Paper 46

The Geophysical History of Discoveries in the James Bay Lowlands from the Victor Kimberlite to the Ring of Fire Copper and Nickel Deposits

Hogg, R.L.S. [1], Munro, S. [1]

1. Scott Hogg & Associates Ltd., Toronto, Ontario, Canada

ABSTRACT

The James Bay Lowlands is a large remote area of Northern Ontario with very limited access. The Archean basement rocks lie beneath a layer of Paleozoic limestone up to 300 m thick that is topped by glacial till and bog. This setting, without outcrop or hard geological knowledge, presented a blank slate well suited to airborne geophysical exploration. This paper presents the aeromagnetic survey methodology and analysis techniques that evolved from the initial kimberlite aeromagnetic program carried out by Selco in 1979 through the 1989 DeBeers discovery of the Victor kimberlite and the 1993 Spider/KWG discovery of the older sub-Paleozoic Kyle series kimberlites and eventually the Ring of Fire. Without property constraints, the exploration methodology was a cycle of survey-interpret-drill then move on and repeat as discoveries and finances permitted. After three cycles of kimberlite discovery, a Spider/KWG/DeBeers partnership encountered volcanogenic massive sulphide copper mineralization in 2001. An airborne electromagnetic survey in 2003 identified a number of excellent prospects and the most technically promising became the Noront Eagles Nest magmatic massive sulphide nickel deposit that began the Ring of Fire saga. These greenfield discoveries, in a blind geological environment beneath limestone cover, illustrate the potential effectiveness of geophysically directed exploration

EXPLORATION SETTING

The James Bay Lowlands (JBLL) of Northern Ontario cover about 100,000 km^2 of featureless terrain. Lakes, bogs and glacial till lie on top of a Paleozoic limestone section up to 400 m thick (Figure 1) that caps the Archean Superior Province of the Canadian Shield.

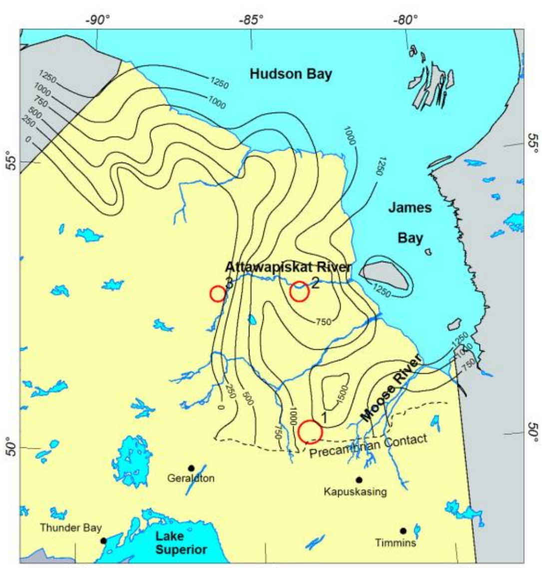


Figure 1: James Bay Lowlands of Northern Ontario, showing basement depth contours expressed in feet (Hobson, 1964). Activity areas discussed: 1 - Selco, 2 - De Beers (Victor Mine region), 3 - Ring of Fire.

Gold and volcanogenic massive sulphide (VMS) deposits surround the basin at a distance; however, the lack of outcrop and the remote location have deterred conventional mineral exploration even at the margins.

Even at the western margin of the basin geological and geophysical information was sparse, prior to the Ring of Fire (ROF) discoveries. Figure 2a presents the Ontario Geological Survey (OGS) geology map (Thurston et al., 1974) with bands of mafic to ultramafic rock indicated, but no sulphide mineralization was noted. The Geological Survey of Canada (GSC) aeromagnetic map (Figure 2b) shows some high amplitude trends that were probably considered in the creation of the geology map. The Paleozoic limestone formations cover what were to become the ROF mineral discoveries.

EARLY KIMBERLITE EXPLORATION AND DISCOVERY

Selco and Esso Minerals – Hearst

Kimberlite mineral sampling in the 1960s drew interest to the Attawapiskat and Moose Rivers basins (Figure 1). Selection Trust (later named Selco and subsequently BP Minerals) and Esso Minerals launched an aeromagnetic exploration program at the Southern end of the JBLL north of Hearst, Ontario, in 1980. In an area of thick limestone cover the aeromagnetic survey identified many shallow magnetic anomalies that were clearly indications of young post-Paleozoic pipe-like intrusives. Initial drill testing returned a tuffisitic breccia similar to diatreme facies kimberlite. By 1982, 45 such features had been drill tested and in the end 34 were formally identified as alkalines, seven as carbonatites and four as massive alnoites, a non-diamondiferous relative of kimberlite (Reed and Sinclair, 1991). As an example,

In "Proceedings of Exploration 17: Sixth Decennial International Conference on Mineral Exploration" edited by V. Tschirhart and M.D. Thomas, 2017, p. 663–669

three such anomalies associated with shallow intrusive rocks are identified on the total field magnetic map represented in Figure 3.

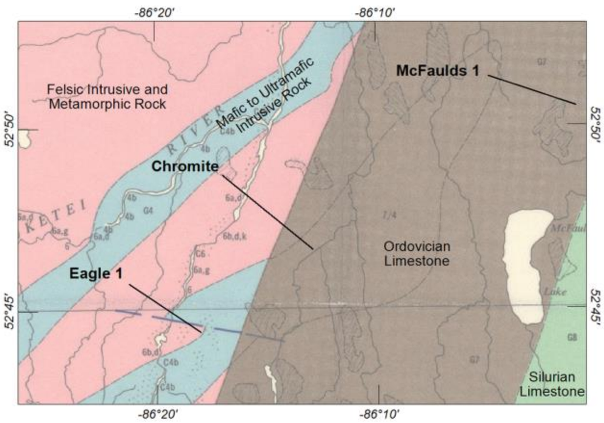


Figure 2a: OGS geology map (from Thurston et al., 1974).

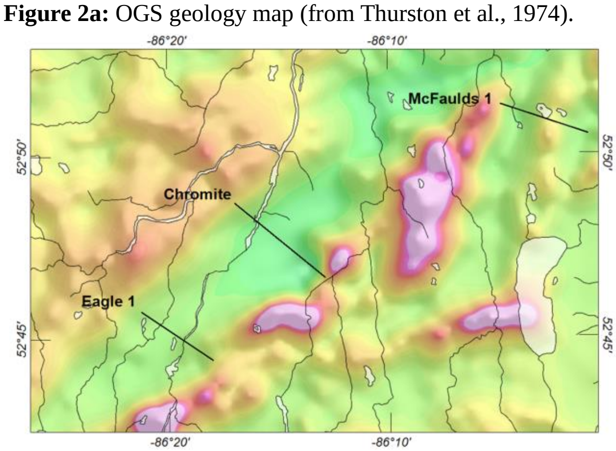


Figure 2b: GSC aeromagnetic map, flown circa 1966.

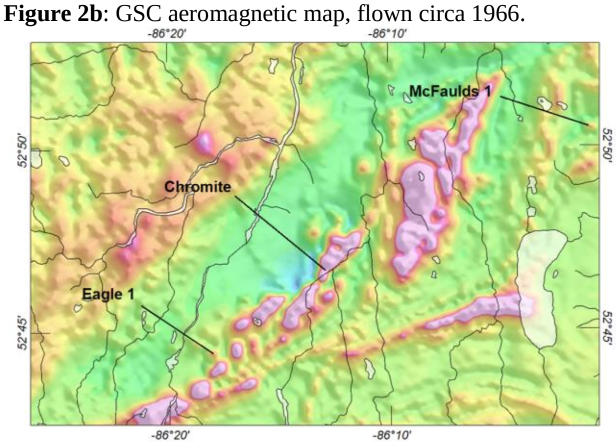


Figure 2c: Spider 3 aeromagnetic map, flown circa 1996.

DeBeers Attawapiskat

DeBeers (operating as Monopros in Canada) first began mineral sampling in the Attawapiskat River region in the 1960s and in 1986 they identified the "Uniform" kimberlite that outcrops on the bank of the Attawapiskat River. In 1988, they carried out a fixed-wing aeromagnetic survey of the local region that located 16 kimberlite pipes including "Victor" which subsequently became a mine (Winzar, 2001). It is interesting to note that the Golf, Victor, Whiskey and Yankee kimberlites were actually detected in 1966 by the GSC's regional aeromagnetic program (Figure 4). The GSC survey was flown at a terrain clearance of 300 m and line spacing of 800 m. The amplitudes of the magnetic anomalies associated with the kimberlites were, in general, less than 10 nT and thus not reflected in a recognizable way in the maps with 10 nT contour intervals.

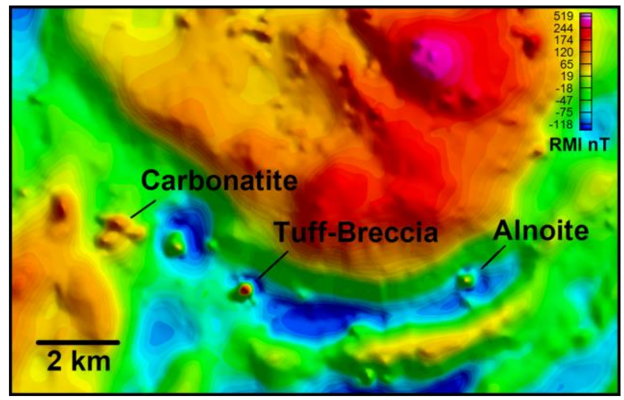


Figure 3: A sample of the 1980 Selco survey, flown at 250 m line spacing and 65 m above terrain. The source rock of several shallow intrusives is noted (Reid and Sinclair, 1991; Geological Survey of Canada, 2003).

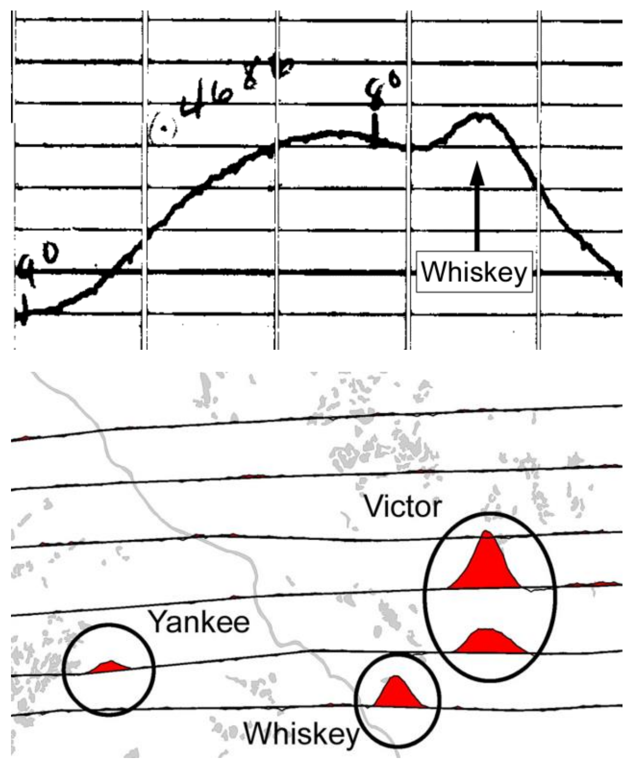


Figure 4: GSC aeromagnetic survey flown in 1966. The analog record (top panel) has a vertical scale of 10 nT per division. Residual filtered profiles in the bottom panel highlight near surface responses from Victor, Whiskey and Yankee kimberlites. Data courtesy of Scott Hogg & Assoc. Ltd.

Spider and KWG Kimberlite Exploration

De Beers did not immediately advertise their success. Spider Resources Inc. and KWG Resources Inc., in a joint venture, independently began a search for kimberlites in the area in 1992. They began a systematic aeromagnetic survey program in 1993, which originated over the De Beers territory. At 80 m terrain clearance and 200 m line spacing, the Spider survey clearly identified the De Beers discoveries. Most of the pipes were easily identifiable as shallow source anomalies with amplitudes ranging from 10s to 100s of nT on the total magnetic intensity (TMI) map. The Spider/KWG kimberlite discoveries were made with higher resolution helicopter magnetic surveys at 100 m line spacing and 30 m terrain clearance. The magnetic expression of the De Beers kimberlites Tango-1, Tango-extension and Bravo-1, and KWG/Spider kimberlites Good Friday, MacFadyen-1 and MacFadyen-2 is illustrated in Figures 5a and 5b.

It was determined that the larger kimberlites could be identified with a 400 m line spacing so an exploration program was designed that expanded westward at an initial 400 m line spacing that was subsequently infilled to 200 m spacing. Finally, the survey was continued further westward, past the edge of the basin, at 400 m spacing. This final survey extension was known as the Spider 3 area (Figure 2c) and was never infilled.

By 1996, 153,000 line-km of fixed-wing aeromagnetic data had been collected. Unlike conventional exploration settings there were no property bounds to consider. Apart from De Beers claims over their kimberlites, the ground was wide open in all directions.

The kimberlite exploration program was based on the aeromagnetic survey and analysis of the data relied on magnetic modelling. The pipes of the De Beers Attawapiskat swarm were relatively young and penetrated the 200 to 300 m of Paleozoic limestone cover to lie within a few tens of metres of the surface. The magnetic fabric of the underlying Archean rocks could be removed by filtering to clearly resolve the younger, shallow magnetic sources. The relative clarity by which these shallow kimberlites could be resolved is illustrated in Figure 5. Three of the kimberlites are resolved by the fixed-wing survey (Figure 5a) but an additional three pipes along a NW-SE magnetic basement trend are resolved only by the helicopter gradiometer survey Figure 5b.

Magnetic modelling of the known kimberlites revealed they fell in a relatively narrow magnetic susceptibility window; above that for collections of magnetic till, and below that of typical mafic rocks. Apart from weak till-based anomalies, all of the notable magnetic anomalies were kimberlite. In comparison to the Selco experience to the south, there were no other types of young intrusive rock to avoid. An anomaly at shallow depth with significant width and depth extent and moderate magnetic susceptibility was almost assured to be a kimberlite.

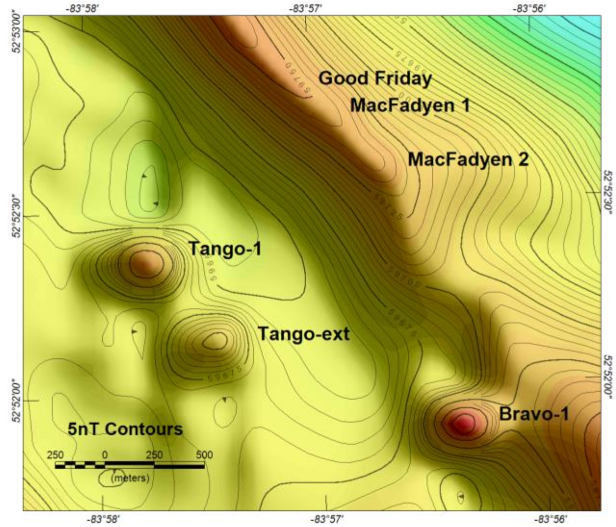


Figure 5a: Attawapiskat kimberlites; Spider fixed-wing TMI map, 200 m line spacing and 80 m terrain clearance. Ontario Geological Survey Geophysical Data Set 1211.

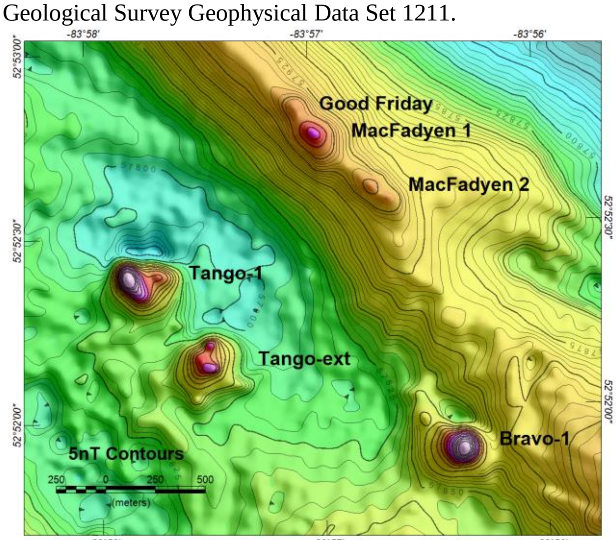
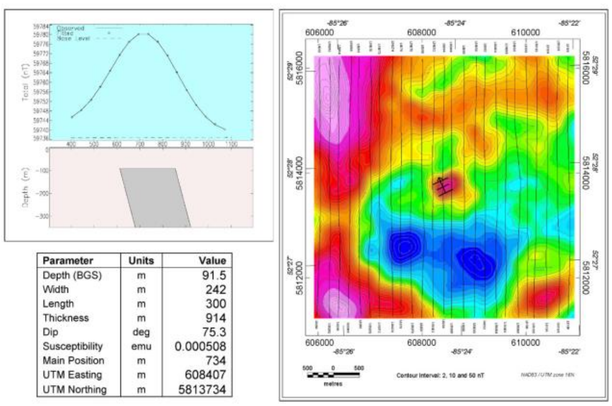


Figure 5b: Attawapiskat kimberlites; KWG Heli-GT 3-axis gradiometer TMI map, at 75 m line spacing and 30 m terrain clearance. Data courtesy KWG Resources Inc. and Noront Resources Ltd.

The airborne survey data, collected at 200 and 400 m spacing, was analyzed with primary focus on the identification of the ideal magnetic signature noted above. Ground magnetic surveying was logistically difficult and expensive so a helicopter towed magnetometer system was used to provide detailed magnetic maps of selected anomalies of interest. A sensor elevation of 30 m and line spacing of 100 m was adopted. At the time of the exploration program, hand held GPS units had limited accuracy, so to avoid the need for line cutting, a marker was placed close to the target prior to the detailed heli-mag survey and its location was recorded as part of the survey. The drill site could then be defined as an off-set from this ground reference point (Hogg and Munro, 2000).

In the first season, near the DeBeers swarm, two anomalies were identified that met the ideal criteria of shallow depth, significant width and depth extent, and moderate magnetic susceptibility. These priority targets became the MacFadyen 1 and 2 kimberlites. Beyond these there were no ideal magnetic prospects.

There was one anomaly named Kyle 1 (Figure 6) with all the right kimberlite characteristics, except depth which was estimated to be 90 to 130 m below surface. Although the depth did not fit the existing geological model, the anomaly was very isolated and singular in terms of its magnetic context. This "singularity" or "isolated" attribute is significant to kimberlite exploration since the intrusion of pipes is an event unrelated to the prior geological and magnetic context. It might be argued that the local host rock may provide a zone or axis of established crustal weakness that a kimberlite vent may follow but such suspected correlations are rare and may be simply coincidental. In spite of the indicated depth, the anomaly was included in the drill program. The target proved to be kimberlite. It also proved to be diamondiferous with an estimated age of 1100 Ma.



Parameter	Units	Value
Depth (BGS)	m	91.5
Width	m	242
Length	m	300
Thickness	m	914
Dip	deg	75.3
Susceptibility	emu	0.000508
Main Position	m	734
UTM Easting	m	608407
UTM Northing	m	5813734

Figure 6: Kyle 1 kimberlite aeromagnetic anomaly. The response amplitude is 45 nT and the modelled susceptibility is 0.0005 emu (or 0.0064 SI emu). Data courtesy of Scott Hogg & Assoc. Ltd.

The confirmation of a diamondiferous kimberlite beneath the limestone cover added another dimension to the exploration program. As the survey area expanded westward, the favoured target remained the shallow intrusive characteristic of the pipes of the Attawapiskat swarm; however, a new class of older pipe at depth became another important exploration target.

By 1996 four additional older pipes were identified and the group was named the Kyle series (1 through 5). Later exploration carried out by Metalex, 2006–2010, included higher resolution aeromagnetic mapping and led to the discovery of another older kimberlite, named T1 as well as the younger U1 and U2 kimberlites (Polk, 2008, 2009a). Higher resolution airborne and ground surveys by Spider and KWG resources identified the younger Good Friday kimberlite near the MacFadyen group (Butler, 2008).

Approaching the margin of the basin to the west, the depth/age discrimination that was so effective in identifying the Attawapiskat swarm is lost. At 80 m terrain clearance with 20 m. of limestone cover the contrast between a young intrusive (80 m) and older intrusive (100 m) was not considered sufficient for reliable model depth discrimination, especially with the lateral uncertainty associated with the 200 m or even 400 m flight line spacing. Only the modelled parameters and the apparent singularity of the anomaly relative to the surrounding magnetic context were available for follow-up prioritization.

During the period from 1994 to 1997 a total of 36 targets were selected for drill testing. Two young kimberlites, MacFadyen 1 and 2, as well as five older kimberlites, Kyle 1 through 5, were discovered. Although many targets did not prove to be kimberlite some were geologically intriguing; felsic and mafic gneiss, mafic and ultramafic volcanics, minor gold and massive iron sulphides. Although some of the geology encountered was interesting from a gold and VMS exploration perspective, the primary focus remained on kimberlite. Table 1 summarizes the geology encountered by the 36 exploration holes.

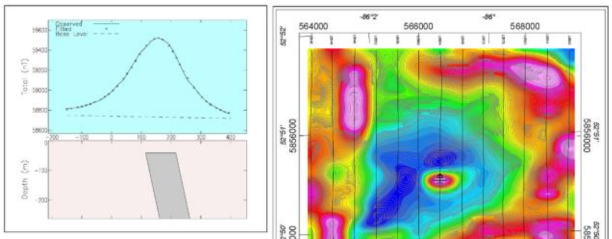
Geology Encountered	Number of Locations
MacFadyen 1-2 kimberlite	2
Kyle 1-5 kimberlite	5
Gneiss	7
Granite Gneiss	4
Felsic intrusive	1
Volcanics	3
Volcanics/breccia	1
Volcanics/Tuffs/Sediments	1
Iron formation/volcanics	1
Basalt	2
Basaltic tuff	1
Basalt-diorite	1
Massive iron sulphides (50m)	1
Mafic gneiss	2
Ultramafic rock	1
Karst?	1
unknown	2

Table 1: Number of encounters with different basement rock types for the 36 exploration holes. Data courtesy of KWG Resources Inc.

A geochemical and kimberlite indicator mineral (KIM) survey was carried out by Spider and KWG in 1996–1997 in the western Spider 3 area and has since been incorporated into a larger OGS survey (Crabtree, 2003). In 1997 the Bre-X crash seriously reduced the ability to finance and the Spider project became essentially dormant.

BASE METAL MINERAL EXPLORATION

In 2001 Spider and KWG formed a joint venture partnership with De Beers to continue exploration in the western Spider 3 area where only a few anomalies had been drilled in 1997. De Beers identified a number of prospects and carried out some local sampling. In 2001 a percussion drill was used to test a number of anomalies in this western section where the Paleozoic cover was thinning or absent. None proved to be kimberlite. Fortuitously they also ventured outside the established kimberlite norm and in April 2001 drilled a singular magnetic anomaly with high magnetic susceptibility, 0.024 emu (0.326 SI emu). They encountered massive copper and zinc sulphides, not kimberlite and named it the McFaulds 1 deposit.



Parameter	Units	Value
Depth (BGS)	m	41.5
Width	m	101.6
Length	m	100
Thickness	m	1098
Dip	deg	77.8
Susceptibility	emu	0.0236
Main Position	m	165
UTM Easting	m	566402
UTM Northing	m	5855165

Figure 7: McFaulds 1: An isolated magnetic anomaly with an amplitude of about 800 nT. The form is typical of kimberlite but the magnetic susceptibility of 0.02 emu (0.326 SI emu) is more than an order of magnitude higher than that of other kimberlites in the region. Note that the survey line spacing is 400 m. Data courtesy of Scott Hogg & Assoc. Ltd.

Following the VMS discovery, a number of small helicopter geophysical surveys, using the Fugro-Dighem frequency domain Mag/HEM system, were flown in July 2001. The illustrations in Figures 8 and 9 show that the McFaulds 1 deposit presented a singular well-defined EM response. A second isolated conductor to the northwest was proven to be another VMS deposit and was named the McFaulds 2. The discoveries were not publicly announced until November 2002.

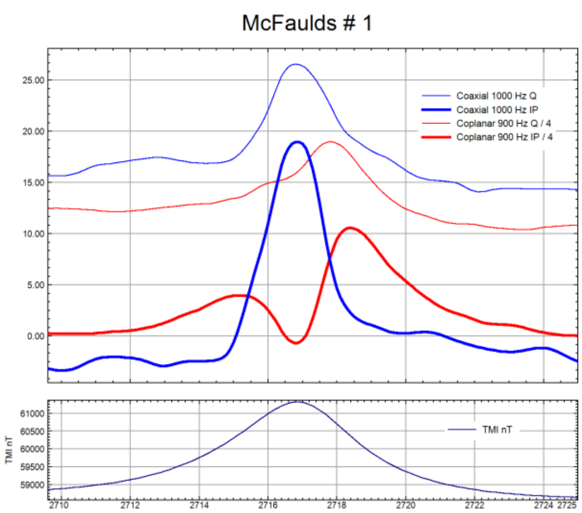


Figure 8: Fugro-Digem HEM and total field magnetic profile response. This is the classic response shape for a relatively narrow, steeply dipping conductor. Data courtesy KWG Resources Inc. and Noront Resources Ltd.

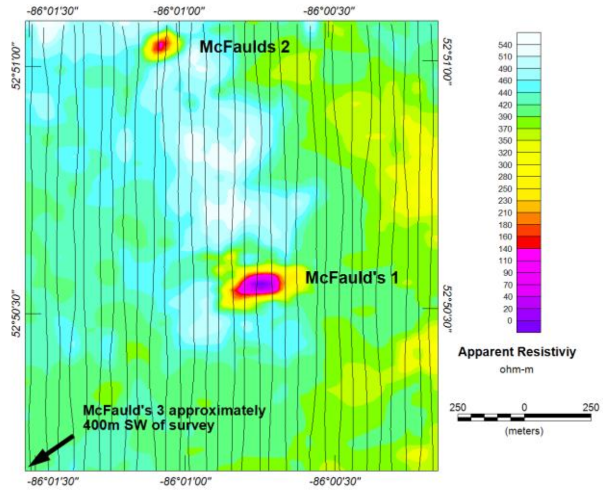
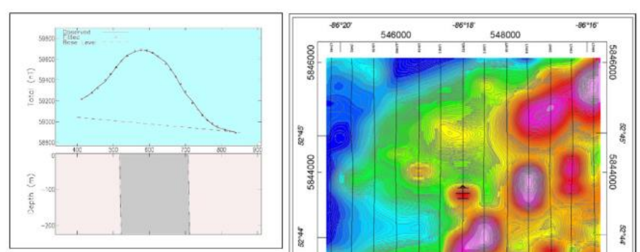


Figure 9: Fugro-Dighem HEM resistivity map. The background resistivity is around 450 ohm-m and the McFaulds 1 anomaly about 50 ohm-m. Data courtesy KWG Resources Inc. and Noront Resources Ltd.

Spider carried out some staking in the vicinity and De Beers withdrew from active participation in any non-diamond exploration. In 2003 Scott Hogg & Associates Ltd., was given permission to prepare an interpretation of the magnetic data (before the data was sold by Spider/KWG for public release by the Ontario Geologic Survey) for Condor Diamond Corporation. The original kimberlite interpretation had focused on isolated anomalies and a total of 420 features had been modelled. Kimberlite anomaly prioritization had favoured bodies with significant width and depth extent, both shallow and deep, with steep dip and moderate magnetic susceptibility. To open the selection process to potential VMS targets it was simply a matter of including the higher susceptibility bodies. In the fall of 2003 Condor staked a number of these anomalies, one of which (Figure 10), would later become the Eagle 1 magmatic massive sulphide (MMS) deposit.



Parameter	Units	Value
Depth (BGS)	m	4.89
Width	m	189.8
Length	m	200
Thickness	m	652
Dip	deg	88.9
Susceptibility	emu	0.00519
Main Position	m	612
UTM Easting	m	547218
UTM Northing	m	5843612

Figure 10: Eagle 1 magnetic anomaly, staked by Condor Diamond Corp. The amplitude is about 700 nT and the magnetic susceptibility is 0.00519 emu (0.065 SI emu), somewhat higher than the typical kimberlite in the region. Data courtesy of Scott Hogg & Assoc. Ltd.

In the summer of 2003 a syndicate that included Spider, KWG, Noront Resources and MacDonald Mines undertook an airborne EM survey of an area around the McFaulds VMS discoveries. Without a base camp and fuel, a fixed-wing survey operating from Pickle Lake was the only practical option. The Fugro GEOTEM 1000 system carried out 2,100 line km of survey at a line spacing pushed out to 300 m to accommodate a limited budget. In spite of the wide line spacing, the survey provided discrete anomalies that in the end were proven to be some very productive targets.

In Figure 11, the GEOTEM survey results in the vicinity of the McFaulds VMS deposits are presented. The new McFaulds 3 deposit (outside the boundary of the Dighem survey in Figure 9) has almost the identical magnetic and conductive signature as McFaulds 1. The McFaulds 2 presented a weaker response.

Other exploration companies, active in the area included Probe Mines, Fancamp Exploration and Freewest Resources. Land positions became complicated and some conductive trends crossed property boundaries. Deals were made and a number of joint ground magnetic and HLEM surveys were completed during 2004. It was during this period that Noront acquired the claims of Condor, including the yet to be tested Eagle 1 anomaly.

In 2005, it was still difficult to raise exploration financing and it was not until February 2006 that a joint venture of Freewest, KWG and Spider began a drill program south of the McFaulds zone. The GEOTEM survey had identified flat lying conductors, up to 50 Siemens conductance, over strong magnetic anomalies. The interpretation speculated that weathering of the magnetic unit might be the cause. These zones are outlined by a dotted line are illustrated in Figure 12, zone 8 and Figure 13, zone 15. In Figure 12 conductor axis 4a was interpreted to be a steeply dipping conductor with an estimated conductance of 57 Siemens**.** Drilling identified the source as massive sulphide, primarily pyrite. Conductor axis 6 was a weak response suggesting a conductor with NW dip. A drill hole, FW-06-03, located near the end of the yet to be defined Big Daddy chromite, encountered a thick peridotitic sill including two beds of chromite (Gowans and Murahwi, 2009). This was the first indication of chromite potential in the area.

Further to the southwest on Noront property the Fugro GEOTEM survey identified a steeply dipping conductor coincident with a magnetic anomaly (anomaly 14 in Figure 13). This response was interpreted as the most promising VMS type conductor within the GEOTEM survey area. It had an indicated conductance of 68 Siemens, the highest of the survey. Anomaly 15 was interpreted as a flat lying source with an indicated conductance of 45 Siemens, similar to anomalies 8 in Figure 12. Anomaly 12 was interpreted as having a steep NW dip with a conductance 43 Siemens.

By 2007, Noront had completed ground geophysical magnetic and HLEM surveys over their properties and were able to drill anomaly 14. In August they discovered what was to be called the Eagle 1 MMS nickel copper platinum-group elements (PGE) deposit (Greenough and Palmer, 2010).

Ring of Fire Launched

With the Noront discovery of Eagle 1 the "Ring of Fire" area with VMS, MMS and massive chromite, was launched. By the end of 2007 four drills were at the Noront site and extensive claim staking was in progress. Noront took the lead in organizing a shared Aeroquest airborne EM survey. By 2008 this survey had grown to include more than 28,000 line-km at 100 m spacing. In the spring of 2008 another VMS deposit was discovered, the Metalex 501 (Polk, 2009b). This was another magnetic target that had been previously staked on the basis of interpreted Spider 3 data. Since 2008 a sequence of geophysical mapping programs have been carried out that have involved just about every technology available. The rapidly expanding geological database from drill results has permitted a better understanding of the discovered mineralization and its context. Exploration continues.

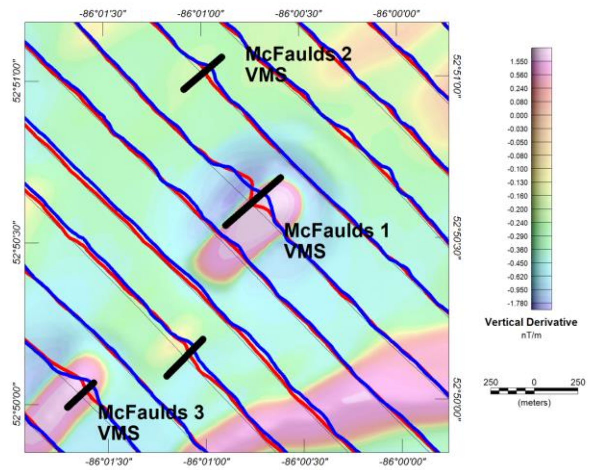


Figure 11: Fugro GEOTEM over McFaulds VMS. The background is calculated magnetic vertical gradient and the profiles are GEOTEM channel 16 (Z red, X blue). Data courtesy KWG Resources Inc. and Noront Resources Ltd.

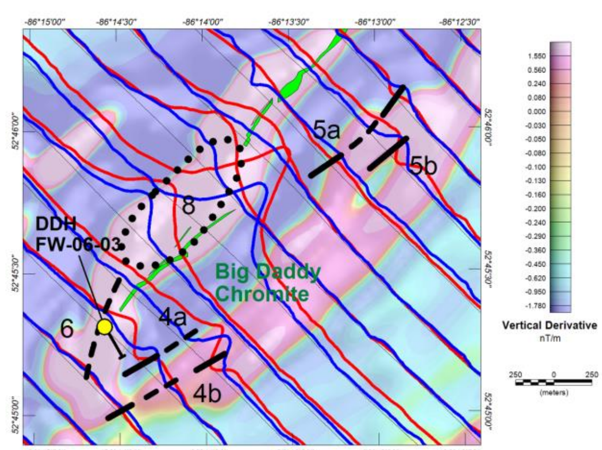


Figure 12: Fugro GEOTEM over chromite. The background is calculated magnetic vertical gradient and the profiles are GEOTEM channel 16 (Z red, X blue). Data courtesy KWG Resources Inc. and Noront Resources Ltd.

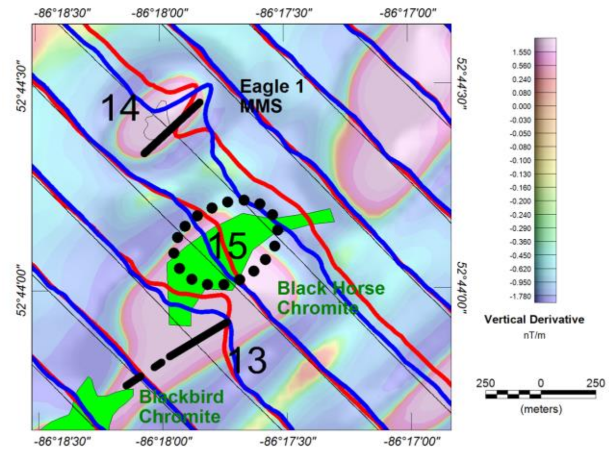


Figure 13: Fugro GEOTEM over Eagle 1. The background is calculated magnetic vertical gradient and the profiles are GEOTEM channel 16 (Z red, X blue). Data courtesy KWG Resources Inc. and Noront Resources Ltd.

CONCLUSIONS

The JBLL presented a unique setting; kimberlite potential and no existing mineral tenure for hundreds of kilometers in all directions. Spider and KWG began a systematic aeromagnetic survey program with detailed interpretation and modelling that in the end covered about 16,000 square km. From the outset it proved very effective for identifying young shallow kimberlites such a Victor. The discovery of older, deeper diamondiferous Kyle kimberlites was an unexpected surprise that added momentum to the exploration program. After a number of years the survey had reached the western margin of the basin and another unexpected discovery of the McFaulds 1 VMS deposit added another exploration dimension to the region. The opportunity to systematically expand a magnetic survey over a wide area, identify anomalies of interest and drill for a geological explanation is uncommon. The discovery of the deep kimberlites and VMS mineralization was both well planned and fortuitous. The success confirms that building on established mineralization models and geophysical attributes is important but it also highlights the benefit of stepping outside the norm to investigate singular geophysical anomalies. If a blind geophysical magnetic, electromagnetic or gravity anomaly stands out, without confident geologic explanation, a drill test may yield large dividends.

REFERENCES

Butler, H. R., 2008, Technical (Geological) Report on the MacFadyen and Adjoining Properties: Debut Diamonds Inc. 43-101 Report.

Crabtree, D.C., 2003, Preliminary Results from the James Bay Lowland Indicator Mineral Sampling Program: Ontario Geological Survey, Open File Report 6108.

Gowans, R. and C. Murahwi, 2009, NI 43-101 technical report on the Big Daddy chromite deposit and associated Ni-Cu-PGE: for Spider Resources Inc., KWG Resources Inc. and Freewest Resources Inc, 21 p.

Greenough, G. and P. Palmer, 2010, Technical Report and Resource Estimate, 43-101: Golder Associates Ltd. April 23, 2010.

Hobson, G.D., 1964, Seismic refraction survey Ontario Hudson Bay Lowlands: Geological Survey of Canada, Preliminary Map P243.

Hogg, R.L.S. and S. Munro, 2000, The aeromagnetic discovery of kimberlites and sulphides at depths up to 200 m: 70th Annual International Meeting, SEG, Expanded Abstracts, 367-370.

Geological Survey of Canada, 2003, Kenogami River aeromagnetic survey, magnetic data: Ontario Geological Survey, Geophysical Data Set 1227.

Polk, B., 2008, Assessment Report - Work on Claim 4213813: BMA 528 844 Porcupine Mining Division, OGS Assessment File 2.39900.

Polk, B., 2009a, Drill Hole PRC-03 Summary Report for Assessment: OGS Assessment File 2.42294.

Polk, B., 2009b, Drill Hole 5.01-14 Summary Report for Assessment: OGS Assessment File 2.43418.

Reed, L.E. and I.G.L. Sinclair, 1991, The Search for Kimberlite in the James Bay Lowlands: CIM Bulletin, 84 (947), 132-139.

Thurston, P.C., G.M. Siragusa, R.P. Sage and R.A. Riley, 1974, Winisk Lake, geological compilation series, Kenora District: Ontario Geological Survey Map 2287.

Winzar, D.J., 2001, Assessment Report on the Winter 2001 Reverse Circulation Drilling Programme of the Whiskey Kimberlite: OGS Assessment File 2.22622.

ADDITIONAL READING

Hogg, R.L.S., 2003, Freewest Resources Canada Inc Airborne Magnetic and Electromagnetic Survey McFauld's Lake - Northwestern Ontario Compilation and Interpretation Report: OGS Assessment File 2.29707.

Hogg, R.L.S., 2004, Practicalities, pitfalls and new developments in airborne magnetic gradiometry: First Break, 22 (7).

Hogg, R.L.S., 2009, Airborne Geophysics in the James Bay Lowlands; a recipe for the discovery of copper, zinc, nickel diamonds etc.: Presented at the KEGS Symposium: Geophysical Applications to VMS Exploration: Past, Present, and Future.

O'Donohoe, D. and French A., 2003, Summary of Exploration Work on Anomalies SP3-0011 and SP3-0029 of Spider-3 Joint Venture: OGS Assessment File 2.25123.