

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
 - Hydrated phases
 - Nominally anhydrous phases
 - devolatilization
- 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**

.... On Loihi