



# Electrical Resistivity



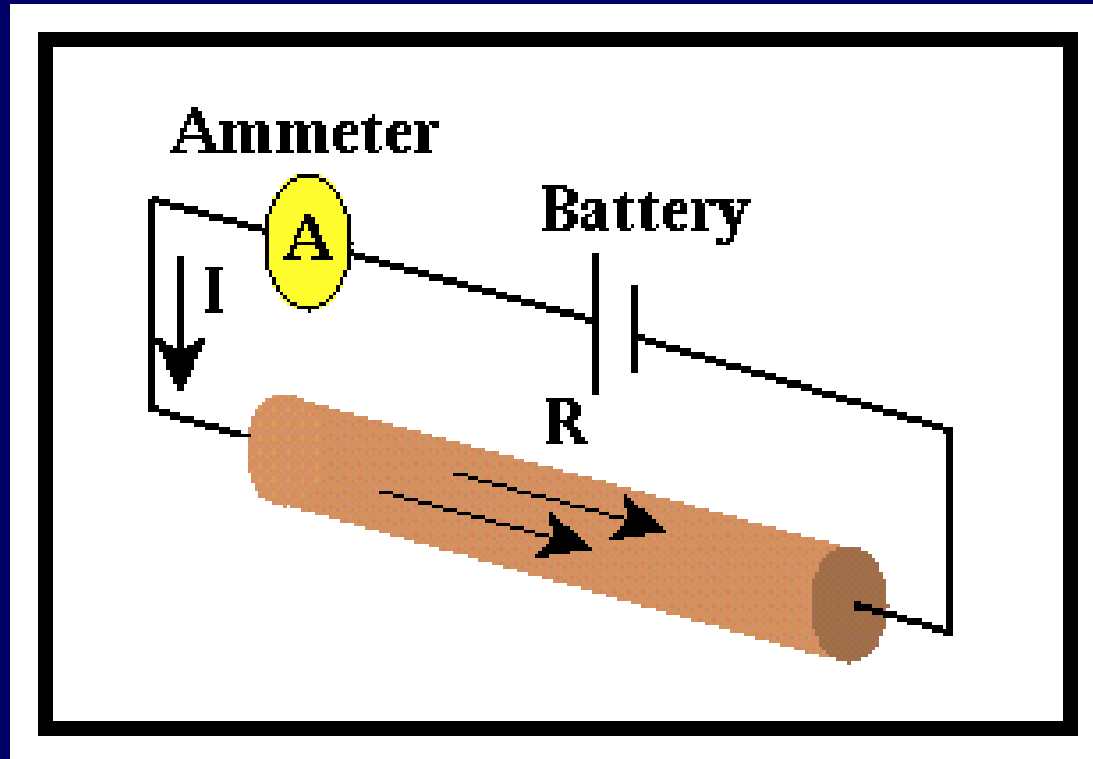


# Resistivity

- Resistivity is the property of a material that resists the flow of electrical current.
- Property that describes a material's ability to transmit electrical current that is independent of the geometrical factors.



# Voltage - Current Relationship

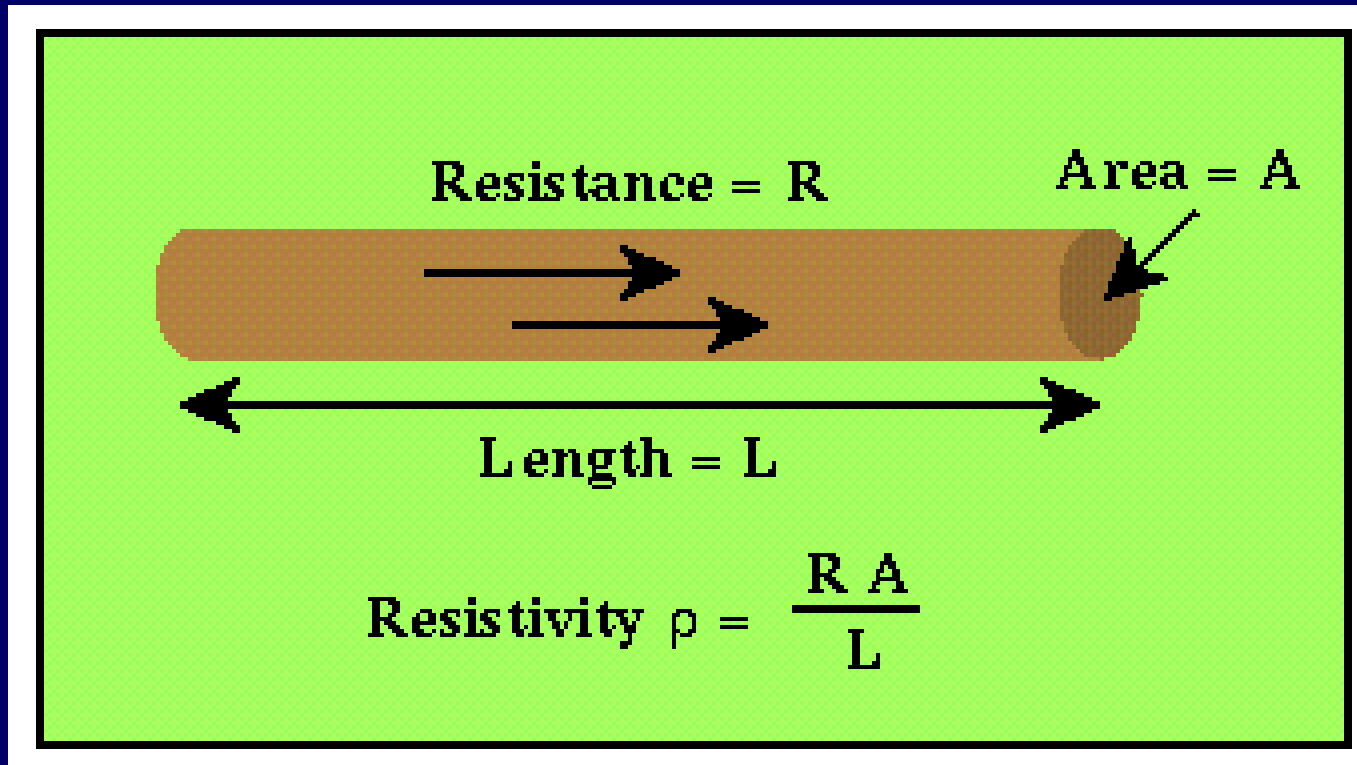


$$V = IR$$

# Resistance and Resistivity

Resistance: depends on the material and the geometry

Resistivity: independent of the geometry



# Resistivity of Earth Materials

Material	Resistivity (Ohm-meter)
Air	Infinite
Pyrite	$3 \times 10^{-1}$
Galena	$2 \times 10^{-3}$
Quartz	$4 \times 10^{10} - 2 \times 10^{14}$
Calcite	$1 \times 10^{12} - 1 \times 10^{13}$
Rock Salt	$30 - 1 \times 10^{13}$
Mica	$9 \times 10^{12} - 1 \times 10^{14}$
Granite	$100 - 1 \times 10^6$
Gabbro	$1 \times 10^3 - 1 \times 10^6$
Basalt	$10 - 1 \times 10^7$
Limestones	$50 - 1 \times 10^7$
Sandstones	$1 - 1 \times 10^8$
Shales	$20 - 2 \times 10^3$
Dolomite	$100 - 10,000$
Sand	$1 - 1,000$
Clay	$1 - 100$
Ground Water	$0.5 - 300$
Sea Water	$0.2$

# Resistivity Methods

- Profile: to map lateral variations; electrode spacing is fixed for all readings
- Sounding: to map vertical variations
- Voltmeter: measures voltage (potential difference in volts)
- Ammeter: measures the amount of current flowing into the ground (amperes)

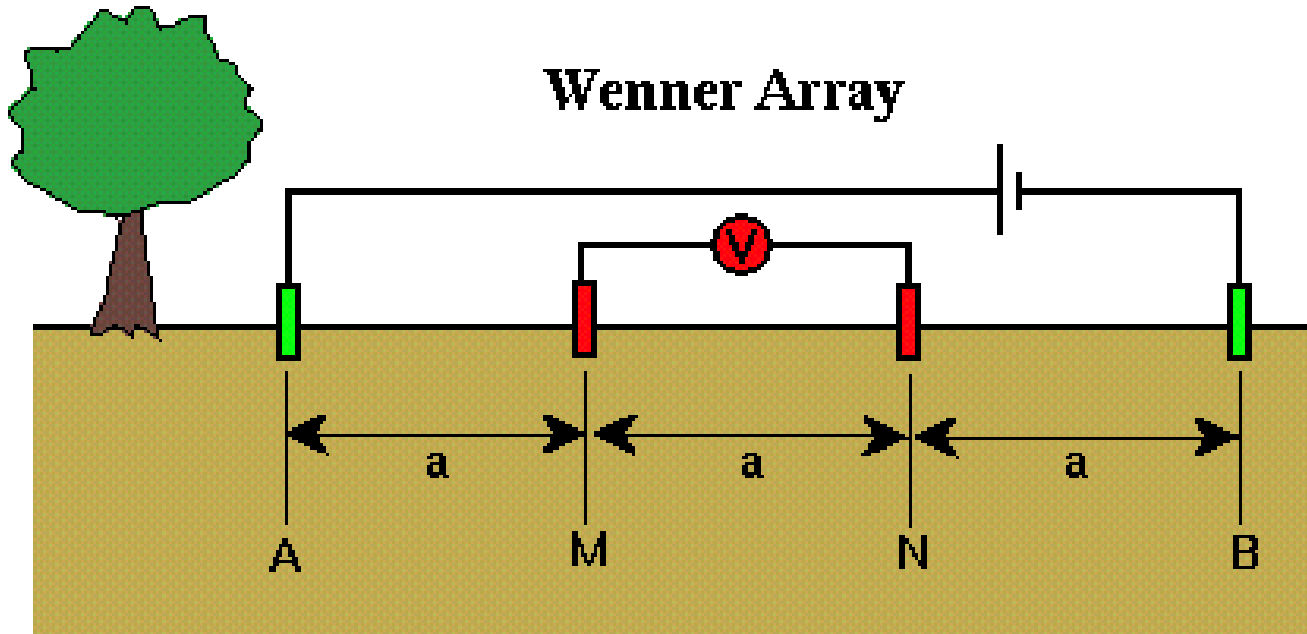
# Conducting the Survey

- Profile or Sounding? - Decide
- Choose the electrode configuration:  
Wenner, Schumberger, Dipole-dipole
- Profiling: keep the electrode spacing constant, move the electrodes in a grid pattern, Wenner
- Sounding: Increase the electrode spacing for each reading from a center point

# Interpretation

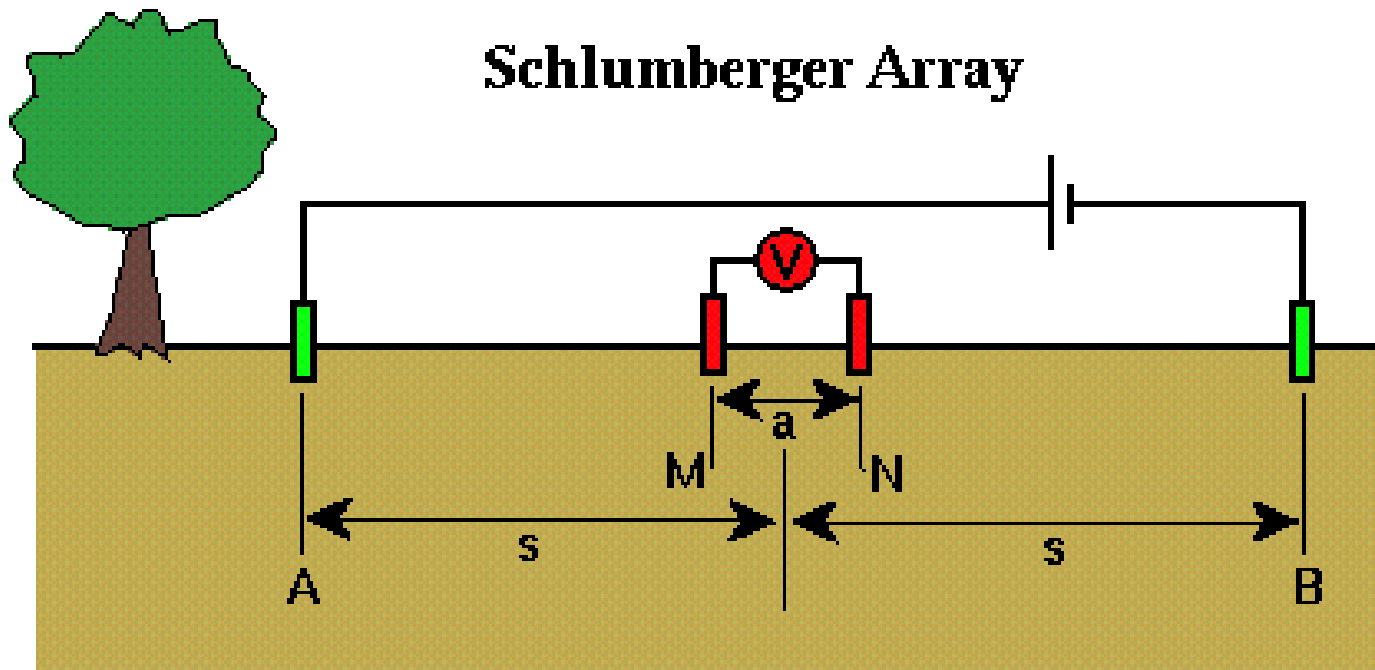
- Knowing the current, potential difference (voltage), and the electrode spacing, apparent resistivity is calculated
- Plot (log-log) apparent resistivity Vs electrode spacing
- Match the field data to a theoretical curve
- Theoretical curves are available for various layer thicknesses and resistivities
- Inverse modeling softwares are used





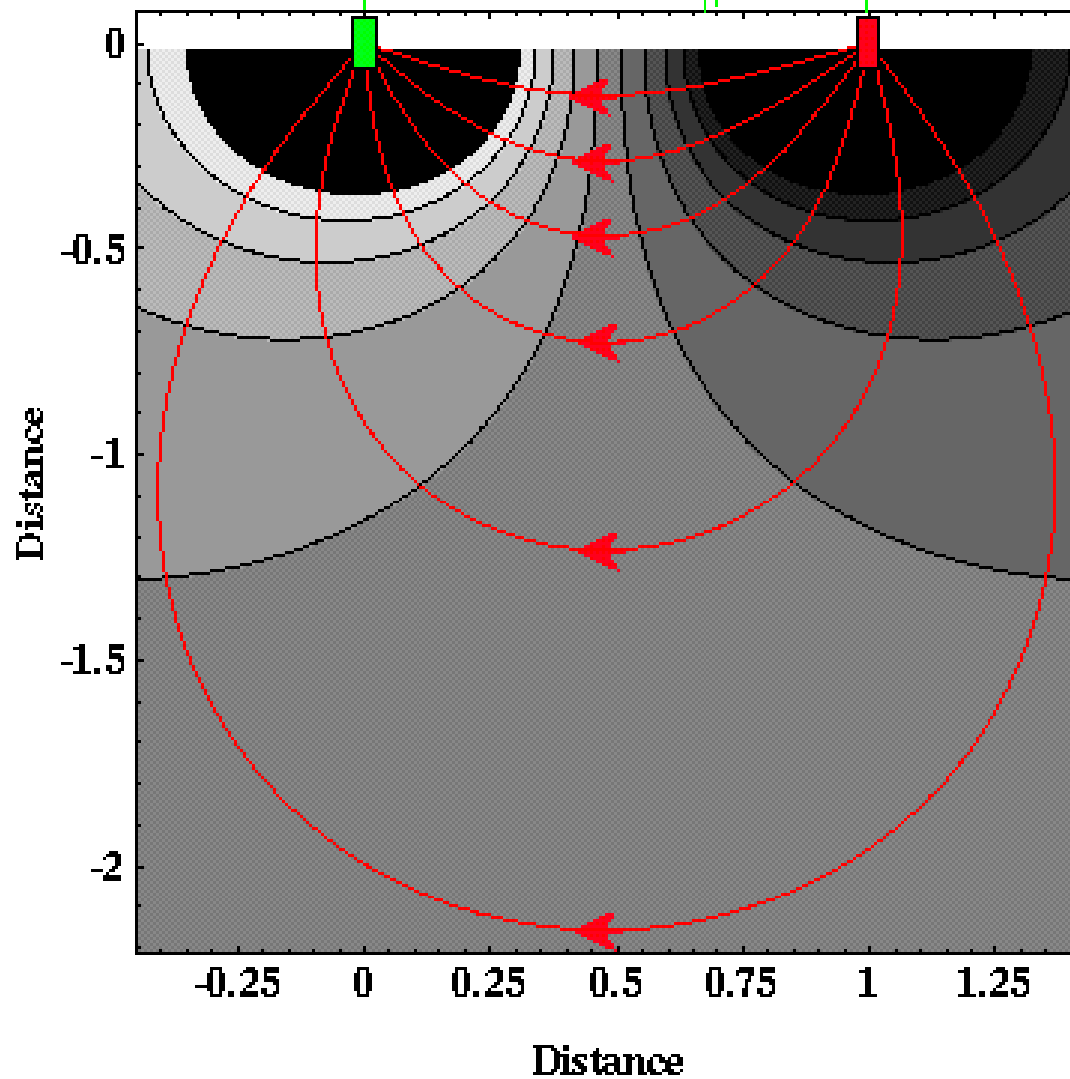
$$\rho_{\alpha} = 2\pi a \frac{\Delta V}{i}$$

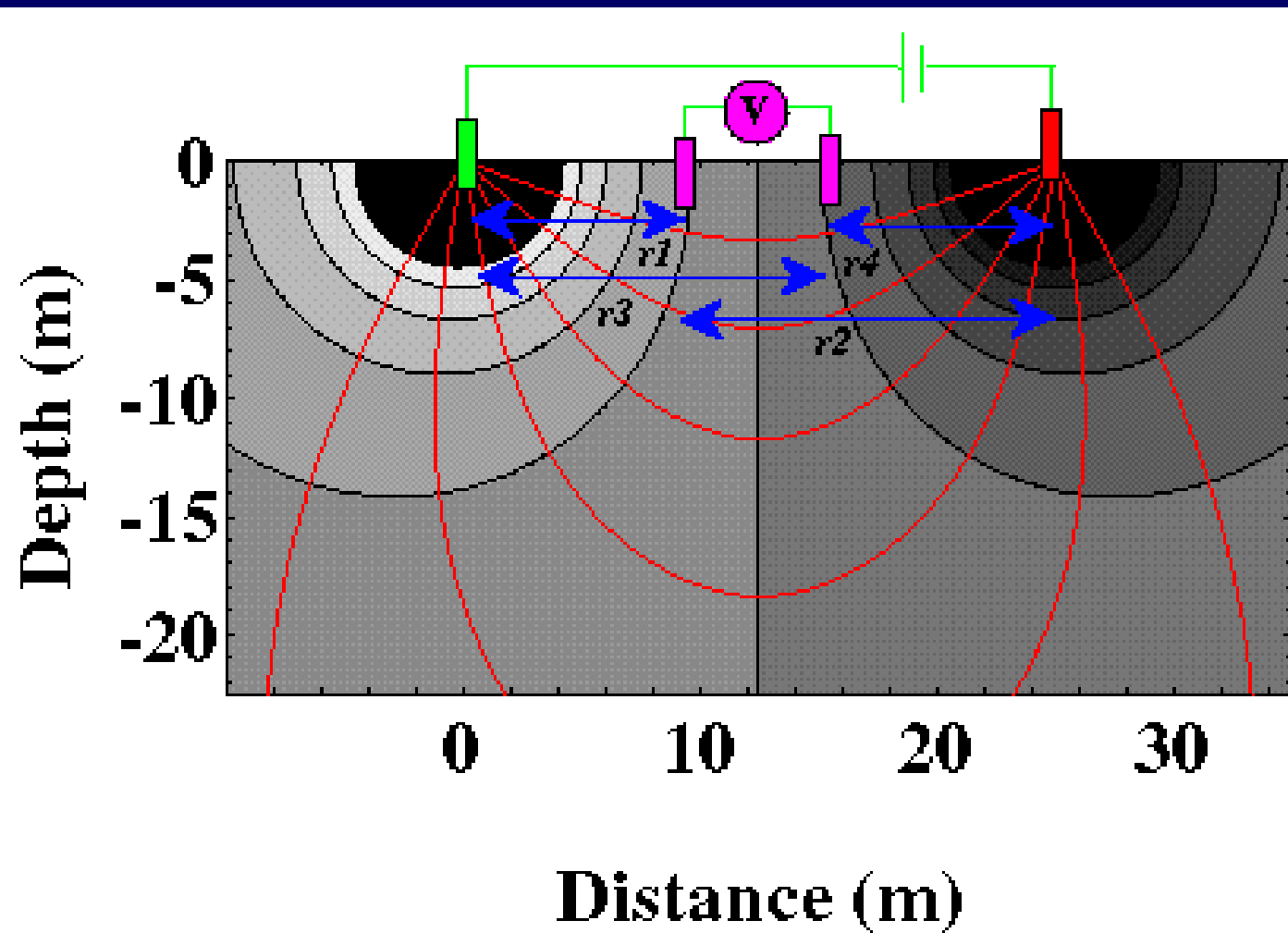
## Schlumberger Array



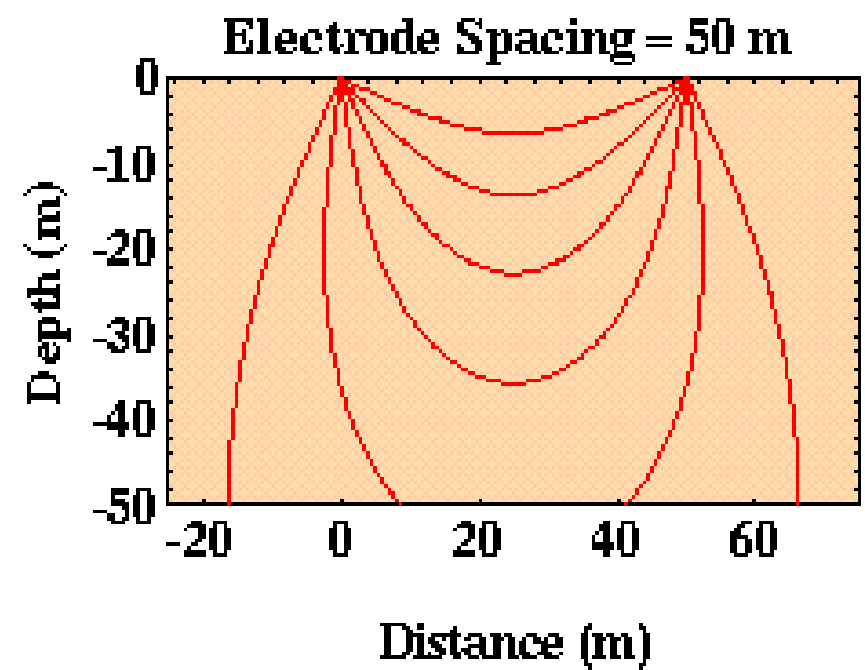
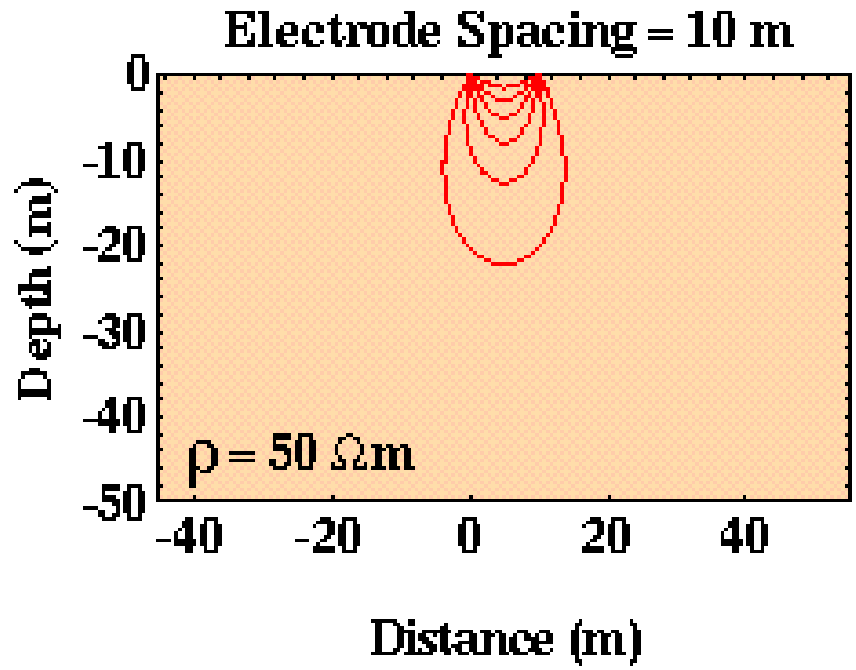
$$\rho_a = \frac{\pi(s^2 - a^2/4) \Delta V}{a i}$$

### Current Flow and Potentials



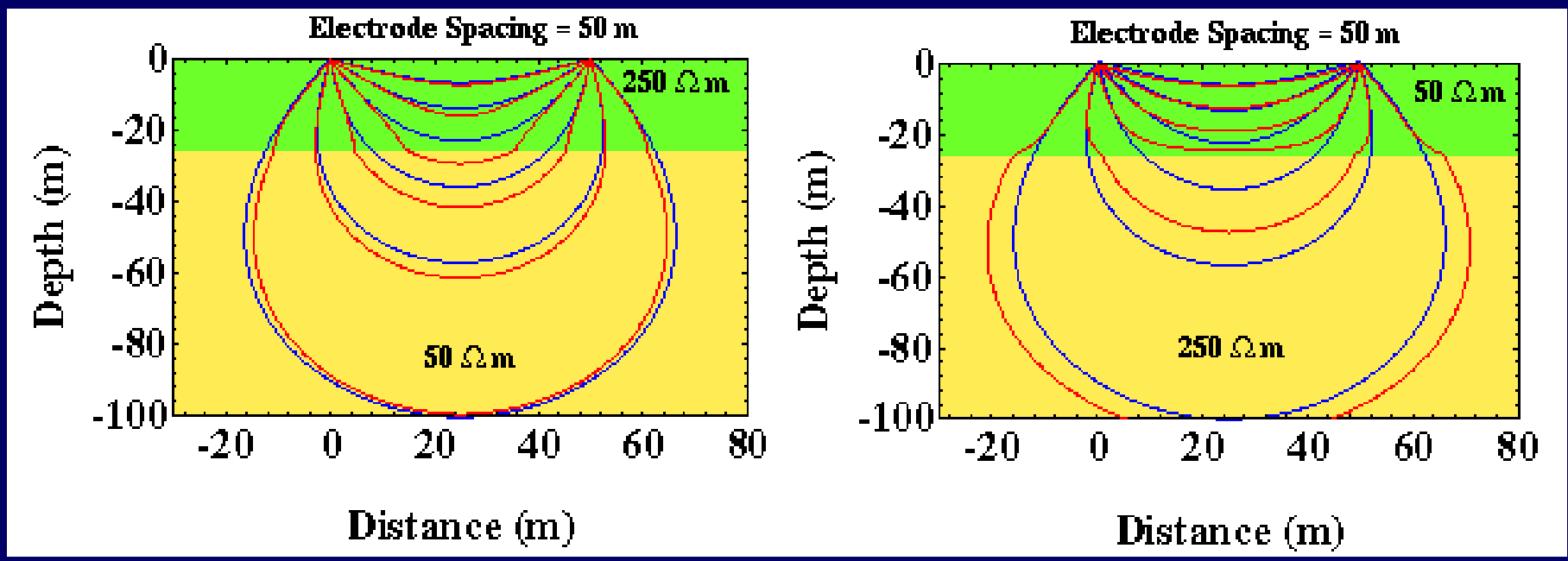


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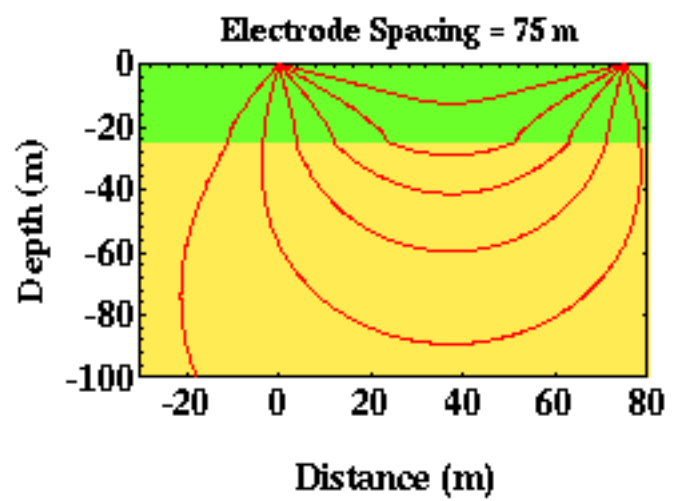
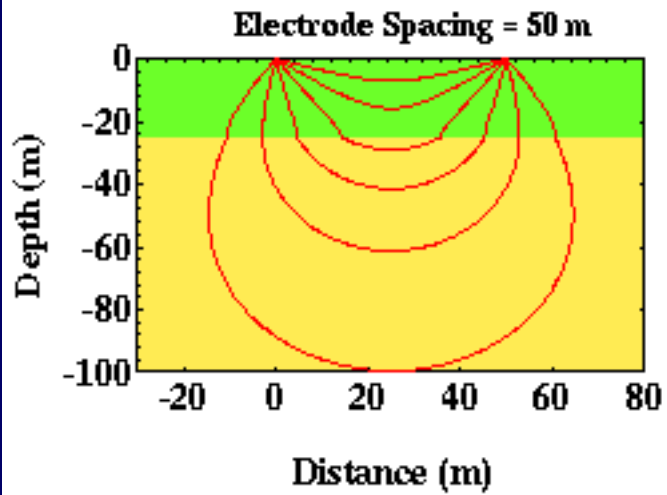
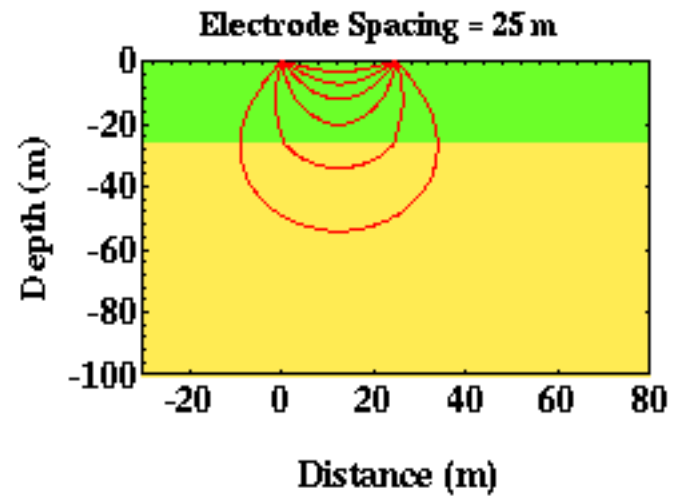
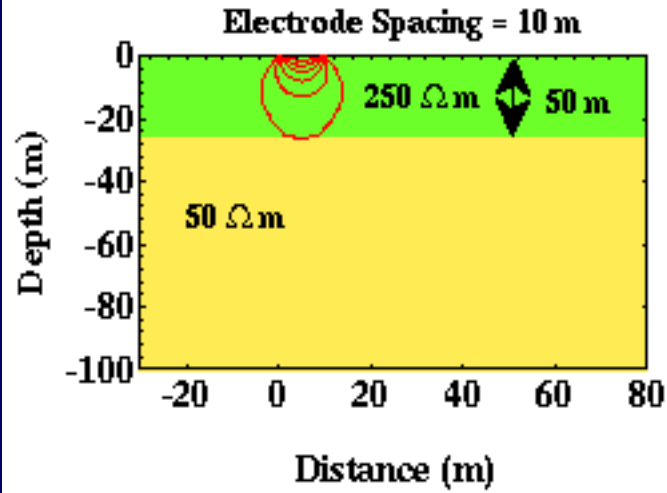


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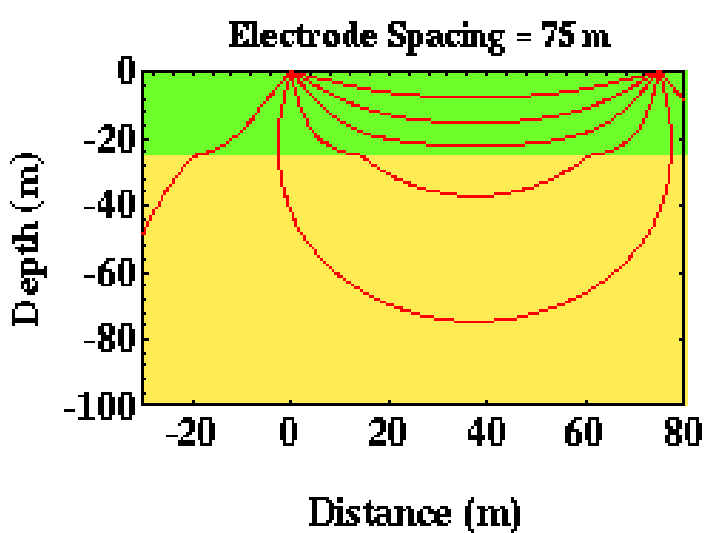
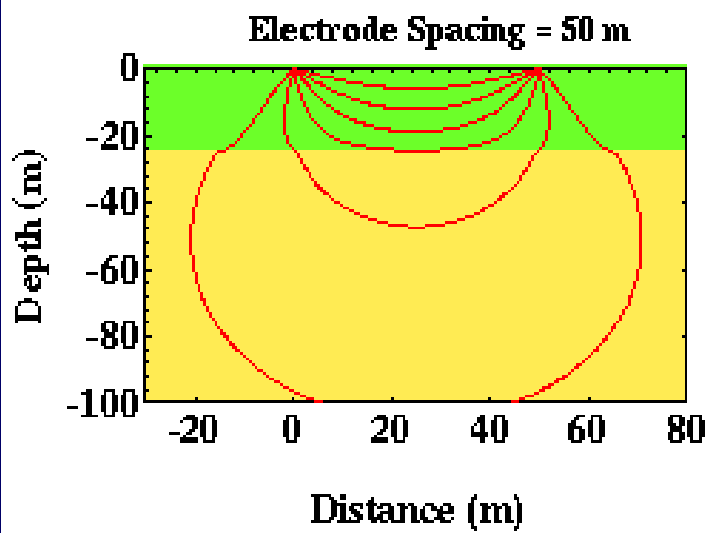
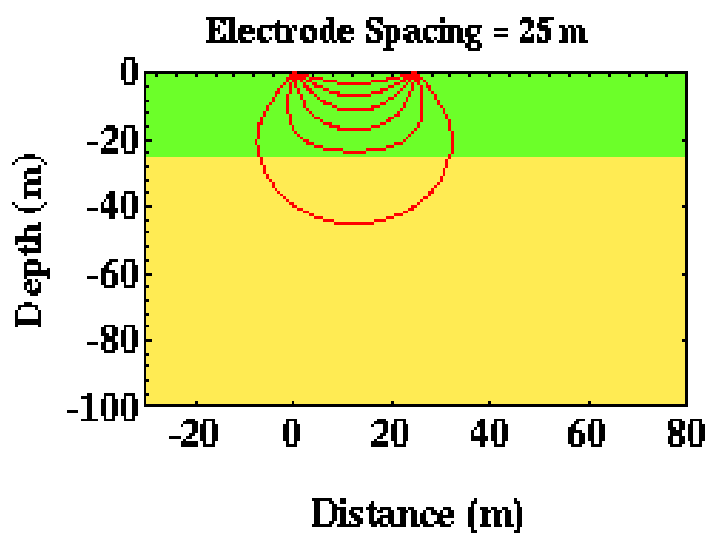
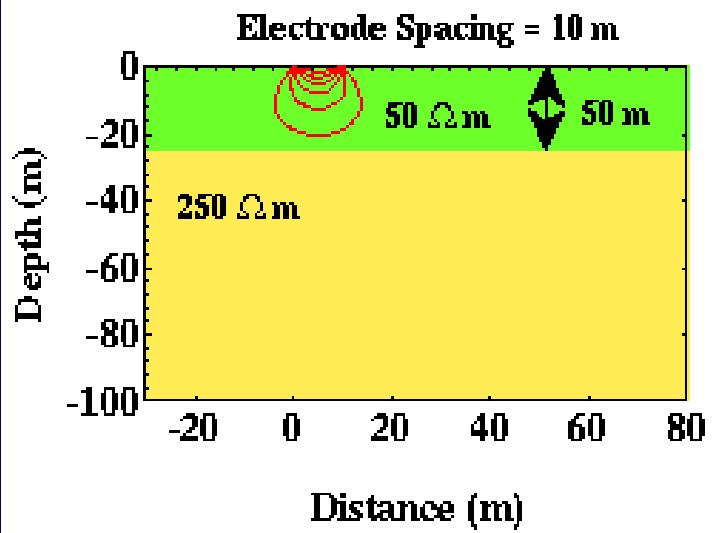


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### Low Resistivity Layer

