Geophysics 223 Lab Assignment 6 – 2009

Ground-penetrating radar

General comments about the write up

- Clearly explain the steps taken to analyse the data
- You should also explain the results which led to your conclusion

Question 1 – Reflection Profiles

Figure 1 shows three different GPR reflection profiles collected at 50, 100 and 200 MHz (a,b,and c respectively). TX-RX offset is fixed.

(a) The first arrival does not vary with horizontal distance. Which wave is this and why is the arrival so strong and flat?

(b) From the wavelength of the GPR pulse (metres), estimate the velocity in the Earth. Do this for all three frequencies.

(c) What vertical resolution you can expect from each profile?

(d) The measured signal vanishes at different depths in each profile. Can you give a quantitative explanation? Estimate the conductivity of the Earth at this location.

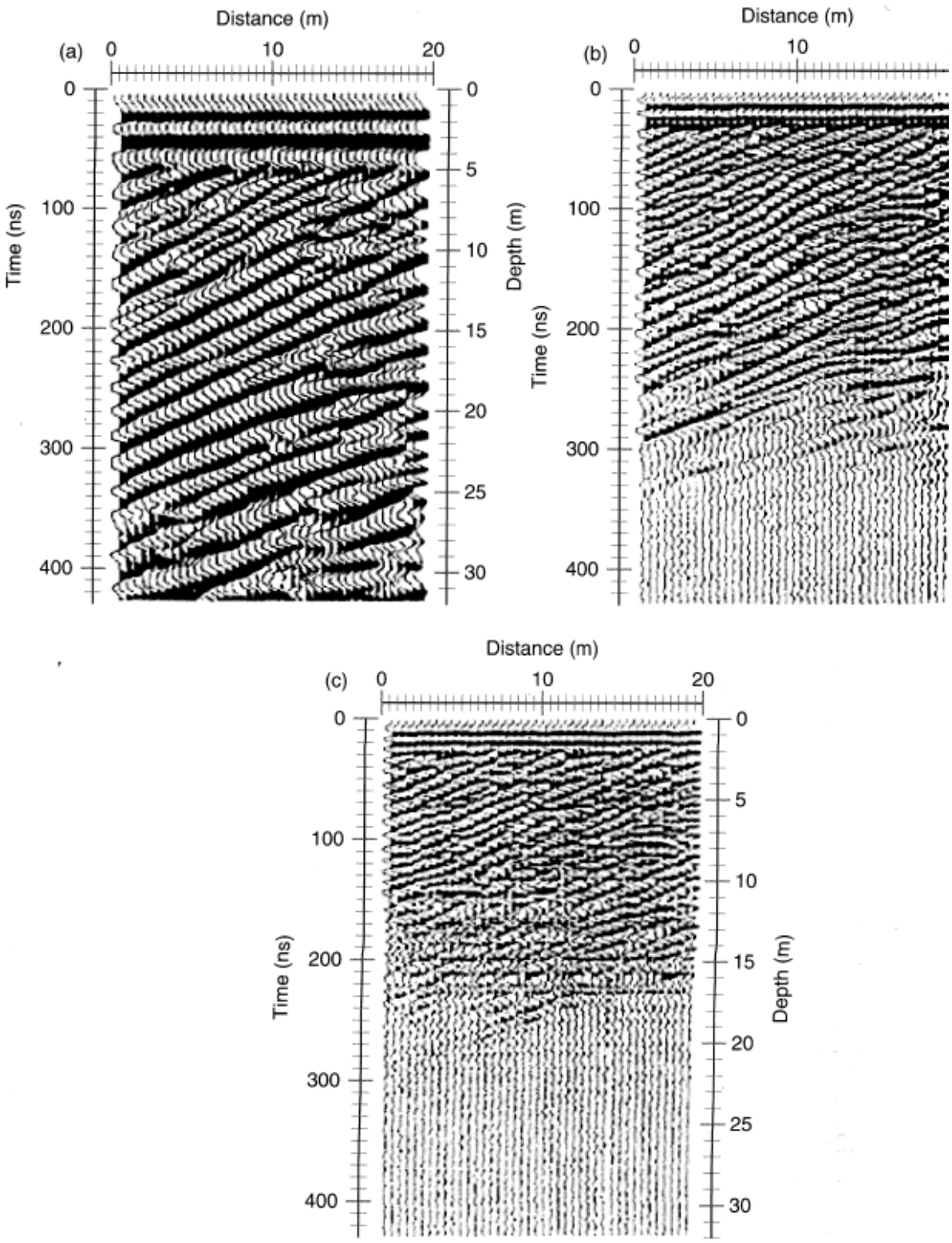

Figure 1 – Reflection profiles at 50 MHz(a), 100 MHz (b), and 200 MHz(c). From Burger et al.,

Question 2 – Wide Angle Reflection and Refraction (WARR)

Figure 2 shows GPR data collected with a fixed transmitter and variable TX-RX offset.

(a) Two arrivals have been highlighted by black lines. Calculate the velocity at which the wave travels and then identify the wave.

(b) Assume that this profile was collected in a location where the subsurface layers are horizontal. Sketch ray paths taken by the reflections at later arrival times.

(c) Choose the reflectors that has t_0 = 52 ns. Assume that the dielectric constant does not change between the surface and that reflector. Calculate the depth to this reflector and the velocity above the reflector by plotting a graph of t^2-x^2 in EXCEL.

Does this velocity agree with your answer to (a)?

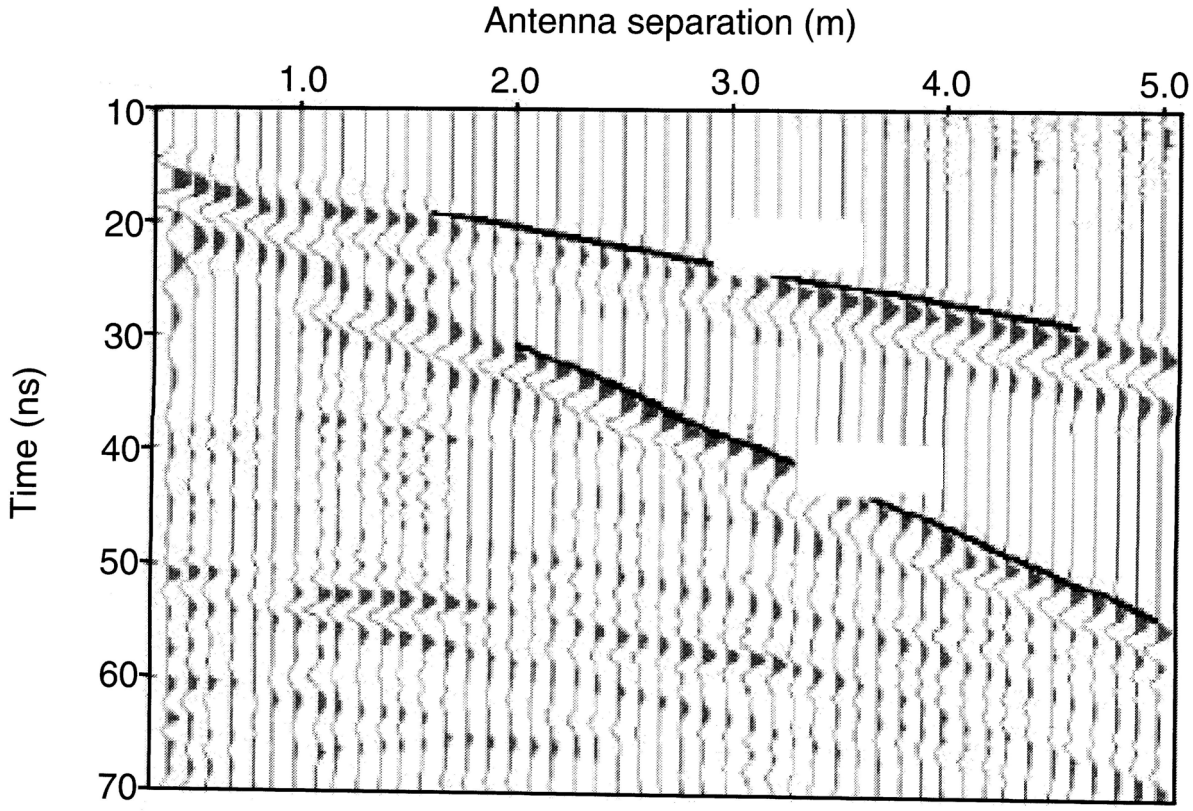

Figure 2 – GPR data collected using 225 MHz antenna (Burger, 1992)

Question 3 – Common Midpoint Profile (CMP)

Figure 3 shows an example of a common midpoint array.

(a) A common midpoint array is designed so that each arrival is reflected at the same subsurface point. Sketch a diagram of the ray paths reflecting from one interface in a CMP array.

(b) Compare your sketch to the sketch from 2(b). Why is it that we measure the same travel times for the ray paths sketched in both diagrams?

(c) Sketch a situation in which the travel times measured by the two different arrays would differ at longer offsets, but the zero offset time is still the same.

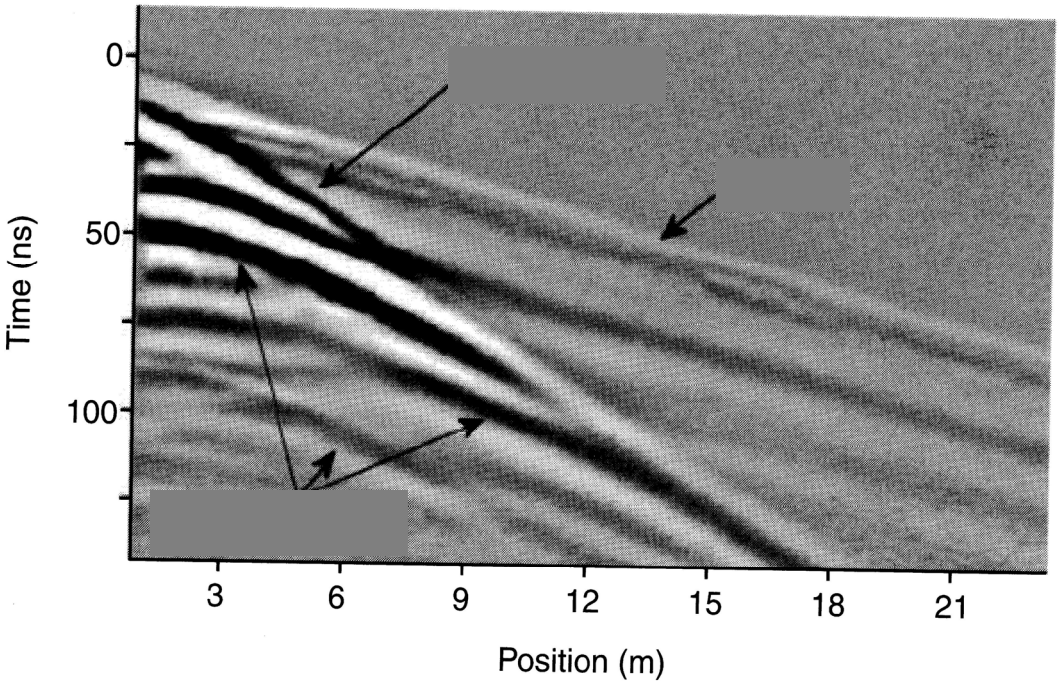

Figure 3 – CMP profile (Burger, 1992)