

AIRBORNE GEOPHYSICS -

HELICOPTER + FIXED WING

58-235

GEOPHYSICS

Airborne Geophysics - Helicopter
or Fixed Wing

L.E.E. 4/7/58

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LYELL - E.Z. - EXPLORATIONS

G.P. 11
GENERAL

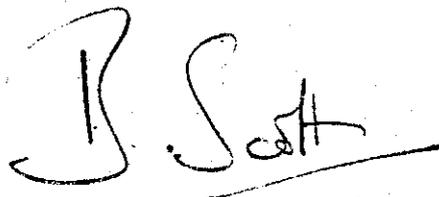
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22nd July,

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To: Mr. G.F. Hudspeth.

Attached is a brief discussion on the electro-magnetic techniques, as in fixed wing aircraft (Catalina) and in a helicopter (S 55). This report has been prepared as a result of the recent discussions in Queenstown on these techniques.



Geologist-in-Charge.

MICROFILMED

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4th July, 1958

To: Mr. G.F. Hudspeth.

Airborne Geophysics - Helicopter and Fixed-Wing

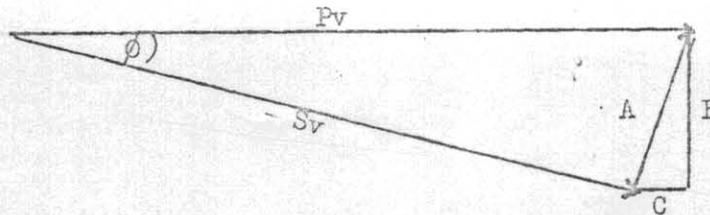
1. The essential differences between A.E.M.¹ and H.E.M.² can be summarised as follows:
 - A. Both measure the variation in the phase angle and in the magnitude of the secondary field at certain frequencies. According to Adastra Hunting Geophysics Ltd., this phase shift, in their electrical system, consists of 3% variation in phase angle and 97% variation in the magnitude of the secondary field.
 - B. H.E.M. resolves this phase shift into its out-of-phase and in-phase components, this enables an interpreter to obtain a better evaluation of the relative conductivity of an anomalous zone than in the A.E.M. (i.e. it could distinguish between bodies of medium and high conductivity, whilst A.E.M. would group these two together as one).

This principle is basically the same as that in the helicopter-borne electromagnetic survey carried out by A.H.G. Ltd. during the summer 1956-57.

Graphically these quantities would be represented as:

¹Airborne Electro-Magnetic. Combined Geophysics in fixed-wing aircraft as carried out by the A.H.G. Pty. Ltd.

²Helicopter Electro-Magnetic. In this instance the Newmont/Aero Service System, of the Aero Service Corporation, Philadelphia, U.S.A.



Pv = Primary Field.

Sv = Secondary Field.

ϕ = A measurement of the phase difference between Pv and Sv.
This is obviously directly proportional to quantity "A".

A = A quantity proportional to variation in phase angle and magnitude of secondary field Sv.

B = Out of phase component of "A".

C = In phase component of "A".

A.E.M. Measures "A".

H.E.M. Measures "B" & "C".

2. The H.E.M. method has an undoubted advantage over the A.E.M. technique. However, it should be remembered that both techniques measure and indicate areas of above average conductivity, they do not indicate directly which is sulphide ore, which is a barren fault zone or which is a graphite zone. This relationship, of anomaly to effect is a result of interpretation. The H.E.M. was successful in the New Brunswick area in differentiating between sulphide ore and graphite zones because in this area the graphite had a low to medium conductivity, with the orebodies as good conductors. Consequently, the former (graphite) gave a low response on the in-phase component whilst the latter (sulphides) gave a correspondingly high response on this component. As far as I can evaluate, if the graphite

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had had a medium to high conductivity, as it may well have in other areas, it would not have been possible to differentiate between the graphite and sulphides. In this case, in reasonable terrain, the H.E.M. technique would have no advantage over the A.E.M. technique of A.H.G. Pty. Ltd. The Newmont Aero Service people emphasise this point on their result sheet of "Graphite Band near 44 Mile Brook Camp".

3. Consequently, if in the future it is decided to traverse the helicopter borne equipment (H.E.M.) over the electro-magnetic anomalies derived from the A.H.G. Pty. Ltd. (A.E.M.), it must first be demonstrated that the graphite horizons in the Dundas Group of S.W. Tasmania have a lower conductivity than sulphide occurrences in the same Group (i.e. the conditions which apply in New Brunswick also apply in Tasmania).

4. Apart from the above considerations, the H.E.M. has the great advantage over the A.E.M. in that it can be operated in mountainous terrain, due to the differing characteristics of the parent aircraft (helicopter v. fixed-wing) and method of attaching the receiving coil.

This statement must be qualified in that, under the circumstances of flat terrain, as far as I am aware the best combination would appear to be the use of the A.E.M. to delineate conducting zones, with a first follow-up on these by the H.E.M. technique in order to differentiate between these conductors, provided of course, that the remarks under sections 2 & 3 apply.

5. The A.E.M. technique has proved to be successful in Canada, in particular with the discovery of the Heath-Steele lead/zinc body

in New Brunswick. In the same part of Eastern Canada the A.E.M. technique has been instrumental in other sulphide discoveries. Also the Mattagami Syndicate's orebody in N.W. Quebec totalling 10 million tons of 10% zinc and 0.75% copper was found by drilling an aeroelectromagnetic anomaly.

An indication of the extensive use of the A.E.M. technique in Canada can be gauged in that during 1957 101,000 line miles of airborne electromagnetic work were flown.

6. It must be remembered that airborne geophysics is a means to an end and not an end in itself. Airborne geophysical anomalies should always be tested by ground follow-up techniques such as geophysics, geochemistry and geological mapping. In this way a distinction between a graphite and sulphide zone could be made by the use of geochemical and gravimetric surveys.

Geologist-in-Charge

SUMMARY TABLE

	Helicopter Electro-Magnetic (H.E.M.)	Airborne Electro-Magnetic (A.E.M.)
1. Aircraft used	Helicopter S55	D.C.3 or Catalina
2. Horizontal distance apart of trans. & rec. coils (H).	60 feet	490 feet at airspeed of 90 knots.
3. Vertical distance apart of trans. & rec. coils (V).	Nil, coils are coaxial.	164 feet at airspeed of 90 knots.
4. Frequency used.	390 cps.	400 and 2300 cps.
5. Survey height of aircraft.	100 feet.	500 feet.
6. Arrangement of coils.	a) Trans coil rigidly attached to aircraft. b) Rec. coil rigidly attached to aircraft.	a) Trans. coil rigidly attached to aircraft. b) Rec. coil at the end of a cable about 530' in length (see V & H above).
7. Principle	a) Msmt. of variations in the phase angle & in the magnitude of the secondary field at 390 cps. This forms the phase shift. b) Resolution of (a) into the in-phase & out-phase components relative to the primary field.	a) Msmt. of variations in the phase angle & in the magnitude of the secondary field at 400 & 2300 cps. This forms the phase shift.
8. Line-spacing	$\frac{1}{8}$ mile	$\frac{1}{4}$ mile