Upper mantle

- What is the viscosity beneath continents & oceans?
  - Geoid
  - Rebound
- What are the lateral viscosity variations?
- What is the evolution & fate of continental lithosphere?
- Can dehydration generate a compositional lithosphere?
- *Test hypotheses for the dramatic increase in* η*: due to dehydration*
  - Predict upper mantle distribution (hydrated/dehydrated) & compare with seismic observations (Global and regional studies)
  - Address the shape and evolution of hotspot swells

Disciplinary discussion group
Geodynamics

Length scales of heterogeneity:

- *Test the plum pudding/veined mantle hypothesis*
  - *What length scales can be expected to be present after 4Gyr of convection?*
  - *What compositional range "...."?*
  - *How are heterogeneities sampled by melting & melt extraction?*
- How are reservoirs isolated (so they evolve differently) in a convecting mantle? How are the distributed in the mantle? Layers? Blobs? How large/small can they be?
- Can a transition zone water filter preserve geochemical reservoirs?

Techniques, effects and philosophy

- Effects of dehydration on solid η /flow; on melt migration; solidus?
- Realistic rheologies, *e.g.* grain size dependence, $H_2 0$
- What minimal level of complexity can explain different aspects of the Earth?

Lower mantle heat

- How much heat transferred by upwellings, downwellings, reservoirs
- What are the lateral viscosity variations & how do they influence the heat budget
- How important are slab avalanches to LM heat & core cooling?

Plumes

- How wet are plumes? What causes wetspots?
- What other mechanisms can cause hotspots? What range of volcanic features can these explain/not explain?
  - Richter rolls?
  - Small scale convection & feedback with melting
  - Edge-driven convection
  - What else can form microplate, near ridge, ridge-centered
- Can we satisfy global budget without plumes?
- Can cold downwellings generate plume-like upwellings?

Slabs

- How much water is transferred to the mantle via subduction?
- How can eclogite & other chemical buoyancies effect slab penetration & avalanches?
- Are there slab avalanches?
  - What conditions allow for them & are these conditions present in the Earth?
  - Are they evident in the geologic record? True polar wander, changes in Earth's magnetic field, & plate motions?
- *What is the fate of slabs? How deep do they penetrate?*
  - *Why do they appear to widen or change shape near 660?*
  - *Models to explore slab dynamics in 3-D, using realistic rheologies and plate motion*
  - *Conditions needed to explain tomographic images in 3-D using realistic rheologies*