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rite, pyrrhotite, sphalerite, galena & arsenopyrite.

REFERENCES TO PREVIOUS WORK end of report. See Selected Bibliography pages 29 through 31 at

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TYPE OF WORK IN THIS REPORT	EXT (IN	ENT OF WORK				ON	WHICH CLAIMS			COST APPORTIONED
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Note: Maps 2, 3, and 4 are revised from maps in the writers previous reports. Maps 5 and 6 are found in the writers previous reports.

#### SUMMARY

Induced polarization, resistivity and horizontal loop EM surveys were carried out during January and February, 1987 over the northern portion of the Wait claims located on Wait and Mather Creeks, 10.5 km due east of the town of Kimberley, British Columbia. The purpose of the work was to extend the known IP anomalies discovered from previous surveys as well as to cover a previously discovered gravity anomaly.

The property is easily accessible by 2-wheel drive vehicle. The terrain consists of flat to gentle slopes covered with grazing land and sparsely-populated pine trees with light underbrush.

The general area is underlain by the Purcell Supergroup of sediments of Precambrian age that is cut by block faulting. Most of the Wait claims are covered with glacial and fluvial overburden but the underlying rock-types are probably of the Creston Formation and of the Aldridge Formation which underlies the Creston Formation. Part of the northwestern part of the property (north of the Kimberley fault) may be underlain by the Kitchener Formation which overlies the Creston. The rock-types are predominantly argillites, siltstones and quartzites with some dolomite.

Three diamond drill holes were put down on IP and gravity anomaly A at up to depths of 478 m (1,567 feet). All intersected mineralization throughout the lengths of the holes with the mineralization consisting of stratabound banded pyrite, pyrrhotite, sphalerite, galena, and arsenopyrite.

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The IP and resistivity surveys were carried out using a Huntec receiver operating in the time-domain mode with the pole-dipole array at 1 separation. Also some lines were done with two separations and one line was done with four separations. The dipole length and reading interval were 150 m. 38.25 line km were done. The readings were plotted on a survey plan, contoured and interpreted.

The electromagnetic survey, which totalled 13.25 km, was carried out with an Apex Parametrics MaxMin II electromagnetometer in the horizontal loop mode. The coil spacing was 100 m, the reading interval, 25 m, and five frequencies were read, 222, 444, 888, 1777 and 3555 Hz. In some places, the reading interval was reduced to 12.5 m. The EM readings were profiled and interpreted where possible for location, dip, depth to top, and conductivity-thickness.

#### CONCLUSIONS

1. The IP survey has revealed anomalous zones to be much more extensive over the Wait claims. Considering that diamond drilling on IP anomaly A has shown that it is caused by sulphide mineralization, all other IP anomalies are in all probability caused by sulphide mineralization as well.

# 2. The IP survey resulted in: (a) discovering an entirely new zone, labelled G, that correlates with three gravity highs labelled B, D1, and D2 respectively.

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(b) extending anomalous zone F in a north-northeasterly direction. Its northernmost peak, labelled F3, correlates almost directly with gravity anomaly D3.
(c) delineating the northeastern end of anomaly E. However, the pseudosections, because of anomalous readings at depth, indicate that anomalies E and G may be of the same zone.

- 3. The pseudosections indicate all IP causative sources, some definitely and some possibly, have a northwesterly dip.
- 4. The southern part of IP anomalies E and F have some of the strongest readings on the property but gravity surveying has not been done in these areas to indicate the relevance of these anomalies.
- 5. The resistivity results have shown only a partial correlation of resistivity lows with the IP and gravity anomalies. However, it does appear to have delineated a lithological contact on the eastern side of the survey area. West of this contact is probably Aldridge and Creston formations and east, may be the Eagle formation, possibly the white siliceous guartzite.
- 6. The horizontal loop EM results have revealed many conductors on the property, six of which have been labelled by the Roman numerals I through VI.
- 7. Two of these conductors, I and V, correlate directly with gravity highs A and D3. The EM results therefore corroborate the likely causative sources of the two gravity highs to be massive sulphides. However, they also indicate that the causative sources are steeply dipping, and not relatively flat and stratabound as previously thought. This

would explain why the Wait drilling of anomaly A did not encounter the gravity source.

- 8. Conductor II was found to correlate directly with IP anomaly A, conductor IV with IP anomaly F3, and conductor VI with IP anomaly G2. Conductor III occurs within a swamp and is likely caused by three separate conductors. This is not surprising since mineral zones often weather topographically low.
- 9. Some probable and many possible conductors were also delineated. These more likely reflect fault zones especially considering that some correlate with gravity-mapped faults.

#### RECOMMENDATIONS

- 1. The IP survey should be continued to the northwest to cover gravity anomaly C and to delineate the northern and/or northeastern end of IP anomaly F. Detailing should also be done to more accurately define IP anomalies E and F. The detailing may indicate that these two anomalous zones are actually connected. Pseudosections should also be done at least to the second level across the anomalous results. It has been found that the pseduosections are very important to the interpretation.
- 2. The horizontal loop EM survey should at the very minimum be carried out across all the gravity anomalies. This recommendation is conditional, however, on where pulse EM surveying was done and what its results were like. It has

become apparent that the EM surveying may be more accurately delineating the location of the causative source(s) of the gravity anomalies.

Testing should also be done with a 200-m coil separation if there is a weak EM response or no EM response over any of the gravity anomalies. For a more accurate EM interpretation, the EM readings should be taken at right angles to the expected strike of the causative sources.

3. EM conductor I/gravity anomaly A should be diamond drilled with a -45° hole dipping to the southeast. It is recommended the collar be placed at about (5+00E, 2+00N) since it is felt in this area the depth of the overburden is at a minimum.

#### GEOPHYSICAL REPORT

ON

# INDUCED POLARIZATION, RESISTIVITY & HORIZONTAL LOOP EM SURVEYS

#### OVER THE NORTHERN PORTION OF THE

#### WAIT CLAIMS

#### WAIT CREEK AND MATHER CREEK, KIMBERLEY AREA

FORT STEELE M.D.

BRITISH COLUMBIA

#### INTRODUCTION AND GENERAL REMARKS

This report discusses the instrumentation, theory, field procedure and results of induced polarization (IP), resistivity and horizontal loop electromagnetic (EM) surveys carried out over the northern portion of the Wait claims, located near Kimberley in the Fort Steele Mining Division of British Columbia.

The field work was completed from January 17th to February 14th, 1987 under the supervision of the writer and under the field supervision of Andrew Rybaltowski, geophysicist. The survey was carried out with a crew of four men run by Marc Beaupre, geophysical technician.

The purpose of the IP survey was to extend and delineate previously discovered IP anomalies as well as to discover new ones. The purpose was also to cover a promising-looking gravity anomaly on the northern edge of the previous survey area. Gravity/IP anomaly A was drill-tested in November and December, 1986 by three holes and encountered widespread sulphide mineralization that could be host to a Sullivan-type ore deposit.

The purpose of the horizontaal loop EM survey was to map fault systems. The area is criss-crossed with block faulting which is an important consideration in the determination of where the mineralization is located.

Exploration on the property is under the supervision of B.H. Kahlert, P.Eng., consulting geological engineer, who worked closely with the IP crew.

#### PROPERTY AND OWNERSHIP

The property consists of 21 contiguous claims totalling 288 units as shown on Map 2 and as described below:

Name of Claim	No of Units	Record Number	Expiry Date
Wait 1	20	2533	Dec. 11, 1988
Wait 2	20	2534	Dec. 11, 1988
Wait 3	15	2535	Dec. 11, 1988
Wait 4	4	2536	Dec. 11, 1988
Wait 5	12	2537	Dec. 11, 1988
Wait 6	12	2538	Dec. 11, 1988
Wait 7	20	2577	Feb. 20, 1989
Wait 8	6	2578	Feb. 20, 1989
Wait 9	8	2584	March 6, 1989
Wait 10	8	2585	March 6, 1989
Wait 11	12	2586	March 6, 1987*
Wait 12	10	2587	March 6, 1989
Wait 13	8	2673	Sept. 16, 1987*
Wait 14	16	2625	June 4, 1989
Wait 15	20	2626	June 4, 1989
Wait 16	20	2627	June 4, 1989
Wait 17	15	2628	June 4, 1989
Wait 18	20	Wait 18 to 21	claims have just
Wait 19	12	been staked ar	nd may or may not
Wait 20	12	be recorded.	
Wait 21	18		
	288		

\* Work has been filed on these two claims so that the expiry date will become 1989 assuming the work is accepted for assessment credits.

The 21 Wait claims as shown on Map 2 are jointly owned by Victoria Resource Corporation and Anglo Canadian Mining Corporation both of Vancouver, B.C. Normine Resources Ltd. of Vancouver, B.C., is optioning the property for a 51% ownership.

#### LOCATION AND ACCESS

The Wait claims are located in the Kimberley River valley on Mather and Wait Creeks 10.5 km due east of the town of Kimberley.

The geographical coordinates for the center of the property are 49° 42' north latitude and 115° 49' west longitude.

Access is easily gained from the town of Kimberley by travelling easterly along Highway #95A which runs through the center of the property. The western boundary of the Wait #5 claim is about 10 km from Kimberley.

#### PHYSIOGRAPHY

The property occurs within the eastern part of the Purcell Mountains, a physiographic division of the Columbia Mountains. It occurs within the broad U-shaped Kootenay River valley to the immediate west of the Rocky Mountain Trench which runs along the southerly-flowing Kootenay River. The terrain is typical of valley bottoms, which is quite gentle. The elevations vary from 790 meters (2,600 feet) a.s.l. at the northeastern corner of the Wait #15 claim to 1,130 meters (3,700 feet) a.s.l. along the western edge of the Wait #18 claim to give an elevation difference of 340 m (1,100 feet).

The property is mainly drained by the southeasterly- to easterlyflowing Mather Creek as well as its southeasterly-flowing tributary, Wait Creek. Mather Creek is a tributary of the Kootenay River which flows south-southeasterly across the northeastern corner of the Wait #15 claim. Hahas Lake occurs within the northwestern part of the property in addition to small shallow lakes and swamps occurring throughout the property.

The vegetation consists mainly of grazing land and sparselypopulated pine trees with very light underbrush except along the creeks where the underbrush is thick.

#### HISTORY OF PREVIOUS WORK

Reconnaissance work has undoubtedly been done throughout the area, mostly by Cominco, but results are not available. Furthermore, the thick glacial overburden in the river valley has prevented much significant work from being done. However, during November, 1972, when the area was covered by the Hunt #1 to #48 claims owned by C. Warren Hunt, a reconnaissance IP survey was carried out, mostly along roads in the area. It discovered a large, high amplitude IP anomaly that could well be caused by sulphide mineralization. It is unknown whether the anomaly was drill tested but it is considered probable that it was not.

Since the first Wait claims were staked in 1985, the initial work was some prospecting and chip sampling by B.H. Kahlert.

In January and February 1986, this was followed up by IP resistivity and magnetic surveys carried out by Geotronics, (report by Mark, March 1986), and a gravity survey carried out by Wild Rose Exploration Services Ltd. of Calgary (report by W.T. Salt, March, 1986).

The work revealed very promising results, more specifically, widespread correlating IP and gravity anomalies of high amplitude. Considering the most logical interpretation was massive lead-zinc mineralization and considering the nearby location of the world-class Sullivan silver-lead-zinc orebody, the survey results presented obvious drill targets.

In September of 1986, the property was optioned to Normine Resources Ltd. who became the operators. Later that month Geotronics carried out some IP and resistivity detailing (report by Mark, November, 1986) and Wild Rose carried out further gravity and magnetic work. In November and December, 1986, three holes were diamond drilled up to a depth of 478 m (1,567 feet), the locations of which are shown on Maps 3 and 4.

In January and February of 1987, while Geotronics was extending the IP resistivity survey area, and carrying out MaxMin horizontal loop EM surveying, Wild Rose extended the gravity and magnetic surveys. In addition, Crone Geophysics carried out a deeppenetration pulse EM survey.

#### GEOLOGY

#### a) Regional

The following is quoted from Kahlert in his report to Victoria Resource Corporation and Anglo Canadian Mining Corporation.

"The work by Cairns, Rice, Leech, Hoy and others has developed a good understanding of the geology and structure of the Kimberley district of southeastern B.C. The area lies within the Purcell Anticlinorium, a geological sub-province which lies between the Rocky Mountain Thrust and Fold Belt to the east and the Kootenay Arc to the west.

"In the core of the Purcell anticlinorium, the Purcell Supergroup includes up to 11 kilometres of dominantly carbonate and finegrained clastic rocks. The anticlinorium is cut by a number of late, NE-trending faults. These faults appear to follow the loci of older structures that have been actively, intermittently, and locally modified the type, distribution and thickness of late Proterozoic and Paleozoic rocks (Leech, 1985; Lis and Price, 1976). Dramatic thickness and facies changes in Purcell rocks east of the trench, particularly along the Boulder Creek fault zone indicate that, at least locally, these structures were active during deposition of Purcell strata (Hoy, 1979, 1982)."

"In summary, it is evident that deep crustal structures in underlying crystalline basement affected the eastern margin of the Purcell basin. Furthermore, the distribution of base metal concentrations, such as Sullivan, North Star, Stemwinder and Kootenay King, appears to be tectonically controlled (Kanasewich, 1968). Such concentrations occur near the intersection of the Ntrending, rifted, continental margin and a pronounced SWtrending, tectonic zone. The tectonic control may be direct, with zones of crustal weakness localizing deep-rooted basement faults that controlled the outflow of metal-charged fluids, or indirect, with these zones localizing geothermal convective cells that controlled sulphide deposition."

# b) <u>Property</u>

The following is taken from the G.S.C. map of the area by Leech.

Almost the entire area of the Wait claims is covered by glacial till and fluvial sands and gravels making bedrock outcrops nonexistent to scarce. Furthermore, the extensive block-faulting makes it difficult to ascertain the rock-types underlying the overburden from the known rock-types from the surrounding areas.

However, outcrops within the southwestern (Wait 3 and 4 claims) and northwestern (Wait 18 and 20 claims) parts of the property are extensive enough to map bedrock in these areas.

The Wait 3 claim is mostly underlain by the <u>Creston Formation</u> which is composed of grey and green argillites and siltstones as well as grey, green, white and purple quartzites.

Underlying the Creston Formation is the older <u>Aldridge Formation</u> which outcrops over the Wait 4 claim, the southwestern part of the Wait 5 claim and to the west of the Wait 7 claim. This formation is composed of grey quartzites and siltstones as well as dark argillites. This is the favourable host-rock for mineralization in the area.

The three drill holes collared in the area of the Wait 2/Wait 6 boundary encountered the Aldridge formation in the sub-outcrop below overburden varying in depths from 18 to 38 m. This indicates that much of the Wait claims could be underlain by the Aldridge formation. The holes, labelled 86-01, 86-02, and 86-03 were drilled to depths of 469.5, 477.7, and 358.1 m, respectively. The rock-types encountered were interbedded quartzites, siltstones and argillites.

The Kimberley fault is projected to extend easterly across the upper central part of the Wait 7 claim. Though extensively covered by overburden, the north side of the fault is projected to be underlain by a formation of siltstone, argillite, quartzite, andesitic lava, breccia and tuff undivided with the <u>Kitchener Formation</u>. The Kitchener Formation, younger than the Creston Formation, is composed of grey and green argillite and dolomitic argillite, grey dolomite, quartzite and grey limestone.

All of the above-named formations are of the Precambrian Purcell age.

The only intrusives known in the area are Cretaceous quartz monzonites as seen in outcrops as close as 3.5 km south of the southern boundary of the Wait claims.

# c) Mineralization

The only known mineralization on the property is the widespread sulphides encountered in each of the 3 drill holes. The sulphides occur in concentrations of up to 15% and, without a doubt, are the causative source of the IP anomaly. The following description is given by Klewchuk.

"<u>Pyrite</u> is the dominant iron sulphide intersected by the Wait drilling; <u>pyrrhotite</u> increases downward in all three holes but rarely predominates over pyrite.

"Pyrite occurs in four ways

- 1. "Disseminated in quartzites.
- 2. "Disseminated in light grey siltstones and in dark, finely laminated siltstones. This pyrite is concentrated along bedding planes, and in light grey siltstones the pyrite typically occurs just below the upper contact. Pyrite in the dark, finely laminated siltstones is probably the source of the IP anomalies.
- 3. "Narrow bedding-parallel laminations up to 3 mm thick.
- 4. "Narrow cross-cutting veins. These may be entirely pyrite or with some quartz and carbonate (dolomite, ankerite and calcite all occur in the Wait drill holes although dolomite predominates).

"Regionally in the Aldridge formation disseminated iron sulphides are common in the Upper and Lower Aldridge and in thin-bedded argillaceous zones of the Middle Aldridge. Typically the disseminated iron sulphide in Aldridge rocks is pyrrhotite while pyrite occurs on fracture surfaces (often chloritic) and as narrow crosscutting veinlets.

"At the Sullivan orebody, pyrrhotite occurs in the central part of the orebody while pyrite occurs on the uneconomic fringe of the deposit.

"The presence and style of occurrence of iron sulphides at the Wait property is not anomalous but the concentration of pyrite is greater than is seen in the Aldridge regionally and the fact that the iron sulphide is pyrite rather than pyrrhotite may also be anomalous.

"Although the concentration of <u>sphalerite</u> and <u>galena</u> in the Wait drill core is small, it is greater than average amounts seen in the Aldridge. Most of the base metal sulphides occur in crosscutting or bedding-parallel quartz-dolomite veinlets; a minor amount occurs in argillite or siltstone as disseminations. In all three drill holes there is a recognizable increase in the concentration of sphalerite with depth. The source of the remobilized vein sulphides conceivably is a large concentration at depth, and, which is also the cause of the gravity anomaly.

"<u>Arsenopyrite</u> occurs with Sullivan ore and can be found regionally in the Aldridge Formation, especially where other favourable features occur, such as conglomerate or tourmelinite. In the Wait drill holes the presence of arsenopyrite is favourable but the amounts seen are small."

Anomalous gold values were also encountered in the Wait drill holes as described by Klewchuk: "Routine geochemical sampling of the Wait core has indicated anomalous gold values up to 290 ppb over a core length of 5 metres. Subsequent re-sampling of selected specimens produced a maximum value of 21.45 g/ton (0.626 oz/ton) in a 15 cm length of core.

"The anomalous gold values occur in some of the fault zones in both 86-1 and 86-2 and near or within the Upper-Middle Aldridge transition zone. These preliminary results indicate that a real possibility exists for the gold to be stratiform in occurrence and related to the U/M contract."

#### INDUCED POLARIZATION-RESISTIVITY SURVEY

# a) Instrumentation

The transmitter used for the induced polarization-resistivity survey was a Model IPT-1, manufactured by Phoenix Geophysics Ltd.of Markham, Ontario. It was powered by a 2.0 kw motor-generator, Model MG-2, also manufactured by Phoenix.

The receiver used was a model Mark IV manufactured by Huntec ('70) Limited of Scarborough, Ontario. This is state-of-the-art equipment, with software-controlled functions, programmable through the front panel.

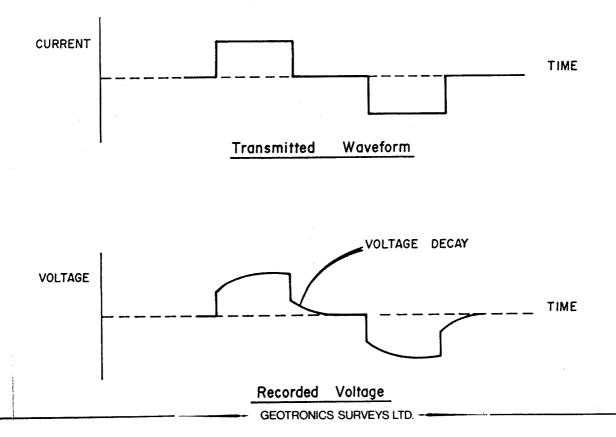
The Mark IV system is capable of time domain, frequency domain, and complex resistivity measurements.

## b) <u>Theory</u>

When a voltage is applied to the ground, electrical current flows, mainly in the electrolyte-filled capillaries within the rock. If the capillaries also contain certain mineral particles that transport current by electrons (most sulphides, some oxides and graphite), then the ionic charges build up at the particleelectrolyte interface, positive ones where the current enters the particle and negative ones where it leaves. This accumulation of charge creates a voltage that tends to oppose the current flow across the interface. When the current is switched off, the created voltage slowly decreases as the accumulated ions diffuse back into the electrolyte. This type of induced polarization phenomena is known as electrode polarization.

A similar effect occurs if clay particles are present in the conducting medium. Charged clay particles attract oppositely-charged ions from the surrounding electrolyte; when the current stops, the ions slowly diffuse back to their equilibrium state. This process is known as membrane polarization and gives rise to induced polarization effects even in the absence of metallic-type conductors.

Most IP surveys are carried out by taking measurements in the "time-domain" or the "frequency-domain".



Time-domain measurements involve sampling the waveform at intervals after the current is switched off, to derive a dimensionless paramater, the chargeability, "M" which is a measure of the strength of the induced polarization effect. Measurements in the frequency-domain are based on the fact that the resistance produced at the electrolyte-charged particle interface decreases with increasing frequency. The difference between apparent resistivity readings at a high and low frequency is expressed as the percentage frequency effect, "PFE".

The quantity, apparent resistivity,  $\rho_{\alpha}$ , computed from electrical survey results is only the true earth resistivity in a homogenous sub-surface. When vertical (and lateral) variations in electrical properties occur, as they always will in the real world, the apparent resistivity will be influenced by the various layers, depending on their depth relative to the electrode spacing. A single reading cannot therefore be attributed to a particular depth.

The ability of the ground to transmit electricity is, in the absence of metallic-type conductors, almost completely depending on the volume, nature and content of the pore space. Empirical relationships can be derived linking the formation resistivity to the pore water resistivity, as a function of porosity. Such a formula is Archie's Law, which states (assuming complete saturation) in clean formations:

 $\frac{RO}{RW} = 0^{-2}$ 

Where: Ro is formation resistivity Rw is pore water resistivity 0 is porosity

### c) Survey Procedure

The IP and resistivity measurements were taken in the time-domain mode using an 8-second square wave charge cycle (2-seconds positive charge, 2-seconds off, 2-seconds negative charge, 2-seconds off). The delay time used after the charge shuts off was 200 milliseconds and the integration time used was 1,500 milli-seconds divided into 10 windows.

The configuration used in the field was the pole-dipole array shown as follows:

POLE-DIPOLE ARRAY Current Potential Electrodes Electrodes > 10a uuuuuu Plotting Point

The electrode spacing (or dipole length) is denoted at 'a' and was chosen as 150 m. The 'n' was read to one dipole separation ('na') over the whole survey area which was therefore 150 m. This gives a theoretical depth penetration of 200 m which depends not only on the 'na' spacing but also on the ground resistivity. In addition, portions of 10+00W, 5+00W, 0+00, 5+00E and 10+00E were read to two dipole separations (300 m) which gives a theoretical depth penetration of close to 400 m and a portion of line 15+00E was read to four dipole separations (600 m) which gives a theoretical depth penetration of close to 700 m.

The pole-dipole array was chosen because of its greater speed for the purpose of reconnaissance work. Where the target is large, the lack of symmetry of the pole-dipole array is considered to be of small disadvantage.

Stainless steel stakes were used for current electrodes. Normally the potential electrodes are comprised of metallic copper in copper sulphate solution, in non-polarizing, unglazed, porcelain pots. However, the frozen ground necessitated the use of stainless steel stakes for the potential electrodes as well.

The survey's baseline runs in a direction of N40°E-S40°W and the survey lines on which the IP and resistivity readings were taken occur every 500 m at a perpendicular direction to the baseline being N50°W-S50°E. In addition, four short detail lines were put in within an area of anomalous IP readings resulting in a spacing of 250 m.

A total of 38.25 km was done at one separation. Of this, 13.45 km was done at two separations and 1.8 km was done at four separations.

In addition to the regular IP and resistivity measurements, the IP decay (or discharge) curve was measured and plotted at two different locations.

The survey's progress was somewhat hampered by frozen ground because of the planting of the electrodes.

# d) Compilation of Data

The chargeability (IP) values are read directly from the instrument and no data processing is therefore required prior to plotting. The resistivity values are derived from current and voltage

readings taken in the field. These values are combined with the geometrical factor appropriate for the pole-dipole array, to compute the apparent resistivities.

The chargeability and resistivity data to the first separation were plotted in survey plan form on Maps 3 and 4, respectively, at a scale of 1:10,000. They were plotted at the midway point of the receiver dipole. The chargeability data were contoured at a 10 milli-second contour interval, and the resistivity data, at a 50 ohm-m contour interval below 500 ohm-m and at a 100 ohm-m contour interval above 500 ohm-m.

The IP and resistivity pseudosections are plotted on Map #7 at a scale of 1:10,000. Each value is plotted at the intersection of a vertical line below the midpoint of the receiver dipole and a 45° line from the current pole. The data were contoured using the same intervals as for the survey plans.

#### MAXMIN ELECTROMAGNETIC SURVEY

a) Instrumentation and Theory

A MaxMin II portable 2-man electromagnetometer, manufactured by Apex Parametrics Ltd. of Toronto, Ontario was used for this survey. This instrument is designed for measuring the electromagnetic field which results from a conductive body; that is a structure which conducts electricity better than barren rocktypes do.This particular instrument has the advantage of flexibility over most other EM units in that it can operate with different modes and frequencies as well as having a variety of distances between transmitter and receiver. Five frequencies can be used (222, 444, 888, 1777 and 3555 Hertz) and six different coil separations (25, 50, 100, 150, 200 and 250 meters). In all electromagnetic prospecting, a transmitter induces an alternating magnetic field (called the primary field) by having a strong alternating current move through a coil of wire. This primary field travels through any medium and if a conductive mass such as a sulphide body is present, the primary field induces a secondary alternating current in the conductor and this current in turn induces a secondary magnetic field. The receiver picks up the primary field and, if a conductor is present, the secondary field. The fields are expressed as a vector which has two components, the in-phase (or real) component and the out-of-phase (or quadrature) component. The results are expressed as the percent deviation of each component from what the values would be if no secondary field (and therefore no conductor) was present.

Since the fields lose strength proportionally with the distance they travel, a distant conductor has less of an effect than a close conductor. Also, the lower the frequency of the primary field, the further the field can travel and therefore the greater the depth penetration.

The MaxMin II EM unit can vary the strength of the primary field and so use different separations between transmitter and receiver coils, change the frequency of the primary field for varying depth penetrations, and use three different ways of orienting the coils to duplicate the survey in three styles so that more accuracy is possible in the interpretation of the data.

The use of the MaxMin II electromagnetometer allows for better discrimination between low conductive structures such as clay beds and barren shear zones and more conductive bodies like massive sulphide mineralization. It also gives several different types of data over a given area so that statistical analysis can result in less error in the interpretation.

#### b) Survey Procedure

The electromagnetic survey was carried out with the slope separation between the transmitter and receiver measured to an accuracy of 100 m  $\pm$  0.3 m. Readings were taken every 25 m, except where the EM field changed rapidly, then the readings were taken every 12.5 m.

The receiver operator read and recorded the in-phase and out-ofphase responses. Calibration and phase mixing tests were also conducted three times a day and the appropriate corrections made when necessary.

All five frequencies were read by the receiver operator, which were 222, 444, 888, 1777, and 3555 Hz.

A total of 13.25 km of electromagnetic survey was carried out over all or portions of lines 5+00W, 3+25W, 0+00W, 6+00E, 10+00E and 25+00E.

#### c) Compilation of Data and Interpretion Methods

The EM data for all five frequencies were profiled on a separate drawing for each line (Maps 8 to 13, respectively) at a and the scale 1:5,000. The in-phase data horizontal of out-of-phase data of two frequencies were profiled. The plotting point is taken at the mid-point between the transmitter and the receiver. The vertical scale used for both the in-phase and out-of-phase data was 1 cm = 10%.

Quantitative interpretation was carried out wherever anomalous readings (and thus, conductors) were encountered. All five frequencies were plotted at an exaggerated vertical scale in order to facilitate comparison and curve matching with type-curves. These plots were strictly working copies and therefore are not given as part of this report. Type-curves are produced either by computer models or actual scale models tested under laboratory conditions. The type-curves used were those published by the Geological Survey of Finland. The quantitative interpretation included:

- (1) the location of the top of the conductor,
- (2) the depth to the top of the conductor,
- (3) the dip of the conductor, and
- (4) the conductivity-thickness of the conductor.

Conductivity-thickness is always described as a product since a poorly conductive, thick conductor can give the same EM profile as a highly conductive, thin conductor.

The EM-mapped conductors have been divided into 3 classes, definite, probable, and possible conductors. Often, very little quantitative information can be interpreted from the probable and possible conductors, usually because of noise problems. On this property, it is more likely the possible conductors are reflecting faults.

The trace of the top of each conductor has been drawn on the chargeability survey plan (Map 3), in order to facilitate easy correlation. The definite conductor is drawn in solid, the probable conductor, dashed, and the possible conductor, dotted.

### d) Interpretation Pitfalls

One of the main problem with EM surveying is conductive overburden. If the overburden thickness is uniform, then the problem is minimized. The conductive overburden causes the in-phase and outof-phase profiles to separate from each other and away from the zero line as well as alters the amplitude of the negative peak for both the in-phase and out-of-phase. One therefore moves the

zero line to correlate with the background reading of the inphase profile and/or the out-of-phase profile and then uses special guantitative interpretation procedures. Conductive overburden occurs throughout the survey area.

More difficult problems are produced, however, if the thickness of the conductive overburden undulates, or if there exists a buried bedrock trough, or ridge. This can produce an EM profile similar in shape to that over a normal conductor. However, this feature will become minimal at lower frequencies, and, therefore, this type of "false conductor" can be sorted out.

The dip of the conductor is probably the most difficult piece of information to interpret from the EM profiles. The major cause is non-uniform conductive overburden which tends to affect the shape (from which the dip is taken) of the EM profile over a conductor. Another cause of the problem is 2 closely spaced conductors, as occurs on this survey, so that one affects the shape of the other.

Another problem is geological noise which is produced from such features as faults, fracture zones, contacts, and graphitic horizons. This can also affect the shape of the EM profile over a conductor.

In some cases, an interpretation can be carried out using 2 different models. Both models have been interpreted, and under "Discussion of Results", the preferred model only is given. The most common problem was deciding whether the causative source was one wide conductor, or two narrow conductors. Often the interpretation for each case produced similar results (i.e. similar dip, similar depth-to-top).

## DISCUSSION OF RESULTS

a) Induced Polarization - Resistivity

The results of the additional IP surveying have shown the IP anonmalies, and thus the sulphide mineralization, to be much more extensive than previously thought.

When the property was first surveyed by IP in January and February, 1986, six IP anomalies were discovered that were labelled by the capital letters A to F, respectively. The detailing carried out later that year showed anomaly A, the largest one, to be composed of two parts, and anomalies B and C to actually be the same anomaly which is now labelled B. Anomaly A which correlates with gravity anomaly A, was then drilled in three places. The drilling encountered widespread stratabound sulphide mineralization that explained the IP anomaly but did not adequately explain the gravity anomaly.

The present work extended the previous survey area to the northwest as well as to the northeast. This resulted in

- 1. Possibly delineating the northeast end of anomaly E
- 2. Extending anomaly F to the north
- 3. Discovering a new anomalous zone that has been labelled G

<u>Anomaly E</u>, which contains the surveys highest IP value of 150 msec., appears to have maximum strike length of about 1,500 m according to the survey plan. It is completely open to the southeast. However, the pseudosections on lines 10+00W and 5+00W suggest this anomaly may be connected at depth with anomaly G. If this is the case, then the combined length of E and G in a northeasterly direction is a minimum 4,500 m. There is a correlation of IP anomaly E with a resistivity low though the low is not particularly strong and the correlation is not that pronounced.

On lines 15+00W and 10+00W, anomaly E correlates with a low amplitude gravity high. However, over the strongest part of the anomaly on line 25+00W, no gravity surveying was done.

<u>Anomaly F</u> was extended in a northeasterly direction to line 0+00 extending the strike length to 2,500 m with it still being open to the southwest. It also revealed a 1,000 m northerly arm extending from line 10+00 to line 0+00.

Anomaly F contains three peaks which have been labelled F1, F2, and F3, respectively. F1 occurs on line 25+00E and has a high of 116 msec. F2 occurs on line 10+00E and has a high of 139.5 msec (seen on the second separation of the pseudosection). F3 occurs on line 0+00 and has a high of 90.2 msec.

The survey plan as well as the pseudosections suggest that anomalous zone F may actually be composed of three causative sources (that are in all probability sulphides) that are sub-parallel to each other. The first causative source would run from F1 in a northeasterly direction to line 15+00W and probably to line 10+00W for a minimum length of 1,500 m. The second causative source would run from the central part of F2 on line 10+00W to line 0+00 for a length of over 1,000 m. The third causative source would run from the northwestern part of F2 to F3 in a north-northeasterly direction to give a minimum length of 1,100 m.

All three pseudosections (10+00W, 5+00W and 0+00) across anomalous zone F indicate the causative sources to probably dip to the northwest, though the evidence is not always that strong.

The discarge curves for the 2nd separation was measured at 2 locations close to anomaly F2, namely (10+00W, 28+00N) where the IP reading was 93.6 msec, and (5+00W, 34+00N) where the IP reading was 94.5 msec. The 2 discharge curves are very similar to each other and very similar to one measured on anomaly A at (0+00, 1+25N) where the reading was 99 msec. This strongly indicates that the causative source of anomaly F2 is similar to that of anomaly A, namely banded and disseminated sulphides consisting of pyrite, pyrrhotite, sphalerite, galena and arsenopyrite.

F1 and its northeastern extension on line 15+00W correlates with a resistivity low. F2 also correlates with a resistivity low though the strongest part of this particular low correlates with an IP low on line 15+00W. F3 correlates with the northwestern edge of a resistivity low. In general, the resistivity results do not define IP anonmalous zone F that well.

No gravity surveying was done across F1, and for F2, there is no gravity correlation. Nevertheless, there is excellent correlation of gravity anomaly D3 with IP anomaly F3. The correlation, however, is somewhat offset with the center of F3 occurring about 250 m south of the center of D3. Considering the gravity/IP correlation, it would appear that the causatice source is massive sulpides, quite possibly lead-zinc, occurring within a zone of disseminated and banded sulphides. The IP pseudosection on line 0+00 indicates a possible northwesterly dip. The offset may then be explained by he gravity reflecting the down dip extension of the causative source of F3.

However, it must be remembered that there will not necessarily be a direct correlation since IP and gravity are measurements of two completely different physical properties. IP measures the capacitative effect of a sulphide deposit with generally the greater the surface area of sulphides, the higher the IP reading. Gravity

essentially measures the mass density of a sulphide deposit with the result that less surface area of sulphides for the volumne will result in higher gravity readings.

Of very strong exploration interest is the new <u>anomalous zone G</u>. It extends for at least 2,000 m in a northeasterly direction and about 1,300 m in a northwesterly direction at its widest point in line 2.5+00E. The zone is composed of three highs (or peaks) labelled G1, G2, and G3, respectively, that reach a value of 60 to 70 msec. Each one may reflect separate causative sources.

All pseudosections done across G, that is, 0+00, 5+00E, 10+00E, and 15+00E, show higher IP values with depth, and thus increasing sulphides with depth. They also show a probable dip to the northwest, though for pseudosection 15+00E which was done to four separations, the dip of the causative source to the northwest is definite.

What is so interesting about anomaly G is its correlation with gravity anomalies B, D1, and D2. As with correlating IP anomaly F3 and gravity anomaly D3, there is no direct correlation with the peaks of gravity highs with the peaks of IP anomaly G. However, the pseudosections show the correlation to be much closer. This is seen on pseudosections 15+00W and 10+00E which show IP anomaly G to occur to the immediate northwest of gravity anomaly B. And on pseudosection 5+00E, gravity anomaly D1 correlates directly with IP anomaly G3 at depth. No IP measurements were carried out directly across D3, but the above would indicate a much closer correlation.

As with IP anomaly F3/gravity anomaly D3, the likely causative source of each of the gravity anomalies B, D1, and D2 is massive sulphides, possibly lead-zinc. The IP would reflect disseminated and/or banded sulphides associated with the massive sulphide bodies. IP anomaly G and its correlating gravity highs correlate in general with higher resistivity values with much lower resistivity values occurring to the north and to the south. Pseudosection 15+00E shows a resistivity high correlating directly with a gravity high, but the apparent resistivity values decrease to background with depth. The other pseudosections show no real correlation of resistivity with either gravity highs or IP highs.

What is of interest, however, is the apparent resistivity low of 13 ohm-m directly below 22+00N. This is the lowest apparent resistivity value on the property. The real resistivity value would be lower which would indicate the causative source to be quite conductive. According to Kahlert, the low correlates directly with a pulse EM conductor at depth. Both the resistivity low and pulse EM conductor correlate very closely to gravity anomaly B.

In reviewing the survey results, it is apparent that there is no real correlation of the resistivity results with the IP results. Sometimes an IP high will correlate with a resistivity low, sometimes with a resistivity high, and sometimes with a resistivity background. It should be noted that the resistivity values are low to begin with and are likely a reflection of the sedimentary bedrock. Therefore, alteration and fracturing that may accompany a mineral zone do not affect the rock resistivities that much. As a result, the resistivity results that are correlating with an IP high and/or gravity high may be reflecting lithology or perhaps overburden thickness rather than alteration and fracturing. In fact, the areas of lowest resistivity values correlate with areas of background IP values.

The most prominent feature of the resistivity survey as seen on the resistivity survey plan is a resistivity contact with higher resistivity values on the eastern part of the survey area. The contact, which strikes in a north-northwesterly direction and is

possibly best represented by the 400 ohm-m contour, quite likely reflects a lithological contact. West of the contact, the resistivities average about 250 ohm-m and likely reflect Aldridge and Creston formations. To the east, the resistivities are significantly higher averaging about 700 ohm-m and therefore may be reflecting the Fort Steele formation, perhaps its white siliceous quartzite.

To the immediate west of the resistivity high is a northern- to north-northwesterly-trending series of prominent resistivity lows. These lows may be reflecting a lithological unit, or perhaps major valley faulting that follows the trend of the Rocky Mountain Trench.

There is some correlation of the gravity-mapped block-type faulting with resistiviy lows. This corroborates at least some of the gravity-interpreted faults but it is somewhat difficult to use the resistivity results to map faulting.

The gravity survey has revealed what appears to be a very strong gravity high labelled C at the northwestern ends of lines 15+00E and 20+00E. So far there is no apparent correlation of IP results with this high, but considering that IP highs are always offset from gravity highs, further work to the northwest will probably reveal a correlating IP high.

# b) Horizontal Loop EM

A few lines on which horizontal loop EM surveying was done has revealed very positive results. Six conductive zones have been delineated and these have been labelled by the Roman numerals I through VI. <u>Conductor I</u> was delineated on lines 0+00 and 5+00E occurring to the immediate northwest of the baseline. This conductor has the response of all the conductors but this does not mean it has the best conductivity. It strikes northeasterly and dips steeply to the northwest, no shallower than 70°. The depth to the top on line 5+00E is close to the surface, probably no greater than 20 m, but on line 0+00 the depth is greater, possibly about 40 m. This would indicate that the conductor sub-outcrops since these depths are similar to depths of overburden in this area.

Conductor I may consist of two conductors but is more likely to be one wide conductive zone of 70 to 100 m width. If it consists of two conductors, their location would be along the edges of the wide conductive zone as drawn on Map #3. Conductor I has poor conductivity with an increase in conductivity towards its northwestern flank on line 5+00E.

While this conductor correlates with the southeastern flank of IP anomaly A, its most interesting aspect is its <u>direct</u> correlation with gravity anomaly A. This suggests, therefore, that the reason the drilling did not encounter the source of the gravity high is that it is steeply dipping (90° to 70° northwest). Drill hole 86-01 was drilled to the immediate southeast of conductor I close to line 0+00 and drill hole 86-02 was drilled to its immediate northwest close to line 5+00E. It is obvious that the two drill holes barely missed the causative source of the gravity high and EM conductor.

The correlation of conductor I with gravity anomaly A corroborates that conductor I is a wide conductive zone. If it actually consists of two narrow conductors, the mass of the causative source would not be enough to cause the gravity high.

<u>Conductor II</u> is sub-parallel to conductor I occurring about 200 m to the northwest. It is a definite conductor only on line 0+00 and is downgraded to a possible conductor on the other three lines. It also dips steeply to the northwest but is considered to be comprised of one narrow conductor, perhaps about 15 m wide. The depth to top is probably the overburden thickness.

Conductor II correlates directly with IP anomaly peaks A1 and A2. This correlation suggests that the possible EM conductor at (5+00E, 4+75N) is an arm of conductor II.

<u>Conductor III</u> occurs on the northwestern edge of IP anomaly A and is seen only on line 0+00. It appears to be reflecting multiple conductors, probably three, located at 11+50N, 12+00N, and 12+75N, respectively. It is difficult to say what the dip is, but it probably is steeply to the south, probably near vertical.

Conductor III occurs within a swamp area which is not surprising considering that mineral zones often weather topographically low.

<u>Conductors IV and V</u> are seen on the northwestern end of line 0+00and possibly on line 5+00W as well, though on this line the response is extremely weak. On line 0+00, the response is not that strong and therefore little quantitative interpretation can be given. The low response may be caused by deep overburden and/or crossing the conductor at an oblique angle which is corroborated by the gravity results.

Both conductors IV and V correlated directly with IP anomaly F3, which as mentioned above, is off-center of gravity anomaly D3 by about 250 m. As a result, only conductor V correlates with the center of gravity anomaly D3.

The gravity anomaly strikes about west-northwest with the survey line 0+00 cutting across it at an oblique angle. This would suggest that if the horizontal loop was run in a north direction, the response of conductor V may be much stronger, and this perhaps quantitative interpretation could be gained.

<u>Conductor VI</u> occurs at 26+25N on line 0+00. It has a weak response and is simply mentioned because of its correlation with the northwestern edge of IP anomaly G2.

No horizontal loop EM surveying was done over the rest of the gravity anomalies, though line 10+00E, which was done across the southwestern tip of the gravity anomaly B, shows a probable and a possible conductor. Therefore, considering the strong direct correlation of EM conductors with gravity anomalies A and D3, it is expected there would be an EM response over the remaining gravity anomalies as well.

Over the rest of the horizontal loop EM survey lines are a number of weak responses that have been termed either probable or mostly possible conductors. The likely causative sources of these conductors are fault systems which is verified by some of these correlating with gravity-mapped faults. Another possible cause is bedrock troughs or channels which results in thicker overburden causing the weak EM response. But it should also be considered that it is likely the bedrock troughs or channels are caused by faulting.

Respectfully submitted, GEOTRONICS SURVEYS LTD.

David G. Mark, Geophysicist

March 5, 1987 37/G390

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### GEOPHYSICIST'S CERTIFICATE

I, DAVID G. MARK, of the City of Vancouver, in the Province of British Columbia, do hereby certify:

That I am a consulting geophysicist of Geotronics Surveys Ltd., with offices located at 530-800 West Pender Street, Vancouver, British Columbia.

I further certify:

- I am a graduate of the University of British Columbia (1968) and hold a B.Sc. degree in Geophysics.
- 2. I have been practising my profession for the past 19 years and have been active in the mining industry for the past 22 years.
- 3. I am an active member of the Society of Exploration Geophysicists and a member of the European Association for Exploration Geophysicists.
- 4. This report is compiled from data obtained from induced polarization, resistivity and horizontal loop EM surveys carried out by a crew of Geotronics Surveys Ltd., under my supervision and under the field supervision of Andrew Rybaltowski, geophysicist, from January 17th to February 14th, 1987.
- 5. I do not hold any interest in Anglo Canadian Mining Corporation, Victoria Resource Corporation nor Normine Resources Ltd., nor in any of the properties discussed in this report, nor will I receive any interest as a result of writing this report.

G. Mark Geophysicist

March 5, 1987 37/G390

1.

### AFFIDAVIT OF EXPENSES

This is to certify that I have caused induced polarization, resistivity and magnetic surveys to be done over the northern portion of the Wait claims located on Mather and Wait Creeks, 10.5 km due east of the town of Kimberley within the Fort Steele Mining Division from January 17 to February 14, 1987 to the value of the following:

### FIELD:

Mobilization/demobilization	\$ 3,000
4-man IP crew, 17 days at \$1,500/day	25,500
2-man MaxMin crew, 6 days @ \$700/day	8,400
	\$36,900

### OFFICE:

Geophysicist, 40 hrs. @ \$45/hr	\$ 1,800
Geophysicial technician, 50 hrs @ \$25/hr	1,250
Drafting & printing	1,600
Word processing, photocopying & compilation	250
	\$ 4,900

### Grand Total \$41,800\*

\*Note: \$12,300 of this figure was carried out on the North Wait claim group (Wait 11, 1, 14, 15 claims) on which assessment work was filed.

Respectfully submitted, GEOTRONICS SURVEYS LTD.

David/G. Mark, Geophysicist Manager

March 5, 1987 37/G390

## APPENDIX

# IP DISCHARGE CURVES

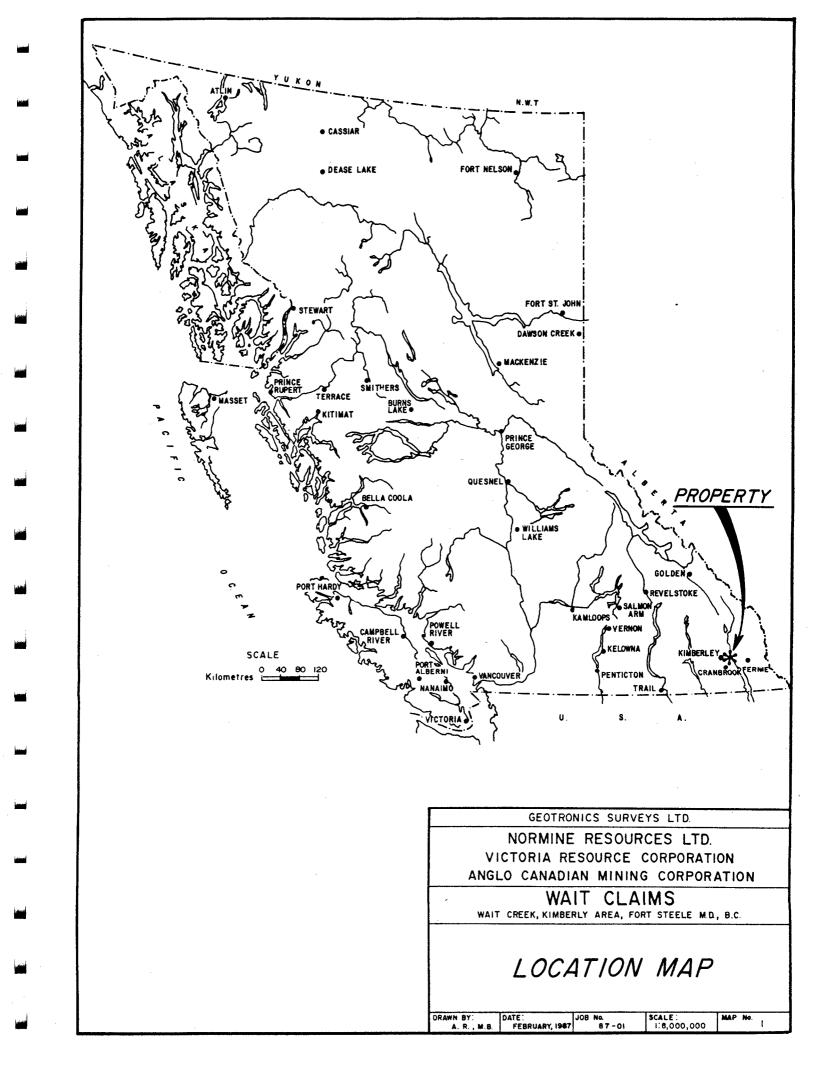
Wait Claims, Kimberley Area, British Columbia

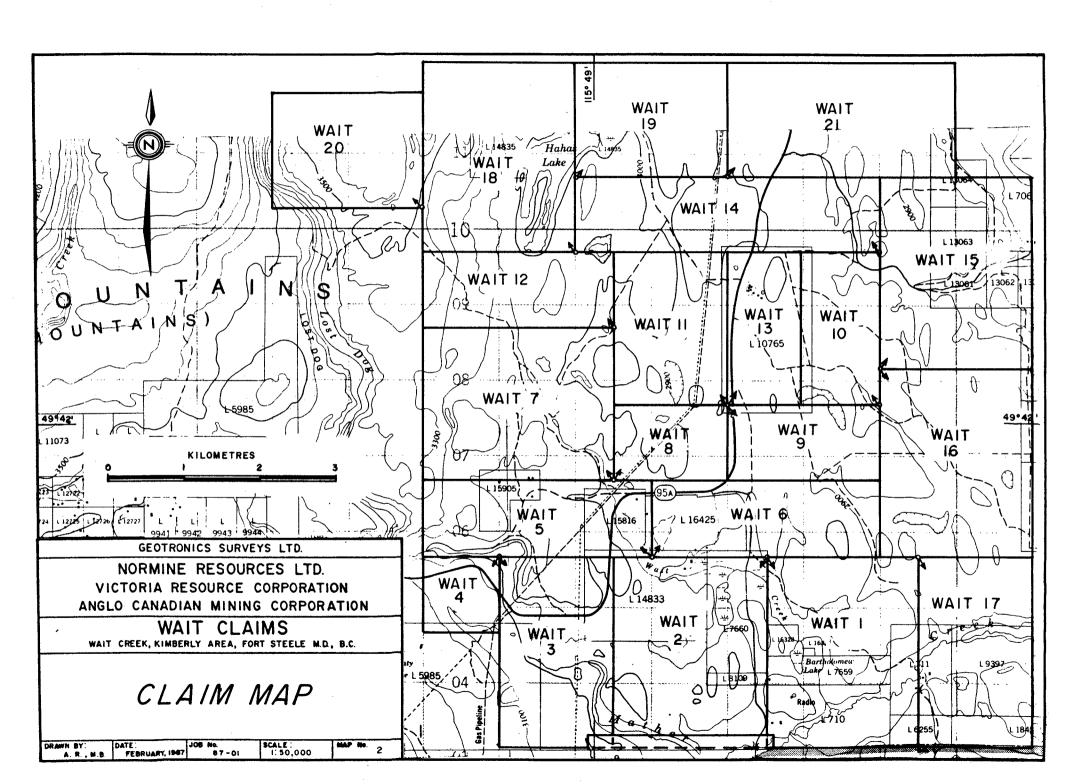
 Delay Time - 200 milliseconds
 Integration Time - 1,500 milliseconds divided into 10 windows of 150 milliseconds each.
 Horizontal Axis - Time displayed as 10 150-millisecond windows.
 Vertical Axis - IP (chargeability) in Milliseconds.

**E** WAIT CLAIMS 1 ••• ni j 1 245 DISCHARGE CURVE Line 10+00 W, 28+00 N n = 2chargeability = 93.6 msec ÷. 18 ..... 16 12 - .- <del>1</del>- : ÷..... 10 1 ) 1 1 - 1 - 1 - 1 172.4 B 14.1 6 4 Z ·····  $\alpha(n)$ 聖 1. M. eac 10 **O** 2. 6 в 10 in the second 5 P ..... \_\_\_\_\_ 

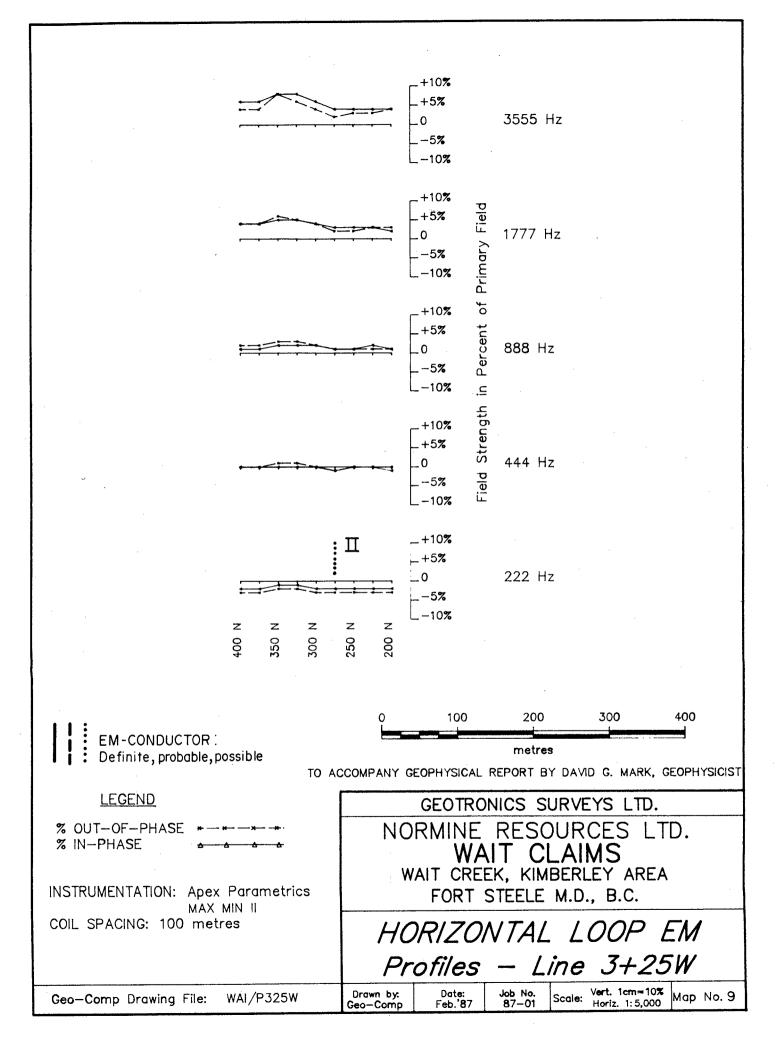
ing and a second se

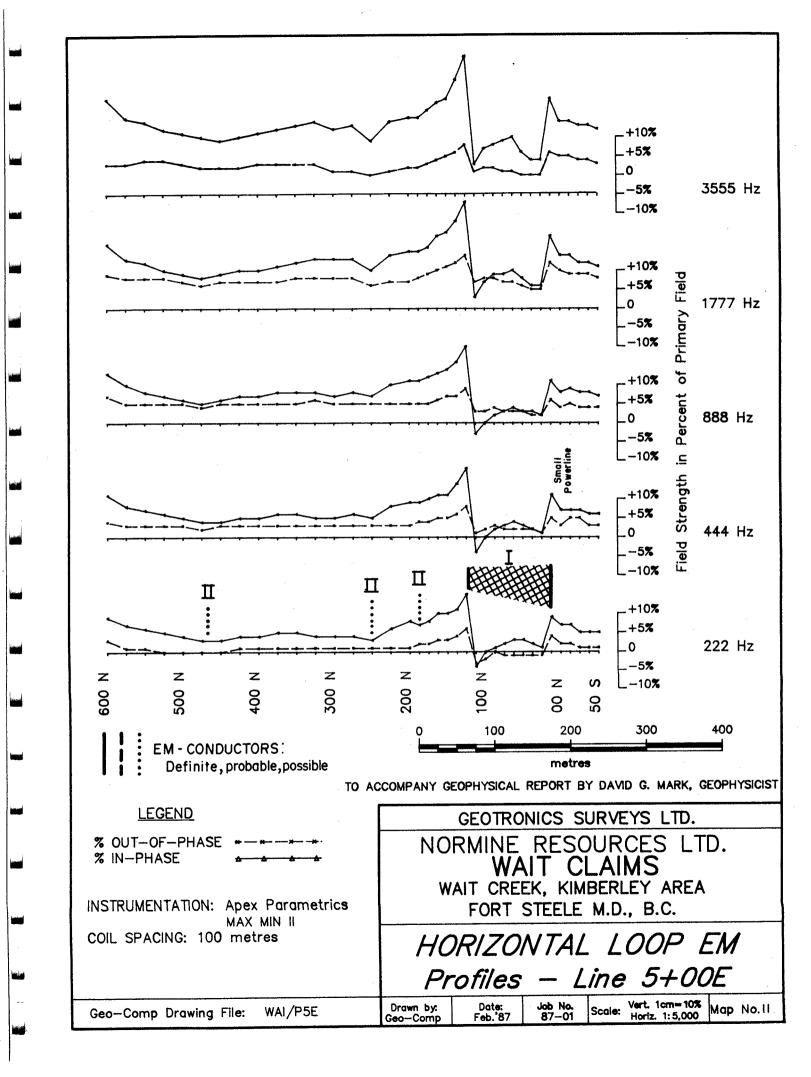
18 WAIT CLAIMS Discharge Curve Line 5+00W, 3++00N n=2chargeability - 94.5 msec. 14 ÷i · 12 10 8 6 HHH. J ..... 4 ntry – tr ì -j 2 11 () (DE 10 0 2 4 6 8 i and i para Ĵ-1₽ 





E . .

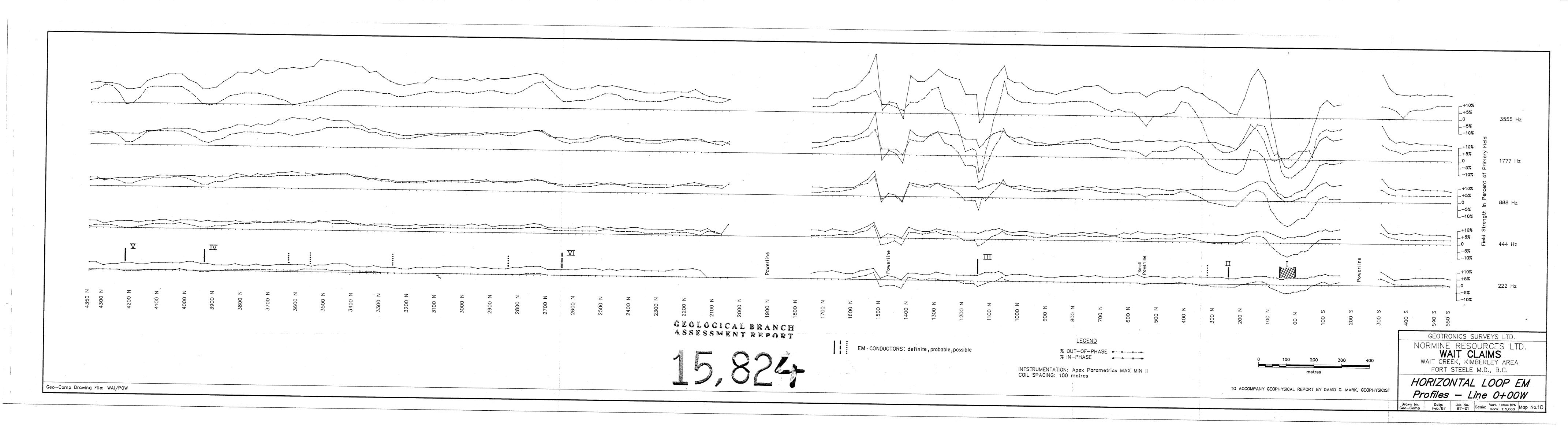


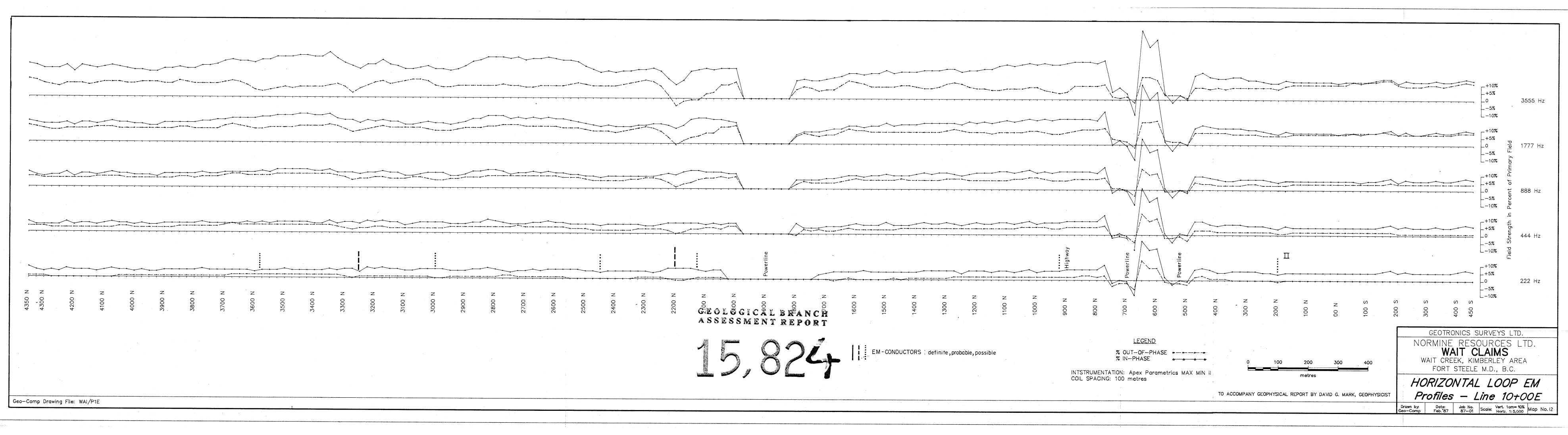


# INSERT

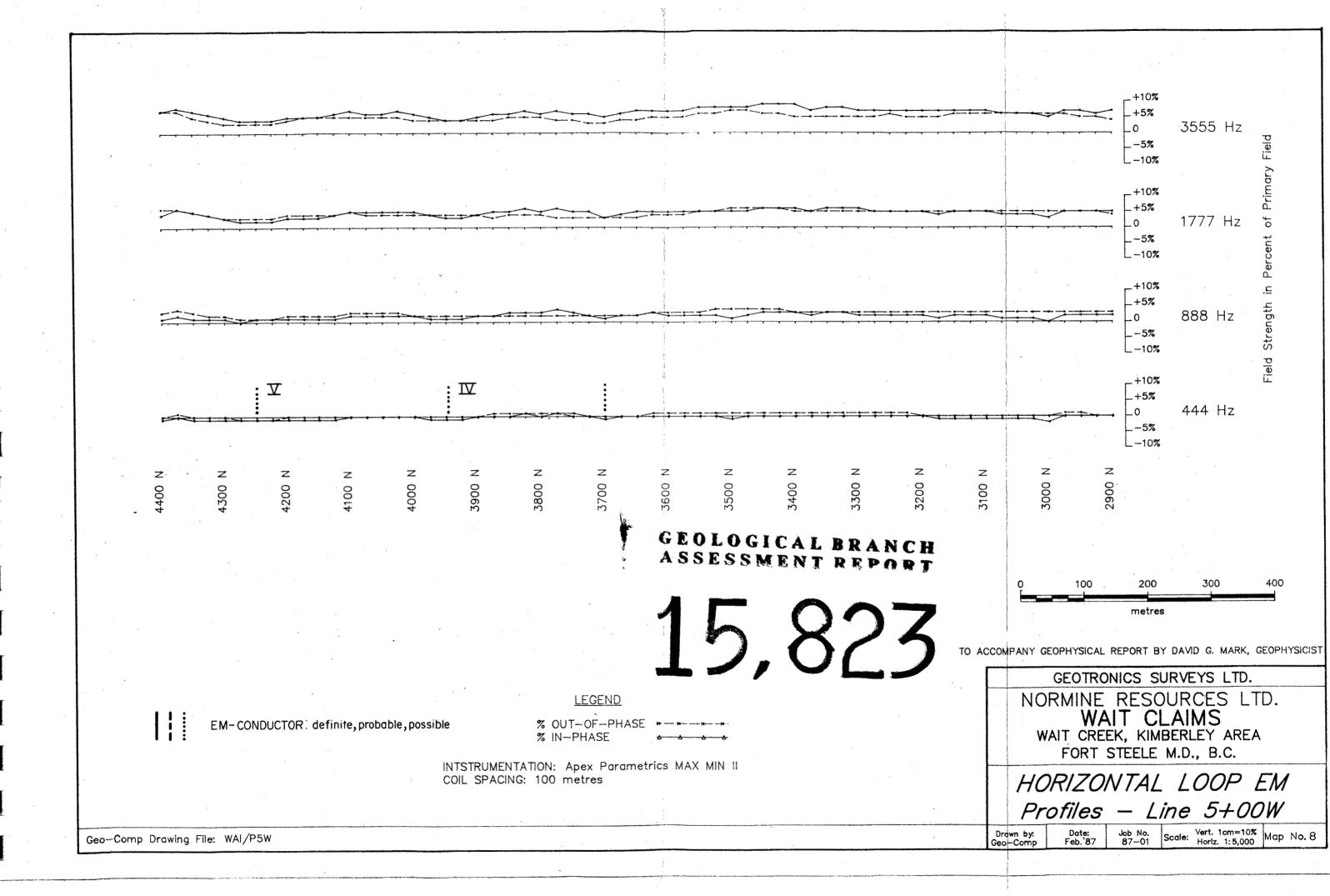
# LARGE

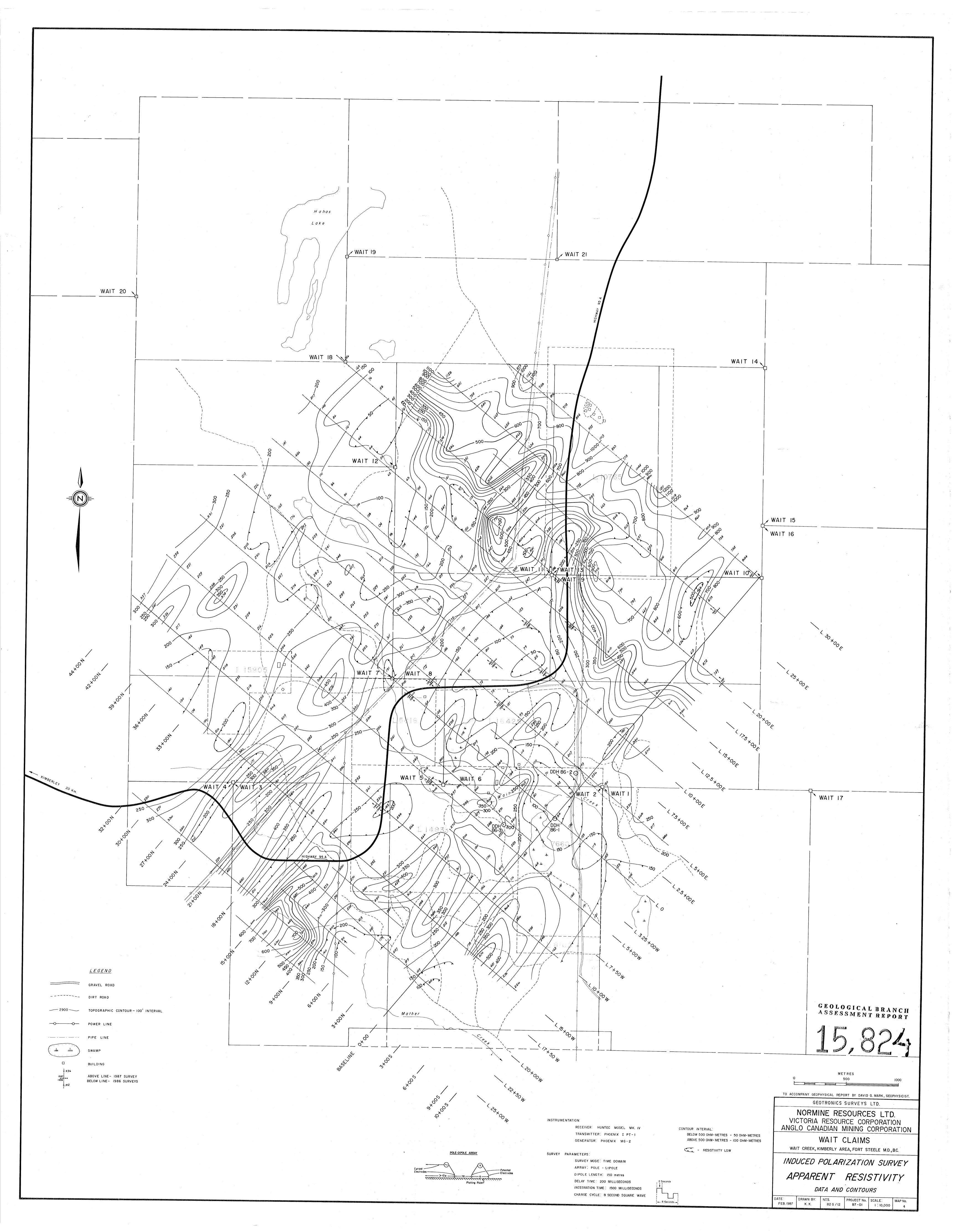
FORMAT 15824 LF 2 A

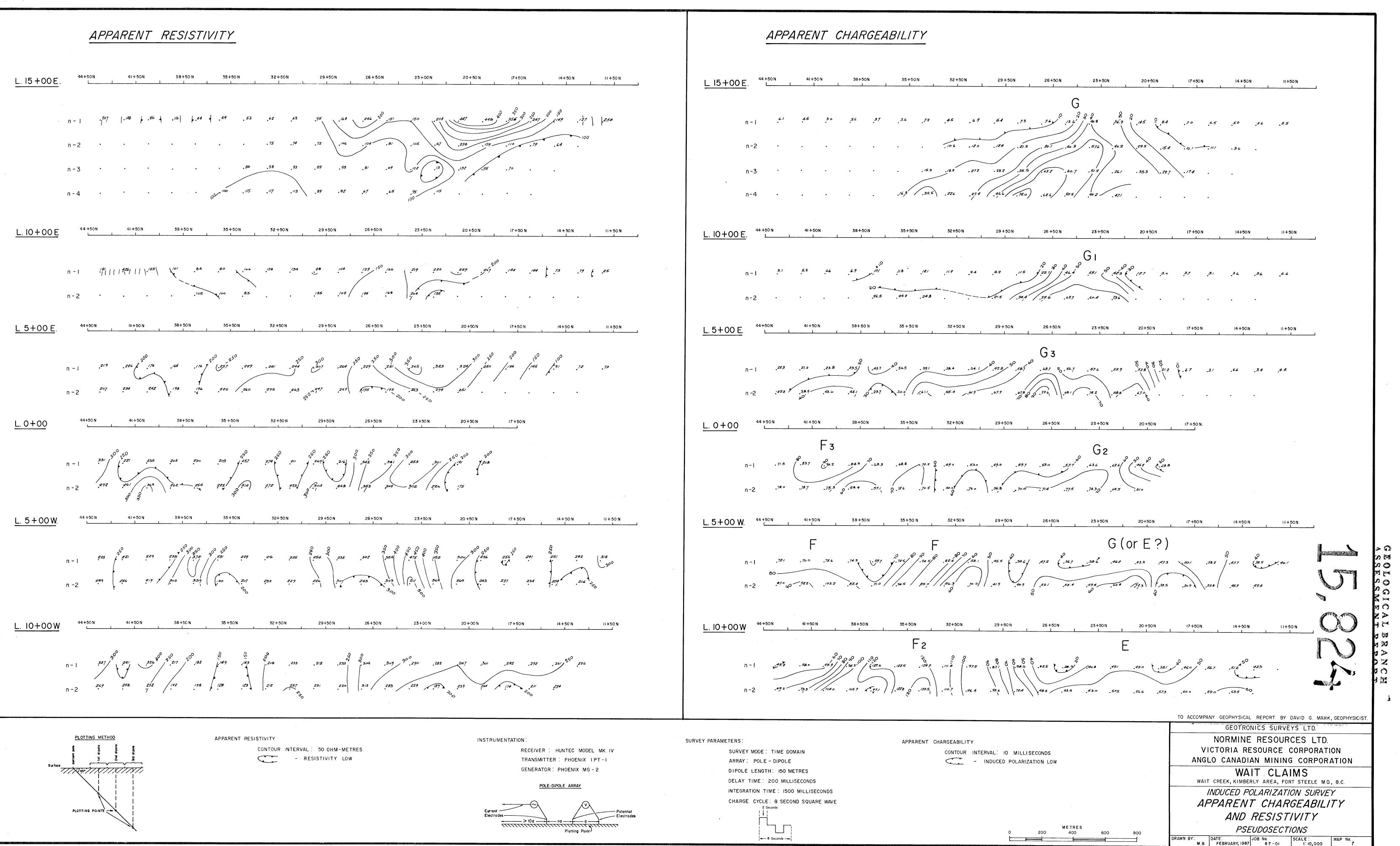


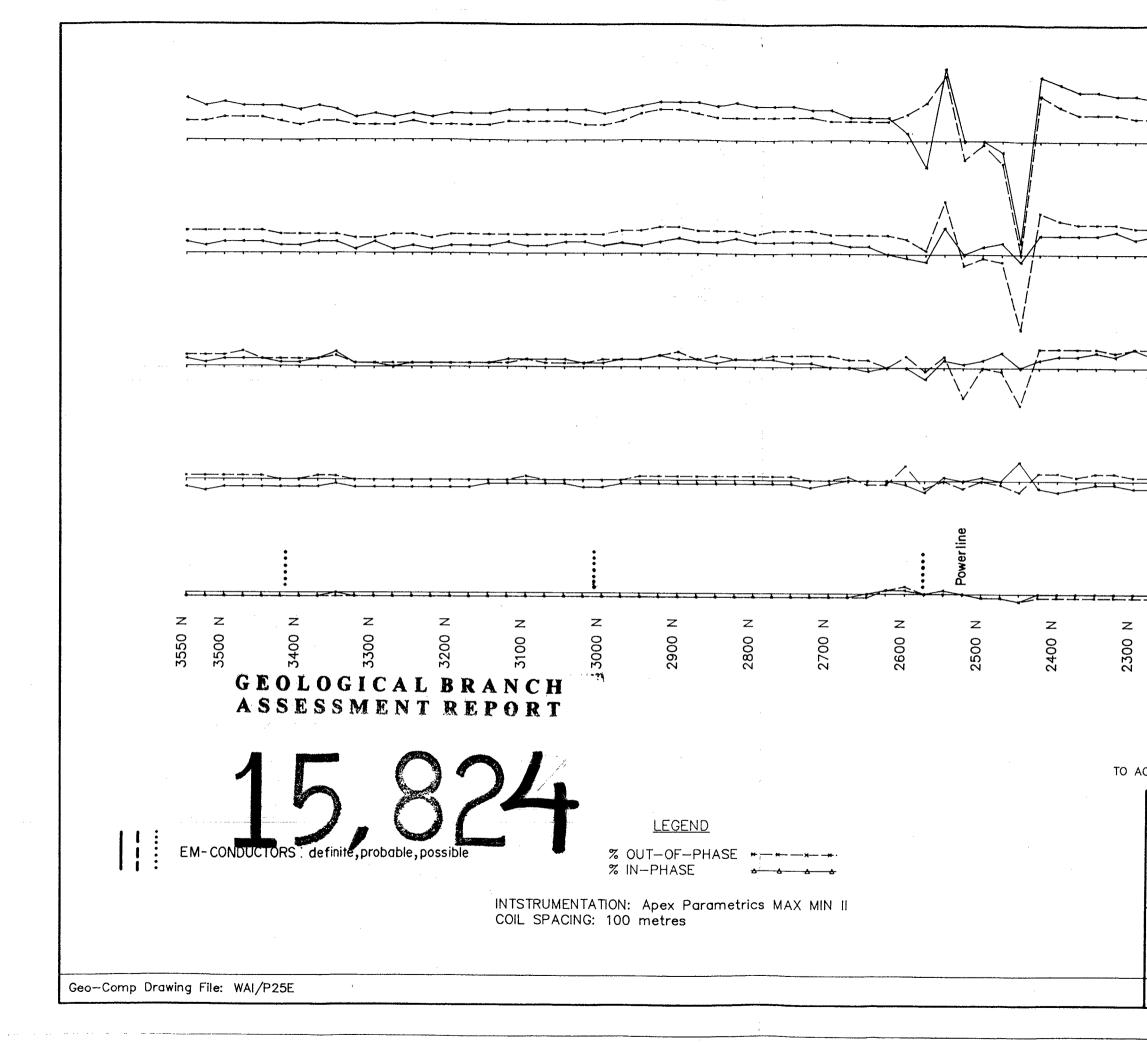












		+10% +5% 0 -5% -10%		3555 Hz				
		+10% +5% 0 -5% -10%	rimary Field	1777 Hz				
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		+10% +5% 0 -5% -10%	Field Strength	444 Hz				
	2200 N 2150 N	$ \begin{bmatrix} +10\% \\ +5\% \\ 0 \\ -5\% \\ -10\% \end{bmatrix} $		222 Hz				
	Q 1	00	200	300	400			
			metres					
AC	ACCOMPANY GEOPHYSICAL REPORT BY DAVID G. MARK, GEOPHYSICIST							
	GEOTRONICS SURVEYS LTD.							
	NORMINE RESOURCES LTD. WAIT CLAIMS							
	WAIT CLAINS WAIT CREEK, KIMBERLEY AREA FORT STEELE M.D., B.C.							
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	Profiles - Line 25+00E							
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