Science Questions

DUGL group meeting, Oct. 2015

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Background

- How I got here
  - Joint seismic program high frequency array experiments of 1990s
  - Long term interest in using seismic data to determine earth structure
  - Constantly asking “what are fundamental problems”?

Joint Seismic Program

- History
- High frequency array experiments
- Unresolved issues that have bugged me for 20 year:
  - Near surface complications
  - The textbook story of longitudinal P and transverse S is demonstrably wrong. Why?

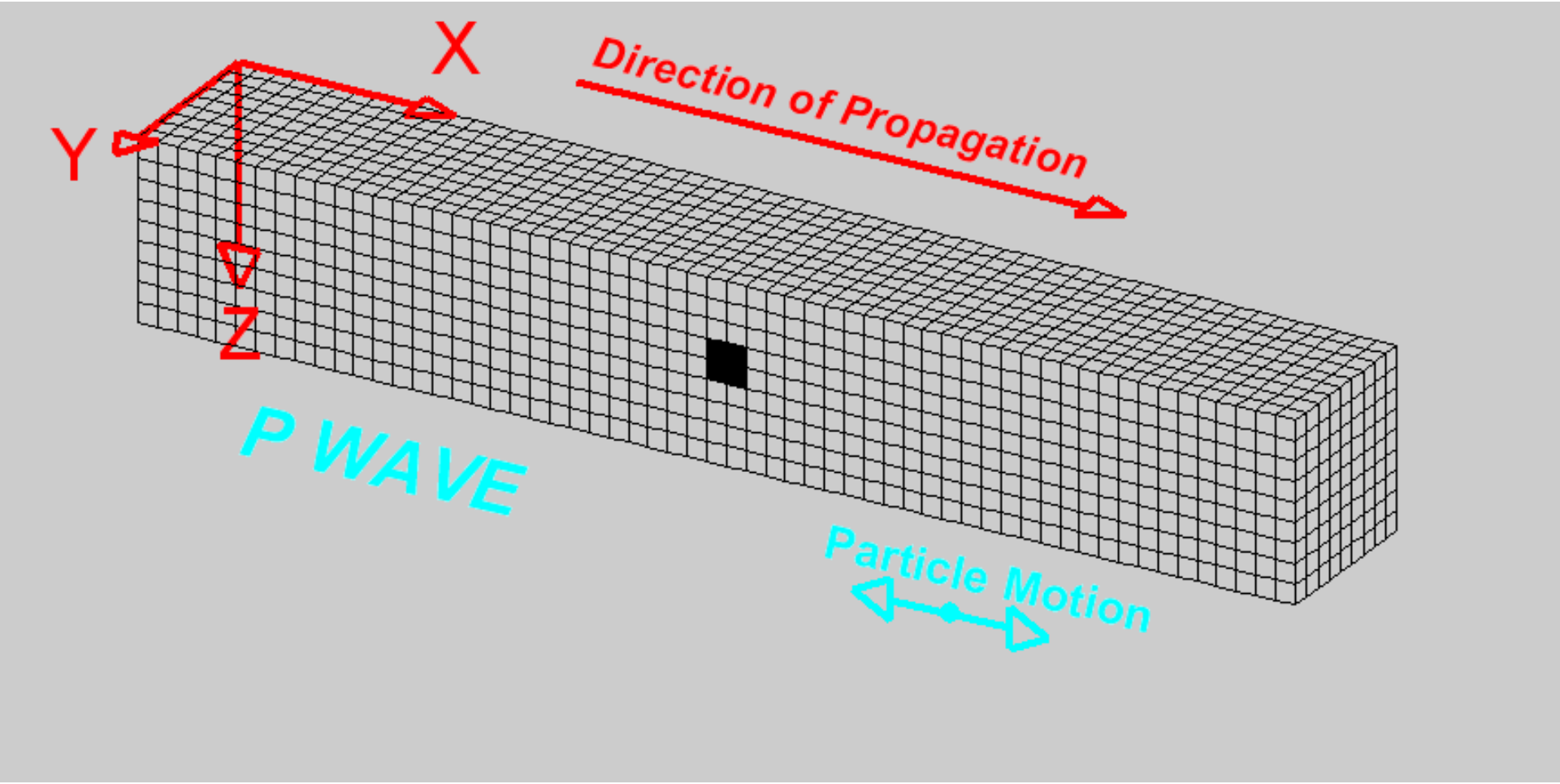
The Near Surface Problem

- Let me draw some stuff on the board

Anisotropy

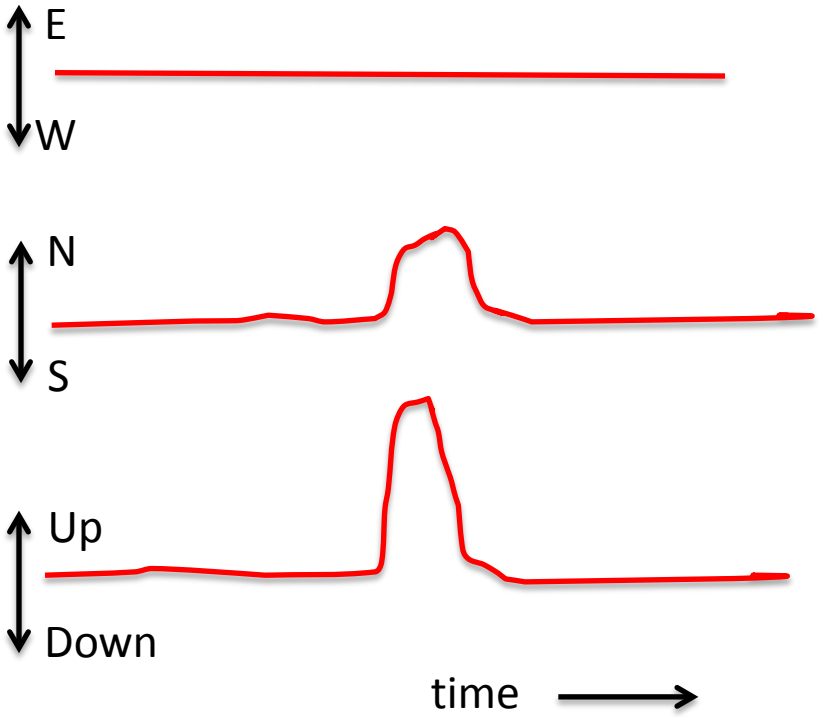
- Particle motion?
  - P?
  - S?

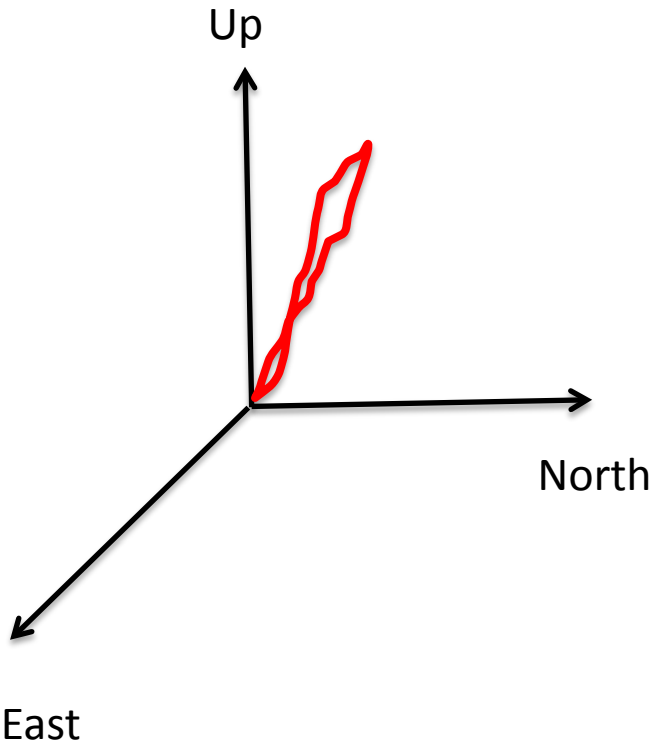
Recall this understanding of a P wave



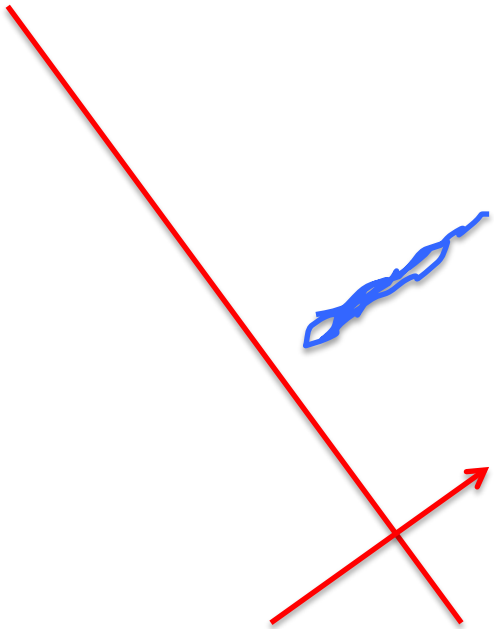
Deformation propagates. Particle motion consists of alternating compression and dilation. Particle motion is parallel to the direction of propagation (longitudinal). Material returns to its original shape after wave passes.

Seismograms and Vector Particle Motion





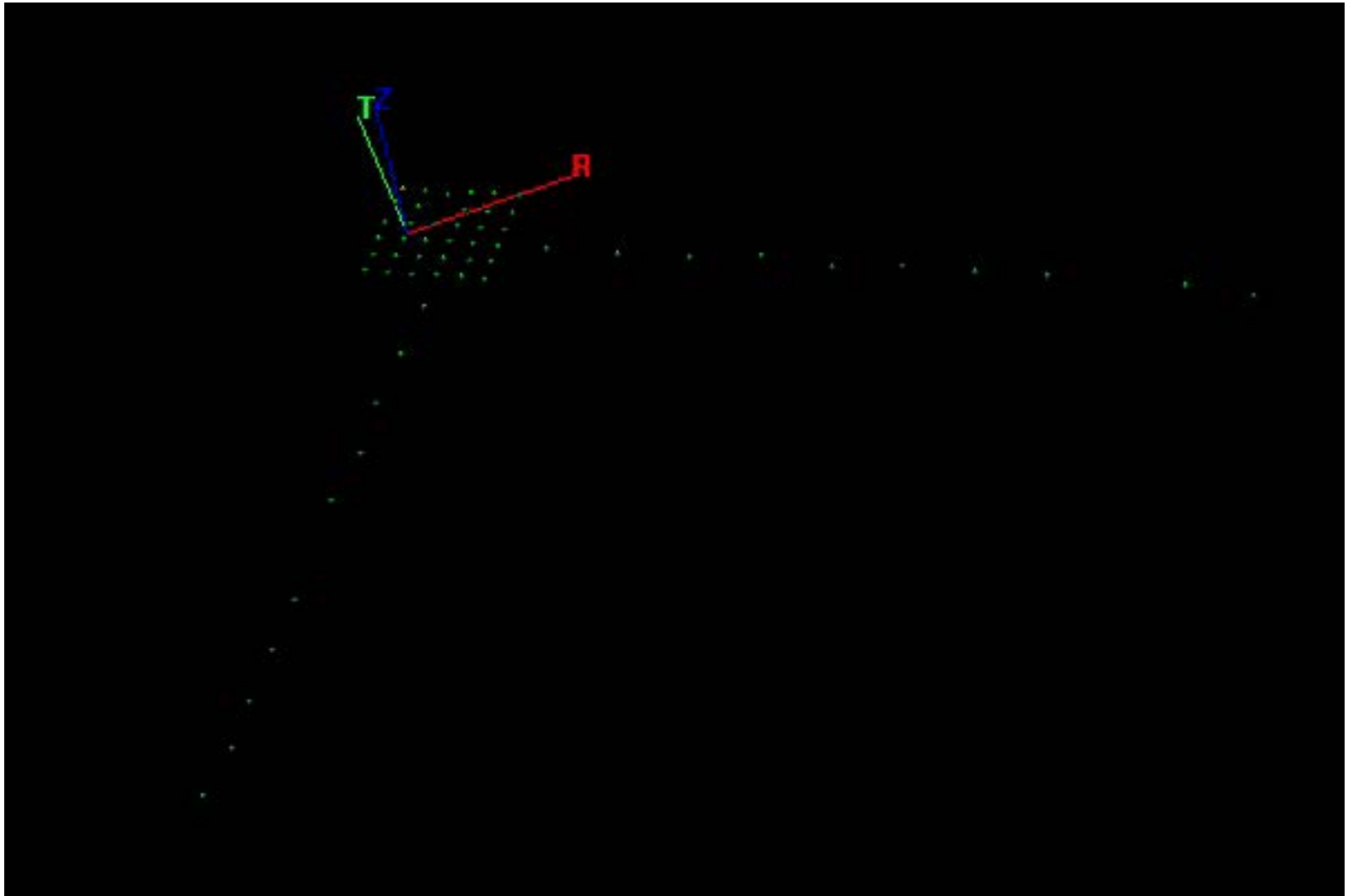
Isotropic Theory would predict



Expected Particle Motion

Propagating P wave

In reality we see something else



Why Homestake?

- Underground gives isolation from near surface scattering
  - Is particle motion problem an artifact of near surface scattering and site response?
  - Do particle motions get clean underground where we can remove the free surface scattering?
  - Do particle motions work to measure anisotropy?
- We can sample rock properties directly at a range of scales
  - Can we quantify an elusive concept called structure induced anisotropy? (needs geologic data form Sanford)
  - Do methods to predict rock properties from mineral assemblages work? (future work)