s) generate(s) topography on the transition zone boundary?
- How can we use topography to test for *compositional* contributions versus *thermal* contributions versus the presence of *water*.
- How to test for scales of convection using boundary layer topography.

Fluids in the transition zone

- Is there evidence for melt?
- What is the role of water and what methods can we use to test ideas about water in the transition zone?
- Does the transition zone have different characteristics near slabs?

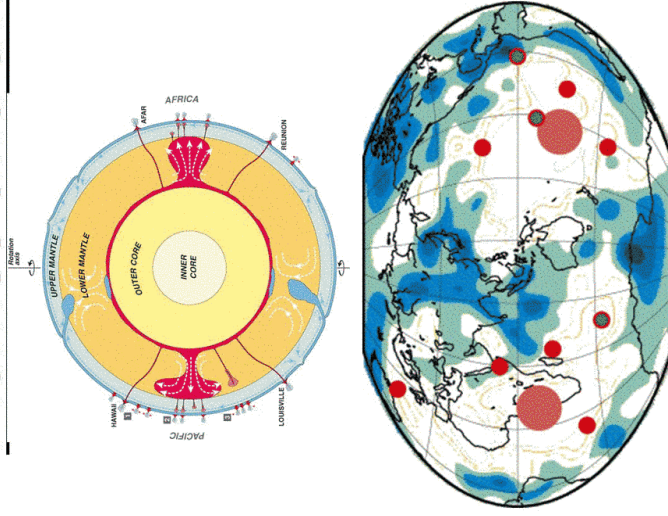


R. Dasgupta and M. Hirschmann (2004)

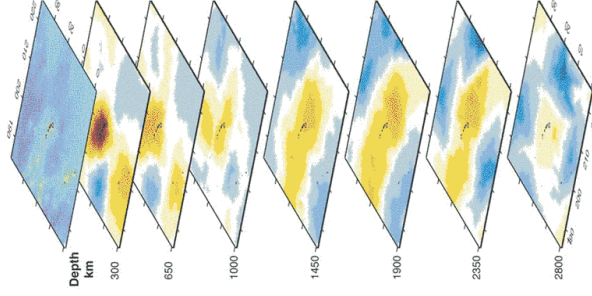
Plumes and the Transition zone

- Can plumes be tomographically imaged?
- Do plumes change their tomographic "signature" during passage through the transition zone?
- What do recent observations tell us about how plumes behave in the transition zone?

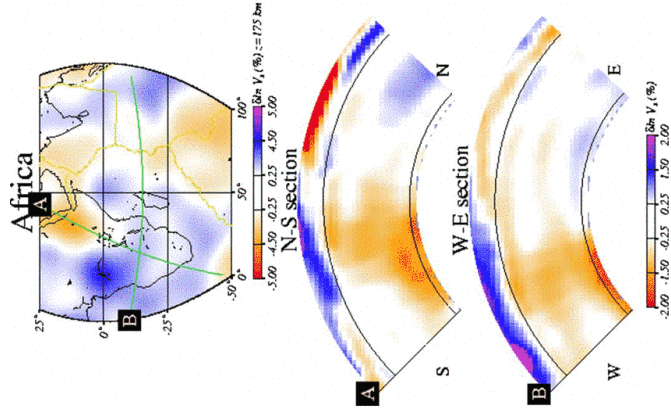
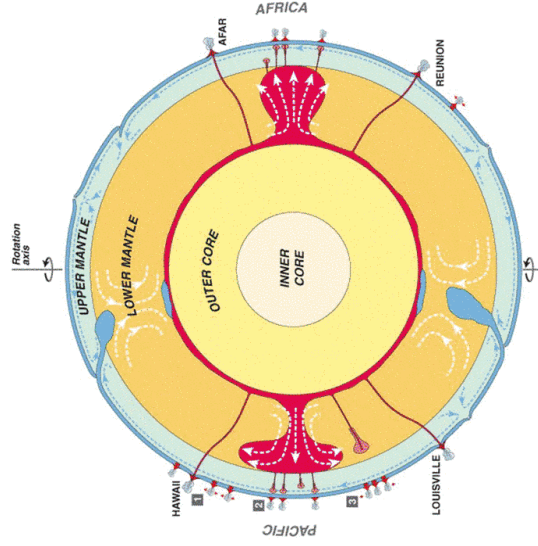
Plumes and the transition zone



Courtilot et al. 2003



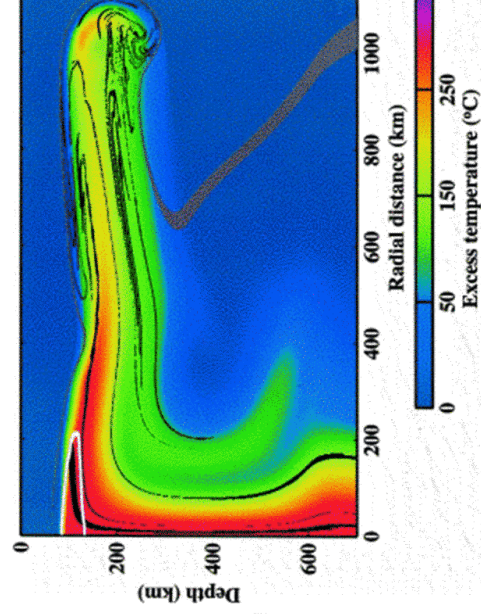
From Nolet: Hawaii



Mégnin and Romanowicz, GJI 2000

What are the potential temperatures of plumes/hotspots?

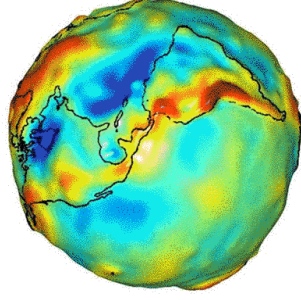
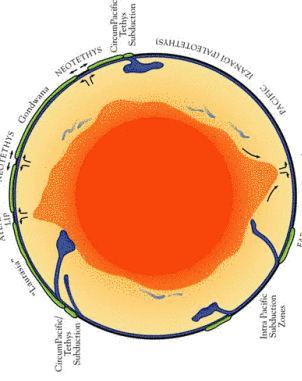
- How well can these be estimated petrologically from existing literature and databases like GeoRoc and PetDB?
- Are there correlations with other geochemical, dynamical or tomographic information?



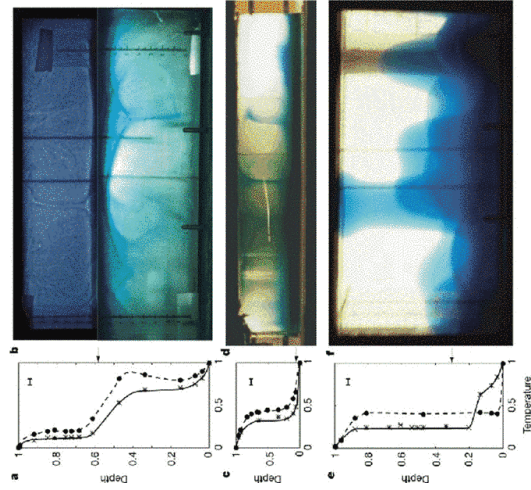
Courtesy of C. Farnetani

Thermo-chemical convection

- Are thermo-chemical mantle models with large dome-like geochemical piles or undulating layers consistent with observations of the long wavelength geoid?
- How can these be reconciled with the success of earlier models that consider only thermal anomalies?

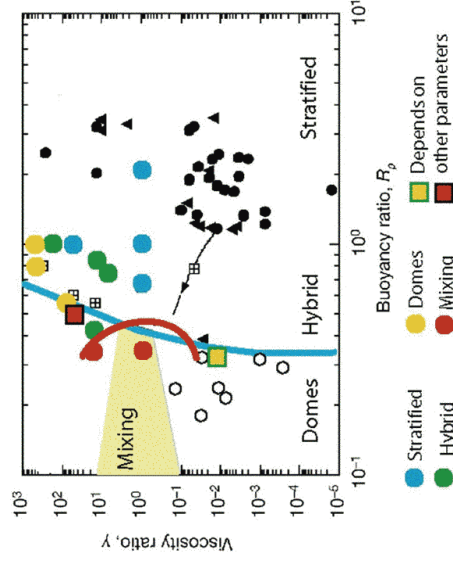


Gravity model from the Gravity Recovery and Climate Experiment (GRACE) satellite



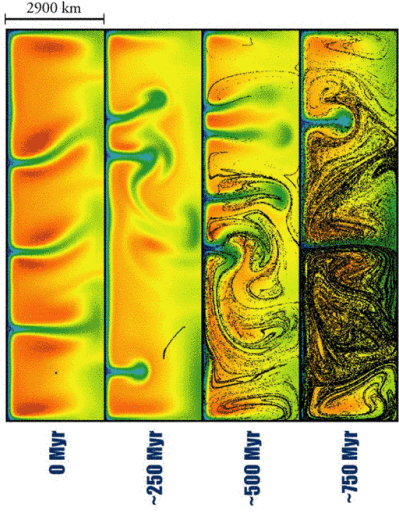
Layered convection experiments by Anne Davaille,

(Nature 402, 756, Dec. 1999)



Fractal nature of mantle convection

- Various numerical tracer models appear to be fractal.
- Does this hold generally?
- If so, do different fractal dimensions occur above and below the transition zone?
- (Started in CIDER 04.)



Hunt and Kellogg, 1990s



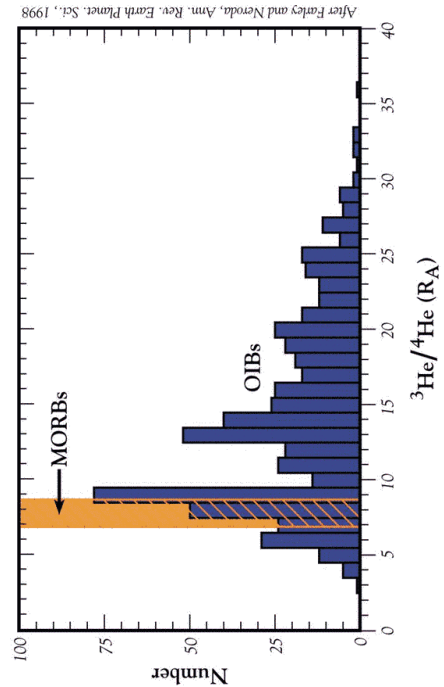
Hoffman and McKenzie, 1970s

Global scale: mantle contains both well-mixed regions and heterogeneity

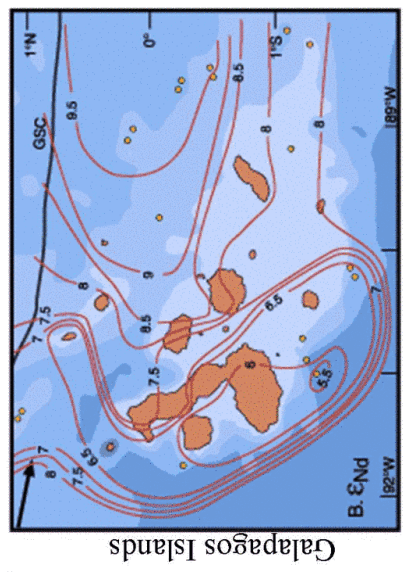
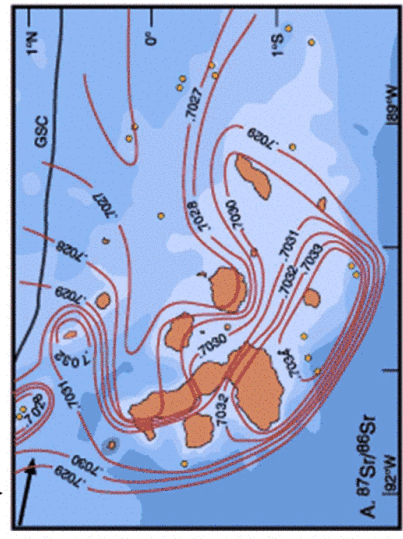
↑

Fine scale heterogeneity

→



After Farley and Nerdoda, Ann. Rev. Earth Planet. Sci., 1998



What has been left out?

- Your questions....