Quiz Review

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Seismic velocity of materials depends upon the elastic moduli of the material. An elastic modulus is the ratio of a particular stress to a resulting strain.

The data recorded by a seismometer consists of records of ground motion for 10's to 100's of milliseconds following the initial source energy.

When looking at first arrival times in a seismic refraction survey, what relationship between the layer velocities allow us to determine the velocity of layer 3 and know that it is in fact the velocity for layer 3? V1 < V2 < V3

- Remember that if the velocity of a lower layer is less than the velocity of the layer above it, we won't get a critically refracted ray. Thus, if we want to determine the velocity of layer 3, we must get a critical refraction from the interface between layers 2 and 3. For us to know that it is in fact the velocity for layer 3, we must also get critical refractions for the interface between layers 1 and 2.

A ray path is critically refracted at the interface between Layer 1 and Layer 2 with incident angle of 45 degrees. Suppose the velocity of Layer 1 is 500 m/s, what is the velocity of Layer 2? 707 m/s

- To solve this, use Snell's law: $\frac{\sin\theta}{v_1} = \frac{1}{v_2}$

Acoustic impedance refers to the product of density and velocity of the material.

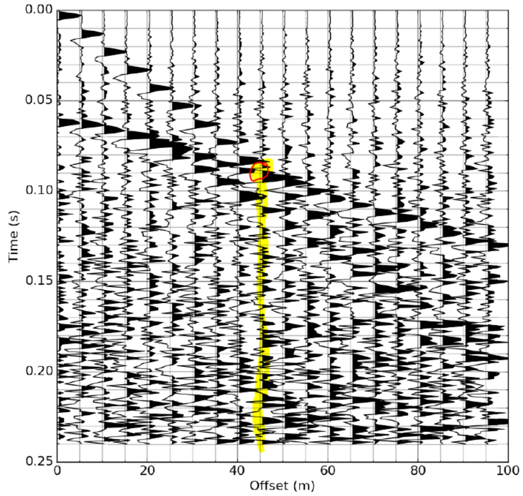
In a travel-time versus distance plot in seismic refraction, the slopes of the segments depend on the seismic velocity and dip in each layer.

- Remember that when we have a dipping layer, we get a different slope, depending on what side the shot was on.

Seismic refraction surveys have been at two different sites, where the basic geological models are all believed to be a single horizontal layer plus basement. The two time-offset plots have the same slope for direct arrival and refracted arrival but differ in the intercept time. The intercept time at Site A is 20 ms while at Site B it is 35 ms. What can be concluded? The surface layer in Site B is thicker than that in Site A.

- If the thickness was the same at both sites, the intercept time should be the same as well. Because the intercept time is later at Site B, it means the wave travelled a longer distance. Since we know the layer is the same layer, it must mean that at Site B, the layer is now thicker.

From the data plot, what is the observed crossover distance for the refracted arrival? 45 m: look for where the direct arrival and refracted arrival cross each other.



Calculate the velocity of the layer under the interface revealed by the refracted arrivals. 1300 m/s

- To find this answer, we need to pick two points on the line and determine the slope. Remember that slope = 1/v, so v = 1/slope. Slope is equal to "rise over run", so 1/slope is "run over rise". Using the points (offset=100 and t= 0.125) and (offset=45 and t = 0.09), we get: v = 1/slope = (100-45)/(0.125-0.09) = 1570 m/s. I clearly haven't read the graph precisely enough but the closest value from the available answers is 1300 m/s.

To find the to depths that define a dipping layer, what is the minimum number of shots needed? Two shots, one at each end of the line.

A common midpoint gather refers to seismic traces that have a source and receiver symmetrically placed about a single location.

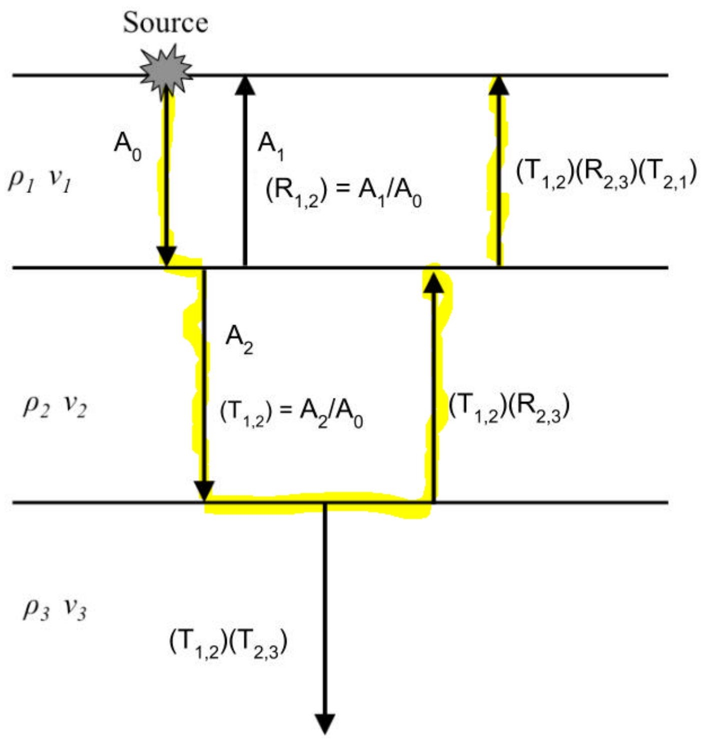
The final seismic trace after processing (Normal Incidence Seismogram) is best thought of as reflections from layers directly below a coincident source and receiver at the surface.

- Remember that by "[normal incidence]", we mean that the source and receiver are in the same location. So the wave travels straight down, reflects off the interface, and travels straight back up.

Consider an earth composed of two layers over a basement. Let Rij denote the reflection coefficient and Tij denote the transmission coefficient associated with the interface the i'th and j'th layers. If the initial amplitude of the seismic wave is unity, what is the amplitude of the wave that arrives at the surface after reflecting off of the second interface?

- Unity = one, so A = 1.
- First, the wave travels down through layer 1. At the first interface, part of the wave will be transmitted down (T12) and part will be reflected back up (R12). The transmitted part will travel through layer 2. At the second interface, part of it will transmit down (T23) and part of it will be reflected back up (R23). This part that is reflected back up will hit the first interface again. Part of it will be transmitted into layer 1 (T21).

- So, the determine the amplitude of the wave that reflected off of the second interface, we multiply the coefficients together: A = A0 * T12 * R23 * T21.
- Because A0 is 1, the answer is T12 * R23 * T21.
- The highlighted path in the drawing from the GPG shows you the path the wave took.



Prior to “stacking” the data from a Common Midpoint Gather survey, the data must be corrected for the normal moveout of the reflections.

An MASW survey might be useful for geological engineers because observed surface waves are inverted to yield S-wave velocity which is relate to Young’s modulus.