Outline of Lecture 18 (5-28-02)

I) Seismic Wave Velocities:
   1) Remember that seismic velocities are controlled by density, bulk modulus and shear modulus.
      A) What do the bulk and shear moduli represent?
      B) What are good near surface crustal values of each? [units]
      C) How do each of the three variables effect both the P and S wave velocities?
      D) Why is it the P waves are ALWAYS faster than S waves?
      E) How can we find the distance to an earthquake? What information do we need?
   2) Using Triangulation to locate earthquakes along earth's surface.
      A) how many stations are necessary for precisely locating an earthquake?
      B) What is the best understanding for why there may not be a convergence with multiple stations?
   3) Consideration of Poisson Solids (near surface crustal approximation)
      A) What does it mean if a rock is a Poisson's solid?
      B) What would be the resulting relative ratio between P and S wave velocities
      C) What is a common mineral example that is clearly not a Poisson's Solid?
   4) Examination of seismic velocity vs. density.
      A) Though density is in the denominator of the velocity equations, why is it the laboratory studies show that seismic velocities actually increase with density?
      B) What does this mean for velocities through the earth?

II) Seismic Waves through Multiple Layers:
   1) P and S waves obey standard wave properties which govern the reflected and refracted angles at which waves travel.
   2) The transmitted and reflected angles are controlled by Snell's Law
      A) What is the definition of Snell's Law?
      B) EQN: \( \frac{\sin i_1}{\alpha_1} = \frac{\sin i_2}{\alpha_2} \)
      C) Where is the angle of incidence, \( i \) measured from?
      D) When a wave is transmitted into a faster material, what happens to \( i \)?
   3) Since we now know that velocities increase with density and that density increases with depth, what is the generalized path of seismic waves through the earth?
   4) Case of a low velocity layer between two higher velocity layers
      A) What is the critical angle, \( i_c \)? How do we calculate it?
      B) What happens to refracted waves once the incident wave passes the critical angle?
      C) What examples do we know of on earth (geologically or technologically)?
   5) In actuality, both P and S waves will generate each P and S reflected and refracted waves when passing from one solid to another.
   6) How can we use Snell's Law to find the angle of incidence of an S wave, given an incident P wave [remember, S waves are controlled by \( \beta \) not \( \alpha \)]?

III) Now that we have shown that seismic wave paths are governed too by the velocities at which they travel we can use this information to begin inferring information about the earth's interior (a place that we cannot see directly).