SELF POTENTIAL METHOD

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m.sc3rd sem

Disclaimer:

This presentation is a part of the assignment for MSc III Semester Mineral Exploration theory paper. This is an attempt to enable the students to collect and review the literature, prepare powerpoint presentation and present the work, independently. The data and literature used here has been taken from various sources, and duly acknowledged. This can help as a guideline, and should not be treated as final.

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Introduction :-

- sp is also called spontaneous polarization and is naturally occurring difference between points in the ground.

  sp depends on small potential or voltages being naturally produced by some massive ores.

- It associate with sulphide and some types of ores.

  it works strongly on pyrite, pyrrhotite, chalcopyrite, graphite.

Occurrence of self potential:-

- sp method is passive i.e. Differences in natural ground potentials are measured between any two points on the ground surface.
- The potential measured can range from < a millivolt (mv) to > 1 volt.
- + or – sign of the potential is an important diagnostic factor in the interpretation of sp anomalies.
- Self potentials are generated by a number of natural sources.

Anomalies:-

natural ground potential consists of 2 components –

1. Background potentials- fluctuate with time caused by different processes ranging from Ac currents induced by thunderstorms , variations in earth's magnetic fields, effect of heavy rainfalls.
2. Mineral potential – constant due to electrochemical processes.

Mechanism of self potential:-

- Some physical processes caused sources of sp are still unclear.
- Groundwater is thought to be common factor responsible for sp.
- Potentials are generated by the flow of water, by water reaching as an electrolyte and as a solvent of different minerals.
- Electrical conductivity to produce potentials of porous rocks depends on porosity and on mobility of water to pass through the pore spaces depend on ionic mobilities , solution concentrations ,viscosity, temperature $ pressure.

There are few types of sp:-

1. Electrokinetic potential
2. Thermoelectric potential
3. Electrochemical potential
4. Mineral/ mineralization potential

Electrokinetic potentials:-

$$E_K = \frac{\varepsilon p\, C_E\, \Delta p}{4\prod \eta}$$

Where,

ε = dielectric permittivity of pore fluid

p = electrical resistivity of pore fluid

C_E = electrofiltration coupling coefficient

ΔP = pressure difference

η = dynamic viscosity of pore fluid

Thermoelectric potential:-

sp generated from TE potentials are of smaller amplitudes than usually seen in geothermal areas.

Electrochemical potential :-

- **diffusion + nernst potentials = electrochemical or static , self potential**

- **Diffusion potential -**

$$E_d = \frac{RT(Ia - Ic)}{nF(Ia + Ic)} \ln (C1/C2)$$

where, Ia,Ic = mobilities of the anions (-ve) and cations (+ve)

R = universal gas constant

T = absolute temperature

n = is ionic valence

F = farady's constant

C1,C2 = solution concentration

- **Nernst potential :-**

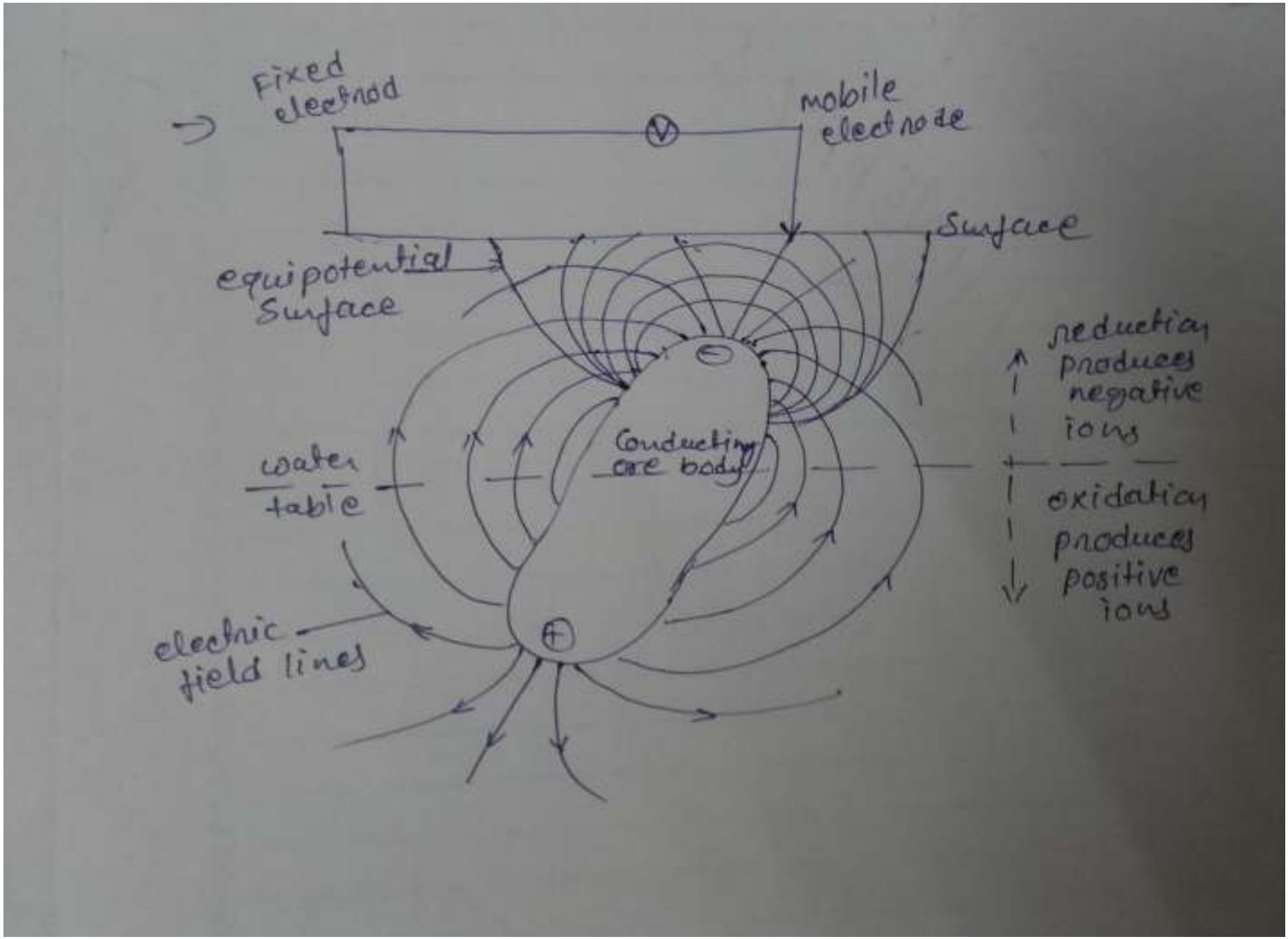
$$En = - (RT /nF) \ In (C1/C2)$$

where, Ia= Ic in the diffusion potential equation

Mineral potential -

- Is the most important in mineral exploration of sp associated with massive sulphide ore bodies.

- Large negative (-) sp anomalies (100 – 1000 mv) can be observed particularly over deposits of pyrite , chalcopyrite, pyrrhotite , magnetite and graphite **.**

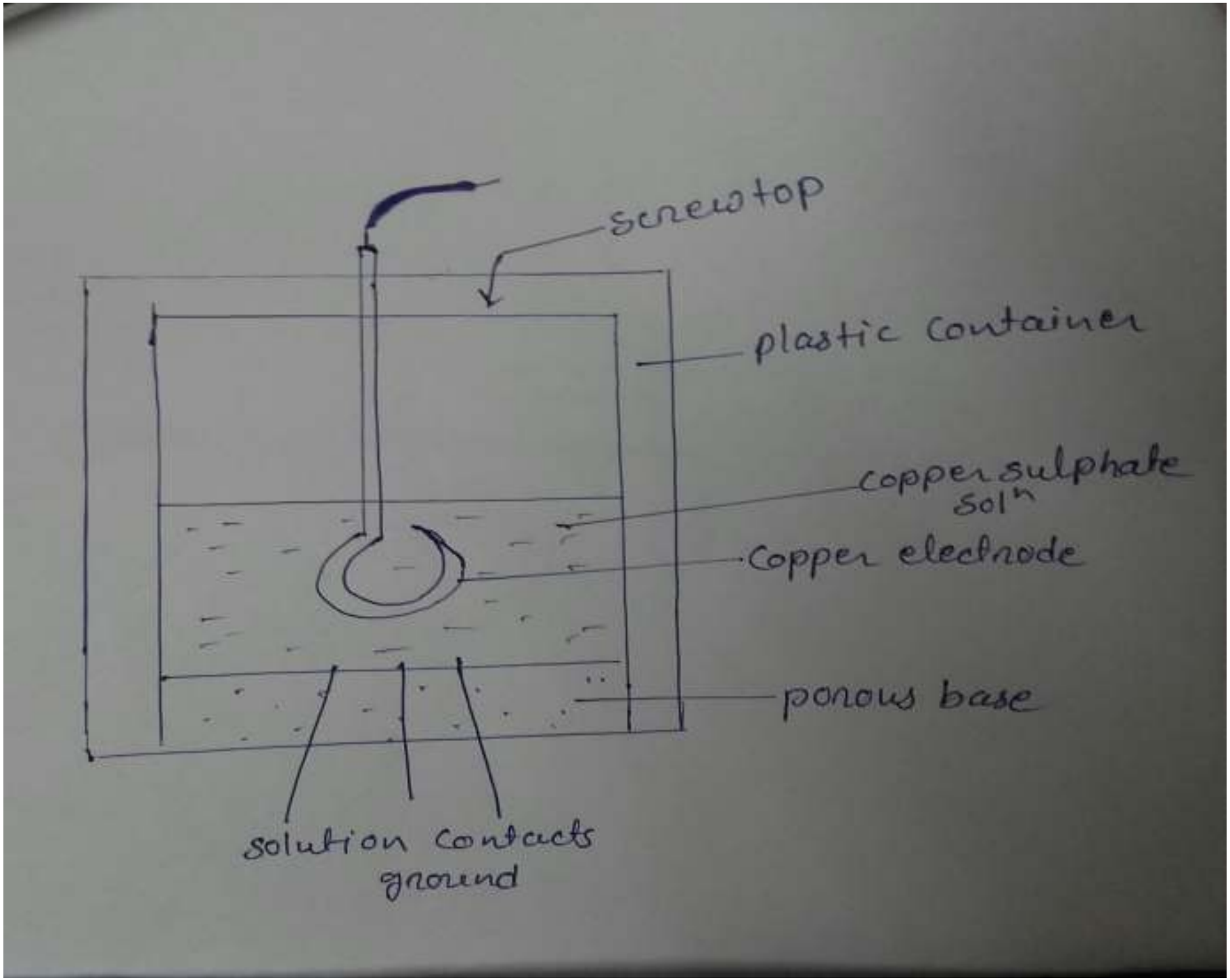

Fixed electrod
mobile electrode
V
Surface
equipotential Surface
reduction produces negative ions
Conducting ore body
water table
oxidation produces positive ions
electric field lines

Measurement of self potential :-

- Simple and inexpensive
- 2 non- polarizable porous-pot electrodes connected to a precision voltmeters capable of measuring to at least 1 mv.

- Each electrode is made up of a copper electrode dipped in a saturated solution of copper sulphate which can percolate through the porous base to the pot.

- An alternate zinc electrode in saturated zinc sulphate solution or silver in silver chloride can used.


screw top
plastic container
copper sulphate soln
copper electrode
porous base
solution contacts ground

- In the sp method two types of circuits are employed for the measurment of the weak earth current:-

1. Microammetre
2. potentiometer

Applications :-

- Groundwater applications rely principally upon potential differences produced by pressure gradients in the groundwater . Applications have included detection of leaks in dams and reservoirs.
- Location of faults voids and rubble zones which affect groundwater flow delineation of water flow patterns around landslides , wells , drainage structures , and springs , studies of regional groundwater flow.

Thanking you