Name:_____

Direct Current & Induced Polarization

December 2, 2016

Multiple Choice

DC Resistivity

1. Which of the following statements is true regarding the flow of currents in a DC resistivity survey?
   (a) Currents are deflected into conductive bodies but flow around resistive bodies.
   (b) Primary current densities flow from the A to B current electrodes.
   (c) Electrical currents flow along conductive layers making it difficult to sample material beneath them.
   (d) All of the above

2. On an interface between two regions of differing conductivity
   (a) Positve charges build up when the current passes from the more resistive to the more conductive unit.
   (b) Positve charges build up when the current passes from the more conductive to the more resistive unit.
   (c) Positive charges will always always build up on the interface ragardless of the current direction.
   (d) Negative charges will always always build up on the interface ragardless of the current direction.

3. Of the factors listed below, which does not contribute to the electrical conductivity?
   (a) Density
   (b) Porosity
   (c) Salinity of fluids
   (d) Hydraulic permeability

4. Which of the following DC resistivity electrode arrays has the largest depth of investigation but the lowest spatial resolution?
   (a) Dipole-Dipole
   (b) Pole-Dipole
   (c) Schlumberger
   (d) Pole-Pole

5. Which factor least affects the depth of investigation of a DC resistivity survey?
   (a) Current electrode separation
   (b) Conductivity of the overburden
   (c) Separation between the potential electrodes
   (d) Distance between current and potential electrodes

6. Conductivities of earth materials are often expressed in mS/m. A value of 100 mS/m corresponds to what resistivity?
   (a) 100 Ωm
   (b) 1 Ωm
   (c) 10 Ωm
   (d) 0.01 Ωm

7. Which of the following statements is NOT true for a DC resistivity survey
   (a) The DC resistivity datum is the voltage difference at the surface of the earth measured between two electrodes.
   (b) The current flow in the earth is distorted because of the variation of electrical conductivity in the earth.
   (c) The strength of the measured voltage difference is related to subsurface charges through Coloumbs Law.
   (d) A generator connected to a single probe inputs current into the ground.

8. DC resistivity surveys might be useful in which of the following situations.
   (a) Finding sand and gravel deposits in a peat bog.
   (b) Determining the depth to bedrock.
   (c) Finding a buried tunnel.
   (d) All of the above.

9. Which of the following statements about pseudo-sections is NOT accurate?
   (a) Pseudo-sections are typically used for plotting 2D DC and IP data.
   (b) Pseudo-sections can be easily interpreted to identify the location of anomalous bodies.
   (c) The vertical axis on a pseudo-section relates to separation of the current and potential electrodes, and therefore does not provide a true depth.
   (d) Pseudo-sections are often useful for reconnaissance purposes sincethey can help you pick out the rough along line location of anomalous targets.

10. Which of the following scenarios can present difficulties for a DC resistivity experiment?
    (a) Locating a resistive target beneath a thick conductive overburden.
    (b) Locating a conductive target beneath a thick conductive overburden.
    (c) Locating a shallow, air filled tunnel in a moderately conductive background.
    (d) Both (a) and (b)
    (e) (a), (b) and (c)

Induced Polarization

11. What physical property are we most interested in measuring when we perform an IP survey, and what are the typical units we use?
    (a) Resistivity in Ωm
    (b) Conductivity in Siemens/m
    (c) Chargeability in Volts
    (d) Chargeability in mVolts/Volts

12. Which are the following statements is incorrect when considering induced polarization?
    (a) The IP response can be identified through the phenomenon that the voltage continues to increase in time as constant injected current into the ground.
    (b) The IP effect is also known as the over-voltage effect.
    (c) Chargeability is closely related to IP .
    (d) The value for the intrinsic chargeability (η) is usually $\eta > 1$.

13. Which suites of earth materials will display the highest chargeabilities?
    (a) Gravels, and sulfides
    (b) Clays, graphite and pyrite
    (c) Alluvium, clays, limestone
    (d) Pyrite, limestone and clays

Both/General

14. Which of the following statements about pseudo-sections is NOT accurate?
    (a) Pseudo-sections are typically used for plotting 2D DC and IP data.
    (b) Pseudo-sections can be easily interpreted to identify the location of anomalous bodies.
    (c) The vertical axis on a pseudo-section relates to separation of the current and potential electrodes, and therefore does not provide a true depth.
    (d) Pseudo-sections are often useful for reconnaissance purposes since they can help you pick out the rough along line location of anomalous targets.

15. Which of the following statements is correct
    (a) The DC resistivity data are first inverted to produce an electrical conductivity model which is then used when inverting the IP data.
    (b) The IP data are first used to generate a pseudo-section which is then directly inverted to yield chargeability. The process is identical to inverting DC resistivity data.
    (c) The IP data are plotted as pseudo-sections and then directly interpreted in terms of geology.
    (d) The IP data are converted to voltages and then inverted as DC resistivity data.

Short Response

16. Consider the current electrode geometry outlined in Figure 1.

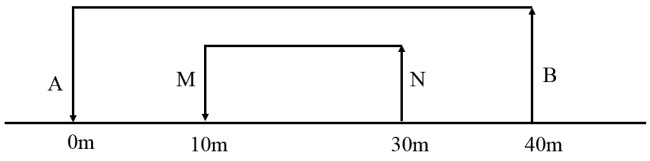
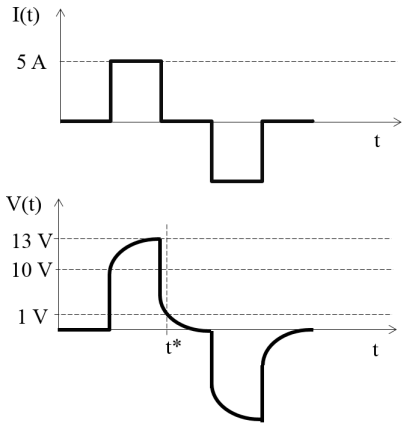


Figure 1: Simple electrode geometry.

- Sketch the electric potential along a line that extends from (-10, 50) m. As indicated, A is the positive current electrode and B is the negative current electrode.
- Indicate on your sketch what the voltage (potential difference) would be if the volt meter is attached to the locations M and N. For the voltage measurement, M is connected to the positive end of the volt meter and N is connected to the negative terminal.
- Suppose that the input current was 5 Amperes. The current waveform and the measured voltages are shown below.
- What is the apparent resistivity of the earth that gives rise to the measured potential?
- What is the value of the IP datum at time t*?

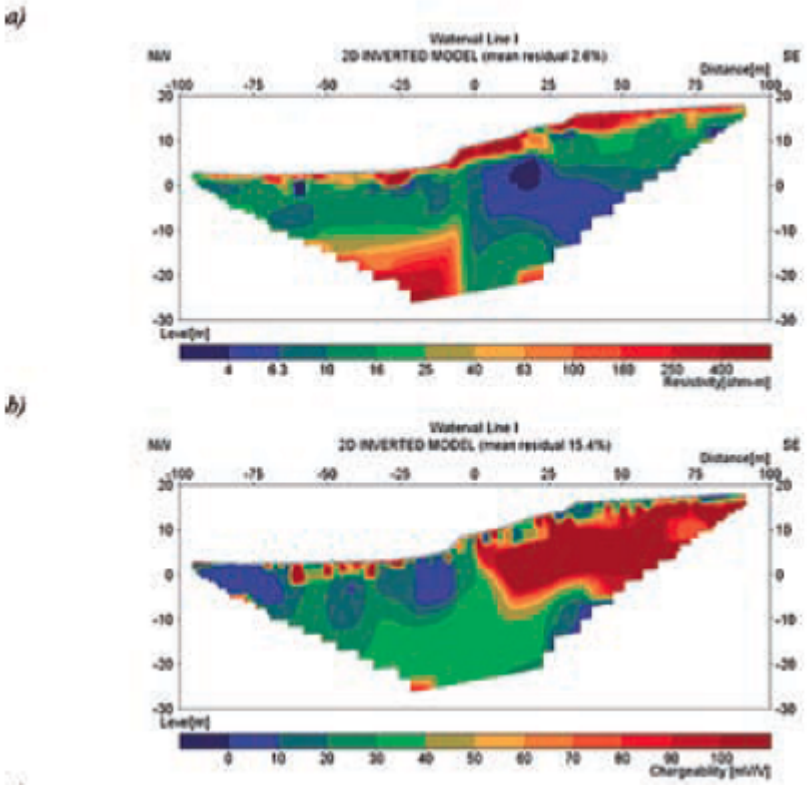


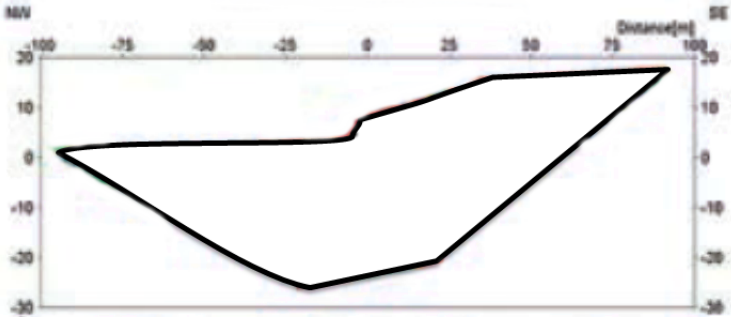
17. The below resistivity (a) and chargeability (b) models shown below were recovered by inverting DC and IP data collected over a waste deposit in South Africa. Note that on the left plot, red is more resistive, and on the plot on the right, red indicates a more chargeable material. There are several geologic units to consider:

    - gravels
    - sediments
    - granitic basement
    - organic waste
    - leachate with a high ion concentration

Material	Resistivity	Chargeability
Gravels		
Sediments		
Granitic basement		
Organic Waste		
Leachate		

    The granitic basement is overlain by sediments and cut by a fault. The surface layer is composed of gravels. Use the physical properties, and the geophysical results below to draw an interpreted geologic cross section (including all of the materials discussed above).


a)
Waterval Line I
2D INVERTED MODEL (mean residual 2.6%)
NW
SE
Distance[m]
-100 -75 -50 -25 0 25 50 75 100
20 10 0 -10 -20 -30
Level[m]
4 6.3 10 16 25 40 63 100 160 250 400
Resistivity [ohm-m]
b)
Waterval Line I
2D INVERTED MODEL (mean residual 15.4%)
NW
SE
Distance[m]
-100 -75 -50 -25 0 25 50 75 100
20 10 0 -10 -20 -30
Level[m]
0 10 20 30 40 50 60 70 80 90 100
Chargeability [mV/V]


NW
SE
Distance[m]
-100 -75 -50 -25 0 25 50 75 100
20 10 0 -10 -20 -30