Lateral Variations

- Shear moduli
  Experimental measurements
    Brillouin spectroscopy
      (requires oriented single crystals, only practically done at ~ ambient)
  Calculations
    Ab-initio
    Lattice dynamics
      Not as good or reliable, ground truth to Brillouin, emphasize relative shear moduli as a function of composition
Disciplinary group discussions: Mineral physics / petrology
Lateral Variations

- **Physics of composites** ~ Can we describe the mantle through VRH average?
  
  *Seismologist need to measure the seismic velocities for us.

  *Make the problem harder: Detect the presence of melt, effects of melts on wave speeds, anisotropy
Lateral Variations

- **Compositional variations**
  - Mineral assemblage, wavespeed variations as a function of
    - Major element variations (Fe, Al, Mg)
    - Minor and trace element variations
      - WATER!
Plumes

• See problem 1
Heat in LM

- Thermal conductivity
- Heat capacities
- Partitioning of radiogenic elements
Slabs

- Water
  - Hydrous phases
  - Nominally anhydrous phases
  - devolitalization

- P-V-T-x Equation of state
Upper mantle structure and composition

- Temperature and pressure derivatives of wave speeds
- Mineral/melt interactions with and without water
OVER-RIDING problem

- Effect of volatiles on:
  - Wave speeds
  - Mineralogy/Phase equilibria
  - Melt
  - Rheology

Extend experiments to very low melt fraction, very low water contents
Make this interdisciplinary

- How does water move in the Earth’s interior?
  - Seismology (Queen)
    - Map it. … attenuation, wave speed variations
  - Geodynamics (King)
    - Transport mechanisms
  - Geochemistry (FOZO the clown)
    - Trace evidence of higher and lower water concentrations
    - Partitioning
    - metasomatism
  - Mineral physics (Fairy Godmother)
    - Phase stability, solubility and diffusion
We propose the formation of a research institute:

Institute for Earth Processes and Technology

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