

1. Earthquake studies near Butte, and the Butte-Challis refraction paper you read, imply a mantle P-wave velocity of 8.0 km/s and a crustal thickness of 40 kilometers beneath that line.

Assume that the mantle and crust velocities of 8.0 km/s and 6.5 km/s respectively, are correct for the Montana-Idaho region and that the Butte-Challis refraction line was over a northeast trending strike line (horizontal line) on the crust-mantle interface.

Suppose a one-way seismic refraction line run to the northwest and perpendicular to the Butte-Challis refraction line returns an apparent mantle P-wave velocity of 7.50 km/s.

a. What is the critical angle for this situation of 6.5 km/s over 8.0 km/s?

b. Can you say anything about the dip, if any, of the crust mantle interface? Why?

c. What is the amount of dip, if any, in degrees?

d. Why is it important that the one-way line is perpendicular to the Butte-Challis refraction line?

2. Consider a site in eastern Chile with longitude 68° west, and latitude 34° south. Suppose a set of time averaged (10^6 years) paleomagnetic directions from the site yields **declination = 68° , inclination = -68°** .

a. What should the time-averaged recent declination and inclination be at the site? Why?

b. What is an apparent pole position and what is its usefulness?

c. Calculate the location of the apparent pole position for the data above:

d. If there is a discrepancy between your apparent pole position and the expected pole position, provide a tectonic hypothesis explaining the difference; include any necessary assumptions or caveats.

3. Suppose you have P & S arrival time data from 15 seismic stations distributed around the globe. Each reports the distance and direction to a recent large earthquake near the Solomon Islands.

a. If a direct P-wave traveling at 8 km/s arrives at a station to the northwest of the epicenter 12 seconds ahead of an S-wave traveling at 6 km/s, how far is the station from the epicenter?

b. If the epicenter is at 160° E, 10° S, how far was it in kilometers from Missoula (114° W, 47° N)?

4. Find the vector average of these declinations and inclinations:

Declination	Inclination				
255	-52				
256	-43				
272	-43				