Exercise #2

Background: The data shown at left were measured on a flat grassy quad of a college campus in the photos on the right. The objective was to estimate the velocity of the soil layer, and attempt to figure out if there is bedrock near the surface.

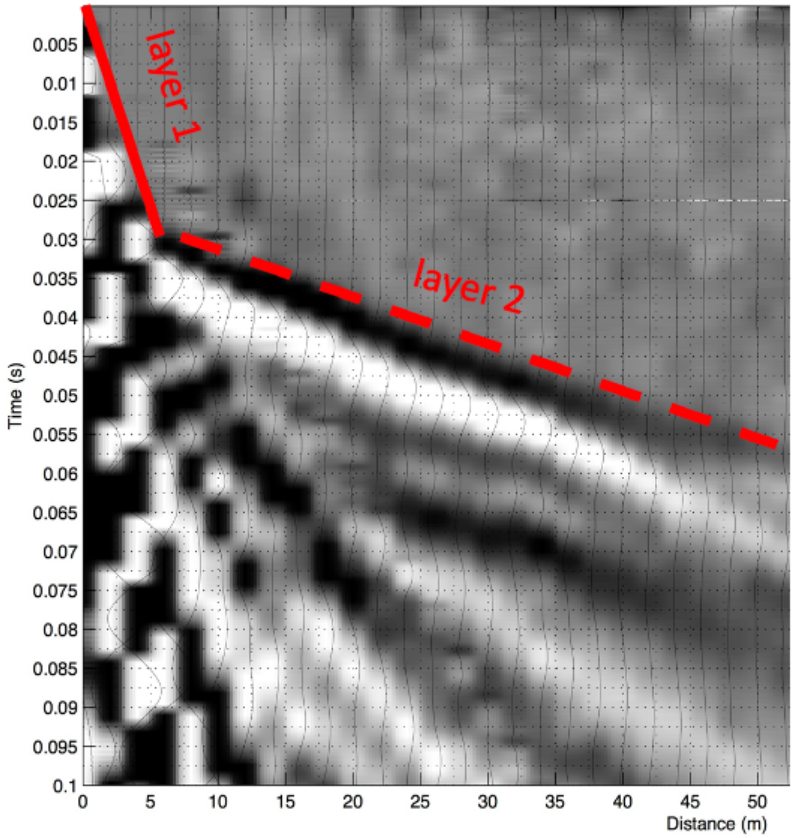
Assignment:

Using the data image "travel-time/offset plot" to the left, calculate the thickness (h) of the top layer using the velocities (v_1, v_2) of both layers in the equation provided in red below from the lecture slides. After calculating the velocities and layer thickness, draw a simple "layered earth" diagram of the subsurface with labels for velocity and thickness, as well as your interpretation of if there is bedrock near the ground surface. [See PPT Unit 2, Part 2, Slide 14]

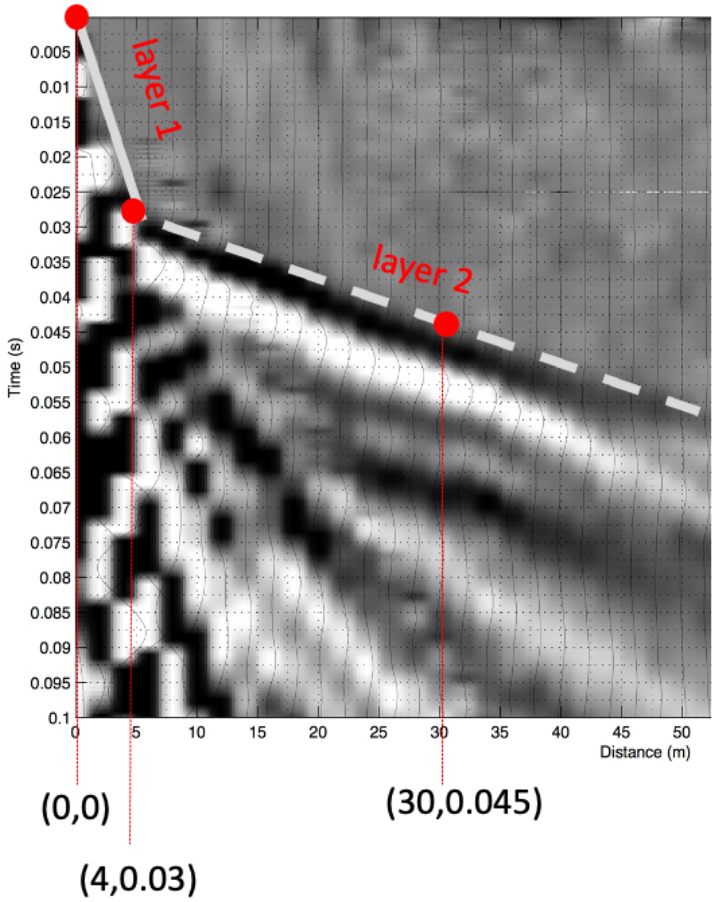
Hints

- v_1 and v_2 can be read off of the travel-time/offset plot by finding the slopes of the refracted seismic arrivals, rise-over-run, on the data image
- t_1 can be projected on the graph based on the slope of v_2 - extend the V2 line to the y-axis and the y-intercept is t_1

Step 1: Identify the refraction arrivals associated with layer 1 and layer 2



Step 2: extract rise-over-run values from the image on the slope of layer 1 and layer 2



note: We could have picked any points along each of the slopes, however we can use these because they are easy to find and save time. The d = 4 m, t = 0.03 s point is used in both slopes.

Once we have extracted the d/t coordinate pairs, we can difference them to calculate the rise over run of each slope. For example:

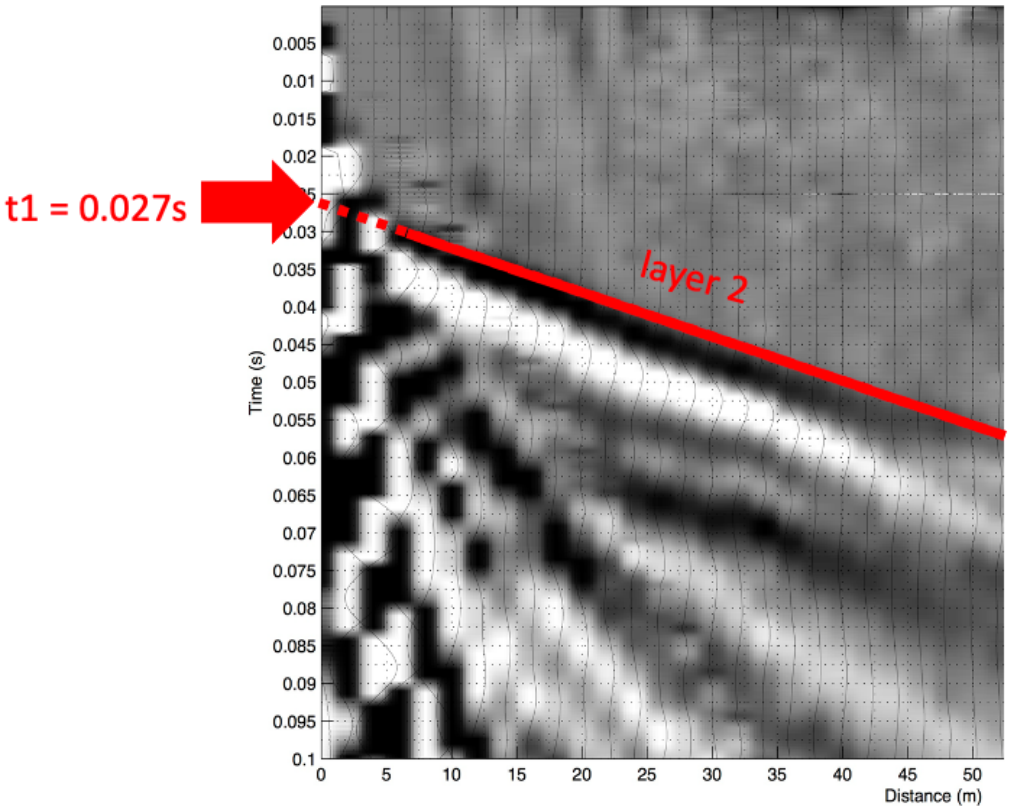
4 – 0 = 4 m
0.03 – 0 = 0.03 s

	d (offset, m)	**t (travel-time, s)**	*difference*
Layer 1	0	0	0.03
	4	0.03	4

rise/run = slope
4 m / 0.03 s = 133 m/s = V1

Now, calculate V2 on your own following the same steps as we just did for V1.

Step 3: find the t1 intercept from the data image



Based on the slope of the layer 2 refraction arrivals that you already identified in step #1, project this line back to the time axis, as shown by the dashed line above. The "t-intercept" will be t1 that we need for the next calculation.

Step 4: now, use the provided equation with the values you just extracted from the data image to calculate the thickness of the top layer, h. (the highlighted V2 in the equation is what you calculated on your own in the previous step)

$$h = \frac{t_1}{2\sqrt{\frac{1}{v_1^2} - \frac{1}{v_2^2}}}$$

$$h = \frac{0.027s}{2\sqrt{\frac{1}{133m/s^2} - \frac{1}{v_2^2}}}$$

Plug this into your calculator or EXCEL to find the final layer 1 thickness answer. now you can draw a diagram showing thicknesses, velocities, and estimates of material properties.