University of Arkansas

GEOPHYSICS - GEOL 4433

LAB 02 - INTRODUCTION TO SEISMIC REFRACTION METHODS

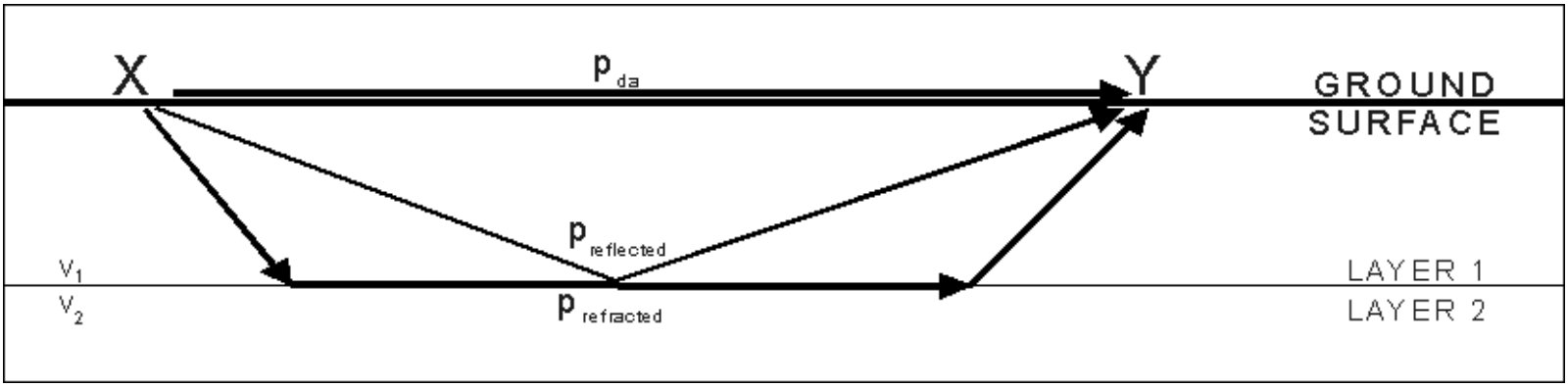
Due Date 18 September 2006

Usually, we do not have access to direct information relating to the elastic properties of rocks. Consider a common geological scenario where you might enter a frontier basin for the first time. You have no prior knowledge of this site - no geologic maps, no stratigraphy, no prior studies for reference.

In such a situation, where do you even begin a study to gain understanding of the geological make-up and history of this basin? It is in these situations that geophysical survey methods are most valuable allies. In particular, seismic refraction and seismic reflection surveys can provide rapid, cost-effective solutions to basic problems of basin analysis.

Your lab today is an attempt to familiarize you with the basic content of a seismic refraction survey. While we cannot conduct a refraction survey of our own at the present time, we can conduct a "virtual survey" by just thinking about it and predicting how the results will look.

Consider the following simple geological situation where you have a single horizontal boundary separating 2 distinct layers. The upper layer (Layer 1) has a velocity, V_1, whereas the lower layer (Layer 2) has a velocity, V_2.



A source disturbance at point X will generate a wave form which might be detected at a receiver, Y, in a number of different ways. We can receive a direct arrival from the source (i.e. a ray path which follows the surface directly to the receiver, p_{da}). We might detect energy reflected from the Layer 1- Layer 2 interface ($p_{reflected}$) or we might detect energy refracted along the L1-L2 interface ($p_{refracted}$). If V_1 = 3000 m s^{-1} and V_2 = 4000 m s^{-1}, and Layer 1 is 5 m thick, construct travel time curves for the direct arrival, the reflected arrival and the refracted arrival to a source-receiver offset of 200 m.

To do this, you must calculate **arrival times** at progressive **source receiver offsets** (distances) up to 200 meters. For this exercise, use offsets of 2, 4, 6, 8, 10, 20, 30, 50, 100, 200 m. You may find it easiest to construct several tables to show your calculations. Produce a separate table for the direct arrival, the reflected *p*-wave and the refracted *p*-wave. What do these tables show? Plot your data on suitable media and examine the results. What do you see? We will discuss these results over the next few days.

To complete your assignment, construct the table as indicated above using Micrsoft Excel or other suitable spreadsheet software. Use the graphics capability of Excel to plot the time-distance relations for the direct arrival, reflected ray, and refracted ray. Upload your spreadsheet file to your comp.uark.edu public_html directory and create a hyperlink on your website so I can download your file to grade it. Your spreadsheet should contain a table of your results and the graphic plot of your data.