Announcements

Reading for Friday: p.12-15

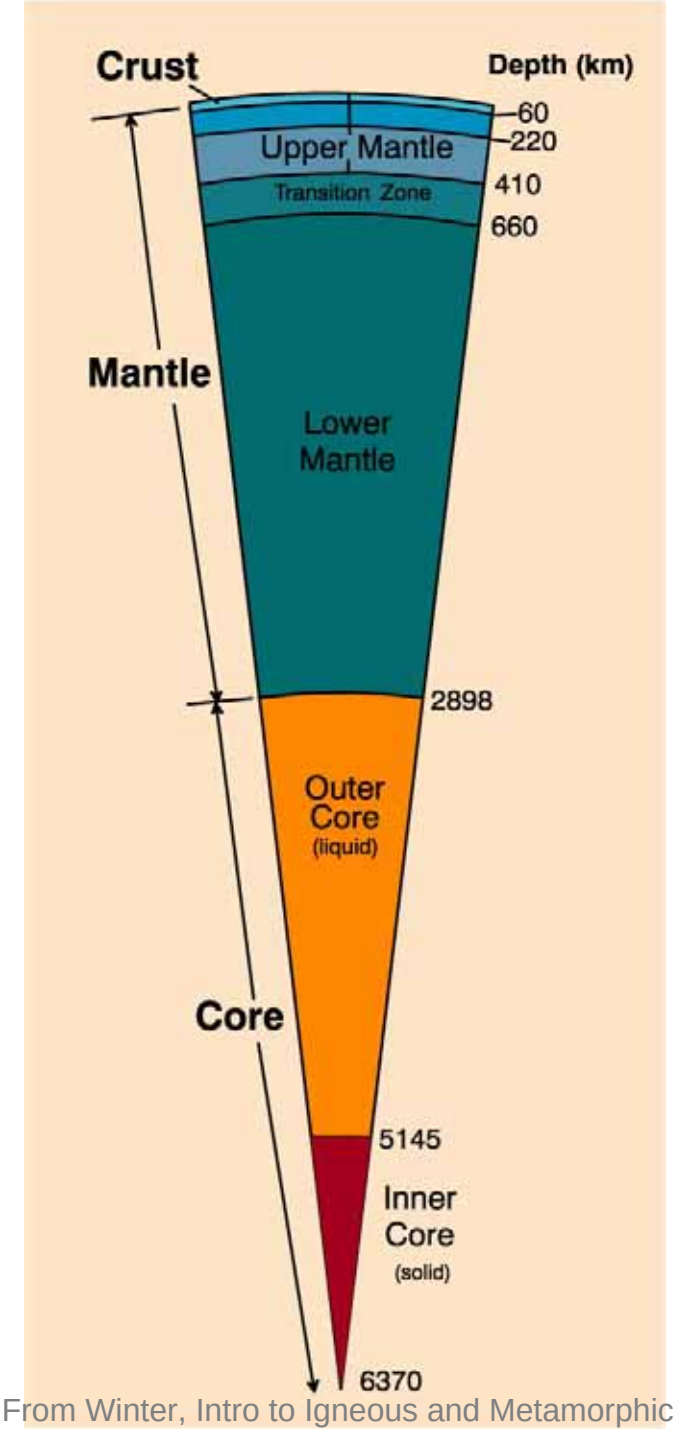
Get computer accounts, buy hand lenses after lecture $7.53, UC Regents

First lab today

Overview of next two weeks

- **Structure and composition of the Earth**
- **Heat production and thermal gradients in the Earth**
- **Mechanisms for melt generation**
- **What is a melt and how does it behave?**

- **Lab: Learn to identify and classify igneous rocks, minerals, and textures**



Structure of Earth

Sort of like an onion

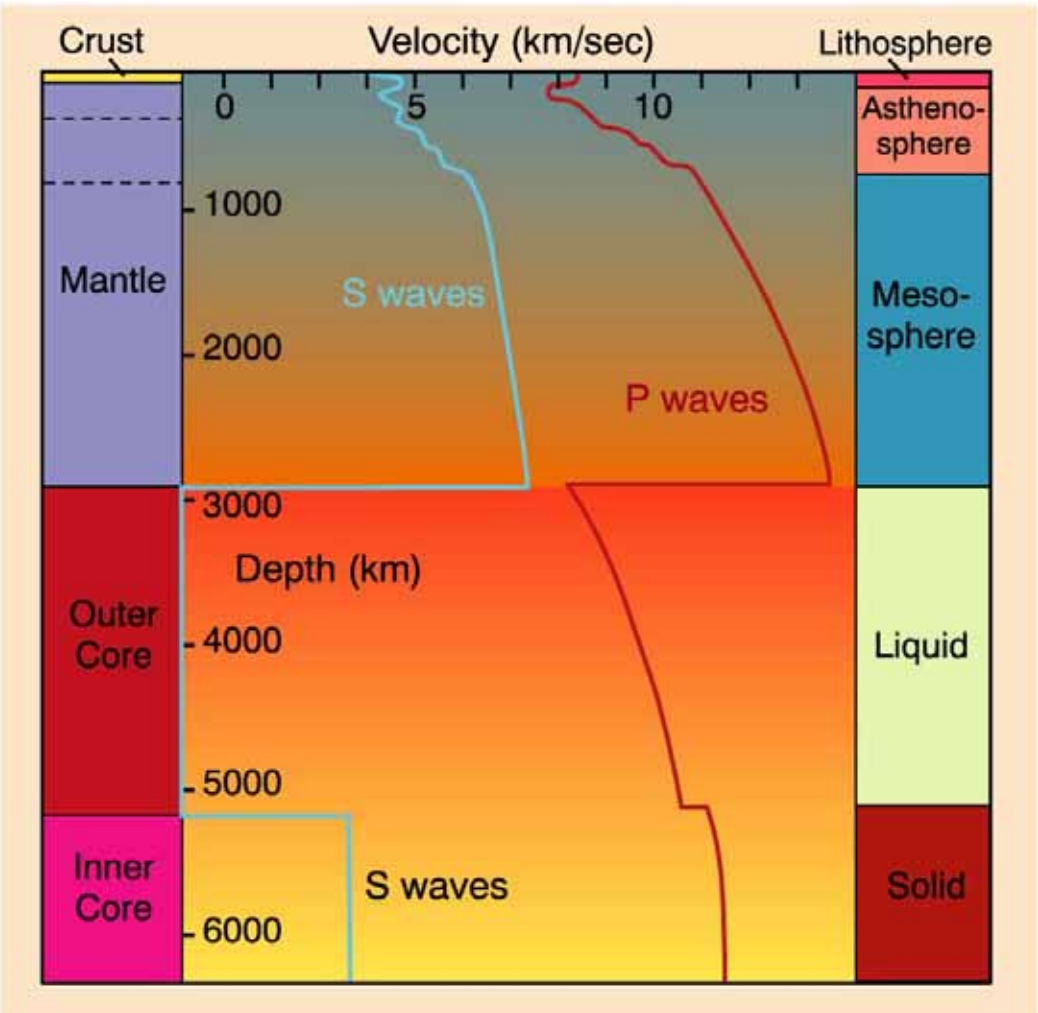
Why do we care for Igneous Petrology?

Where are the igneous rocks?

How do we “know” this?

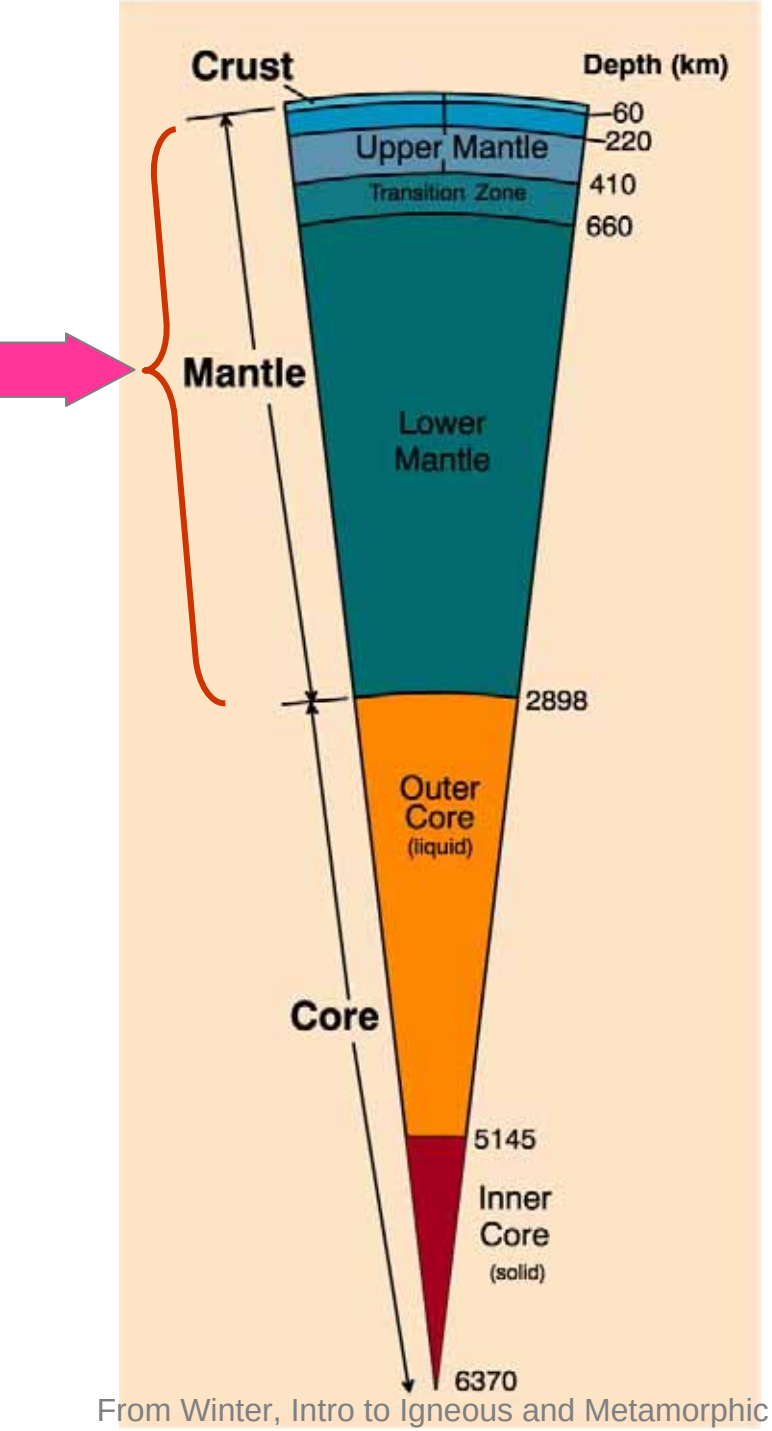
From Winter, Intro to Igneous and Metamorphic Petrology

Seismic profile of the Earth



From Winter, Intro to Igneous and Metamorphic Petrology

- Why do we need to use geophysics to look inside the Earth?
- S = shear wave
  - Not propagated through liquid (why?)
- P = compressional
  - Slow down through liquid
- Slinky demo



Earth's interior

Peridotite (ultramafic)

Upper Mantle:

Low Velocity Layer 60-220 km

410 km (olivine -> spinel)

Transition Zone: velocity increases rapidly

660 km spinel -> perovskite-type Si^{IV} -> Si^{VI}

Lower Mantle has more gradual velocity increase

From Winter, Intro to Igneous and Metamorphic Petrology

The Earth's Interior

Core:

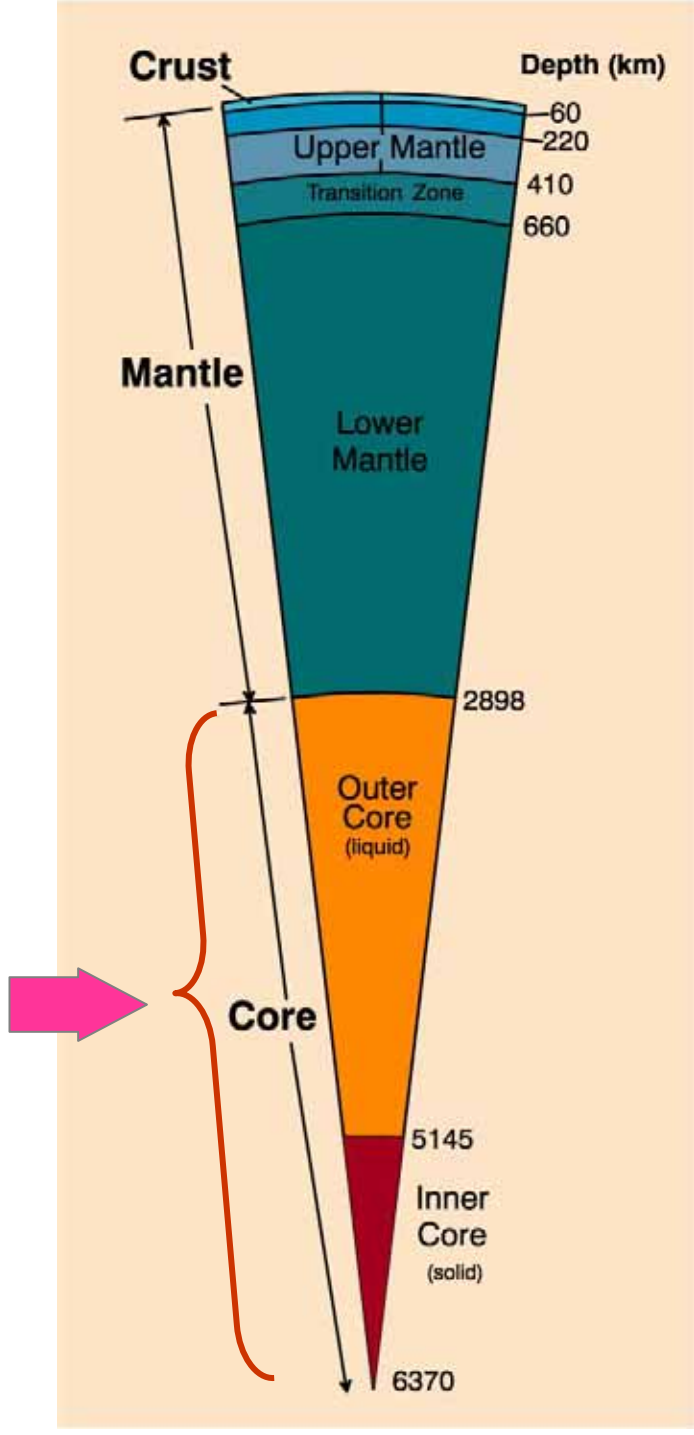
Fe-Ni metallic alloy

Outer Core is liquid

- No S-waves

Inner Core is solid

Why is the structure of the Earth important in igneous petrology?



From Winter, Intro to Igneous and Metamorphic Petrology

The Upper Mantle and Crust

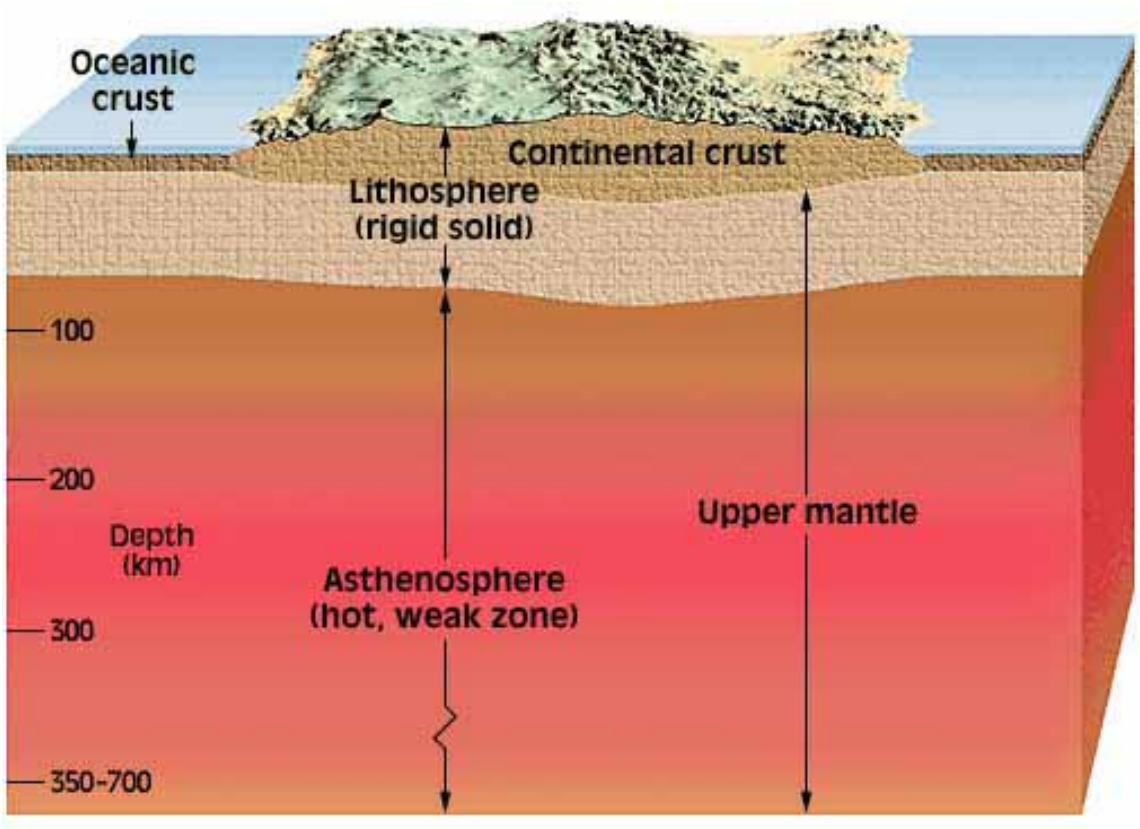
Crust:

Oceanic crust

- Thin: 10 km
- Relatively uniform stratigraphy

Continental Crust

- Thicker: 20-90 km average ~35 km
- Highly variable composition
- – Average ~ granodiorite

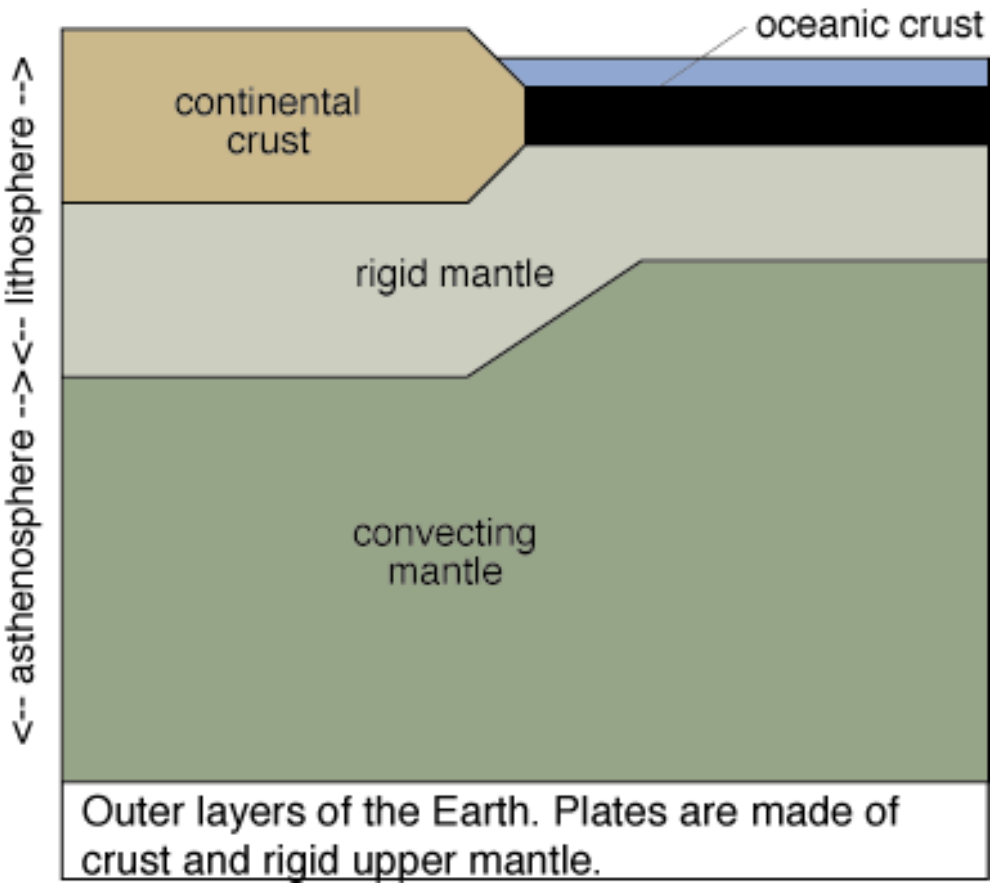


From Winter, Intro to Igneous and Metamorphic Petrology

Lithosphere = rigid

Asthenosphere = weaker zone

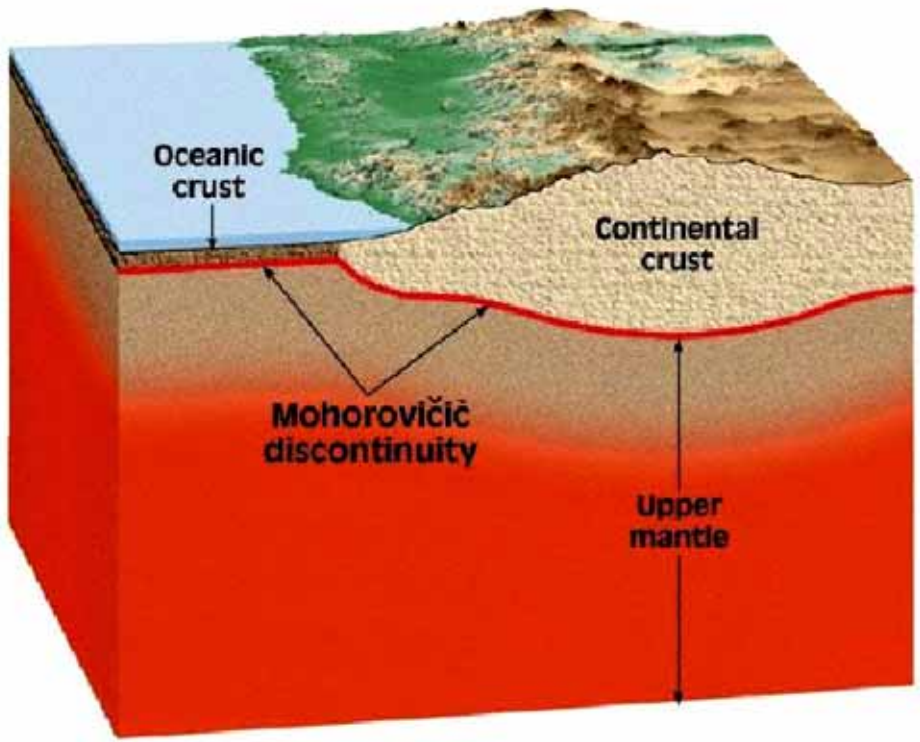
Another diagram
Compositional vs. Physical



http://volcano.und.edu/vwdocs/vwlessons/plate_tectonics/part1.html

The crust/mantle boundary

- What does the lower crust and upper mantle look like?
- Any outcrops?
- New project to drill to the moho (IODP in Atlantic)



How many stories tall is the lithosphere?

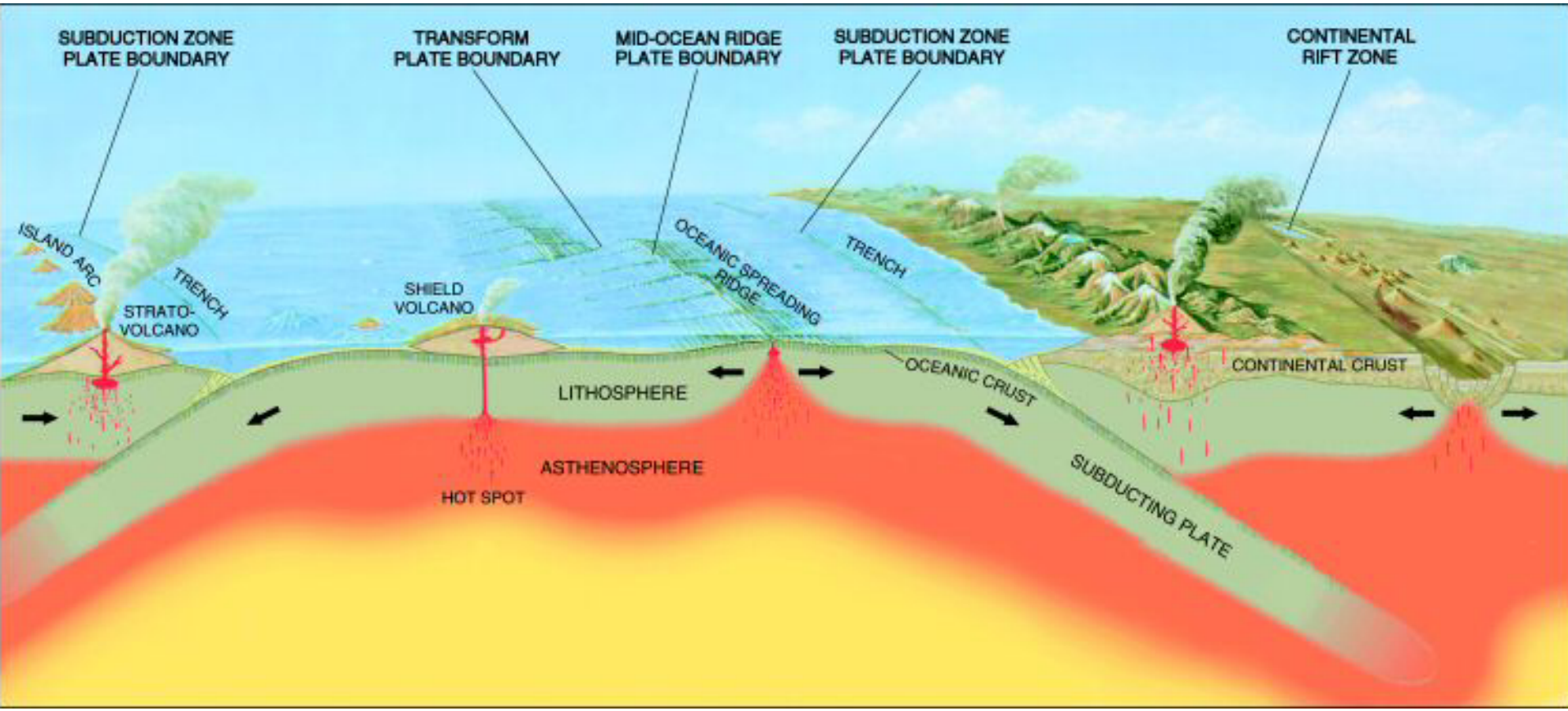
Information:
Lithosphere = 30 km under oceans
One story = 3 m (about 10 feet)
1 km = 1000 m

$$\text{Lithosphere: } 30 \text{ km} \left(\frac{1000 \text{ m}}{1 \text{ km}}\right) = 30000\text{m} = 3\text{x}10^4 \text{ m}$$

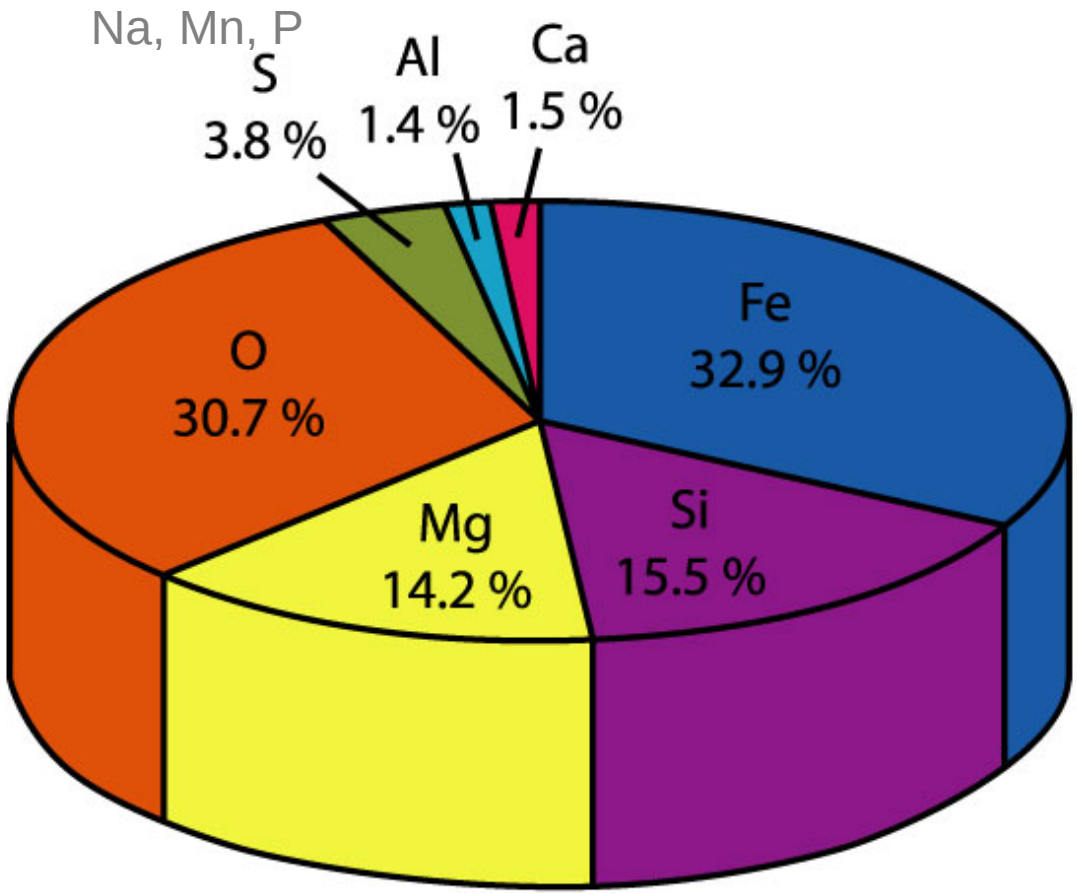
$$\frac{3\text{x}10^4 \text{ m}}{3 \text{ m}} = 1\text{x}10^4 = 10{,}000 \text{ stories !!!}$$

Earth like an onion?

Plate tectonics



Bulk composition of the Earth



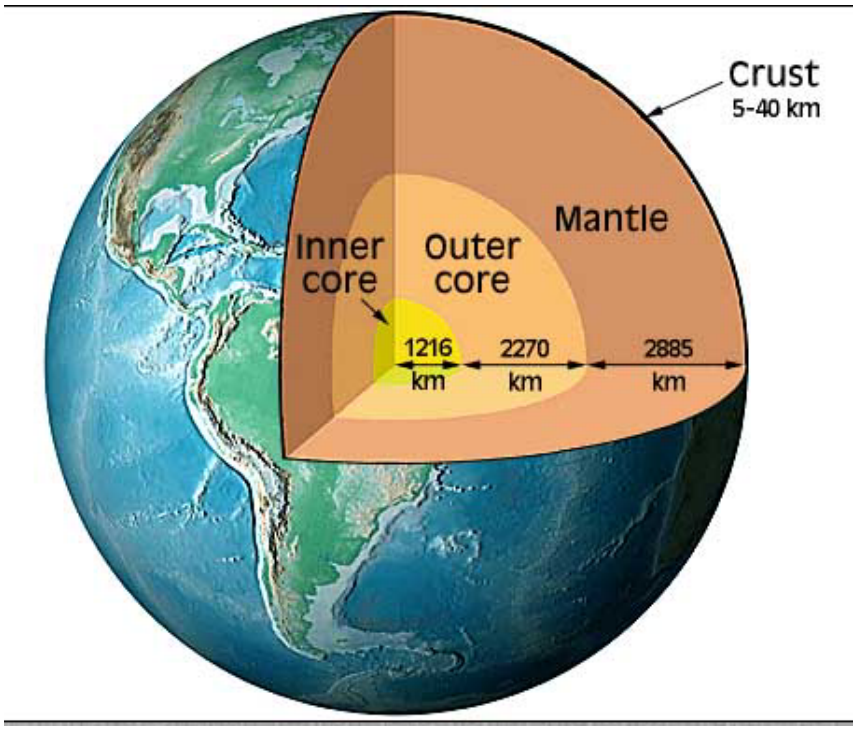
- How do we "know" this?
- What would bulk mantle look like?
- Average core composition?

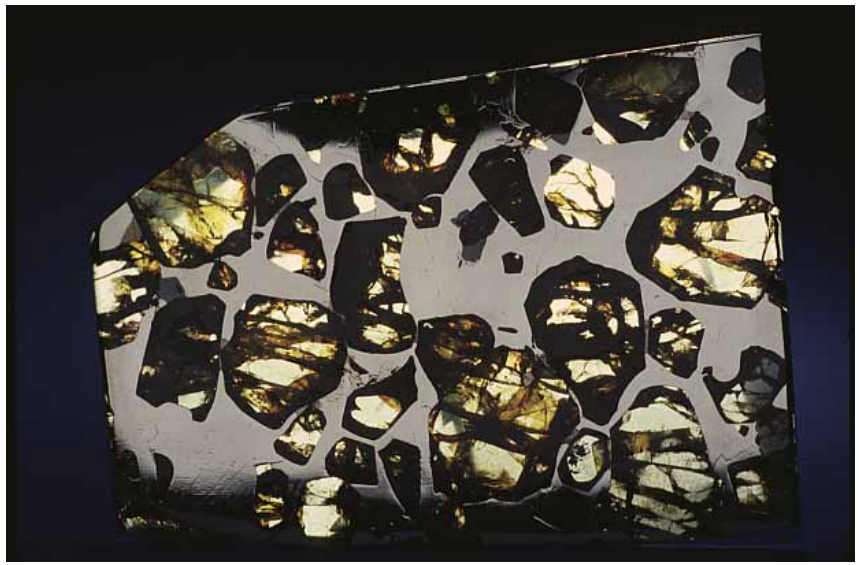
From Winter, Intro to Igneous and Metamorphic Petrology

Meteorites as “average composition” of the Solar System

- Ordinary chondrites represent earliest, undifferentiated material
- Assume bulk Earth composition is same as bulk solar system composition
- Take away metallic part of ordinary chondrite ~ bulk mantle + crust

Formation of planets: differentiation of large bodies





Pallasite: core-mantle boundary of planetoid

Summary of important points

- Igneous rocks are everywhere
- Structure of Earth, especially crust and upper mantle
- Bulk composition of Earth approximated by ordinary chondrites

- Rocks of the crust and mantle in lab