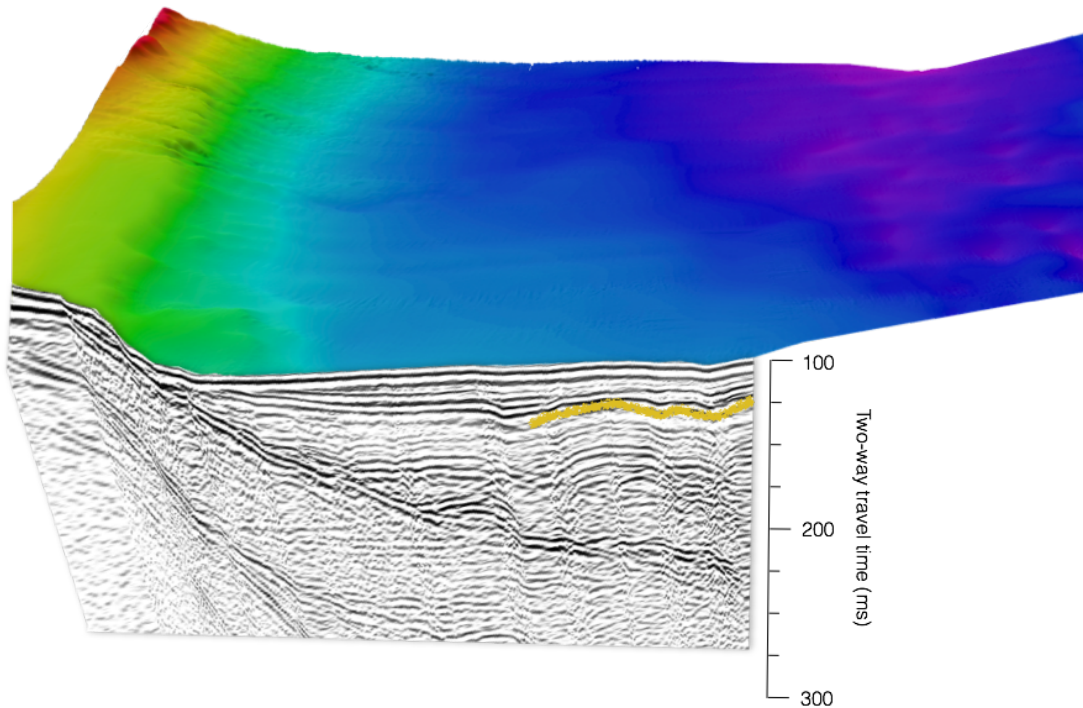


Problem Set Lecture 1: Introduction

1. Calculate the depth from the seafloor to the seismic reflection horizon highlighted by the yellow line in the image below by assuming a reasonable compressional wave velocity for the sediments.



2. Using the Mass and Volume definitions for the bulk density, grain density, fluid density and porosity, show that the following equation is true.

$$\rho_B = \rho_G(1 - \phi) + \rho_f(\phi)$$

3. Re-arrange the equation for bulk density to derive an expression for porosity.

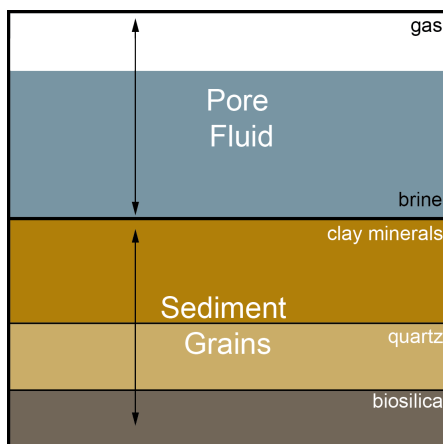
$$\rho_B = \rho_G(1 - \phi) + \rho_f(\phi)$$

4. We know that porosity is measured from 0-100%, but more realistic bounds for sediments are 10-90%. What are the corresponding minimum and maximum value for the void ratio?

5. Calculate the fractional porosity of a brine saturated clean quartz sand with a bulk density of 1600 kg/m^3 , and a clay with a bulk density of 1.6 g/cm^3 .

6. Using Wyllie's Time-Averaged equation, calculate the magnitude of the reflection coefficient if a sound wave passed from oil to brine filled sandstone? Would a pocket of oil in this sandstone unit generate a bright spot or a dim spot? Assume a porosity of 25% for the sandstone, a grain density of 2.65 g/cm^3 , and a matrix velocity of 4000 m/s . The brine has a density of 1.024 g/cm^3 and the oil 0.230 g/cm^3 .

7. Determine the bulk density of a sediment parcel that has a porosity of 50%, but whose pore fluid composition is 25% gas (density of 0.0009 g/cm^3), and 75% brine, and the solid fraction is composed of 30% quartz, 20% biosilica, and 50% clay minerals.



8. What is the difference between an empirical equation, and one that is derived from first principles? Provide an example of each from the lecture.

9. In the context of downhole logging, what is meant by the term *fluid invasion*, and what effect does it have on logging measurements?

10. You are comparing the sedimentology of a recovered core, with the measurement from a generic logging tool. You notice 2 identical clean sand layers in the core. They have the same porosity and composition, but one is thicker. However, the logging response across these two units is quite different. A) Why does the magnitude of the logging measurement differ across these two units? B) Why does the logging tool measurement start to change before and after the lithologic change, and not at the exact boundary?

