

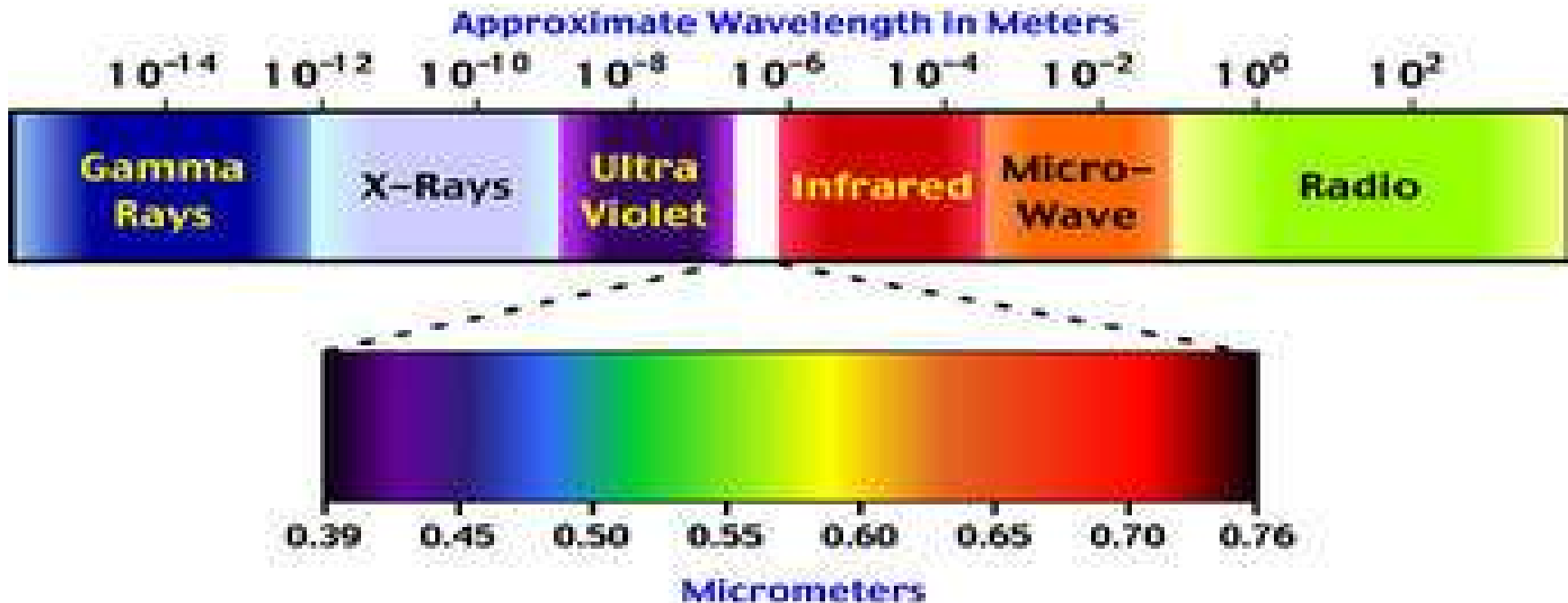
# ELECTROMAGNETIC METHOD FOR MINERAL EXPLORATION

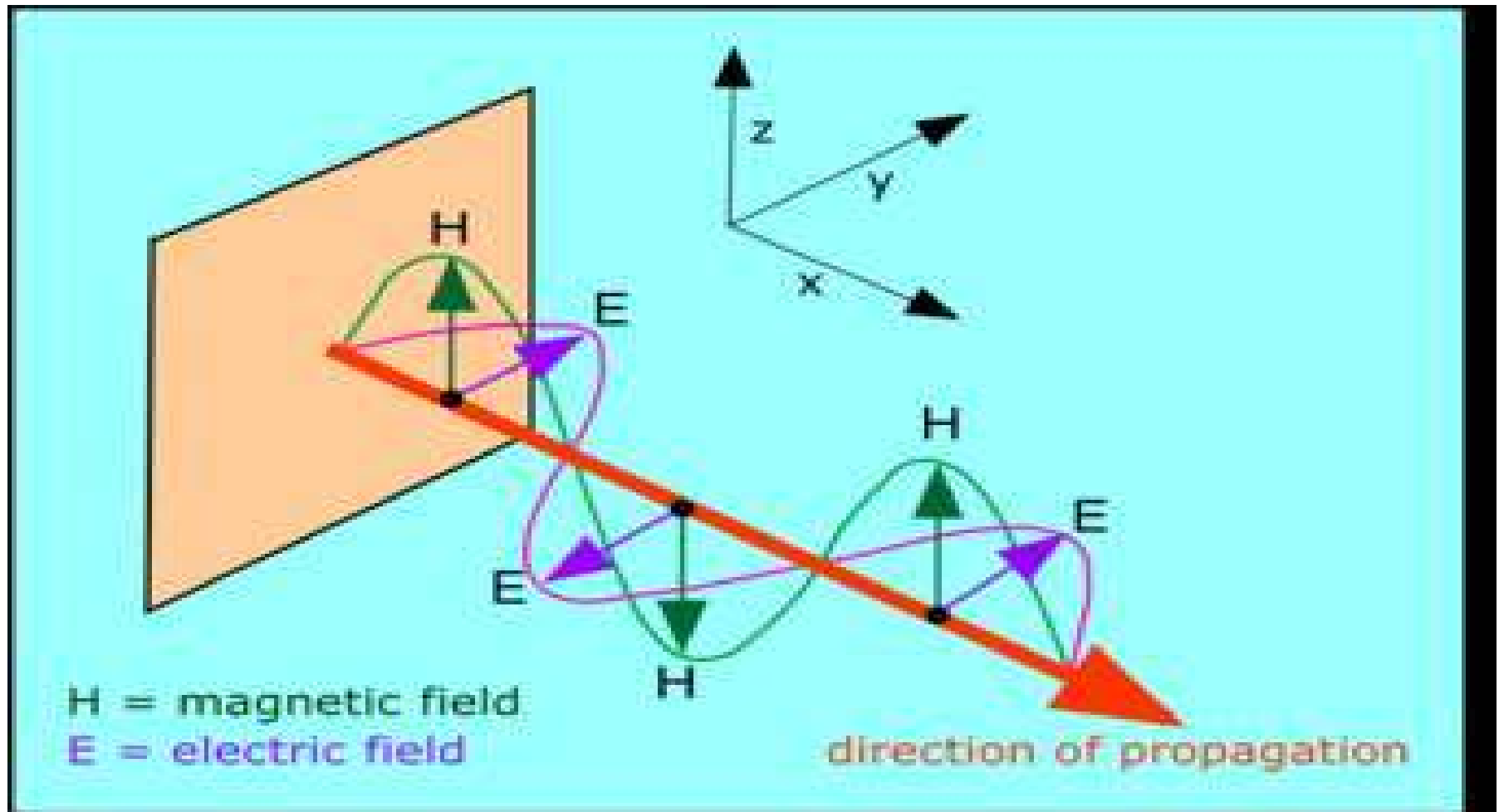
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# INTRODUCTION

- Electromagnetic methods are similar to Resistivity method because both respond to variation in the resistivity of conductivity of the subsurface.  
Difference is EM method Induce current flows in subsurface without electrode.
- Light is electromagnetic that has properties of wave.





Propagation of electromagnetic waves

- **CLASSIFICATION OF EM METHODS** –

1. FDEM – Frequency domain electromagnetic.
2. TDEM - Time domain electromagnetic.

EM can be either classified –

- (a) Passive – utilizing natural ground signal ( Magneto telluric)
- (b) Active - where artificial transmitter is used either in the near field ( as in ground conductivity meters )

- **APPLICATION** –

1. Mineral exploration ( Sulphide Deposits mainly )
2. Ground water survey
3. Location of geological fault
4. Geological mapping
5. Detection of natural and artificial cavities.

- **FACTOR AFFECTING EM SIGNALS –**

The signal at the Receiver depends on –

1. Material (Rocks , Minerals )
2. Shape of the ore body
3. Depth of the target
4. Design and position of the transmitter and receiver coils.

- **SKIN DEPTH -**

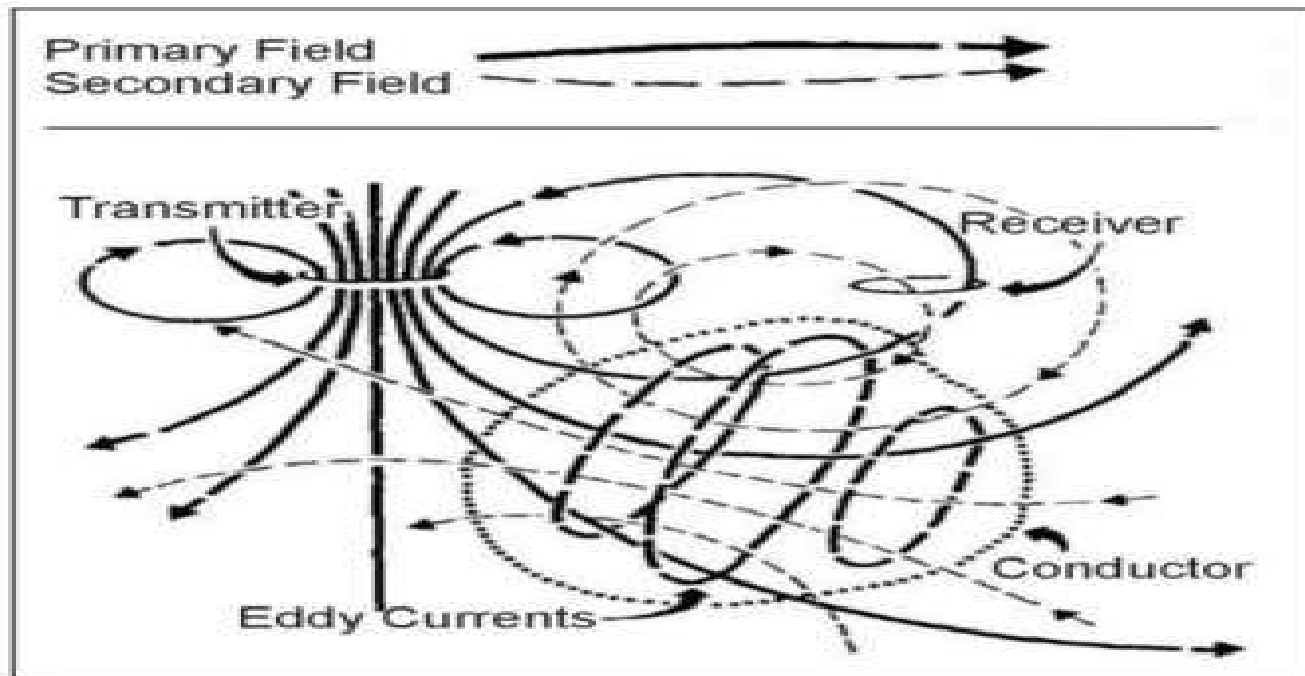
Skin depth is the depth at which the amplitude of a plane wave has decreased to  $1/e$  or 37% relative to its initial amplitude. Amplitude decreasing with depth due to absorption of two frequencies.

- **INSTRUMENTS –**

EM methods usually used instruments is called Transmitter and Receiver it forms many turns of wire or a large loop of wire. Example – Geonics EM 31 , Geonics EM 34 etc.

## PRINCIPLE

- EM field can be generated by passing an alternating current through either a small coil comprising many turns of wire .
- Frequency range of EM may be very wide greater than 15 Hz.
- The primary EM field travels from the transmitter coil to the receiver coil via paths both above and below the surface.



- Presence of conductive body ( Ore body) the magnetic component of the EM field penetrating the ground includes alternating currents or eddy currents to flow in the conductor.
- The eddy currents generates their own secondary EM field which travels to the receiver.
- When a magnetic field passing through an electrical conductor or ore body change it causes or induce an alternating current to flow in conductor.
- This induced currents in turns produces secondary field which can be detected at the surface so revealing the presence of ore.
- **UNIT –**  
EM surveying Conductivity is used rather than Resistivity  
conductivity  $\sigma = 1/\rho$  (rho) and it measured in Siemens/ meter.  
Unit of radiation frequency is Hertz ( cycles per second)

## FIELD PROCEDURE OF SOME EM SYSTEM

### 1. Moving Transmitter – plus Receiver system ( SLINGRAM)

- Slingram instrument it has Transmitter and Receiver connected by a cable and their separation kept constant as they are moved together along a traverse.

### 2. Turam system

- It is the powerful system than slingram .
- Turam system use a very large stationary transmitter coil or wire laid out on the ground and only the Receiver is moved.

### 3. VLF ( Very Low Frequency ) method

- This method dose not have its own transmitter for it makes use of a very powerful radio Transmitter that are used for communicating with submarine’.
- Transmitter an aerial that is vertical wire up and down which a large currents alternates producing magnetic field lines that are horizontal circles.



#### 4. Magneto telluric MT Surveying –

( Looking into the deep crust and Mantle study or Petroleum exploration)

- EM waves absorbed by ground because it is conductive but lower Frequency ( longer wavelength) penetrate deeper than higher frequencies.
- To investigate the deep crust or mantle require very long as well as powerful waves , which can not be generated by man made instruments.
- Low Frequency waves are generated naturally by currents in ionosphere as lightening

#### 5. Ground Penetrating Radar (GPR)

- GPR has by far the highest frequency of any EM methods and display the wave aspect most cleanly it depends on reflection pulses of wave and so resemble seismic reflection.
- A pulse of EM waves is transmitted downwards reflect of interface and is received back at the surface.

## SUMMARY

- Most EM methods do not require electrical contact with the ground.
- Instead currents are induced in the target by alternating magnetic field which are detected by Receiver .
- EM can be used from aircraft and ships as well as down boreholes.
- Light weight and easily portable .
- Measurement can be collected rapidly with a minimum number of field personnel.
- High Accuracy .
- This method is good for ground water pollution survey and Massive sulphide deposit survey.

## REFERENCE

- An Introduction to Geological Geophysics by Alan E. Musset and M. Aftab Khan.
- Mining Geology by RNP Arogyswamy.

# **Thanks You**

**samudra Behara**

**M.Sc Third semester (geology)**

## **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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