Geophysical Report and Review
On the
Kettle Property

Vernon Mining Division
British Columbia, Canada

NTS 82E/15E

BCGS Map Sheets 082E/097, 082E/087

Latitude **49° 55′ 43″ N** Longitude **118° 41′ 53″ W**

Claims Worked On: Kettle #1 to Kettle #10, K1 to K5

Prepared On Behalf Of Owners:

J.A. Kemp, FMC 113908
J.J. Turner, FMC 145292

Part 1 of 2 (Text and Appendices)

Report by:
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Penticton, British Columbia
V2A7B5

May 25, 2004

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Introduction

Summary

This report was prepared for submission to the British Columbia Ministry of Energy and Mines as an Assessment Report, in support of a Statement of Work being filed on the Kettle Property, which consisted of the Kettle #1 to Kettle #10, and K1 to K4 Mineral Claims at the time that this fieldwork was done. The costs being claimed for assessment credit relate to a DIGHEM^{V} helicopter-airborne geophysical survey carried out by Fugro Airborne Surveys Corp. over the entire Property, which at the time of the survey consisted of 2,000 hectares. The survey was flown between January 5 2004 and February 22 2004. The purpose of the survey was to identify anomalous electromagnetic conductors and magnetic patterns that could be indicative of mineralization and geology, and to provide information useful for mapping the geology and structure of the Property. The report on the airborne survey is appended to this report as Appendix 2.

The Kettle Property is located 55 kilometres southeast of Vernon, along the upper Kettle River in south-central B.C. J. A. Kemp and J. J. Turner hold title to the Property. In November 2003, the Property was optioned to Leroy Ventures Inc., a private mineral exploration company. The Property now (May 2004) consists of 20 located Mineral Claims, covering 2,150 hectares.

The Property was discovered and staked in 1972, after mineralization was first exposed by new logging road construction. The owners carried out small-scale work programs until 1980, when Mohawk Oil Company (Mohawk) obtained an option on the Property. Mohawk conducted extensive field programs between 1980 and 1987, when the Property reverted to the original owners. All mineral claims lapsed in mid-1999, at which time the Property was re-staked.

Fugro Airborne Surveys Corp. was engaged to fly a DIGHEM$^{V\text{-}DSP}$ helicopter-airborne survey of the entire Property, and this was completed in February, 2004. The survey has yielded relevant correlations to previous ground geophysical, geochemical and geological fieldwork, as well as responses over the known Zones, and has also indicated new target areas well removed from the known showings.

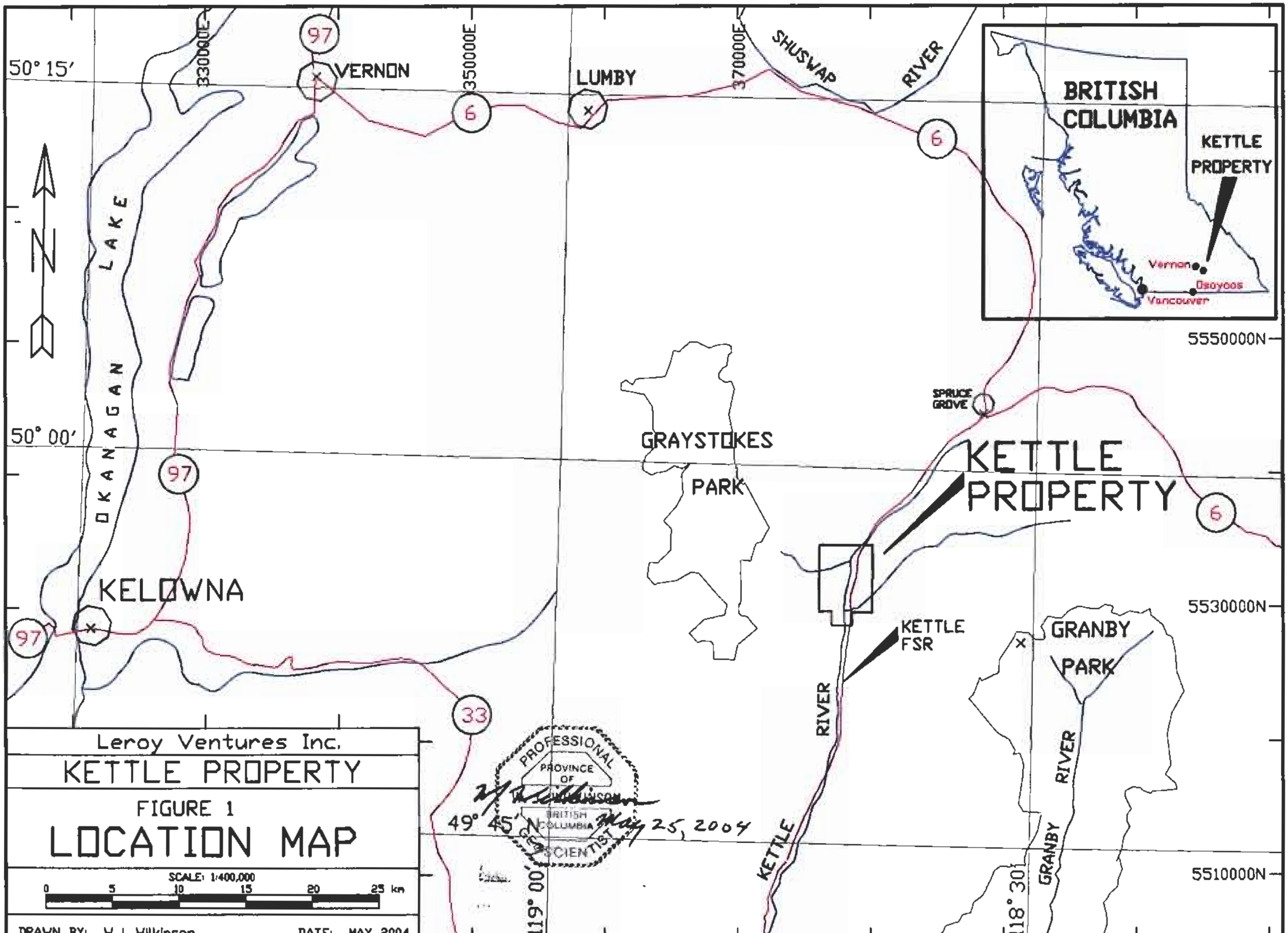
The Property has good potential for 'porphyry' style mineralization, for hydrothermal mineralization associated with the Kettle River Fault Zone, and for skarn mineralization related to the 'roof pendant' metasediments.

Location

The Kettle Property is located approximately 55 kilometres southeast of Vernon, and 55 kilometres east of Kelowna, in southern British Columbia (Figure 1). It is centered at $49^{\circ} 55' 43''$ north latitude, and $118^{\circ} 41' 53''$ west longitude. The Kettle River flows south through the center of the Property. Several prominent creeks enter the Kettle River on the Property, including Stove Creek from the west, and Winnifred Creek from the northeast.

Access

Access to the property is via the Kettle Forest Service Road (Kettle FSR), a two-lane gravel road, which crosses the Property from north to south on the east side of the Kettle River, providing direct links with the provincial highway system to both north and south. Toward the north, the Kettle FSR joins Highway 6 just 15 kilometers north of the Property, near Spruce Grove. From this junction, the road distance west to Highway 97 at Vernon is about 81 kilometres. The Kettle FSR also connects toward the south with Highway 33 at Westbridge. From Westbridge, Highway 33 then links with Highway 3 (the Southern Trans-Provincial Highway) at Rock Creek, as well as with Highway 97 toward the northwest, at Kelowna.


50° 15'
330000E
97
VERNON
350000E
6
LUMBY
370000E
SHUSWAP
RIVER
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BRITISH
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KETTLE
PROPERTY
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Osoyoos
Vancouver
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GRANBY
119° 00'
118° 30'
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PROVINCE OF
BRITISH COLUMBIA
GEOSCIENTIST
May 25, 2004
Leroy Ventures Inc.
KETTLE PROPERTY
FIGURE 1
LOCATION MAP
SCALE: 1:400,000
0 5 10 15 20 25 km
DRAWN BY: W.J. Wilkinson
DATE: MAY 2004

The Stove Creek Forest Service Road also traverses the Property, on the west side of the Kettle River. Other secondary logging and mining exploration roads traverse the Property, and could be readily rehabilitated.

Initial requirements for ground access are likely to be met largely by the re-activation of existing roads, which were built during previous logging, mineral exploration and mining activities. Requirements for heavy equipment for roadwork, trenching, et cetera, can probably be met locally, given the large amount of logging in the area. When required, drilling and other contractors will have no problem accessing the Property via the Forestry Roads. If winter programs are implemented, arrangements for snow removal on the Kettle FSR will be necessary, as only portions of the road are kept clear, as needed to accommodate winter logging activity.

An extreme fire hazard forced a temporary closure of all wilderness areas of southern B.C. in the summer of 2003. If hot, dry weather returns in 2004, fieldwork on the Property may be affected.

Physiography

The claims occupy the Kettle River valley, with elevations ranging from 1000 metres on the river at the southern boundary, to a maximum of 1600 metres toward the northwest, and 1400 metres toward the east. The terrain is irregular, with moderate to steep slopes and bluffs facing inwards toward the narrow central valley of the south-flowing Kettle River.

Stove Creek crosses the northwest quadrant of the Property, and joins the Kettle to the north of the area of known mineralization. Winnifred Creek, a large tributary of the Kettle River, flows southwesterly across the southeast quadrant of the Property. Originating in the Midway Range toward the northeast, it joins the Kettle River near the southern Property boundary.

Here near its' headwaters, the Kettle is not a large river, but does flow year-round. An adequate water supply for drilling or mining would be available from the Kettle River itself, from Winnifred Creek on the east side of the river, and from Stove Creek, which flows in from the west. There are also ponds and smaller creeks on the Property.

Climate

The climate is typical of conditions at higher elevations in south central B.C. Summers are warm, with moderate rainfall. Winter snows generally last from late October through early May. Accumulations of two metres of snow in the valley, and three metres or more at higher elevations, are not uncommon.

Vegetation

The original vegetation on the Property consisted of lodge pole pine, fir, balsam spruce, and alder. Much of the Property has been logged, particularly at lower elevations. Secondary stands of pine and fir now cover some older logged areas. Alder and vine maple brush is prevalent in the more recently clear-cut areas.

History

R.W. Yorke-Hardy and S.E. Arnold first staked claims in this area in 1972, following their discovery of mineralized quartz veins, recently exposed in road construction. In 1973 and 1974 these individuals prospected and mapped the property, and located and sampled numerous quartz veins and gossans. Trenching and stripping in 1976 exposed a large mineralized stockwork or breccia zone.

Geochemical and electromagnetic surveys conducted in 1977 were followed up in 1978 with investigation of the anomalies found, by road construction, mapping, trenching and percussion drilling. In 1979 an induced polarization survey was carried out over part of the property, and further trenching, mapping and sampling was done. At about this time, the discovery became known as the SAB property.

Early in 1980, Mohawk Oil Co. Ltd. optioned the property, and had completed 3,114 metres of NQ diamond drilling in 25 holes by October 26, 1980. Most of this drilling was carried out in close proximity to known mineral showings.

"The 1980 program was followed by an induced polarization survey in 1981; VLF-EM surveys in 1981 and 1982; geochemical surveys for silver and gold in 1981, 1982 and 1984; a magnetometer survey in 1982; induced polarization and resistivity surveys in 1984; prospecting in 1985; and additional diamond drill programs in 1981, 1982, 1983, and 1984. In 1982, a pilot mill was constructed on the property, and in 1983, concentrates were sold to the Cominco smelter in Trail."... quotation from Minfile Database, 'SAB' showing, 082ENE044. (The writer has confirmed much of the above quotation from other sources, but is unaware of any primary documentation related to the mining and milling, or the sale of concentrates.)

Although not all of the data derived from fieldwork was filed for assessment credit, part of the work that was not reported on directly was described in later assessment reports, which included extensive and detailed compilations and reviews (A.R. 18533 in 1989; A.R. 24533 in 1996). However, drill logs and reports on the 1981 through 1984 diamond drill programs are not available. Evidently very little drill core was assayed.

No fieldwork was done in 1986 or 1987, and Mohawk relinquished their option in 1987. Little more was done until 1996, when the 'Upper Lead Zone' and 'Lead Zone Open Cut' were mapped and channel sampled (AR24533).

All prior Mineral Claims on the Sab Property had lapsed by the summer of 1999. Ten two-post claim units, Kettle #1 through Kettle #10, were located over the showings in August/September of 1999 by John Kemp, as agent for himself and L. Caron. In late 1999, geological fieldwork and sampling was done (see AR26382, by L. Caron). The Caron half-interest has since passed to J.J. Turner, while Kemp retained his half-interest. The claims were optioned to Leroy Ventures Inc. in November of 2003.

In January and February of 2004, Fugro Airborne Surveys Corp. completed a DIGHEM$^{V\text{-}DSP}$ helicopter-airborne electromagnetic and magnetometer survey of the entire Property, which had been enlarged to 2,000 hectares to include areas of significant potential. In early May 2004, six more claim units were added, extending the Property one km further toward the south, along the Kettle River. It now covers 2,150 hectares (see Figure 2).

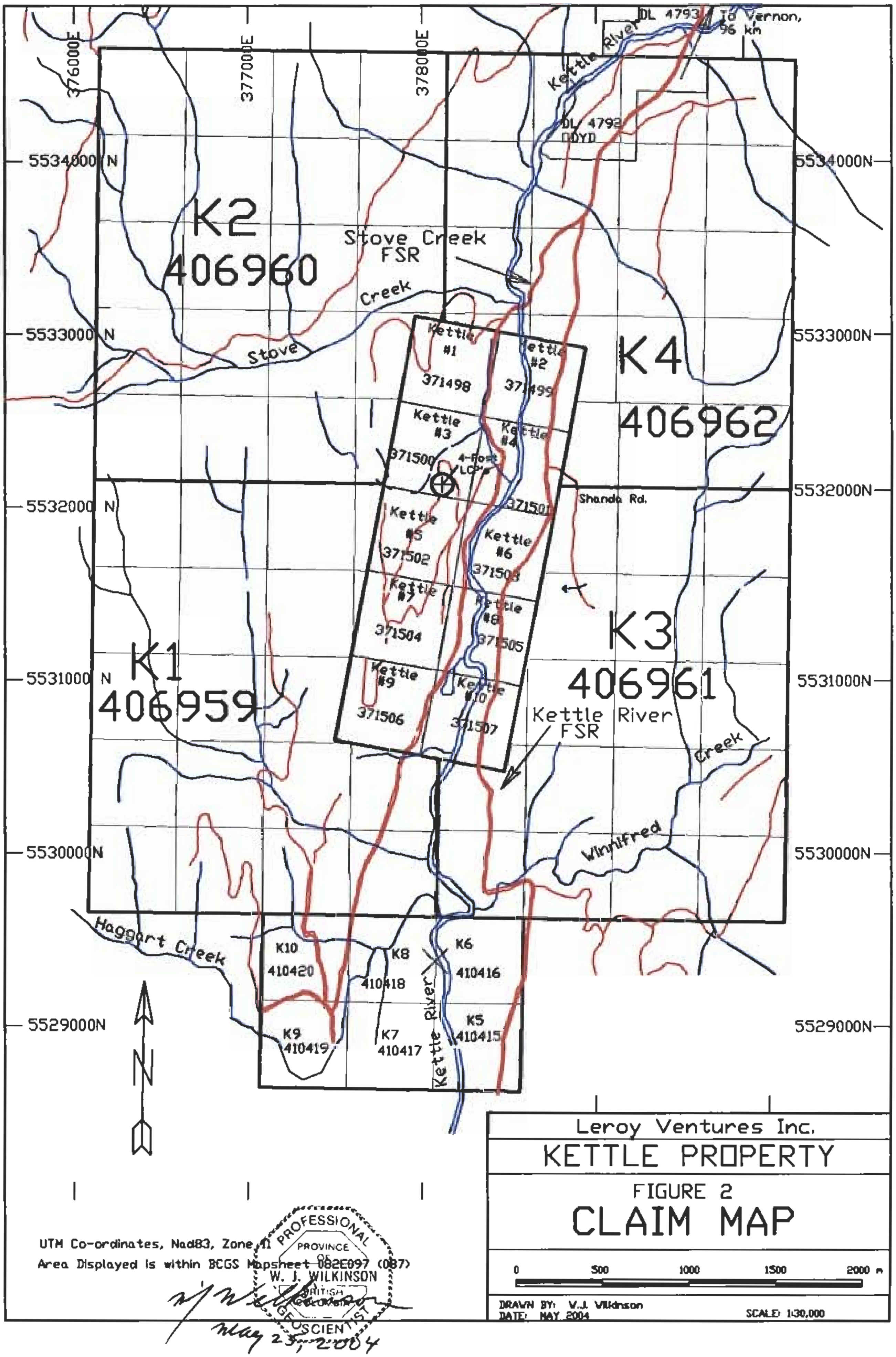
Claims and Ownership

J.A. Kemp and J.J. Turner each own a 50% interest in each of the fourteen claims, Kettle #1 to Kettle #10, and K1 to K4. The claims K5 through K10 are held entirely by John Kemp, subject to the inclusion clause in the option to Leroy Ventures Inc.

All of the claims comprising the Kettle Property are under option to Leroy Ventures Inc., a private exploration company, by an agreement dated November 20 2003.

At the time that the airborne survey was flown, the Property consisted of 14 contiguous, located mineral claims, of which ten were 2-post, single claim units, and four were 4-post, 20-unit (metric grid) claims. The 4-post claims were acquired in November, 2003 in order to expand the Property to include areas of significant potential, and these claims overlie the 2-post claims in such a way that the property boundary and size (2,000 hectares) were defined entirely by the boundaries of the 4-post claims. John Kemp added an additional six contiguous units covering 150 hectares to the south side of the Property on May 8 2004.

The claims are shown on Figure 2, as they are plotted on Mineral Titles Map M082E097, but



376000E
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5534000 N
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5530000N
5529000N
DL 4793
To Vernon, 96 km
Kettle River
DL 4792
DOYD
K2
406960
Stove Creek
FSR
Creek
Stove
K4
406962
Kettle #1
371498
Kettle #2
371499
Kettle #3
371500
Kettle #4
371501
4-Post LCP's
Shanda Rd.
Kettle #5
371502
Kettle #6
371503
Kettle #7
371504
Kettle #8
371505
Kettle #9
371506
Kettle #10
371507
K3
406961
K1
406959
Kettle River
FSR
Creek
Winnifred
Haggart Creek
K10
410420
K8
410418
K6
410416
K9
410419
K7
410417
K5
410415
Kettle River
N
Leroy Ventures Inc.
KETTLE PROPERTY
FIGURE 2
CLAIM MAP
0
500
1000
1500
2000 m
DRAWN BY: V.J. Wilkinson
DATE: MAY 2004
SCALE: 1:30,000
UTM Co-ordinates, Nad83, Zone 11
Area Displayed is within BCGS Mapsheet 082E097 (087)
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May 25, 2004

with the location of the recent staking also shown. (The three most southerly claims are partially situated on Map M082E087). Pertinent claim data is presented in table form, below. I have examined the Legal Post position for the K1 through K4 4-post claims, and several of the 2-post claim locations. These were found to be in accord with the locations shown on the Mineral Title Map, and the requirements for proper posting and marking of the claim lines appear to have been adequately met. However, the entire property boundary was not independently verified. No legal surveys of these claims have been carried out, and therefore their locations may differ slightly from the locations shown on the Mineral Titles Map.

Table: Claims Information

Claim Name	Tenure No.	Type	No. of Units	Expiry Date	Registered Owners
Kettle # 1	371498	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 2	371499	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J.Turner (50%)
Kettle # 3	371500	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 4	371501	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 5	371502	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 6	371503	2 Post	1	August 27, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 7	371504	2 Post	1	September 02, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 8	371505	2 Post	1	September 02, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 9	371506	2 Post	1	September 02, 2004	J.A. Kemp (50%) J.J. Turner (50%)
Kettle # 10	371507	2 Post	1	September 02, 2004	J.A. Kemp (50%) J.J. Turner (50%)
K1	406959	4 Post	20	November 26, 2004	J.A. Kemp (50%) J.J. Turner (50%)
K2	406960	4 Post	20	November 26, 2004	J.A. Kemp (50%) J.J. Turner (50%)
K3	406961	4 Post	20	November 26, 2004	J.A. Kemp (50%) J.J. Turner (50%)
K4	406962	4 Post	20	November 26, 2004	J.A. Kemp (50%) J.J. Turner (50%)
K5	410415	2 Post	1	May 08, 2005	J.A. Kemp (100%)
K6	410416	2 Post	1	May 08, 2005	J.A. Kemp (100%)
K7	410417	2 Post	1	May 08, 2005	J.A. Kemp (100%)
K8	410418	2 Post	1	May 08, 2005	J.A. Kemp (100%)
K9	410419	2 Post	1	May 08, 2005	J.A. Kemp (100%)
K10	410420	2 Post	1	May 08, 2005	J.A. Kemp (100%)

Economic and General Assessment

There are no known environmental liabilities on the property. Permits will be required for any significant ground disturbance, but no particular difficulty is anticipated with respect to obtaining such permits.

The Property consists of Crown Land, with no indication of private interests other than for logging, cattle grazing, and mining. The northern boundary of the K-4 claim does overlap somewhat upon two surveyed parcels, District Lots 4792 and 4793 ODYD (Osoyoos Division, Yale District), situated on the east and west sides of the Kettle River, respectively, at Bruer Creek. It appears that title to these two parcels resides with the Crown, but this has not been confirmed.

Food and lodging are available at Spruce Grove on Highway 6, just north of the Property, and at Lumby, situated toward the west on Highway 6, as well as at a number of campgrounds and motels along this highway. Routine supply requirements should be obtainable from the nearby communities, at the convenience of the field workers.

A main power transmission line follows Highway 6, passing within about 16 kilometres of the Property. Vernon is the closest city, but small communities are scattered along Highway 6, and throughout the area.

The northern boundary of Granby Park, which was established to protect grizzly bear habitat, is located 10 Km east of the southeast corner of the Kettle Property and extends about 40 km to the south, in the Granby River drainage. Graystokes Park (Protected Area) was established to protect part of the North Okanagan highlands vegetation and wildlife habitat. It is situated about 5 km west of the Kettle Property.

Wildlife is abundant in the area. The Kettle River and the many small upland lakes are popular destinations for camping and fishing.

Along the Kettle River, well downstream from the Property, there are a number of small ranches, and a few campgrounds and resorts. The nearest population center downstream on the Kettle River is Westbridge, situated 85 km. to the south along the Kettle FSR, where there is a grade school and a small general store, with Post Office.

A mining operation on the Kettle Property would have little difficulty attracting employees interested in living and working in a pleasant, rural setting.

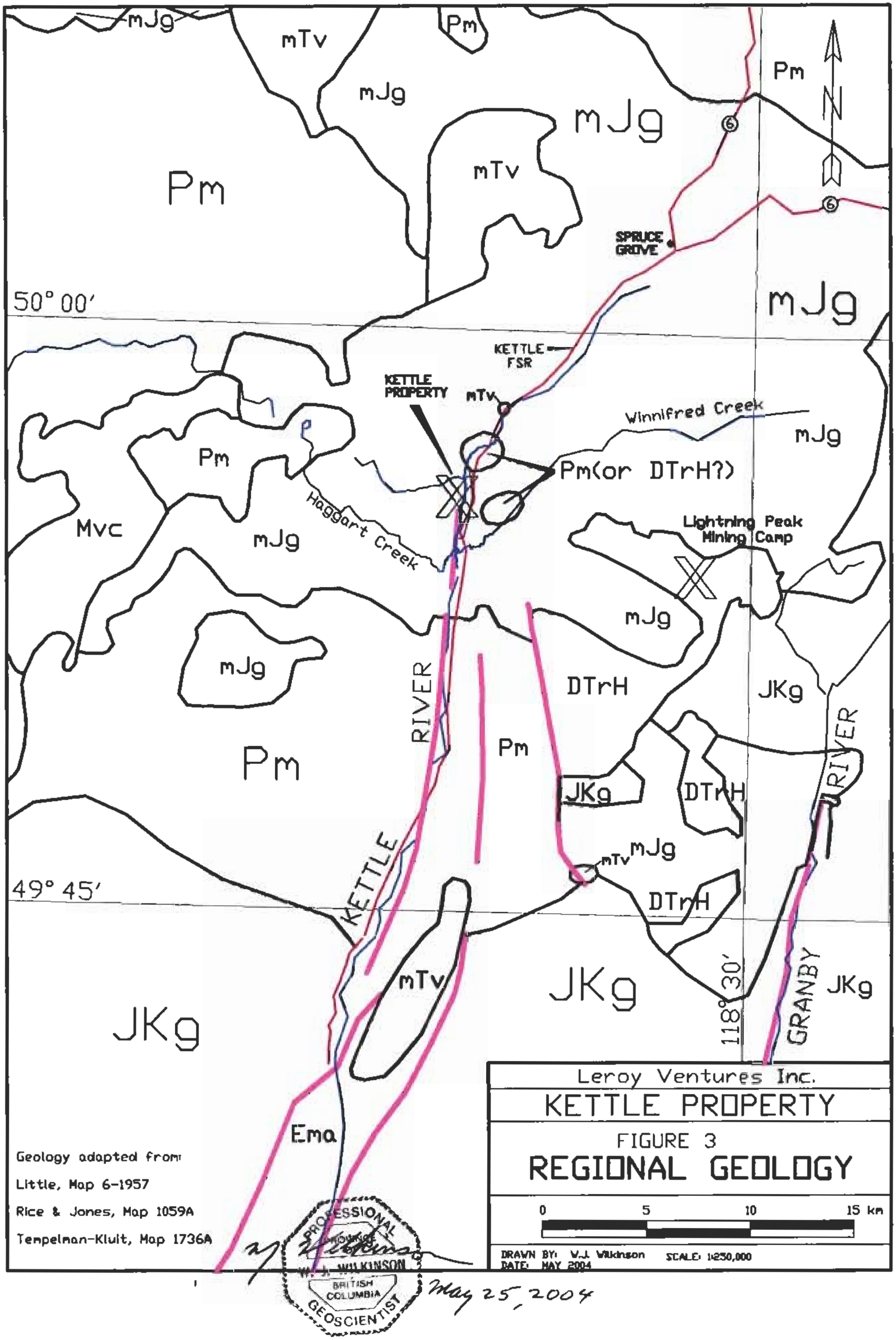
Geological Setting

Regional and Local Geology

The geology of the upper Kettle River is described by Little (1957). A more recent compilation by Tempelman-Kluit (1989) also shows the north-south fault structures situated to the south of the Property, along the Kettle River valley. A compilation by James Logan (Geoscience Map 2002-1) presents a more detailed classification for the intrusive rocks in the area.

The Property lies within the Sugarloaf Pluton (mid-Jurassic, according to Logan, 2002), within an area of predominantly intrusive rocks ranging in age from Tertiary to Jurassic. Areas of Proterozoic (?) and/or Paleozoic (?) metasedimentary rocks, predominantly gneisses and schists, flank the pluton towards the west and south, and also occur as small remnants ('roof pendants') within the intrusive.

Eocene volcanic rocks have infilled a prominent north-south graben structure, which has been mapped along the Kettle River for 70 kilometres, extending north from Westbridge to a point just 14 kilometres south of the Property boundary. An apparently related structure, the


mJg
mTv
Pm
mJg
mJg
mTv
Pm
6
6
SPRUCE GROVE
50° 00′
mJg
KETTLE FSR
KETTLE PROPERTY
mTv
Winnifred Creek
mJg
Pm
Pm(or DTrH?)
Mvc
mJg
Haggart Creek
Lightning Peak Mining Camp
mJg
mJg
RIVER
DTrH
JKg
Pm
Pm
JKg
DTrH
RIVER
KETTLE
mTv
mJg
49° 45′
DTrH
mTv
JKg
118° 30′
GRANBY
JKg
JKg
Ema
Geology adapted from:
Little, Map 6-1957
Rice & Jones, Map 1059A
Tempelman-Kluit, Map 1736A
Leroy Ventures Inc.
KETTLE PROPERTY
FIGURE 3
REGIONAL GEOLOGY
0 5 10 15 km
DRAWN BY: W.J. Wilkinson
SCALE: 1:250,000
DATE: MAY 2004
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BRITISH COLUMBIA
GEOSCIENTIST
May 25, 2004

'Kettle River Fault Zone', extends across the Property, through the area of known showings, and may have played a key role in the emplacement of mineralization.

Miocene plateau basalts blanket some of the higher terrain toward the northwest, (southeast of Vernon). Regional maps show one small occurrence located just north of the Property. These rocks may occur as dykes on the Kettle Property.

Property Geology

The predominant rocks on the Kettle Property are porphyritic granodiorite and related rocks of the mid-Jurassic Sugarloaf Pluton. These have locally undergone moderate to intense alteration, to secondary biotite, sericite, kaolinite and epidote (Waldner, 1982). In the (brecciated quartz) Stockwork Zone, alteration consists of quartz, sericite, and pyrite. These alteration types (propylitic and phyllic) are characteristic of the well-known 'porphyry' ore exploration model, but can also occur in hydrothermal ore systems. The mineralized zones found to date are situated within these altered intrusives, near the Kettle River Fault Zone.

Metasedimentary rocks-recrystallized limestone (marble), quartzite, and argillite-were mapped (by Waldner) in a narrow, 3 kilometre-long belt along the west side of the Kettle River, in fault contact with the intrusives. A few outcrops were also found along the east bank, but little work has been done east of the river. It is possible that these older metasediments may cover a much larger area toward the east. Waldner states: "Sulphide mineralization has not been observed within the metasediments but mineralization within fault zones along the metamorphic/intrusive contact has been observed." The age of these rocks is uncertain, and could be either Paleozoic or Proterozoic. The 'roof pendants' shown on regional geology maps in the Property area were identified in regional mapping as 'Monashee Gneiss' (age unknown). However, similar rocks in the Lightning Peak Mining Camp, just 8 km to the southeast, and assigned to the Devonian-Triassic Harper Ranch Group (until recently identified as the Anarchist Group), are host to a number of gold and silver showings.

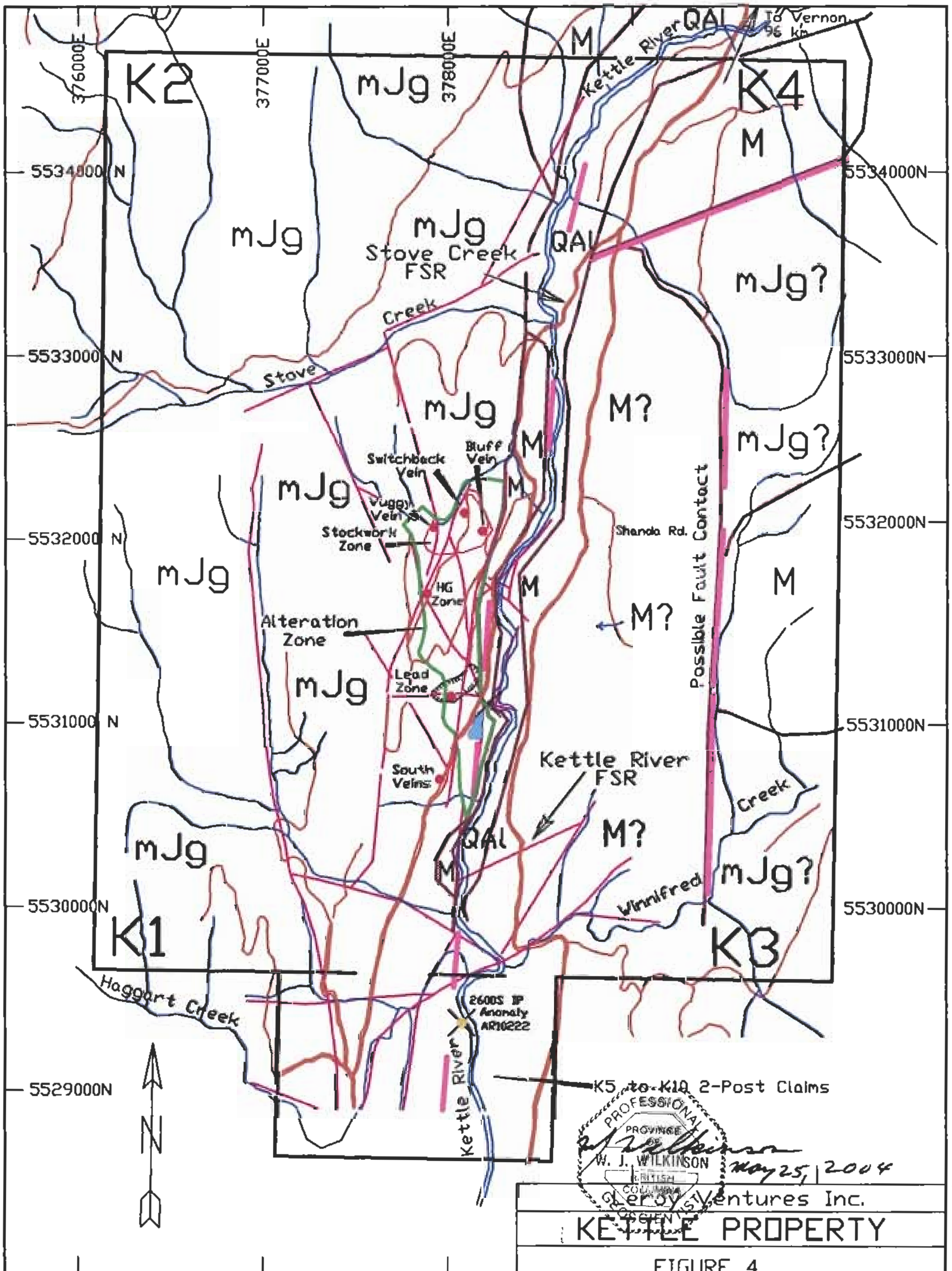
Narrow basaltic and lamprophyre dykes intrude the granodiorites, and cut through the mineralized zones. Waldner suggests they are probably related to the "Kamloops Group" (Miocene age) Plateau Basalts.

The 'Kettle River Fault Zone' is the most prominent structural feature on the Property. It has a steep easterly dip, and generally follows the Kettle River across the Property in a north northeasterly direction, with westerly and northwesterly cross-fault displacements mapped or inferred along sharp bends in the river. The strong alteration zone related to the SAB mineral showings appears to be related to proximity to this fault zone.

Mineralization

Known mineralized showings occur in close proximity to fault planes related to the Kettle River Fault Zone, and are usually associated with strong propylitic or phyllic alteration of the host intrusive rocks. Some showings are evidently controlled by the cross faulting.

The showings have been found over a distance of nearly two kilometres from south to north. Collectively they are known as the SAB mineral showing, and are identified in Minfile as occurrence 082ENE044. They include the South Zone, the Lead Zone, the HG Zone, and the Stockwork Zone. Mineralogy varies between the showings, yet all have yielded significant assays from sampling. High-grade gold-quartz veins or veinlets (with silver and lead) occur in the South and HG Zones. The Lead Zone quartz vein has high silver values, plus lead and zinc. The Stockwork Zone (which includes the Switchback Vein, Bluff Vein and Vuggy Vein), have yielded relatively low, but significant values in gold and silver.



Glenroy Ventures Inc.

KETTLE PROPERTY

FIGURE 4

GEOLOGY MAP

0 500 1000 1500 2000 m

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DATE: MAY 2004
SCALE: 1:30,000

UTM Co-ordinates, Nad83, Zone 11
Geology modified from Regional Maps using mapping of Waldner, Yorke-Hardy et al (assessment reports-see Section 16.0)
Area Displayed is within BCGS Mapsheet 082E097

Leroy Ventures Inc.

Kettle Property

Geological Legends

(Legend To Accompany Figure 3)

mTv	Plateau basalt - Miocene
Ema	Marron Group volcanics - Eocene
JKg	Okanagan Batholith - Cretaceous and/or Jurassic granite, granodiorite
mJg	Nelson Plutonic Rocks - mid-Jurassic granodiorite, quartz diorite, granite (includes Sugarloaf Pluton)
CPa	Harper Ranch Group- Devonian-Triassic argillite, chert, limestone, clastics (Anarchist Group?-Carboniferous amphibolite, greenstone, schist)
Pm	Monashee Complex, Shuswap (rocks could correlate with Anarchist, etc. ?) - metamorphosed Proterozoic and/or Paleozoic rocks

SYMBOLS

- Regional Fault, Inferred or Mapped
- Contact, mapped or probable
- Stream
- Road

Geology from Little, Map 6-1957; Rice & Jones, Map 1059A (1959);
Tempelman-Kluit, Map 1736A (1989); Page,Minfile 082ENE - Kettle River, (1997);
Contact and fault locations are approximate.

Figure 3a

PROFESSIONAL PROVINCE OF W. J. WILKINSON BRITISH COLUMBIA GEOSCIENTIST

(Legend To Accompany Figure 4)

QAl	Quaternary Alluvium
mJg	Nelson Plutonic Rocks - mid-Jurassic granodiorite, quartz diorite, granite (includes Sugarloaf Pluton)
M	Metamorphosed Proterozoic and/or Paleozoic rocks [Monashee Complex ?(May be related to Harper Ranch/Anarchist, etc.?)]

SYMBOLS

- Regional Fault, Inferred or Mapped
- Fault, Inferred or Mapped, Property mapping
- Contact, mapped or probable
- Alteration Zone (propylitic, phyllic) Limits
- Mineralized Showing
- Stream
- Road
- LK1 Property Boundary (Claim I.D.)

Geology from Little, Map 6-1957; Rice & Jones, Map 1059A (1959);
Tempelman-Kluit, Map 1736A (1989); Page, Minfile 082ENE - Kettle River, (1997),
Waldner, Yorke-Hardy et al (Assessment Reports)
Contact and fault locations are approximate.

W. J. Wilkinson, May, 2004

Figure 4a

PROFESSIONAL PROVINCE OF W. J. WILKINSON BRITISH COLUMBIA GEOSCIENTIST

Bulk samples in the order of twenty tonnes were reported to have been extracted by surface mining of the showings, with the milling products later sold. However, no documented information is available on this work, and the writer presents it only as historical background.

The following description of the mineralized Zones is taken from an assessment report written by L. Caron, P. Eng., who examined and sampled the showings in 1999 (Assessment Report 26382):

<u>South Zone</u>

A N-NW striking, shallow west-dipping quartz vein is exposed in large open cuts along the main Stove Creek road, and in trenches, over a strike length of 185 metres. The vein ranges from 0.5 to 4.1 m in width, and averages about 1.5 m wide. It is hosted in unaltered Kspar megacryst porphyry, and cut by late decomposing biotite-lamprophyre dykes.

Grab samples from the vein have returned values to 1.6 oz./t Au, 4.5 oz/t Ag, 1.7%Pb and 2% Zn.

<u>Pb (Lead) Zone</u>

Several trenches and open cuts expose a mineralized shear zone over a strike length of 300 metres. The shear strikes about 070^0-080^0, with a moderate-steep S dip, and averages about 30 cm in width. The shear hosts a narrow mineralized quartz vein. Drilling has tested the zone to 75 metres depth and it remains open at depth. Surface sampling from the zone has returned grades of:

20.8 oz/t Ag over 2.5 m (in the K1 trench, hanging wall to the main shear)
56.7 oz/t Ag over 2.4 m

and grab samples to 32 oz/t Ag, 35% Pb and 10% Zn from vein material. Copper and gold are weakly anomalous. Silver reportedly occurs as fine-grained ruby silver and as native silver.

A small portable mill set up on the property in the early 1980's largely processed material from the Pb Zone (with minor ore from the South and HG Zones).

<u>HG (High Grade) Zone</u>

In the HG Zone, sub parallel quartz veins and veinlets are hosted in altered intrusives. The veins contain about 5% sulfides (pyrite, chalcopyrite, bornite and galena), with accessory scheelite mentioned. Grab samples from surface have returned up to 0.96 oz/t Au and 15.2 oz/t Ag, while more detailed chip sampling from the zone gave an average of 0.24 oz/t Au and 2.4 oz/t Ag from one vein, over an average 0.75m width. Drilling has returned values to 0.5 oz/t Au, 8.2 oz/t Ag, 1.3% Pb, 0.1% Zn, 0.1% Cu over 0.7 m from this zone (ddh 82-13).

The zone has been tested by trenching and drilling and remains open on strike (and at depth?). The full width of the zone is not exposed, with the greatest exposed width being about 3 metres.

A 24.2-ton bulk sample was collected from this zone in the early 1980's and shipped to Slocan City for mill testing. The sample returned an average grade of 0.11 oz/t Au, 4.2 oz/t Ag.

<u>Stockwork Zone(Including Vuggy Vein, Switchback Vein, Bluff Vein)</u>

The Stockwork Zone is an area of about 300 x 450 metres where sulfide mineralization is associated with a brecciated quartz stockwork in quartz-sericite-pyrite altered intrusive. Veins are bull-type quartz with pyrite, plus accessory scheelite and zircon. The zone has a large coincident IP anomaly as well as a coincident Au soil anomaly. Several larger veins within this zone are given individual names (Vuggy Vein, Switchback Vein, Bluff Vein). In *general Au and Ag values to date have been low from the Stockwork Zone. One drill hole (ddh 80-3) did return 0.7 m of 0.112 oz/t Au and 1.3 oz/t Ag.*

Based on my own brief examination, and on my extensive review of other available data on the Property, the writer believes the forgoing account to be a fair and accurate description of the known mineralization on the Property. The surface sampling data is based on Caron's own fieldwork. The drill results described by Caron are from older sources, and are not verifiable. It should be emphasized that the mineralization described does not yet represent a measurable economic reserve. Much more work will be required to demonstrate a viable continuity of economic size and metal values within these zones.

Fieldwork Done

Airborne Geophysical Survey (2004)

In January and February of 2004, Fugro Airborne Surveys Corp. flew a DIGHEM$^{V\text{-}DSP}$ electromagnetic and magnetometer survey of the Kettle Property. A total of 235 line-km was flown at a nominal sensor clearance (subject to terrain and weather) of approximately 30 metres, with a line spacing of 100 metres.

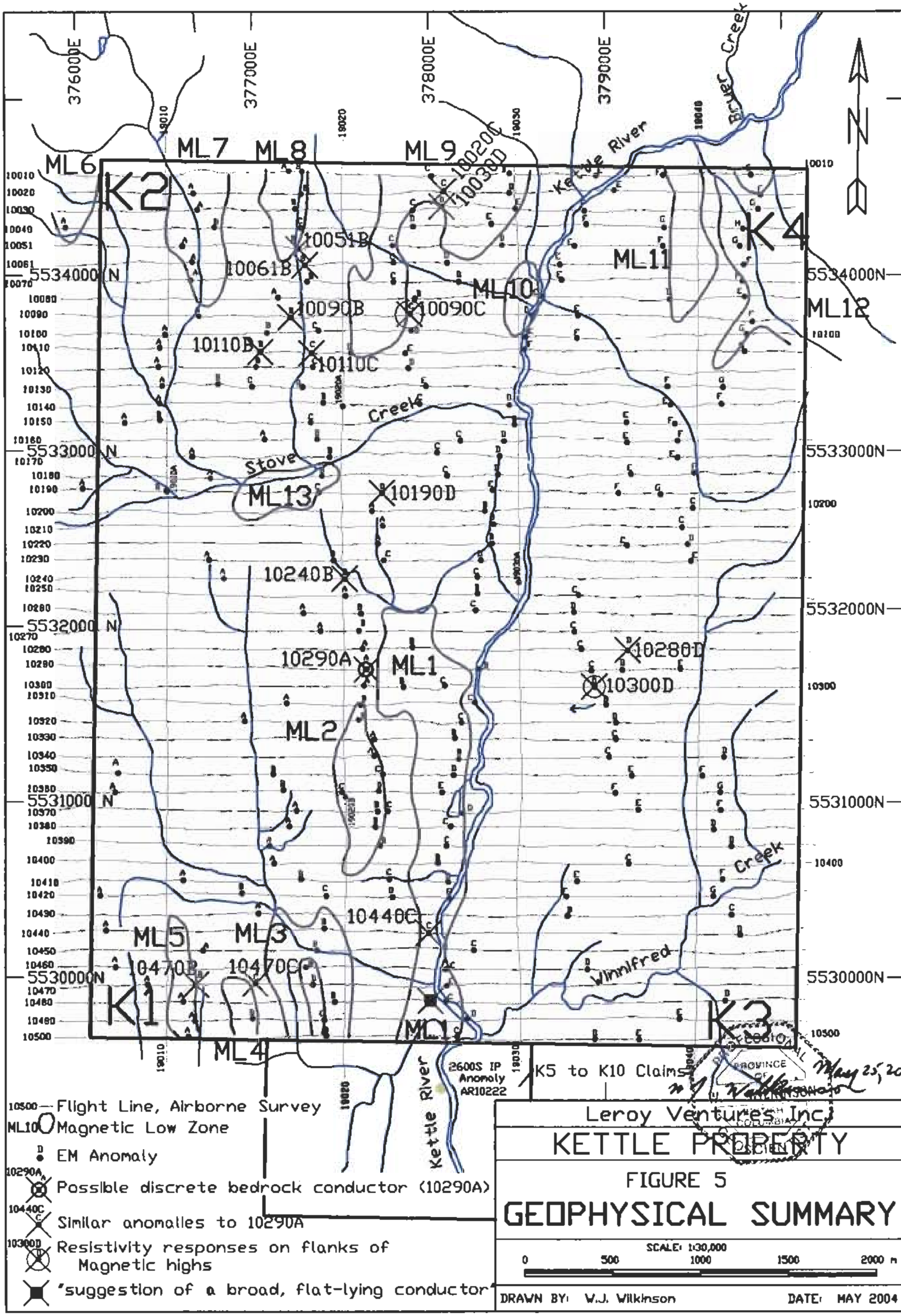
Findings of this survey are presented in the report, "DIGHEM$^{V\text{-}DSP}$ SURVEY FOR MAX INVESTMENTS INC. ON BEHALF OF LEROY VENTURES INC., KETTLE PROPERTY, BRITISH COLUMBIA, written by Douglas G. Garrie, Geophysicist, of Fugro Airborne Surveys Corp., Mississauga, Ontario (Appendix 2).

Garrie has provided a fault and/or contact interpretation of the geophysical data, which will be extremely helpful in planning exploration, and for determining geological relationships. The response patterns appear to reflect features identified in earlier fieldwork. He has noted the clear association of a prominent large magnetic low and conductive zone with the mapped alteration zone and the associated SAB mineral showings. Other magnetic lows mapped by the airborne survey may also indicate the boundaries of alteration zones, possibly also associated with mineralization. He therefore categorized areas with geophysical parameters similar to ML1 as a series of magnetic lows, labeled ML1 through ML13 (ML 1 includes the SAB showings and alteration zone). Garrie's discussion of these 'ML' zones is quite complete (see Appendix 1), and will not be repeated here. However, comments based on my study of the available data are presented below. For clarity the 'ML' Zones and other anomalies identified as being of potential significance are reproduced in Figure 5 of this Report.

Zone ML 1

This Zone encompasses the intrusive alteration zone, as presently known, and the related 'SAB' showings. It also extends to the south, well beyond the airborne survey area. Garrie singled out two conductors within Zone ML1 as being of potential significance. Anomaly 10440C, (*"possibly a thin near-vertical conductor"*), situated 400 metres south of the South (Vein) Zone, and the other, near line 10480, fiducial 7908, having the *"suggestion of a broad, flat-lying conductor at depth"*, and situated 800 metres south of the South Zone.

An IP anomaly was found in 1981 along the trend of ML 1, 1.2 km south of the South Vein Zone, and 500 m south of the Line 10480 airborne anomaly, (beyond the southern boundary of the airborne survey). This anomaly occurs at the easternmost extent (at the Kettle River) of Line 26+00 South on the old SAB grid. This anomaly is described in Assessment Report 10222, Geophysical Section (Anderson, 1981): *"The IP anomaly at the eastern end of the line is by far the most significant revealed by this survey. The response is greater with depth, implying a deep-seated cause. There is some sympathetic decline in resistivity values corresponding to the IP*



376000E
377000E
378000E
379000E
5534000N
5533000N
5532000N
5531000N
5530000N
K1
K2
K3
K4
ML1
ML2
ML3
ML4
ML5
ML6
ML7
ML8
ML9
ML10
ML11
ML12
ML13
10020C
10030D
10051B
10061B
10090B
10090C
10110B
10110C
10190D
10240B
10280D
10290A
10300D
10440C
10470B
10470C
Kettle River
Stove Creek
Bruer Creek
Winnifred Creek
2600S IP Anomaly AR10222
K5 to K10 Claims
10500 Flight Line, Airborne Survey
ML10 Magnetic Low Zone
EM Anomaly
Possible discrete bedrock conductor (10290A)
Similar anomalies to 10290A
Resistivity responses on flanks of Magnetic highs
'suggestion of a broad, flat-lying conductor'
Leroy Ventures Inc.
KETTLE PROPERTY
FIGURE 5
GEOPHYSICAL SUMMARY
SCALE: 1:30,000
0 500 1000 1500 2000 m
DRAWN BY: W.J. Wilkinson
DATE: MAY 2004
May 25, 2004

high." In his report Recommendations, Anderson states: *"Detailed infill lines should be completed around the anomaly on line 26+00, and the line extended east if possible. When a drill is available on site several holes are justified to determine the causative mechanism of the anomaly."* There are no records available as to whether any follow-up investigation was ever done.

The geochemical response for gold in soils in this area appears to be the best that was found on the (former SAB) Property.

Based on these observations, the author recommended additional staking to enlarge the Kettle Property toward the south, to cover this IP anomaly.

Zone ML 2

This zone has geophysical characteristics similar to ML1, and is about the same width, but is not as long (900 m). It runs parallel to ML1, 500 m further west. Good gold geochemical response was found here.

Two holes, 84-4 and 84-5, were drilled near the north end of this zone in 1984. The objective of the drilling, location, orientation and results are all unknown.

Zone ML2 represents a promising exploration target.

Zones ML3, ML4, and ML5

These zones are situated in the southeast corner of the Property (along the southern boundary of the K1 claim), and are open toward the south. Two associated anomalies located within the K1 claim, 10470B and 10470C, are suggestive of vertical conductors, and should be investigated at an early stage.

Zones ML6, ML7

These zones are worthy of investigation, but lack supporting data to justify a priority classification.

Zone ML8, ML9, and ML13

These zones are more attractive due to a widespread, although generally weak, gold geochemical response. The area merits geological fieldwork and prospecting.

Zone ML10

This magnetic low could represent a (faulted?) extension of the ML1 Zone. The area should receive an early visit by a geologist to identify the geological setting and potential of this zone.

Zones ML11, ML12

These zones appear to occur where metasedimentary rocks are in fault contact with the Sugarloaf Pluton granodiorite, in the extreme northeast corner of the Property. Fieldwork is required to confirm the geological setting and potential.

Other EM Conductors

Other EM conductors of potential significance were identified (see Figure 5 summary; also Garrie Report). Several are of particular interest, as they are associated with a large magnetic high situated along the east side of the Kettle River, which may be indicating the presence of a belt of metasedimentary rocks, with a potential for the development of skarn and skarn-hosted mineralization. The response patterns appear to reflect features identified in earlier fieldwork.

Interpretation and Conclusions

Previous exploration work on this Property has exposed significant mineral showings within granitic rocks, which have yielded high assay values in gold-bearing quartz veins and veinlets, as well as in silver, lead and zinc mineralization. Significant features of the geological setting of the Kettle Property with respect to ore potential are the strong alteration and/or brecciation observed in the intrusives in the vicinity of the mineralized Zones, the presence of strong north-south faulting (the 'Kettle River Fault Zone') and the presence of metasedimentary rocks, including marble, in close proximity to these Zones.

The altered intrusives have potential to host a large mineralized 'porphyry' ore system, as well as the rich vein or manto-style deposits more commonly associated with fault-controlled hydrothermal systems. The Kettle River Fault Zone may have been the conduit for hydrothermal activity, possibly associated with the Eocene volcanism that flooded the Kettle River valley toward the south, and could have caused the deposition of a high-grade gold-quartz vein System, with the currently known gold-silver and silver-lead-zinc showings representing fringe mineralization.

Important skarn ore may be present, occurring along the intrusive/metasedimentary contact, or hosted within calcareous metasedimentary rocks.

Exploration techniques that did not exist at the time of the previous fieldwork could now prove instrumental in the successful location of ore. Recent advances in the field of infrared spectrometry offer the prospect of obtaining accurate, relatively inexpensive identification of clay minerals in field samples. Variations in the proportions of clay minerals are related to patterns of ore deposition in both porphyry and hydrothermal systems. Recent advances in ground geophysical equipment may similarly enable a geophysical operator to better distinguish between responses due to geological parameters and those indicative of the presence of ore, when both may be present.

The Kettle Property has very good potential to contain an ore deposit. The geological setting is favorable for the presence of porphyry, hydrothermal vein and skarn mineralization. Metals known to be present in significant concentrations, approaching ore grades (but not dimensions) include gold, silver, lead and zinc. Copper and tungsten are known to occur in trace to minor amounts.

Successful exploration will require an extensive program using a full range of techniques, including prospecting, geological mapping, soil and rock geochemical sampling, ground geophysical surveys, mechanical trenching and diamond drilling.

The 2004 Fugro airborne geophysical survey has provided the data essential to the development of a good geological picture of the Property. The anomalous responses and variations in geophysical characteristics mapped in the survey show good correlation to the previous, more limited field surveys, and have identified targets in previously unexplored areas, as well as indicating apparent extensions of mineralized Zones. No previous low-level airborne geophysical survey work is known to have been done over the Property.

Mineralization on the Property is known to respond to soil geochemistry, particularly for gold, silver, lead, zinc, and copper. If possible, geochemical response should be tested over the in situ mineralization at the showings to provide an indication of the relative importance of geochemical anomalies in the un-explored areas. Anomalous geochemistry indicated by prior surveys should also be re-sampled to verify the original data.

The Phase 1 program envisioned would call for prospecting of the entire Property, with particular attention given to locating and evaluating the airborne geophysical anomalies. Priority target areas would be selected for their favorable coincident responses to both geophysical and geochemical surveys, and attractive geological setting (if known). A systematic geological mapping of the Property should be undertaken, beginning with the known mineralized zones and the most promising anomalous targets, including all three potential ore environments.

This evaluation will require extensive grid-based work, including ground geophysical surveys, soil geochemical sampling, and excavator trenching.

Phase 2 would be partially dependent on the findings of the Phase 1 program. Diamond drilling would be justified by the discovery (in Phase 1) of significant alteration or mineralization in one or more of the anomalous target zones.

A full evaluation of the widespread anomalies on the Property may not be possible within the Phase 1 budget, given the large area to be covered and the difficult terrain in which many anomalies occur. However, sufficient information should be available from fieldwork completed in Phase 1 to decide whether further work is justified, and to establish clear priorities for Phase 2 exploration.

Recommendations

A two-phase program is recommended for the Kettle Property, with a total budget of $500,000. A total of $200,000 should be allowed for Phase 1, consisting of the establishment of accurate ground control and base maps, geological, geophysical and geochemical ground surveys and prospecting, followed by excavator trenching, and detailed mapping and sampling of existing and new exposures.

Phase 2 should consist of additional geophysical surveys, excavator trenching, and 1,500 metres of NQ diamond drilling. A field office facility should be established on the Property to expedite fieldwork, drill core logging, sampling and sample preparation activities. Suitable arrangements for retrievable storage of drill core and other materials should also be provided.

Full utilization of the Phase 2 budget for diamond drilling would be contingent on Phase 1 results, although the full amount of drilling will be required to adequately test the known targets, if their significance can be confirmed in Phase 1.

Unless good surface mineralization is found in Phase 1, diamond drilling will be best left until a better picture of the geological and geophysical setting of target areas is developed from the Phase 1 work. A total of 1,500 metres of NQ diamond drilling are recommended for Phase 2, to be allocated to the various targets in accordance with Phase 1 results. Excavator trenching should continue to explore the areas of interest not previously tested.

Respectfully submitted,

PROFESSIONAL PROVINCE OF W. J. WILKINSON BRITISH COLUMBIA GEOSCIENTIST

William J. Wilkinson, B.Sc., P. Geo.

May 25, 2004

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17.0 Statement of Qualifications

I, William John Wilkinson, of the City of Penticton, in the Province of British Columbia, hereby certify the following:

1. I am an independent geologist with a residence at 126 Nagle Place, Penticton, British Columbia.
2. I am currently self-employed
3. I am a graduate of the University of British Columbia (B. Sc., 1966), and in 1967 completed an additional year of geological studies at U.B.C.
4. I have practiced my profession continuously since 1967, and I had previously worked at several mines, and on mining exploration field projects, since 1955. My experience includes prospecting, geological fieldwork and field program management, underground mine geological supervision, mapping and exploration, open pit mine exploration, development and production supervision.
5. I am a Fellow of the Geological Association of Canada.
6. I am registered with The Association of Professional Engineers and Geoscientists of British Columbia as a Professional Geoscientist (P.Geo.).
7. I am familiar with the general vicinity of the Kettle Property, and have considerable experience with mines and mining camps in the area, including Franklin Camp, Phoenix and Lone Star in the Grand Forks-Greenwood area, and the Nickel Plate Mine at Hedley. I visited the Kettle Property on April 27, 2004.
8. I have no direct or indirect interest in the property described herein, or in the securities of Leroy Ventures Inc., nor do I expect to receive any.
9. I am a Qualified Person as defined by National Instrument 43-101 and Form 43-101F1.
10. Completed at Penticton, British Columbia, May 25, 2004.

PROFESSIONAL
PROVINCE OF
W. J. WILKINSON
BRITISH COLUMBIA
GEOSCIENTIST

W. J. Wilkinson, B.Sc., P.Geo.

Appendix 1

EXPENDITURES STATEMENT

KETTLE PROPERTY, BRITISH COLUMBIA

Provided By Mr. C.I.S. Dyakowski, P.Geo.

Expenditures Statement

Kettle Property

Helicopter airborne geophysical program, Fugro Airborne Surveys Corp.	$75,000.00
Subtotal	$75,000.00
Overhead and Contract Administration	$10,000.00
Grand Total	**$85,000.00**

PROFESSIONAL PROVINCE W. J. WILKINSON BRITISH COLUMBIA GEOSCIENTIST

W.J. Wilkinson, B.Sc., P.Geo.

May 25, 2004

Appendix 2

"DIGHEM$^{V\text{-}DSP}$ SURVEY FOR MAX INVESTMENTS INC. ON BEHALF OF LEROY

VENTURES INC., KETTLE PROPERTY, BRITISH COLUMBIA"

By

Douglas G. Garrie, Geophysicist

Fugro Airborne Surveys Corp.

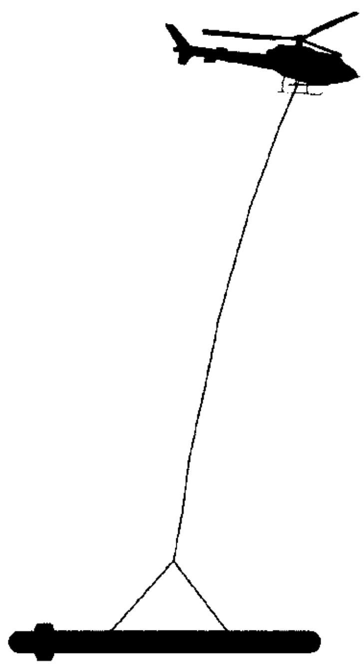
Mississauga, Ontario

FUGRO AIRBORNE SURVEYS

Report #03096

DIGHEM^{V-DSP} SURVEY
FOR
MAX INVESTMENTS INC.
ON BEHALF OF
LEROY VENTURES INC.
KETTLE PROPERTY, BRITISH COLUMBIA

NTS: 82E/15



Fugro Airborne Surveys Corp.
Mississauga, Ontario

Douglas G. Garrie
Geophysicist

April 29, 2004

Fugro Airborne Surveys, 2270 Argentia Road, Unit 2, Mississauga, Ontario, Canada, L5N 6A6
Phone: 1 905 812 0212, Fax: 1 905 812 1504

SUMMARY

This report describes the logistics, data acquisition, processing and presentation of results of a DIGHEM^{V} airborne geophysical survey carried out for Max Investments Inc., on behalf of Leroy Ventures Inc., over a property located in the Vernon Mining District near Kelowna, British Columbia. Total coverage of the survey block amounted to 235 km. The survey was flown from January 5 to January 29, 2004, and from February 21 to February 22, 2004. Due to poor weather conditions, the survey crew demobilized between January and February.

The purpose of the survey was to detect zones of conductive mineralization and to provide information that could be used to map the geology and structure of the survey area. This was accomplished by using a DIGHEM$^{V\text{-}DSP}$ multi-coil, multi-frequency electromagnetic system, supplemented by a high sensitivity cesium magnetometer. The information from these sensors was processed to produce maps that display the magnetic and conductive properties of the survey area. A GPS electronic navigation system ensured accurate positioning of the geophysical data with respect to the base maps.

The survey data were processed and compiled in the Fugro Airborne Surveys Toronto office. Map products and digital data were provided in accordance with the scales and formats specified in the Survey Agreement.

The survey property contains several anomalous features, although many of which are poorly defined and weakly conductive EM targets. Most of these features appear to warrant

further investigation using appropriate surface exploration techniques. Areas of interest may be assigned priorities on the basis of supporting geophysical, geochemical and/or geological information. After initial investigations have been carried out, it may be necessary to re-evaluate the remaining anomalies based on information acquired from the follow-up program.

CONTENTS

APPENDICES

FIGURES

1. INTRODUCTION

A DIGHEM$^{V\text{-}DSP}$ electromagnetic/resistivity/magnetic survey was flown for Max Investments Inc., on behalf of Leroy Ventures Inc., from January 5 to January 29, 2004, and from February 21 to February 22, 2004, over a survey block located in the Vernon Mining District near Kelowna, British Columbia.. Due to poor weather conditions, the survey crew demobilized between January and February. The survey area can be located on NTS map sheet 82E/15 (Figure 1).

Survey coverage consisted of approximately 235 line-km, including tie lines. Flight lines were flown in an azimuthal direction of 90°/270° with a line separation of 100 metres. Tie lines were flown orthogonal to the traverse lines with a line separation of 1000 m.

The survey employed the DIGHEM$^{V\text{-}DSP}$ electromagnetic system. Ancillary equipment consisted of a magnetometer, radar and barometric altimeters, video camera, analog and digital recorders, and an electronic navigation system. The instrumentation was installed in an AS350B2 turbine helicopter (Registration C-GDMM) that was provided by Northern Air Support Inc. The helicopter flew at an average airspeed of 71 km/h with an EM sensor height of approximately 30 metres.

In some portions of the survey area, the steep topography forced the pilot to exceed normal terrain clearance for reasons of safety. It is possible that some weak conductors may have escaped detection in areas where the bird height exceeded 120 m. In difficult areas where near-vertical climbs were necessary, the forward speed of the helicopter was reduced to a level that permitted excessive bird swinging. This problem, combined with the severe stresses to which the bird was subjected, gave rise to aerodynamic noise levels that are slightly higher than normal on some lines. Where warranted, reflights were carried out to minimize these adverse effects.

Due to the presence of cultural features in the survey area, any interpreted conductors that occur in close proximity to cultural sources, should be confirmed as bedrock conductors prior to drilling.

2. SURVEY AREA

The base of operations for the survey was established at Kelowna, British Columbia.

Table 2-1 lists the corner coordinates of the survey area(s) in NAD83, UTM Zone 11, central meridian 117°.

Table 2-1

Nad83 Utm Zone 11

Block	Corners	X-UTM (E)	Y-UTM (N)
03096-1	1	376020	5534613
Kettle	2	380020	5534613
Property	3	380020	5529613
	4	376020	5529613

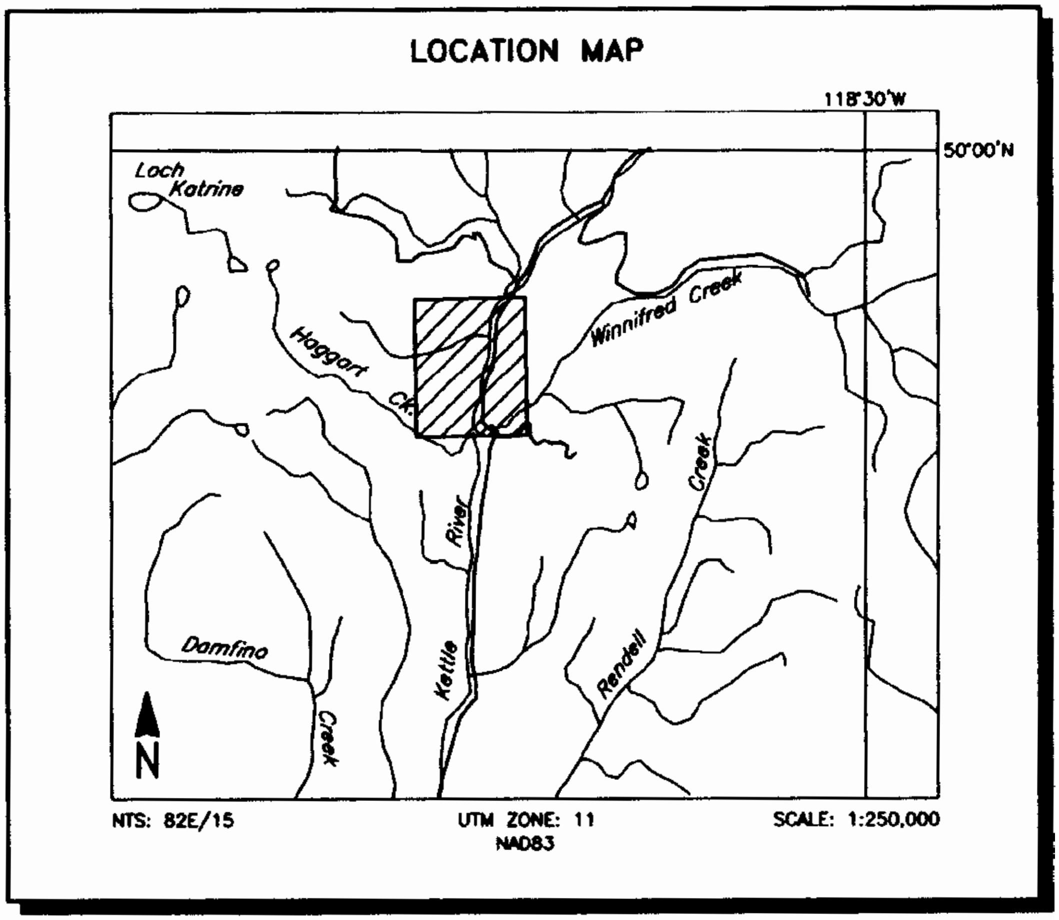


Figure 1
Location Map and Sheet Layout
Kettle Property, British Columbia
Job #03096

The survey specifications were as follows:

Parameter	Specifications
Traverse line direction	90°/270°
Traverse line spacing	100 m
Tie line direction	0°/180°
Tie line spacing	1000 m
Sample interval	10 Hz, 3.3 m @ 120 km/hr
Aircraft mean terrain clearance	60 m
EM sensor mean terrain clearance	30 m
Mag sensor mean terrain clearance	30 m
Average speed	71 km/hr
Navigation (guidance)	±5 m, Real-time GPS
Post-survey flight path	±2 m, Differential GPS

3. SURVEY EQUIPMENT

This section provides a brief description of the geophysical instruments used to acquire the survey data and the calibration procedures employed. The geophysical equipment was installed in an AS350B2 helicopter. This aircraft provides a safe and efficient platform for surveys of this type.

Electromagnetic System

Model: DIGHEM^{V-DSP}

Type: Towed bird, symmetric dipole configuration operated at a nominal survey altitude of 30 metres. Coil separation is 8 metres for 900 Hz, 1000 Hz, 5500 Hz and 7200 Hz, and 6.3 metres for the 56,000 Hz coil-pair.

Coil orientations, frequencies *and dipole moments*

Atm^2	orientation	nominal	actual
211	coaxial /	1000 Hz	1088 Hz
211	coplanar /	900 Hz	874 Hz
67	coaxial /	5500 Hz	5177 Hz
56	coplanar /	7200 Hz	7131 Hz
15	coplanar /	56,000 Hz	55,940 Hz

Channels recorded:
5 in-phase channels
5 quadrature channels
2 monitor channels

Sensitivity:
0.06 ppm at 1000 Hz Cx
0.12 ppm at 900 Hz Cp
0.12 ppm at 5,500 Hz Cx
0.24 ppm at 7,200 Hz Cp
0.60 ppm at 56,000 Hz Cp

Sample rate: 10 per second, equivalent to 1 sample every 3.3 m, at a survey speed of 120 km/h.

The electromagnetic system utilizes a multi-coil coaxial/coplanar technique to energize conductors in different directions. The coaxial coils are vertical with their axes in the flight direction. The coplanar coils are horizontal. The secondary fields are sensed simultaneously by means of receiver coils that are maximum coupled to their respective transmitter coils. The system yields an in-phase and a quadrature channel from each transmitter-receiver coil-pair.

EM System Calibration

The initial calibration procedure at the factory involves three stages; primary field bucking, phase calibration and gain calibration. In the first stage, the primary field at each receiver coil is cancelled, or "bucked out", by precise positioning of five bucking coils.

The initial phase calibration adjusts the phase angle of the receiver to match that of the transmitter. A ferrite bar, which produces a purely in-phase anomaly, is positioned near each receiver coil. The bar is rotated from minimum to maximum field coupling and the responses for the in-phase and quadrature components for each coil pair/frequency are measured. The phase of the response is adjusted at the console to return an in-phase only response for each coil-pair.

The initial gain calibration uses external coils designed to produce an equal response on in-phase and quadrature components for each frequency/coil-pair. The coil parameters and distances are designed to produce pre-determined responses at the receiver, when the calibration coil is activated. The gain at the console is adjusted to yield secondary responses of exactly 100 ppm and 200 ppm on the coaxial and coplanar channels respectively. Gain calibrations on the ground are carried out at the beginning and end of the survey, or whenever key components are replaced.

The phase and gain calibrations each measure a relative change in the secondary field, rather than an absolute value. This removes any dependency of the calibration procedure on the secondary field due to the ground, except under circumstances of extreme ground conductivity.

Subsequent calibrations of the gain, phase and the system zero level are performed in the air. These internal calibrations are carried out before, after, and at regular intervals during each flight. The system is flown to an altitude high enough to be out of range of any secondary field from the earth (the altitude is dependent on ground resistivity) at which point the zero, or base level of the system is established. Calibration coils in the bird are activated for each frequency by closing a switch to form a closed circuit through the coil. The transmitter induces a current in this loop, which creates a secondary field in the receiver of precisely known phase and amplitude. Linear system drift is automatically removed by re-establishing zero levels between the internal calibrations. Any phase and gain changes in the system are recorded by the digital receiver to allow post-flight corrections. (The Fugro AutoCal process automatically resets the phase and gain to the correct, pre-determined value.)

Using real-time Fast Fourier Transforms and the calibration procedures outlined above, the data are processed in real-time from the measured total field to inphase and quadrature components, at a rate of 10 samples per second.

Airborne Magnetometer

Model:	Fugro AM102 processor with Geometrics G822 sensor
Type:	Optically pumped cesium vapour
Sensitivity:	0.01 nT
Sample rate:	10 per second

The magnetometer sensor is housed in the EM bird, 28 m below the helicopter.

Magnetic Base Station

Primary

Model:	Fugro CF1 base station with timing provided by integrated GPS	
Sensor type:	Geometrics G822	
Counter specifications:	Accuracy:	±0.1 nT
	Resolution:	0.01 nT
	Sample rate	1 Hz
GPS specifications:	Model:	Marconi Allstar
	Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
	Sensitivity:	-90 dBm, 1.0 second update
	Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is 2 metres

Environmental
Monitor specifications: Temperature:

- *Accuracy:* ±1.5°C *max*
- Resolution: 0.0305°C
- Sample rate: 1 Hz
- Range: -40°C to +75°C

Barometric pressure:

- Model: Motorola MPXA4115A
- Accuracy: ±3.0° kPa max (-20°C to 105°C temp. ranges)
- Resolution: 0.013 kPa
- Sample rate: 1 Hz
- Range: 55 kPa to 108 kPa

A digital recorder is operated in conjunction with the base station magnetometer to record the diurnal variations of the earth's magnetic field. The clock of the base station is synchronized with that of the airborne system, using GPS time, to permit subsequent removal of diurnal drift. The Fugro CF1 was the primary magnetic base station. It was located at latitude 49°58'9.6924"N, longitude 119°22'55.7112"W, elevation 377.4 m.

Navigation (Global Positioning System)

Airborne Receiver for Real-time Navigation & Guidance

Model:	Ashtech Glonass GG24 with PNAV 2100 interface
Type:	SPS (L1 band), 24-channel, C/A code at 1575.42 MHz, S code at 0.5625 MHz, Real-time differential.
Sensitivity:	-132 dBm, 0.5 second update
Accuracy:	Manufacturer's stated accuracy is better than 5 metres real-time

Antenna:	*Mounted on tail of aircraft*

Airborne Receiver for Flight Path Recovery

Model:	Ashtech Z-Surveyor
Type:	Code and carrier tracking of L1 band, 24-channel, dual frequency C/A code at 1575.2 MHz, and L2 P-code 1227 MHz.
Sample rate:	0.5 second update.
Accuracy:	Manufacturer's stated accuracy for differential corrected GPS is better than 1 metre.
Antenna:	Mounted on nose of EM bird.

GPS Base Station

Model:	Marconi Allstar OEM, CMT-1200
Type:	Code and carrier tracking of L1 band, 12-channel, C/A code at 1575.42 MHz
Sensitivity:	-90 dBm, 1.0 second update
Accuracy:	Manufacturer's stated *accuracy for differential corrected* GPS is 2 metres.

The Ashtech GG24 is a line of sight, satellite navigation system that utilizes time-coded signals from at least four of forty-eight available satellites. Both Russian GLONASS and American NAVSTAR satellite constellations are used to calculate the position and to *provide real time guidance to the helicopter. For flight path processing an* Ashtech Z-surveyor was used as the mobile receiver. The Marconi Allstar GPS unit, part of the CF-1, was used for a base station. The mobile and base station raw XYZ data were recorded, thereby permitting post-survey differential corrections for theoretical accuracies of better than 2 metres.

Each base station receiver is able to calculate its own latitude and longitude. For this survey, the GPS station was located at latitude 49°58'9.6924"N, longitude 119°22'55.7112"W at an elevation of 377.4 metres above the ellipsoid. The GPS records data relative to the WGS84 ellipsoid, which is the basis of the revised North American Datum (NAD83).

Radar Altimeter

Manufacturer:	Honeywell/Sperry
Model:	RT330
Type:	Short pulse modulation, 4.3 GHz
Sensitivity:	0.3 m
Sample rate:	2 per second

The radar altimeter measures the vertical distance between the helicopter and the ground. This information is used in the processing algorithm that determines conductor depth.

Barometric Pressure and Temperature Sensors

Model:	DIGHEM D 1300	
Type:	Motorola MPX4115AP analog pressure sensor AD592AN high-impedance remote temperature sensors	
Sensitivity:	Pressure:	150 mV/kPa
	Temperature:	100 mV/°C or 10 mV/°C (selectable)
Sample rate:	10 per second	

The D1300 circuit is used in conjunction with one barometric sensor and up to three temperature sensors. Two sensors (baro and temp) are installed in the EM console in the aircraft, to monitor pressure (1KPA) and internal operating temperatures (2TDC).

Analog Recorder

Manufacturer:	RMS Instruments
Type:	DGR33 dot-matrix graphics recorder
Resolution:	4x4 dots/mm
Speed:	1.5 mm/sec

The analog profiles are recorded on chart paper in the aircraft during the survey. Table 3-1 lists the geophysical data channels and the vertical scale of each profile.

Table 3-1. The Analog Profiles

Channel Name	Parameter	Scale units/mm
1X9I	coaxial in-phase (1000 Hz)	2.5 ppm
1X9Q	coaxial quad (1000 Hz)	2.5 ppm
3P9I	coplanar in-phase (900 Hz)	2.5 ppm
3P9Q	coplanar quad (900 Hz)	2.5 ppm
2P7I	coplanar in-phase (7200 Hz)	5 ppm
2P7Q	coplanar quad (7200 Hz)	5 ppm
4X7I	coaxial in-phase (5500 Hz)	5 ppm
4X7Q	coaxial quad (5500 Hz)	5 ppm
5P5I	coplanar in-phase (56000 Hz)	10 ppm
5P5Q	coplanar quad (56000 Hz)	10 ppm
ALTR	altimeter (radar)	3 m
MAGC	magnetics, coarse	20 nT
MAGF	magnetics, fine	2.0 nT
CXSP	coaxial spherics monitor	
CPSP	coplanar spherics monitor	
CXPL	coaxial powerline monitor	
CPPL	coplanar powerline monitor	
1KPA	altimeter (barometric)	30 m
2TDC	internal (console) temperature	1° C
3TDC	external temperature	1° C

Digital Data Acquisition System

Manufacturer: RMS Instruments

Model: DGR 33

Recorder: San Disk compact flash card (PCMCIA)

The stored data are downloaded to the field workstation PC at the survey base, for verification, backup and preparation of in-field products.

Video Flight Path Recording System

Type: *Panasonic WVCD/32 Colour Video Camera*

Recorder: Panasonic AG-720

Format: NTSC (VHS)

Fiducial numbers are recorded continuously and are displayed on the margin of each image. This procedure ensures accurate correlation of data with respect to visible features on the ground.

4. QUALITY CONTROL

Digital data for each flight were transferred to the field workstation, in order to verify data quality and completeness. A database was created and updated using Geosoft Oasis Montaj and proprietary Fugro Atlas software. This allowed the field personnel to calculate, display and verify both the positional (flight path) and geophysical data on a screen or printer. Records were examined as a preliminary assessment of the data acquired for each flight.

In-field processing of Fugro survey data consists of differential corrections to the airborne GPS data, verification of EM calibrations, drift correction of the raw airborne EM data, spike rejection and filtering of all geophysical and ancillary data, verification of flight videos, calculation of preliminary resistivity data, diurnal correction, and preliminary leveling of magnetic data.

All data, including base station records, were checked on a daily basis, to ensure compliance with the survey contract specifications. Reflights were required if any of the following specifications were not met.

Navigation - Positional (x,y) accuracy of better than 10 m, with a CEP (circular error of probability) of 95%.

Flight Path - No lines to exceed 25 metres departure from nominal line spacing over a continuous distance of more than 1 km, except for reasons of safety.

Clearance - Mean terrain sensor clearance of 30 m, ±10 m, except where precluded by safety considerations, e.g., restricted or populated areas, severe topography, obstructions, tree canopy, aerodynamic limitations, etc.

Airborne Mag - Aerodynamic magnetometer noise envelope not to exceed 0.5 nT.

Base Mag - Diurnal variations not to exceed 10 nT over a straight line time chord of 1 minute.

EM - Reflights will result when peak to peak noise envelopes of the EM channels exceeds the specified tolerance continuously over a horizontal distance of 2,000 metres under normal survey conditions. The tolerances by frequency and coil orientation are:

Frequency	**Coil Orientation**	**Peak to Peak Noise Envelope (ppm)**
1000 Hz	vertical coaxial	5.0
900 Hz	horizontal coplanar	10.0
5500 Hz	vertical coaxial	10.0
7200 Hz	horizontal coplanar	20.0
56,000 Hz	horizontal coplanar	40.0

Spheric pulses may occur having strong peaks but narrow widths. *The EM data are considered acceptable when their occurrence is* less than 10 spheric events exceeding the stated noise specification for a given frequency per 100 samples continuously over a distance *of 2,000 metres.*

5. DATA PROCESSING

Flight Path Recovery

The raw range data from at least four satellites are simultaneously recorded by both the base and mobile GPS units. The geographic positions of both units, relative to the model ellipsoid, are calculated from this information. Differential corrections, which are obtained from the base station, are applied to the mobile unit data to provide a post-flight track of the aircraft, accurate to within 2 m. Speed checks of the flight path are also carried out to determine if there are any spikes or gaps in the data.

Electromagnetic Data

EM data are processed at the recorded sample rate of 10 samples/second. If necessary, appropriate spheric rejection filters are applied to reduce noise to acceptable levels. EM test profiles are then created to allow the interpreter to select the most appropriate EM anomaly picking controls for a given survey area. The EM picking parameters depend on several factors but are primarily based on the dynamic range of the resistivities within the survey area, and the types and expected geophysical responses of the targets being sought.

Anomalous electromagnetic responses are selected and analysed by computer to provide a preliminary electromagnetic anomaly map. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. Using the preliminary map in conjunction with the multi-parameter stacked profiles, the interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data. The final interpreted EM anomaly map includes bedrock, surficial and cultural conductors.

Apparent Resistivity

The apparent resistivity in ohm-m can be generated from the in-phase and quadrature EM components for any of the frequencies, using a pseudo-layer half-space model. The inputs to the resistivity algorithm are the inphase and quadrature amplitudes of the secondary field. The algorithm calculates the apparent resistivity in ohm-m, and the apparent height of the bird above the conductive source. The upper (pseudo) layer is merely an artifice to allow for the difference between the computed sensor-source distance and the measured sensor height, as determined by the radar or laser altimeter. Any errors in the altimeter reading, caused by heavy tree cover, are included in the pseudo-layer and do not affect the resistivity calculation. The apparent depth estimates, however, will reflect the altimeter errors.

In areas where the effects of magnetic permeability or dielectric permittivity have suppressed the inphase responses, the calculated resistivities will be erroneously high. Various algorithms and inversion techniques can be used to partially correct for the effects of permeability and permittivity.

Apparent resistivity maps portray all of the information for a given frequency over the entire survey area. This full coverage contrasts with the electromagnetic anomaly map, which provides information only over interpreted conductors. The large dynamic range afforded by the multiple frequencies makes the apparent resistivity parameter an excellent mapping tool.

The preliminary apparent resistivity maps and images are carefully inspected to identify any lines or line segments that might require base level adjustments. Subtle changes between in-flight calibrations of the system can result in line-to-line differences that are more recognizable in resistive (low signal amplitude) areas. If required, manual level adjustments are carried out to eliminate or minimize resistivity differences that can be attributed, in part, to changes in operating temperatures. These leveling adjustments are usually very subtle, and do not result in the degradation of discrete anomalies.

After the manual leveling process is complete, revised resistivity grids are created. The resulting grids can be subjected to a microleveling technique in order to smooth the data for contouring.

The calculated resistivities for the three coplanar frequencies are included in the XYZ and grid archives. Values are in ohm-metres on all final products.

Total Magnetic Field

A fourth difference was calculated from the raw total magnetic intensity data (TMI). The raw TMI was examined in profile form along with the fourth difference. Spikes and duplicate points were manually defaulted and interpolated with an Akima spline. None of the defaulted areas exceeded one second in length. The diurnal variations recorded by the base station were edited for any cultural contamination and filtered to remove high-frequency noise. This diurnal magnetic data was then subtracted from the despiked TMI to provide a first order diurnal correction. An average base value of 56280 nT was added back to the diurnal corrected airborne total magnetic field records. The diurnal removed magnetic field data were then gridded and compared to a grid of the despiked magnetic data to ensure that the data quality was improved by diurnal removal.

The lag in the magnetic data was calculated from the lag test and applied to the survey data. A vertical gradient was calculated from the lagged magnetic data and examined for evidence of lag and leveling problems. The lag of –1.0 second seemed appropriate for the survey data and few leveling errors were noted. To remove any short wavelength residual line-to-line discrepancies in the total field magnetics, a microleveling technique was used to remove errors of less than 5.0 nT striking parallel to the line direction. This microlevelled channel was used to produce the final residual magnetics grid.

Calculated Vertical Magnetic Gradient

The diurnally-corrected total magnetic field data were subjected to a processing algorithm that enhances the response of magnetic bodies in the upper 500 m and attenuates the response of deeper bodies. The resulting vertical gradient map provides better definition and resolution of near-surface magnetic units. It also identifies weak magnetic features that may not be evident on the total field map. However, regional magnetic variations and changes in lithology may be better defined on the total magnetic field map.

Apparent Magnetic Susceptibility

Helicopter electromagnetic data can be used to map the magnetic susceptibility of the geology surveyed. The apparent magnetic susceptibility is computed from the 900 Hz coplanar EM data set. The EM derived susceptibility measurement complements the magnetic survey-derived susceptibility, and will be different in several aspects.

- The depth of penetration is controlled by the geometry and frequency of the EM system.
- Anomaly width is narrower, giving better lateral resolution.
- The shape of the response is unaffected by geomagnetic latitude.
- The response is unaffected by remanent magnetization.

Digital Elevation

The radar altimeter values (ALTR – aircraft to ground clearance) are subtracted from the differentially corrected and de-spiked GPS-Z values to produce profiles of the height above the ellipsoid along the survey lines. These values are gridded to produce contour maps showing approximate elevations within the survey area. The calculated digital terrain data are then tie-line leveled and adjusted to mean sea level. Any remaining subtle line-to-line discrepancies are manually removed. After the manual corrections are applied, the digital terrain data are filtered with a microleveling algorithm.

The accuracy of the elevation calculation is directly dependent on the accuracy of the two input parameters, ALTR and GPS-Z. The ALTR value may be erroneous in areas of heavy tree cover, where the altimeter reflects the distance to the tree canopy rather than the ground. The GPS-Z value is primarily dependent on the number of available satellites. Although post-processing of GPS data will yield X and Y accuracies in the order of 1-2 metres, the accuracy of the Z value is usually much less, sometimes in the ±10 metre range. Further inaccuracies may be introduced during the interpolation and gridding process.

Because of the inherent inaccuracies of this method, no guarantee is made or implied that the information displayed is a true representation of the height above sea level. Although this product may be of some use as a general reference, <u>THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.</u>

Contour, Colour and Shadow Map Displays

The geophysical data are interpolated onto a regular grid using a modified Akima spline technique. The resulting grid is suitable for image processing and generation of contour maps. The grid cell size is 20% of the line interval.

Colour maps are produced by interpolating the grid down to the pixel size. The parameter is then incremented with respect to specific amplitude ranges to provide colour "contour" maps.

Monochromatic shadow maps or images are generated by employing an artificial sun to cast shadows on a surface defined by the geophysical grid. There are many variations in the shadowing technique. These techniques can be applied to total field or enhanced magnetic data, magnetic derivatives, resistivity, etc. The shadowing technique is also used as a quality control method to detect subtle changes between lines.

Multi-channel Stacked Profiles

Distance-based profiles of the digitally recorded geophysical data are generated and plotted at an appropriate scale. These profiles also contain the calculated parameters that are used in the interpretation process. These are produced as worksheets prior to interpretation, and are also presented in the final corrected form after interpretation. The profiles display electromagnetic anomalies with their respective interpretive symbols. Table 5-1 shows the parameters and scales for the multi-channel stacked profiles.

In Table 5-1, the log resistivity scale of 0.06 decade/mm means that the resistivity changes by an order of magnitude in 16.6 mm. The resistivities at 0, 33 and 67 mm up from the bottom of the digital profile are respectively 1, 100 and 10,000 ohm-m.

Table 5-1. Multi-channel Stacked Profiles

Channel Name (Freq)	Observed Parameters	Scale Units/mm
MAG	total magnetic field (fine)	5 nT
ALTBIRDM	EM sensor height above ground	6 m
CXI1000	vertical coaxial coil-pair in-phase (1000 Hz)	2 ppm
CXQ1000	vertical coaxial coil-pair quadrature (1000 Hz)	2 ppm
CPI900	horizontal coplanar coil-pair in-phase (900 Hz)	4 ppm
CPQ900	horizontal coplanar coil-pair quadrature (900 Hz)	4 ppm
CXI5500	vertical coaxial coil-pair in-phase (5500 Hz)	5 ppm
CXQ5500	vertical coaxial coil-pair quadrature (5500 Hz)	5 ppm
CPI7200	horizontal coplanar coil-pair in-phase (7200 Hz)	10 ppm
CPQ7200	horizontal coplanar coil-pair quadrature (7200 Hz)	10 ppm
CPI56K	horizontal coplanar coil-pair in-phase (56,000 Hz)	10 ppm
CPQ56K	horizontal coplanar coil-pair quadrature (56,000 Hz)	10 ppm
CXPLR	coaxial powerline monitor	
CPPLR	coplanar powerline monitor	
	Computed Parameters	
DIFI (5500 Hz)	difference function in-phase from CXI and CPI	4 ppm
DIFQ (7200 Hz)	difference function quadrature from CXQ and CPQ	4 ppm
RES900	log resistivity	.06 decade
RES7200	log resistivity	.06 decade
RES56K	log resistivity	.06 decade
DEP900	apparent depth	6 m
DEP7200	apparent depth	6 m
DEP56K	apparent depth	6 m
CDT	Conductance	1 grade

6. PRODUCTS

This section lists the final maps and products that have been provided under the terms of the survey agreement. Other products can be prepared from the existing dataset, if requested. These include magnetic enhancements or derivatives, percent magnetite, resistivities corrected for magnetic permeability and/or dielectric permittivity, digital terrain, resistivity-depth sections, inversions, and overburden thickness. Most parameters can be displayed as contours, profiles, or in colour.

Base Maps

Base maps of the survey area were produced by scanning published topographic maps to a bitmap (.bmp) format. This process provides a relatively accurate, distortion-free base that facilitates correlation of the navigation data to the map coordinate system. The topographic files were combined with geophysical data for plotting the final maps. All maps were created using the following parameters:

<u>Projection Description</u>:

Datum:	NAD83
Ellipsoid:	GRS1980
Projection:	UTM (Zone: 11)
Central Meridian:	117
False Northing:	0
False Easting:	500000
Scale Factor:	0.9996

The following parameters are presented on one map sheet, at a scale of 1:10,000. All maps include flight lines and topography, unless otherwise indicated. Preliminary products are not listed.

Final Products

	No. of Map Sets	
	Blackline	Colour
EM Anomalies	2	
Total Magnetic Field		2
Calculated Vertical Magnetic Gradient		2
Magnetic Susceptibility (EM Derived)		2
Apparent Resistivity 900 Hz		2
Apparent Resistivity 7200 Hz		2
Apparent Resistivity 56,000 Hz		2

<u>Additional Products</u>

Digital Archive (see Archive Description)	1 CD-ROM
Survey Report	3 copies
Multi-channel Stacked Profiles	All lines
Analog Chart Records	All lines
Flight Path Video (VHS)	2 cassettes
HP Plot Files	All final map products

7. SURVEY RESULTS

General Discussion

Table 7-1 summarizes the EM responses in the survey area, with respect to conductance grade and interpretation.

The anomalies shown on the electromagnetic anomaly maps are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly map if they have a regional character rather than a locally anomalous character.

These broad conductors, which more closely approximate a half-space model, will be maximum coupled to the horizontal (coplanar) coil-pair and should be more evident on the resistivity parameter. Resistivity maps, therefore, may be more valuable than the electromagnetic anomaly maps, in areas where broad or flat-lying conductors are considered to be of importance. Contoured resistivity maps, based on the 900 Hz, 7200 Hz and 56,000 Hz coplanar data are included with this report.

TABLE 7-1 EM ANOMALY STATISTICS

KETTLE PROPERTY, BRITISH COLUMBIA

CONDUCTOR GRADE	CONDUCTANCE RANGE SIEMENS (MHOS)	NUMBER OF RESPONSES
7	>100	0
6	50 - 100	0
5	20 - 50	0
4	10 - 20	0
3	5 - 10	1
2	1 - 5	17
1	<1	112
*	INDETERMINATE	125
TOTAL		255

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
B	DISCRETE BEDROCK CONDUCTOR	1
S	CONDUCTIVE COVER	251
H	ROCK UNIT OR THICK COVER	3
TOTAL		255

(SEE EM MAP LEGEND FOR EXPLANATIONS)

Excellent resolution and discrimination of conductors was accomplished by using a fast sampling rate of 0.1 sec and by employing a "common" frequency (5500/7200 Hz) on two orthogonal coil-pairs (coaxial and coplanar). The resulting difference channel parameters often permit differentiation of bedrock and surficial conductors, even though they may exhibit similar conductance values.

Anomalies that occur near the ends of the survey lines (i.e., outside the survey area), should be viewed with caution. Some of the weaker anomalies could be due to aerodynamic noise, i.e., bird bending, which is created by abnormal stresses to which the bird is subjected during the climb and turn of the aircraft between lines. Such aerodynamic noise is usually manifested by an anomaly on the coaxial in-phase channel only, although severe stresses can affect the coplanar in-phase channels as well.

Magnetics

A Fugro CF-1 cesium vapour magnetometer was operated at the survey base to record diurnal variations of the earth's magnetic field. The clock of the base station was synchronized with that of the airborne system to permit subsequent removal of diurnal drift.

The total magnetic field data have been presented as contours on the base map using a contour interval of 5 nT where gradients permit. The map shows the magnetic properties of the rock units underlying the survey area.

The total magnetic field data have been subjected to a processing algorithm to produce maps of the calculated vertical gradient. This procedure enhances near-surface magnetic units and suppresses regional gradients. It also provides better definition and resolution of magnetic units and displays weak magnetic features that may not be clearly evident on the total field maps.

The magnetic data displays a dynamic range of just less than 1000 nT across the entire survey block. Most of the magnetic features display a north-south strike direction, as evident in the total field magnetic data and the calculated vertical magnetic gradient data.

There is some evidence on the magnetic map that suggests that the survey area has been subjected to deformation and/or alteration. These structural complexities are evident on the contour maps as variations in magnetic intensity, irregular patterns, and as offsets or changes in strike direction.

Several highly magnetic, north-south trending units have been maped just east of tie-line 19030, in close proximity to Kettle River. These units are truncated in the north by an arcuate shape break evident as a sharp resistivity contact displayed on all of the resistivity maps. West of Kettle River, this break is coincident with Stone Creek. Several other north-south trending magnetic units between tie-lines 19010 and 19030 are also truncated by this break.

If a specific magnetic intensity can be assigned to the rock type that is believed to host the target mineralization, it may be possible to select areas of higher priority on the basis of the total field magnetic data. This is based on the assumption that the magnetite content of the host rocks will give rise to a limited range of contour values that will permit differentiation of various lithological units.

The magnetic results, in conjunction with the other geophysical parameters, have provided valuable information that can be used to effectively map the geology and structure in the survey area.

Apparent Resistivity

Apparent resistivity maps, which display the conductive properties of the survey area, were produced from the 900 Hz, 7200 Hz and 56,000 Hz coplanar data. The maximum resistivity values, which are calculated for each frequency, are 3,000, 10,000 and 28,000 ohm-m respectively. These cutoffs eliminate the erratic higher resistivities that would result from unstable ratios of very small EM amplitudes.

In general there is a strong correlation between the magnetic and resistivity patterns. The highly conductive portions of the survey area correspond well to regions of low magnetic amplitudes.

Electromagnetic Anomalies

The EM anomalies resulting from this survey appear to fall within one of two general categories. The first type consists of discrete, well-defined anomalies that yield marked inflections on the difference channels. These anomalies are usually attributed to conductive sulphides or graphite and are generally given a "B" or "D" interpretive symbol, denoting a bedrock source.

The second class of anomalies comprises moderately broad responses that exhibit the characteristics of a half-space and do not yield well-defined inflections on the difference channels. Anomalies in this category are usually given an "S" or "H" interpretive symbol. The lack of a difference channel response usually implies a broad or flat-lying conductive source such as overburden. Some of these anomalies could reflect conductive rock units, zones of deep weathering, or the weathered tops of kimberlite pipes, all of which can yield "non-discrete" signatures.

The effects of conductive overburden are evident over portions of the survey area(s). Although the difference channels (DIFI and DIFQ) are extremely valuable in detecting bedrock conductors that are partially masked by conductive overburden, sharp undulations in the bedrock/overburden interface can yield anomalies in the difference channels which may be interpreted as possible bedrock conductors. Such anomalies usually fall into the "S?" or "B?" classification but may also be given an "E" interpretive symbol, denoting a resistivity contrast at the edge of a conductive unit.

The "?" symbol does not question the validity of an anomaly, but instead indicates some degree of uncertainty as to which is the most appropriate EM source model. This ambiguity results from the combination of effects from two or more conductive sources, such as overburden and bedrock, gradational changes, or moderately shallow dips. The presence of a conductive upper layer has a tendency to mask or alter the characteristics of bedrock conductors, making interpretation difficult. This problem is further exacerbated in the presence of magnetite.

In areas where EM responses are evident primarily on the quadrature components, zones of poor conductivity are indicated. Where these responses are coincident with magnetic anomalies, it is possible that the in-phase component amplitudes have been suppressed by the effects of magnetite. Poorly-conductive magnetic features can give rise to resistivity anomalies that are only slightly below or slightly above background. If it is expected that poorly-conductive economic mineralization could be associated with magnetite-rich units, most of these weakly anomalous features will be of interest. In areas where magnetite causes the in-phase components to become negative, the apparent conductance and depth of EM anomalies will be unreliable. Magnetite effects usually give rise to overstated (higher) resistivity values and understated (shallow) depth calculations.

It is impractical to assess the relative merits of EM anomalies on the basis of conductance. It is recommended that an attempt be made to compile a suite of geophysical "signatures" over any known areas of interest. Anomaly characteristics are clearly defined on the multi-parameter geophysical data profiles that are supplied as one of the survey products.

The electromagnetic anomaly map shows the anomaly locations with the interpreted conductor type, conductance and depth being indicated by symbols. Direct magnetic correlation is also shown if it exists.

Kettle Property

The geologic information summarized in this report was based on Adam Travis' report, "Kettle Property Gold Vein and Stockwork Target", September 23, 2003, which was supplied by Max Investments Inc.

The Four Mineralized Zones

Three mineralized zones, South, Pb and HG, are situated within a magnetic low, labelled ML1, on the interpretation map. The Stockwork zone is located on the northern flank of ML1. This magnetic zone is approximately 300 meters wide with a north-south extent of over 2300 metres. The southern extent of this zone is open as it extends beyond the survey boundary. The magnetic low displays a fairly good correlation with a conductive unit.

All of the mineralized zones, except the South Zone, are located within altered intrusive rock. The South Zone is situated within an unaltered potassium feldspar megacryst porphyry. The western and northern extents of the alteration zone are shown within Travis' report, while the eastern and southern limits were not identified. There is good correlation between the mapped alteration contact and the magnetic data. Using this good correlation, the lateral extents of the alteration zone may be better defined by this magnetic low. If this correlation holds true, then the South Zone may be located within the altered intrusive rock rather than the unaltered rock. The magnetic data may be indicating that the alteration zone is larger at depth than its surface expression indicates.

The South Zone

The South Zone is located in close proximity to the intersection of two broad conductive units near line 10400, fiducial 6003. Both of these conductive units have been interpreted from the EM data as wide, flat-lying conductors. The South Zone is composed of a N-NW striking, shallow west dipping quartz vein. The quartz vein itself will be resistive but with any large amount of sulphide mineralization along these veins, it could result in a weakly conductive response. The veins are only 0.5 to 4.1 m in width, which may be too narrow to be directly detected by the airborne survey. However, if significant amounts of conductive mineralization are present along these narrow veins, combined with the shallow westward dip direction, this could account for the interpreted broad flat lying conductor. It has not yet been determined if this conductivity is bedrock in nature.

The Pb Zone

The Pb Zone is located near line 10350, fiducial 4424. It consists of a mineralized shear zone striking in a 070°/080° direction for over 300 metres in length, with a moderate southern dip. The width of the shear zone is unknown. The shear zone consists of narrow (average 30 cm in width) mineralized quartz veins. The strike direction of the shear zone is sub-parallel to the flight line direction. It is unclear if the airborne survey flew directly over the zone or if it is situated in-between two flight lines. With average widths of 30 cm, and an E-W strike direction, the individual weakly conductive quartz veins are unlikely to be easily detected by the survey. However, the Pb Zone is mapped within a slightly resistive unit. This lower conductivity may be defining the lateral extends of the resistive quartz veining within the shear zone. There is a slight magnetic high in close proximity to this zone. It is approximately 10 nT in amplitude and is situated on the western flank of a north-south trending magnetic zone.

HG Zone

The HG Zone is located immediately north of line 10300, fiducial 2600. It consists of sub parallel quartz veins and veinlets containing about 5% sulphides hosted in altered intrusive. It may be associated with a north-south trending magnetic anomaly. The amplitude of this response is approximately 15 nT. There is a weakly conductive response coincident with this area, but it is not yet determined if it is related to the HG mineralization.

The Stockwork Zone

This zone consists of the Bluff, Switchback and Vuggy veins. The sulphide minerals are associated with the brecciated quartz stockwork and cover an area of 300 x 450 metres. There is a weakly conductive response within this general area but it does not appear as a well-defined discrete zone within the resistivity datasets.

Other Potential Targets in the Kettle Property Survey Area

As economic mineralization within the area may be associated with resistive quartz veins with sulphide mineralization, all weakly conductive trends may be of importance. All of the mineralized zones within the survey area occur within magnetic lows. Any weakly conductive unit, with a coincident magnetic low may be of interest.

Several magnetic lows have been mapped by the survey. Some of these lows may be mapping the boundaries of alteration zones, which may have influenced mineralization within the area, or these zones could represent non-magnetic rock units. These zones were based on the total field magnetic patterns and were labelled ML1 though ML13 on the interpretation map.

Zone ML1

This zone contains the previously described mineralized areas. It is approximately 300 metres wide and extends over 2300 metres in a north-south direction. The southern extent of this zone is open as it extends beyond the survey boundary.

The magnetic low displays a fairly good correlation with a conductive unit. The source of this conductivity is unknown. Based on the EM shapes, the resistivity data and pseudo-depths, the most appropriate geometric model is a broad flat lying conductor. It has yet to be determined if this EM response is due to conductive mineralization, the alteration process or if it is related to overburden.

The survey data does reveal structural information that may have influenced mineralization within the area. Several breaks and linear features are revealed within the magnetic datasets. Some of these are displayed on the interpretation map. Particular interest should be placed on any linear features that occur near the known zones of mineralization.

Two other areas of interest are located within this Zone. The first is located approximately 400 metres south of the South Zone, near line 10440, fiducial 7000, identified as anomaly 10440C. The EM signature here indicates the presence of a weakly conductive discrete source, possibly due to a thin, near vertical conductor. Further south within this zone, near line 10480, fiducial 7908; the EM characteristics are more suggestive of a broad, flat-lying conductor at depth. Both of these two areas are situated on the western flank of a north-south trending magnetic unit.

Zone ML2

Zone ML2 may be of interest. It is located 500 metres west Zone ML1. It is approximately 300x900 metres in size and trends north-south. The zone is coincident with a north-south trending conductor and a Au soil anomaly. The EM characteristics throughout this zone are similar to those found within Zone ML1, however they may suggest the presence of a slightly more discrete conductive source. Both of the magnetic and resistivity patterns suggest that this zone may continue further to the north, although slightly higher magnetic amplitudes are mapped within this region. Other anomalous Au soil samples were also identified immediately north of this zone. This also indicates that this zone may be extended further northward.

Zones ML3, ML4, and ML5

All three zones are situated along the southern edge of the survey boundary. As a result their southern extent is not known. Zones ML4 and ML5 reveal some correlation with weakly conductive north-south trending features. Zone ML3, is coincident with a broad resistivity low that may be part of a larger more regional trend. Two anomalies, 10470B within Zone ML3 and 10470C, within ML4, may suggest the presence of a vertical conductor rather than a flat lying unit.

Zone ML6

This zone is located in the northwest corner of the survey block. As a result its lateral extents are unknown. There is a coincident conductive feature but the conductivity extends further south than the magnetic low, indicating that the two sources may not be related.

Zone ML7

The zone covers an area of approximately 800x350 metres, with the northern limit of this zone open as it extends northward beyond the survey area. There is no direct correlation with a conductive unit, but the conductivity does increase toward the southern boundary of this magnetic low. The EM data suggests the presence of a flat lying conductor.

Zone ML 8

This magnetic low is open to the north and truncated to the south by a NE/SW trending break. Immediately west of this zone is a slight north-south trending bi-lobed magnetic anomaly. A linear conductive unit trends along the western extents of this zone, with the EM data generally suggesting the presence of a flat-lying conductor until line 10051, fiducial 3158. The EM data at this point suggests the presence of a more vertical conductor. This vertical EM signature is very weak but is displayed on two adjacent lines. It is represented by anomalies 10051B, 10061B. Immediately south of Zone ML8 the resistivity patterns broaden into a much wider conductive zone, and appear to be associated with a more regional trend.

Zones ML9, ML11, and ML12

All of these zones are located on the northern edge of the survey and as a result the total lateral extents are not known. There does not appear to be a good correlation with the resistivity patterns throughout each of these zones, suggesting the EM data is mapping a different source than the magnetic data.

Zone ML10

This magnetic low is approximately 200x400 metres in size trending in a general north-south direction. It is located immediately west of Kettle River. The zone is located within a much larger resistivity low. The EM data may be responding to conductive river sediments rather than bedrock features, but that has yet to be determined. The magnetic data indicates that a possible structural break along the eastern edge of this zone continues southward and flanks the eastern edge of the mineralized zone ML1.

Zone ML13

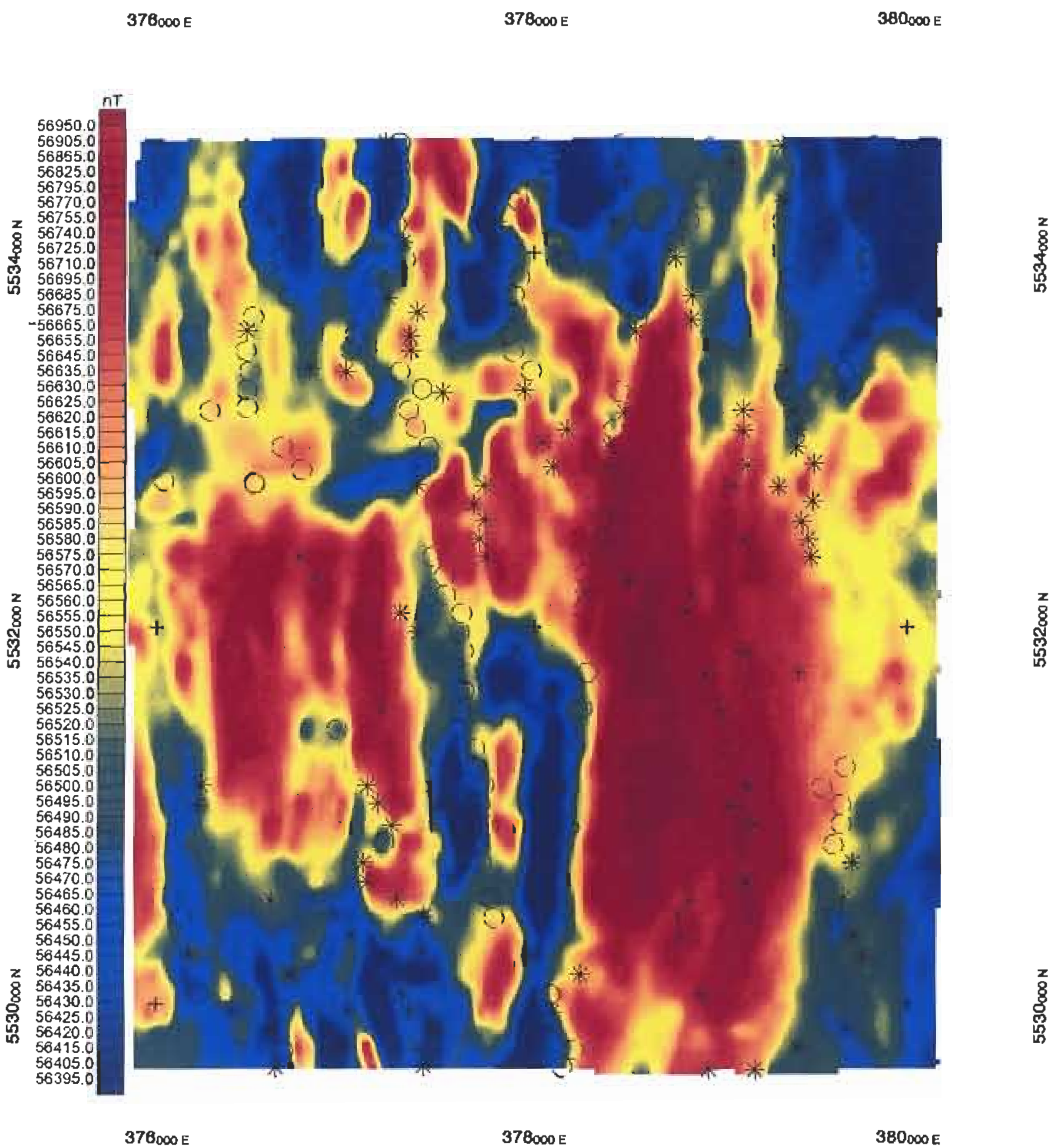
Zone 13 represents a small NE/SW trending magnetic low. It is located along an arcuate shaped break evident within the magnetic data. It is situated on the southern edge of a broad regional conductive unit.

Other EM Targets within the Kettle Property

Most of the EM anomalies yield poorly-defined response shapes and are only weakly to moderately conductive. Some of the EM anomalies suggest the presence of vertical or near-vertical conductors rather than a broad, flat-lying conductive unit. This can be determined by comparing the EM response between that of the coaxial and coplanar data sets. There are a few responses that indicate the presence of a thin, weakly conductive dyke-like unit. All anomalies of this type are poorly defined and weakly conductive, and are evident mainly on the quadrature component. Some of these anomalies may be due to edge effects from larger surficial sources. All of these responses are below the stated noise specifications of the system and should be viewed with caution. Further work should be done to confirm these features as bedrock conductors prior to drilling. These anomalies are identified as 10020C, 10030D, 10051B, 10061B, 10090B, 10110B, 10110C, 10190D, 10240B, 10280D, 10290A, 10440C, 10470B and 10470C.

There are two small resistivity lows that may be of some interest. One is centered at line 10090, fiducial 5350, and the second at line 10300, fiducial 2524. The EM data over both of these features is suggestive of a surficial source. Both are fairly isolated resistivity responses, small in diameter, and located on the flanks of magnetic highs which may make them of some interest.

FIGURES



N

0 2.5km

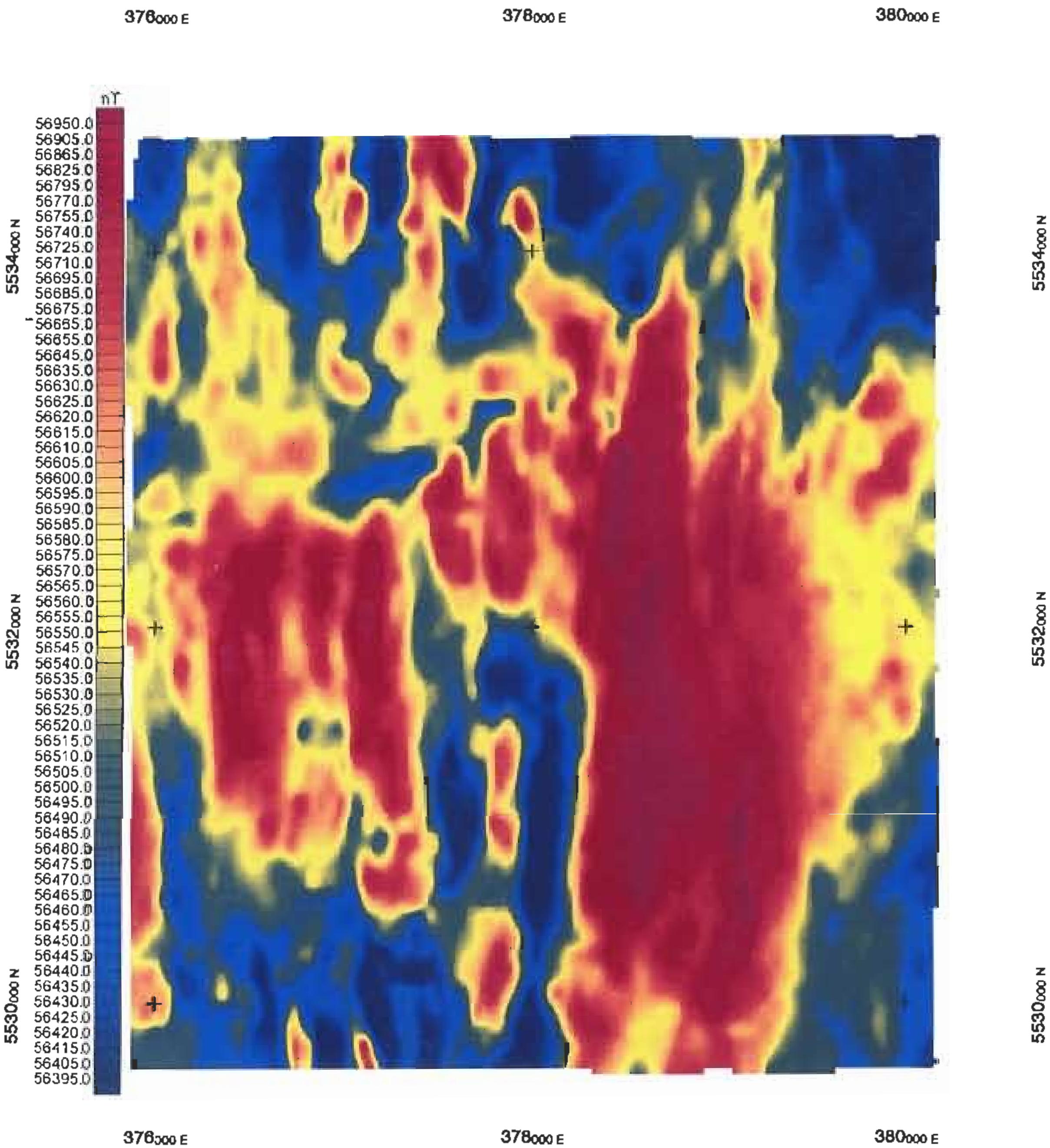
Scale 1:35000

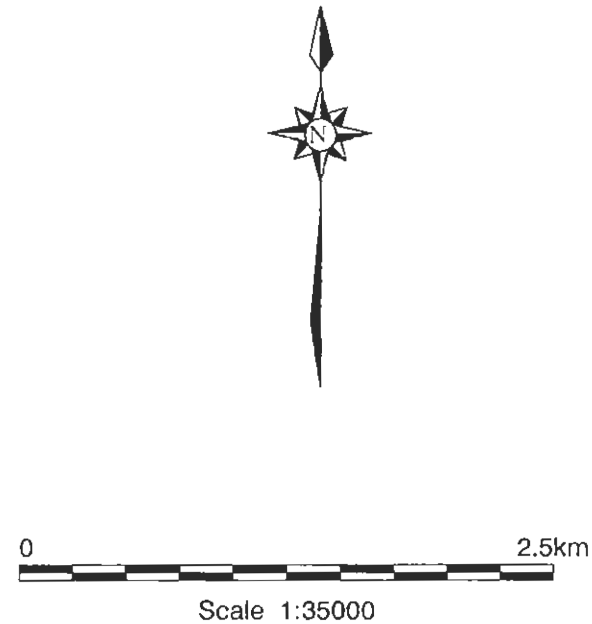
LEROY VENTURES INC.
KETTLE PROPERTY, B.C.

MAG/EM SUMMARY MAP

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





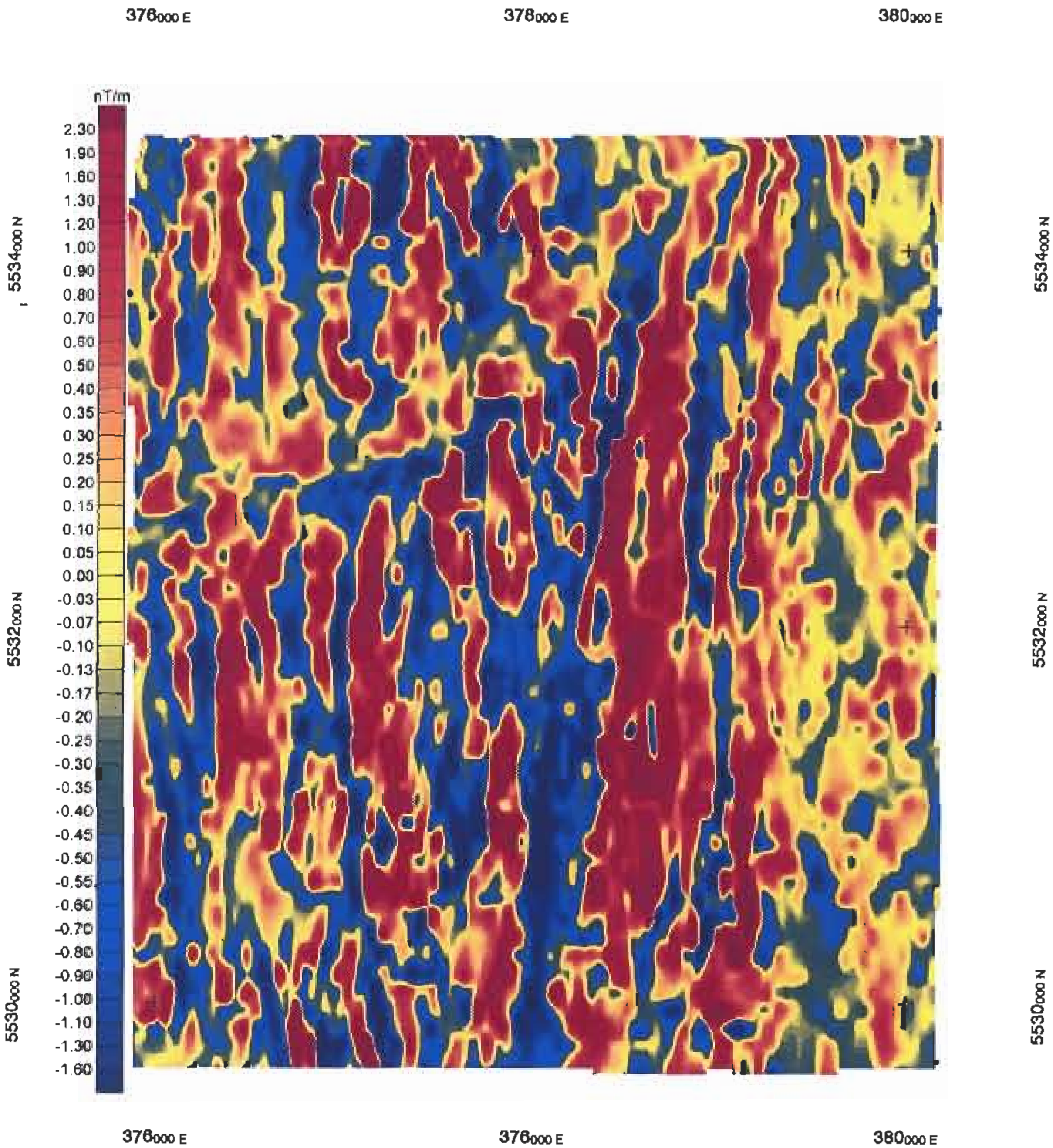
LEROY VENTURES INC.

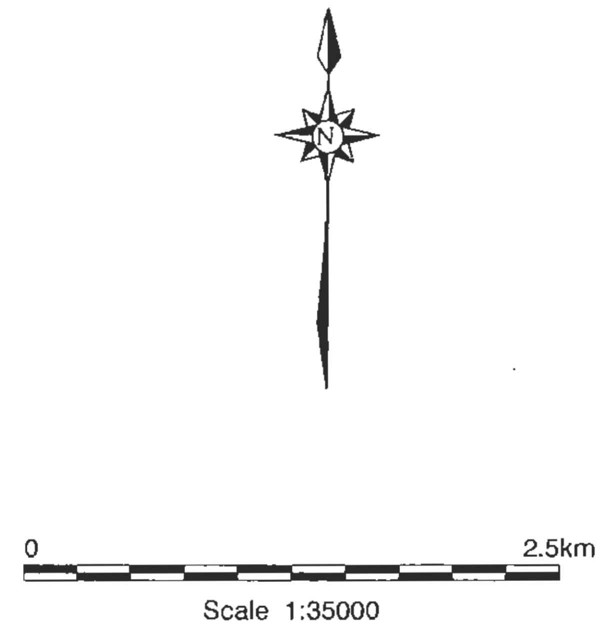
KETTLE PROPERTY, B.C.

TOTAL MAGNETIC FIELD

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS



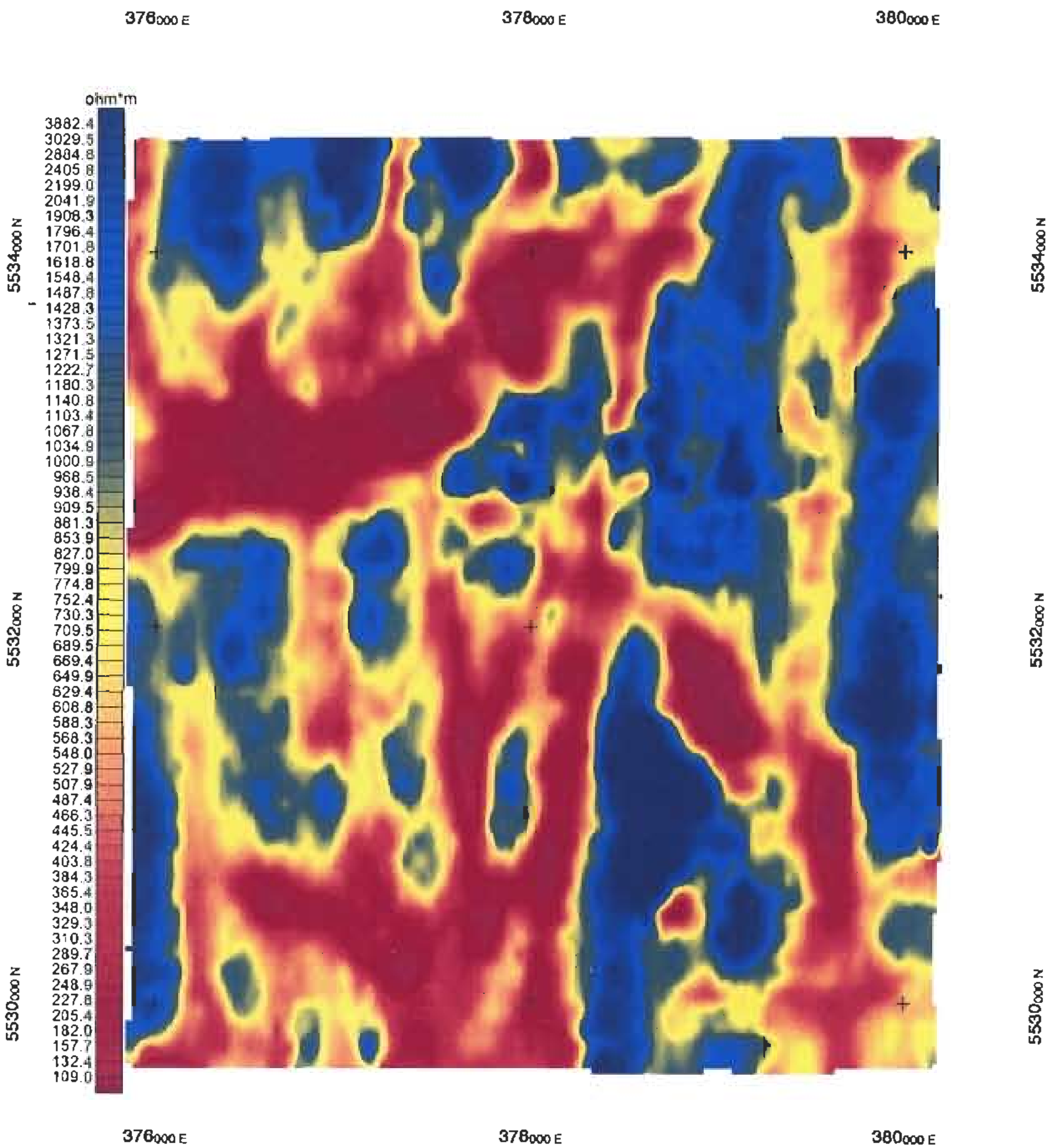


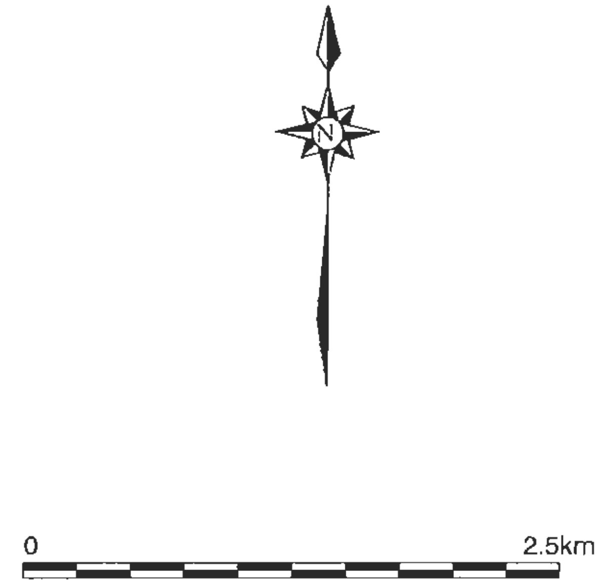
LEROY VENTURES INC.
KETTLE PROPERTY, B.C.

CALCULATED VERTICAL GRADIENT

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





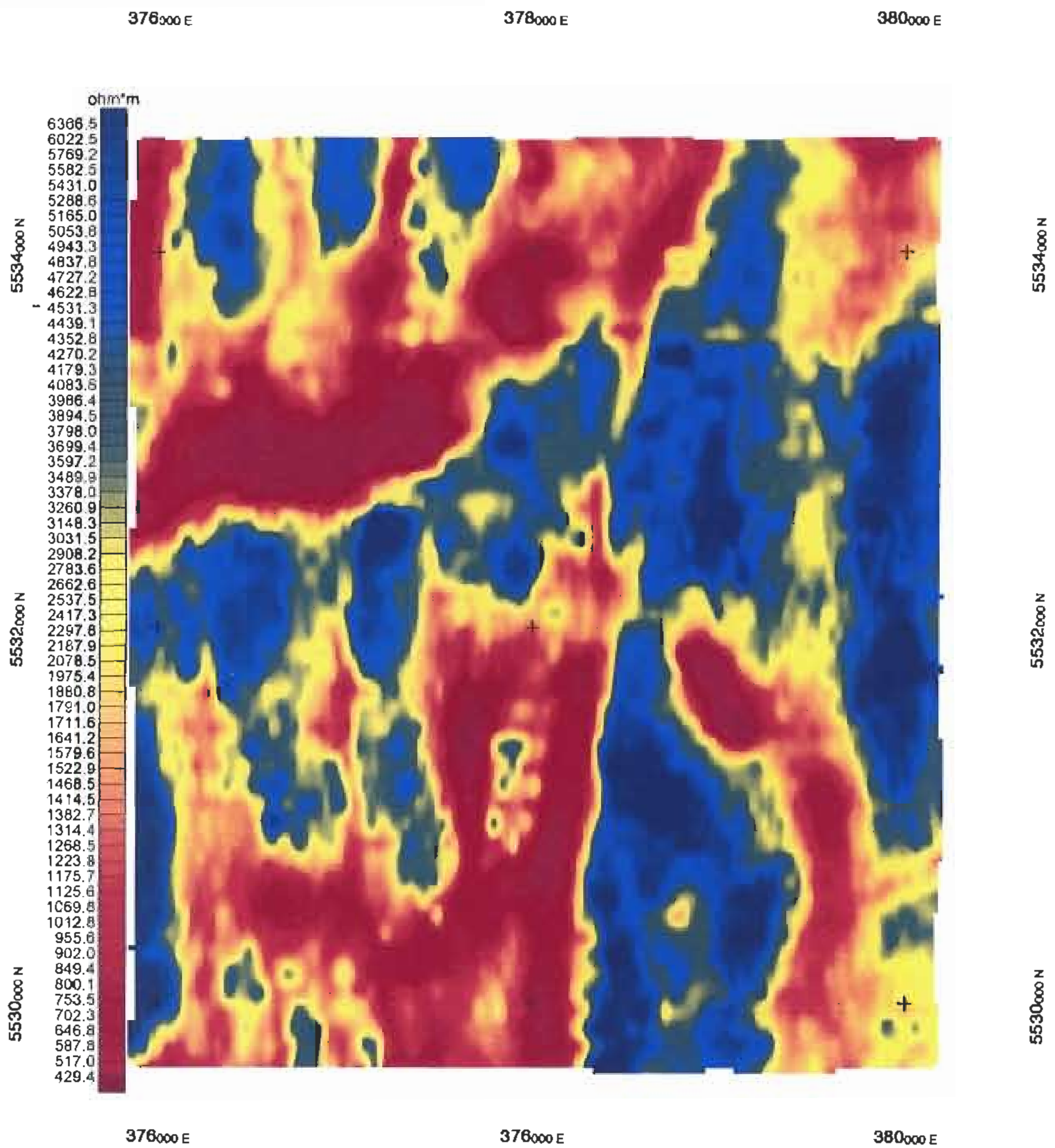
Scale 1:35000

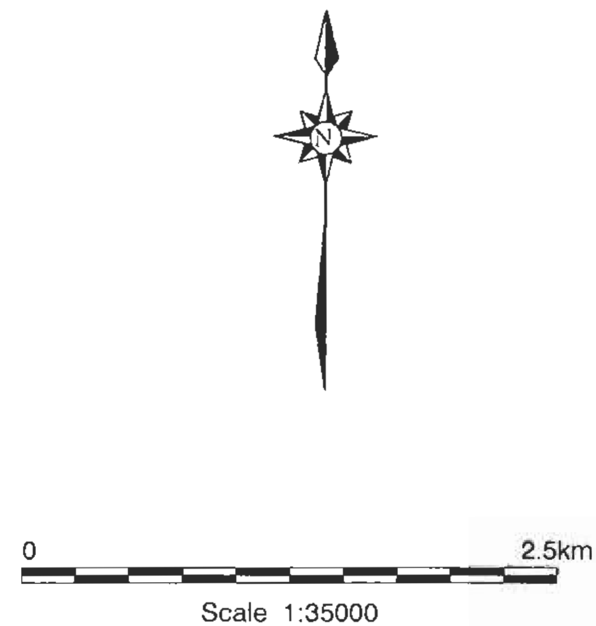
LEROY VENTURES INC.
KETTLE PROPERTY, B.C.

APPARENT RESISTIVITY 56000 Hz

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





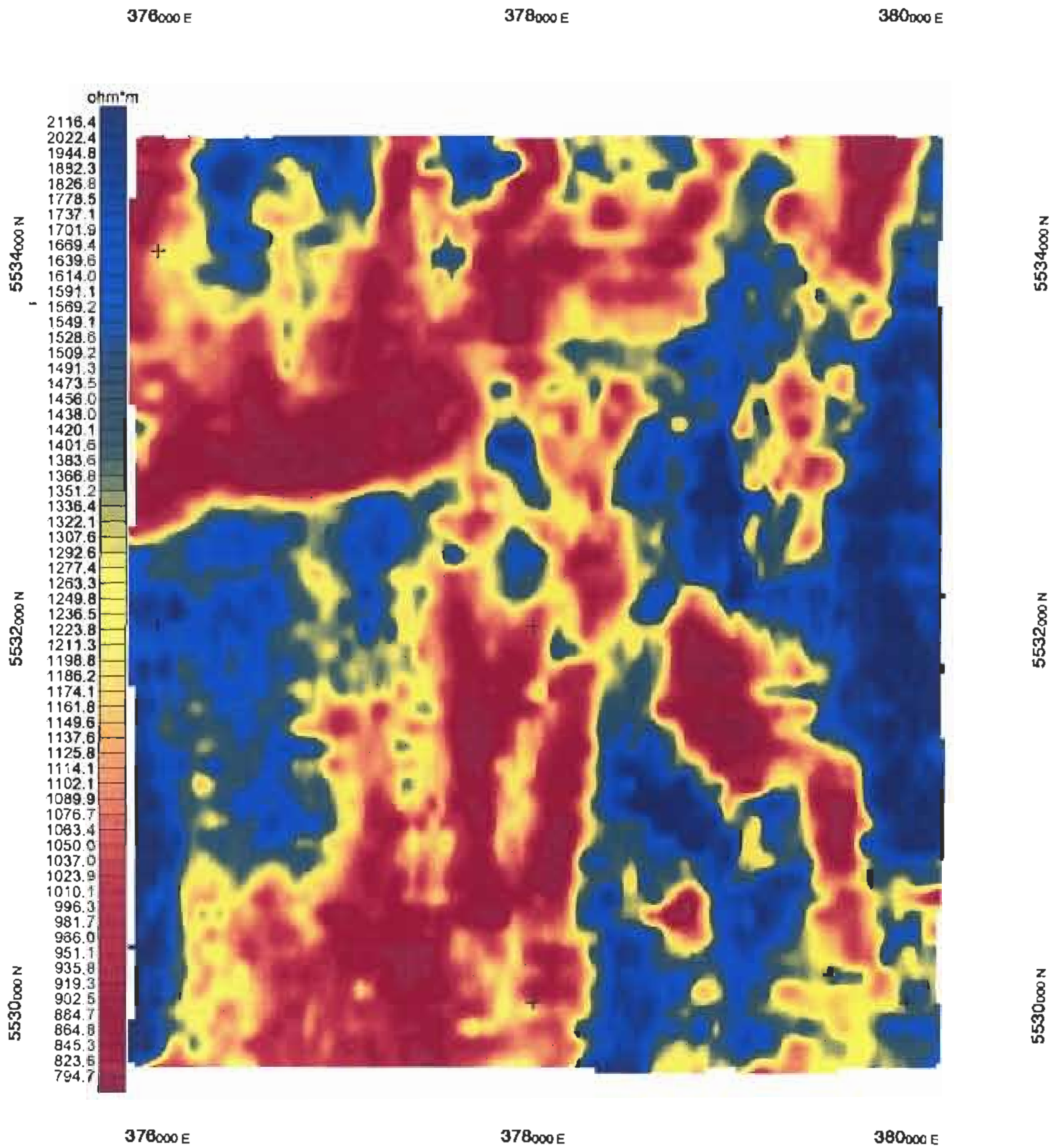
LEROY VENTURES INC.

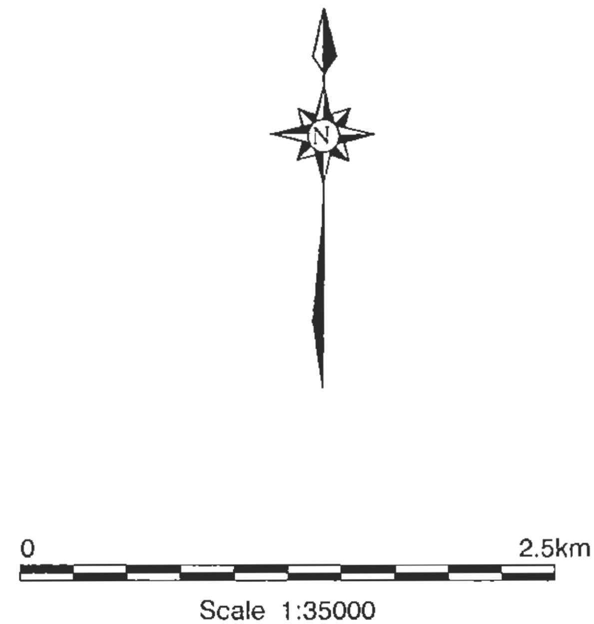
KETTLE PROPERTY, B.C.

APPARENT RESISTIVITY
7200 Hz

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS



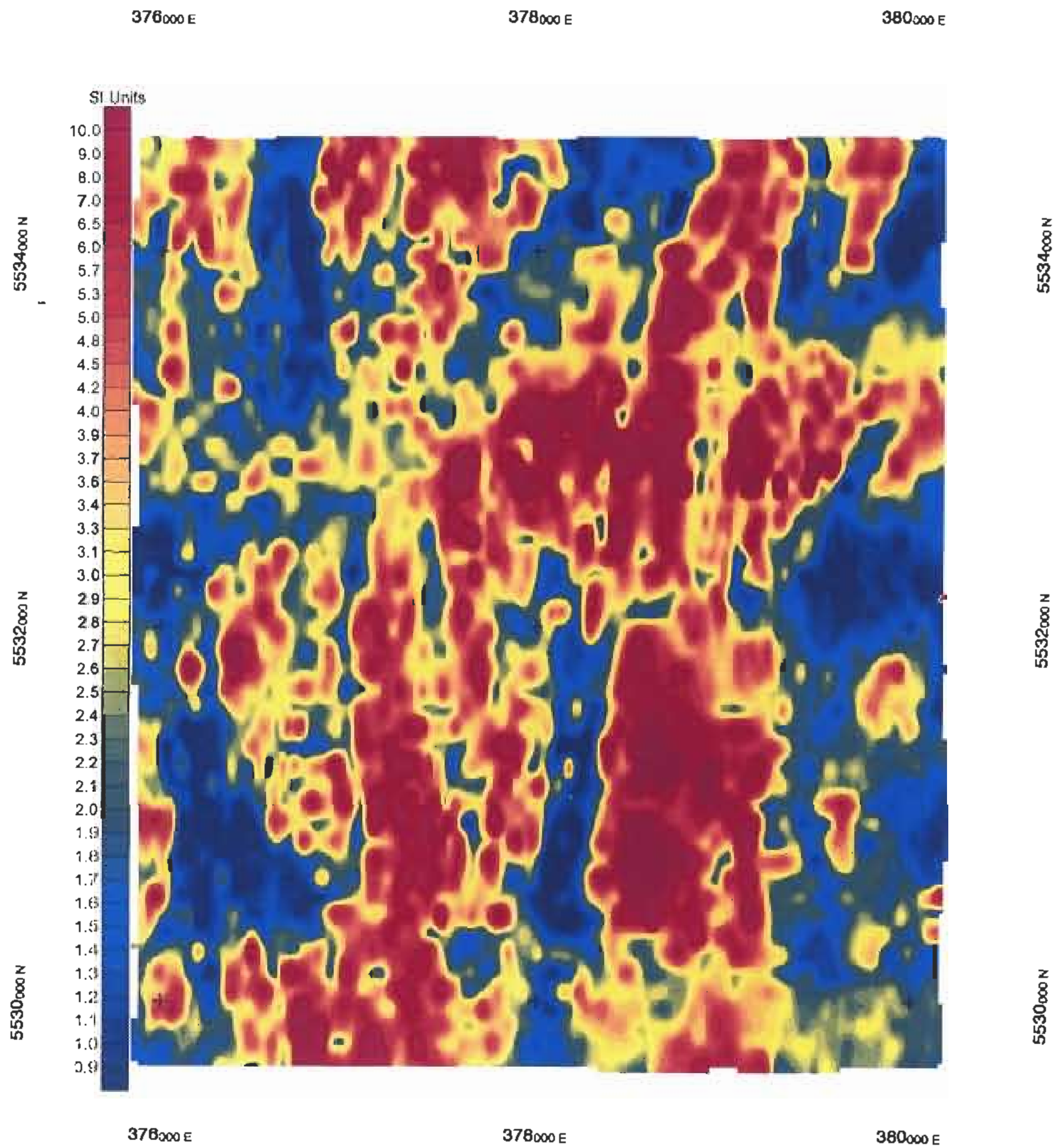


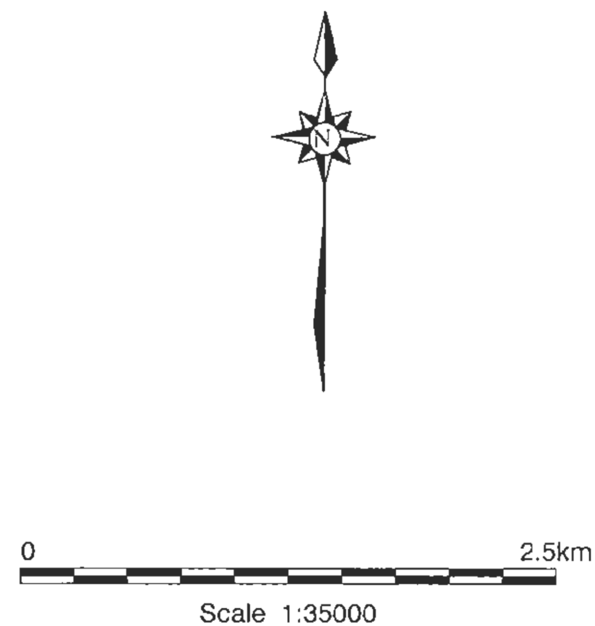
LEROY VENTURES INC.
KETTLE PROPERTY, B.C.

APPARENT RESISTIVITY 900 Hz

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





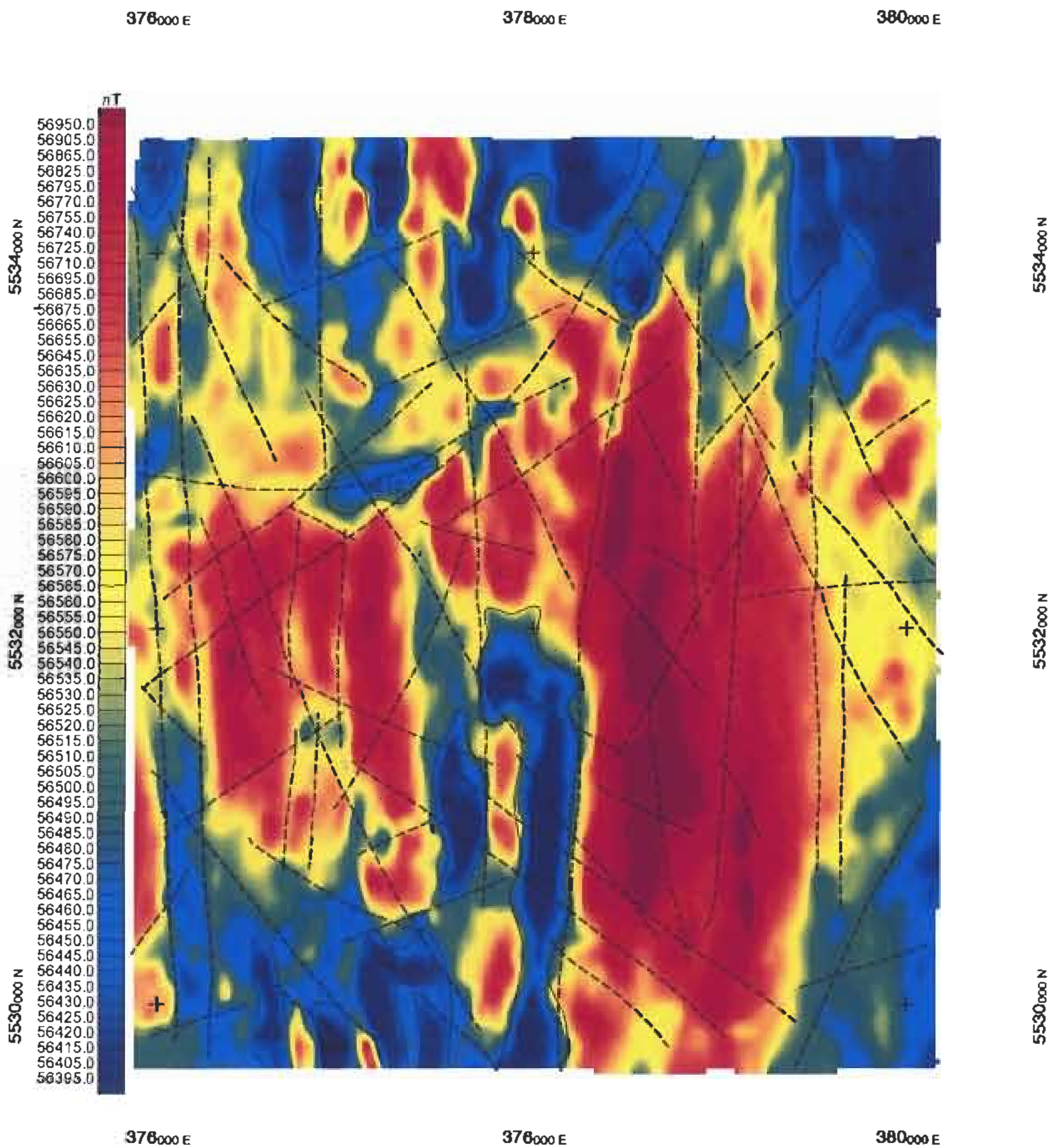
LEROY VENTURES INC.

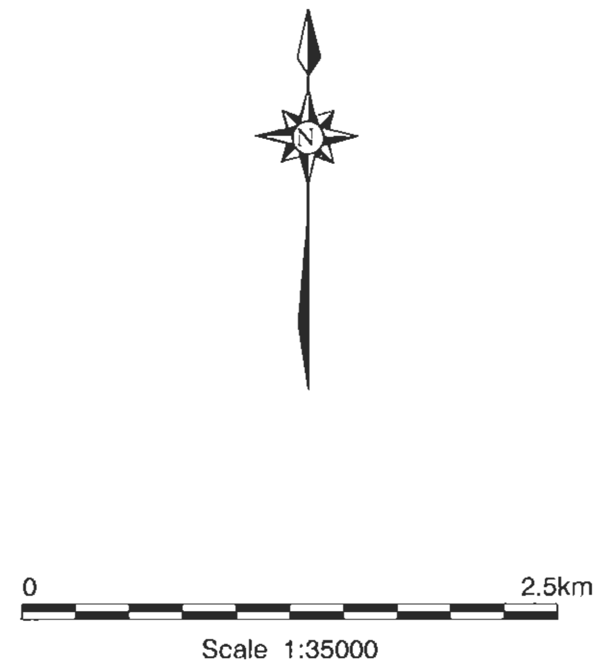
KETTLE PROPERTY, B.C.

APPARENT MAGNETIC SUSCEPTIBILITY

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





LEROY VENTURES INC.

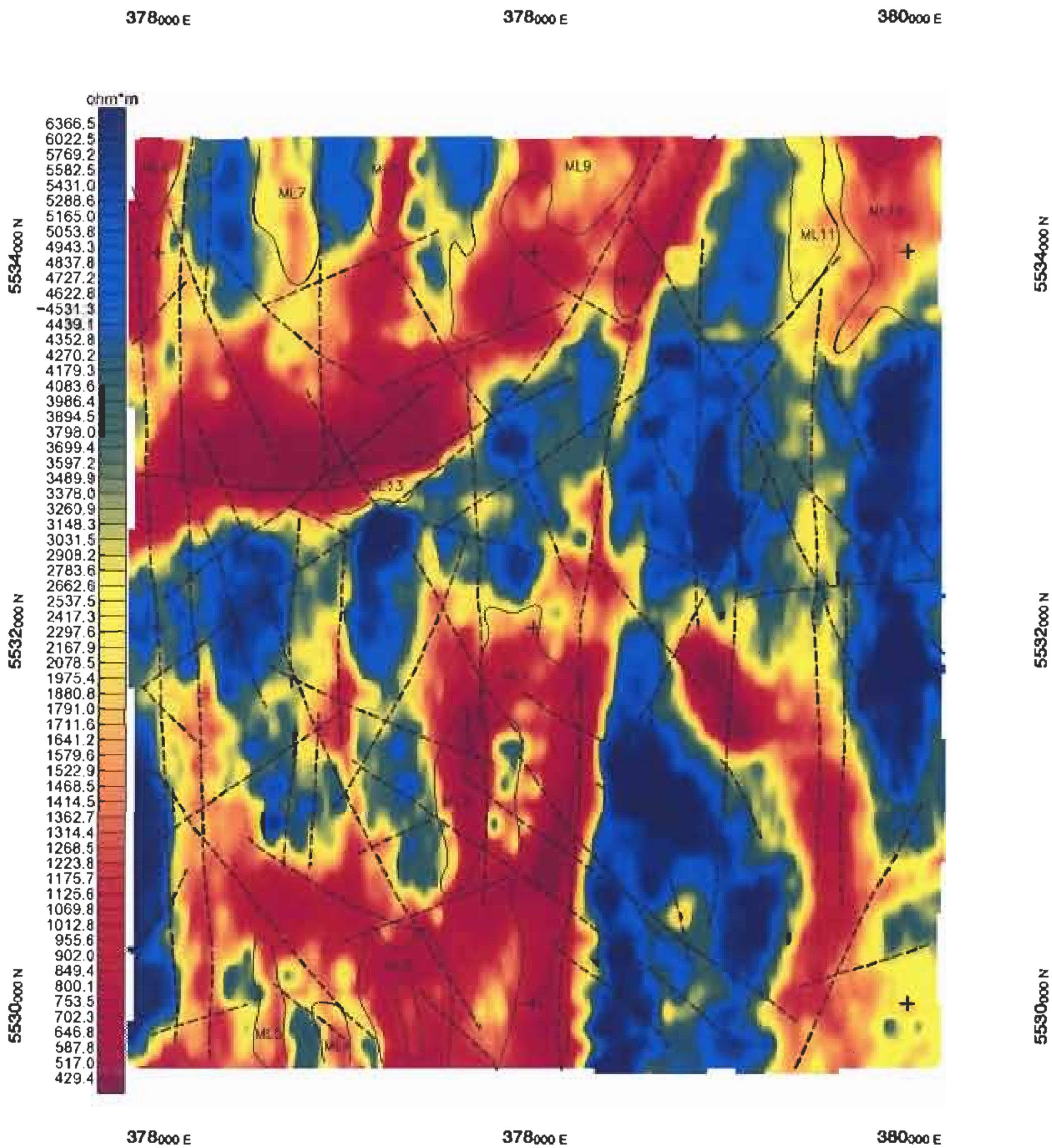
KETTLE PROPERTY, B.C.

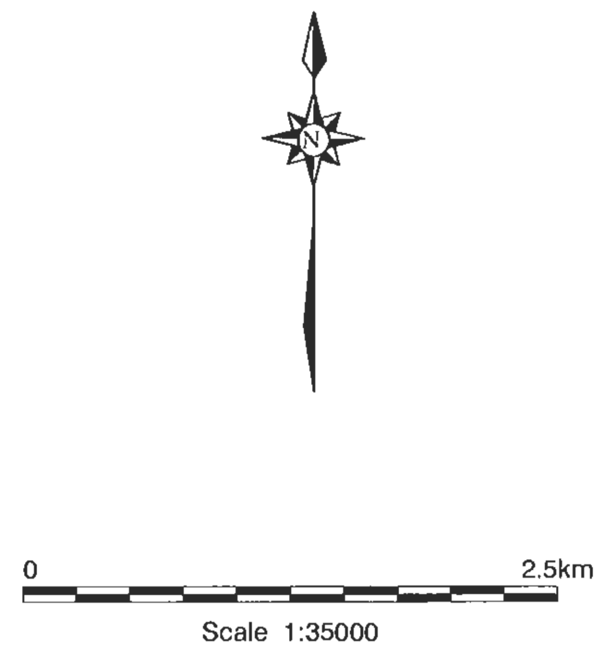
INTERPRETATION

TOTAL MAGNETIC FIELD

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL, 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS





LEROY VENTURES INC.

KETTLE PROPERTY, B.C.

INTERPRETATION

APPARENT RESISTIVITY 7200 Hz

FUGRO AIRBORNE SURVEYS	UTM Zone 11N
DATE: APRIL, 2004	JOB: 03096

FUGRO AIRBORNE SURVEYS

8. CONCLUSIONS AND RECOMMENDATIONS

This report provides a very brief description of the survey results and describes the equipment, data processing procedures and logistics of the survey.

The survey was also successful in locating a few moderately weak or broad conductors that may warrant additional work. The various maps included with this report display the magnetic and conductive properties of the survey area. It is recommended that a complete assessment and detailed evaluation of the survey results be carried out, in conjunction with all available geophysical, geological and geochemical information. Particular reference should be made to the multi-parameter data profiles that clearly define the characteristics of the individual anomalies.

As economic mineralization within the area may be associated with resistive quartz veins with sulphide mineralization, all weakly conductive trends may be of importance. All of the four known mineralized zones within the area occur within magnetic lows or very close to their margins. Any magnetic low may therefore be of interest.

Most of the discrete EM anomalies in the area are moderately weak and poorly-defined, and evident primarily on the quadrature components. These types of anomalies yield EM responses that are below the stated noise specifications of the system and as a result should be viewed with caution and confirmed as bedrock prior to drilling. Some have been attributed to conductive overburden or deep weathering, although a few appear to be associated with magnetite-rich rock units. Others coincide with magnetic gradients that may reflect contacts, faults or shears. Such structural breaks are considered to be of particular interest as they may have influenced mineral deposition within the survey area.

Further work should be done to provide a better understanding of the known mineralized zones. This includes obtaining more detailed geological information, identification of structural breaks and contacts, and more ground geophysical work. As more information is obtained, anomalies that are currently considered to be of moderately low priority may require upgrading if follow-up results are favourable.

It is also recommended that image processing of existing geophysical data be considered, in order to extract the maximum amount of information from the survey results. Current software and imaging techniques often provide valuable information on structure and lithology, which may not be clearly evident on the contour and colour maps. These techniques can yield images that define subtle, but significant, structural details.

Respectfully submitted,

FUGRO AIRBORNE SURVEYS CORP.

Douglas G. Garrie
Geophysicist

DGG/sdp

R03096MAR.04

APPENDICES

APPENDIX A

LIST OF PERSONNEL

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a DIGHEM^V airborne geophysical survey carried out for Max Investments Inc. on behalf of Leroy Ventures Inc., near Kelowna, British Columbia.

David Miles	Manager, Helicopter Operations
Emily Farquhar	Manager, Data Processing and Interpretation
Jazz Bola	Senior Geophysical Operator
Chris Sawyer	Field Geophysicist
Mark LaPointe	Pilot (Northern Air Support)
Gordon Smith	Data Processing Supervisor
Elizabeth Bowslaugh	Geophysical Data Processor
Douglas G. Garrie	Interpretation Geophysicist
Lyn Vanderstarren	Drafting Supervisor
Susan Pothiah	Word Processing Operator
Albina Tonello	Secretary/Expeditor

The survey consisted of 235 km of coverage, flown from January 5 to January 29, 2004, and from February 21 to February 22, 2004. Due to poor weather conditions, the survey crew demobilized between January and February.

All personnel are employees of Fugro Airborne Surveys, except for the pilot who is an employee of Northern Air Support.

BACKGROUND INFORMATION

Electromagnetics

Fugro electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulphide lenses and steeply dipping sheets of graphite and sulphides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulphide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, kimberlite pipes and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the geophysical maps are analyzed according to this model. The following section entitled **Discrete Conductor Analysis** describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

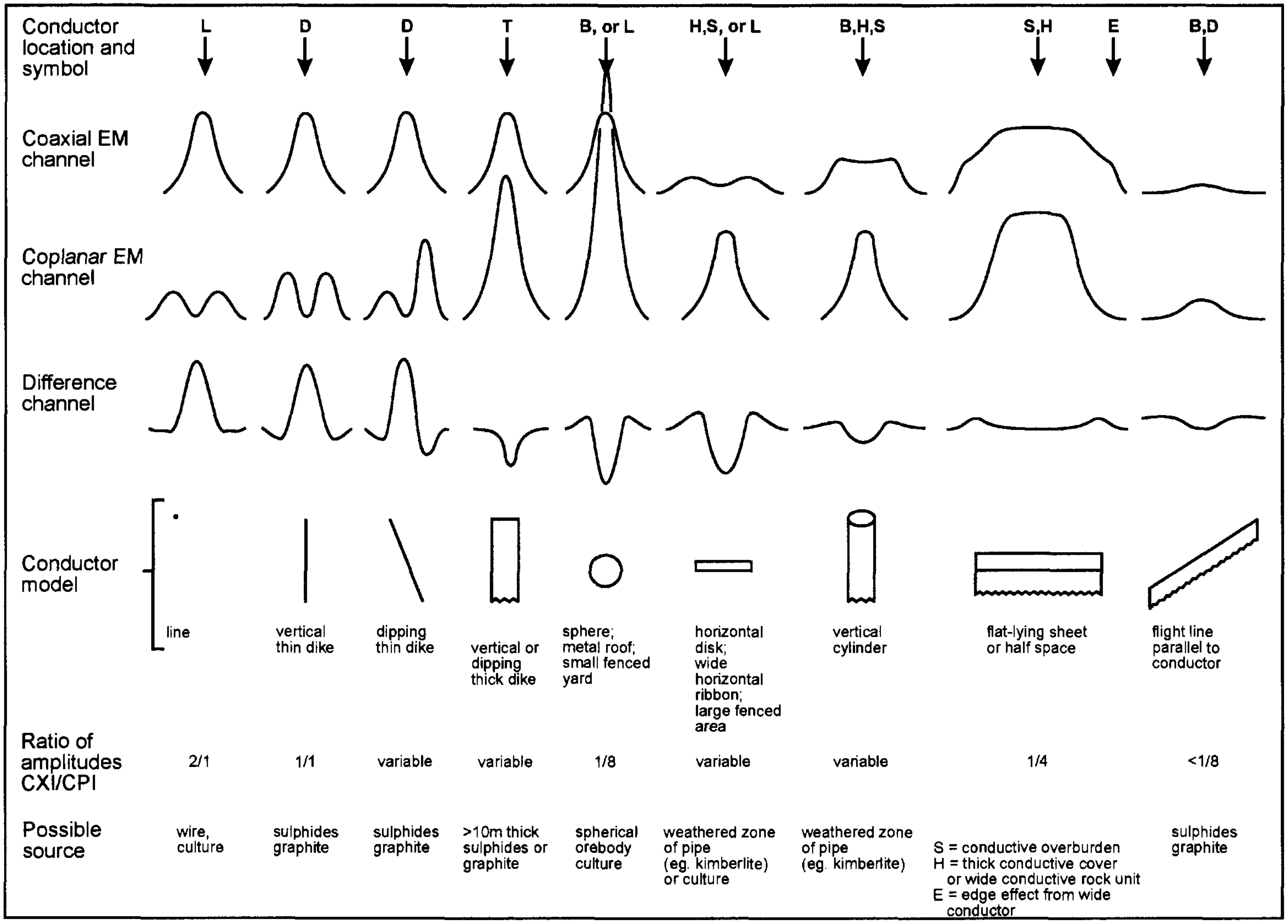
The conductive earth (half-space) model is suitable for broad conductors. Resistivity contour maps result from the use of this model. A later section entitled **Resistivity Mapping** describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulphide bodies.

Geometric Interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. Figure B-1 shows typical HEM anomaly shapes which are used to guide the geometric interpretation.

Discrete Conductor Analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in siemens (mhos) of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into seven grades of conductance, as shown in Table B-1. The conductance in siemens (mhos) is the reciprocal of resistance in ohms.



Typical HEM anomaly shapes

Figure B-1

The conductance value is a geological parameter because it is a characteristic of the conductor alone. It generally is independent of frequency, flying height or depth of burial, apart from the averaging over a greater portion of the conductor as height increases. Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Table B-1. EM Anomaly Grades

Anomaly Grade	Siemens
7	> 100
6	50 - 100
5	20 - 50
4	10 - 20
3	5 - 10
2	1 - 5
1	< 1

Conductive overburden generally produces broad EM responses which may not be shown as anomalies on the geophysical maps. However, patchy conductive overburden in otherwise resistive areas can yield discrete anomalies with a conductance grade (cf. Table B-1) of 1, 2 or even 3 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities are below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, and sometimes E on the geophysical maps (see EM legend on maps).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: the New Insco copper discovery (Noranda, Canada) yielded a grade 5 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 6; and the Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 7 anomaly. Graphite and sulphides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 6 and 7) are characteristic of massive sulphides or graphite. Moderate conductors (grades 4 and 5) typically reflect graphite or sulphides of a less massive character, while weak bedrock conductors (grades 1 to 3) can signify poorly connected graphite or heavily disseminated sulphides. Grades 1 and 2 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well-defined grade 2 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction. Faults, fractures and shear zones may produce anomalies that typically have low conductances (e.g., grades 1 to 3). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

For each interpreted electromagnetic anomaly on the geophysical maps, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The horizontal rows of dots, under the interpretive symbol, indicate the anomaly amplitude on the flight record. The vertical column of dots, under the anomaly letter, gives the estimated depth. In areas where anomalies are crowded, the letter identifiers, interpretive symbols and dots may be obliterated. The EM grade symbols, however, will always be discernible, and the obliterated information can be obtained from the anomaly listing appended to this report.

The purpose of indicating the anomaly amplitude by dots is to provide an estimate of the reliability of the conductance calculation. Thus, a conductance value obtained from a large ppm anomaly (3 or 4 dots) will tend to be accurate whereas one obtained from a small ppm anomaly (no dots) could be quite inaccurate. The absence of amplitude dots indicates that the anomaly from the coaxial coil-pair is 5 ppm or less on both the in-phase and quadrature channels. Such small anomalies could reflect a weak conductor at the surface or a stronger conductor at depth. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

The conductance measurement is considered more reliable than the depth estimate. There are a number of factors that can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of bedrock anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes that may define the geological structure over portions of the survey area. The absence of conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

The electromagnetic anomalies are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The anomaly ppm and depth are indicated by inconspicuous dots which should not distract from the conductor patterns, while being helpful to those who wish this information. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness. The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The appended EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet model. No conductance or depth estimates are shown for weak anomalous responses that are not of sufficient amplitude to yield reliable calculations.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the vertical sheet parameters of conductance and depth.

Questionable Anomalies

The EM maps may contain anomalous responses that are displayed as asterisks (*). These responses denote weak anomalies of indeterminate conductance, which may reflect one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM legend on maps). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The Thickness Parameter

A comparison of coaxial and coplanar shapes can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI channel) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as <u>thin</u> when the thickness is likely to be less than 3 m, and <u>thick</u> when in excess of 10 m. Thick conductors are indicated on the EM map by parentheses "( )". For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulphide ore bodies are thick. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

Resistivity Mapping

Resistivity mapping is useful in areas where broad or flat lying conductive units are of interest. One example of this is the clay alteration which is associated with Carlin-type deposits in the south west United States. The resistivity parameter was able to identify the clay alteration zone over the Cove deposit. The alteration zone appeared as a strong resistivity low on the 900 Hz resistivity parameter. The 7,200 Hz and 56,000 Hz resistivities showed more detail in the covering sediments, and delineated a range front fault. This is typical in many areas of the south west United States, where conductive near surface sediments, which may sometimes be alkalic, attenuate the higher frequencies.

Resistivity mapping has proven successful for locating diatremes in diamond exploration. Weathering products from relatively soft kimberlite pipes produce a resistivity contrast with the unaltered host rock. In many cases weathered kimberlite pipes were associated with thick conductive layers that contrasted with overlying or adjacent relatively thin layers of lake bottom sediments or overburden.

Areas of widespread conductivity are commonly encountered during surveys. These conductive zones may reflect alteration zones, shallow-dipping sulphide or graphite-rich units, saline ground water, or conductive overburden. In such areas, EM amplitude changes can be generated by decreases of only 5 m in survey altitude, as well as by increases in conductivity. The typical flight record in conductive areas is characterized by in-phase and quadrature channels that are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive bedrock and conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The apparent resistivity is calculated using the pseudo-layer (or buried) half-space model defined by Fraser (1978)[1]. This model consists of a resistive layer overlying a conductive half-space. The depth channels give the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half-space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors that might exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the in-phase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the conductive half-space (the

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[1] Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p.144-172

source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height when the conductivity of the measured material is sufficient to yield significant in-phase as well as quadrature responses. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. Depth information has been used for permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

Interpretation in Conductive Environments

Environments having low background resistivities (e.g., below 30 ohm-m for a 900 Hz system) yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. However, Fugro data processing techniques produce three parameters that contribute significantly to the recognition of bedrock conductors in conductive environments. These are the in-phase and quadrature difference channels (DIFI and DIFQ, which are available only on systems with "common" frequencies on orthogonal coil pairs), and the resistivity and depth channels (RES and DEP) for each coplanar frequency.

The EM difference channels (DIFI and DIFQ) eliminate most of the responses from conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. Edge effects often occur near the perimeter of broad conductive zones. This can be a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the resistivity channels (RES). The most favourable situation is where anomalies coincide on all channels.

The DEP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the depth profiles (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If the DEP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DEP channel is below the zero level and the high frequency DEP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

Reduction of Geologic Noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned previously that the EM difference channels (i.e., channel DIFI for in-phase and DIFQ for quadrature) tend to eliminate the response of conductive overburden.

Magnetite produces a form of geological noise on the in-phase channels. Rocks containing less than 1% magnetite can yield negative in-phase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the in-phase EM channels may continuously rise and fall, reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the in-phase difference channel DIFI. This feature can be a significant aid in the recognition of conductors that occur in rocks containing accessory magnetite.

EM Magnetite Mapping

The information content of HEM data consists of a combination of conductive eddy current responses and magnetic permeability responses. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both in-phase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an in-phase component which is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive in-phase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative in-phase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique, based on the low frequency coplanar data, can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it *is far less sensitive but is more able to resolve closely spaced magnetite zones*, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half-space. It can individually resolve steep dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as negative in-phase responses on the data profiles.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

The Susceptibility Effect

When the host rock is conductive, the positive conductivity response will usually dominate the secondary field, and the susceptibility effect[2] will appear as a reduction in the in-phase, rather than as a negative value. The in-phase response will be lower than would be predicted by a model using zero susceptibility. At higher frequencies the in-phase conductivity response also gets larger, so a negative magnetite effect observed on the low frequency might not be observable on the higher frequencies, over the same body. The susceptibility effect is most obvious over discrete magnetite-rich zones, but also occurs over uniform geology such as a homogeneous half-space.

High magnetic susceptibility will affect the calculated apparent resistivity, if only conductivity is considered. Standard apparent resistivity algorithms use a homogeneous half-space model, with zero susceptibility. For these algorithms, the reduced in-phase response will, in most cases, make the apparent resistivity higher than it should be. It is important to note that there is nothing wrong with the data, nor is there anything wrong with the processing algorithms. The apparent difference results from the fact that the simple geological model used in processing does not match the complex geology.

Measuring and Correcting the Magnetite Effect

Theoretically, it is possible to calculate (forward model) the combined effect of electrical conductivity and magnetic susceptibility on an EM response in all environments. The difficulty lies, however, in separating out the susceptibility effect from other geological effects when deriving resistivity and susceptibility from EM data.

Over a homogeneous half-space, there is a precise relationship between in-phase, quadrature, and altitude. These are often resolved as phase angle, amplitude, and altitude. Within a reasonable range, any two of these three parameters can be used to calculate the half space resistivity. If the rock has a positive magnetic susceptibility, the in-phase component will be reduced and this departure can be recognized by comparison to the other parameters.

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2 Magnetic susceptibility and permeability are two measures of the same physical property. Permeability is generally given as relative permeability, μ_r, which is the permeability of the substance divided by the permeability of free space ($4 \pi \times 10^{-7}$). *Magnetic susceptibility k* is related to permeability by $k=\mu^r-1$. Susceptibility is a unitless measurement, and is usually reported in units of 10^{-6}. The typical range of susceptibilities is –1 for quartz, 130 for pyrite, and up to 5×10^5 for magnetite, in 10^{-6} units (Telford et al, 1986).

The algorithm used to calculate apparent susceptibility and apparent resistivity from HEM data, uses a homogeneous half-space geological model. Non half-space geology, such as horizontal layers or dipping sources, can also distort the perfect half-space relationship of the three data parameters. While it may be possible to use more complex models to calculate both rock parameters, this procedure becomes very complex and time-consuming. For basic HEM data processing, it is most practical to stick to the simplest geological model.

Magnetite reversals (reversed in-phase anomalies) have been used for many years to calculate an "FeO" or magnetite response from HEM data (Fraser, 1981). However, this technique could only be applied to data where the in-phase was observed to be negative, which happens when susceptibility is high and conductivity is low.

Applying Susceptibility Corrections

Resistivity calculations done with susceptibility correction may change the apparent resistivity. High-susceptibility conductors, that were previously masked by the susceptibility effect in standard resistivity algorithms, may become evident. In this case the susceptibility corrected apparent resistivity is a better measure of the actual resistivity of the earth. However, other geological variations, such as a deep resistive layer, can also reduce the in-phase by the same amount. In this case, susceptibility correction would not be the best method. Different geological models can apply in different areas of the same data set. The effects of susceptibility, and other effects that can create a similar response, must be considered when selecting the resistivity algorithm.

Susceptibility from EM vs Magnetic Field Data

The response of the EM system to magnetite may not match that from a magnetometer survey. First, HEM-derived susceptibility is a rock property measurement, like resistivity. Magnetic data show the total magnetic field, a measure of the potential field, not the rock property. Secondly, the shape of an anomaly depends on the shape and direction of the source magnetic field. The electromagnetic field of HEM is much different in shape from the earth's magnetic field. Total field magnetic anomalies are different at different magnetic latitudes; HEM susceptibility anomalies have the same shape regardless of their location on the earth.

In far northern latitudes, where the magnetic field is nearly vertical, the total magnetic field measurement over a thin vertical dike is very similar in shape to the anomaly from the HEM-derived susceptibility (a sharp peak over the body). The same vertical dike at the magnetic equator would yield a negative magnetic anomaly, but the HEM susceptibility anomaly would show a positive susceptibility peak.

Effects of Permeability and Dielectric Permittivity

Resistivity algorithms that assume free-space magnetic permeability and dielectric permittivity, do not yield reliable values in highly magnetic or highly resistive areas. Both magnetic polarization and displacement currents cause a decrease in the in-phase component, often resulting in negative values that yield erroneously high apparent resistivities. *The effects of magnetite occur at all frequencies, but are most evident at* the lowest frequency. Conversely, the negative effects of dielectric permittivity are most evident at the higher frequencies, in resistive areas.

The table below shows the effects of varying permittivity over a resistive (10,000 ohm-m) half space, at frequencies of 56,000 Hz (DIGHEM^V) and 102,000 Hz (RESOLVE).

Apparent Resistivity Calculations
Effects of Permittivity on In-phase/Quadrature/Resistivity

Freq (Hz)	Coil	Sep (m)	Thres (ppm)	Alt (m)	In Phase	Quad Phase	App Res	App Depth (m)	Permittivity
56,000	CP	6.3	0.1	30	7.3	35.3	10118	-1.0	1 Air
56,000	CP	6.3	0.1	30	3.6	36.6	19838	-13.2	5 Quartz
56,000	CP	6.3	0.1	30	-1.1	38.3	81832	-25.7	10 Epidote
56,000	CP	6.3	0.1	30	-10.4	42.3	76620	-25.8	20 Granite
56,000	CP	6.3	0.1	30	-19.7	46.9	71550	-26.0	30 Diabase
56,000	CP	6.3	0.1	30	-28.7	52.0	66787	-26.1	40 Gabbro
102,000	CP	7.86	0.1	30	32.5	117.2	9409	-0.3	1 Air
102,000	CP	7.86	0.1	30	11.7	127.2	25956	-16.8	5 Quartz
102,000	CP	7.86	0.1	30	-14.0	141.6	97064	-26.5	10 Epidote
102,000	CP	7.86	0.1	30	-62.9	176.0	83995	-26.8	20 Granite
102,000	CP	7.86	0.1	30	-107.5	215.8	73320	-27.0	30 Diabase
102,000	CP	7.86	0.1	30	-147.1	259.2	64875	-27.2	40 Gabbro

Methods have been developed (Huang and Fraser, 2000, 2001) to correct apparent resistivities for the effects of permittivity and permeability. The corrected resistivities yield more credible values than if the effects of permittivity and permeability are disregarded.

Recognition of Culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXPL and CPPL monitor 60 Hz radiation. An anomaly on these channels shows that the conductor is radiating power. Such an indication is normally a guarantee that the conductor is cultural. However, care must be taken to ensure that the conductor is not a geologic body that strikes across a power line, carrying leakage currents.

2. A flight that crosses a "line" (e.g., fence, telephone line, etc.) yields a centre-peaked coaxial anomaly and an m-shaped coplanar anomaly.[3] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar response is 2. Such an EM anomaly can only be caused by a line. The geologic body that yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 1 rather than 2. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 2 is virtually a guarantee that the source is a cultural line.

3. A flight that crosses a sphere or horizontal disk yields centre-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/8. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or small fenced yard.[4] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight that crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a centre-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[5] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies that coincide with culture, as seen on the camera film or video display, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a centre-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort

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[3] See Figure B-1 presented earlier.

[4] It is a characteristic of EM that geometrically similar anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels and on the camera film or video records.

Magnetic Responses

The measured total magnetic field provides information on the magnetic properties of the earth materials in the survey area. The information can be used to locate magnetic bodies of direct interest for exploration, and for structural and lithological mapping.

The total magnetic field response reflects the abundance of magnetic material in the source. Magnetite is the most common magnetic mineral. Other minerals such as ilmenite, pyrrhotite, franklinite, chromite, hematite, arsenopyrite, limonite and pyrite are also magnetic, but to a lesser extent than magnetite on average.

In some geological environments, an EM anomaly with magnetic correlation has a greater likelihood of being produced by sulphides than one which is non-magnetic. However, sulphide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

Iron ore deposits will be anomalously magnetic in comparison to surrounding rock due to the concentration of iron minerals such as magnetite, ilmenite and hematite.

Changes in magnetic susceptibility often allow rock units to be differentiated based on the total field magnetic response. Geophysical classifications may differ from geological classifications if various magnetite levels exist within one general geological classification. Geometric considerations of the source such as shape, dip and depth, inclination of the earth's field and remanent magnetization will complicate such an analysis.

In general, mafic lithologies contain more magnetite and are therefore more magnetic than many sediments which tend to be weakly magnetic. Metamorphism and alteration can also increase or decrease the magnetization of a rock unit.

Textural differences on a total field magnetic contour, colour or shadow map due to the frequency of activity of the magnetic parameter resulting from inhomogeneities in the distribution of magnetite within the rock, may define certain lithologies. For example, near surface volcanics may display highly complex contour patterns with little line-to-line correlation.

Rock units may be differentiated based on the plan shapes of their total field magnetic responses. Mafic intrusive plugs can appear as isolated "bulls-eye" anomalies. Granitic intrusives appear as sub-circular zones, and may have contrasting rings due to contact metamorphism. Generally, granitic terrain will lack a pronounced strike direction, although granite gneiss may display strike.

Linear north-south units are theoretically not well-defined on total field magnetic maps in equatorial regions due to the low inclination of the earth's magnetic field. However, most stratigraphic units will have variations in composition along strike that will cause the units to appear as a series of alternating magnetic highs and lows.

Faults and shear zones may be characterized by alteration that causes destruction of magnetite (e.g., weathering) that produces a contrast with surrounding rock. Structural breaks may be filled by magnetite-rich, fracture filling material as is the case with diabase dikes, or by non-magnetic felsic material.

Faulting can also be identified by patterns in the magnetic total field contours or colours. Faults and dikes tend to appear as lineaments and often have strike lengths of several kilometres. Offsets in narrow, magnetic, stratigraphic trends also delineate structure. Sharp contrasts in magnetic lithologies may arise due to large displacements along strike-slip or dip-slip faults.

Gamma Ray Spectrometry

Radioelement concentrations are measures of the abundance of radioactive elements in the rock. The original abundance of the radioelements in any rock can be altered by the subsequent processes of metamorphism and weathering.

Gamma radiation in the range that is measured in the thorium, potassium, uranium and total count windows is strongly attenuated by rock, overburden and water. Almost all of the total radiation measured from rock and overburden originates in the upper .5 metres. Moisture in soil and bodies of water will mask the radioactivity from underlying rock. Weathered rock materials that have been displaced by glacial, water or wind action will not reflect the general composition of the underlying bedrock. Where residual soils exist, they may reflect the composition of underlying rock except where equilibrium does not exist between the original radioelement and the products in its decay series.

Radioelement counts (expressed as counts per second) are the rates of detection of the gamma radiation from specific decaying particles corresponding to products in each radioelements decay series. The radiation source for uranium is bismuth (Bi-214), for thorium it is thallium (Tl-208) and for potassium it is potassium (K-40).

The uranium and thorium radioelement concentrations are dependent on a state of equilibrium between the parent and daughter products in the decay series. Some daughter products in the uranium decay are long lived and could be removed by processes such as leaching. One product in the series, radon (Rn-222), is a gas which can easily escape. Both of these factors can affect the degree to which the calculated uranium concentrations reflect the actual composition of the source rock. Because the daughter products of thorium are relatively short lived, there is more likelihood that the thorium decay series is in equilibrium.

Lithological discrimination can be based on the measured relative concentrations and total, combined, radioactivity of the radioelements. Feldspar and mica contain potassium.

Zircon, sphene and apatite are accessory minerals in igneous rocks that are sources of uranium and thorium. Monazite, thorianite, thorite, uraninite and uranothorite are also sources of uranium and thorium which are found in granites and pegmatites.

In general, the abundance of uranium, thorium and potassium in igneous rock increases with acidity. Pegmatites commonly have elevated concentrations of uranium relative to thorium. Sedimentary rocks derived from igneous rocks may have characteristic signatures that are influenced by their parent rocks, but these will have been altered by subsequent weathering and alteration.

Metamorphism and alteration will cause variations in the abundance of certain radioelements relative to each other. For example, alterative processes may cause uranium enrichment to the extent that a rock will be of economic interest. Uranium anomalies are more likely to be economically significant if they consist of an increase in the uranium relative to thorium and potassium, rather than a sympathetic increase in all three radioelements.

Faults can exhibit radioactive highs due to increased permeability which allows radon migration, or as lows due to structural control of drainage and fluvial sediments which attenuate gamma radiation from the underlying rocks. Faults can also be recognized by sharp contrasts in radiometric lithologies due to large strike-slip or dip-slip displacements. Changes in relative radioelement concentrations due to alteration will also define faults.

Similar to magnetics, certain rock types can be identified by their plan shapes if they also produce a radiometric contrast with surrounding rock. For example, granite intrusions will appear as sub-circular bodies, and may display concentric zonations. They will tend to lack a prominent strike direction. Offsets of narrow, continuous, stratigraphic units with contrasting radiometric signatures can identify faulting, and folding of stratigraphic trends will also be apparent.

APPENDIX C

OPTIONAL PRODUCTS

APPENDIX C

OPTIONAL PRODUCTS

Resistivity-depth Sections (optional)

The apparent resistivities for all frequencies can be displayed simultaneously as coloured resistivity-depth sections. Usually, only the coplanar data are displayed as the close frequency separation between the coplanar and adjacent coaxial data tends to distort the section. The sections can be plotted using the topographic elevation profile as the surface. The digital terrain values, in metres a.m.s.l., can be calculated from the GPS Z-value or barometric altimeter, minus the aircraft radar altimeter.

Resistivity-depth sections can be generated in three formats:

(1) Sengpiel resistivity sections, where the apparent resistivity for each frequency is plotted at the depth of the centroid of the in-phase current flow[5]; and,

(2) Differential resistivity sections, where the differential resistivity is plotted at the differential depth[6].

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5 Sengpiel, K.P., 1988, Approximate Inversion of Airborne EM Data from Multilayered Ground: Geophysical Prospecting 36, 446-459.

6 Huang, H. and Fraser, D.C., 1993, Differential Resistivity Method for Multi-frequency Airborne EM Sounding: presented at Intern. Airb. EM Workshop, Tucson, Ariz.

(3) Occam[7] or Multi-layer[8] inversion.

Both the Sengpiel and differential methods are derived from the pseudo-layer half-space model. Both yield a coloured resistivity-depth section that attempts to portray a smoothed approximation of the true resistivity distribution with depth. Resistivity-depth sections are most useful in conductive layered situations, but may be unreliable in areas of moderate to high resistivity where signal amplitudes are weak. In areas where in-phase responses have been suppressed by the effects of magnetite, or adversely affected by cultural features, the computed resistivities shown on the sections may be unreliable.

Both the Occam and multi-layer inversions compute the layered earth resistivity model that would best match the measured EM data. The Occam inversion uses a series of thin, fixed layers (usually 20 x 5m and 10 x 10m layers) and computes resistivities to fit the EM data. The multi-layer inversion computes the resistivity and thickness for each of a defined number of layers (typically 3-5 layers) to best fit the data.

EM Magnetite (optional)

The apparent percent magnetite by weight is computed wherever magnetite produces a negative in-phase EM response. This calculation is more meaningful in resistive areas.

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7 Constable et al, 1987, Occam's inversion: a practical algorithm for generating smooth models from electromagnetic sounding data: Geophysics, 52, 289-300.

8 Huang H., and Palacky, G.J., 1991, Damped least-squares inversion of time domain airborne EM data based on singular value decomposition: Geophysical Prospecting, 39, 827-844.

Residual Magnetic Intensity (optional)

The residual magnetic intensity (RMI) is derived from the total magnetic field (TMF), the diurnal, and the regional magnetic field. The total magnetic intensity is measured in the aircraft, the diurnal is measured from the ground station, and the regional magnetic field is calculated from the international geo-referenced magnetic field (IGRF). The low frequency component of the diurnal is extracted from the filtered ground station data and removed from the TMF. The average of the diurnal is then added back in to obtain the resultant total magnetic intensity. The regional magnetic field, calculated for the specific survey location and the time of the survey, is then removed from the resultant total magnetic intensity to yield the residual magnetic intensity.

Magnetic Derivatives (optional)

The total magnetic field data can be subjected to a variety of filtering techniques to yield maps or images of the following:

enhanced magnetics
second vertical derivative
reduction to the pole/equator
magnetic susceptibility with reduction to the pole
upward/downward continuations
analytic signal

All of these filtering techniques improve the recognition of near-surface magnetic bodies, with the exception of upward continuation. Any of these parameters can be produced on request.

APPENDIX D

DATA ARCHIVE DESCRIPTION

APPENDIX D

ARCHIVE DESCRIPTION

Geosoft GDB and XYZ ARCHIVE SUMMARY

JOB TITLE:

JOB #	:03096
TYPE OF SURVEY	:EM, MAGNETICS, RESISTIVITY
AREA	:Kettle Property, British Columbia
CLIENT	:Max Investments Inc. on behalf of Leroy Ventures Inc.

****

SURVEY DATA FORMAT:

NUMBER OF DATA FIELDS : 44

#	CHANNAME(16LONG)	TIME	UNITS	/ DESCRIPTION	# BYTES	decimal
1	X	0.10	m	UTME-NAD83	10	2
2	Y	0.10	m	UTMN-NAD83	11	2
3	FID	1.00	n/a	Synchronization Counter	10	1
4	ALTBIRDM	0.10	m	Em Bird to Earth-Surface	9	2
5	GALT	0.10	m	Height above ellipsoid	9	2
6	BARO	0.10	m	Barometric Altitude	9	2
7	DTM	0.10	m	Digital Terrain Model	9	2
8	LONG	0.10	deg	Longitude-NAD83	13	7
9	LAT	0.10	deg	Latitude-NAD83	13	7
10	MAGR	0.10	nT	Uncorrected Total Magnetic Field	10	3
11	DIURNAL	0.10	nT	Daily Variations of Magnetic Field	10	3
12	MAG	0.10	nT	Total Magnetic Field	10	3
13	CPIR900	0.10	ppm	Raw Inphase-Coplanar 874 Hz	10	2
14	CPQR900	0.10	ppm	Raw Quad-Coplanar 874 Hz	10	2
15	CXIR1000	0.10	ppm	Raw Inphase-Coaxial 1088 Hz	10	2
16	CXQR1000	0.10	ppm	Raw Quad-Coaxial 1088 Hz	10	2
17	CXIR5500	0.10	ppm	Raw Inphase-Coaxial 5177 Hz	10	2
18	CXQR5500	0.10	ppm	Raw Quad-Coaxial 5177 Hz	10	2
19	CPIR7200	0.10	ppm	Raw Inphase-Coplanar 7131 Hz	10	2
20	CPQR7200	0.10	ppm	Raw Quad-Coplanar 7131 Hz	10	2
21	CPIR56K	0.10	ppm	Raw Inphase-Coplanar 55940 Hz	10	2
22	CPQR56K	0.10	ppm	Raw Quad-Coplanar 55940 Hz	10	2
23	CPI900	0.10	ppm	Inphase-Coplanar 874 Hz	10	2
24	CPQ900	0.10	ppm	Quad-Coplanar 874 Hz	10	2
25	CXI1000	0.10	ppm	Inphase-Coaxial 1088 Hz	10	2
26	CXQ1000	0.10	ppm	Quad-Coaxial 1088 Hz	10	2
27	CXI5500	0.10	ppm	Inphase-Coaxial 5177 Hz	10	2
28	CXQ5500	0.10	ppm	Quad-Coaxial 5177 Hz	10	2
29	CPI7200	0.10	ppm	Inphase-Coplanar 7131 Hz	10	2
30	CPQ7200	0.10	ppm	Quad-Coplanar 7131 Hz	10	2
31	CPI56K	0.10	ppm	Inphase-Coplanar 55940 Hz	10	2
32	CPQ56K	0.10	ppm	Quad-Coplanar 55940 Hz	10	2
33	RES900	0.10	ohm·m	Apparent Resistivity 874 Hz	10	2
34	RES7200	0.10	ohm·m	Apparent Resistivity 7131 Hz	10	2

35	RES56K	0.10	ohm·m	Apparent Resistivity 55940 Hz	10	2
36	DEP900	0.10	m	Apparent Depth 874 Hz	10	2
37	DEP7200	0.10	m	Apparent Depth 7131 Hz	10	2
38	DEP56K	0.10	m	Apparent Depth 55940 Hz	10	2
39	SUS900	0.10	n/a	Apparent Magnetic Susceptibility	10	2
40	CDT	0.10	n/a	Conductivity Thickness	10	2
41	DIFI	0.10	ppm	Inphase Difference Channel	10	2
42	DIFQ	0.10	ppm	Quadrature Difference Channel	10	2
43	CXPLR	0.1	n/a	Coaxial Powerline Monitor	10	2
44	CPPLR	0.1	n/a	Coplanar Powerline Monitor	10	2

****

ISSUE DATE :March 22, 2004
FOR WHOM :Max Investments Inc. on behalf of Leroy Ventures Inc.

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Reference:  CCD02113
# of CD's:  1
Archive Date:  2004-Mar-22

------------------------------------------------------------------------------------
This archive contains final data archives and grids of an airborne geophysical
survey conducted by FUGRO AIRBORNE SURVEYS CORP. on behalf of Max Investments Inc.
and Leroy Ventures Inc. during January, 2004 and February, 2004.

Job # 03096

------------------------------------------------------------------------------------

******* Disc 1 of 1 *******

This CD-ROM comprises 20 files contained in 5 directories

\GRIDS
        Grids in Geosoft format.

      CVG.GRD                  - Calculated Vertical Magnetic Gradient
      MAG.GRD                  - Total Magnetic Field
      RES900.GRD               - Apparent Resistivity 900 Hz coplanar
      RES7200.GRD              - Apparent Resistivity 7200 Hz coplanar
      RES56K.GRD               - Apparent Resistivity 56000 Hz coplanar
      SUS900.GRD               - Apparent Magnetic Susceptibility 900 Hz coplanar

\LINEDATA
      KETTLEPROPERTY.TXT       - Documentation for data archive files
      ANOMALY.TXT        - Documentation for anomaly archive files
      KETTLEPROPERTY.XYZ       - Final data archive in Geosoft XYZ format
      KETTLEPROPERTY.GDB       - Final data archive in Geosoft GDB format
        AN03096A.XYZ           - Anomaly archive in Geosoft XYZ format

\HP750
        Plot files in HPGL/2 format, 750 driver ver 4.63
        AEM.PRN                - Electromagnetic Anomalies
        CVG.PRN                - Calculated Vertical Magnetic Gradient
        MAG.PRN                - Total Magnetic Field
        RES900.PRN             - Apparent Resistivity 900 Hz
        RES7200.PRN            - Apparent Resistivity 7200 Hz
        RES56K.PRN             - Apparent Resistivity 56000 Hz
        SUS900.PRN             - Apparent Magnetic Susceptibility 900 Hz

\DXF
        FPATH.DXF        - Flight Path
        ANOM.DXF         - Anomalies

\REPORT
        KETTLEPROPERTY.PDF     - Logistics and Interpretation Report

------------------------------------------------------------------------------------
The coordinate system for all grids and the data archive is projected as follows

Datum                              NAD83
Spheroid                           GRS 1980
Projection                         UTM
Central meridian                   117 West (Z11N)
```

False easting	500000
False northing	0
Scale factor	0.9996
Northern parallel	N/A
Base parallel	N/A
WGS84 to local conversion method	Molodensky
Delta X shift	0
Delta Y shift	0
Delta Z shift	0

If you have any problems with this archive please contact

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APPENDIX E

EM ANOMALY LIST

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10010			FLIGHT 100										
A	1626.3	S?	377210	5534593	0.3	10.2	44.0	36.5	5.6	5.6	---	---	0
B	1622.0	S?	377285	5534589	9.2	5.2	50.5	36.5	42.9	8.1	2.8	31	0
C	1543.1	S	378016	5534564	4.0	14.6	24.5	156.0	8.0	21.0	0.3	9	0
D	1514.4	S?	378459	5534579	3.9	9.8	10.4	34.9	0.1	4.8	0.4	9	0
E	1493.1	S	378949	5534565	5.5	10.8	26.4	53.5	11.9	8.0	0.6	8	0
F	1481.9	S	379330	5534568	3.1	12.2	0.6	43.0	6.6	5.0	---	---	124
G	1466.2	S	379827	5534570	5.2	28.3	49.6	208.9	2.0	29.3	0.3	0	31
LINE 10020			FLIGHT 100										
A	1811.7	S	376669	5534466	1.0	7.8	10.9	40.4	3.4	5.9	---	---	0
B	1849.1	S	377281	5534462	10.8	22.7	42.7	131.5	9.6	19.4	0.7	1	0
C	1892.7	S?	378086	5534476	7.9	61.5	40.6	200.7	3.4	26.9	0.2	0	33
D	1906.7	S	378459	5534467	2.8	8.5	4.8	22.9	1.4	3.2	---	---	0
E	1927.6	S	379052	5534483	0.9	11.5	22.1	66.9	0.0	8.7	---	---	24
F	1960.1	S	379879	5534456	5.2	31.5	28.5	217.3	4.3	28.6	0.2	0	19
LINE 10030			FLIGHT 100										
A	2281.2	S	376691	5534373	1.3	5.7	29.5	29.9	27.2	4.6	---	---	0
B	2246.7	S?	377246	5534377	14.5	24.6	37.3	100.1	22.2	14.7	0.9	2	0
C	2183.8	S	377911	5534369	4.7	11.9	20.7	118.9	1.3	15.7	0.5	20	76
D	2170.0	S	378076	5534390	5.1	21.7	25.6	101.9	1.2	13.9	0.3	2	0
E	2137.2	S	378493	5534378	1.9	7.7	6.2	29.1	1.2	3.1	---	---	0
F	2120.5	S	378884	5534366	4.8	6.6	28.1	46.6	8.6	6.9	0.8	17	60

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10030			FLIGHT 100										
G	2091.3	S	379868	5534376	5.8	32.7	19.9	121.9	1.6	17.0	0.3	0	0
LINE 10040			FLIGHT 100										
A	2425.9	S?	375944	5534271	3.4	25.0	36.3	126.0	1.2	17.2	0.2	0	0
B	2456.1	S	376789	5534273	4.7	8.1	13.6	31.3	10.3	4.6	0.6	34	0
C	2479.7	S?	377275	5534268	13.2	14.8	46.7	119.5	17.4	17.8	1.4	26	0
D	2509.6	S	377914	5534278	3.6	12.5	19.6	94.9	12.5	12.7	0.3	9	238
E	2523.2	S	378357	5534291	2.9	13.2	6.0	43.7	2.5	5.3	---	---	0
F	2538.7	S	378894	5534288	6.6	9.1	31.2	64.2	14.5	10.1	0.9	26	53
G	2554.3	S	379335	5534272	4.1	19.0	19.8	93.9	9.5	11.9	---	---	0
H	2572.2	S	379782	5534264	2.3	11.6	11.3	123.5	4.3	16.3	---	---	0
LINE 10051			FLIGHT 100										
A	3130.1	S	376606	5534166	0.2	4.6	11.0	38.1	7.6	5.3	---	---	0
B	3158.4	S?	377263	5534151	7.8	11.1	29.5	69.8	13.3	11.0	0.9	24	0
C	3189.3	S	377797	5534168	1.2	8.6	13.9	51.7	4.3	6.5	---	---	0
D	3212.6	S	378417	5534171	3.2	23.2	11.5	101.4	0.0	14.0	---	---	32
E	3225.7	S	378827	5534166	7.8	11.5	29.7	66.0	17.1	10.7	0.9	20	0
F	3246.2	S	379329	5534164	4.2	7.7	15.9	70.4	11.5	9.2	0.6	23	0
G	3266.6	S	379763	5534164	5.0	20.8	10.4	165.1	9.7	21.4	0.3	0	0
LINE 10061			FLIGHT 100										
A	4655.7	S	376661	5534075	0.1	7.1	14.3	23.9	10.0	3.9	---	---	0
B	4628.1	S?	377301	5534057	3.0	9.9	17.7	60.1	3.3	9.6	---	---	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10061			FLIGHT 100										
C	4591.0	S	377801	5534072	2.6	6.2	12.7	48.8	2.1	7.0	---	---	0
D	4577.7	S	378106	5534070	3.1	6.9	10.7	44.4	1.2	6.6	0.4	21	48
E	4556.1	S	378744	5534060	4.2	5.1	31.7	48.3	6.2	9.3	0.9	26	37
F	4526.9	S	379785	5534060	6.4	19.1	9.1	90.3	0.7	12.4	0.4	0	0
LINE 10070			FLIGHT 100										
A	4786.0	S	376655	5533975	3.8	10.2	9.6	32.8	4.8	4.5	0.4	15	0
B	4812.4	S	377313	5533964	4.2	7.3	18.6	62.1	13.1	9.8	0.6	34	0
C	4838.1	S	377802	5533961	2.4	8.6	18.2	101.1	11.0	14.5	---	---	0
D	4850.0	S	378172	5533963	6.2	19.5	24.6	86.5	6.3	11.4	0.4	0	20
E	4867.8	S	378754	5533973	2.0	20.0	25.3	126.8	28.7	20.3	---	---	80
F	4918.8	S	379776	5533966	5.6	7.2	6.7	100.0	12.2	13.9	0.9	22	94
LINE 10080			FLIGHT 100										
A	5132.0	S	377150	5533874	3.1	8.0	14.1	65.4	5.5	10.4	0.4	28	0
B	5081.3	S	377922	5533867	3.8	5.9	18.4	45.2	0.3	7.8	0.6	39	0
C	5050.0	S	378638	5533880	5.1	6.6	36.5	30.4	10.5	5.1	0.9	15	0
D	5028.0	S?	379366	5533863	6.9	6.8	6.0	17.7	6.2	1.6	1.3	30	0
E	5010.8	S	379790	5533878	6.1	13.1	12.6	71.3	3.0	9.6	0.6	2	35
LINE 10090			FLIGHT 100										
A	5299.9	S	376699	5533768	3.4	9.7	10.3	26.0	2.8	3.8	0.4	21	0
B	5322.2	S?	377220	5533760	2.0	13.4	20.7	67.5	7.8	10.6	---	---	0
C	5351.8	S	377892	5533778	8.7	20.7	46.7	132.9	4.0	20.1	0.6	3	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10090			FLIGHT 100										
D	5371.1	S	378588	5533771	11.8	8.6	29.0	29.0	17.6	4.2	2.2	21	0
E	5380.4	S	378847	5533770	3.0	11.6	23.4	37.0	29.9	6.3	---	---	0
F	5442.7	S	379832	5533735	1.1	6.2	7.0	34.8	1.2	4.7	---	---	0
LINE 10100			FLIGHT 100										
A	5903.8	S	376508	5533661	3.5	10.1	7.7	32.0	2.2	4.2	0.4	16	0
B	5881.4	S	377086	5533673	3.9	8.4	18.7	49.1	2.4	8.3	0.5	22	0
C	5869.0	S	377378	5533684	2.6	10.5	8.2	30.2	4.9	4.2	---	---	0
D	5836.4	S	377904	5533685	6.5	19.1	42.6	118.7	3.7	18.0	0.4	2	0
E	5809.6	S	378550	5533648	5.9	6.2	42.5	15.7	40.1	0.4	1.1	13	0
F	5799.6	S	378840	5533642	3.7	6.9	10.8	26.7	14.4	5.1	---	---	0
G	5761.7	S	379802	5533664	1.5	6.0	10.3	53.3	2.4	6.6	---	---	0
LINE 10110			FLIGHT 100										
A	6031.7	S	376477	5533588	1.8	9.7	12.0	49.9	5.0	7.1	---	---	0
B	6061.1	S	377048	5533564	6.7	15.0	12.6	42.0	14.0	8.4	0.6	15	0
C	6079.4	S?	377338	5533556	2.7	15.4	3.0	18.4	10.4	3.1	---	---	134
D	6092.8	S	377560	5533558	5.5	14.6	9.5	35.5	13.2	5.1	---	---	0
E	6105.6	S	377869	5533555	12.8	47.7	56.6	239.6	9.0	34.3	0.5	0	0
F	6130.6	S	378540	5533579	10.6	7.8	20.9	20.5	18.4	3.7	---	---	0
G	6181.2	S	379788	5533566	0.2	7.4	10.1	42.5	2.3	5.8	---	---	0
LINE 10120			FLIGHT 1										
A	314.0	S	376470	5533479	3.0	6.7	11.3	29.9	0.8	5.4	0.4	21	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10120			FLIGHT 1										
B	345.7	S?	377022	5533478	3.4	8.9	10.9	25.4	3.3	4.5	0.4	15	0
C	363.2	S	377344	5533478	2.7	9.0	5.2	14.3	3.1	2.3	---	---	118
D	387.1	S	377887	5533470	3.1	7.5	13.0	39.5	1.8	6.7	0.4	0	0
LINE 10130			FLIGHT 100										
A	6558.6	S	376491	5533369	9.7	19.6	24.3	81.8	3.5	13.8	0.7	7	0
B	6575.1	S?	376808	5533381	2.7	7.5	5.6	31.8	5.5	5.3	---	---	0
C	6586.5	S?	377000	5533365	1.2	6.2	9.6	15.7	3.1	4.3	---	---	0
D	6601.7	S	377285	5533363	4.2	21.8	11.5	81.1	18.7	13.4	0.2	8	45
E	6628.3	S	377985	5533367	4.4	11.7	11.9	59.4	5.7	7.9	0.4	1	0
F	6687.7	S	379352	5533365	1.5	3.1	2.7	29.0	4.3	4.1	---	---	14
G	6711.8	S	379665	5533362	5.9	6.1	5.6	39.1	9.9	5.7	1.2	30	0
LINE 10140			FLIGHT 100										
A	7405.5	S	376476	5533270	7.6	11.8	24.6	50.1	8.9	8.5	0.8	15	0
B	7364.5	S?	377404	5533273	5.7	4.1	30.6	50.8	4.3	9.7	1.7	49	23
C	7336.0	S	377946	5533266	1.2	8.6	3.2	33.3	1.5	5.4	---	---	0
D	7310.5	S	378456	5533259	11.0	16.6	25.2	63.3	18.3	8.9	0.9	16	36
E	7279.5	S	379369	5533261	5.2	19.7	11.0	51.3	14.0	6.8	0.3	5	0
F	7265.7	S	379657	5533265	5.2	9.5	13.2	41.7	10.0	6.6	---	---	0
LINE 10150			FLIGHT 100										
A	7600.1	S?	376278	5533159	5.4	12.0	6.7	33.7	3.4	6.5	0.5	22	44
B	7607.7	S	376477	5533176	14.1	24.7	31.4	111.0	4.1	17.2	0.9	13	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10150			FLIGHT 100										
C	7646.3	S	377332	5533160	7.6	19.8	27.2	77.0	5.7	13.4	0.5	11	68
D	7704.5	S	378485	5533149	6.4	10.4	26.1	39.5	29.7	6.3	---	---	0
E	7736.5	S	379119	5533160	2.1	7.0	4.0	23.6	3.0	4.2	---	---	0
F	7755.4	S	379392	5533152	4.2	10.4	14.9	41.3	12.1	5.8	---	---	0
LINE 10160			FLIGHT 100										
A	8009.1	S	377069	5533064	5.0	8.8	9.0	45.8	1.4	7.7	0.6	28	0
B	7996.3	S	377368	5533068	4.6	15.1	42.9	107.1	4.2	20.3	0.4	14	86
C	7950.7	S	378178	5533057	2.1	7.9	0.3	34.9	0.2	6.1	---	---	0
D	7936.4	S	378426	5533055	11.5	22.6	22.0	63.4	19.2	9.3	0.7	6	0
E	7911.2	S	379121	5533047	7.9	15.2	0.0	28.7	0.0	5.9	---	---	95
F	7894.0	S	379407	5533056	3.0	23.9	8.4	77.8	15.1	11.7	---	---	0
LINE 10170			FLIGHT 200										
A	1175.9	H	376660	5532967	10.7	31.0	50.7	127.4	1.1	21.4	0.5	4	0
B	1212.3	S?	377438	5532964	12.8	18.4	55.3	86.8	2.8	17.0	1.0	15	0
C	1246.6	S	378046	5532987	1.7	16.1	0.4	63.5	0.8	7.6	---	---	18
D	1261.4	S?	378402	5532968	17.9	21.2	28.1	46.3	23.1	6.0	---	---	0
E	1334.9	S	379407	5532961	1.4	6.8	5.5	34.3	4.8	4.1	---	---	19
LINE 10180			FLIGHT 200										
A	1588.0	H	376763	5532843	10.8	27.6	49.0	126.6	4.8	18.1	0.6	11	90
B	1566.8	S?	377396	5532856	8.5	11.7	58.0	30.7	45.6	7.0	1.0	15	0
C	1530.3	S	378103	5532857	2.8	5.6	3.3	42.8	7.8	5.5	---	---	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10180			FLIGHT 200										
D	1515.8	S	378391	5532863	10.8	10.2	35.9	37.0	33.4	5.1	---	---	0
E	1482.2	S?	379144	5532865	8.3	8.5	9.1	35.5	11.7	4.3	---	---	0
F	1460.6	S	379501	5532874	4.7	10.9	19.5	72.1	23.3	8.2	---	---	70
LINE 10190			FLIGHT 200										
A	1709.2	S	376039	5532784	3.1	17.2	26.9	58.7	3.6	9.1	0.2	0	0
B	1728.4	S	376514	5532776	14.6	38.7	114.4	187.6	5.9	35.1	0.6	2	55
C	1760.3	S?	377377	5532761	5.0	12.4	24.8	15.3	21.7	4.3	---	---	0
D	1775.2	S?	377734	5532758	10.0	12.4	39.0	45.4	41.5	6.1	---	---	0
E	1801.8	S?	378361	5532774	10.2	14.3	35.8	57.8	24.1	8.1	1.0	7	389
F	1852.5	S	379072	5532757	6.7	4.3	15.6	59.4	16.6	2.9	---	---	0
G	1872.0	S?	379310	5532750	2.1	5.3	27.6	56.5	30.4	6.6	---	---	15
LINE 10200			FLIGHT 1										
A	808.6	S	377678	5532655	1.4	8.9	10.3	34.0	2.2	4.8	---	---	0
B	707.0	S	378317	5532655	3.8	10.2	21.2	59.5	8.3	9.1	0.4	13	0
C	632.3	S	379493	5532673	1.1	9.5	10.2	40.2	5.4	6.9	---	---	0
LINE 10210			FLIGHT 1										
A	1041.1	S	377738	5532571	1.6	13.2	13.0	42.5	15.5	5.2	---	---	0
B	1075.4	S	378365	5532581	8.2	7.1	19.3	25.1	13.8	3.7	1.6	19	438
C	1160.0	S	379433	5532564	1.5	2.6	12.2	34.7	11.0	6.0	---	---	0

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EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10220			FLIGHT 1										
A	1416.7	S	377710	5532470	9.6	6.1	22.7	33.3	29.8	6.8	---	---	0
B	1451.9	S?	378357	5532471	11.7	3.1	20.4	18.5	23.8	2.8	8.5	23	0
C	1542.0	S	379120	5532461	0.8	5.5	5.9	33.4	6.0	5.7	---	---	82
D	1572.7	S	379466	5532468	1.2	11.8	5.4	52.9	4.3	7.3	---	---	0
LINE 10230			FLIGHT 1										
A	1891.8	S	376754	5532378	4.8	6.8	12.3	21.8	9.0	3.7	---	---	0
B	1928.0	S?	377459	5532375	3.5	5.2	12.3	27.6	5.7	4.8	0.7	20	0
C	1943.4	S	377743	5532376	0.7	7.8	4.3	17.0	2.3	3.9	---	---	0
D	1973.3	S	378295	5532376	7.4	21.6	19.6	74.0	6.8	12.8	0.5	1	0
E	2108.0	S	379483	5532373	1.3	2.4	4.5	31.7	4.3	4.5	---	---	0
LINE 10240			FLIGHT 1										
A	2327.4	S	376838	5532273	1.7	6.0	15.1	28.2	8.9	4.7	---	---	42
B	2369.3	S?	377522	5532272	4.2	9.3	14.2	32.9	22.8	5.6	0.5	18	0
C	2404.9	S	378273	5532283	3.3	9.2	22.3	53.8	12.3	8.8	0.4	3	0
LINE 10250			FLIGHT 1										
A	2814.0	S?	377528	5532173	4.7	12.7	14.1	46.4	5.1	8.1	0.4	0	27
B	2849.7	S	378275	5532186	1.9	10.1	14.3	57.4	3.3	10.4	---	---	0
C	2872.7	S	378845	5532178	2.9	9.1	6.6	33.0	2.8	5.5	---	---	0

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EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10260			FLIGHT 1										
A	3226.0	S	377289	5532076	1.4	4.7	12.6	23.5	12.3	4.1	---	---	26
B	3244.5	S	377615	5532072	3.5	22.1	13.0	87.5	21.8	14.9	0.2	0	55
C	3278.1	S	378263	5532091	3.1	10.0	8.9	49.1	6.2	9.7	0.3	5	55
D	3303.5	S	378821	5532082	2.0	7.7	9.1	46.8	5.2	7.9	---	---	0
LINE 10270			FLIGHT 1										
A	3634.7	S?	377386	5531973	3.2	7.0	16.2	23.9	10.9	4.8	---	---	0
B	3647.7	S	377602	5531974	7.6	27.3	16.4	91.7	5.6	15.0	0.4	1	0
C	3710.9	S	378823	5531970	5.4	24.7	17.6	124.2	6.7	18.2	0.3	0	0
LINE 10280			FLIGHT 1										
A	4057.6	S	377624	5531873	5.7	14.5	14.3	66.1	2.3	11.0	0.5	6	0
B	4071.5	S	377906	5531880	2.3	8.8	13.0	59.5	9.3	9.7	---	---	0
C	4114.0	S	378862	5531871	4.1	11.5	50.5	137.9	6.4	22.3	0.4	5	0
D	4129.1	S?	379124	5531865	2.4	10.0	7.1	53.3	1.2	8.3	---	---	0
LINE 10290			FLIGHT 2										
A	2258.5	B?	377646	5531754	11.1	26.0	21.8	87.7	1.1	14.8	0.6	2	112
B	2289.2	S	378286	5531758	5.3	5.2	42.3	45.2	18.9	8.8	1.1	12	0
C	2331.5	S	378921	5531749	2.6	6.7	61.9	97.4	9.3	16.1	---	---	0
D	2343.1	S?	379095	5531752	3.4	28.6	53.0	131.4	7.4	20.7	0.2	0	0
E	2374.0	S	379423	5531758	1.7	10.1	3.0	35.9	3.0	5.3	---	---	0

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EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10300			FLIGHT 2										
A	2623.1	S	377631	5531662	6.0	6.7	25.6	74.4	12.8	10.9	1.0	35	0
B	2601.2	S	377854	5531654	3.0	17.7	19.1	91.3	0.5	15.2	0.2	0	0
C	2568.9	S	378089	5531662	0.2	9.1	17.2	53.2	8.3	8.8	---	---	0
D	2526.7	S	378936	5531656	11.3	21.1	50.7	105.1	9.9	16.0	0.8	0	0
LINE 10310			FLIGHT 2										
A	2890.3	S	377195	5531559	1.3	6.9	3.4	47.8	5.7	6.5	---	---	174
B	2915.8	S?	377615	5531550	13.4	34.6	52.7	134.8	2.9	25.1	0.6	0	0
C	2947.5	S	378260	5531567	3.5	6.2	31.4	45.0	14.9	9.2	0.6	0	0
D	2997.9	S	379004	5531552	2.0	5.3	38.7	26.0	11.3	7.8	---	---	0
LINE 10320			FLIGHT 2										
A	3543.6	S	376956	5531459	5.1	12.9	21.7	42.7	14.0	6.3	0.5	5	0
B	3464.7	S	377603	5531466	13.4	18.7	58.7	93.9	7.0	18.0	1.1	2	0
C	3414.3	S	378185	5531451	6.2	13.7	58.1	66.8	32.4	11.7	0.6	15	0
D	3375.8	S	379059	5531451	10.6	39.4	112.6	322.9	13.6	50.0	0.4	0	25
LINE 10330			FLIGHT 2										
A	3772.7	S	377689	5531354	6.2	16.2	65.5	121.5	22.7	23.6	0.5	1	68
B	3798.3	S	378147	5531361	6.4	12.0	43.6	51.8	11.7	13.3	0.6	7	0
C	3848.0	S	379056	5531357	4.7	8.7	29.2	84.0	8.6	12.4	0.6	19	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10340			FLIGHT 2										
A	4087.0	S	377691	5531261	11.4	27.7	56.8	130.7	14.2	22.3	0.6	2	0
B	4043.3	S	378170	5531243	5.2	20.5	54.1	110.6	30.5	18.6	0.3	0	0
C	4002.9	S	379021	5531255	7.8	17.7	24.2	85.3	29.7	11.5	0.6	7	0
D	3969.7	S	379669	5531255	3.6	12.5	11.4	48.3	1.0	7.8	0.3	7	0
LINE 10350			FLIGHT 2										
A	4336.0	S	376238	5531163	1.0	4.7	9.7	25.9	4.1	4.2	---	---	0
B	4377.4	S	377117	5531157	2.0	11.0	4.2	39.9	3.8	5.5	---	---	0
C	4412.2	S?	377739	5531156	9.0	24.0	27.8	79.1	5.1	12.8	0.5	0	0
D	4433.2	S	378139	5531152	1.8	9.5	38.6	88.6	14.0	16.3	---	---	0
E	4500.0	S	379148	5531149	0.8	13.0	20.2	85.1	12.3	12.3	---	---	174
F	4516.6	S	379547	5531148	6.0	16.8	25.5	68.5	3.4	10.1	0.4	0	0
LINE 10360			FLIGHT 2										
A	4950.0	S	376223	5531054	1.7	5.1	13.0	22.1	5.7	3.9	---	---	0
B	4878.1	S	377176	5531066	2.0	19.1	10.9	57.6	11.9	9.2	---	---	0
C	4840.6	S	377506	5531053	5.4	0.4	14.0	0.0	10.4	0.0	---	---	0
D	4824.9	S	377716	5531060	8.7	22.3	36.7	113.8	11.5	18.1	0.5	0	0
E	4799.9	S?	378074	5531053	6.5	17.3	44.2	80.2	11.8	15.0	0.5	2	0
F	4759.7	S?	379056	5531049	1.3	9.4	4.0	46.1	0.5	7.4	---	---	160
G	4728.6	S	379649	5531054	5.9	39.5	41.0	205.8	2.2	31.6	0.2	0	29

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EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10370			FLIGHT 2										
A	5061.0	S	377250	5530948	6.1	12.4	20.4	74.5	23.4	11.4	---	---	87
B	5090.7	S	377710	5530944	12.9	29.4	42.7	135.6	24.2	20.7	0.7	2	0
C	5093.6	S?	377766	5530946	5.1	22.3	42.7	135.6	23.9	20.7	0.3	6	241
D	5112.9	S	378193	5530935	6.1	17.5	51.3	90.4	15.3	17.8	0.4	4	0
E	5172.9	S	379184	5530954	2.8	8.9	17.8	24.5	18.5	3.6	---	---	0
F	5196.4	S	379651	5530953	5.3	35.5	42.6	183.2	3.9	28.7	0.2	0	0
LINE 10380			FLIGHT 2										
A	5454.9	S	377210	5530860	5.0	13.2	22.0	62.2	16.9	9.7	0.4	6	0
B	5413.2	S	377699	5530857	6.3	10.5	20.2	60.8	6.6	10.3	0.7	11	0
C	5368.5	S	378124	5530858	7.6	17.2	65.9	103.0	16.3	20.2	0.6	0	0
D	5296.0	S	379611	5530843	4.0	21.6	33.9	139.1	0.0	21.6	0.2	0	0
LINE 10390			FLIGHT 2										
A	5617.8	S	377099	5530750	2.6	15.1	14.4	72.0	9.7	10.7	---	---	80
B	5653.3	S	377726	5530750	5.2	31.2	25.9	101.9	13.6	15.7	0.2	0	0
C	5671.9	S	378099	5530750	6.6	6.8	48.3	79.8	7.7	16.2	1.2	14	0
D	5759.9	S	379713	5530747	2.9	15.3	20.6	99.7	2.5	15.4	---	---	14
LINE 10400			FLIGHT 2										
A	6072.8	S	377123	5530648	1.1	10.6	16.3	56.5	16.8	8.7	---	---	178
B	5998.4	S	378052	5530652	12.9	25.9	75.6	131.7	19.9	24.2	0.8	0	0
C	5945.4	S?	379139	5530648	0.0	7.7	7.0	18.0	14.5	3.9	---	---	312

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EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10410			FLIGHT 2										
A	6204.1	S	376609	5530553	1.5	4.2	14.5	38.4	1.1	6.5	---	---	57
B	6233.4	S	377276	5530559	1.2	9.8	9.5	61.3	9.3	8.3	---	---	138
C	6257.2	S	377775	5530560	4.0	11.0	17.0	50.3	3.5	8.5	0.4	1	10
D	6269.1	S	378109	5530545	3.2	2.8	30.1	53.7	5.0	10.1	---	---	0
E	6312.6	S	378837	5530548	3.5	20.4	27.3	128.2	26.5	18.9	---	---	0
F	6353.5	S	379662	5530558	2.7	10.9	15.9	52.0	3.4	8.5	---	---	29
LINE 10420			FLIGHT 2										
A	6640.3	S?	376137	5530466	3.3	11.1	14.6	37.4	5.4	6.0	0.3	14	0
B	6598.0	S	376942	5530478	1.0	14.9	16.3	112.2	4.4	17.6	---	---	0
C	6561.8	S	377418	5530462	1.9	12.0	26.6	71.4	27.4	10.0	---	---	0
D	6526.4	S	377793	5530456	7.7	52.3	37.7	240.0	13.8	38.0	0.2	0	90
E	6507.4	S	378116	5530453	4.9	7.2	26.0	40.7	7.9	8.1	0.7	33	0
F	6473.9	S	378777	5530461	3.5	43.0	28.3	185.8	7.5	26.8	---	---	0
G	6422.5	S	379610	5530462	3.7	7.3	17.4	42.0	3.2	7.6	0.5	26	0
LINE 10430			FLIGHT 2										
A	6730.4	S	377034	5530365	1.3	6.6	13.2	77.4	12.2	12.4	---	---	0
B	6808.7	S	378784	5530352	2.7	8.7	6.9	35.3	2.6	6.2	---	---	60
C	6845.1	S	379713	5530359	2.6	6.3	13.3	44.8	4.8	8.4	---	---	0
LINE 10440			FLIGHT 2										
A	7091.3	S	376171	5530268	1.5	8.1	6.9	36.5	5.5	6.3	---	---	38

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10440			FLIGHT 2										
B	7033.2	S	377409	5530278	2.3	18.0	20.8	145.5	7.9	23.2	---	---	0
C	6999.6	S?	377997	5530252	2.5	13.7	29.0	58.5	1.9	10.2	---	---	0
D	6910.8	S	379762	5530243	0.5	7.8	8.7	37.3	2.2	7.6	---	---	19
LINE 10450			FLIGHT 2										
A	7268.2	S?	376721	5530152	2.4	6.5	13.0	38.1	6.9	6.5	---	---	76
B	7295.1	S	377368	5530154	4.9	27.9	36.5	190.1	1.0	29.9	0.2	0	0
C	7324.6	S	378254	5530156	1.2	9.4	17.0	35.5	2.5	6.8	---	---	36
LINE 10460			FLIGHT 2										
A	7594.7	S	376224	5530059	4.3	4.4	16.4	32.8	13.1	5.8	1.0	44	0
B	7536.5	S	377304	5530060	1.5	5.6	10.2	70.8	3.6	14.1	---	---	67
C	7492.9	S	378096	5530047	4.4	3.0	34.3	49.7	9.1	9.5	1.7	40	102
D	7465.9	S	378897	5530046	0.9	8.0	4.5	33.7	4.0	5.6	---	---	186
LINE 10470			FLIGHT 2										
A	7667.4	S	376406	5529958	2.0	6.1	7.8	22.1	4.0	4.4	---	---	0
B	7681.9	S	376680	5529960	7.0	11.8	10.5	46.0	8.4	7.4	0.7	18	0
C	7698.9	S?	377018	5529966	1.4	8.1	1.4	13.7	3.7	2.8	---	---	0
D	7715.1	S	377343	5529960	1.4	8.3	0.3	56.1	0.2	9.1	---	---	59
E	7743.9	S?	378101	5529955	2.9	3.9	20.8	12.7	7.5	4.0	---	---	0
LINE 10480			FLIGHT 2										
A	7968.1	S	376608	5529862	1.3	9.8	29.6	56.8	29.1	8.8	---	---	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 10480			FLIGHT 2										
B	7928.1	S	377467	5529860	2.2	6.1	17.2	75.2	2.2	13.1	---	---	0
C	7905.3	S	378098	5529867	1.8	3.9	27.1	39.5	4.4	8.1	---	---	0
D	7852.0	S	379677	5529868	2.3	5.2	6.2	21.0	1.4	3.1	---	---	0
LINE 10490			FLIGHT 2										
A	8054.0	S?	376674	5529752	6.2	6.3	36.7	25.4	22.6	3.8	1.2	22	0
B	8069.5	S	377002	5529767	2.0	5.8	41.2	31.8	81.5	5.3	---	---	0
C	8087.8	S?	377406	5529758	2.5	7.8	9.2	91.6	18.7	15.1	---	---	0
D	8114.6	S	378216	5529754	4.2	6.2	20.5	32.5	3.9	6.9	0.7	32	0
E	8153.8	S	379418	5529765	0.2	5.1	11.2	40.6	1.5	6.9	---	---	0
LINE 10500			FLIGHT 2										
A	8332.4	S	376635	5529663	5.5	2.6	40.1	36.2	42.7	6.1	---	---	0
B	8295.5	S	377418	5529669	2.7	8.3	25.5	94.8	0.0	14.5	---	---	0
C	8269.9	S	378157	5529662	4.0	6.8	24.0	37.5	3.6	7.9	0.6	25	0
D	8246.0	S?	378939	5529650	1.6	6.2	5.1	17.4	5.4	2.7	---	---	0
E	8237.5	S	379188	5529647	0.0	8.6	3.6	30.9	8.0	3.6	---	---	40
LINE 19010			FLIGHT 3										
A	1297.8	S	376517	5532768	9.3	7.8	64.1	69.8	4.4	17.6	1.7	22	0
LINE 19030			FLIGHT 3										
A	1871.6	S	378508	5532250	2.4	5.0	9.5	35.9	12.3	5.9	---	---	0

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MAx

EM Anomaly List

Label	Fid	Interp	XUTM m	YUTM m	CX 5500 HZ Real ppm	CX 5500 HZ Quad ppm	CP 7200 HZ Real ppm	CP 7200 HZ Quad ppm	CP 900 HZ Real ppm	CP 900 HZ Quad ppm	Vertical Dike COND siemens	Vertical Dike DEPTH* m	Mag. Corr NT
LINE 19020			FLIGHT 3										
A	1646.5	H	377514	5533253	2.3	6.8	14.6	41.2	1.2	9.2	---	---	26
B	1560.6	S	377529	5531027	4.5	6.7	14.2	36.4	17.0	5.9	0.7	29	0

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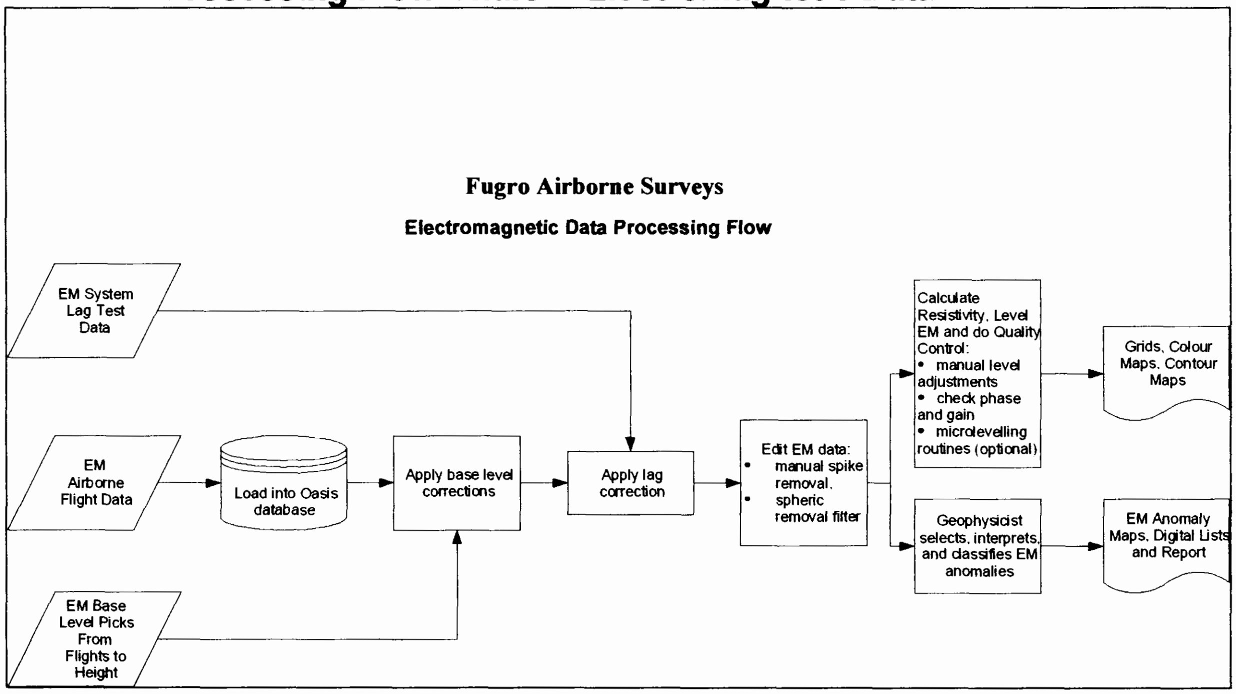
APPENDIX F

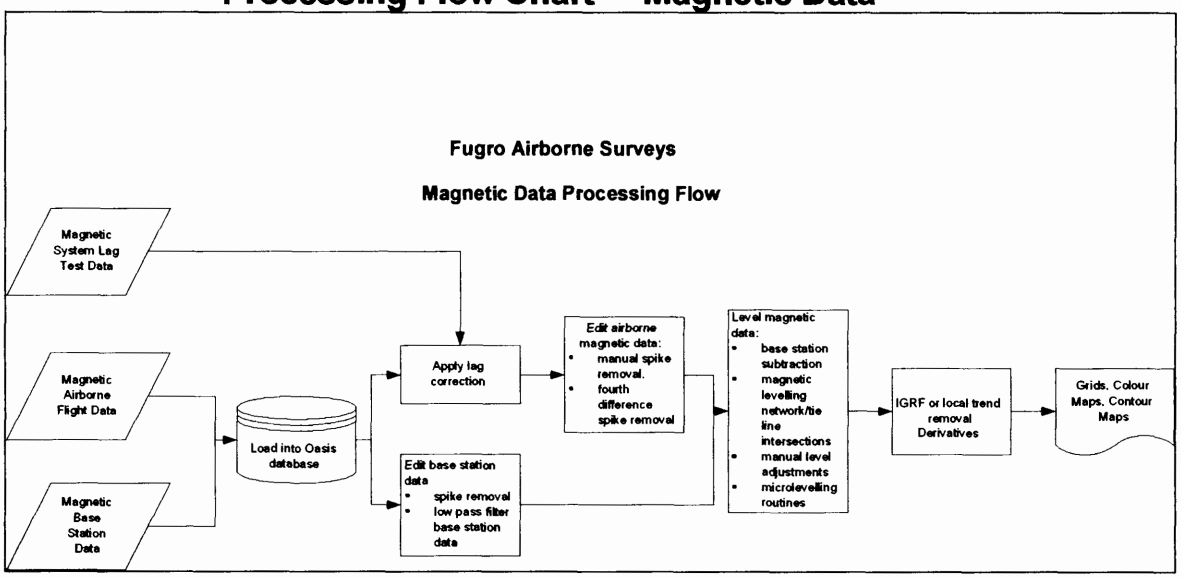
DATA PROCESSING FLOWCHARTS

APPENDIX F

Processing Flow Chart - Electromagnetic Data



Processing Flow Chart - Magnetic Data



APPENDIX G

GLOSSARY

GLOSSARY OF AIRBORNE GEOPHYSICAL TERMS

Note: The definitions given in this glossary refer to the common terminology as used in airborne geophysics.

altitude attenuation: the absorption of gamma rays by the atmosphere between the earth and the detector. The number of gamma rays detected by a system decreases as the altitude increases.

apparent- : the ***physical parameters*** of the earth measured by a geophysical system are normally expressed as apparent, as in "apparent ***resistivity***". This means that the measurement is limited by assumptions made about the geology in calculating the response measured by the geophysical system. Apparent resistivity calculated with ***HEM***, for example, generally assumes that the earth is a ***homogeneous half-space*** – not layered.

amplitude: The strength of the total electromagnetic field. In ***frequency domain*** it is most often the sum of the squares of ***in-phase*** and ***quadrature*** components. In multi-component electromagnetic surveys it is generally the sum of the squares of all three directional components.

analytic signal: The total amplitude of all the directions of magnetic ***gradient***. Calculated as the sum of the squares.

anisotropy: Having different ***physical parameters*** in different directions. This can be caused by layering or fabric in the geology. Note that a unit can be anisotropic, but still **homogeneous**.

anomaly: A localized change in the geophysical data characteristic of a discrete source, such as a conductive or magnetic body. Something locally different from the **background**.

B-field: In time-domain **electromagnetic** surveys, the magnetic field component of the (electromagnetic) **field**. This can be measured directly, although more commonly it is calculated by integrating the time rate of change of the magnetic field **dB/dt**, as measured with a receiver coil.

background: The "normal" response in the geophysical data – that response observed over most of the survey area. **Anomalies** are usually measured relative to the background. In airborne gamma-ray spectrometric surveys the term defines the **cosmic**, radon, and aircraft responses in the absence of a signal from the ground.

base-level: The measured values in a geophysical system in the absence of any outside signal. All geophysical data are measured relative to the system base level.

base frequency: The frequency of the pulse repetition for a ***time-domain electromagnetic*** system. Measured between subsequent positive pulses.

bird: A common name for the pod towed beneath or behind an aircraft, carrying the geophysical sensor array.

calibration coil: A wire coil of known size and dipole moment, which is used to generate a field of known ***amplitude*** and ***phase*** in the receiver, for system calibration. Calibration coils can be external, or internal to the system. Internal coils may be called Q-coils.

coaxial coils: **[CX]** Coaxial coils are in the vertical plane, with their axes horizontal and collinear in the flight direction. These are most sensitive to vertical conductive objects in the ground, such as thin, steeply dipping conductors perpendicular to the flight direction. Coaxial coils generally give the sharpest anomalies over localized conductors. (See also ***coplanar coils***)

coil: A multi-turn wire loop used to transmit or detect electromagnetic fields. Time varying ***electromagnetic*** fields through a coil induce a voltage proportional to the strength of the field and the rate of change over time.

compensation: Correction of airborne geophysical data for the changing effect of the aircraft. This process is generally used to correct data in ***fixed-wing time-domain electromagnetic*** surveys (where the transmitter is on the aircraft and the receiver is moving), and magnetic surveys (where the sensor is on the aircraft, turning in the earth's magnetic field.

component: In ***frequency domain electromagnetic*** surveys this is one of the two **phase** measurements – ***in-phase or quadrature***. In "multi-component" electromagnetic surveys it is also used to define the measurement in one geometric direction (vertical, horizontal in-line and horizontal transverse – the Z, X and Y components).

Compton scattering: gamma ray photons will bounce off the nuclei of atoms they pass through (earth and atmosphere), reducing their energy and then being detected by ***radiometric*** sensors at lower energy levels. See also ***stripping***.

conductance: See ***conductivity thickness***

conductivity: [σ] The facility with which the earth or a geological formation conducts electricity. Conductivity is usually measured in milli-Siemens per metre (mS/m). It is the reciprocal of ***resistivity***.

conductivity-depth imaging: see ***conductivity-depth transform***.

conductivity-depth transform: A process for converting electromagnetic measurements to an approximation of the conductivity distribution vertically in the earth, assuming a ***layered earth***. (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)

conductivity thickness: **[σt]** The product of the ***conductivity***, and thickness of a large, tabular body. (It is also called the "conductivity-thickness product") In electromagnetic geophysics, the response of a thin plate-like conductor is proportional to the conductivity multiplied by thickness. For example a 10 metre thickness of 20 Siemens/m mineralization will be equivalent to 5 metres of 40 S/m; both have 200 S conductivity thickness. Sometimes referred to as conductance.

conductor: Used to describe anything in the ground more conductive than the surrounding geology. Conductors are most often clays or graphite, or hopefully some type of mineralization, but may also be man-made objects, such as fences or pipelines.

coplanar coils: **[CP]** The coplanar coils lie in the horizontal plane with their axes vertical, and parallel. These coils are most sensitive to massive conductive bodies, horizontal layers, and the ***halfspace***.

cosmic ray: High energy sub-atomic particles from outer space that collide with the earth's atmosphere to produce a shower of gamma rays (and other particles) at high energies.

counts (per second): The number of ***gamma-rays*** detected by a gamma-ray ***spectrometer.*** The rate depends on the geology, but also on the size and sensitivity of the detector.

culture: A term commonly used to denote any man-made object that creates a geophysical anomaly. Includes, but not limited to, power lines, pipelines, fences, and buildings.

current gathering: The tendency of electrical currents in the ground to channel into a conductive formation. This is particularly noticeable at higher frequencies or early time channels when the formation is long and parallel to the direction of current flow. This tends to enhance anomalies relative to inductive currents (see also ***induction***). Also known as current channelling.

current channelling: See current gathering.

daughter products: The radioactive natural sources of gamma-rays decay from the original element (commonly potassium, uranium, and thorium) to one or more lower-energy elements. Some of these lower energy elements are also radioactive and decay further. ***Gamma-ray spectrometry*** surveys may measure the gamma rays given off by the original element or by the decay of the daughter products.

dB/dt: As the ***secondary electromagnetic field*** changes with time, the magnetic field [**B**] component induces a voltage in the receiving ***coil***, which is proportional to the rate of change of the magnetic field over time.

decay: In ***time-domain electromagnetic*** theory, the weakening over time of the ***eddy currents*** in the ground, and hence the ***secondary field*** after the ***primary field*** electromagnetic pulse is turned off. In ***gamma-ray spectrometry***, the radioactive breakdown of an element, generally potassium, uranium, thorium, or one of their ***daughter*** products.

decay series: In ***gamma-ray spectrometry***, a series of progressively lower energy ***daughter products*** produced by the radioactive breakdown of uranium or thorium.

decay constant: see time constant.

depth of exploration: The maximum depth at which the geophysical system can detect the target. The depth of exploration depends very strongly on the type and size of the target, the contrast of the target with the surrounding geology, the homogeneity of the surrounding geology, and the type of geophysical system. One measure of the maximum depth of exploration for an electromagnetic system is the depth at which it can detect the strongest conductive target – generally a highly conductive horizontal layer.

differential resistivity: A process of transforming ***apparent resistivity*** to an approximation of layer resistivity at each depth. The method uses multi-frequency HEM data and approximates the effect of shallow layer ***conductance*** determined from higher frequencies to estimate the deeper conductivities (Huang and Fraser, 1996)

dipole moment: [NIA] For a transmitter, the product of the area of a ***coil***, the number of turns of wire, and the current flowing in the coil. At a distance significantly larger than the size of the coil, the magnetic field from a coil will be the same if the dipole moment product is the same. For a receiver coil, this is the product of the area and the number of turns. The sensitivity to a magnetic field (assuming the source is far away) will be the same if the dipole moment is the same.

diurnal: The daily variation in a natural field, normally used to describe the natural fluctuations (over hours and days) of the earth's magnetic field.

dielectric permittivity: **[ε]** The capacity of a material to store electrical charge, this is most often measured as the relative permittivity [ε_r], or ratio of the material dielectric to that of free space. The effect of high permittivity may be seen in HEM data at high frequencies over highly resistive geology as a reduced or negative ***in-phase***, and higher ***quadrature*** data.

drift: Long-time variations in the base-level or calibration of an instrument.

eddy currents: The electrical currents induced in the ground, or other conductors, by a time-varying ***electromagnetic field*** (usually the ***primary field***). Eddy currents are also induced in the aircraft's metal frame and skin; a source of ***noise*** in EM surveys.

electromagnetic: **[EM]** Comprised of a time-varying electrical and magnetic field. Radio waves are common electromagnetic fields. In geophysics, an electromagnetic system is one which transmits a time-varying ***primary field*** to induce ***eddy currents*** in the ground, and then measures the ***secondary field*** emitted by those eddy currents.

energy window: A broad spectrum of ***gamma-ray*** energies measured by a spectrometric survey. The energy of each gamma-ray is measured and divided up into numerous discrete energy levels, called windows.

equivalent (thorium or uranium): The amount of radioelement calculated to be present, based on the gamma-rays measured from a **daughter** element. This assumes that the ***decay series*** is in equilibrium – progressing normally.

fiducial, or fid: Timing mark on a survey record. Originally these were timing marks on a profile or film; now the term is generally used to describe 1-second interval timing records in digital data, and on maps or profiles.

fixed-wing: Aircraft with wings, as opposed to "rotary wing" helicopters.

footprint: This is a measure of the area of sensitivity under the aircraft of an airborne geophysical system. The footprint of an ***electromagnetic*** system is dependent on the altitude of the system, the orientation of the transmitter and receiver and the separation between the receiver and transmitter, and the conductivity of the ground. The footprint of a ***gamma-ray spectrometer*** depends mostly on the altitude. For all geophysical systems, the footprint also depends on the strength of the contrasting ***anomaly***.

frequency domain: An ***electromagnetic*** system which transmits a ***primary field*** that oscillates smoothly over time (sinusoidal), inducing a similarly varying electrical current in the ground. These systems generally measure the changes in the ***amplitude*** and ***phase*** of the ***secondary field*** from the ground at different frequencies by measuring the **in-phase** and **quadrature** phase components. See also ***time-domain***.

full-stream data: Data collected and recorded continuously at the highest possible sampling rate. Normal data are stacked (see ***stacking***) over some time interval before recording.

gamma-ray: A very high-energy photon, emitted from the nucleus of an atom as it undergoes a change in energy levels.

gamma-ray spectrometry: Measurement of the number and energy of natural (and sometimes man-made) gamma-rays across a range of photon energies.

gradient: In magnetic surveys, the gradient is the change of the magnetic field over a distance, either vertically or horizontally in either of two directions. Gradient data is often measured, or calculated from the total magnetic field data because it changes more quickly over distance than the ***total magnetic field***, and so may provide a more precise measure of the location of a source. See also ***analytic signal***.

ground effect: The response from the earth. A common calibration procedure in many geophysical surveys is to fly to altitude high enough to be beyond any measurable response from the ground, and there establish ***base levels*** or ***backgrounds***.

half-space: A mathematical model used to describe the earth – as infinite in width, length, and depth below the surface. The most common halfspace models are ***homogeneous*** and ***layered earth***.

heading error: A slight change in the magnetic field measured when flying in opposite directions.

HEM: Helicopter ElectroMagnetic, This designation is most commonly used to helicopter-borne, ***frequency-domain*** electromagnetic systems. At present, the transmitter and receivers are normally mounted in a ***bird*** carried on a sling line beneath the helicopter.

herringbone pattern: a pattern created in geophysical data by an asymmetric system, where the **anomaly** may be extended to either side of the source, in the direction of flight. Appears like fish bones, or like the teeth of a comb, extending either side of centre, each tooth an alternate flight line.

homogeneous: This is a geological unit that has the same ***physical parameters*** throughout its volume. This unit will create the same response to an HEM system anywhere, and the HEM system will measure the same apparent ***resistivity*** anywhere. The response may change with system direction (see ***anisotropy***).

in-phase: the component of the measured ***secondary field*** that has the same phase as the transmitter and the ***primary field***. The in-phase component is stronger than the ***quadrature*** phase over relatively higher ***conductivity***.

induction: Any time-varying electromagnetic field will induce (cause) electrical currents to flow in any object with non-zero ***conductivity***. (see ***eddy currents***)

infinite: In geophysical terms, an "infinite' dimension is one much greater than the ***footprint*** of the system, so that the system does not detect changes at the edges of the object.

International Geomagnetic Reference Field: **[IGRF]** An approximation of the smooth magnetic field of the earth, in the absence of variations due to local geology. Once the IGRF is subtracted from the measured magnetic total field data, any remaining variations are assumed to be due to local geology. The IGRF also predicts the slow changes of the field up to five years in the future.

inversion, or **inverse modeling**: A process of converting geophysical data to an earth model, which compares theoretical models of the response of the earth to the data measured, and refines the model until the response closely fits the measured data (Huang and Palacky, 1991)

layered earth: A common geophysical model which assumes that the earth is horizontally layered – the ***physical parameters*** are constant to ***infinite*** distance horizontally, but change vertically.

magnetic permeability: **[μ]** This is defined as the ratio of magnetic induction to the inducing magnetic field. The relative magnetic permeability [μ_r] is often quoted, which is the ratio of the rock permeability to the permeability of free space. In geology and geophysics, the ***magnetic susceptibility*** is more commonly used to describe rocks.

magnetic susceptibility: **[k]** A measure of the degree to which a body is magnetized. In SI units this is related to relative ***magnetic permeability*** by $k=\mu_r-1$, and is a dimensionless unit. For most geological material, susceptibility is influenced primarily by the percentage of magnetite. It is most often quoted in units of 10^{-6}. In HEM data this is most often apparent as a negative ***in-phase*** component over high susceptibility, high ***resistivity*** geology such as diabase dikes.

noise: That part of a geophysical measurement that the user does not want. Typically this includes electronic interference from the system, the atmosphere (***sferics***), and man-made sources. This can be a subjective judgment, as it may include the response from geology other than the target of interest. Commonly the term is used to refer to high frequency (short period) interference. See also ***drift***.

Occam's inversion: an ***inversion*** process that matches the measured ***electromagnetic*** data to a theoretical model of many, thin layers with constant thickness and varying resistivity (Constable et al, 1987).

off-time: In a ***time-domain electromagnetic*** survey, the time after the end of the ***primary field pulse***, and before the start of the next pulse.

on-time: In a ***time-domain electromagnetic*** survey, the time during the ***primary field pulse***.

phase: The angular difference in time between a measured sinusoidal electromagnetic field and a reference – normally the primary field. The phase is calculated from $\tan^{-1}$(***in-phase / quadrature***).

physical parameters: These are the characteristics of a geological unit. For electromagnetic surveys, the important parameters for electromagnetic surveys are ***conductivity, magnetic permeability*** (or ***susceptibility***) and ***dielectric permittivity***; for magnetic surveys the parameter is magnetic susceptibility, and for gamma ray spectrometric surveys it is the concentration of the major radioactive elements: potassium, uranium, and thorium.

permittivity: see ***dielectric permittivity***.

permeability: see ***magnetic permeability***.

primary field: the EM field emitted by a transmitter. This field induces ***eddy currents*** in (energizes) the conductors in the ground, which then create their own ***secondary fields***.

pulse: In time-domain EM surveys, the short period of intense ***primary*** field transmission. Most measurements (the ***off-time***) are measured after the pulse.

quadrature: that component of the measured ***secondary field*** that is phase-shifted 90° from the ***primary field***. The quadrature component tends to be stronger than the ***in-phase*** over relatively weaker ***conductivity***.

Q-coils: see ***calibration coil***.

radiometric: Commonly used to refer to ***gamma ray*** spectrometry.

radon: A radioactive daughter product of uranium and thorium, radon is a gas which can leak into the atmosphere, adding to the non-geological background of a gamma-ray spectrometric survey.

resistivity: **[ρ]** The strength with which the earth or a geological formation resists the flow of electricity, typically the flow induced by the ***primary field*** of the electromagnetic transmitter. Normally expressed in ohm-metres, it is the reciprocal of ***conductivity***.

resistivity-depth transforms: similar to ***conductivity depth transforms***, but the calculated ***conductivity*** has been converted to ***resistivity***.

resistivity section: an approximate vertical section of the resistivity of the layers in the earth. The resistivities can be derived from the ***apparent resistivity***, the ***differential resistivities***, ***resistivity-depth transforms***, or ***inversions***.

secondary field: The field created by conductors in the ground, as a result of electrical currents induced by the ***primary field*** from the ***electromagnetic*** transmitter. Airborne ***electromagnetic*** systems are designed to create, and measure a secondary field.

Sengpiel section: a ***resistivity section*** derived using the ***apparent resistivity*** and an approximation of the depth of maximum sensitivity for each frequency.

sferic: Lightning, or the ***electromagnetic*** signal from lightning, it is an abbreviation of "atmospheric discharge". These appear to magnetic and electromagnetic sensors as sharp "spikes" in the data. Under some conditions lightning storms can be detected from hundreds of kilometres away. (see ***noise***)

signal: That component of a measurement that the user wants to see – the response from the targets, from the earth, etc. (See also ***noise***)

skin depth: A measure of the depth of penetration of an electromagnetic field into a material. It is defined as the depth at which the primary field decreases to 1/e of the field at the surface. It is calculated by approximately 503 x √(resistivity/frequency). Note that depth of penetration is greater at higher ***resistivity*** and/or lower ***frequency***.

spectrometry: Measurement across a range of energies, where ***amplitude*** and energy are defined for each measurement. In gamma-ray spectrometry, the number of gamma rays are measured for each energy ***window***, to define the ***spectrum***.

spectrum: In ***gamma ray spectrometry***, the continuous range of energy over which gamma rays are measured. In ***time-domain electromagnetic*** surveys, the spectrum is the energy of the **pulse** distributed across an equivalent, continuous range of frequencies.

spheric: see ***sferic***.

stacking: Summing repeat measurements over time to enhance the repeating ***signal***, and minimize the random ***noise***.

stripping: Estimation and correction for the gamma ray photons of higher and lower energy that are observed in a particular ***energy window***. See also ***Compton scattering***.

susceptibility: See ***magnetic susceptibility***.

tau: [τ] Often used as a name for the ***time constant***.

TDEM: ***time domain electromagnetic***.

thin sheet: A standard model for electromagnetic geophysical theory. It is usually defined as thin, flat-lying, and ***infinite*** in both horizontal directions. (see also ***vertical plate***)

tie-line: A survey line flown across most of the ***traverse lines***, generally perpendicular to them, to assist in measuring ***drift*** and ***diurnal*** variation. In the short time required to fly a tie-line it is assumed that the drift and/or diurnal will be minimal, or at least changing at a constant rate.

time constant: The time required for an ***electromagnetic*** field to decay to a value of 1/e of the original value. In ***time-domain*** electromagnetic data, the time constant is proportional to the size and ***conductance*** of a tabular conductive body. Also called the decay constant.

Time channel: In ***time-domain electromagnetic*** surveys the decaying ***secondary field*** is measured over a period of time, and the divided up into a series of consecutive discrete measurements over that time.

time-domain: ***Electromagnetic*** system which transmits a pulsed, or stepped ***electromagnetic*** field. These systems induce an electrical current (***eddy current***) in the ground that persists after the ***primary field*** is turned off, and measure the change over time of the ***secondary field*** created as the currents ***decay***. See also ***frequency-domain***.

total energy envelope: The sum of the squares of the three ***components*** of the ***time-domain electromagnetic secondary field***. Equivalent to the ***amplitude*** of the secondary field.

transient: Time-varying. Usually used to describe a very short period pulse of ***electromagnetic*** field.

traverse line: A normal geophysical survey line. Normally parallel traverse lines are flown across the property in spacing of 50 m to 500 m, and generally perpendicular to the target geology.

vertical plate: A standard model for electromagnetic geophysical theory. It is usually defined as thin, and ***infinite*** in horizontal dimension and depth extent. (see also ***thin sheet***)

waveform: The shape of the ***electromagnetic pulse*** from a ***time-domain*** electromagnetic transmitter.

window: A discrete portion of a ***gamma-ray spectrum*** or ***time-domain electromagnetic decay***. The continuous energy spectrum or ***full-stream*** data are grouped into windows to reduce the number of samples, and reduce ***noise***.

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Common Symbols and Acronyms

k Magnetic susceptibility
ε Dielectric permittivity
μ, μ_r Magnetic permeability, apparent permeability
ρ, ρ_a Resistivity, apparent resistivity
σ,σ_a Conductivity, apparent conductivity
σ**t** Conductivity thickness
τ Tau, or time constant
Ω**.m** Ohm-metres, units of resistivity
AGS Airborne gamma ray spectrometry.
CDT Conductivity-depth transform, conductivity-depth imaging (Macnae and Lamontagne, 1987; Wolfgram and Karlik, 1995)
CPI, CPQ Coplanar in-phase, quadrature
CPS Counts per second
CTP Conductivity thickness product
CXI, CXQ Coaxial, in-phase, quadrature
fT femtoteslas, normal unit for measurement of B-Field
EM Electromagnetic
keV kilo electron volts – a measure of gamma-ray energy
MeV mega electron volts – a measure of gamma-ray energy 1MeV = 1000keV
NIA dipole moment: turns x current x Area
nT nano-Tesla, a measure of the strength of a magnetic field
ppm parts per million – a measure of secondary field or noise relative to the primary.
pT/s picoTeslas per second: Units of decay of secondary field, dB/dt
S Siemens – a unit of conductance
x: the horizontal component of an EM field parallel to the direction of flight.
y: the horizontal component of an EM field perpendicular to the direction of flight.
z: the vertical component of an EM field.

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