Kaminak Gold Corporation

GEOPHYSICAL REPORT ON THE UPPER COFFEE CREEK PLACER PROSPECTING LEASE

Whitehorse, Yukon Territory
Lease No.: IW00384 – Owner Tom Bokenfohr. 100%

NTS # 115J/14
Latitude: 62^{O}51.4 N Longitude: 139^{O}14.0 W

Whitehorse Mining District

WORK PERFORMED: March 22^{nd} to April 3^{rd}, 2014
DATE OF REPORT: September 26^{th}, 2014

-prepared by-

Rory Kutluoglu, B.Sc. P.Geo

[redacted]

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1.0 SUMMARY

Between March 22^{nd} and April 3^{rd}, 2014, CGG was contracted to conduct a high-resolution, horizontal-gradient airborne magnetic survey using their MIDAS system over the whole of the Coffee Project. The main purpose of this survey is to identify discrete bedrock structures, which are known to host gold and start at surface. The secondary objective is to attempt to map magnetite lenses; gold is known to be associated with. heavier minerals. This lease is located 130km south of Dawson, on the Coffee Creek and flows directly into the Yukon River.

The survey consisted of 200m spaced and a smaller portion of 100m spaced lines transecting the lease at 135^{O} – 315^{O} orientation and took place between March 27^{th} and March 30^{th}, 2014. 46, 200m spaced, lines averaging 5Km in length and 42, 100m spaced lines, averaging 2.5Km, were flown over the prospect lease as part of a larger survey covering the Coffee Project quartz claims. The overall survey was conducted from March 22^{nd} to April 5^{th}, 2014 with the crew and equipment based out of Dawson City, YK.

Although the data is of a high resolution and high quality, there is a significant amount of regional influence, which may require additional post-processing to delineate additional more subtle magnetite lenses.

2.0 LOCATION AND ACCESS

The Prospecting lease is located 135km south of Dawson City, within the Yukon River drainage system in the west-central portion of the Yukon Territory. It is centered at 62^{0}51.4N , 139^{0}14.0W on NTS mapsheet 115J/14 (Figure 1). It is accessible year round via helicopter or fixed wing into the Coffee Camp and land or river transport from that site. There is also a barge landing accessing the Coffee Camp, which allows for access to equipment.

3.0 PROPERTY

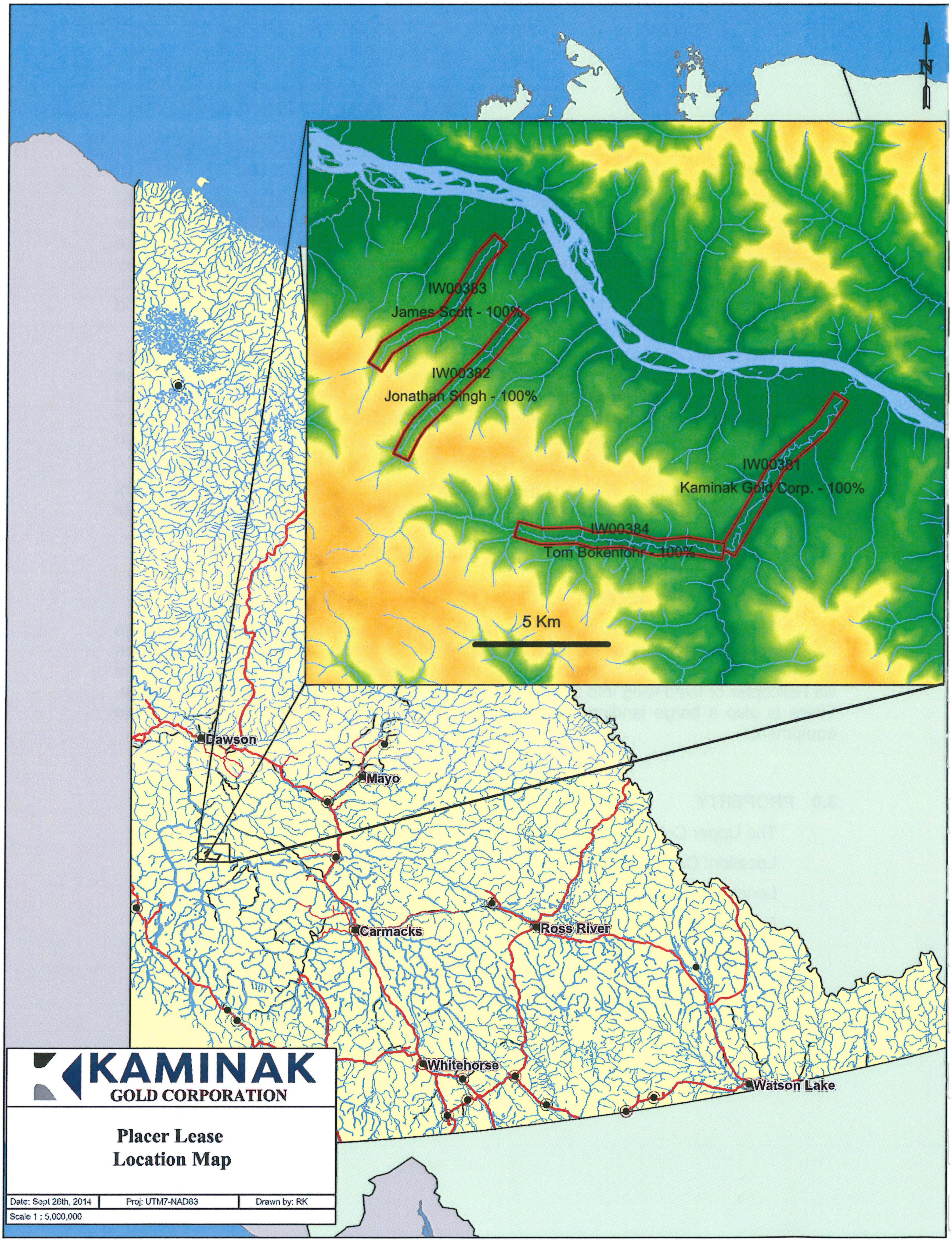
The Upper Coffee Creek Placer Prospecting Lease Tenure:

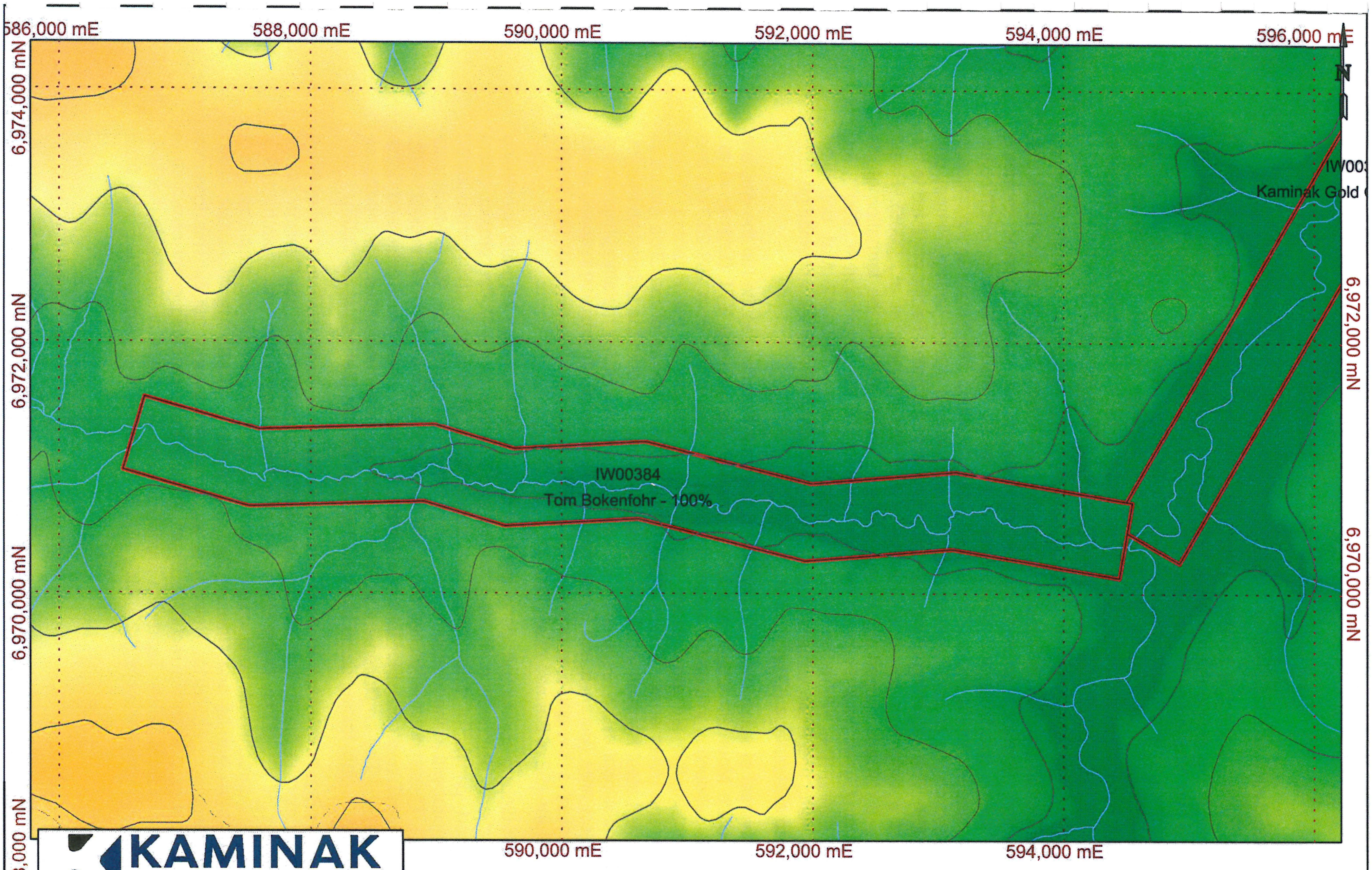
Location: Coffee Creek, IW00384.

Length: 5 miles

Expiry: September 28, 2014 (renewed)

(Figure 2)


IW00383
James Scott - 100%
IW00382
Jonathan Singh - 100%
IW00381
Kaminak Gold Corp. - 100%
IW00384
Tom Bokenfohr - 100%
5 Km
Dawson
Mayo
Carmacks
Ross River
Whitehorse
Watson Lake
N
KAMINAK
GOLD CORPORATION
Placer Lease
Location Map
Date: Sept 26th, 2014
Proj: UTM7-NAD83
Drawn by: RK
Scale 1 : 5,000,000



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Upper Coffee Creek Placer Claim Location Map

Date: Jul 6, 2013	Proj: UTM7-NAD83	Drawn by:
Scale 1 : 40,000		

PHYSIOLOGY AND GEOLOGY

The Coffee project is located in the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that covers a large portion of the Omineca Belt in the Yukon and extends into Alaska and British Columbia. The YTT underlies part of the Tintina gold belt and hosts multiple gold deposits, including the Sonora Gulch gold deposit, the Casino copper-gold-molybdenum porphyry, the Boulevard gold prospect, and the Golden Saddle gold deposit (Bennett et al., 2010; Allan et al., 2013). The YTT also hosts volcanogenic massive sulphide (VMS) and Mississippi Valley-type (MVT) deposits (Figure 4-1).

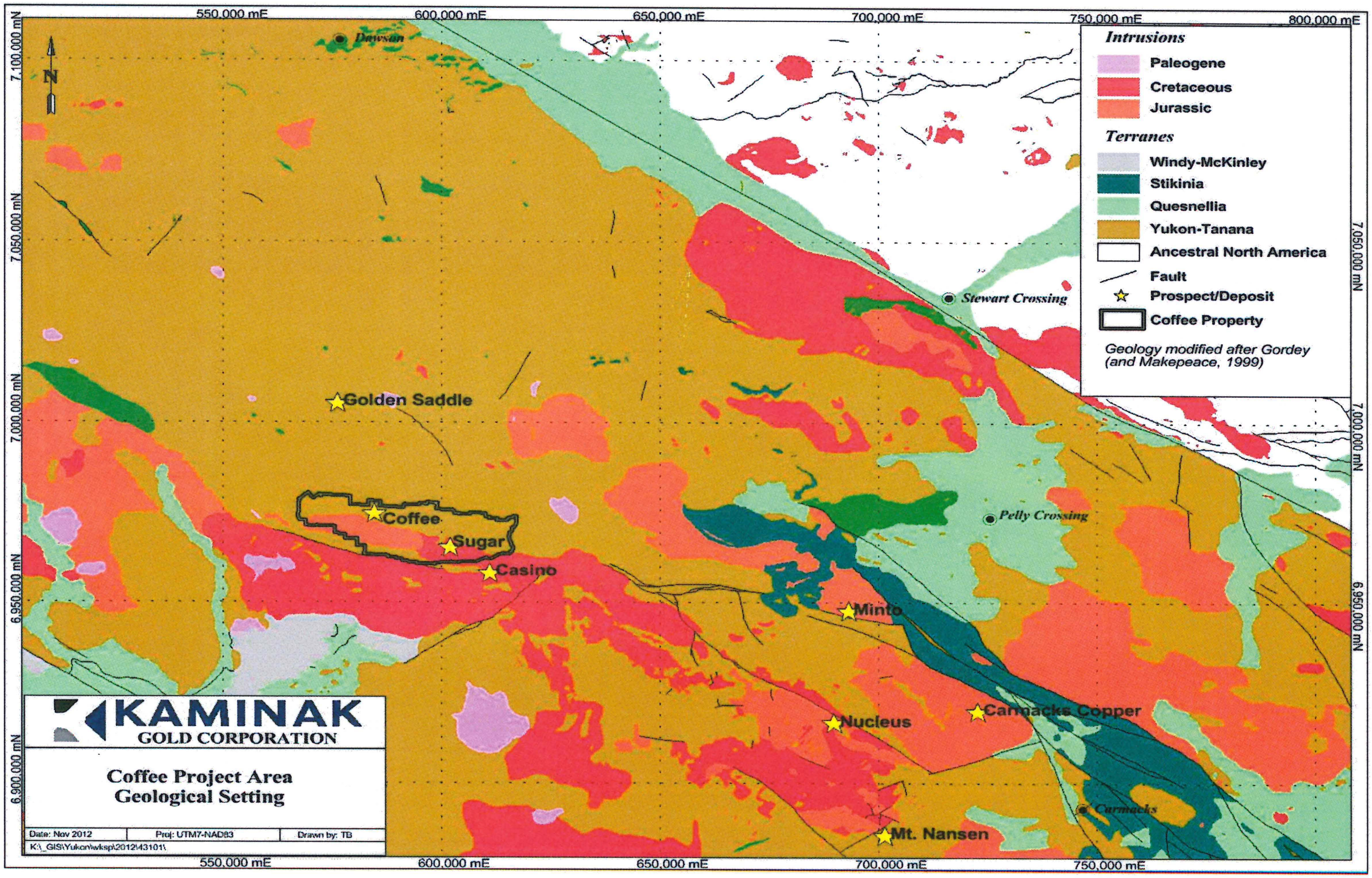
The YTT is composed of a basal metasiliclastic sequence overlain by three subsequent volcanic arcs. The oldest component of the Yukon-Tanana terrane is the pre-Late Devonian Snowcap assemblage, which consists of metasediments including psammitic schist, quartzite, and carbonaceous schist in addition to local amphibolite, greenstone, and ultramafic rocks (Piercey and Colpron, 2009). The Snowcap assemblage was deposited on the ancient Laurentian margin in a passive marine setting (Piercey and Colpron, 2009). The beginning of eastward subduction of the paleo-Pacific plate led to the formation of a magmatic arc at approximately 365 Ma (Colpron et al., 2006). Rapid westward slab rollback caused significant extension, which initiated the formation of the Slide Mountain Ocean back-arc basin by approximately 360 Ma (Colpron et al., 2007). Arc volcanism during the Wolverine-Finlayson magmatic cycle (365-342 Ma) deposited submarine mafic and felsic volcanic rocks of the widespread Finlayson assemblage onto the Snowcap assemblage (Colpron et al., 2006).

A reversal of subduction polarity during the Late Permian resulted in the western margin of Slide Mountain Ocean subducting beneath the evolving YTT (Erdmer et al., 1998). This subduction initiated a magmatic arc which was active from 269-253 Ma and formed the Klondike arc assemblage, the youngest member of the outboard Yukon-Tanana terrane (Allan et al., 2013; Colpron et al., 2006). Closure of the Slide Mountain Ocean by the Latest Permian led to the obduction of the YTT onto the Laurentian margin, causing a collisional event responsible for lower amphibolite facies metamorphism in the Coffee project area (Beranek and Mortensen, 2011). In addition, collision resulted in the development of a low-angle transpositional foliation recognized throughout the Yukon-Tanana terrane (S2 of Berman et al., 2007).

East-dipping subduction along the now docked YTT caused intra-arc shortening and contractional deformation. In the Klondike and the area of the Coffee project, thrust fault-bounded panels of Slide Mountain assemblage greenstone and serpentinized ultramafic occur within the tectonic stratigraphy of the YTT (Buitenhuis, 2014; MacKenzie et al., 2008). These thrust-emplaced slices are generally less than 100 m in thickness, dip to the southwest, and persist for tens of kilometres in some areas (MacKenzie and Craw, 2010 and 2012). The emplacement of these slices is contemporaneous with northeast-vergent, open to tight folding dated between 195 and 187 Ma (Berman et al., 2007).

Beginning in the early to mid-Cretaceous, localized rapid uplift and exhumation occurred throughout the YTT in Yukon and Alaska, including within the Dawson Range (McCausland et al., 2006; Dusel-Bacon et al., 2002; Gabrielese and Yorath, 1991). Extension and unroofing of the Dawson Range was accompanied by the emplacement of the Coffee Creek granite and Dawson Range batholith (~110-90 Ma; McKenzie et al., 2013; Wainwright et al., 2011; Colpron et al., 2006; Mortensen, 1992). This localized extension and exhumation is recorded by an apparent age-resetting event observed in white mica in western Yukon Tanana at roughly 90 Ma (Douglas et al., 2002), in rhenium-osmium dates in molybdenite (92.4 Ma), and U-Pb dates in monazite (92.5 Ma) from plutons in east-central Alaskan YTT (Selby et al., 2002). At the Coffee property, this extension resulted in the activation of the Coffee Creek fault system, a set of dextral strike-slip faults and associated north-to-northeast brittle faults interpreted as splays off of the regional Big Creek fault to the south east (Sánchez et al., 2013; Johnston, 1999).

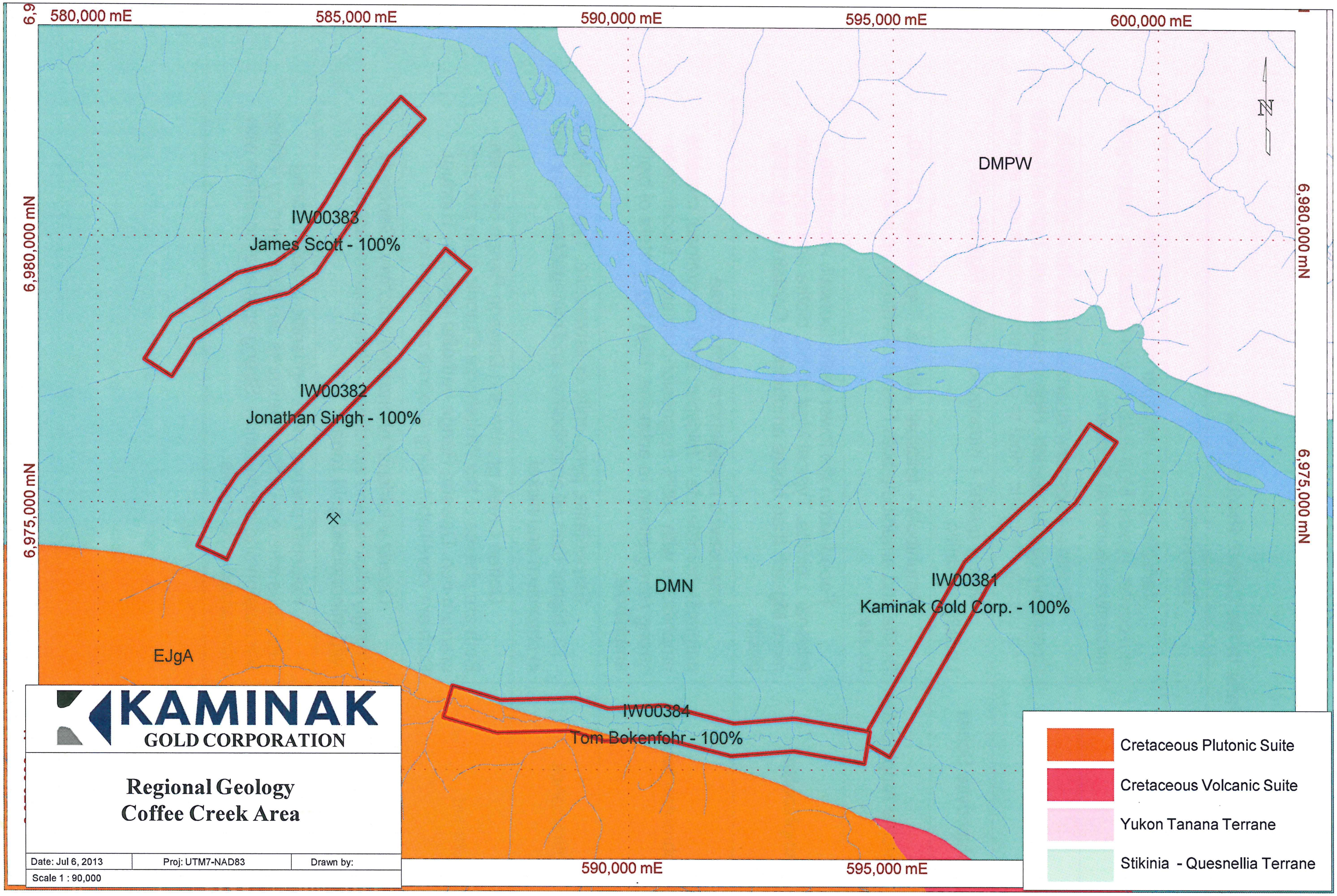
Figure 4-1: Geological Setting of the Coffee Project Area

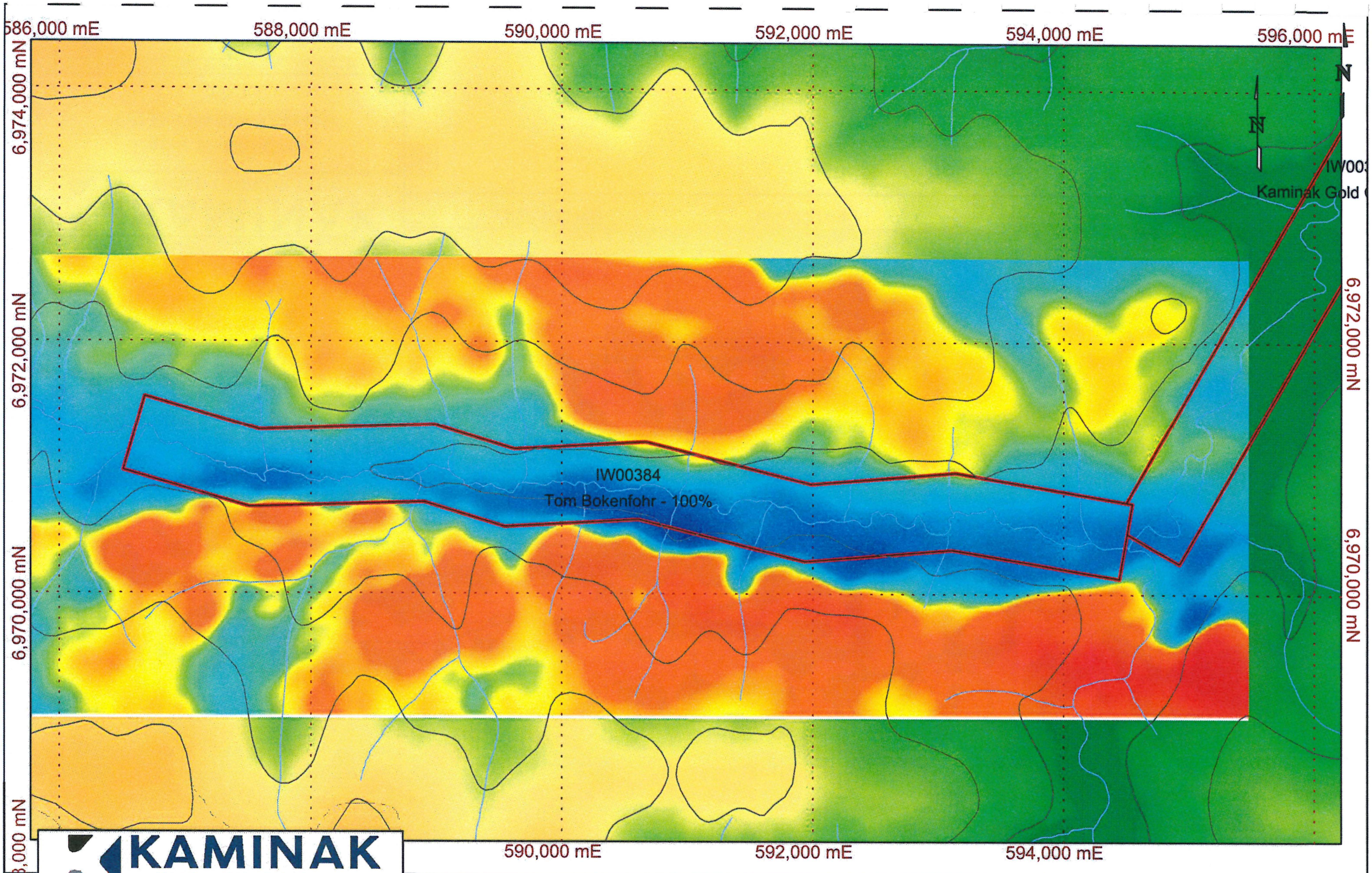


(Modified after Gordey and Makepeace, 1999)

Table 4-1: Main Rock Units in the Coffee Project Area

Rock Unit	Description
Felsic Gneiss	Variable quartz + feldspar augen + biotite + muscovite. Typical Mg# 2-28. Low in potassium. Host to gold mineralized zones at Supremo.
Biotite Schist	Biotite+/-feldspar+/-quartz+/-muscovite+/-amphibole. Commonly carbonate-rich. High in potassium. Typical Mg# 20 - 40.Locally mylonitic. Host to gold mineralized zones at Latte.
Muscovite Schist	Mainly quartz + muscovite. Typical Mg# 10 - 20. Locally mylonitic.
Biotite Amphibolite	Amphibole + feldspar + biotite. Typical Mg# 20 - 40. Biotite and amphibole both Fe-rich. Contains up to 20% biotite.
Amphibolite	Found within the lower mafic footwall. Amphibole + feldspar ± biotite. Typical Mg# 30-50, biotite and amphibole more Mg-rich than biotite amphibolite. Contains up to 15% biotite.
Metagabbro/Amphibolite	Interleaved metagabbro with coarse magnesiohornblende + feldspar, and fine-grained, massive amphibolite with >95% magnesiohornblende. Moderate to strong retrogression to actinolite. High Mg content of biotite, amphibole.
Ultramafics	Serpentinite, pyroxenite or listwaenite. Typical Mg# 50 - 73, higher than all amphibolites and metagabbro. Very high in chromium and nickel.
Granite	Coffee Creek granite and Dawson Range batholith. Both are phases of the Whitehorse Plutonic suite and are uranium-rich. Dawson Range batholith higher in Thorium. Both are identifiable using airborne radiometrics.
Dacite Dykes	Quartz + feldspar phenocryst porphyry. Generally strongly silicified and sericitized. Strong spatial association with mineralized gold zones.
Andesite Dykes	Feldspar phenocrystic. Aphanitic in gold bearing structures where all original textures are destroyed by intense silicification and sericitization. Strong spatial association with mineralized gold zones.


580,000 mE
585,000 mE
590,000 mE
595,000 mE
600,000 mE
6,980,000 mN
6,975,000 mN
DMPW
IW00383
James Scott - 100%
IW00382
Jonathan Singh - 100%
DMN
IW00381
Kaminak Gold Corp. - 100%
EJgA
IW00384
Tom Bokenfohr - 100%
N
KAMINAK
GOLD CORPORATION
Regional Geology
Coffee Creek Area
Date: Jul 6, 2013
Proj: UTM7-NAD83
Drawn by:
Scale 1 : 90,000
Cretaceous Plutonic Suite
Cretaceous Volcanic Suite
Yukon Tanana Terrane
Stikinia - Quesnellia Terrane



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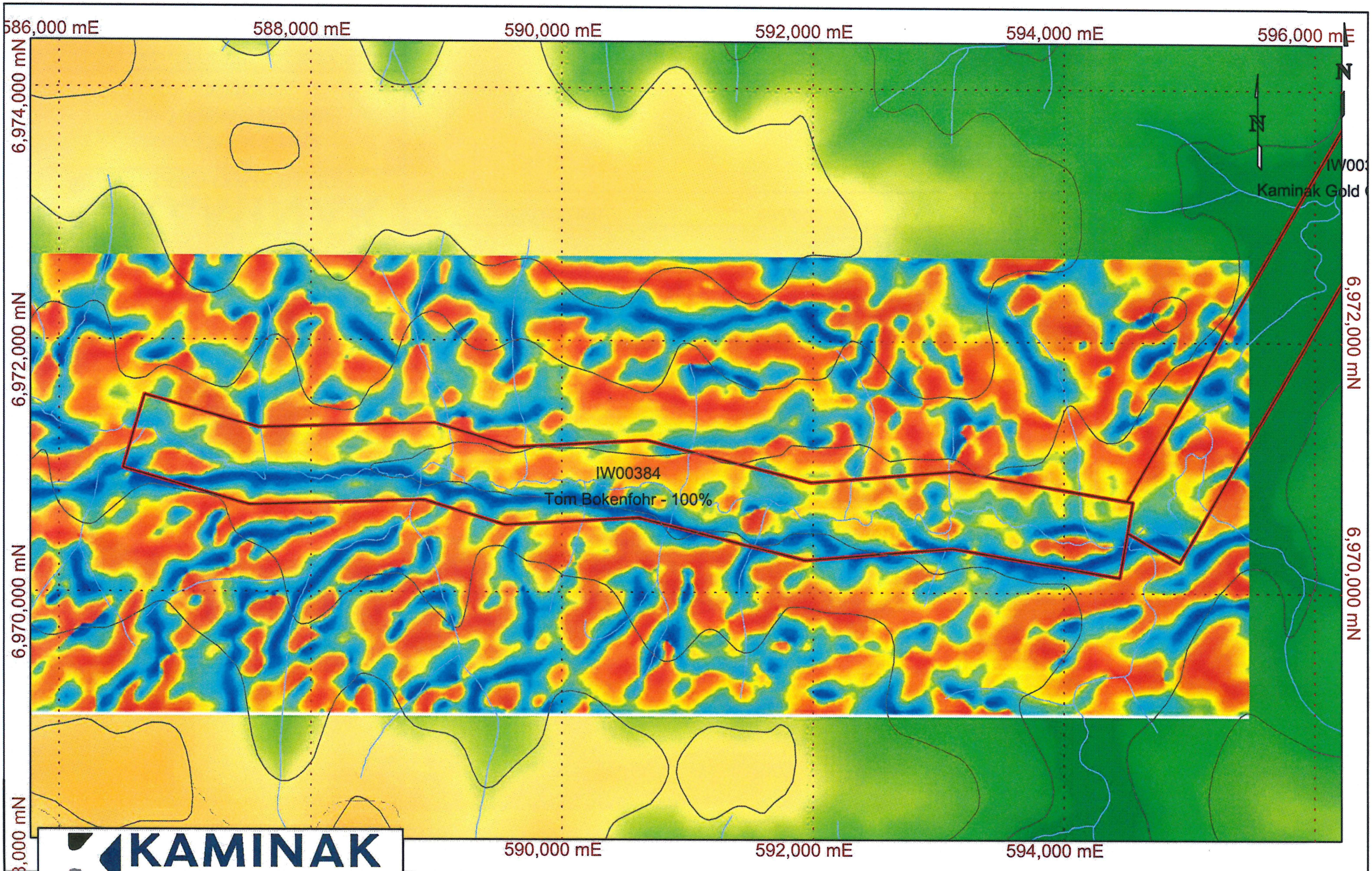
Upper Coffee Creek
Total Magnetic Intensity
Map

Date: Jul 6, 2013	Proj: UTM7-NAD83	Drawn by:
Scale 1 : 40,000		



KAMINAK
GOLD CORPORATION

Upper Coffee Creek
Tilt Derivative Response
Map

Date: Jul 6, 2013	Proj: UTM7-NAD83	Drawn by:
Scale 1 : 40,000		

4.0 MIDAS SURVEY

The MIDAS system is composed of a horizontal boom fixed to the belly of a helicopter containing two magnetometers, a fluxgate magnetometer and a GPS antenna for the flight path recovery. The helicopter has a tail boom mounted GPS antenna for in-flight navigation, radar, laser and barometric altimeters, video camera and data acquisition system. Please see Appendix 1 for more specific details on the system.

5.0 DISCUSSION AND CONCLUSIONS

5.1 Magnetic Response as Applied to Placer Exploration

The survey system used is of high resolution horizontal gradient array and with this data we are able to identify bedrock sources for mineralization (linear, narrow, magnetic lows), which do come to surface. These structures coming to surface and immediately downstream of them would be potentially viable placer targets. In conjunction with this I have been talking with a number of geophysicist that have suggested that with this data it should be possible to identify magnetite lenses in the river channel. These accumulations represent a proxy to gold, which tends to be sorted with other heavy minerals. By identifying these high density minerals we would be able to more accurately target possible gold mineralization in these drainages. This survey represents broader coverage than a ground survey, with comparable resolution so overall it is a more desirable tool for covering our entire property while capturing the responses within the drainages. This could significantly alter where test pits are focused to test for mineralization.

5.2 Results

The data collected provides good initial information indicating a major structural break running roughly in line with the creek itself, this feature is very prominent in the tilt derivative data and is interpreted as the Latte Fault, a first order structure that is likely non-mineralized. The total magnetic intensity is most elevated at 588,520mE 6,970,900mN and 586,980mE 6,971030mN which appear to be points where the creek meanders more these could represent the heavy mineral lenses which are the targets of this survey.

5.3 Conclusion

The technique appears to be able to differentiate subtle differences, but there is a large influence from the bedrock. Further post processing may be able to better delineate these subtle near surface features and filter out the influences of the bedrock.

Test pitting should be conducted in the identified magnetic highs within the lease, using the tilt derivative product to refine where the pits are placed to ensure great chance of success. If the method proves favourable, applying the same logic to the other features identified in this report could be a targeting technique that is satisfactory without having to conduct the desktop post-processing work. There is no suggestion of a bedrock source within this lease due to the interpreted first order latte fault.

Respectfully submitted,

Rory Kutluoglu, P.Geo
Vancouver, British Columbia
September 26th, 2014

Appendix A: References

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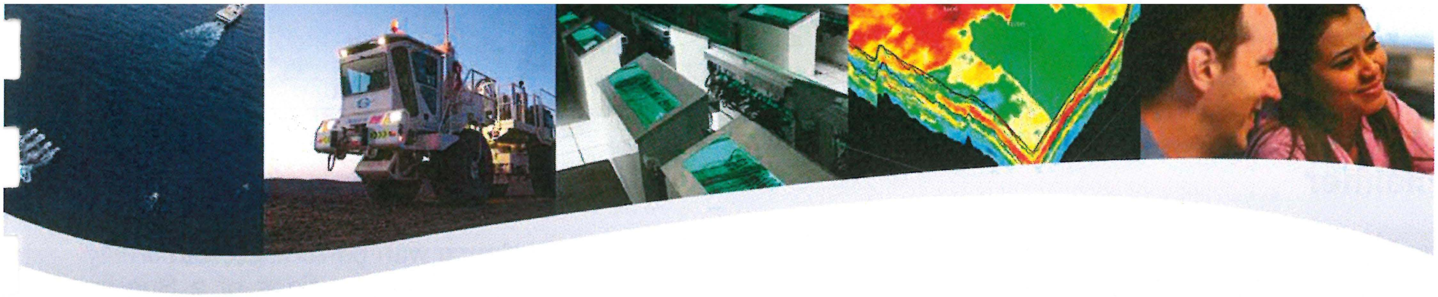
Appendix B: CGG Airborne Geophysical Survey Report



GEOPHYSICAL SURVEY REPORT

MIDAS HIGH RESOLUTION MAGNETIC SURVEY

FORT SELKIRK AREA

PROJECT 14013

KAMINAK GOLD CORP.

May 21, 2014

Disclaimer

1. The Survey that is described in this report was undertaken in accordance with current internationally accepted practices of the geophysical survey industry, and the terms and specifications of a Survey Agreement signed between the CLIENT and CGG. Under no circumstances does CGG make any warranties either expressed or implied relating to the accuracy or fitness for purpose or otherwise in relation to information and data provided in this report. The CLIENT is solely responsible for the use, interpretation, and application of all such data and information in this report and for any costs incurred and expenditures made in relation thereto. The CLIENT agrees that any use, reuse, modification, or extension of CGG's data or information in this report by the CLIENT is at the CLIENT's sole risk and without liability to CGG. Should the data and report be made available in whole or part to any third party, and such party relies thereon, that party does so wholly at its own and sole risk and CGG disclaims any liability to such party.

2. Furthermore, the Survey was performed by CGG after considering the limits of the scope of work and the time scale for the Survey.

3. The results that are presented and the interpretation of these results by CGG represent only the distribution of ground conditions and geology that are measurable with the airborne geophysical instrumentation and survey design that was used. CGG endeavours to ensure that the results and interpretation are as accurate as can be reasonably achieved through a geophysical survey and interpretation by a qualified geophysical interpreter. CGG did not perform any observations, investigations, studies or testing not specifically defined in the Agreement between the CLIENT and CGG. The CLIENT accepts that there are limitations to the accuracy of information that can be derived from a geophysical survey, including, but not limited to, similar geophysical responses from different geological conditions, variable responses from apparently similar geology, and limitations on the signal which can be detected in a background of natural and electronic noise, and geological variation. The data presented relates only to the conditions as revealed by the measurements at the sampling points, and conditions between such locations and survey lines may differ considerably. CGG is not liable for the existence of any condition, the discovery of which would require the performance of services that are not otherwise defined in the Agreement.

4. The passage of time may result in changes (whether man-made or natural) in site conditions. The results provided in this report only represent the site conditions and geology for the period that the survey was flown.

5. Where the processing and interpretation have involved CGG's interpretation or other use of any information (including, but not limited to, topographic maps, geological maps, and drill information; analysis, recommendations and conclusions) provided by the CLIENT or by third parties on behalf of the CLIENT and upon which CGG was reasonably entitled or expected to rely upon, then the Survey is limited by the accuracy of such information. Unless otherwise stated, CGG was not authorized and did not attempt to independently verify the accuracy or completeness of such information that was received from the CLIENT or third parties during the performance of the Survey. CGG is not liable for any inaccuracies (including any incompleteness) in the said information.

Introduction

This report describes the logistics, data acquisition, processing and presentation of results of a MIDAS magnetic airborne geophysical survey carried out for Kaminak Gold Corp. over one property near Dawson City, Yukon. Total coverage of the survey block amounted to 5504.2 km. The survey was flown between March 22 and April 3, 2014.

The purpose of the survey was to map the geology and structure of the area. Data were acquired using a MIDAS magnetic system with two high-sensitivity cesium magnetometers. The information from these sensors was processed to produce maps and images that display the magnetic properties of the survey area. A GPS electronic navigation system ensured accurate positioning of the geophysical data with respect to the base map coordinates.

The survey was performed by CGG Canada Services Ltd., Toronto office. Maps and data in digital format are provided with this report.

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Survey Area Description

Location of the Survey Area

One block near Dawson City, Yukon (Figure 1) was flown between March 22 and April 3, 2014, with Dawson City, Yukon as the base of operations. Survey coverage consisted of 5003.4 km of traverse lines flown with a spacing of 100 or 200 m and 500.7 km of tie lines with a spacing of 1000 or 2000 m for a total of 5504.2 km.

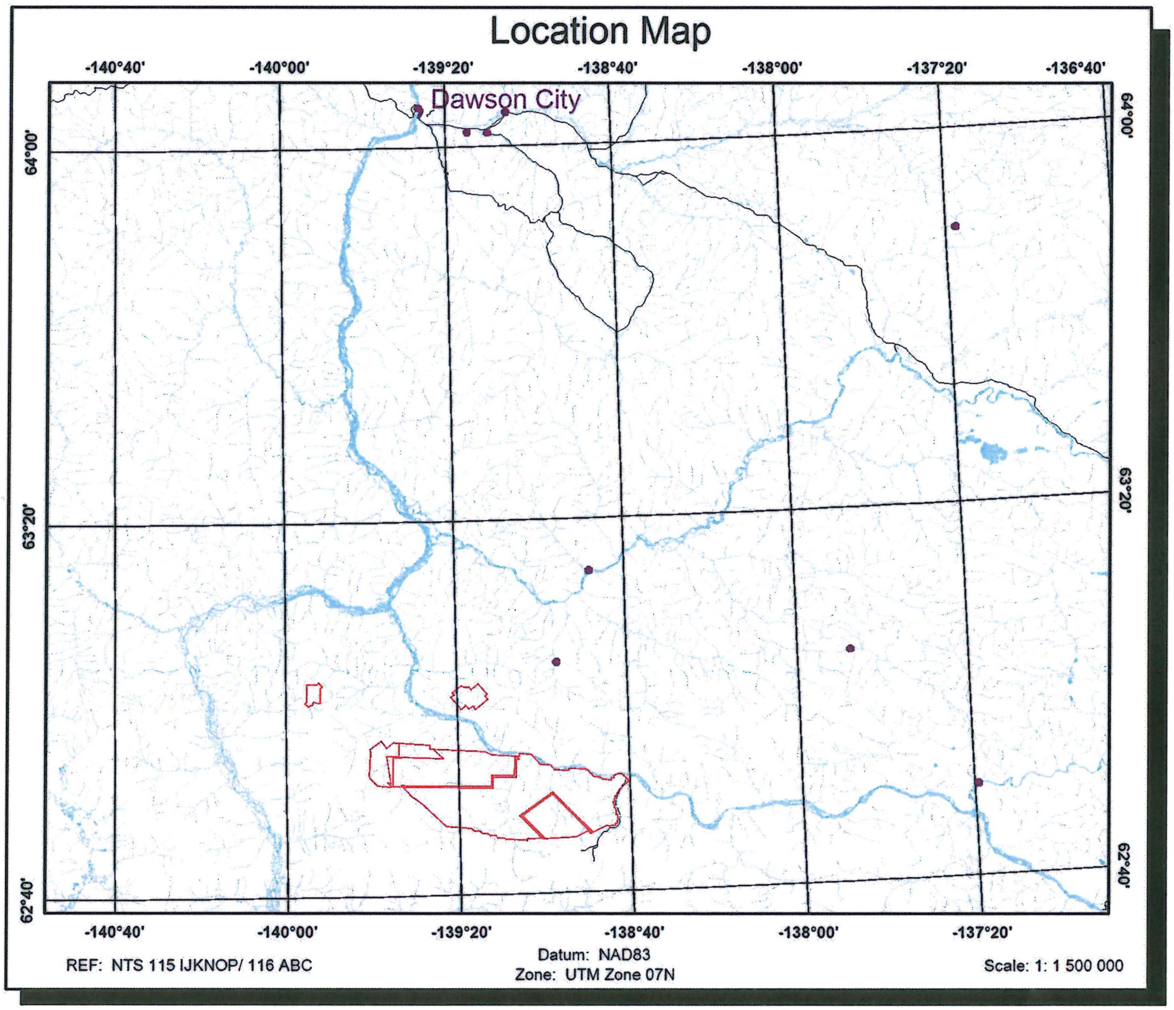


Figure 1 Fort Selkirk Area - Location Map

Table 1 contains the coordinates of the corner points of the survey blocks.

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-1	1	555571	6987137
Apollo Block	2	555395	6987136
	3	555032	6986774
	4	554656	6987135
	5	554313	6987489
	6	554655	6987831
	7	554649	6991246
	8	556660	6991250
	9	557025	6991620
	10	557394	6991251
	11	557745	6990901
	12	557395	6990549
	13	557400	6987596
	14	556947	6987596
	15	556125	6987879
	16	555875	6987155

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-2	1	588000	6986485
Kirkman Block	2	587458	6987131
	3	586695	6986511
	4	586407	6986865
	5	586118	6987219
	6	585763	6986931
	7	585746	6986944
	8	585119	6986418
	9	583095	6988831
	10	583740	6989372
	11	583444	6989727
	12	585200	6991191
	13	585493	6990841
	14	585516	6990860
	15	586061	6990874
	16	586138	6990784
	17	586253	6990880
	18	586645	6990890
	19	587075	6990376
	20	588480	6991547
	21	590240	6989444
	22	589881	6989145
	23	590413	6988510

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-3	1	567291	6978447
Coffee 1 Block	2	569447	6980143
	3	570583	6978703
	4	571974	6979786
	5	572402	6979716
	6	572983	6979677
	7	579121	6979270
	8	579139	6978619
	9	579752	6978587
	10	581717	6976619
	11	573306	6976854
	12	573307	6976728
	13	571780	6976728
	14	571825	6971093
	15	571521	6971106
	16	571501	6970976
	17	568827	6971137
	18	567217	6972749
	19	567135	6973115
	20	567435	6978083

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-4	1	573474	6971319
Coffee 2 Block	2	575578	6971224
	3	591210	6971170
	4	591265	6973334
	5	595745	6973310
	6	595812	6977190
	7	596686	6977162
	8	596711	6977611
	9	598959	6977483
	10	600898	6975562
	11	602645	6975459
	12	602921	6975345
	13	603771	6974480
	14	606468	6974326
	15	606495	6974782
	16	610090	6974578
	17	611549	6973122
	18	612699	6973057
	19	613205	6972578
	20	614914	6972481
	21	614941	6972929

Block	Corners	X-UTM (E)	Y-UTM (N)
	22	615390	6972904
	23	615418	6973360
	24	616342	6973764
	25	617034	6973725
	26	618387	6972368
	27	616492	6970590
	28	616095	6969669
	29	615910	6969241
	30	615620	6969258
	31	615572	6968455
	32	615496	6968279
	33	615248	6968195
	34	615510	6967431
	35	615485	6967015
	36	615656	6967004
	37	615892	6966315
	38	615852	6965642
	39	616129	6965625
	40	616275	6965199
	41	616203	6964115
	42	616132	6963823
	43	615743	6963847
	44	615721	6963475
	45	615523	6963410
	46	615268	6963425
	47	615265	6963383
	48	614382	6963289
	49	614075	6963497
	50	611128	6961941
	51	603315	6969657
	52	597315	6965368
	53	601796	6960861
	54	598436	6960806
	55	598409	6960355
	56	598346	6960359
	57	598346	6960487
	58	594229	6960608
	59	593839	6960943
	60	592580	6960943
	61	592181	6961396
	62	591027	6961399
	63	590543	6961856
	64	589478	6961856
	65	588970	6962316

	66	587825	6962359
	67	587305	6962854
	68	582339	6963149
	69	577906	6967443
	70	576312	6968639
	71	575619	6969096

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-5	1	601396	6960838
Coffee SE Infill	2	596853	6965406
Block	3	603346	6970048
	4	611320	6962172
	5	610950	6961801
	6	610659	6962068
	7	610313	6962323
	8	608012	6961209

Block	Corners	X-UTM (E)	Y-UTM (N)
14013-6	1	571421	6971764
Coffee NW Infill	2	570623	6977028
Block	3	573005	6977028
	4	572983	6979677
	5	573292	6979657
	6	579121	6979270
	7	579139	6978619
	8	590026	6978056
	9	591276	6977385
	10	596034	6977180
	11	596740	6976472
	12	596100	6976499
	13	596040	6973008
	14	591557	6973032
	15	591502	6970869
	16	575570	6970924
	17	571521	6971106
	18	570832	6971791

Table 1 Area Corners NAD83 UTM Zone 7N

Block	Line Numbers	Line direction	Line Spacing	Line km
1	10010 – 10490	135°/315°	100 m	110.6 km
Apollo Block	19010 – 19050	45°/225°	1000 m	11.9 km
2	20010 – 20590	140°/320°	100 m	237.9 km
Kirkman Block	29010 – 29060	50°/230°	1000 m	25.8 km
3	32300 – 33580	135°/315°	200 m	297.8 km
Coffee 1 Block	39010 – 39090	45°/225°	2000 m	31.0 km
4	40000 – 43240	135°/315°	200 m	1888.8 km
Coffee 2 Block	49110 – 49430	45°/225°	2000 m	189.0 km
5	51225 – 52015	135°/315°	100 m	719.7 km
Coffee SE Infill Block	59305 – 59405	45°/225°	1000 m	70.7 km
6	61245 – 63395	135°/315°	100 m	1750.0 km
Coffee NW Infill Block	69045 – 69245	45°/225°	1000 m	176.8 km

Table 2 Planned line kilometre summary

During the survey GPS base stations were set up to collect data to allow post processing of the positional data for increased accuracy. The location of the GPS base stations are shown in Table 3.

Status	Location Name	WGS84 Longitude (deg-min-sec)	WGS84 Latitude (deg-min-sec)	Orthometric Height (m)
Primary	Dawson City, Yukon	139° 07' 12.85" W	64° 02' 49.46" N	385.2
Secondary	Coffee Camp, Yukon	139° 05' 32.77" W	62° 54' 42.79" N	384.7

Table 3 GPS Base Station Location

The location of the Magnetic base stations are shown in Table 4.

Status	Location Name	WGS84 Longitude (deg-min-sec)	WGS84 Latitude (deg-min-sec)
Primary	Coffee Camp, Yukon	139° 05' 32.77" W	62° 54' 42.79" N

Table 4 Magnetic Base Station Location

System Information

Figure 2 MIDAS System

The MIDAS system is composed of a horizontal boom fixed to the belly of a helicopter containing two magnetometers, a fluxgate magnetometer and a GPS antenna for flight path recovery. The helicopter has a tail boom mounted GPS antenna for in-flight navigation, radar, laser and barometric altimeters, video camera and data acquisition system.

Aircraft and Geophysical On-Board Equipment

Helicopter:	AS350 B2
Operator:	Great Slave Helicopters
Registration:	C-GDCV
Average Survey Speed:	93.10 km/h (25.86 m/s)
Digital Acquisition:	CGG HeliDAS.
Video:	Panasonic WVCD/32 Camera with Axis 241S Video Server. Camera is mounted to the exterior bottom of the helicopter between the forward skid tubes
Magnetometer:	2-Scintrex Cesium Vapour (CS-2 and CS-3), mounted on a transverse boom (13.3 m separation); Operating Range: 15,000 to 100,000 nT Operating Limit: -40°C to 50°C Accuracy: ±0.002 nT Measurement Precision: 0.001 nT Sampling rate: 10.0 Hz
Fluxgate:	Billingsley TMF100 Triaxial fluxgate, mounted on one of the booms; Axial alignment: < ±1 degree Sensitivity: 100 µV per nT Sampling rate10.0 Hz
Radar Altimeter:	Honeywell Sperry Altimeter System. Radar antennas are mounted to the exterior bottom of the helicopter between the forward skid tubes Operating Range: 0 – 2500ft Operating Limit: -55°C to 70°C 0 to 55,000 ft Accuracy: ± 3% (100 – 500ft above obstacle) ± 4% (500 – 2500ft above obstacle) Measurement Precision: 1 ft Sample Rate: 10.0 Hz
Laser Altimeter:	Optech G-150 mounted on the belly of the helicopter; Operating Range: 0.2 to 250 m

Operating Limit: -10°C to 45°C
Accuracy:
±5 cm (10°C to 30°C)
±10 cm (-10°C to 45°C)
Measurement Precision: 1 cm
Sample Rate: 10.0 Hz

Aircraft Navigation: NovAtel OEM4 Card with an Aero antenna mounted on the tail of the helicopter;

Operating Limit: -40°C to 85°C
Real-Time Accuracy:
1.2m CEP (L1 WAAS)
Real-Time Measurement Precision: 6 cm RMS
Sample Rate: 2.0 Hz

Barometric Altimeter: Motorola MPX4115AP analog pressure sensor mounted in the helicopter

Operating Range: 55 kPa to 108 kPa
Operating Limit: -40°C to 125°C
Accuracy:
± 1.5 kPa (0°C to 85°C)
± 3.0 kPa (-20°C to 0°C, 85°C to 105°C)
± 4.5 kPa (-40°C to -20°C, 105°C to 125°C)
Measurement Precision: 0.01 kPa
Sampling Rate = 10.0 Hz

Temperature: Analog Devices 592 sensor mounted on the camera box

Operating Range: -40°C to + 75°C
Operating Limit: -40°C to + 75°C
Accuracy: ± 1.5°C
Measurement Precision: 0.03°C
Sampling Rate = 10.0 Hz

Base Station Equipment

Primary Magnetometer: CGG CF1 using Scintrex cesium vapour sensor with Marconi GPS card and antenna for measurement synchronization to GPS. The base station also collects barometric pressure and outside temperature.

Magnetometer Operating Range: 15,000 to 100,000 nT
Barometric Operating Range: 55kPa to 108 kPa
Temperature Operating Range: -40°C to 75°C
Sample Rate: 1.0 Hz

GPS Receiver: NovAtel OEM4 Card with an Aero antenna

Real-Time Accuracy:
1.8m CEP (L1)

Sample Rate: 1.0 Hz

Secondary Magnetometer:	GEM Systems GSM-19

Operating Range: 20,000 to 120,000 nT
Operating Limit: -40°C to 60°C
Accuracy: ± 0.2 nT
Measurement Precision: 0.01 nT
Sample Rate: 0.33 Hz

Quality Control and In-Field Processing

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 CGG Atlas software. This allowed the field personnel to calculate, display and verify both the positional (flight path) and geophysical data. The initial database was examined as a preliminary assessment of the data acquired for each flight.

In-field processing of CGG survey data consists of differential corrections to the airborne GPS data, filtering of all geophysical and ancillary data, verification of the digital video, and diurnal correction of magnetic data.

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

Navigation

A specialized GPS system provided in-flight navigation control. The system determined the absolute position of the helicopter by monitoring the range information of twelve channels (satellites). The Novatel OEM4 receiver was used for this application. In North America, the OEM4 receiver is WAAS-enabled (Wide Area Augmentation System) providing better real-time positioning.

A Novatel OEM4 GPS base station was used to record pseudo-range, carrier phase, ephemeris, and timing information of all available GPS satellites in view at a one second interval. These data are used to improve the conversion of aircraft raw ranges to differentially corrected aircraft position. The GPS antenna was set-up in a location that allowed for clear sight of the satellites above. The set-up of the antenna also considered surfaces that could cause signal reflection around the antenna that could be a source of error to the received data measurements.

Flight Path

Flight lines did not deviate from the intended flight path by more than 25% of the planned flight path over a distance of more than 1 kilometre. Flight specifications were based on GPS positional data recorded at the helicopter.

Clearance

The survey elevation is defined as the measurement of the helicopter radar altimeter to the tallest obstacle in the helicopter path. An obstacle is any structure or object which will impede the path of the helicopter to the ground and is not limited to and includes tree canopy, towers and power lines.

Survey elevations may vary based on the pilot's judgement of safe flying conditions around man-made structures or in rugged terrain.

The average survey elevation achieved for the helicopter and instrumentation during data collection was:

Helicopter	35 metres
Magnetometer	35 metres

Survey elevations did not deviate by more than 20% over a distance of 2 km from the contracted elevation.

Flying Speed

The average calculated ground speed was 93.10 km/h ranging between 26 to 142 km/h. This resulted in a ground sample interval of approximately 0.7 to 3.9 metres at a 10 Hz sampling rate.

Airborne High Sensitivity Magnetometer

To assess the noise quality of the collected airborne magnetic data, CGG monitors the 4th difference results during flight which is verified post flight by the processor. The contracted specification for the collected airborne magnetic data was that the non-normalized 4th difference would not exceed 1.6 nT over a continuous distance of 1 kilometre excluding areas where this specification was exceeded due to natural anomalies.

Magnetic Base Station

Ground magnetic base stations were set-up to measure the total intensity of the earth's magnetic field. The base stations were placed in a magnetically quiet area, away from power lines and moving metallic objects. The contracted specification for the collected ground magnetic data was the non-linear variations in the magnetic data were not to exceed 10 nT per minute. CGG's standard of setting up the base station within 50 km from the centre of the survey block allowed for successful removal of the active magnetic events on the collected airborne magnetic data.

Compensation System

The presence of the helicopter in close proximity to the sensors causes considerable interference on the readings. The orientation of the aircraft with respect to the sensors and the motion of the aircraft through the earth's magnetic field are contributing factors. A special calibration flight is flown to record the information necessary to remove these effects.

The manoeuvre consists of flying a series of calibration lines at high altitude to gain information in each of the required line directions. During this procedure, the pitch, roll and yaw of the aircraft are varied. Each variation is conducted in succession (first vary pitch, then roll, then yaw).

A three-axis fluxgate magnetometer measures the orientation and rates of change of the aircraft's magnetic field with respect to the earth's magnetic field. A compensation algorithm is applied to generate a set of coefficients for each line direction and for each magnetometer sensor to compensate for permanent, induced and eddy current magnetic noise generated by the aircraft.

Data Processing

Flight Path Recovery

To check the quality of the positional data the speed of the bird is calculated using the differentially corrected x, y and z data. Any sharp changes in the speed are used to flag possible problems with the positional data. Where speed jumps occur, the data are inspected to determine the source of the error. The erroneous data are deleted and splined if less than five seconds in length. If the error is greater than five seconds the raw data are examined and if acceptable, may be shifted and used to replace the bad data. The GPS-Z component is the most common source of error. When it shows problems that cannot be corrected by recalculating the differential correction, the barometric altimeter is used as a guide to assist in making the appropriate correction. The corrected WGS84 longitude and latitude coordinates were transformed to NAD83 using the following parameters.

Datum:	NAD83
Ellipsoid:	GRS80
Projection:	UTM Zone 7N
Central meridian:	141° West
False Easting:	500000 metres
False Northing:	0 metres
Scale factor:	0.9996
WGS84 to Local Conversion:	Molodensky
Dx,Dy,Dz:	0, 0, 0

Recorded video flight path may also be linked to the data and used for verification of the flight path. Fiducial numbers are recorded continuously and are displayed on the margin of each digital image. This procedure ensures accurate correlation of data with respect to visible features on the ground. The fiducials appearing on the video frames and the corresponding fiducials in the digital profile database originate from the data acquisition system and are based on incremental time from start-up. Along with the acquisition system time, UTC time is also recorded in parallel and displayed (Figure 3).

Altitude Data

Radar altimeter data are despiked by applying a 1.5 second median and smoothed using a 1.5 second Hanning filter. The radar altimeter data are then subtracted from the GPS elevation to create a digital elevation model that is gridded and used in conjunction with profiles of the radar altimeter and flight path video to detect any spurious values.

Laser altimeter data are despiked and filtered using an alpha-trim filter. The laser altimeter data are then subtracted from the GPS elevation to create a digital elevation model that is examined in grid format for spurious values. The laser does a better job of piercing the tree canopy than the radar altimeter.

Flight Number Heading (°) Fiducial

UTC Time (HH:MM:SS.S)

Speed (km/h)

Latitude DDMM.MMMM (WGS84)
Longitude: DDMM.MMMM (WGS84)

Figure 3 Flight path video

Magnetic Base Station Diurnal

The raw diurnal data are sampled at 1 Hz and imported into a database. The data are filtered using a long wavelength filter to retain wavelengths longer than 51 seconds. A non linear variation is then calculated and a flag channel is created to indicate where the variation exceeds the survey tolerance. Acceptable diurnal data are interpolated to a 10 Hz sample rate and the local regional field value of 56992.5, calculated from the average of the first day's diurnal data, was removed to leave the diurnal variation. This diurnal variation is then ready to be used in the processing of the airborne magnetic data.

Total Magnetic Field

The Total Magnetic Field (TMF) data collected in flight were profiled on screen along with a fourth difference channel calculated from the TMF. Spikes were removed manually where indicated by the fourth difference. The despiked data were then corrected for lag by 2.0 seconds. The diurnal variation that was extracted from the filtered ground station data was then removed from the despiked and lagged TMF. Once, the diurnal was removed, a magnetic value for the centre of the measurement platform was calculated by taking the average of the lagged and diurnally corrected, port and starboard magnetic sensors. The results were then levelled using tie and traverse line intercepts. Manual adjustments were applied to any lines that required levelling, as indicated by shadowed images of the gridded magnetic data. The manually levelled data were then subjected to a microlevelling filter.

Transverse Magnetic Gradient

Transverse magnetic gradient data was calculated from the lag corrected port and starboard sensors of the MIDAS system. The gradient was calculated with respect to the flight line direction with the median removed on a line-by-line basis. The results were then subjected to a microlevelling filter to remove any short wavelength residual line-to-line discrepancies.

Enhanced Total Magnetic Field

Bi-directional gridding with the transverse gradient should produce a surface that correctly renders both the measured data and the measured horizontal gradient at each survey line. This can be an advantage when gridding data that include features approaching the line-separation in size and also for rendering features that are not perpendicular to the line direction, particularly those which are sub-parallel to the line direction

Final transverse magnetic gradient data were used in conjunction with the Total Magnetic Field to create a Horizontal Gradient Enhanced grid of the Total Magnetic Field. This grid was created using the enhanced bi-directional gridding tool in proprietary CGG Atlas software.

Calculated Vertical Magnetic Gradient

The Enhanced Total Magnetic Field grid was subjected to a processing algorithm that enhances the response of magnetic bodies in the upper 500 metres and attenuates the response of deeper bodies. The resulting vertical gradient grid provides better definition and resolution of near-surface magnetic units. It also identifies weak magnetic features that may not be quite as evident in the TMF data. Regional magnetic variations and changes in lithology, however, may be better defined on the Total Magnetic Field.

Digital Elevation

The laser altimeter values are subtracted from the differentially corrected and de-spiked GPS-Z values to produce profiles of the height above mean sea level along the survey lines. These values are gridded to produce contour maps showing approximate elevations within the survey area. Any subtle line-to-line discrepancies are manually removed. After the manual corrections are applied, the digital terrain data are filtered with a microlevelling algorithm.

The accuracy of the elevation calculation is directly dependent on the accuracy of the two input parameters, laser altimeter and GPS-Z. 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 ±5 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, THIS PRODUCT MUST NOT BE USED FOR NAVIGATION PURPOSES.

Contour, Colour and Shadow Map Displays

The magnetic 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.

Final 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. Most parameters can be displayed as contours, profiles, or in colour.

Maps

Base maps of the survey area were produced by converting published raster image 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 some of the final maps. All maps were created using the following parameters:

Projection Description:

Datum:	NAD83
Ellipsoid:	GRS80
Projection:	UTM Zone 7N
Central meridian:	141° West
False Easting:	500000 metres
False Northing:	0 metres
Scale factor:	0.9996
WGS84 to Local Conversion:	Molodensky
Dx,Dy,Dz:	0, 0, 0

Maps depicting the survey results have been plotted and provided as a PDF at a scale of 1:10,000 for sheet 1 and 2, while blocks 3 to 6 are provided at a scale of 1:20,000. Each parameter is plotted on one map sheet.

Final Map Products	No. of Map Sets Plotted
Total Magnetic Field	2
Calculated Vertical Magnetic Gradient of Total Magnetic Field	2
Horizontal Gradient Enhanced Total Magnetic Field	2
Calculated Vertical Gradient of Horizontal Gradient Enhanced Total Magnetic Field	2
Measured Transverse Magnetic Gradient	2

Table 5 Final Map Products

Digital Archives

Line and grid data in the form of a Geosoft database (*.gdb) and XYZ file and Geosoft grids (*.grd) have been written to DVD. The formats and layouts of these archives are further described in Appendix B (Data Archive Description).

Report

Two paper copies of this Geophysical Survey Report plus a digital copy in PDF format.

Flight Path Videos

All survey flights in BIN/BDX format with a viewer.

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 airborne survey over the Fort Selkirk Area, near Dawson City, Yukon. The various maps included with this report display the magnetic properties of the survey area.

The Apollo block (block 1) shows a magnetic high near the center of the map with magnetic lows to the East and West of the magnetic high. The magnetic high coincides with a topographic high peak, which possibly could indicate an intrusion. The total magnetic field shows an active region to the North, which is seen in the calculated vertical gradient.

The Kirkman block (block 2) shows a magnetic dipole to the North. The total magnetic field shows a North-East trending feature to the East, which coincides with a topographic valley and could indicate a contact or possible fault. The measured transverse magnetic gradient and calculated vertical gradient show a magnetic active East-West trend in the South, which coincides with a road.

The Coffee block (blocks 3 to 6) show a South-East trending magnetic feature with one large magnetic trend across the whole map and a smaller magnetic trend to the South. The large South-East magnetic trend shows a break, which could indicate a contact or fault. The Western part of the break coincides with a topographic valley. The large South-East magnetic trend is magnetically active, which is confirmed by the calculated vertical gradient, and is straddled by less magnetically active zones to the North and South.

It is recommended that the survey results be assessed and fully evaluated in conjunction with all other available geophysical, geological and geochemical information. In particular, structural analysis of the data should be undertaken and areas of interest should be selected. An attempt should be made to determine the geophysical "signatures" over any known zones of mineralization in the survey areas or their vicinity.

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,

CGG

R14013

Appendix A List of Personnel

List of Personnel:

The following personnel were involved in the acquisition, processing, interpretation and presentation of data, relating to a MIDAS magnetic airborne geophysical survey carried out for Kaminak Gold Corp. over the Fort Selkirk Area near Dawson City, Yukon.

Duane Griffith	Manager, Geophysical Services
Brett Robinson	Project Manager
Chris Sawyer	Flight Planner
Aaron Rampersad	Electronics Technician
Glenn Charbonneau	Pilot (Great Slave Helicopters)
Jason Howes	AME (Great Slave Helicopters)
Amanda Heydorn	Data Processor
Patrice Marchesi	Data Processor
Nigel Stack	Data Processor
Alex Zlojutro	Data Processor

All personnel were employees of CGG, except where indicated.

Appendix B Data Archive Description

Data Archive Description:

Survey Details:

Survey Area Name: Fort Selkirk Area
Project number: 14013
Client: Kaminak Gold Corp.
Survey Company Name: CGG
Flown Dates: March 22 to April 3, 2014
Archive Creation Date: April 23, 2014

Geodetic Information for map products:

Datum: NAD83
Ellipsoid: GRS80
Projection: UTM Zone 7N
Central meridian: 141° West
False Easting: 500000 metres
False Northing: 0 metres
Scale factor: 0.9996
WGS84 to Local Conversion: Molodensky
Dx,Dy,Dz: 0, 0, 0

Grid Archive:

Geosoft Grids:

File	Description	Units
14013_*_TMI_NAD83Z7	Total Magnetic Field	nT
14013_*_CVG_NAD83Z7	Calculated Vertical Magnetic Gradient of Total Magnetic Intensity	nT/m
14013_*_TMI_HE_NAD83Z7	Horizontal Gradient Enhanced Total Magnetic Field	nT
14013_*_CVG_HE_NAD83Z7	Calculated Vertical Magnetic Gradient of Horizontal Gradient Enhanced Total Magnetic Intensity	nT/m
14013_*_MHG_NAD83Z7	Measured Transverse Magnetic Gradient	nT/m

Note – * represents block number (M represents blocks 3-6 merged and MHS represents blocks 3-6 merged with High Sense data).

Linedata Archive:

Geosoft Database Layout:

Field	Variable	Description	Units
1	x	Easting NAD83 Zone 7	m
2	y	Northing NAD83 Zone 7	m
3	fid	fiducial	-
4	longitude	Longitude WGS84	degrees
5	latitude	Latitude WGS84	degrees
6	flight	Flight number	-
7	date	Flight date	yyyy/mm/dd
8	altrad_heli	Helicopter height above surface from radar altimeter	m
9	altlas_heli	Helicopter height above surface from laser altimeter	m
10	gpsz	Helicopter height above geoid	m
11	dtm	Digital terrain model (above geoid)	m
12	diurnal	Measured ground magnetic intensity	nT
13	diurnal_cor	Diurnal correction – base removed	nT
14	magport _raw	Total magnetic field, port sensor – spike rejected	nT
15	magstar_raw	Total magnetic field, starboard sensor – spike rejected	nT
16	magport _comp	Total magnetic field, port sensor - compensated	nT
17	magstar_comp	Total magnetic field, starboard sensor - compensated	nT
18	mag_ave	Total magnetic field, average of port and starboard sensors	nT
19	mag_ave_lag	Total magnetic field, average of port and starboard sensors – corrected for lag	nT
20	mag_tmi	Total magnetic intensity	nT
21	transgrad	Measured transverse horizontal magnetic gradient	nT/m
22	fx	Fluxgate magnetometer, component 1	nT
23	fy	Fluxgate magnetometer, component 2	nT
24	fz	Fluxgate magnetometer, component 3	nT

Note – The null values in the GDB and XYZ archives are displayed as *.

Maps:

File	Description	Units
14013_*_TMI_^_NAD83Z7	Total Magnetic Field	nT
14013_*_CVG_^_NAD83Z7	Calculated Vertical Gradient of Total Magnetic Field	nT/m
14013_*_TMI_HE_^_NAD83Z7	Horizontal Gradient Enhanced Total Magnetic Field	nT
14013_*_CVG_HE_^_NAD83Z7	Calculated Vertical Gradient of Horizontal Gradient Enhanced Total Magnetic Field	nT/m
14013_*_MHG_^_NAD83Z7	Measured Transverse Magnetic Gradient	nT/m

Note – *: Sheet #, ^: Map Scale.

Report:
A logistics and processing report for Project #14013 in PDF format:

R14013.pdf

Video:

Digital video in BIN/BDX format for all survey flights including a viewer.

CGGSurveyReplay

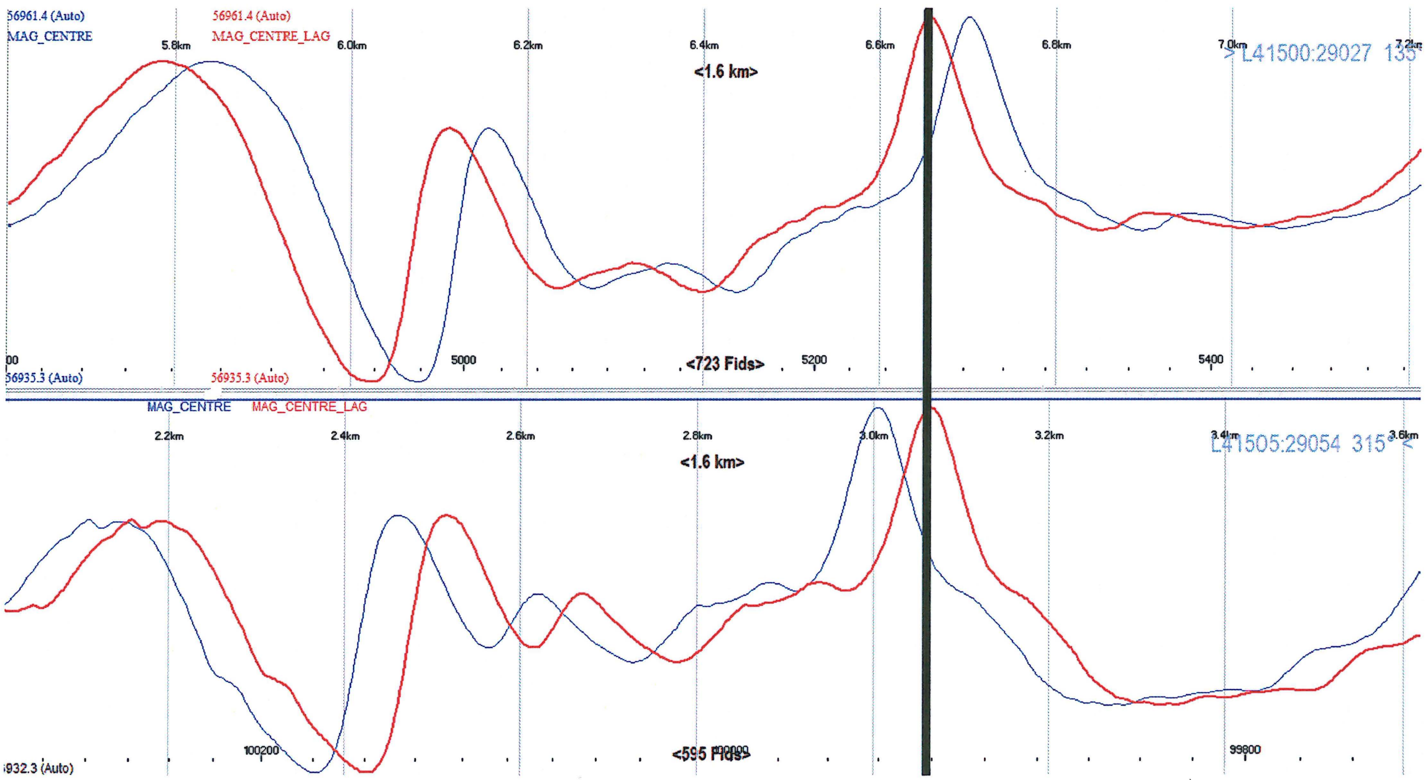
Appendix D Calibration and Tests

Magnetics Lag Test

Project Number: 14013
Date Flown: March 26, 2014
Flight Number: 29027

Survey Type: MIDAS Magnetic Survey
Aircraft Registration: C-GDVC
Location: Fort Selkirk Area

Correction Lag Applied: 20 seconds

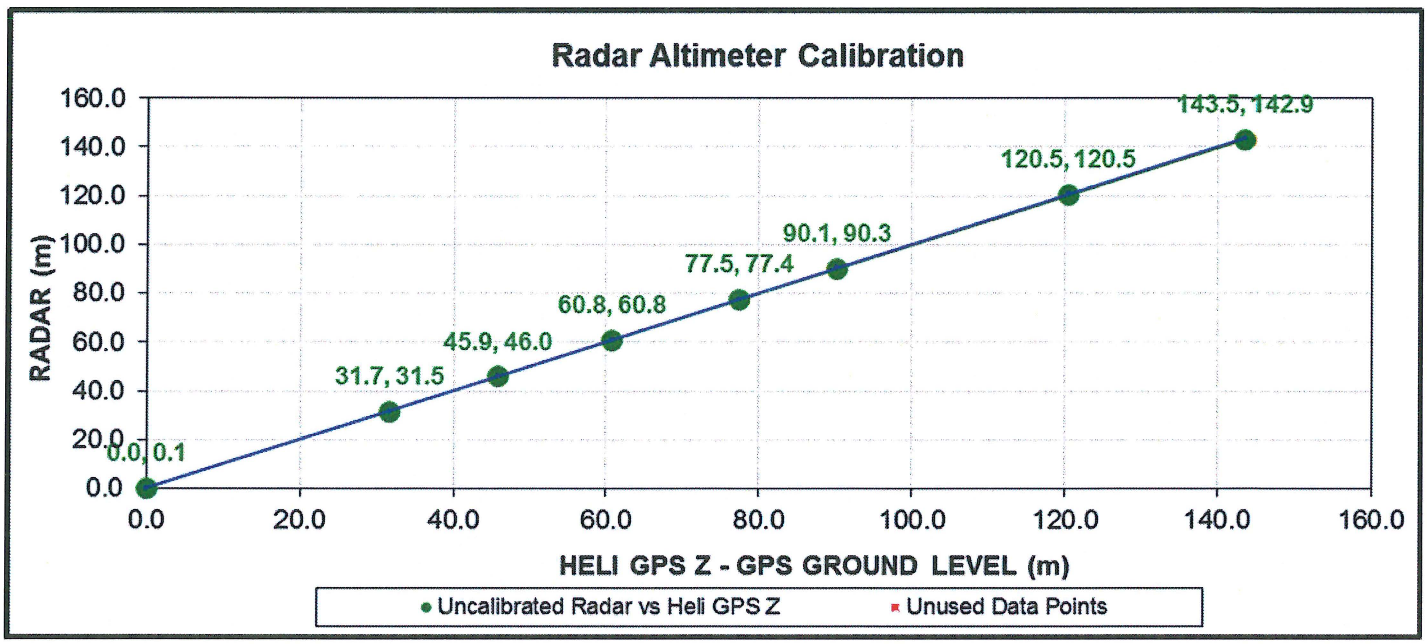


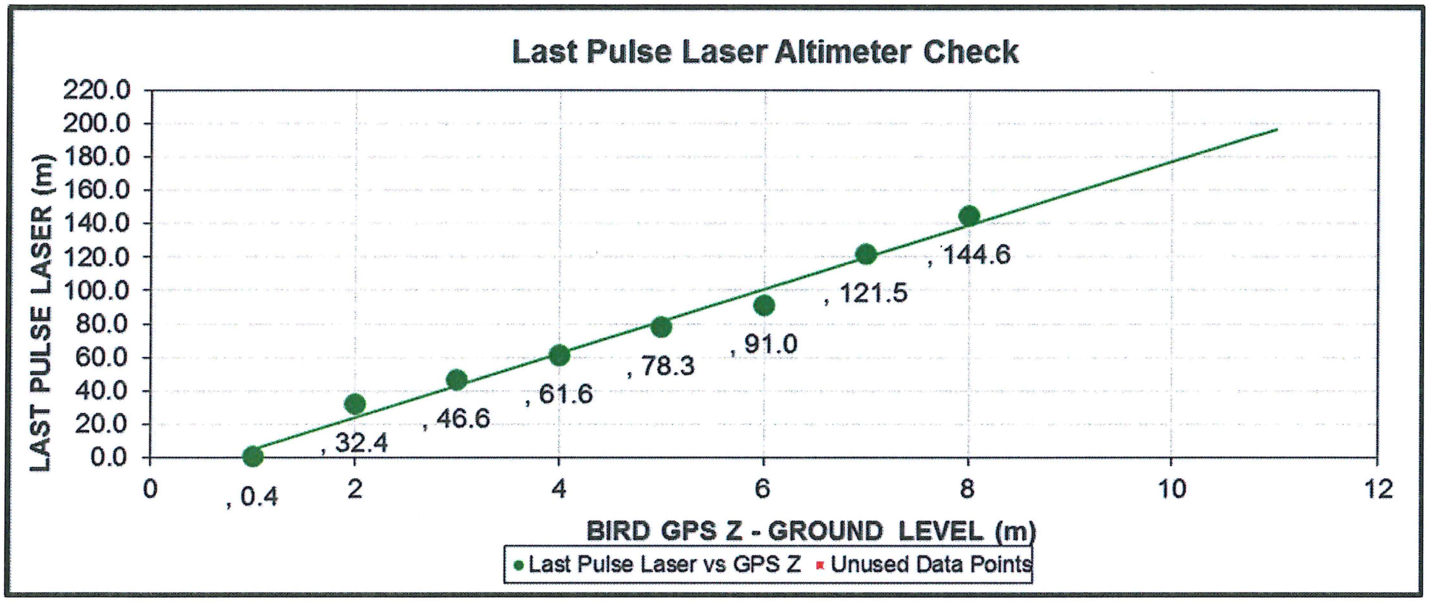
Altimeter Test

Project Number: 14013
Date Flown: March 23, 2014
Flight Number: 29017

Survey Type: MIDAS Magnetic Survey
Aircraft Registration: C-GDVC
Location: Fort Selkirk Area

LINE	TARGET RADAR (ft)	ZHG_HELI	ALTRAD_FT	ALTLASLP_M	ALTBAR_M
1	000	382.44	000.36	000.42	094.76
100	100	414.16	103.35	032.43	132.55
150	150	428.31	150.84	046.62	150.08
200	200	443.20	199.34	061.63	169.15
250	250	459.92	253.89	078.34	190.37
300	300	472.59	296.22	91.018	206.01
400	400	502.93	395.34	121.54	241.85
500	500	525.98	468.72	144.57	269.59




Last Pulse Laser Altimeter Check
LAST PULSE LASER (m)
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
0
2
4
6
8
10
12
, 0.4
, 32.4
, 46.6
, 61.6
, 78.3
, 91.0
, 121.5
, 144.6
BIRD GPS Z - GROUND LEVEL (m)
Last Pulse Laser vs GPS Z
Unused Data Points

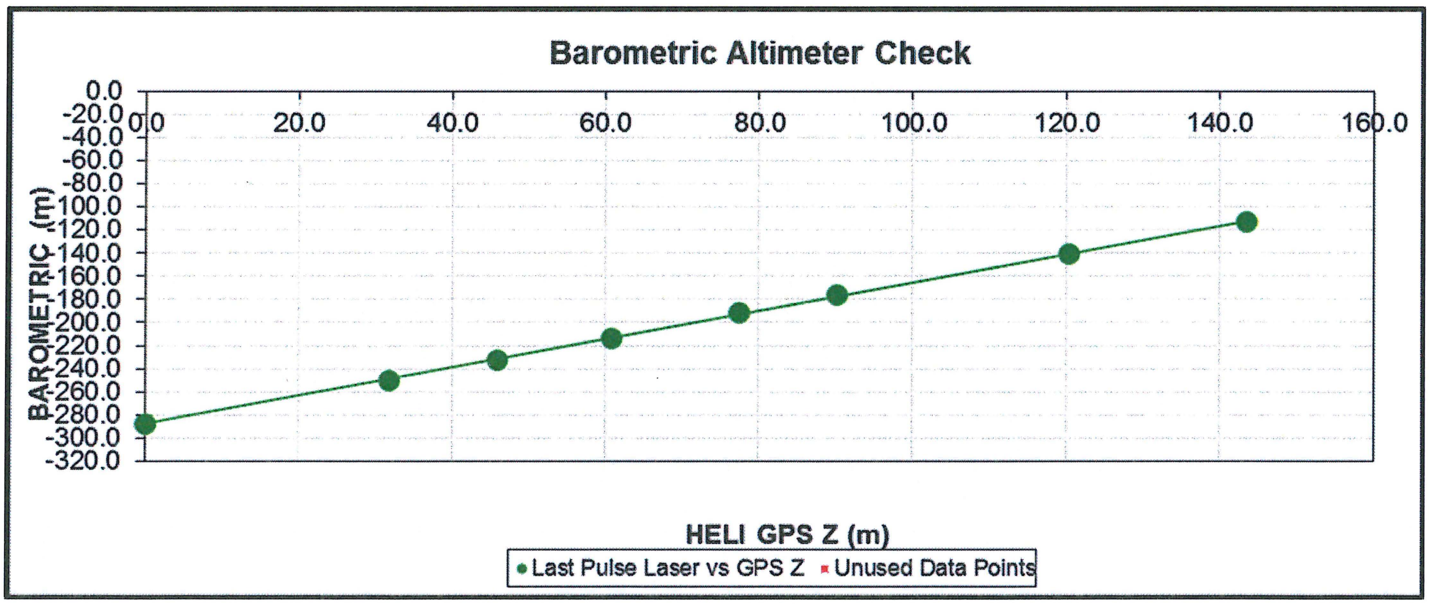

Barometric Altimeter Check
BAROMETRIC (m)
0.0
-20.0
-40.0
-60.0
-80.0
-100.0
-120.0
-140.0
-160.0
-180.0
-200.0
-220.0
-240.0
-260.0
-280.0
-300.0
-320.0
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
HELI GPS Z (m)
Last Pulse Laser vs GPS Z
Unused Data Points

Figure of Merit

Project Number: 14013
Date Flown: March 22, 2014
Flight Number: 29013

Survey Type: MIDAS Magnetic Survey
Aircraft Registration: C-GDVC
Location: Fort Selkirk Area

BOX 1	Sensor Position: STAR		Pitch	Roll	Yaw	Total	Figure of Merit
	Raw Mag Channel: MAG2U		Residual Peak to Peak	Residual Peak to Peak	Residual Peak to Peak		
	Line Number	Heading					
Direction 1:	452	45	0.09	0.14	0.19	0.43	1.69
Direction 2:	1352	135	0.06	0.14	0.14	0.34	
Direction 3:	2252	225	0.10	0.10	0.16	0.36	
Direction 4:	3152	315	0.13	0.19	0.25	0.57	

BOX 2	Sensor Position: PORT		Pitch	Roll	Yaw	Total	Figure of Merit
	Raw Mag Channel: MAG3U		Residual Peak to Peak	Residual Peak to Peak	Residual Peak to Peak		
	Line Number	Heading					
Direction 1:	452	45	0.10	0.13	0.26	0.49	1.64
Direction 2:	1352	135	0.11	0.10	0.16	0.37	
Direction 3:	2252	225	0.12	0.11	0.16	0.39	
Direction 4:	3152	315	0.07	0.12	0.20	0.39	

Appendix E Background Information

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.

Appendix F Glossary

CGG GLOSSARY OF AIRBORNE GEOPHYSICAL TERMS

accelerometer: an instrument that measures both acceleration (due to motion) and acceleration due to ***gravity***.

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.

AGG: Airborne ***gravity gradiometer.***

AGS: Airborne ***gamma-ray spectrometry***.

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**.

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.

attitude: the orientation of a geophysical system relative to the earth. Some surveys assume the instrument attitudes are constant, and other surveys measure the attitude and correct the data for the changes in response because of attitude.

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.

base magnetometer: A stationary magnetometer used to record the ***diurnal*** variations in the earth's magnetic field; to be used to correct the survey magnetic data.

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

bucking: The process of removing the strong ***signal*** from the ***primary field*** at the ***receiver*** from the data, to measure the ***secondary field***. It can be done electronically or mathematically. This is done in ***frequency-domain EM***, and to measure ***on-time*** in ***time-domain EM***.

calibration: a procedure to ensure a geophysical instrument is measuring accurately and repeatably. Most often applied in ***EM*** and ***gamma-ray spectrometry***.

calibration coil: A wire coil of known size and dipole moment, which is used to generate a field of known ***amplitude*** and ***phase*** or ***decay constant*** 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 in an HEM system 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 electrons as they pass through the 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.

continuation: mathematical procedure applied to ***potential field*** geophysical data to approximate data collected at a different altitude. Data can be continued upward to a higher altitude or downward to a lower altitude.

coplanar coils: **[CP]** In HEM, 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 channelling: See current gathering.

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.

daughter products: The radioactive natural sources of gamma-rays decay from the original "parent" element (commonly potassium, uranium, and thorium) to one or more lower-energy "daughter" 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, into their ***daughter*** products.

decay constant: see time constant.

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

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.

dose rate: see **exposure rate**.

drape: To fly a survey following the terrain contours, maintaining a constant altitude above the local ground surface. Also applied to re-processing data collected at varying altitudes above ground to simulate a survey flown at constant altitude.

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.

exposure rate: in radiometric surveys, a calculation of the total exposure rate due to gamma rays at the ground surface. It is used as a measurement of the concentration of all the **radioelements** at the surface. Sometimes called "dose rate".See also: **natural exposure rate**.

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.

Figure of Merit: **(FOM)** A sum of the 12 distinct magnetic noise variations measured by each of four flight directions, and executing three aircraft attitude variations (yaw, pitch, and roll) for each direction. The flight directions are generally parallel and perpendicular to planned survey flight directions. The FOM is used as a measure of the **manoeuvre noise** before and after **compensation.**

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

flight: a continuous interval of survey data collection, generally between stops at base to refuel.

flight-line: a single line of data across the survey area. Surveys are generally comprised of many parallel flight lines to cover the survey area, with wider-spaced ***tie lines*** perpendicular. Flight lines are generally separated by ***turn-arounds*** when the aircraft is outside the survey area.

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 harmonic ***primary field*** that oscillates over time (e.g. 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.

GGI: gravity gradiometer instrument. An airborne gravity gradiometer (AGG) consists of a GGI mounted in an inertial platform together with a temperature control system.

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 can be 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***.

gradiometer, gradiometry: instrument and measurement of the gradient, or change in a field with location usually for ***gravity*** or ***magnetic*** surveys. Used to provide higher resolution of ***targets***, better ***interpretation*** of ***target*** geometry, independence from drift and absolute field and, for ***gravity***, accelerations of the aircraft.

gravity: Survey collecting measurements of the earth's gravitational field strength. Denser objects in the earth create stronger gravitational pull above them.

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 for 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***).

HFEM: Helicopter Frequency-domain ElectroMagnetic, This designation is used for helicopter-borne, **frequency-*domain*** electromagnetic systems. Formerly most often called HEM.

HTEM: Helicopter Time-domain ElectroMagnetic, This designation is used for the new generation of helicopter-borne, ***time-domain*** electromagnetic systems.

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***)

induction number: also called the "response parameter", this number combines many of the most significant parameters affecting the ***EM*** response into one parameter against which to compare responses. For a ***layered earth*** the response parameter is $\mu\omega\sigma h^2$ and for a large, flat, ***conductor*** it is $\mu\omega\sigma th$, where μ is the ***magnetic permeability***, ω is the angular ***frequency***, σ is the **conductivity**, t is the thickness (for the flat conductor) and h is the height of the system above the conductor.

inductive limit: When the frequency of an EM system is very high, or the **conductivity** of the target is very high, the response measured will be entirely **in-phase** with no **quadrature** (**phase** angle =0). The in-phase response will remain constant with further increase in conductivity or frequency. The system can no longer detect changes in conductivity of the target.

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.

lead-in: approach to a ***flight line*** outside of survey area to establish proper track and stabilize instrumentations. The lead-in for a helicopter survey is generally shorter than required for fixed-wing.

line source, or line current: a long narrow object that creates an ***anomaly*** on an ***EM*** survey. Generally man-made objects like fences, power lines, and pipelines (***culture***).

mag: common abbreviation for ***magnetic.***

magnetic: ("**mag**") a survey measuring the strength of the earth's magnetic field, to identify geology and targets by their effect on the field.

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.

manoeuvre noise: variations in the magnetic field measured caused by changes in the relative positions of the magnetic sensor and magnetic objects or electrical currents in the aircraft. This type of noise is generally corrected by magnetic **compensation**.

model: Geophysical theory and applications generally have to assume that the geology of the earth has a form that can be easily defined mathematically, called the model. For example steeply dipping **conductors** are generally modeled as being **infinite** in horizontal and depth extent, and very thin. The earth is generally modeled as horizontally layered, each layer infinite in extent and uniform in characteristic. These models make the mathematics to describe the response of the (normally very complex) earth practical. As theory advances, and computers become more powerful, the useful models can become more complex.

natural exposure rate: in radiometric surveys, a calculation of the total exposure rate due to natural-source gamma rays at the ground surface. It is used as a measurement of the concentration of all the natural **radioelements** at the surface. See also: **exposure rate**.

natural source: any geophysical technique for which the source of the energy is from nature, not from a man-made object. Most commonly applied to natural source ***electromagnetic*** surveys.

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***.

overburden: In engineering and mineral exploration terms, this most often means the soil on top of the unweathered bedrock. It may be sand, glacial till, or weathered rock.

Phase, phase angle: 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 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***.

potential field: A field that obeys Laplace's Equation. Most commonly used to describe ***gravity*** and ***magnetic*** measurements.

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. **On-time** measurements may be made during 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***.

radioelements: This normally refers to the common, naturally-occurring radioactive elements: potassium (K), uranium (U), and thorium (Th). It can also refer to man-made radioelements, most often cobalt (Co) and cesium (Cs)

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.

receiver: the ***signal*** detector of a geophysical system. This term is most often used in active geophysical systems – systems that transmit some kind of signal. In airborne ***electromagnetic*** surveys it is most often a ***coil***. (see also, ***transmitter***)

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***.

response parameter: another name for the **induction number**.

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.***

spec: common abbreviation for *gamma-ray spectrometry*.

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***.

stinger: A boom mounted on an aircraft to carry a geophysical sensor (usually ***magnetic***). The boom moves the sensor farther from the aircraft, which might otherwise be a source of ***noise*** in the survey data.

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 ***decay time constant***.

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

thin sheet: A standard model for electromagnetic geophysical theory. It is usually defined as a thin, flat-lying conductive sheet, ***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.

transmitter: The source of the ***signa***l to be measured in a geophysical survey. In airborne ***EM*** it is most often a **coil** carrying a time-varying electrical current, transmitting the ***primary field***. (see also ***receiver***)

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. Also called a **flight line**.

turn-arounds: The time the aircraft is turning between one ***traverse*** or ***tie line*** and the next. Turn-arounds are generally outside the survey area, and the data collected during this time generally are not useable, because of aircraft ***manoeuvre noise***.

vertical plate: A standard model for electromagnetic geophysical theory. It is usually defined as thin conductive sheet, ***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***.

zero, or zero level: The ***base level*** of an instrument, with no ***ground effect*** or ***drift***. Also, the act of measuring and setting the zero level.

Common Symbols and Acronyms

k	Magnetic susceptibility
ε	Dielectric permittivity
μ, μ_r	Magnetic permeability, relative permeability
ρ, ρ_a	Resistivity, apparent resistivity
σ,σ_a	Conductivity, apparent conductivity
σt	Conductivity thickness
τ	Tau, or time constant
Ωm	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
FOM	Figure of Merit
fT	femtoteslas, common unit for measurement of B-Field in time-domain EM
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	nanotesla, a measure of the strength of a magnetic field
nT/s	nanoteslas/second; standard unit of measurement of secondary field dB/dt in time domain EM.
nG/h	nanoGreys/hour – gamma ray dose rate at ground level
ppm	parts per million – a measure of secondary field or noise relative to the primary or radioelement concentration.
pT	picoteslas: standard unit of measurement of B-Field in time-domain EM
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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Appendix C: Statement of Expenditures

Representation of work incurred on the Upper Coffee Creek Placer Lease during 2014 consisted of an airborne magnetic survey conducted by CGG, as well as other costs relating to compilation, interpretation and report writing.

FIELD WORK (MAR 2014)	Amount
Helicopter	$6,074.51
Accommodation and Meals	$258.54
Survey Costs	$15,399.76
Fuel Costs	$861.33
COMPILATION AND REPORT WRITING	
Geological Compilation	$325.00
(September, 2014)	
(0.5 days x $650. Per day)	
Assessment Report Writing	$650.00
(September, 2014)	
(1 days x $650. Per day)	
TOTAL	**$23,569.14**

Appendix D: Geologist's Certificates

GEOLOGIST'S CERTIFICATE

Rory A. M. Kutluoglu
702-1200 Alberni St.
Vancouver, BC, V6E 1A6

I, Rory Kutluoglu, am Exploration Manager of Kaminak Gold Corp., with offices at Suite 1020–800 West Pender Street in the City of Vancouver, B.C., in the Province of British Columbia.

I am a Practising Geoscientist, with offices at #1020–800 West Pender Street in the City of Vancouver, B.C., in the Province of British Columbia.

I am a registered Geoscientist with the Association of Professional Engineers and Geoscientists of BC and have been a practising member since November of 2011.

I am a graduate of Lakehead University (2004) with a Bachelor of Science degree in Geology and I have practiced my profession continuously since 2004.

Since 2004 I have been involved in mineral exploration for gold, silver, copper, nickel, PGEs, lead, diamonds, uranium, iron and zinc in Canada, USA and Mexico.

I am presently a full time employed Geologist and have been so since September 2009.

Dated at Vancouver, British Columbia, this 26th day of September, 2014.

Rory Kutluoglu, B.Sc Geology, P.Geo.