Tuesday, Feb. 25th, 2020

Applied Geophysics – GEO 5660/6660
Lab Exercise # 3

Due: Tuesday, March 10th, 3 PM

(Email lab write-ups to rgmcdermott@aggiemail.usu.edu)

TOPICS: Working with seismic data from the USU Quad and Gosport, IN

PART I: Seismic data from the USU Quad

1. Download .txt files of the data and .tiff images of the seismic traces from the course website. To process the data, you may choose whatever technique you are most comfortable with. Python, MS Excel, MATlab, DataThief (DataThief.org), etc.

2. Compare and contrast the two profiles. What is similar? What is different between the two? What do you suppose the differences might imply about the subsurface under the quad? Are there differences in the profiles with 3 ft versus 9 ft geophone spacing?

3. Using the provided seismic trace images, compare the forward and reverse shots. (HINT: Make the reverse shot partially transparent, flip the image, and overlay on the forward shot. Note the amplitude direction will be switched, this is fine). What can we infer about the subsurface from this comparison?

4. Choose the time of 1st arrival on all profiles, forward and reverse using the software of your choice. Provide images showing your picks!

5. Model your picks in *Refract*. *Include your time-distance plots, model window, and cross section as figures in your write-up*. What in your opinion is the most likely interpretation of what you found?

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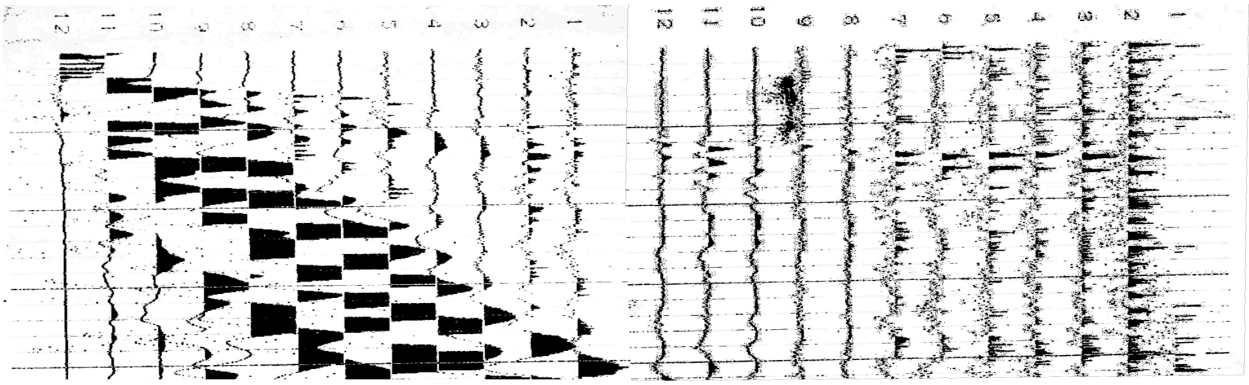
PART II: Seismic data from Gosport, Indiana

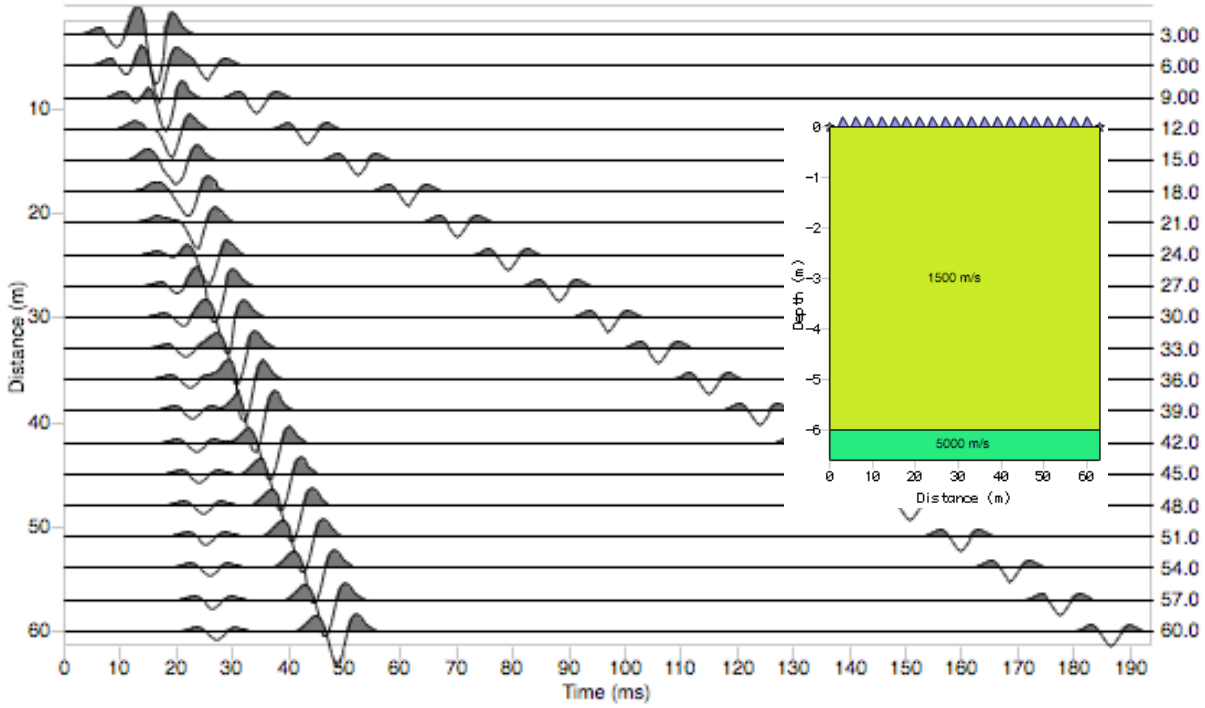


1. Seismic data above were collected on a farm near Gosport, IN. The *faint lines demark 0.01 s intervals; darker lines are at 0.05 s.*

(a) Pick (*as best you can*) the time of the first arrival on each trace. (Hint: The furthest first arrival is at < 0.1 s). *Geophone distances are (0, 4, 8, 12, 16, 20, 26, 32, 38, 44, 50, 56, 62 , 68, 74, 80, 86, 92, 96, 100, 104, 108, 112, 116*) m from the source.

(b) Enter the times & distances into *Refract* and model the velocity structure assuming 0° dip on all layer boundaries. Do any features of the data suggest nonuniform layer thickness?

2. The plot below shows output from the program Reflect. Assume the distance between traces corresponds to a displacement amplitude of 1. Do amplitudes reflect expected relations for geometrical spreading? For attenuation? Why or why not?



Model traces for direct, air, first refracted, 1 reflected waves

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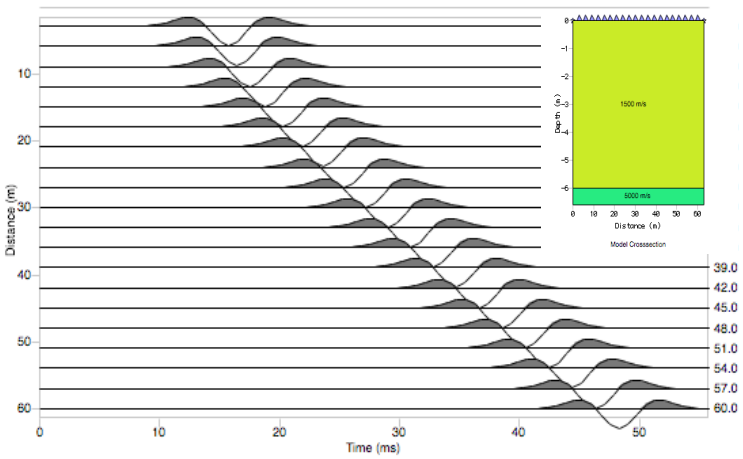
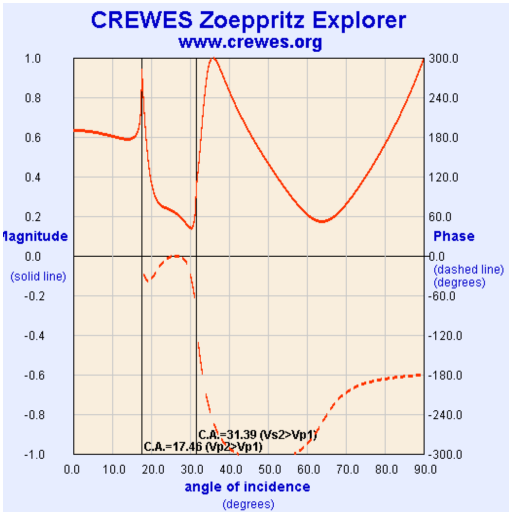
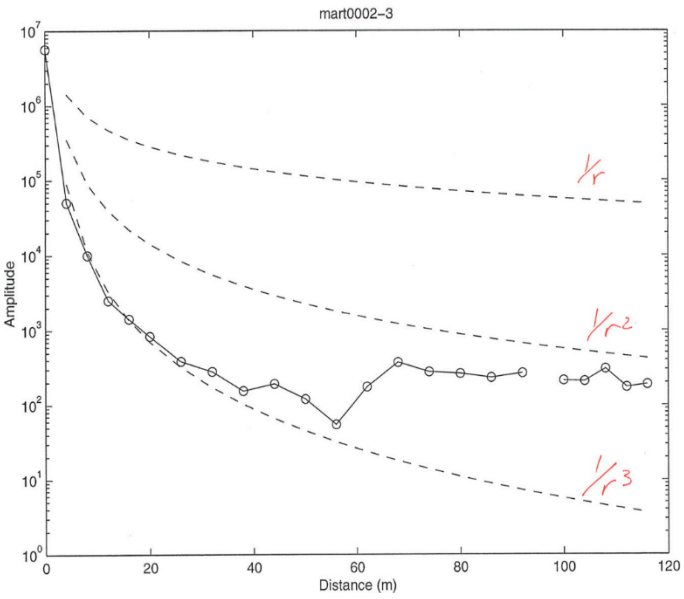
3. In the figure below, the plot at left shows only the reflected wave for the same model.
   (a) Derive a relation for angle of incidence θ of the reflected P-wave as a function of distance.
   (b) The image at right (from the Crewes web application) shows Zoeppritz amplitudes for the reflected P. Are these amplitude relations exhibited in the model at left? Why or why not?



Model traces for 1 reflected waves



4. Amplitudes shown below were measured from first arrivals in the Gosport data
   (a) Are these consistent with what you might expect from your travel-time analysis? Why or why not? (Hint: Think about the propagation path of each arrival!)
   (b) Estimate frequency of the first-arriving wave for each arrival from the plot.
   (c) Correct the amplitudes for the effects of geometrical spreading. Then, separately for each layer, estimate the quality factor (Q_P) of anelastic attenuation.



(d) Assuming that both your velocity and your attenuation structure estimates are correct, look through your text (and whatever other literature you may be able to find, but be sure to include references!) for examples of soils/sediments/rocks that match your estimates of V_P and Q_P. Does the combination of these two properties reduce the ambiguities in possible interpretations? What interpretation of the data would make the most geological sense given the location (farm country near the terminus of Laurentide glaciation)?

REPORTS: Your reports should include any relevant plots, numerical data and short blurbs (nothing formal) for where you are asked to comment. Submit your assignment as a single document (Word, PDF, etc). ***Include your name in the filename.***