

A manifesto by Group 7

- What we sample at **MOR**, a great reflection of the upper mantle, is **not the whole mantle**, as it does not add up to chondritic conditions
- This is not to say there are **two reservoirs**
- This is not to say there are **two layers**
- Resolve paradox between geochemistry and seismology: find **reservoir**.
Seismologists, give us a reservoir, **delineate** it. Let's look for a sharp, non-horizontal boundary around D''

The Earth Sciences

A haiku by James B. Kellogg

If not primitive – *what?*

If not 670 – *where ?*

If not primordial – *how?*

If not us – *who?*

Some facts
we're comfortable stating

- **Zircon** cannot be produced in the mantle; finding it in a plume implies it came from a subducted slab
- **Plume melting** occurs maybe around 100 km, certainly not 500 km or deeper; we know this from garnet trace elements
- What if **mass transfer** is unimpeded but chemical variations are? Diffusion needs to be faster than advection. This does not explain Sm/Nd isotopes, if anything

A modest proposal

- **Geodynamics:** tell us what plumes look like, how fast they go, viscosity contrast
- **Geochemists:** tell us what they're likely to be made of
- **Mineral physicists:** tell us what the wave speeds of those will be
- **Seismologists:** prove that you can see them, and take their picture

What we need

- We need **experimental mineral physics** to tell us the effect of physical variables on wave speeds at depths and pressures
- We need **geodynamics** that tell us whether boundary layers are possible at depths other than the CMB and whether the types of structures seen seismically are any good
- We need **first-principles calculations** of trace elements in small concentrations require huge unit cells; simulating liquids is even harder

Some more questions
we want answers to

- What kind of **heat transfer** is going on as a slab goes down, and we need to know physical constants (diffusivity, etc.)
- What are the **thermal properties** of “slab” and “mantle”
- What happens at the **bottom** of the mantle?
- What do **slabs** really think?
- How do **melts** interacts physically and chemically with the mantle
- Is the mantle **layered**, and why, when

- **Geodynamicists:** use the seismic models, look for what they *mean*
- **Mineral physics:** step away from the idealized end-member solutions, and completely understand melting etc.
- Find how seismic velocity variations map presence of **partial melt**; find pressure and depth variations of said velocities

Headlines

- Area geophysicist develops infallible toolset to detect **melt and volatiles** anywhere in the mantle
- Seismologist confirms that **slabs lose sharpness and definition** in the lower mantle
- Earth scientists maps complete **thermochemical structure of D''**
- **Wadati-Benioff** zone explained