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
• 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