

Geophysics 223 Assignment 1 (2009)

Answering the following questions will require formulae from the notes

This assignment will be due in class on **Wednesday January 28 2009**

Question 1

Samples of copper and granite are being studied in the lab. Each sample is a cylinder that 10 cm long and has a radius of 1 cm. Copper has a resistivity $\rho = 10^{-8} \Omega\text{m}$ and granite has a resistivity of $2000 \Omega\text{m}$

- (a) What is the resistance of each cylinder to current flow along the cylinder?
- (b) What voltage is required to make a current of 0.1 A flow along each cylinder?

Question 2

Consider the rock sample shown in the notes in B1.3.4

Assume that the cube of rock is 1 m long on each side.

Compute the resistivity of the cube to electric current flow that is (a) parallel and (b) perpendicular to the cracks.

Hint : Two resistors have resistances R_1 and R_2

When combined in **series**, the total resistance is R_{ser} where $R_{\text{ser}} = R_1 + R_2$

When combined in **parallel**, the total resistance is R_{par} where $1/R_{\text{par}} = 1/R_1 + 1/R_2$

Question 3

A layer of sediments was found to have a bulk resistivity of $200 \Omega\text{m}$ and is completely saturated with pore fluid containing 20 g per litre TDS.

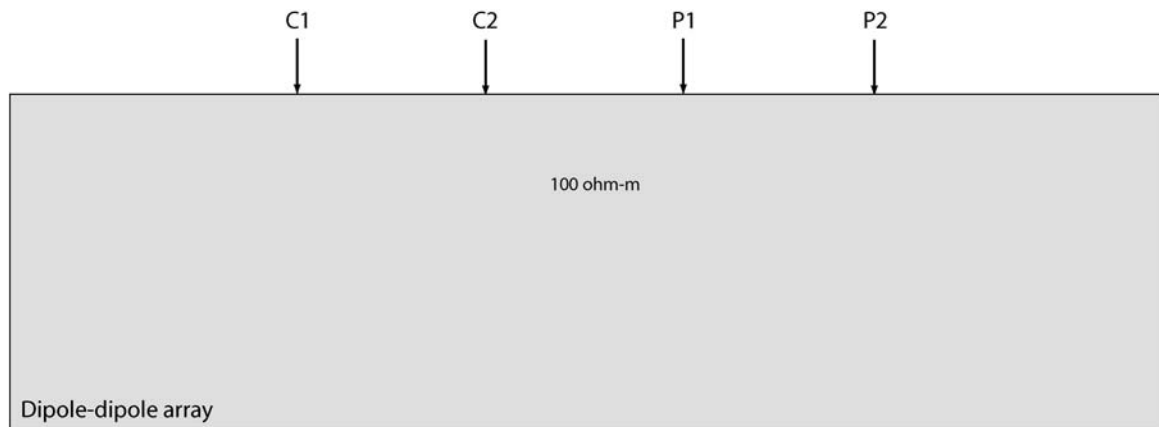
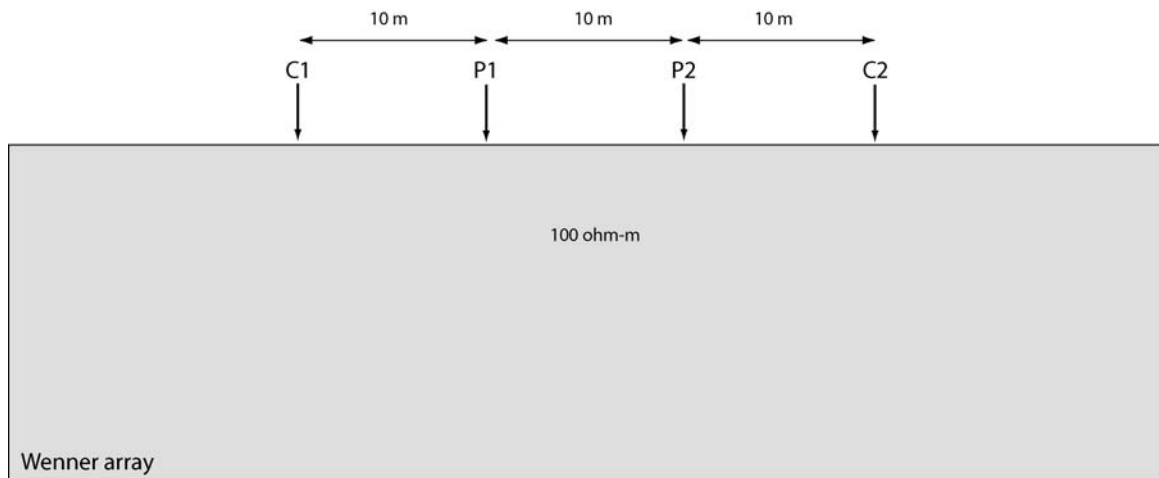
What range of porosities are predicted by Archie's Law?

How will your answer change if clay is present?

Question 4

Two electrode arrays are being used to measure the resistivity of the Earth (Wenner and dipole-dipole). The resistivity of the Earth is $100 \Omega\text{m}$ in the study area

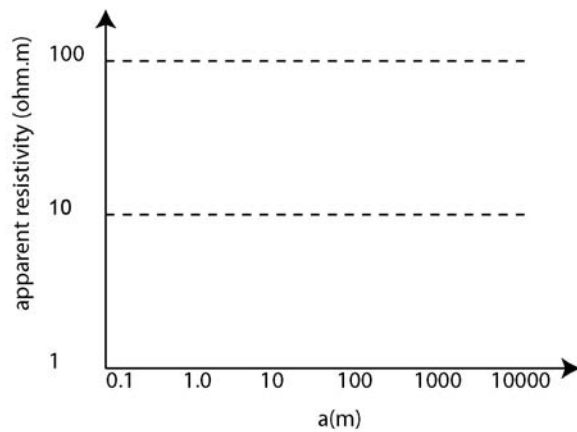
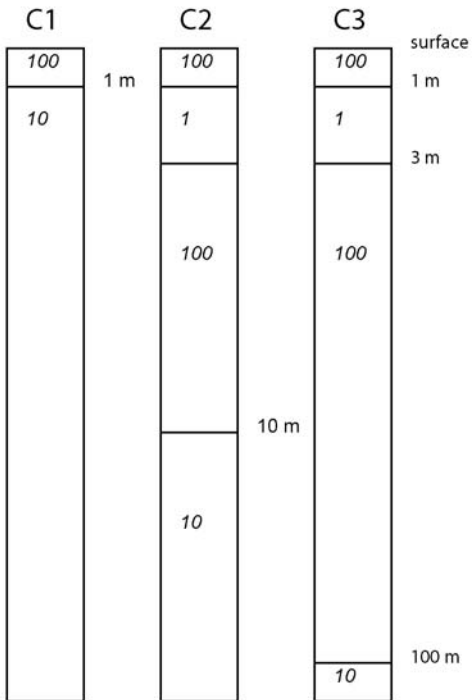
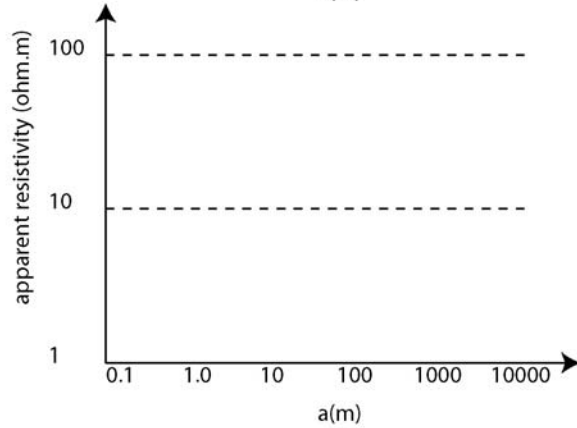
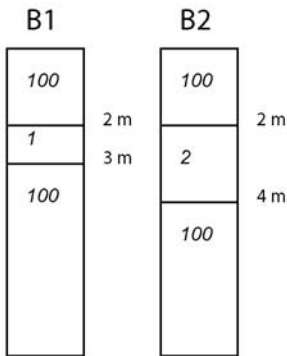
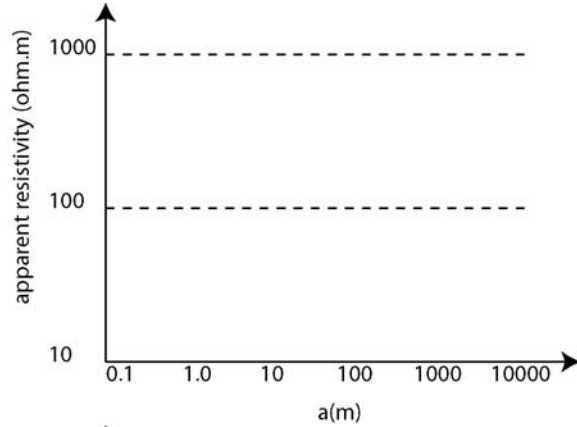
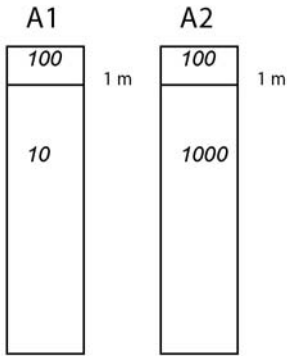
- A current of 0.01 A (10 milliamps) flows in the ground between the current electrodes. What voltage will be measured between the electrodes in each array?
- Sketch the pattern of electric current flow in each array.
- An accurate measurement requires that a voltage of 0.01 V is measured between the potential electrodes. What current is needed in each case to achieve this?



Question 5

The figure below shows 3 sets of 1-D resistivity models. Sketch the apparent resistivity that would be measured for each with a Wenner array. Be quantitative where possible.

Sketch your answers on this sheet.



All resistivity values are in ohm.m

Name _____