Geophysics 424 , Assignment 3
Controlled source EM exploration techniques

Question 1

Repeat Example 2 in section E2.2.2 (vertical magnetic dipoles) with the conductor **dipping to the left at 30° to the vertical**

Sketch how the ratio H^T/H^P will vary as the instrument is moved across the ore body.

Explain clearly how you obtained your answer.

Question 2

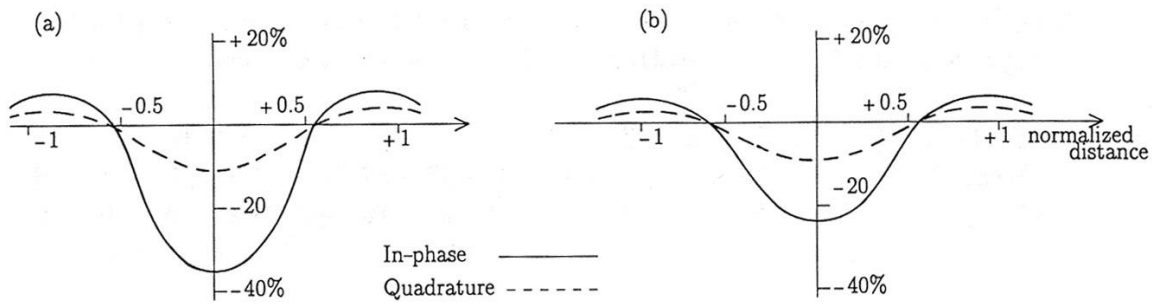
The vertical magnetic field of a vertical magnetic dipole (VMD) located on the surface of the Earth is given by

$$H_z = \frac{IA}{2\pi k^2 r^5} \{9 - (9 + 9ikr - 4k^2r^2 - ik^3r^3) e^{-ikr} \}$$

Show that at low induction number that this result simplifies to

$$H_z = -\frac{IA}{2\pi k^2 r^5} \left(\frac{k^2r^2}{2} - \frac{k^4r^4}{8}\right)$$

Question 3



An HLEM system was used to collect in-phase and quadrature data over two massive sulphide deposits. The ore body is dike shaped with conductivity 10 S/m.

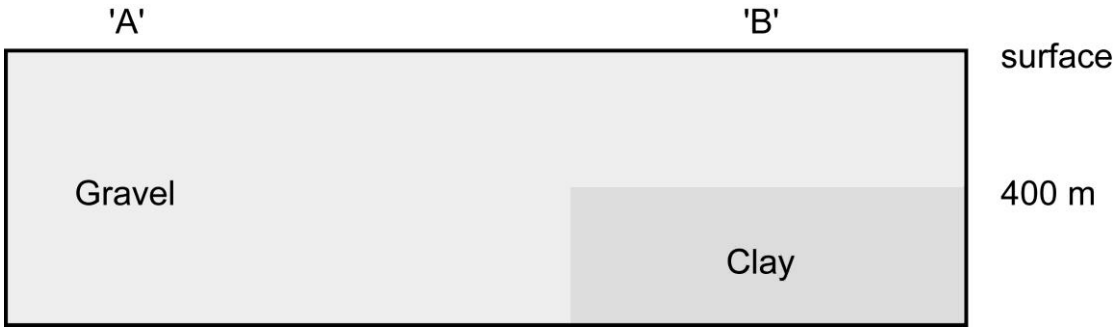
The HLEM profile crossed each deposit at right angles to the strike direction.

TX-RX separation is 50 m and the TX operates at a frequency is 1910 Hz.

What can be determined about each ore body from these data?

Use the characteristic curves derived in E2.3

Question 4



A time-domain EM system is being used to measure the resistivity during a ground water survey. The system parameters are:

Transmitter geometry	10 m x 10 m square loop
Transmitter current	I = 200 amps
Number of turns on transmitter	N = 20

The transient on the next page was recorded at 'A'.

(a) Plot the transient.

(b) When does the late-time decay begin?

(c) Calculate the conductivity of the gravel. Justify any assumptions you make.

(d) A second transient was recorded at 'B' where a **high conductivity clay layer** was present. Sketch the transient at 'B' on the graph in (a). Be quantitative where possible.

This assignment will be due at 5 pm on **Monday December 4 2023**

time (s)	$\frac{dB_z}{dt}$ (nT/s)
1.0000000e-006	2.8647890e+006
1.2589254e-006	2.8647890e+006
1.5848932e-006	2.8647890e+006
1.9952623e-006	2.8647890e+006
2.5118864e-006	2.8647889e+006
3.1622777e-006	2.8647826e+006
3.9810717e-006	2.8645694e+006
5.0118723e-006	2.8615302e+006
6.3095734e-006	2.8397940e+006
7.9432823e-006	2.7508621e+006
1.0000000e-005	2.5196506e+006
1.2589254e-005	2.1041631e+006
1.5848932e-005	1.5525733e+006
1.9952623e-005	9.8314337e+005
2.5118864e-005	5.0893524e+005
3.1622777e-005	1.8377414e+005
3.9810717e-005	9.2174249e+002
5.0118723e-005	7.8246648e+004
6.3095734e-005	9.6359028e+004
7.9432823e-005	8.5788166e+004
1.0000000e-004	6.6042595e+004
1.2589254e-004	4.6662185e+004
1.5848932e-004	3.1139792e+004
1.9952623e-004	1.9956928e+004
2.5118864e-004	1.2415036e+004
3.1622777e-004	7.5522603e+003
3.9810717e-004	4.5162329e+003
5.0118723e-004	2.6652712e+003
6.3095734e-004	1.5568564e+003
7.9432823e-004	9.0213593e+002
1.0000000e-003	5.1947248e+002
1.2589254e-003	2.9764812e+002
1.5848932e-003	1.6988253e+002
1.9952623e-003	9.6661992e+001
2.5118864e-003	5.4866131e+001
3.1622777e-003	3.1082449e+001
3.9810717e-003	1.7581769e+001
5.0118723e-003	9.9330822e+000
6.3095734e-003	5.6064569e+000
7.9432823e-003	3.1620022e+000
1.0000000e-002	1.7822696e+000
1.2589254e-002	1.0040986e+000
1.5848932e-002	5.6547571e-001
1.9952623e-002	3.1836132e-001
2.5118864e-002	1.7919357e-001
3.1622777e-002	1.0084208e-001
3.9810717e-002	5.6740799e-002
5.0118723e-002	3.1922501e-002
6.3095734e-002	1.7957957e-002
7.9432823e-002	1.0101457e-002
1.0000000e-001	5.6817875e-003