Electromagnetic Methods of Prospecting

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(1) Limitations of frequency domain EM method :-

- Depth and size of conductor primarily affect amplitude of secondary field so variation can be done in output.
- Similarly, quality of conductor also affects the ratio of in-phase to out-of-phase amplitude, so different type of conductor varies very much the amplitude in output
- Since many of the methods (electrical) deals with the problems related to VLF terrain conductivity but FDEM can't be often used in geotechnical and environmental problems
- That is the reason it can be mapped upto 50Hz mostly for fine results.

(3) The amplitude and phase difference is variable. A reference signal is taken from the transmitter loop and passed to compensator to change the amplitude and phase and applied to receiver input to cancel the primary field. The output is connected to a potentiometer such that variable amplitude with 180° phase lag can be applied to receiver coil to cancel primary field at

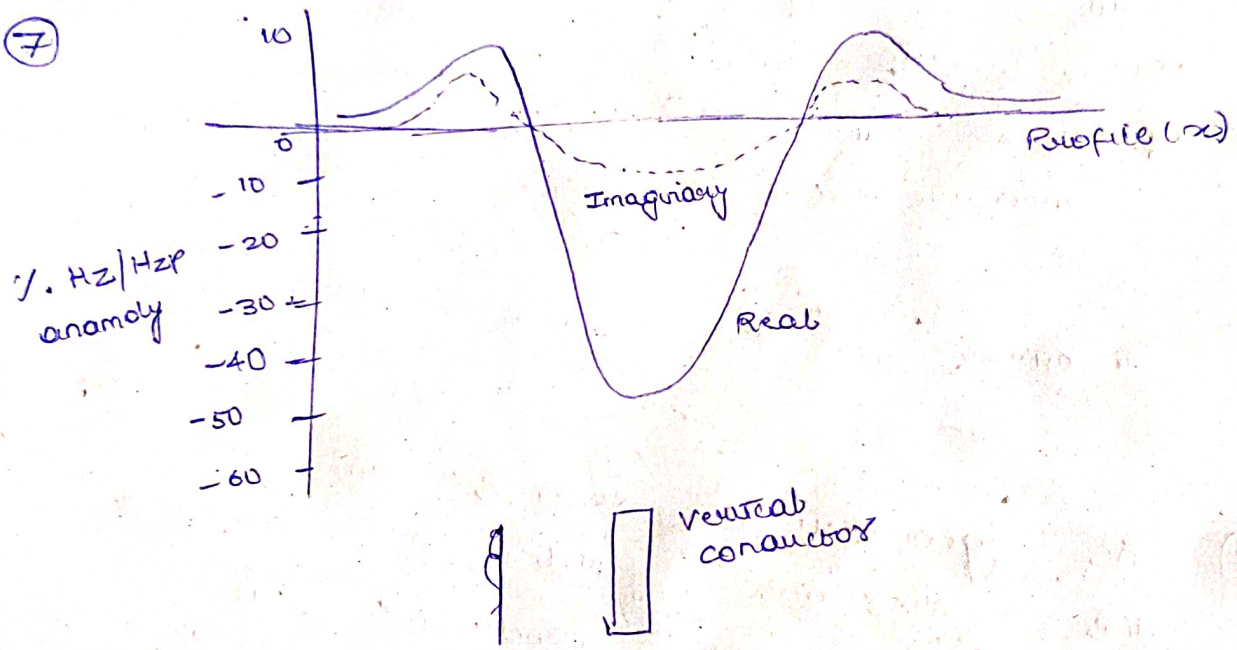
(4) Phase diagrams are homograms that is used to interpret data in graphical methods. It is also called characteristic curves. It is a plot between ~~phase~~ Quadrature (⊥) and in-phase (∥) for different dip ~~around~~ values using which we can read P and Z/R values in EM scale modelling.

(5) Yes, a single plate can be used to model different conductors in field- we can do it by adjusting frequency as :-

$$\eta^2 = \left(\frac{\sigma_b}{\sigma_m}\right)\left(\frac{f_m}{f_f}\right)$$

(6) The effect of primary field is removed in compensator method, so we measure the real and imaginary component of secondary field.

(7)



(8) Given,

HCPL system,

Error in anamoly = 12%.

Error is due to incorrect measurement of T-R separation only.

We know,

$$H \propto \frac{1}{r^3}.$$

$$\Rightarrow \quad dH \propto -\frac{3}{r^4}\, dr.$$

$$\Rightarrow \quad \frac{dH}{H} = -\frac{3}{r^4} \times \frac{r^3}{1}\, dr$$

$$\Rightarrow \quad \frac{dH}{H} = -3\,\frac{dr}{r}$$

$\therefore$ 1% error in T.P separation will result in 3% change in anomaly.

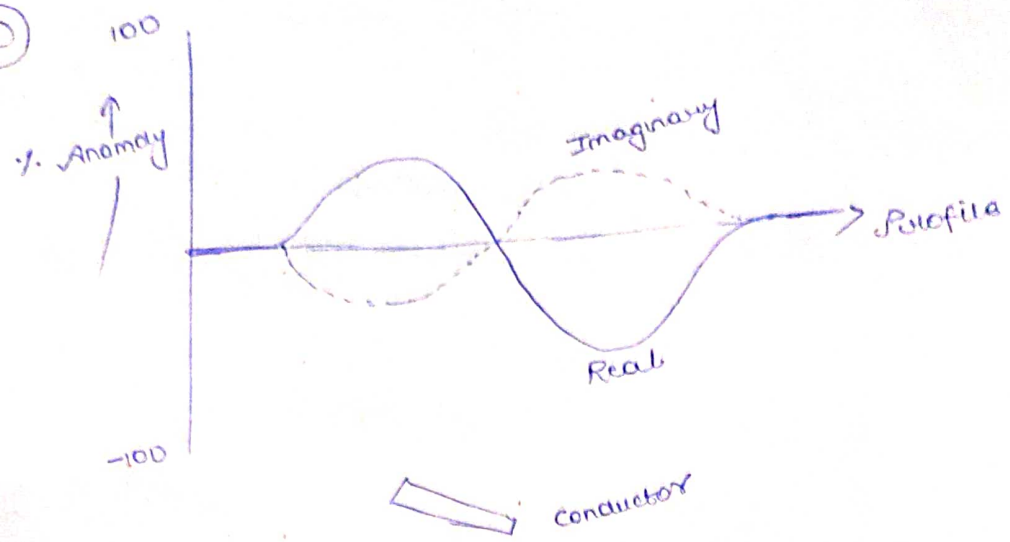
Since we have 12% error so % error in T.R separation measurement $= \frac{12}{3}\% = 4\%$.

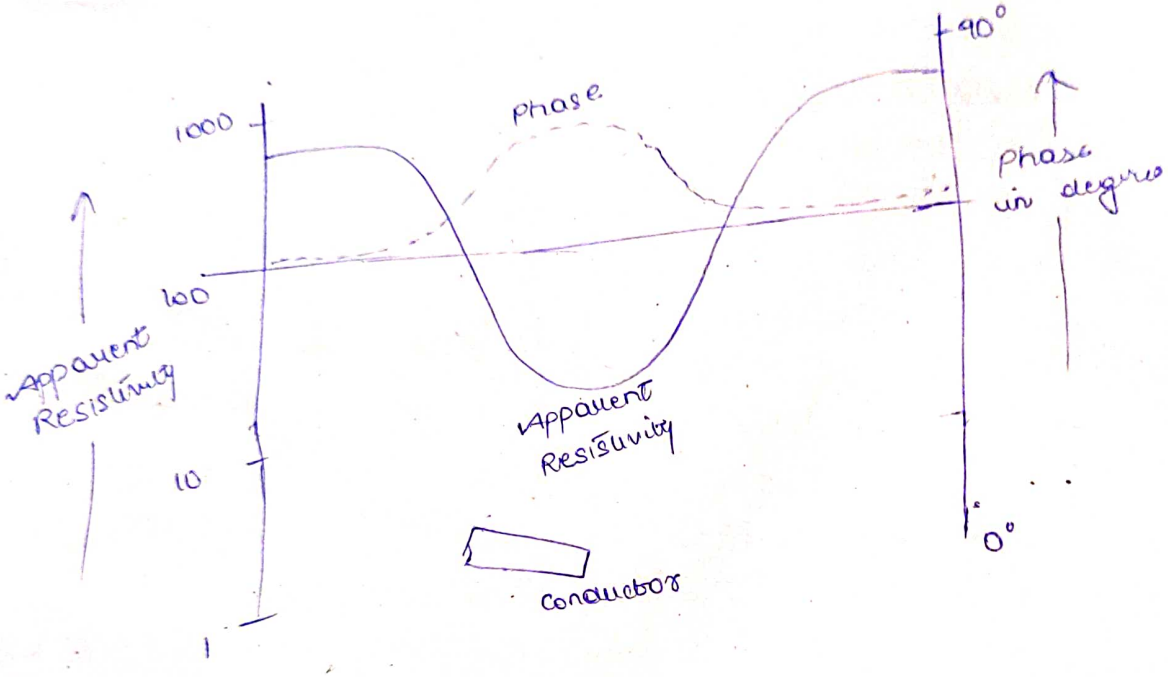
$\therefore$ % error in T-R separation measurement $= 4\%$

(9) The geometrical shape in which the resultant field is polarized over a poor conductor is circle. in special case.

Resultant field is ~~electrical circularly~~ ~~pol~~ elliptically polarized.

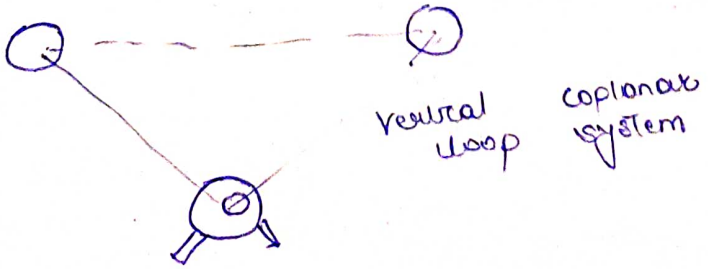
(10)





(11) The method to generate spherically polarized primary field for EM survey is as :-

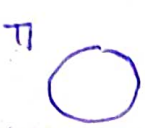
To measure both amplitude and phase "T" and "B" both should be sufied in the aircraft.



Vertical coaxial loop system

Another approach is :- consist of two naturally perpendicular transmitter coil.

Rotatory field approach -



$H_{f1} = A \sin(\omega t)$

$H_{f2} = A \sin(\omega t - \frac{\pi}{2})$

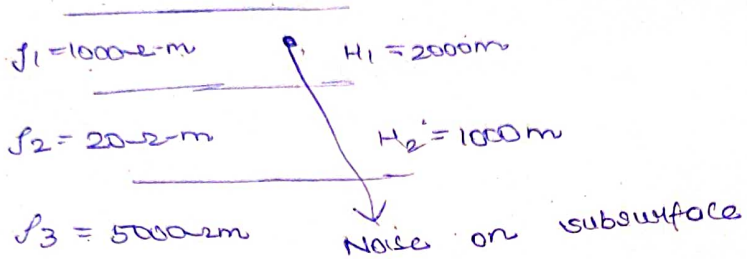
Such transmitter produces a primary field which is spherically polarized. Therefore signal in receiver is independent on orientation.

It can easily generated by using two perpendicular transmitter coil and passing in both coils with a phase difference of 90° between them

(12) Static Shift Correction

We get wrong estimate of resistivity and thickness from data use which are affected by unvision of static shift.

eg:-



Correction :-

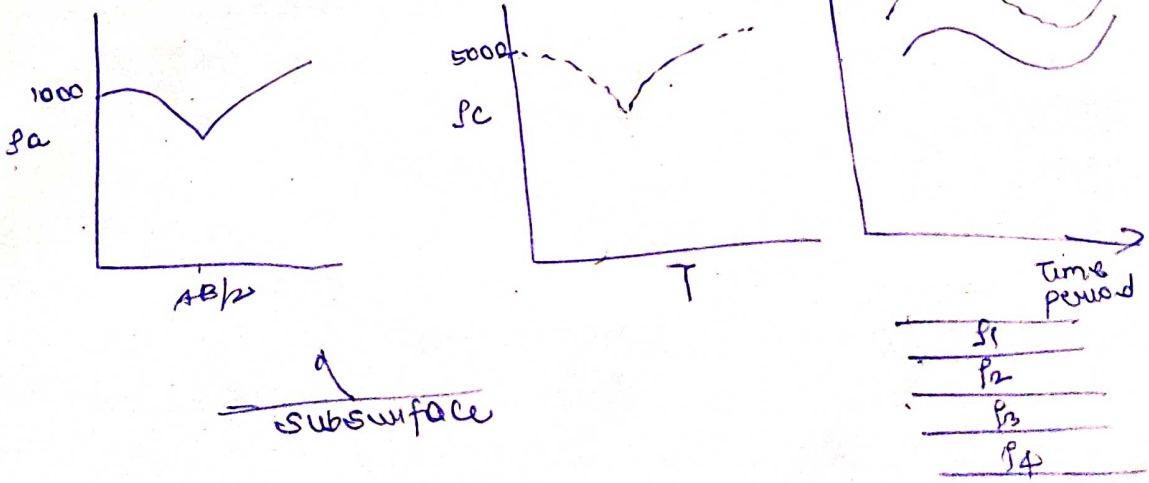
$\rho_1' = 1000 \times S$ | $h_1' = 2000 \times \sqrt{S}$

$\rho_2' = 20 \times S$ | $h_2' = 1000 \times \sqrt{S}$

$\rho_3' = 5000 \times S$

S = static shift or log scale.

We can determine a MT data is affected or not affected by static shift by a prior geological or other geophysical unformation.



(13) Electromagnetic Methods in which measurement of resultant fields is done like Biele's - Wadson method.

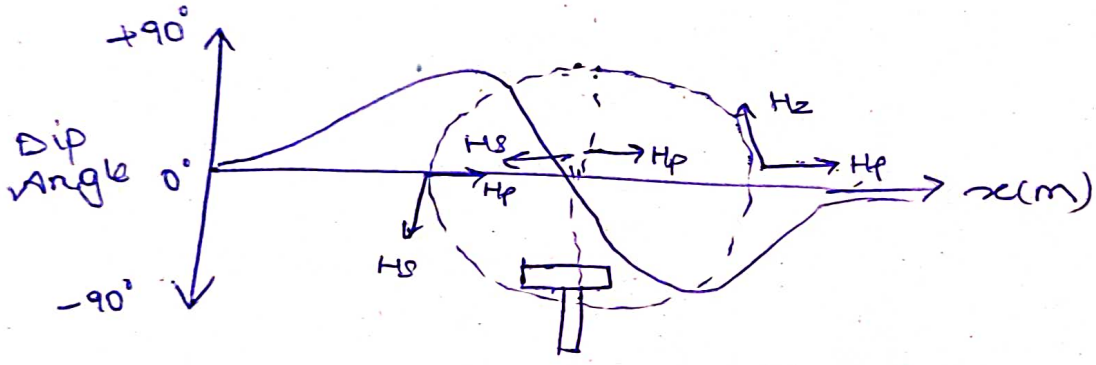
(14) Dip - angle profile :-

Transmitter -

Vertical loop i.e horizontal primary field.

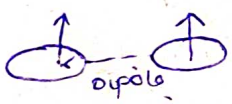
Since horizontal conducting body is lying parallel to the field its secondary field will have comparatively low significance than the vertical conductor

∴ The dip profile will be just like for a normal vertical conductor.



(15) Dipole EM soundings are useful in many ways. Dipole EM sounding uses two circular loops are used in such a way that distance between them is more than 5 times the diameter of the loops.

- At a particular location frequency is varied and observed data is recorded.
- Measurement of final data is of either resultant or secondary data with compensator (as unlike other methods in which primary field data response is measured at receiver location)
- It involves use of mutual impedance
- Loops orientation varied from horizontal coplanar position to perpendicular loop system to give maximum and minimum coupled result respectively

i.e. 

Horizontal coplanar


Perperdicular loops.

- Nature of curves (in dipole (EM sounding) for a particular orientation (loop) remain similar over homogenous half-space as well as layered earth structure.
- With additional information of Schlumberger sorting data helps to overcome the limitation of equivalence problem in Schlumberger case sorting.