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BC Geological Survey

Assessment Report
Title Page and Summary

TYPE OF REPORT [type of survey(s)]: Geophysical

TOTAL COST: 4,236.39

AUTHOR(S): Jenny Haywood, Eric Thiessen

SIGNATURE(S):

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S):

YEAR OF WORK: 2013

STATEMENT OF WORK - CASH PAYMENTS EVENT NUMBER(S)/DATE(S): 5505929 -Recorded on May 26, 2014

PROPERTY NAME: SI property

CLAIM NAME(S) (on which the work was done): SI

COMMODITIES SOUGHT: Zn, Pb, Ag

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN:

MINING DIVISION: Liard

NTS/BCGS: 094F13W /094F021

LATITUDE: 57 ° 58 ' 53 " **LONGITUDE:** 125 ° 48 ' 07 " **(at centre of work)**

OWNER(S):
1) Teck Resources Ltd.
2)

MAILING ADDRESS:
3300-550 Burrard Street, Vancouver, B.C.
Canada V6C0B3

OPERATOR(S) [who paid for the work]:
1) Teck Resources Ltd.
2)

MAILING ADDRESS:
3300-550 Burrard Street, Vancouver, B.C.
Canada V6C0B3

PROPERTY GEOLOGY KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude):
Ordovician-Devonian, Devonian-Mississippian, Earn Group, Road River Group, Mudstones, Siltstones, Shales, Cambrian, Kechika Group, Sedex, Sphalerite, Galena, Barite

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:

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TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
GEOLOGICAL (scale, area)			
Ground, mapping			
Photo interpretation			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic			
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other			
Airborne	VTEM		Refer to cost statements
GEOCHEMICAL (number of samples analysed for...)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres; number of holes, size)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling/assaying			
Petrographic			
Mineralographic			
Metallurgic			
PROSPECTING (scale, area)			
PREPARATORY / PHYSICAL			
Line/grid (kilometres)			
Topographic/Photogrammetric (scale, area)			
Legal surveys (scale, area)			
Road, local access (kilometres)/trail			
Trench (metres)			
Underground dev. (metres)			
Other			
		TOTAL COST:	4,236.39

Report on the 2013 VTEM Survey

of the

SI Property

Claim
221913

Liard Mining Division
Northeastern British Columbia

NTS Map Sheets
094F/13W

6429977 N, 334298 E
(NAD83, Zone 10)

Report prepared by
Jenny Haywood, M.Sc., G.I.T.
and
Eric Thiessen, M.Sc., G.I.T

May 26, 2014
Revised: March 26, 2015

Teck Resources Limited
Suite 3300, 550 Burrard Street
Vancouver, BC, V6C 0B3

SUMMARY

The SI property is located in the Muskwa Ranges at the northern end of the Rocky Mountains in the Liard Mining District of northeastern BC, approximately 204 km northeast of Fort Nelson. The property is 100% owned by Teck Resources Limited and comprises 1 claim covering 450 ha.

The SI property occurs in the northern portion of the Kechika Trough, the southeastern extension of the Selwyn Basin. Both the Selwyn basin and the Kechika Trough host numerous sedimentary exhalative (SEDEX) deposits ranging in age from Cambrian through Devonian-Mississippian, that are interpreted to have formed during periods of regional extension when upwelling metalliferous basinal brines interacted with reduced sulphur near the seafloor to form deposits of laminated base metal sulphides and pyrite +/- barite. In the Kechika Trough district, the most significant deposits, including Driftpile and Cirque, are hosted in the Gunsteel formation of the lower Devonian-Mississippian Earn Group which occurs in a series of imbricate folds and thrusts that formed during the Jura-Cretaceous Columbia-Laramide Orogeny.

No mineralization outcrops at surface on the SI property, and no drilling has ever been conducted; however, isolated occurrences of pyrite and blebby, bedded barite have been identified. On the adjacent Bear property, drilling has delineated a mineralized horizon containing pyrite ± sphalerite ± galena ± barite. A historic geochemical anomaly and favourable stratigraphy suggest the mineralization may continue north onto the SI property.

An airborne VTEM survey was flown over the Driftpile Creek and SI properties on the 6th, 7th and 16th of June, 2013. The survey grid was oriented at 50˚ and consisted of sixteen lines (23.4 line km) spaced 200 m. The survey indicated that follow-up evaluation of specific anomalies should occur in conjunction with geological mapping, surface chemistry and historical drilling.

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1 INTRODUCTION

1.1 LOCATION, ACCESS, AND PHYSIOGRAPHY

The SI property is located in the Muskwa Ranges at the northern end of the Rocky Mountains in northeastern BC, in the Liard Mining District (Figure 1). The property is roughly centered at 6429977 N and 334298 E (NAD83, Zone 10) and is contained entirely within the traditional territories of the Kwadacha First Nation and the Liard First Nation. Two provincial parks, Dune Za Keyih Park and the Kwadacha Wilderness Park are located 1.5 km east and 27 km southeast of the property, respectively. The nearest communities are Fort Ware (~61 km south) and Muncho Lake (~97 km north-northeast), and the nearest supply centers include the towns of Fort Nelson (204 km northwest) and Mackenzie (339 km south-southeast) and the cities of Fort St. John (355 km southeast) and Prince George (~492 km south-southeast).

The SI property can only be accessed by air; there is no road access (Figure 2). The property has historically been accessed by helicopter, either from the Driftpile Creek property, which is located ~12 km to the north of the SI property and contains a 600 m long gravel airstrip suitable for fixed wing aircraft (Evans, 1995); or from Mayfield Lake, a float plane accessible lake located ~25 km northeast of the property (Carne, 1981). For the 2013 VTEM survey, the helicopter and geophysical personnel were stationed at Canada Zinc's Akie camp located ~90 km to the southeast.

A north-south trending ridgeline flanked by U-shaped glacial cirques runs through the center of the SI property. Elevations range between ~1500 m asl in the valley bottoms to 2200 m asl at the top of the tallest peak. Most of the property is situated above treeline, which is located ~1600 m. Exposure is typically good on ridgelines. Slopes typically contain talus and piles sub-crop rather than intact outcrop. Vegetation is sparse above treeline, consisting predominantly of grasses and scrub bush that dot talus slopes. The climate is classified as sub-alpine to alpine, with long cold winters and mild summers. The exploration season extends from June through late-September, and is limited by cold temperatures and snow cover. The SI property is located within the Liard River drainage basin, which eventually empties into the Mackenzie River at Fort Simpson, NWT. Local waterways flow north through the Rocky Mountain Trench before joining the Liard River near Fireside, BC.

1.2 TENURE

The SI property is 100% owned by Teck Resources Limited. It is situated in the Liard Mining district, and comprises 1 claim covering 450 ha (Figure 3). It is part of the historic "Bear Claims Group" which included the Bear, Si, Cub, and Bob 2, 3 and 4 claims. Of these, only the SI property is currently owned by Teck Resources Limited. Many of the remaining properties are currently owned by Canada Zinc. The tenure number, claim name, issue date, size, dollar amount of work claimed for 2013, and the due date for the next assessment are shown in Table 1.

Table 1. Tenure summary for the SI Property. The 'good to' date is pending assessment filing.

Tenure No.	Claim	Owner	Issue Date	Area (ha)	2013 Claimed	Current Good-to-Date	New Good-to-Date
221913	SI	126548	10-Dec-79	450	$4,236.39	29-Jun-14	29-Jun-16

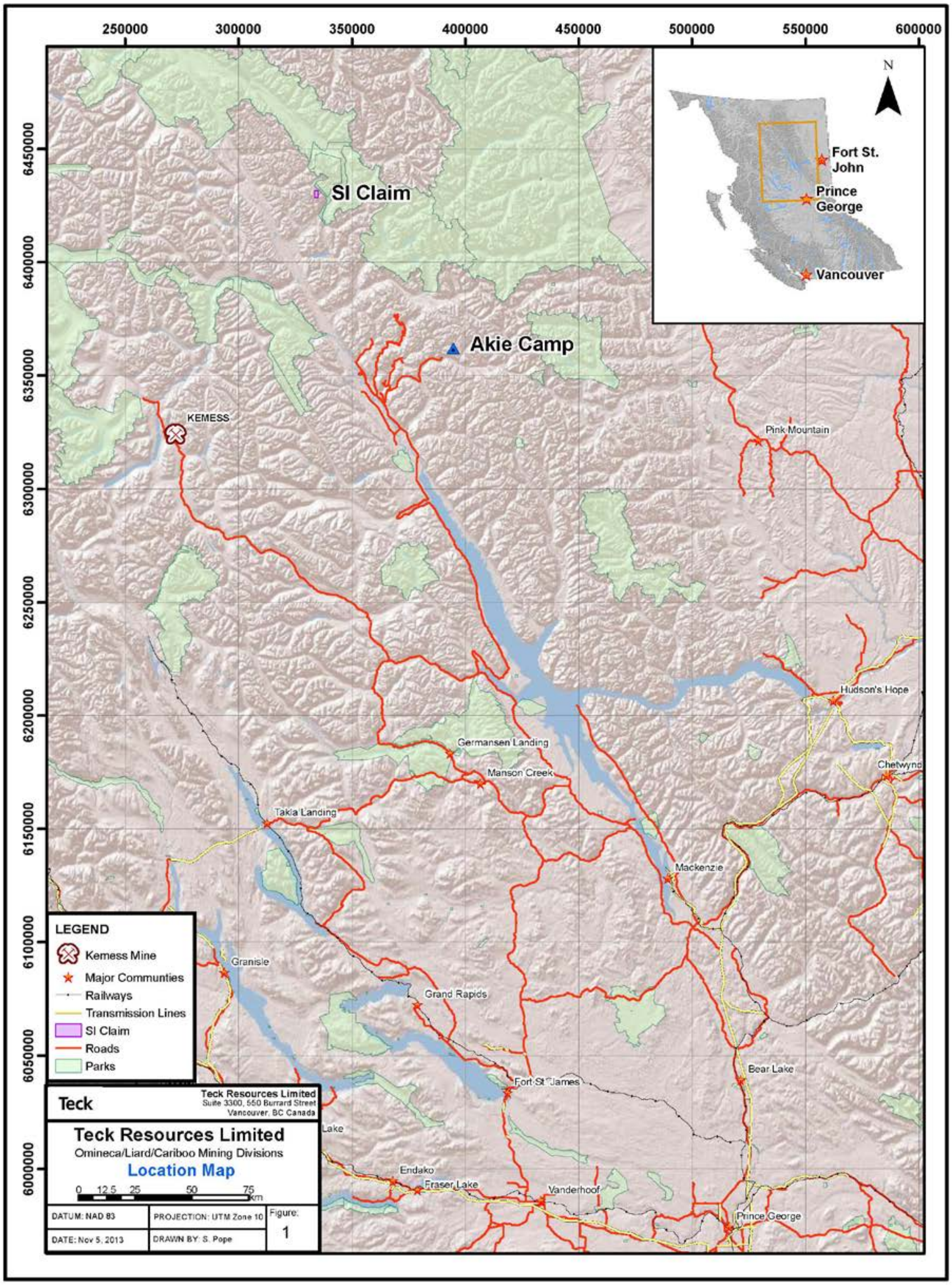


Figure 1. Location of the SI property

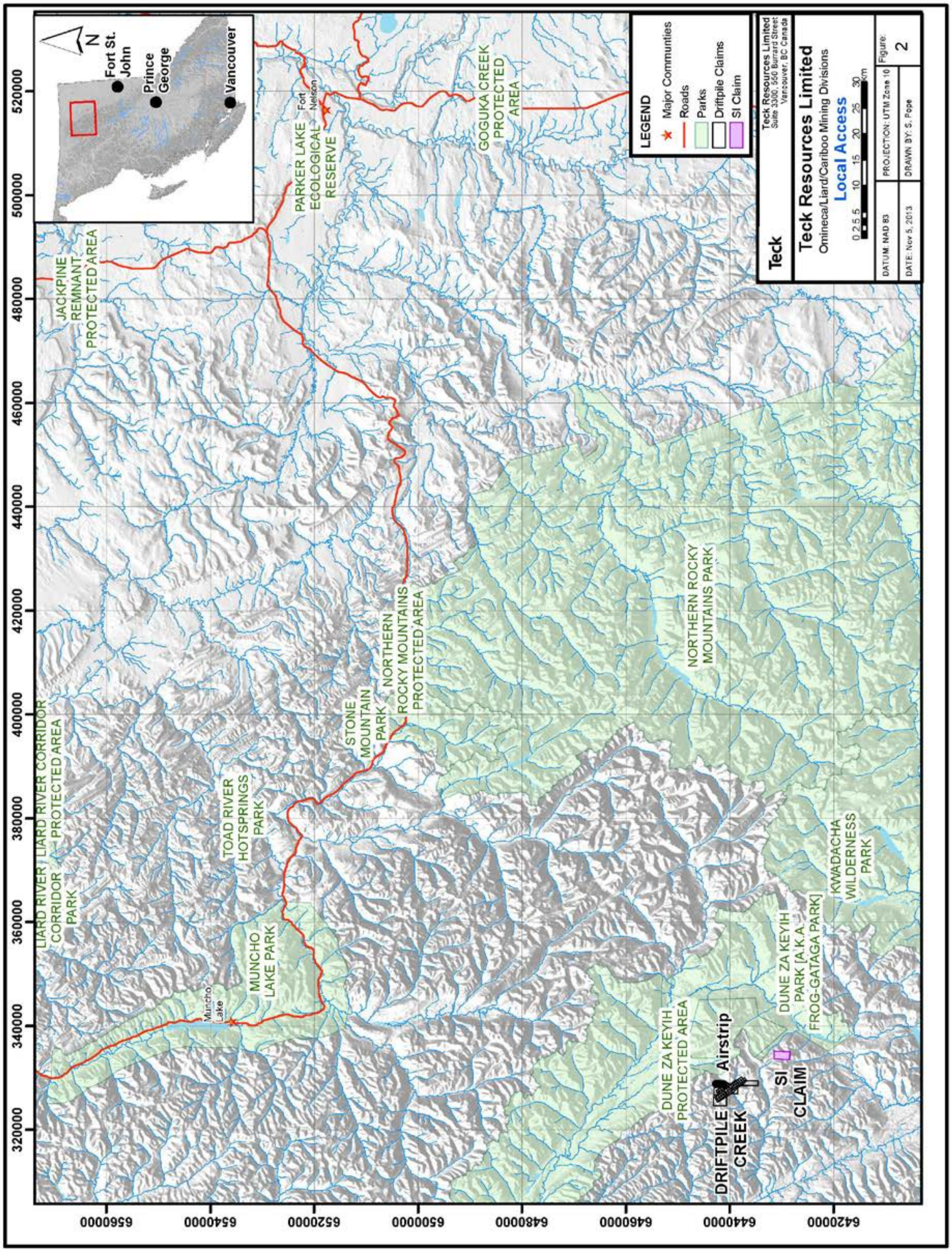


Figure 2. Local access to the SI property

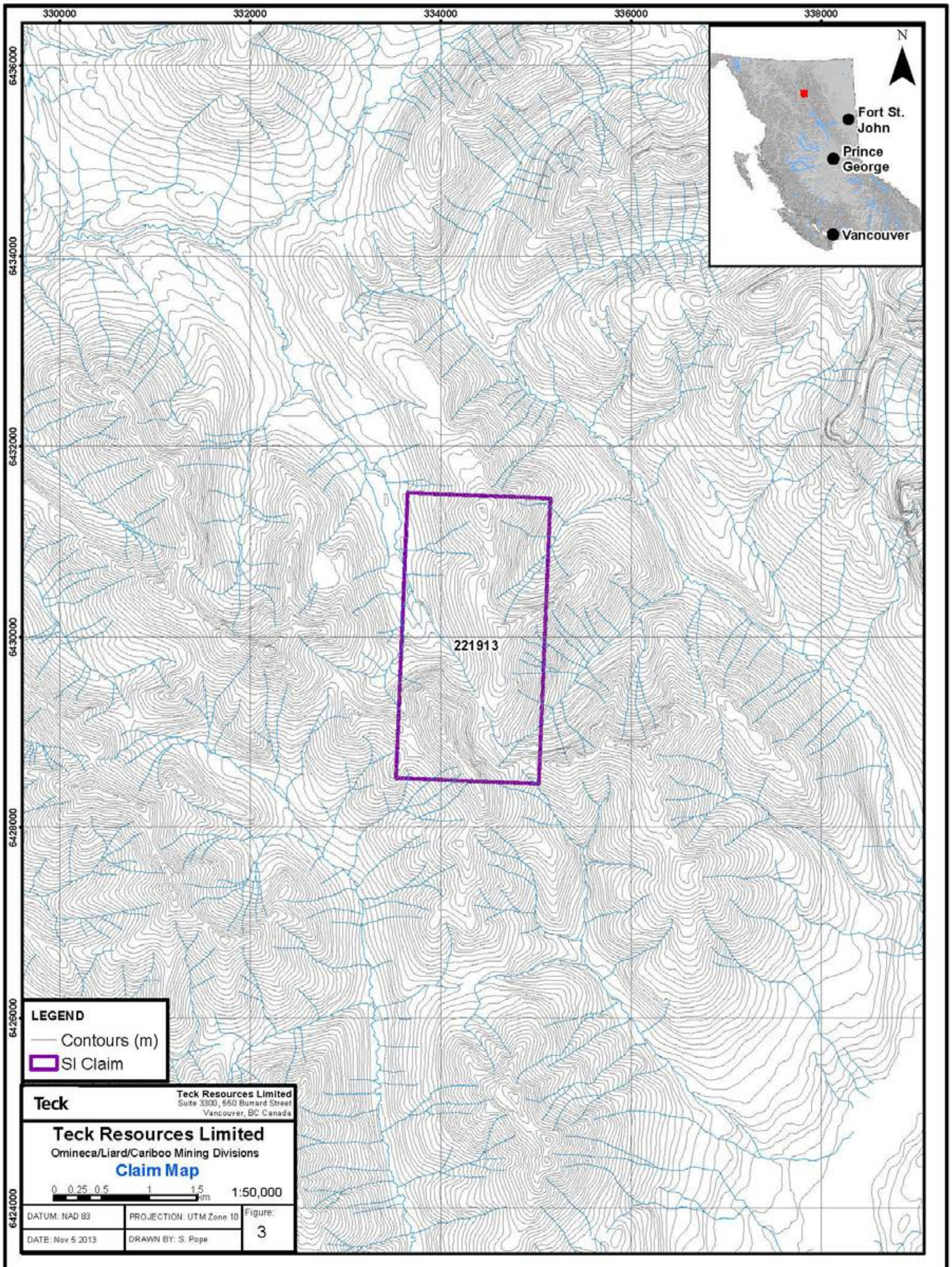


Figure 3. SI tenure map

1.3 HISTORY AND PREVIOUS WORK

Exploration for SEDEX style mineralization in the Kechika Trough was initiated in 1970. During a reconnaissance regional stream sediment survey that year, Geophoto Consultants identified several geochemical anomalies in the area of Driftpile Creek located ~12 km to the north of the SI property. In 1973, mineralized boulders of float, limonitic gossans, ferricrete and barite kill zones were discovered and a joint venture consisting of Canex Placer Limited (Placer Syndicate), General Crude Oil Co. Northern Limited and Pembina Pipe Line Limited staked the Driftpile Creek property the following year. Mineralization was intercepted in drill core at Driftpile Creek in 1978, and since then 7 distinct zones of stratiform Fe ± Zn ± Pb ± Ba mineralization have been discovered on the Driftpile property.

In 1976, Castlemaine Exploration Limited conducted a second regional, reconnaissance stream sediment survey. As a result of this work, the adjacent Bear Claims were staked in 1977 by Gataga Joint Venture (GJV) comprising Aquitaine Company of Canada Limited, Chevron Canada Ltd., Getty Canadian Metals Limited, Kidd Creek Mines Limited, Welcome North Mines Limited and Castlemaine Exploration Limited. The SI claims were staked in 1979 following the identification of a soil geochemical anomaly from 1977. Archer, Cathro and Associates (1981) Limited (AC) managed field programs for GJV, and their involvement continued when the property was transferred to Getty Canadian Minerals in 1981. During this time, 7 diamond drill holes on the Bear Property intercepted a mineralized sequence containing massive pyrite and barite with interstitial carbonate with sphalerite and galena mineralization (Carne, 1981; Evans, 1995). No drilling was conducted on the SI claims.

Teck Exploration Limited (later Teck Resources Limited) acquired the SI and Bear claim blocks in 1992 and conducted geological mapping, geochemical sampling, and drilled 8 more diamond drill holes (1808 m, Bear claims only) in 1993 and 1994. Teck Resources Limited currently owns only the SI property from the historic “Bear Claims Group”; all other adjacent claims are owned by other parties. This report outlines, for assessment purposes, the results of a VTEM survey that was completed on the property in 2013.

Table 2. Summary of the ownership and work history of the SI property

Ownership History	Year	Operator	Work Conducted	Holes Drilled	Meters Drilled
Pembina Pipelines, General Crude Oil Company Ltd. and Sun Oil	1970	Geophoto Consultants Limited	Reconnaissance stream sediment survey		
JV between Canex Placer Limited (Placer Syndicate), General Crude Oil Co. Northern Ltd. And Pembina Pipe Line Limited	1973	Canex Placer Limited	Prospecting		
	1974		153 claims staked		
	1974-1975		Geologic Mapping, EM survey, hand trenching		
	1976-1977	No work conducted			
Gataga Joint Venture (GJV) - option	1978	Archer, Cathro and Associates (1981) Limited	GJV (Chevron Canada Ltd., Getty Canadian Metals Limited, Kidd Creek Mines Ltd., Welcome North Mines Ltd. And Castlemaine Exploration Ltd.) optioned the property from the syndicate		
			Soil geochemistry, geological mapping, hand trenching and diamond drilling	9	1016
	1979		Soil geochemistry, geological mapping, hand trenching and diamond drilling	21	2416
	1980		Soil geochemistry, geological mapping, backhoe trenching and diamond drilling	10	2020
	1981		Soil geochemistry, geological mapping, backhoe trenching, diamond drilling, grid and geophysical surveys (MaxMin II EM, gravity), airstrip construction	11	2003
	1982		Geologic mapping, diamond drilling, airstrip completed	3	1122
	1983-1991	No work conducted			
Teck Exploration Limited (later Teck Resources Limited)	1992	Teck Exploration Limited	Teck Exploration Limited purchased 100% interest; lithogeochemistry samples collected		
	1993		Geological mapping, diamond drilling	13	4559.31
	1994		Geological mapping, diamond drilling, grid re-established	24	4817.09
	1995-2012	No work conducted			
			Total	**91**	**17953.4**

2 GEOLOGY

2.1 REGIONAL GEOLOGY

The following synthesis of the regional geology is summarized primarily from MacIntyre (1998), Ferri et al. (1999), and Nelson and Colpron (2007).

The SI property is located within the Kechika Trough in northeastern British Columbia (Figure 1; Figure 4). The Kechika Trough is a narrow, north-northwest trending, parautochthonous tectonostratigraphic entity (Figure 4), comprising mainly fine-grained clastic Paleozoic rocks deposited in a subsiding basin along the western margin of ancestral North America. The Kechika Trough is bound on the west by the northern Rocky Mountain Trench—a major structural boundary marking the western edge of parauthochthonous North American rocks from a tectonically displaced off-shelf carbonate platform (i.e., the Cassiar Platform or Cassiar Terrane)—and on the east by the shallow-water sedimentary rocks of the MacDonald Platform—a carbonate shelf (Figure 4). Even after dextral displacement on major faults in northeastern British Columbia is restored, the Cassiar Platform would still have been located west of the Kechika Trough in Devono-Mississippian time, restricting the western boundary of the basin (e.g., Nelson and Colpron, 2007). Regional metamorphic grades for Paleozoic strata in the Kechika Trough are restricted to sub-greenschist facies (e.g., Greenwood et al., 1991).

The basement to the Kechika Trough is thought to be composed of thick siliciclastic sequences (or more basin-ward equivalents) of Proterozoic-age overlying tectonically thinned, late Paleoproterozoic, felsic to intermediate crystalline lower crust (e.g., Clowes et al., 2005; Evenchick et al., 2005). Proterozoic metasedimentary rocks of the <1.8 Ga Muskwa Assemblage, and possibly the 1.2 (0.88?)–0.78 Ga Mackenzie Mountain Supergroup, are only exposed near the northern and eastern boundaries of the northern Cordillera. They are inferred, however, to underlie the 0.78–0.54 Ga Windermere Supergroup, which is widely exposed in northeastern British Columbia (Gordey and Makepeace, 1999; Clowes et al., 2005; Evenchick et al., 2005). Proterozoic rocks were deposited during major intracratonic to continental extensional/rifting events and may be the primary source of metals for the SEDEX-forming fluids (Goodfellow and Lydon, 2007).

Following the last continental rifting event in the Late Neoproterozoic, a relatively quiescent or passive tectonic setting existed along the Early Paleozoic western continental margin of North America. During this period, mainly siliciclastic sedimentary rocks were deposited as westward-thickening sequences during sporadic subsidence and basin development in the Kechika Trough. This ‘passive margin’ setting with intermittent basin subsidence ± rifting, led to the deposition of two regionally extensive, long-lived sedimentary facies (e.g., Gordey and Anderson, 1993). A platformal or “shelf” facies consisting of shallow water carbonate and clastic rocks was deposited on the MacDonald Platform in the east. A basinal facies consisting of deeper-water shale, chert, limestone, and turbiditic sediments deposited on the rapidly subsiding rifted margin in the Kechika Trough, west of the MacDonald Platform (Gordey and Anderson, 1993). The extensive off-shelf Cassiar Platform marks the western limit to the Kechika Trough, although laterally discontinuous mid-Devonian carbonate reefs were also formed locally in central portions of the Kechika Trough (Ferri et al., 1999). Intermittent basinal

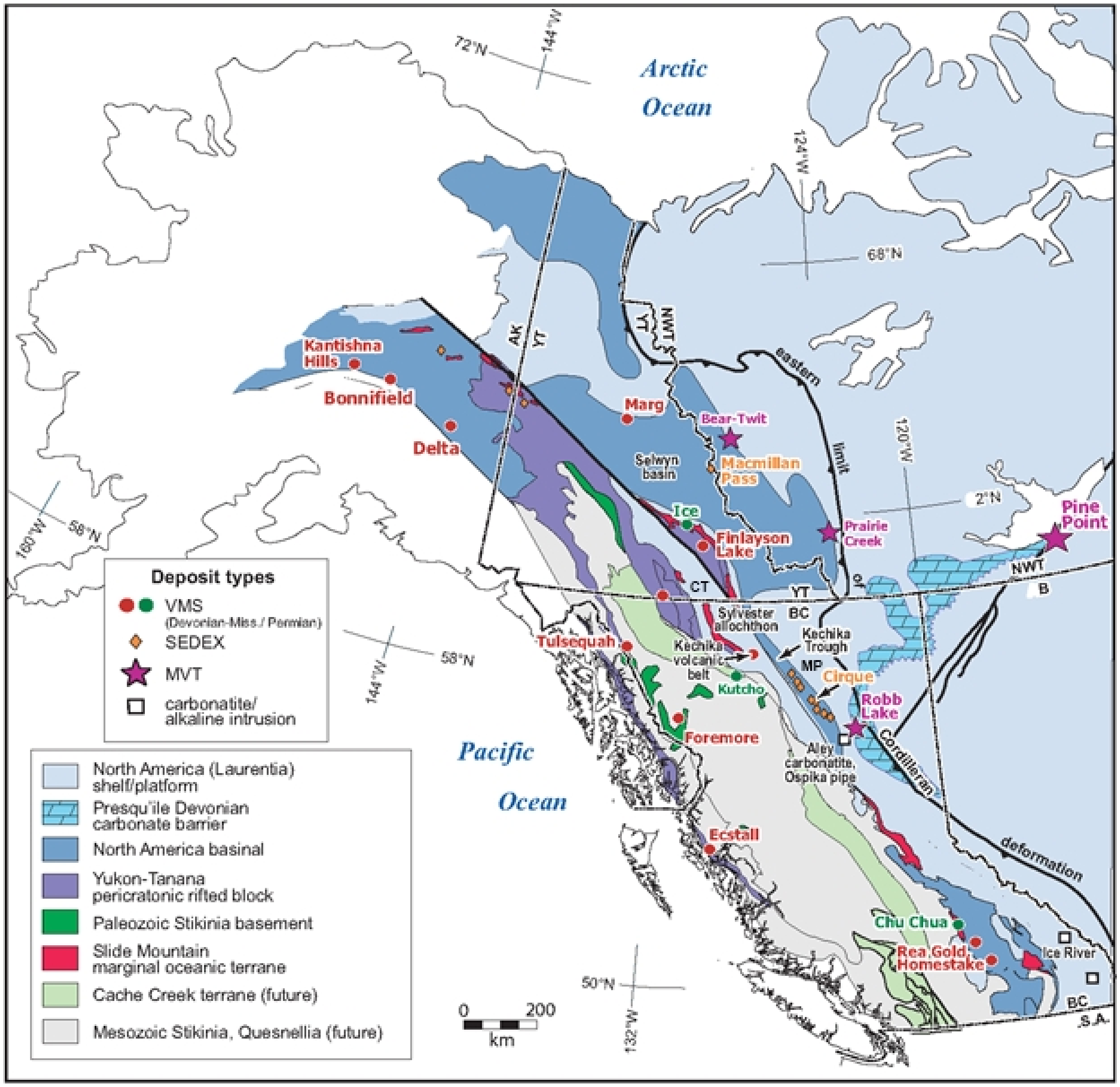


Figure 4. Devonian-Mississippian mineralization relative to terranes of the northern Cordillera (modified from Nelson and Colpron, 2007). Abbreviations are CT: Cassiar Terrane and MP: Macdonald Platform.

extension and subsidence was also associated with the intrusion and eruption of basaltic magmas (and, less commonly, intermediate to felsic equivalents) at basin–platform boundaries throughout the northern Cordillera, in the Cambrian and the Mid- to Upper Ordovician (e.g., Goodfellow et al., 1995).

In the Late Devonian to Early Mississippian, a major shift in depositional patterns occurred when a northern Cordilleran-wide influx of turbiditic and cherty clastic sediments interrupted Lower Paleozoic ‘passive margin’ sedimentation. A widespread marine transgression at this time has typically been attributed to uplift and rifting at the western margin of North America, producing a back-arc region to an east-subducting oceanic slab. This back-arc rifting led to the separation of several pericratonic terranes from the western margin of Laurentian by the opening of the Slide Mountain ocean basin west of the

Cassiar Platform. Block faulting, mafic back-arc magmatism, and exhalative barite and base metal mineralization occurred throughout the Kechika Trough during the Devono–Mississippian.

Periodic extensional tectonism and restricted sedimentation within the Kechika Trough led to the formation of stratiform Zn–Pb–Ag–Ba, or sedimentary exhalative (SEDEX) deposits in the Cambrian, Middle Ordovician, Lower Silurian, and Upper Devonian (Ferri et al., 1999). The Upper Devonian deposits are the most economically significant, and include mineralization at the Cirque, Elf, Driftpile Creek, and Mount Alcock properties of the Kechika Trough, as well as the Tom and Jason deposits farther north in the Macmillan Pass area of the Selwyn Basin (Figure 5; Ferri et al., 1999). Despite the influx of clastic sediments in the Devono-Mississippian, SEDEX mineralization occurred in sediment-starved, anoxic, third-order sub-basins (grabens or half-grabens) actively subsiding along their bounding faults (e.g., MacIntyre, 1998; Ferri et al., 1999).

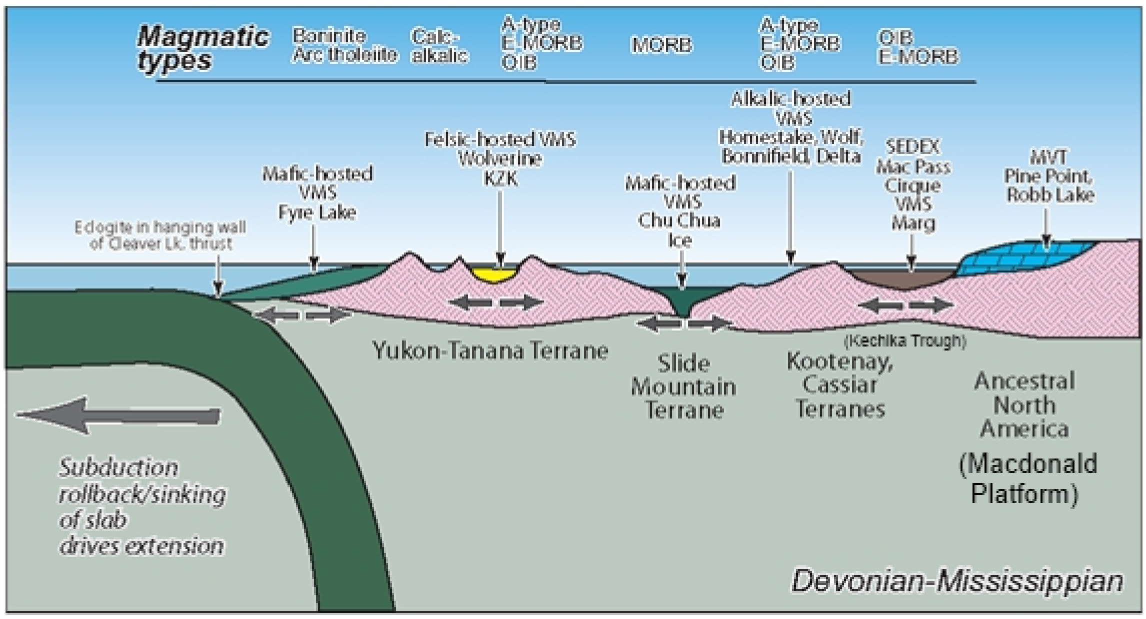


Figure 5. Schematic tectono-metallogenic model for the Devonian-Mississippian western margin of North America (modified from Nelson and Colpron, 2007). Individual exhalative barite and base metal mineralized centres are named above each corresponding terrane.

2.2 PROPERTY GEOLOGY

The SI claims are underlain by supracrustal rocks of Ordovician to Mississippian age, which occur in three of the five thrust-bound panels in the district. Two main groups are exposed in the western and central panels in the vicinity of the SI claims: the Ordovician to Devonian Road River Group and the Devono–Mississippian Earn Group. Significant lateral facies variations occur within these groups on both a local and regional scale, and reflect the complexity of the Paleozoic basinal architecture.

The Road River Group is a deep-water package of mainly fine-grained siliciclastic rocks deposited along the ancestral western margin of most of the northern Cordillera, including within the Kechika Trough. Regionally variably calcareous shale and siltstone dominate this unit, but lesser sandstone and deep-water limestone are also present (Gordey and Anderson, 1993). Intermittent, syn-depositional, extensional or basin-deepening events are indicated by the occurrences of local mafic volcanic rocks and intermediate to felsic intrusive rocks. The Road River Group has regionally been sub-divided into an Ordovician unit(OR-; Figure 6) and Silurian units (SRL, SRM, SRU; Figure 6), that respectively correspond to the Duo Lake and Steel formations mapped farther north in the Selwyn Basin (Gordey and Anderson, 1993; Ferri et al., 1999). Unlike the Selwyn Basin, however, at least two Devonian units are also included in the Road River Group within the Kechika Trough (the Kwadacha Reef, or DK-, and the Paul River Formation, or DP-; Figure 6).

The Road River Group outcrops in the southeastern corner of the SI property where is occurs in the hanging wall of the northeast verging Mt. Waldemar thrust fault. The Road River Group includes a basal, thin package of Ordovician-age graptolitic, carbonaceous, calcareous black shale and mudstone (OR-) overlain by Silurian-age, dolomitic, micaceous siltstone (SRU) that contains graptolites and abundant trace fossils (burrows, feeding tubes etc.), and forms a distinctive, resistant, orange-brown weathering marker horizon (McClay et al., 1988; Carne, 1980). A recessively weathering sequence of Lower Devonian-age carbonaceous, variably calcareous black shale, chert and minor limestone (classified here as Paul River formation, DP-) overlies the Silurian siltstone. No volcanic rocks have been observed in the Road River Group on or adjacent to the SI property.

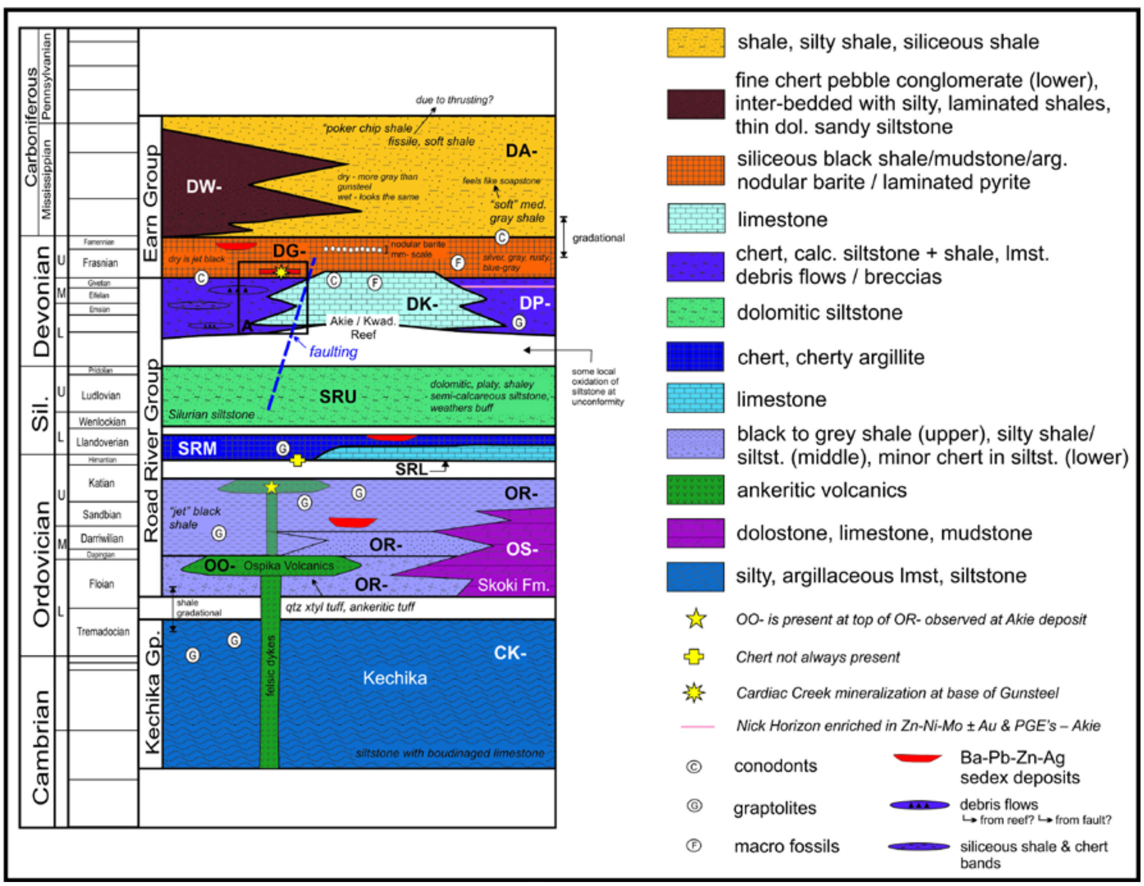


Figure 6. Schematic stratigraphic column for the Lower to Middle Paleozoic units in the Kechika Trough (the Bear mineralization is located within Gunsteel formation). Modified from MacIntyre, 1998.

The Earn Group is a package of predominantly clastic rocks deposited during the influx of westerly derived detritus during uplift and rifting of the western margin of ancestral North America that led to the formation of pericratonic terrane(s) and the opening of the Slide Mountain ocean basin. These rocks consist mainly of fine-grained siliciclastic sedimentary rocks, with rare deep-water limestone, and are associated with minor mafic to felsic igneous rocks. In the Kechika Trough, the Earn Group was subdivided into three units by Jefferson et al. (1983), Pigage (1986), and MacIntyre (1992), informally known as the Gunsteel (DG-), Akie (DA-), and Warneford (DW-) formations (Figure 6). These three 'formations' are stratigraphically and/or structurally interfingered, making differentiation of these units difficult at any scale of mapping (e.g., Ferri et al., 1999). Multiple horizons of stratiform Fe-Zn-Pb +/- Barite mineralization occurs within fine-grained, black argillites, cherty argillites and cherts of the Gunsteel formation.

Of the Earn Group rocks only the Gunsteel formation has been identified on the SI property. It consists of a sequence of grey to black shale, argillite, siliceous shale, and chert containing variable concentrations of pyrite and carbonate nodules, and more coarse grained silty shale and siltstone layers and chert pebble conglomerates that are interpreted to represent turbidite horizons. The chert pebble conglomerate is thought to occur at the base of the succession; however, the detailed relationships between the units are generally poorly understood due to the structural complexity and the lack of identifiable marker horizons. Localized wedges of brecciated chert with a sulphide matrix are inferred to be debris flow deposits that may identify the location of Devonian-age extensional structures (Evans, 1995).

The Gunsteel formation outcrops in a series of northeast verging duplex structures, and forms a northwest trending belt that continues off the property to the north and south (see 1.5.1 for more a more detailed structural assessment). The Mt. Waldemar fault bounds the Earn Group in the southwestern portion of the property, thrusting graptolitic and bioturbated siltstone, shale and argillite of the Road River Formation over the Gunsteel formation. This same fault zone also juxtaposes the Road River and Earn Groups at the Driftpile Creek property to the north.

Several sub-units within the Road River and Earn Groups have been distinguished historically, but due to differences between generations of historic mapping and uncertainties in the relative stratigraphic position of some of these units they are not detailed in this report.

2.3 STRUCTURAL GEOLOGY

Regional structural and lithostratigraphic correlations are well-described by Pigage (1986), McClay and Insley, (1986), McClay et al. (1987), Insley (1990), McClay (1991), MacIntyre (1992), Paradis et al. (1995), Paradis et al. (1998) and McClay et al. (1989). During the Cambrian to Mississippian, basin subsidence and extension, and related normal faulting (D_1), produced parallel asymmetric graben systems with steeply dipping bounding faults and containing internal arrays of domino-like rotated fault blocks responsible for more localized sub-basins. The Road River and Earn Group sedimentary rocks were deposited with distinctive wedge-shaped geometries due to sedimentation within the faulted sub-basins.

McClay and Insley (1986) and Insley (1990) recognized an initial phase of local folding (D_2) that produced northeast trending, asymmetric folds and an associated (metre-scale) fanning, axial planar cleavage that developed prior to the main Cordilleran compressional event (D_3). These folds are minor and thought to only occur in lower Earn Group strata. Northeast-trending compression (D_3) from the Late Jurassic to mid-Cretaceous deformed the Paleozoic strata into the prominent northwest-trending Cordilleran fold and thrust belt and reactivated Devonian-age extensional structures as thrust faults. McClay et al. (1989) documented a complex sequence of folding, thrusting and back thrusting in the Bear 'sub-basin' (Figure 7). On the SI property this phase of deformation manifests as series of shallowly plunging, northeast verging imbricate thrust faults and anticline-syncline pairs. Upright, tight to open folds occur within thrust panels, while overturned synclines typically occur in the footwall of thrusts. Within fold cores, sedimentary units are folded into upright chevron folds (Paradis et al., 1995). A regionally pervasive, steeply dipping to vertical, axial planar cleavage (S_2) with associated pressure solution development, is associated with this phase of deformation, and accounts for a significant portion of the regional shortening.

Late Mesozoic to Tertiary extension and dextral transpression (D_4) is the latest and current stress regime affecting these rocks. Regionally, this extension has led to the formation of steeply dipping north- and northwest-trending normal faults, some with dextral (right-lateral) movement, which crosscut all pre-existing structures. Deformation produced vertical to steeply dipping normal and strike-slip faults (D_4) that cross-cut and offset all earlier structures, and northeast to east-trending dextral kink folds with steep to vertically plunging fold axes.

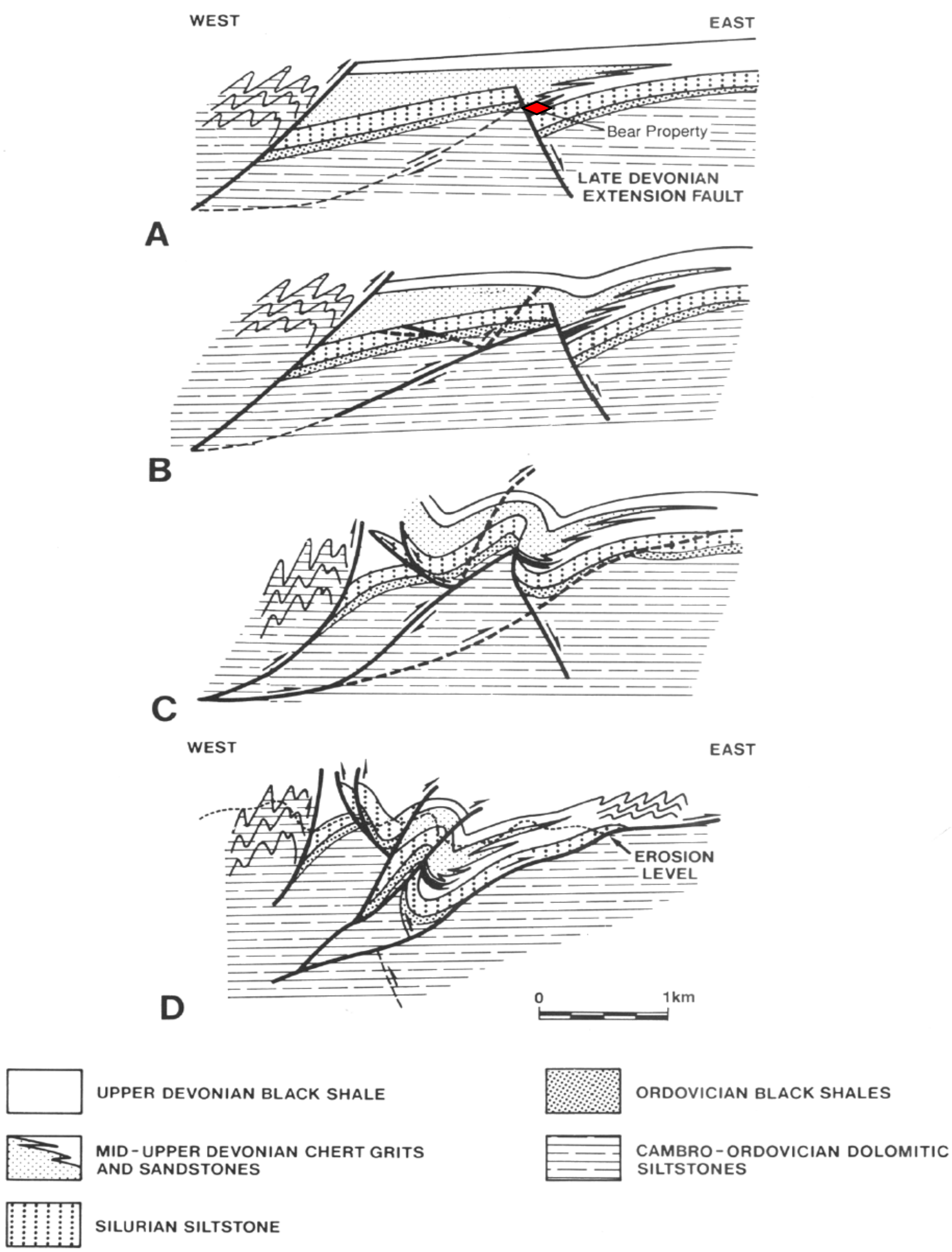


Figure 7. Depiction of the inversion of the Bear 'sub-basin' showing the complex sequence of thrusting, fault rotation and reactivation, and backthrusting that produced the present day configuration of units (from McClay et al., 1989). The Bear deposit, located just to the south of the SI property, is shown in red.

2.4 ALTERATION AND MINERALIZATION

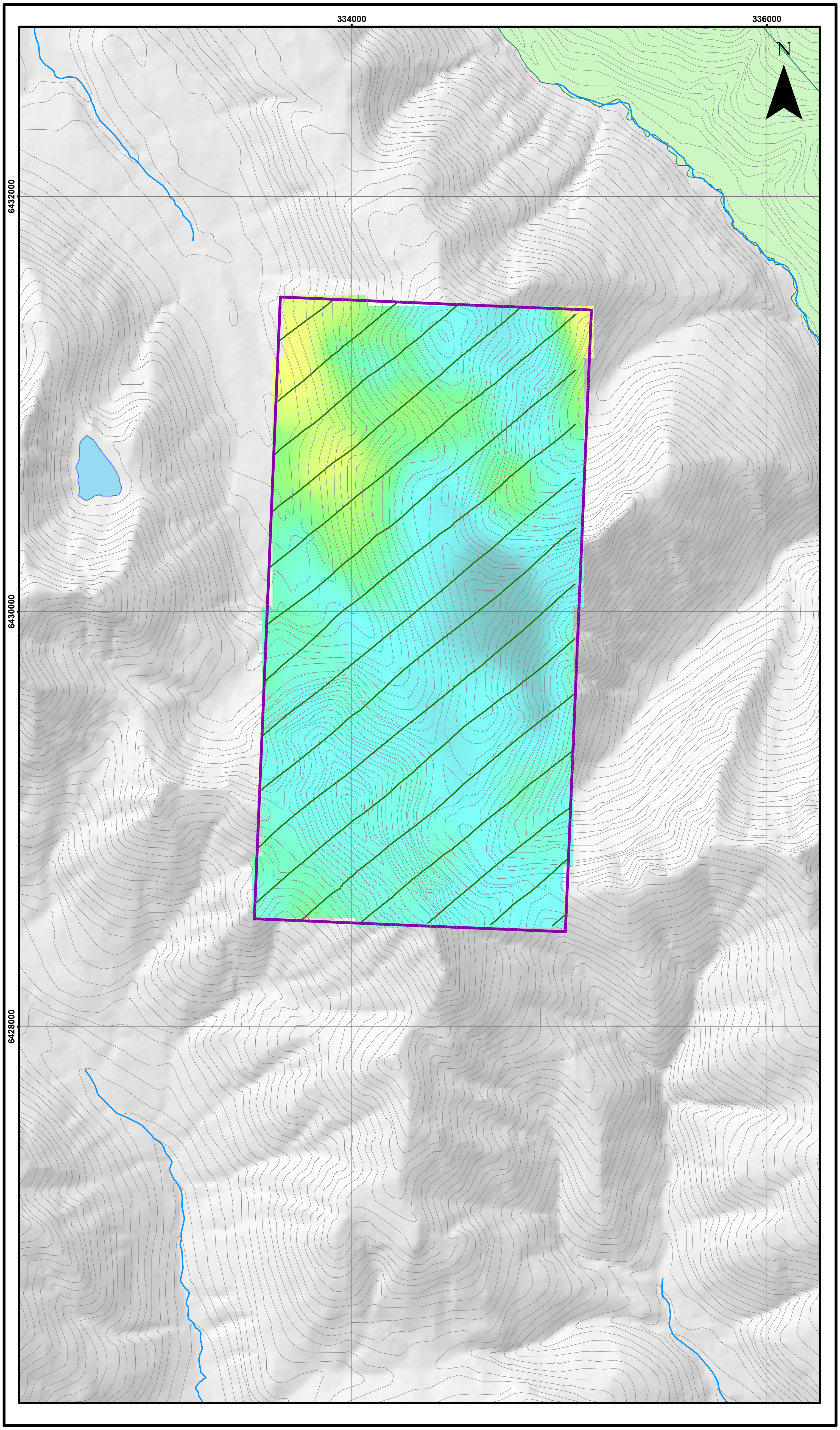
Regionally, stratiform Ba-Fe-Zn-Pb mineralization in the Kechika Trough occurs as tabular, stratiform bodies within the fine-grained, black argillites, cherty argillites and cherts of the Gunsteel formation. No mineralization outcrops at surface on the SI property, and no drilling has ever been conducted; however, isolated occurrences of pyrite and blebby, bedded barite have been identified. Exhalative mineralization has been identified at both the Driftpile Creek property, located 12 km to the northwest, and at the Bear property located immediately to the south. Mineralization at both the Driftpile Creek and Bear properties is hosted in a package of Gunsteel formation situated in the footwall of the Mt. Waldemar fault zone. The Mt. Waldermar fault zone and the underlying package of Gunsteel formation extend north from the Bear property onto the SI property.

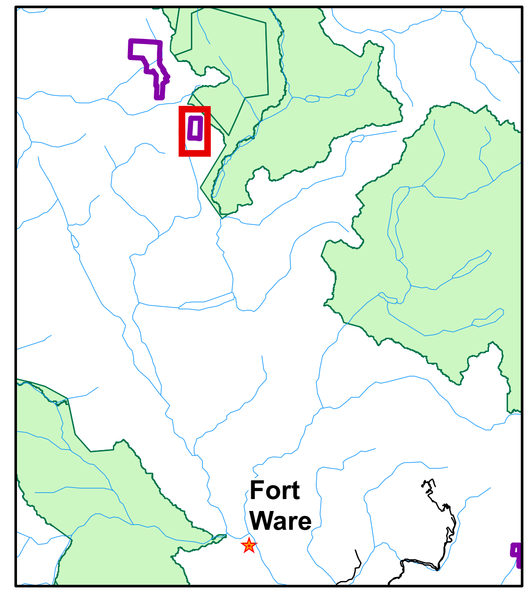
3 2013 GEOPHYSICAL SURVEY

An airborne VTEM survey was flown over the Driftpile Creek and SI properties on the 6^{th}, 7^{th} and 16^{th} of June, 2013. The survey grid was oriented at 50˚ and consisted of sixteen lines (23.4 line km) spaced at 200 m. Appendix 3 contains a report submitted by Geotech Ltd. which presents the procedures for data acquisition, processing, final image presentations and the specifications for the digital dataset.

4 CONCLUSIONS AND RECOMMENDATIONS

The survey identified that the geological trend of the area runs northwest which agrees with regional geological mapping. Although no conductors were identified on the SI property the data (Figure 8) warrants formal interpretation including anomaly picking and modeling of local conductive targets prior to ground follow-up and drill targeting. Magnetic data contained weak broad anomalies thought to result from sediments in wide valleys.





SURVEY SPECIFICATIONS:
Survey Date: June 17th to July 17th, 2013
Survey Base: Akie Camp, British Columbia
Aircraft: Aerospatiale A-Star 350 B3 (C-FVTM)
Survey Line Spacing: 200 Meters
Survey Line Direction: N 50° E / N 230° E
Actual Average Terrain Clearance: 96 Meters
EM Transmitter Loop: Towed at an average terrain clearance of 35 meters below the helicopter
Magnetic Sensor: Towed at an average terrain clearance of 13 meters below the helicopter

INSTRUMENTS
Geotech Time Domain Electromagnetic System (VTEM)
Concentric Rx/Tx Geometry
Z-Coil Diameter 1.2m
Transmitter Loop: Diameter 17.6 Meters
Dipole Moment: 239,358 nIA
Transmitter Wave Form: Trapezoid, Pulse Width 3.40 ms, Base Frequency 30 Hz
Geometrics High Sensitivity Cesium Magnetomete
rMag Resolution: 0.02 nT at 10 samples/sec

2013 VTEM Lines

2013 VTEM TauSF

Value

High : 2.46606

Low : 0.0357015

Topographic Features

SI Claim
Contours (m)
River
Road
Lake
Provincial Park

Teck

Teck Resources Limited
Suite 3300, 550 Burrard Street
Vancouver, BC Canada

Teck Resources Limited

Omineca/Liard/Cariboo Mining Divisions

2013 VTEM Interpretation

0 0.5 1 km 1:20,000

DATUM: NAD 83	PROJECTION: UTM Zone 10	Figure:
Mar 2015	DRAWN BY: S. Pope	8

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APPENDIX I – STATEMENT OF QUALIFICATIONS

Jennifer Crandall Haywood, M.Sc., B.A., GIT (APEG BC)

I, Jennifer Haywood, M.Sc., B.A., GIT, do hereby certify that:

I a, a Geologist employed by Teck Resources Ltd. (3300-550 Burrard Street, Vancouver, BC, V6C 0B3) at Vancouver Head Office for the 2013 field season, and at the time of the writing of this report.

I graduated from the University of British Columbia, Canada, in May 2011 with a research-based Master of Science in Geological Sciences.

I graduated from The Colorado College, USA, in May 2006 with a Bachelor of Arts in Geology.

I have been practicing my profession since graduation in 2011 as a geological scientist in Canada and the United States of America.

The data contained in this report and the interpretations drawn from it are true and accurate to the best of my knowledge.

Jennifer Haywood, M.Sc., B.A., GIT

Signed at Vancouver, B.C., Canada this 22nd day of May, 2014

Eric James Thiessen, M.Sc., B.Sc., GIT (APEGBC)

I, Eric Thiessen, do hereby certify that:

> I am a geologist employed by Teck Resources Ltd. (3300-550 Burrard Street, Vancouver, BC, V6C 0B3) at the time of the writing of this report.
>
> I graduated from the University of Alberta, Canada, in January 2013 with a research-based Masters of Science in Geology.
>
> I graduated from Queen’s University, Canada, in May 2010 with a Bachelor of Science in Geology.
>
> I have been practicing my profession since graduation in 2010 as a geologist in Canada.
>
> The data contained in this report and the interpretations drawn from it are true and accurate to the best of my knowledge.

____

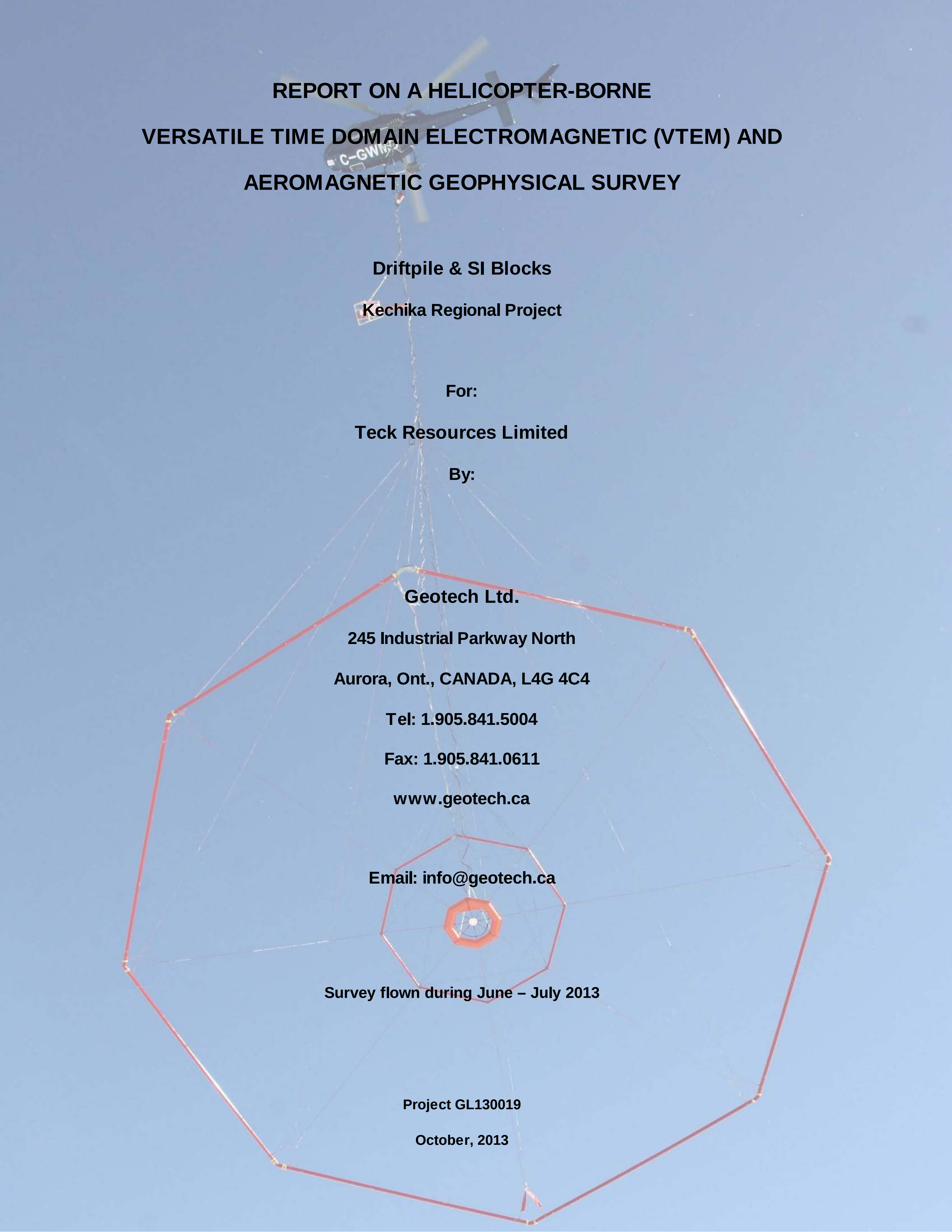
Eric James Thiessen, M.Sc., B.Sc., GIT (APEGBC)

Signed at Vancouver, British Columbia, Canada this 26th day of May, 2014.

APPENDIX II – STATEMENT OF EXPENSES

Exploration Work type	Comment	Days			Totals
Personnel (Name)* / Position	**Field Days (list actual days)**	**Days**	**Rate**	**Subtotal***	
Pilot	June 6th, 7th and 16th, 2013	note: personnel days included in cost per line km	$0.00	$0.00	
Mechanical Engineer	June 6th, 7th and 16th, 2013		$0.00	$0.00	
Crew Chief	June 6th, 7th and 16th, 2013		$0.00	$0.00	
System Operator	June 6th, 7th and 16th, 2013		$0.00	$0.00	
			$0.00	$0.00	
			$0.00	$0.00	
				$0.00	**$0.00**
Office Studies	**List Personnel (note - Office only, do not include field days**				
Literature search			$0.00	$0.00	
Database compilation			$0.00	$0.00	
Computer modelling			$0.00	$0.00	
Reprocessing of data			$0.00	$0.00	
General research			$0.00	$0.00	
Report preparation			$0.00	$0.00	
Other (specify)	Interpretation of preliminary AEM and AMAG data - 1 geophysicist	0.5	$0.00	$0.00	
				$0.00	**$0.00**
Airborne Exploration Surveys	**Line Kilometres / Enter total invoiced amount**				
Aeromagnetics			$0.00	$0.00	
Radiometrics			$0.00	$0.00	
Electromagnetics (VTEM)	23.35 line km/$4,236.64 (total invoiced amount)	23.4	$181.43	$4,236.39	
Gravity			$0.00	$0.00	
Digital terrain modelling			$0.00	$0.00	
Other (specify)			$0.00	$0.00	
				$4,236.39	**$4,236.39**
TOTAL Expenditures					**$4,236.39**

APPENDIX III – REPORT ON AIRBORNE GEOPHYSICAL SURVEY



REPORT ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM) AND AEROMAGNETIC GEOPHYSICAL SURVEY

Driftpile & SI Blocks

Kechika Regional Project

For:

Teck Resources Limited

By:

Geotech Ltd.

245 Industrial Parkway North

Aurora, Ont., CANADA, L4G 4C4

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Survey flown during June – July 2013

Project GL130019

October, 2013

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REPORT ON A HELICOPTER-BORNE VERSATILE TIME DOMAIN ELECTROMAGNETIC (VTEM) and AEROMAGNETIC SURVEY

Driftpile & SI Blocks
Kechika Regional Project

Executive Summary

During June 17th to July 17th, 2013 Geotech Ltd. carried out a helicopter-borne geophysical survey over Driftpile & SI blocks located near Akie Camp, British Columbia, Canada.

Principal geophysical sensors included a versatile time domain electromagnetic (VTEM) system, and a cesium magnetometer. Ancillary equipment included a GPS navigation system and a radar altimeter. A total of 245.8 line-kilometres of geophysical data were acquired.

In-field data quality assurance and preliminary processing were carried out on a daily basis during the acquisition phase. Preliminary and final data processing, including generation of final digital data and map products were undertaken from the office of Geotech Ltd. in Aurora, Ontario.

The processed survey results are presented as the following maps:

- Total Magnetic Intensity
- B-Field Z Component Channel grid
- Calculated Time Constant (TAU)
- Electromagnetic stacked profiles of the B-field Z component
- Electromagnetic stacked profiles of the dB/dt Z component

Digital data includes all electromagnetic and magnetic products, ancillary data and the VTEM waveform.

The survey report describes the procedures for data acquisition, processing, final image presentation and the specifications for the digital data set.

1. INTRODUCTION

1.1 General Considerations

Geotech Ltd. performed a helicopter-borne geophysical survey over Driftpile & SI near Akie Camp, British Columbia, Canada (Figure 1 & 2).

Boris Lum represented Teck Resources Limited during the data acquisition and data processing phases of this project.

The geophysical surveys consisted of helicopter borne EM using the versatile time-domain electromagnetic (VTEM) system with Z component measurements and aeromagnetics using a cesium magnetometer. A total of 245.8 line-km of geophysical data were acquired during the survey.

The crew was based out of Akie Camp in British Columbia for the acquisition phase of the survey. Survey flying started on June 17th and was completed on July 17th, 2013.

Data quality control and quality assurance, and preliminary data processing were carried out on a daily basis during the acquisition phase of the project. Final data processing followed immediately after the end of the survey. Final reporting, data presentation and archiving were completed from the Aurora office of Geotech Ltd. in October, 2013.

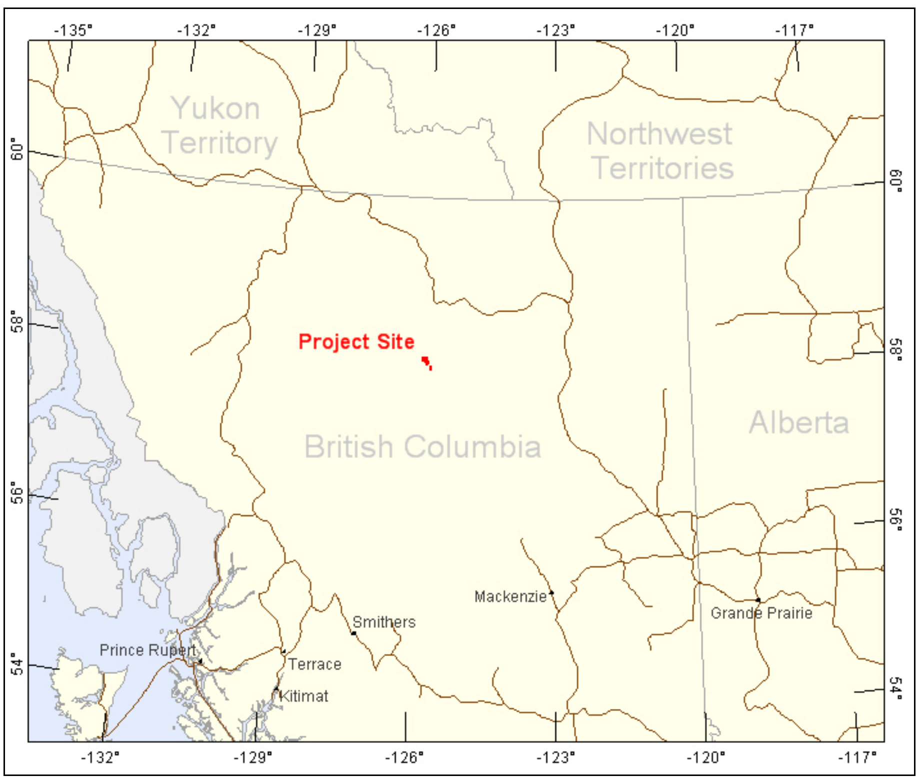

Figure 1: Property Location.

1.2 Survey and System Specifications

The Blocks are located northeast of Akie Camp, British Columbia (Figure 2).

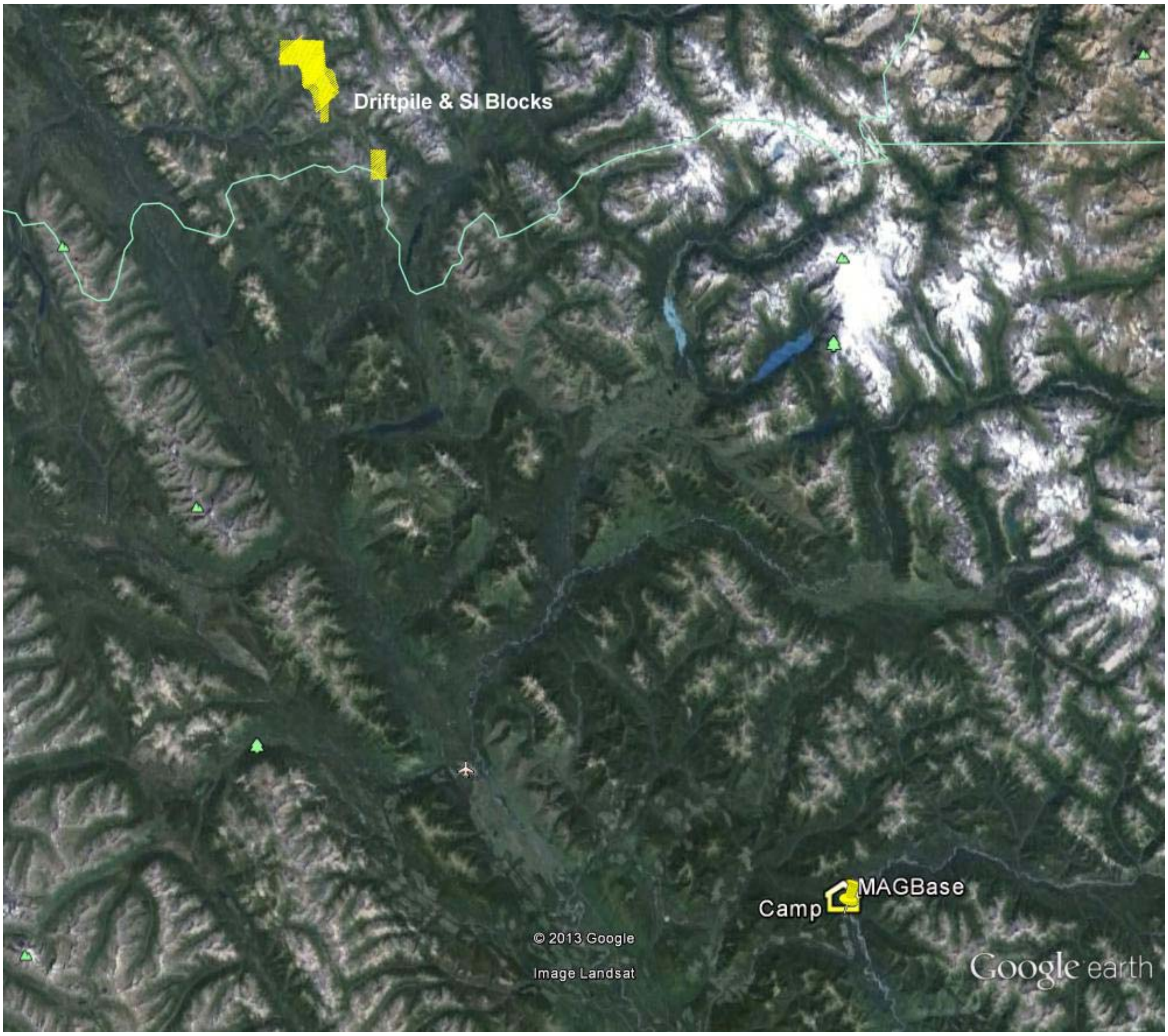

Figure 2: Survey area location on Google Earth.

The Blocks were flown in a southwest to northeast (N 50° E azimuth) direction with traverse line spacing of 100 & 200 metres as depicted in Figure 3. Tie lines were neither planned nor flown for this survey.

For more detailed information on the flight spacing and direction see Table 1.

1.3 Topographic Relief and Cultural Features

Topographically, the Blocks exhibit a high relief with elevations ranging from 1256 to 2120 metres above mean sea level over an area of 25 square kilometres (Figure 3).

There are various rivers and streams running through the survey area which connect various lakes and wetlands. There are no visible signs of culture such as roads and a power lines within the survey areas.

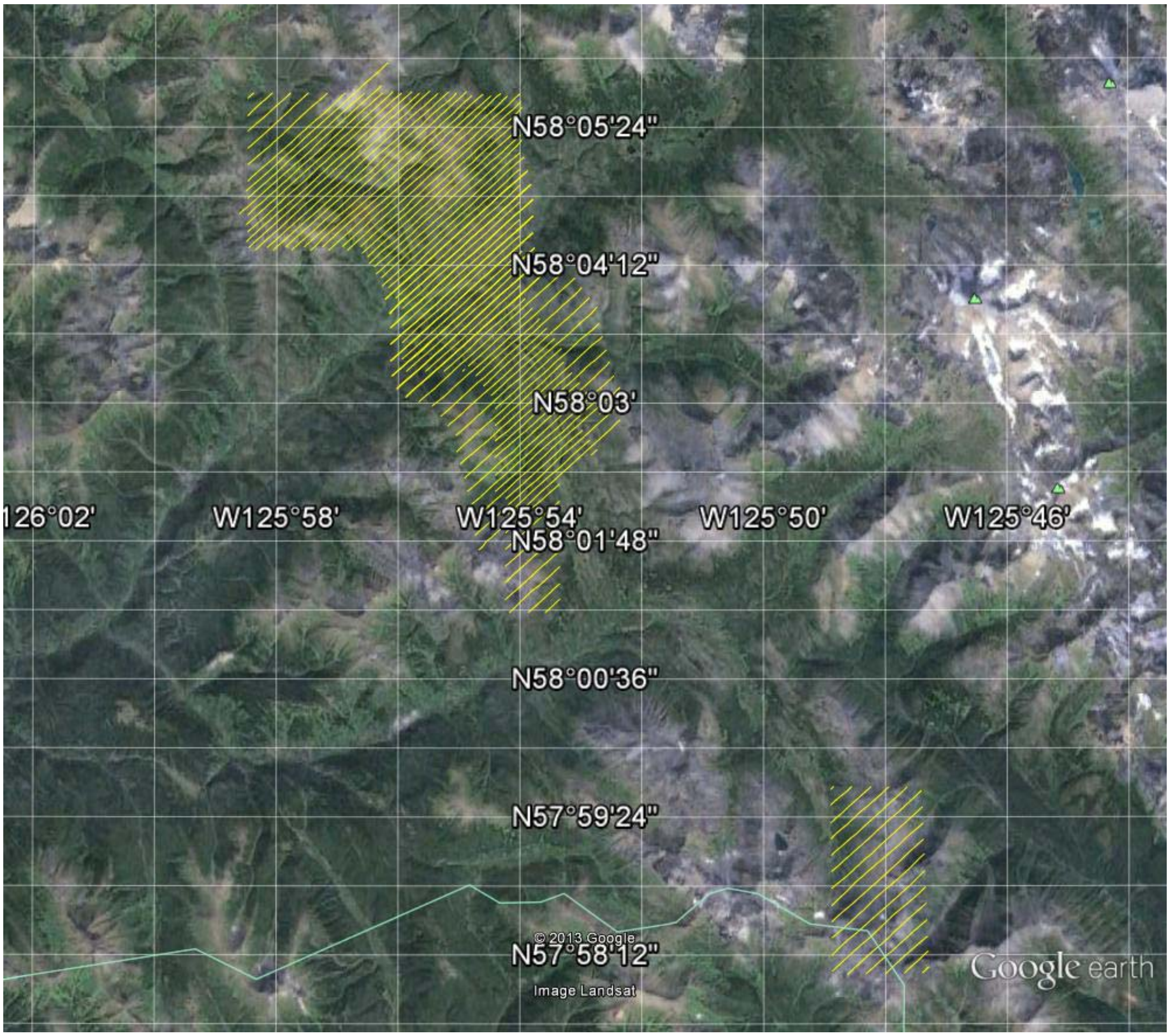

Figure 3: Flight path over a Google Earth Image – Driftpile & SI Blocks.

2. DATA ACQUISITION

2.1 Survey Area

The survey blocks (see **Error! Reference source not found.** and Appendix A) and general flight specifications are as follows:

Table 1: Survey Specifications

Survey block	Traverse Line spacing (m)	Area (Km^2)	Planned[1] Line-km	Actual Line-km	Flight direction	Line numbers
Driftpile &SI	Traverse: 100 & 200	25	245.8	263.6	N 50° E / N 230° E	L1250 – L2140 L10080 – L10420
TOTAL		25	245.8	263.6		

Survey block boundaries co-ordinates are provided in Appendix B.

2.2 Survey Operations

Survey operations were based out of Akie Camp from June 17th to July 17th, 2013. The following table shows the timing of the flying.

Table 2: Survey schedule

Date	Flight #	Flow km	Block	Crew location	Comments
17-Jun-2013				Akie Camp, BC	Mobilization
18-Jun-2013				Akie Camp, BC	Crew arrived
19-Jun-2013				Akie Camp, BC	System assembly
20-Jun-2013				Akie Camp, BC	Heli install & Testing
21-Jun-2013	1			Akie Camp, BC	Testing & 62km flown
22-Jun-2013	2,3			Akie Camp, BC	Other area being flown
23-Jun-2013	4,5			Akie Camp, BC	Other area being flown
24-Jun-2013	6			Akie Camp, BC	Other area being flown
25-Jun-2013				Akie Camp, BC	No production due to weather
26-Jun-2013				Akie Camp, BC	No production due to weather
27-Jun-2013				Akie Camp, BC	No production due to weather
28-Jun-2013	7			Akie Camp, BC	Other area being flown
29-Jun-2013				Akie Camp, BC	No production due to weather
30-Jun-2013	9,10			Akie Camp, BC	Other area being flown
1-Jul-2013				Akie Camp, BC	No production due to weather
2-Jul-2013	11			Akie Camp, BC	Other area being flown
3-Jul-2013	12,13			Akie Camp, BC	Other area being flown
4-Jul-2013	14,15,16			Akie Camp, BC	Other area being flown
5-Jul-2013	17			Akie Camp, BC	Other area being flown
6-Jul-2013	18,19	47.7		Akie Camp, BC	47.7km flown

[1] Note: Actual Line kilometres represent the total line kilometres in the final database. These line-km normally exceed the Planned line-km, as indicated in the survey NAV files.

Date	Flight #	Flow km	Block	Crew location	Comments
7-Jul-2013	20,21	77.2		Akie Camp, BC	77.2km flown
8-Jul-2013	22,23,24			Akie Camp, BC	Other area being flown
9-Jul-2013				Akie Camp, BC	No production due to technical & weather issues
10-Jul-2013	25			Akie Camp, BC	No production due to technical & weather issues
11-Jul-2013				Akie Camp, BC	No production due to technical & weather issues
12-Jul-2013				Akie Camp, BC	No production due to technical & weather issues
13-Jul-2013				Akie Camp, BC	No production due to technical & weather issues
14-Jul-2013	26			Akie Camp, BC	Other area being flown
15-Jul-2013	27,28			Akie Camp, BC	Other area being flown
16-Jul-2013	29,30	138.7		Akie Camp, BC	138.7km flown
17-Jul-2013	31			Akie Camp, BC	Remaining kms were flown – flying complete

2.3 Flight Specifications

During the survey the helicopter was maintained at a mean altitude of 81 metres above the ground with an average survey speed of 80 km/hour. This allowed for an average EM bird terrain clearance of 42 metres and a magnetic sensor clearance of 68 metres.

The on board operator was responsible for monitoring the system integrity. He also maintained a detailed flight log during the survey, tracking the times of the flight as well as any unusual geophysical or topographic features.

On return of the aircrew to the base camp the survey data was transferred from a compact flash card (PCMCIA) to the data processing computer. The data were then uploaded via ftp to the Geotech office in Aurora for daily quality assurance and quality control by qualified personnel.

2.4 Aircraft and Equipment

2.4.1 Survey Aircraft

The survey was flown using a Eurocopter Aerospatiale (Astar) 350 B3 helicopter, registration C-FVTM. The helicopter is owned and operated by Geotech Aviation. Installation of the geophysical and ancillary equipment was carried out by a Geotech Ltd crew.

2.4.2 Electromagnetic System

The electromagnetic system was a Geotech Time Domain EM (VTEM) system. VTEM, with the serial number 17 had been used for the survey. The configuration is as indicated in Figure 5.

The VTEM Receiver and transmitter coils were in concentric-coplanar and Z-direction oriented configuration. The EM bird was towed at a mean distance of 35 metres below the aircraft as shown in Figure 5 and Figure 6. The receiver decay recording scheme is shown diagrammatically in Figure 4.

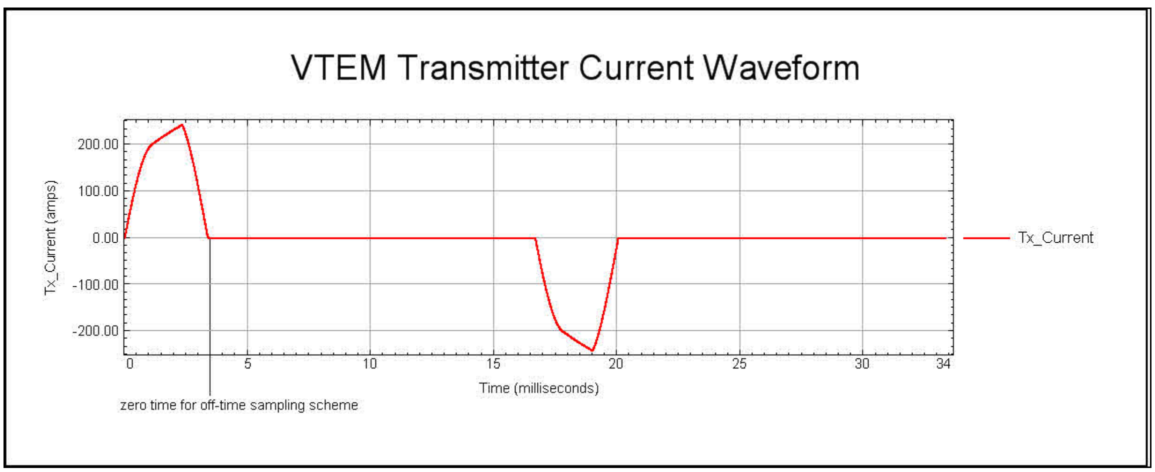

Figure 4: VTEM Waveform

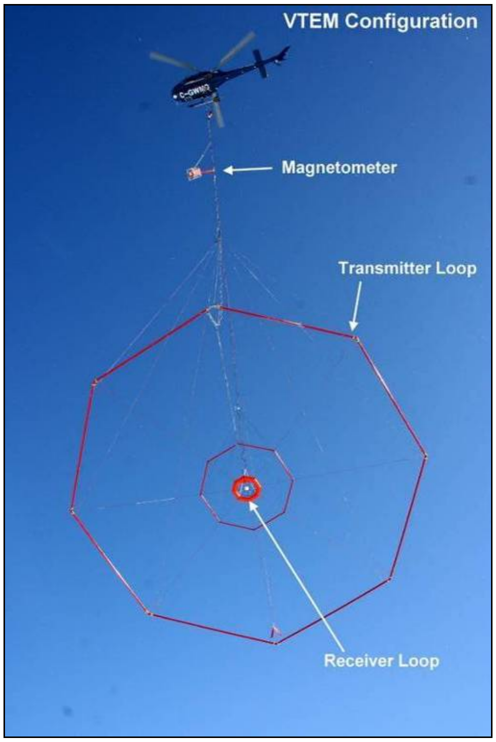

Figure 5: VTEM Configuration, with magnetometer.

The VTEM decay sampling scheme is shown in Table 3 below. Thirty-two time measurement gates were used for the final data processing in the range from 0.096 to 7.036 msec. Zero time for off-time sampling scheme is equal to current pulse width and defined as the time near the end of the turn-off ramp where the dI/dt waveform falls to 1/2 of its peak value.

Table 3: Off-Time Decay Sampling Scheme

VTEM Decay Sampling Scheme			
Index	**Middle**	**Start**	**End**
Milliseconds			
14	0.096	0.090	0.103
15	0.110	0.103	0.118
16	0.126	0.118	0.136
17	0.145	0.136	0.156
18	0.167	0.156	0.179
19	0.192	0.179	0.206
20	0.220	0.206	0.236
21	0.253	0.236	0.271
22	0.290	0.271	0.312
23	0.333	0.312	0.358
24	0.383	0.358	0.411
25	0.440	0.411	0.472
26	0.505	0.472	0.543
27	0.580	0.543	0.623
28	0.667	0.623	0.716
29	0.766	0.716	0.823
30	0.880	0.823	0.945
31	1.010	0.945	1.086
32	1.161	1.086	1.247
33	1.333	1.247	1.432
34	1.531	1.432	1.646
35	1.760	1.646	1.891
36	2.021	1.891	2.172
37	2.323	2.172	2.495
38	2.667	2.495	2.865
39	3.063	2.865	3.292
40	3.521	3.292	3.781
41	4.042	3.781	4.341
42	4.641	4.341	4.987
43	5.333	4.987	5.729
44	6.125	5.729	6.581
45	7.036	6.581	7.560

VTEM system specification:

Transmitter

- Transmitter loop diameter: 17.6 m
- Number of turns: 4
- Effective Transmitter loop area: 973 m^2
- Transmitter base frequency: 30 Hz
- Peak current: 246 A
- Pulse width: 3.40 ms
- Wave form shape: Bi-polar trapezoid
- Peak dipole moment: 239,358 nIA
- Actual average EM Bird terrain clearance: 42 metres above the ground

Receiver

- Z-Coil diameter: 1.2 m
- Number of turns: 100
- Effective coil area: 113.04 m^2

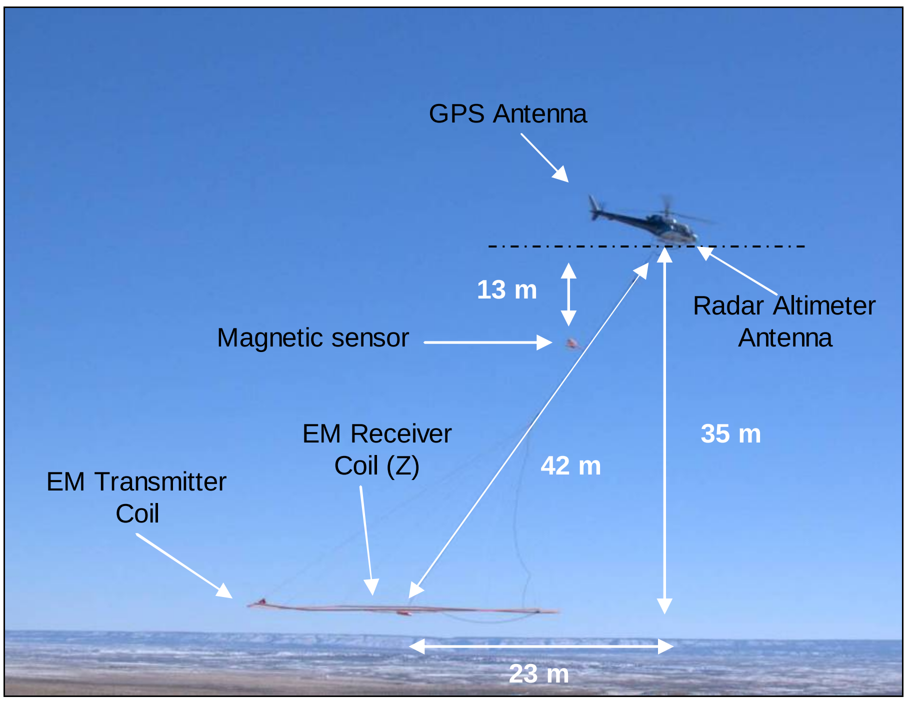

Figure 6: VTEM System Configuration.

2.4.3 Airborne magnetometer

The magnetic sensor utilized for the survey was Geometrics optically pumped cesium vapour magnetic field sensor mounted 13 metres below the helicopter, as shown in Figure 6. The sensitivity of the magnetic sensor is 0.02 nanoTesla (nT) at a sampling interval of 0.1 seconds.

2.4.4 Radar Altimeter

A Terra TRA 3000/TRI 40 radar altimeter was used to record terrain clearance. The antenna was mounted beneath the bubble of the helicopter cockpit (Figure 6).

2.4.5 GPS Navigation System

The navigation system used was a Geotech PC104 based navigation system utilizing a NovAtel's WAAS (Wide Area Augmentation System) enabled GPS receiver, Geotech navigate software, a full screen display with controls in front of the pilot to direct the flight and a NovAtel GPS antenna mounted on the helicopter tail (Figure 6). As many as 11 GPS and two WAAS satellites may be monitored at any one time. The positional accuracy or circular error probability (CEP) is 1.8 m, with WAAS active, it is 1.0 m. The co-ordinates of the block were set-up prior to the survey and the information was fed into the airborne navigation system.

2.4.6 Digital Acquisition System

A Geotech data acquisition system recorded the digital survey data on an internal compact flash card. Data is displayed on an LCD screen as traces to allow the operator to monitor the integrity of the system. The data type and sampling interval as provided in Table 4.

Table 4: Acquisition Sampling Rates

Data Type	Sampling
TDEM	0.1 sec
Magnetometer	0.1 sec
GPS Position	0.2 sec
Radar Altimeter	0.2 sec

2.5 Base Station

A combined magnetometer/GPS base station was utilized on this project. A Geometrics Cesium vapour magnetometer was used as a magnetic sensor with a sensitivity of 0.001 nT. The base station was recording the magnetic field together with the GPS time at 1 Hz on a base station computer.

The base station magnetometer sensor was installed 75 metres south of Akie Camp (57º 17' 30.9"N, 125º 00' 02.3"W); away from electric transmission lines and moving ferrous objects such as motor vehicles. The base station data were backed-up to the data processing computer at the end of each survey day.

3. PERSONNEL

The following Geotech Ltd. personnel were involved in the project.

Field:

Project Manager:	Scott Trew (office)
Data QA/QC:	Neil Fiset (office)
Crew Chief:	Brian Youngs
System Operators:	Michael Altman

The survey pilot and the mechanical engineer were employed directly by the helicopter operator – Geotech Aviation.

Pilot:	Walter Zec
Mechanical Engineer:	Chris Ward

Office:

Preliminary Data Processing:	Neil Fiset
Final Data Processing:	Timothy Eadie
Final Data QA/QC:	Alexander Prikhodko
Reporting/Mapping:	Wendy Acorn

Data acquisition phase was carried out under the supervision of Andrei Bagrianski, P. Geo, Chief Operations Officer. The processing and interpretation phase was under the supervision of Alexander Prikhodko, P. Geo, Ph.D. The overall contract management and customer relations were by Blair Walker and David Hitz.

4. DATA PROCESSING AND PRESENTATION

Data compilation and processing were carried out by the application of Geosoft OASIS Montaj and programs proprietary to Geotech Ltd.

4.1 Flight Path

The flight path, recorded by the acquisition program as WGS 84 latitude/longitude, was converted into the NAD83 Datum, UTM Zone 10 North coordinate system in Oasis Montaj.

The flight path was drawn using linear interpolation between x, y positions from the navigation system. Positions are updated every second and expressed as UTM easting's (x) and UTM northing's (y).

4.2 Electromagnetic Data

A three stage digital filtering process was used to reject major sferic events and to reduce system noise. Local sferic activity can produce sharp, large amplitude events that cannot be removed by conventional filtering procedures. Smoothing or stacking will reduce their amplitude but leave a broader residual response that can be confused with geological phenomena. To avoid this possibility, a computer algorithm searches out and rejects the major sferic events.

The signal to noise ratio was further improved by the application of a low pass linear digital filter. This filter has zero phase shift which prevents any lag or peak displacement from occurring, and it suppresses only variations with a wavelength less than about 1 second or 15 metres. This filter is a symmetrical 1 sec linear filter.

The results are presented as stacked profiles of EM voltages for the time gates, in linear - logarithmic scale for the B-field Z component and dB/dt responses in the Z. B-field Z component time channel recorded at 1.010 milliseconds after the termination of the impulse is also presented as a color image. Calculated Time Constant (TAU) with anomaly contours of Calculated Vertical Derivative of TMI is presented in Appendix C and E. Tau was calculated for B-Field and dB/dt. Resistivity Depth Image (RDI) is also presented in Appendix F.

VTEM receiver coil orientation Z-axis coil is oriented parallel to the transmitter coil axis and is horizontal to the ground. Generalized modeling results of VTEM data, are shown in Appendix D.

Z component data produce double peak type anomalies for "thin" subvertical targets and single peak for "thick" targets.

The limits and change-over of "thin-thick" depends on dimensions of a TEM system the system's height and depth of a target. For example see Appendix D, Fig.D-16.

4.3 Magnetic Data

The processing of the magnetic data involved the correction for diurnal variations by using the digitally recorded ground base station magnetic values. The base station magnetometer data was edited and merged into the Geosoft GDB database on a daily basis. The aeromagnetic data was corrected for diurnal variations by subtracting the observed magnetic base station deviations.

The corrected magnetic data was interpolated between survey lines using a random point gridding method to yield x-y grid values for a standard grid cell size of approximately 50 metres at the mapping scale. The Minimum Curvature algorithm was used to interpolate values onto a rectangular regular spaced grid.

5. DELIVERABLES

5.1 Survey Report

The survey report describes the data acquisition, processing, and final presentation of the survey results. The survey report is provided in two paper copies and digitally in PDF format.

5.2 Maps

Final maps were produced at scale of 1:20,000 for best representation of the survey size and line spacing. The coordinate/projection system used was NAD83 Datum, UTM Zone 10 North. All maps show the mining claims, flight path trace and topographic data; latitude and longitude are also noted on maps.

The preliminary and final results of the survey are presented as EM profiles, a late-time gate gridded EM channel, and a color magnetic TMI contour map. The following maps are presented;

- VTEM dB/dt profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
- VTEM B-Field profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
- VTEM B-Field late time Z Component colour image.
- Total Magnetic Intensity (TMI) colour image and contours.
- VTEM dB/dt Calculated Time Constant (TAU) with contours of anomaly areas of the Calculated Vertical Derivative of TMI

5.3 Digital Data

- Two copies of the data and maps on DVD were prepared to accompany the report. Each DVD contains a digital file of the line data in GDB Geosoft Montaj format as well as the maps in Geosoft Montaj Map and PDF format.

- DVD structure.

Data	contains databases, grids and maps, as described below.
Report	contains a copy of the report and appendices in PDF format.

Databases in Geosoft GDB format, containing the channels listed in Table 5.

Table 5: Geosoft GDB Data Format

Channel name	Units	Description
X:	metres	UTM Easting NAD83 Zone 10 North
Y:	metres	UTM Northing NAD83 Zone 10 North
Z:	metres	GPS antenna elevation (above Geoid)
Longitude:	Decimal Degrees	WGS 84 Longitude data
Latitude:	Decimal Degrees	WGS 84 Latitude data
Radar:	metres	helicopter terrain clearance from radar altimeter
Radarb:	metres	Calculated EM bird terrain clearance from radar altimeter
DEM:	metres	Digital Elevation Model
Gtime:	Seconds of the day	GPS time
Mag1:	nT	Raw Total Magnetic field data
Basemag:	nT	Magnetic diurnal variation data
Mag2:	nT	Diurnal corrected Total Magnetic field data
Mag3:	nT	Levelled Total Magnetic field data
CVG	nT/m	Calculated Magnetic Vertical Gradient
SFz[14]:	$pV/(A*m^4)$	Z dB/dt 0.096 millisecond time channel
SFz[15]:	$pV/(A*m^4)$	Z dB/dt 0.110 millisecond time channel
SFz[16]:	$pV/(A*m^4)$	Z dB/dt 0.126 millisecond time channel
SFz[17]:	$pV/(A*m^4)$	Z dB/dt 0.145 millisecond time channel
SFz[18]:	$pV/(A*m^4)$	Z dB/dt 0.167 millisecond time channel
SFz[19]:	$pV/(A*m^4)$	Z dB/dt 0.192 millisecond time channel
SFz[20]:	$pV/(A*m^4)$	Z dB/dt 0.220 millisecond time channel
SFz[21]:	$pV/(A*m^4)$	Z dB/dt 0.253 millisecond time channel
SFz[22]:	$pV/(A*m^4)$	Z dB/dt 0.290 millisecond time channel
SFz[23]:	$pV/(A*m^4)$	Z dB/dt 0.333 millisecond time channel
SFz[24]:	$pV/(A*m^4)$	Z dB/dt 0.383 millisecond time channel
SFz[25]:	$pV/(A*m^4)$	Z dB/dt 0.440 millisecond time channel
SFz[26]:	$pV/(A*m^4)$	Z dB/dt 0.505 millisecond time channel
SFz[27]:	$pV/(A*m^4)$	Z dB/dt 0.580 millisecond time channel
SFz[28]:	$pV/(A*m^4)$	Z dB/dt 0.667 millisecond time channel
SFz[29]:	$pV/(A*m^4)$	Z dB/dt 0.766 millisecond time channel
SFz[30]:	$pV/(A*m^4)$	Z dB/dt 0.880 millisecond time channel
SFz[31]:	$pV/(A*m^4)$	Z dB/dt 1.010 millisecond time channel
SFz[32]:	$pV/(A*m^4)$	Z dB/dt 1.161 millisecond time channel
SFz[33]:	$pV/(A*m^4)$	Z dB/dt 1.333 millisecond time channel
SFz[34]:	$pV/(A*m^4)$	Z dB/dt 1.531 millisecond time channel
SFz[35]:	$pV/(A*m^4)$	Z dB/dt 1.760 millisecond time channel
SFz[36]:	$pV/(A*m^4)$	Z dB/dt 2.021 millisecond time channel
SFz[37]:	$pV/(A*m^4)$	Z dB/dt 2.323 millisecond time channel
SFz[38]:	$pV/(A*m^4)$	Z dB/dt 2.667 millisecond time channel
SFz[39]:	$pV/(A*m^4)$	Z dB/dt 3.063 millisecond time channel
SFz[40]:	$pV/(A*m^4)$	Z dB/dt 3.521 millisecond time channel
SFz[41]:	$pV/(A*m^4)$	Z dB/dt 4.042 millisecond time channel
SFz[42]:	$pV/(A*m^4)$	Z dB/dt 4.641 millisecond time channel
SFz[43]:	$pV/(A*m^4)$	Z dB/dt 5.333 millisecond time channel
SFz[44]:	$pV/(A*m^4)$	Z dB/dt 6.125 millisecond time channel
SFz[45]:	$pV/(A*m^4)$	Z dB/dt 7.036 millisecond time channel
BFz	$(pV*ms)/(A*m^4)$	Z B-Field data for time channels 14 to 45
PLM:		60 Hz power line monitor

Channel name	Units	Description
TauSF	milliseconds	Time Constant (Tau) calculated from dB/dt data
Nchan_SF		Last channel where the Tau algorithm stops calculation, dB/dt data
TauBF	milliseconds	Time Constant (Tau) calculated from B-Field data
Nchan_BF		Last channel where the Tau algorithm stops calculation, B-Field data

Electromagnetic B-field and dB/dt Z component data is found in array channel format between indexes 14 – 45.

- Database of the Resistivity Depth Images in Geosoft GDB format, containing the following channels:

Table 6: Geosoft Resistivity Depth Image GDB Data Format

Channel name	Units	Description
Xg	metres	UTM Easting NAD83 Zone 10 North
Yg	metres	UTM Northing NAD83 Zone 10 North
Dist:	meters	Distance from the beginning of the line
Depth:	meters	array channel, depth from the surface
Z:	meters	array channel, depth from sea level
AppRes:	Ohm-m	array channel, Apparent Resistivity
TR:	meters	EM system height from sea level
Topo:	meters	digital elevation model
Radarb:	metres	Calculated EM bird terrain clearance from radar altimeter
SF:	pV/(A*m^4)	array channel, dB/dT
MAG:	nT	TMI data
CVG:	nT/m	CVG data
DOI:	metres	Depth of Investigation: a measure of VTEM depth effectiveness

- Database of the VTEM Waveform "GL130019_waveform_final.gdb" in Geosoft GDB format, containing the following channels:

Time:	Sampling rate interval, 5.2083 microseconds
Tx_Current:	Output current of the transmitter (Amp)
Rx_Volt:	Output voltage of the receiver coil (volt)

- Grids in Geosoft GRD and GeoTIFF format, as follows:

Mag3:	Total Magnetic Intensity (TMI)
BFz31:	B-Field Z Component Channel 31 (Time Gate 1.010 ms)
SFz16:	B-Field Z Component Channel 16 (Time Gate 0.126 ms)
SFz25:	B-Field Z Component Channel 25 (Time Gate 0.440 ms)
SFz35:	B-Field Z Component Channel 35 (Time Gate 1.760 ms)
TauSF:	dB/dt Calculated Time Constant (TAU)
TauBF:	B-Field Calculated Time Constant (TAU)
CVG:	Calculated Vertical Derivative of TMI (CVG)
DEM:	Digital Elevation Model

A Geosoft .GRD file has a .GI metadata file associated with it, containing grid projection information. Grid cell sizes of 50 metres were used.

- Maps at 1:20,000 in Geosoft MAP format, as follows:

GL130019_20K_dBdt_bb: dB/dt profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
GL130019_20K_Bfield_bb: B-field profiles Z Component, Time Gates 0.220 – 7.036 ms in linear – logarithmic scale.
GL130019_20K_BFz31_bb: B-Field late time Z Component Channel 31, Time Gate 1.010 ms colour image.
GL130019_20K_TMI_bb: Total Magnetic Intensity (TMI) colour image and contours.
GL130019_20K_TauSF_bb: dB/dt Calculated Time Constant (TAU) with contours of anomaly areas of the Calculated Vertical Derivative of TMI

Where bb represents the block name ie GL130019_20k_TMI_Driftpile_SI

Maps are also presented in PDF format.

- 1:50,000 topographic vectors were taken from the NRCAN Geogratis database at; http://geogratis.gc.ca/geogratis/en/index.html.

- A Google Earth file *GL130019_Teck.kml* showing the flight path of the block is included. Free versions of Google Earth software from: http://earth.google.com/download-earth.html

6. CONCLUSIONS AND RECOMMENDATIONS

A helicopter-borne versatile time domain electromagnetic (VTEM) geophysical survey has been completed over Driftpile, SI, Yuen, Cirque East and Pie blocks located near Akie Camp, British Columbia.

The total area coverage is 25 km^2. Total survey line coverage is 245.8 line kilometres. The principal sensors included a Time Domain EM system and a magnetometer. Results have been presented as stacked profiles, and contour color images at a scale of 1:20,000. A formal Interpretation has not been included or requested.

Each area is located within the Kechika Trough of northern British Columbia. This area is a known host of SEDEX mineralization.

Further to the northwest are the Driftpile and SI blocks. The main strike of the geology is NW-SE, similar to the previously mentioned area. In this area, there are multiple conductors in close proximity to one another. Of note on line 10230, are three conductors which appear to be flat-lying and is best seen in the RDI.

For each of the areas, the magnetic data contained weak broad anomalies likely the result of sediments present in valleys within the block. These anomalies did not present well in the first vertical derivative as the anomalies response was near the noise level of the magnetic data for the survey.

For each of the areas, additional interpretation is strongly recommended over the survey block consisting of: Anomaly Picking and modeling of local conductive targets. The recommended interpretation should be performed prior to ground follow-up and drill testing.

Respectfully submitted[2],

Neil Fiset
Geotech Ltd.

Tim Eadie
Geotech Ltd.

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ALEXANDER PRIKHODKO
PRACTISING MEMBER
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ONTARIO

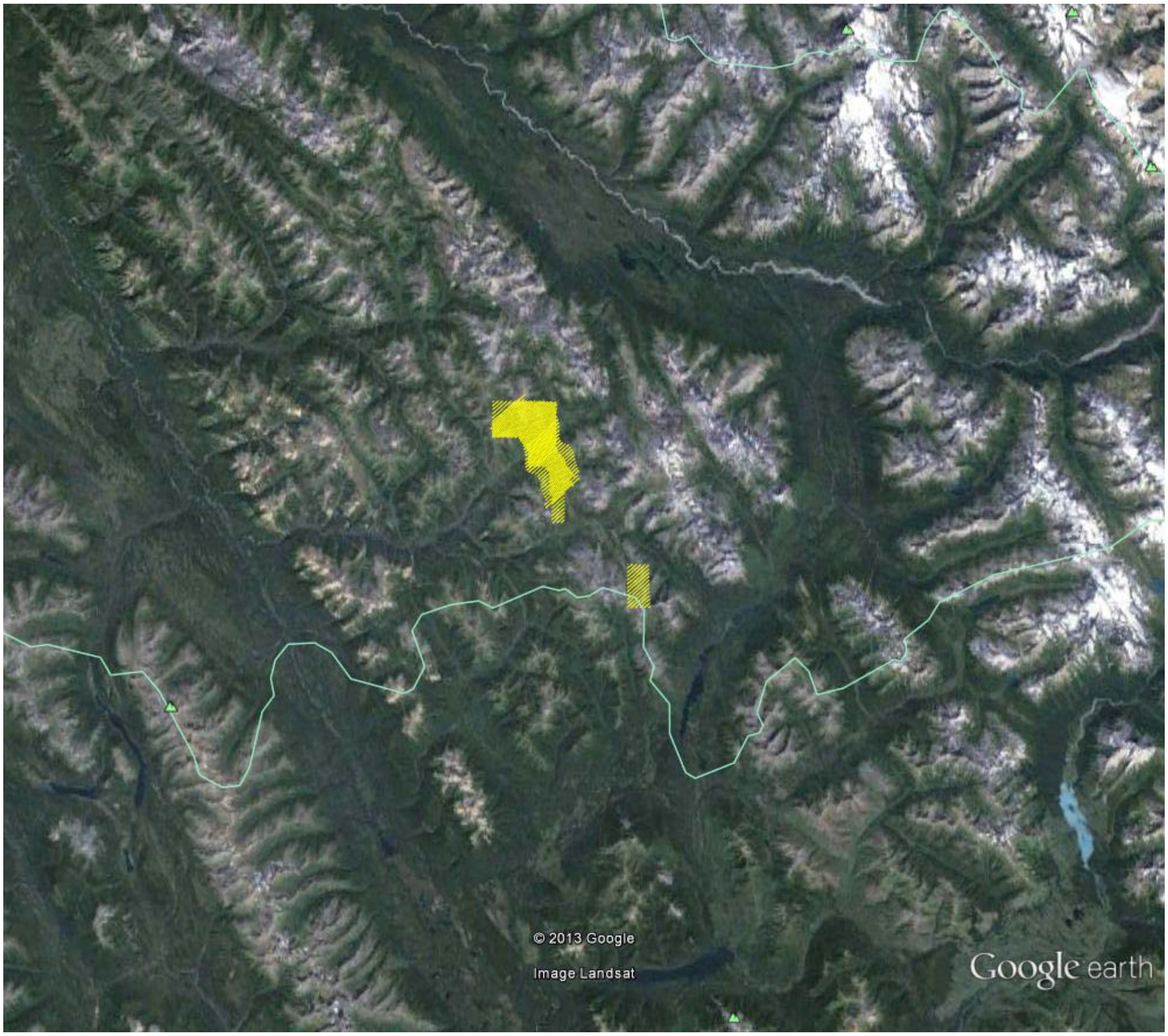
Alexander Prikhodko, P. Geo PhD
Manager of Data Interpretation
Geotech Ltd.

October 2013

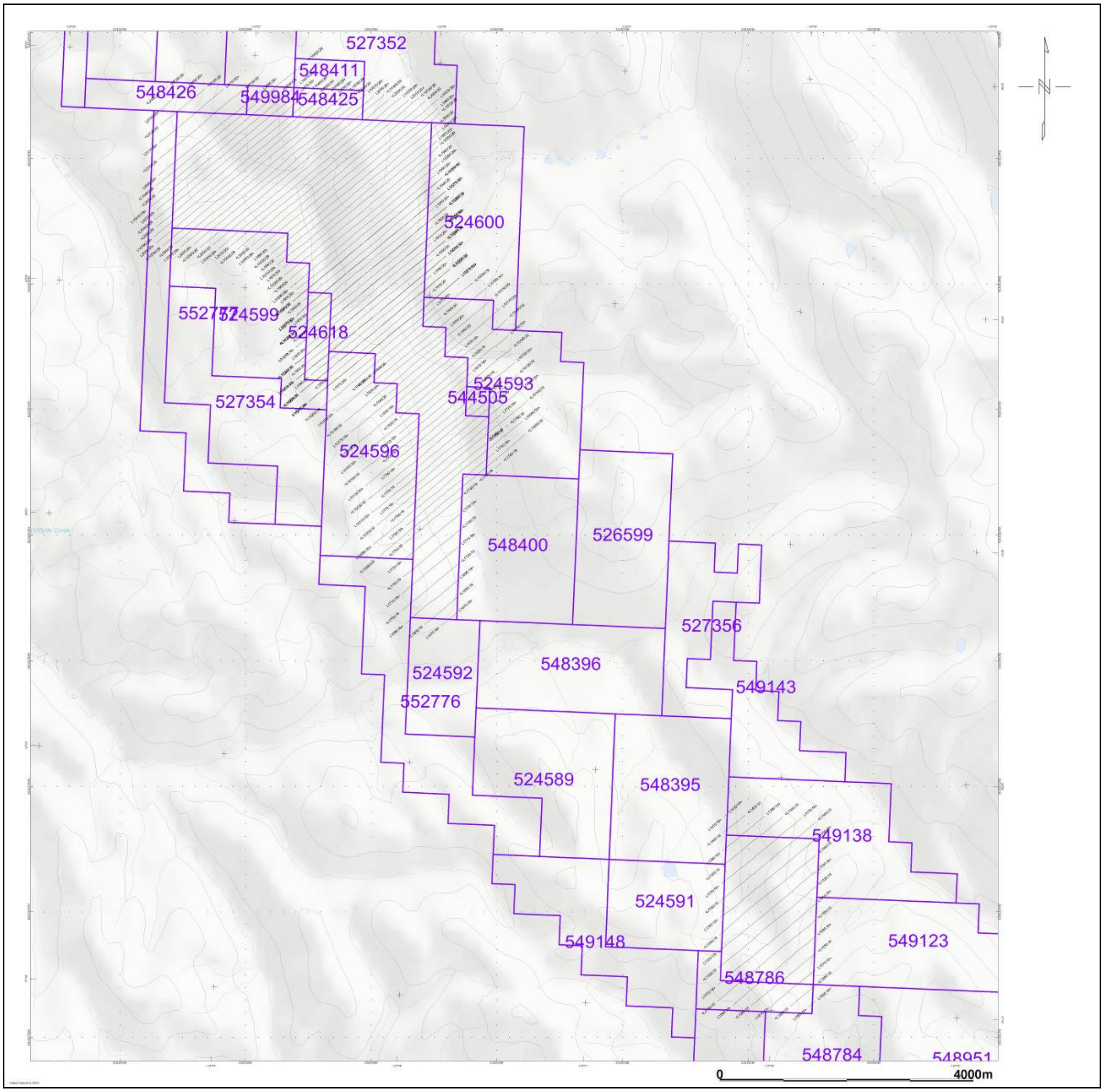
[2] Final data processing of the EM and magnetic data were carried out by Neil Fiset and Tim Eadie, from the office of Geotech Ltd. in Aurora, Ontario, under the supervision of Alexander Prikhodko, P.Geo., PhD, Manager of Data Interpretation.

APPENDIX A

SURVEY BLOCK LOCATION MAP



Survey Overview of the Blocks



Mining Claims – Driftpile & SI

APPENDIX B

SURVEY BLOCK COORDINATES
(WGS 84, UTM Zone 10 North)

Driftpile

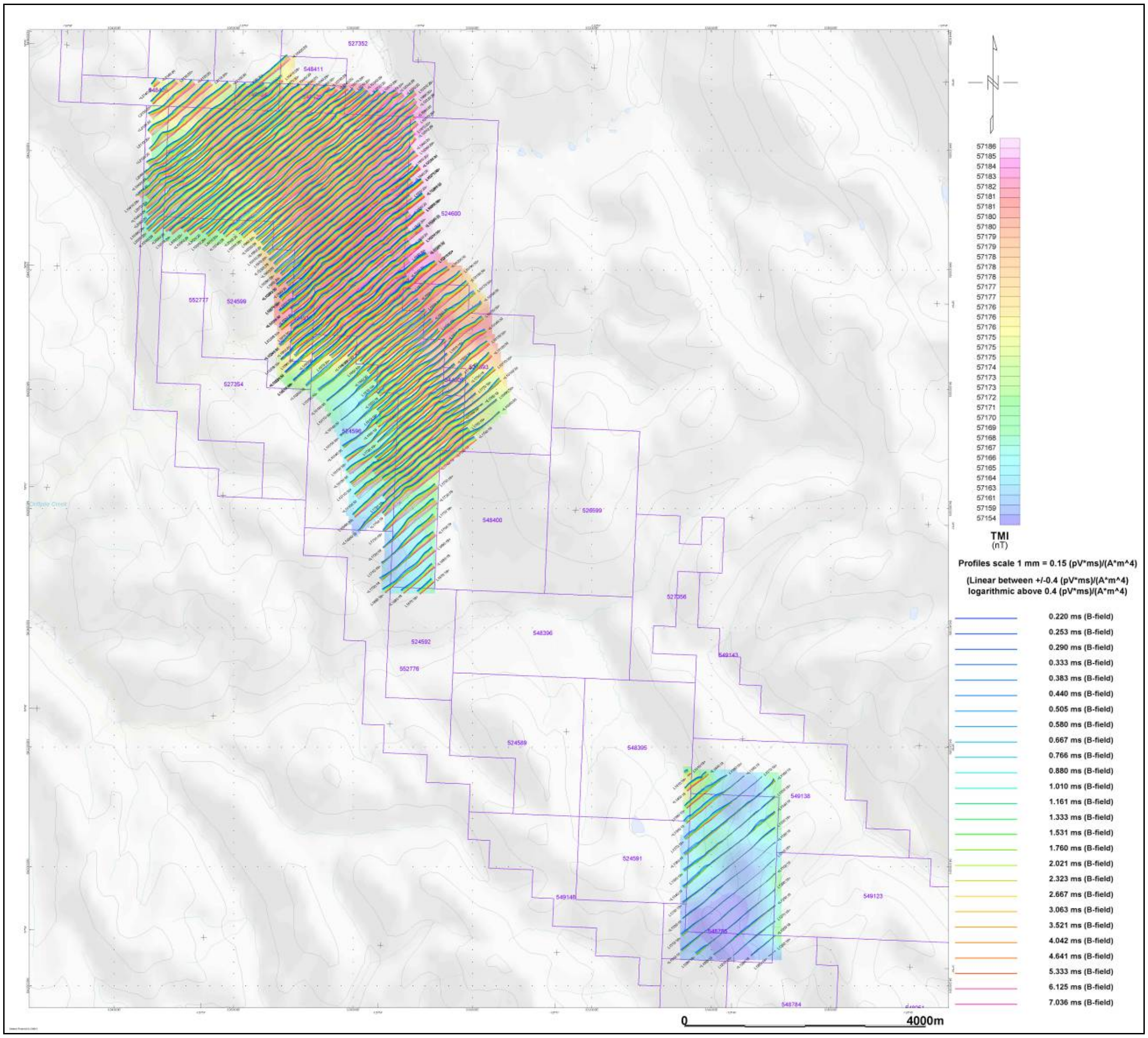
X	Y
324709	6443123
329048	6442869
328984	6439652
329619	6438784
330233	6437789
329937	6437472
330106	6437112
329514	6436710
329387	6434551
328540	6434614
328603	6436434
328413	6436456
328476	6438001
328032	6438615
328011	6438466
326995	6438488
327058	6439482
326466	6440520
324624	6440625

SI

X	Y
333662	6431502
335186	6431439
335102	6428412
333556	6428497

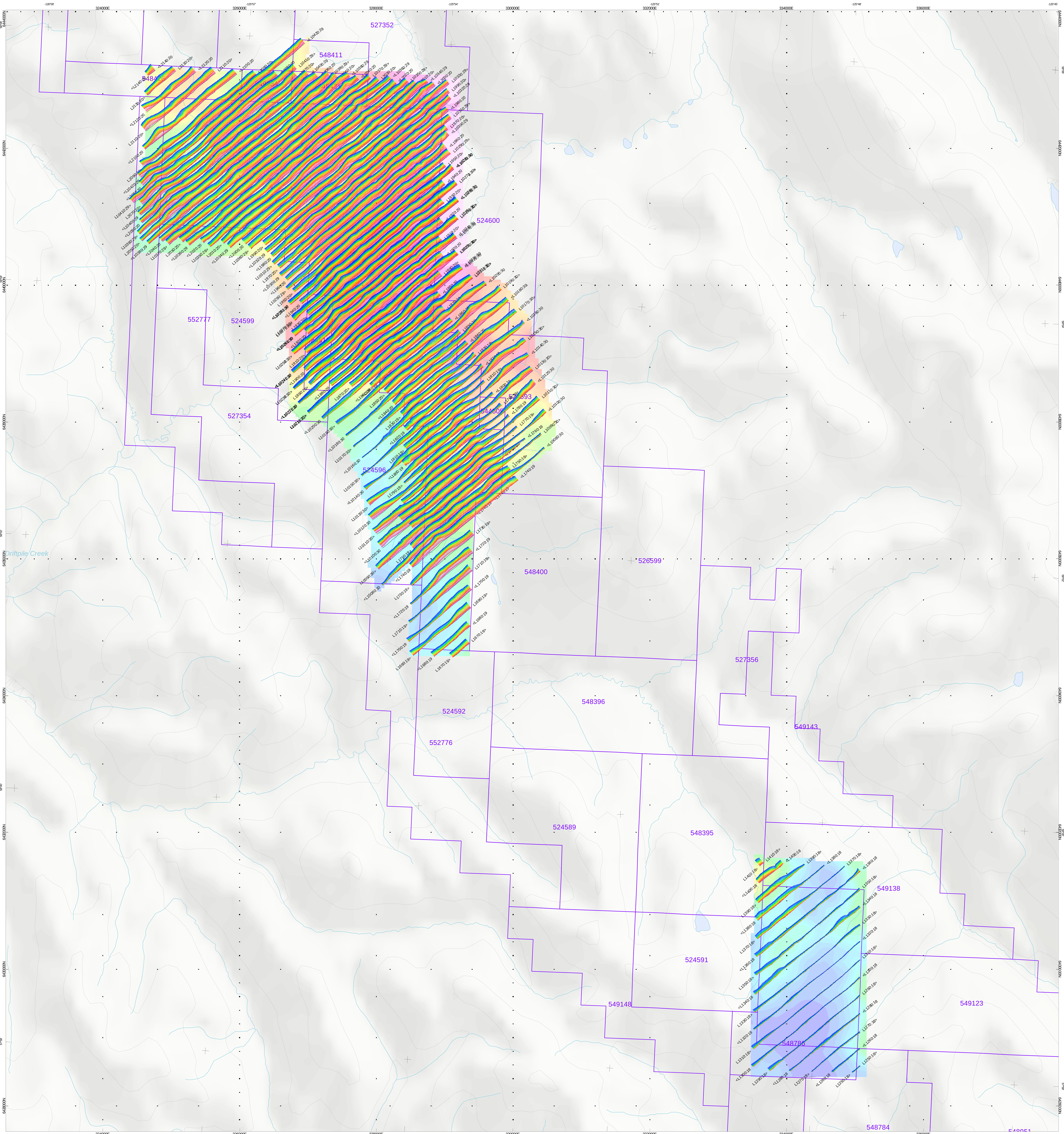
APPENDIX C

GEOPHYSICAL MAPS[1]



VTEM B-Field Z Component Profiles, Time Gates 0.220 to 7.036 ms Driftpile and SI

[1] Full size geophysical maps are also available in PDF format on the final DVD



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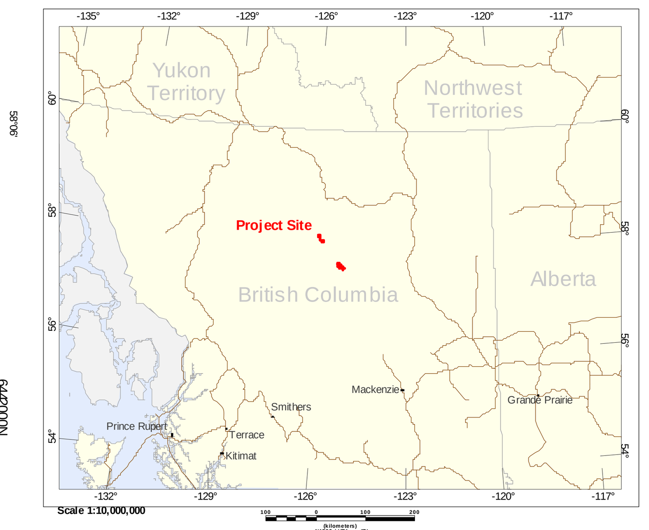


SURVEY SPECIFICATIONS:

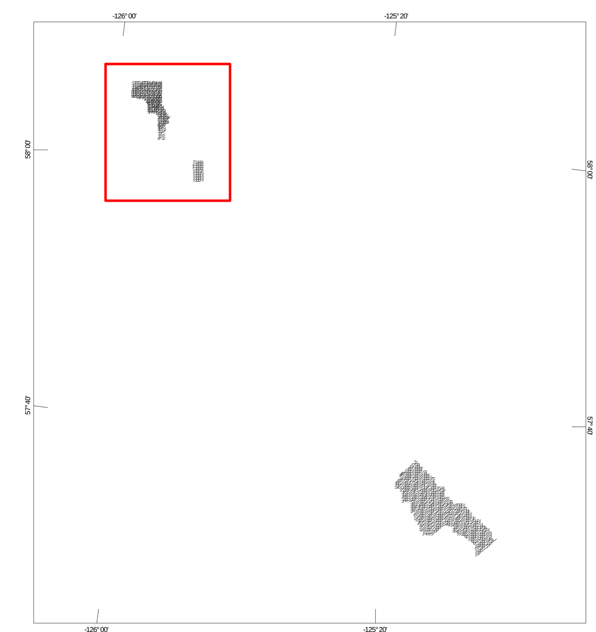
Survey Date: June 17th to July 17th, 2013
Survey Base: Akie Camp, British Columbia
Aircraft: Aerospatiale A-Star 350 B3 (C-FVTM)
Survey Line Spacing: 200 Meters
Survey Line Direction: N 50° E / N 230° E
Actual Average Terrain Clearance: 96 Meters
EM Transmitter Loop: Towed at an average terrain clearance of 35 meters below the helicopter
Magnetic Sensor: Towed at an average terrain clearance of 13 meters below the helicopter

INSTRUMENTS

Geotech Time Domain Electromagnetic System (VTEM)
Concentric Rx/Tx Geometry
Z-Coil Diameter 1.2m
Transmitter Loop: Diameter 17.6 Meters
Dipole Moment: 239,358 nIA
Transmitter Wave Form: Trapezoid, Pulse Width 3.40 ms, Base Frequency 30 Hz
Geometrics High Sensitivity Cesium Magnetometer
Mag Resolution: 0.02 nT at 10 samples/sec

MAP PROJECTION

Datum: NAD83
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378137.000
Inverse Flattening: 298.25722
NTS: 094L08, 094K05, 094L01, 094K04, 094F13, 094F14
NTS: 094F12, 094F11, 094F10, 094F06, 094F07



Profiles scale 1 mm = 0.15 (pV*ms)/(A*m^4)
(Linear between +/-0.4 (pV*ms)/(A*m^4) logarithmic above 0.4 (pV*ms)/(A*m^4)

0.220 ms (B-field)
0.253 ms (B-field)
0.290 ms (B-field)
0.333 ms (B-field)
0.383 ms (B-field)
0.440 ms (B-field)
0.505 ms (B-field)
0.580 ms (B-field)
0.667 ms (B-field)
0.766 ms (B-field)
0.880 ms (B-field)
1.010 ms (B-field)
1.161 ms (B-field)
1.333 ms (B-field)
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1.760 ms (B-field)
2.021 ms (B-field)
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2.667 ms (B-field)
3.063 ms (B-field)
3.521 ms (B-field)
4.042 ms (B-field)
4.641 ms (B-field)
5.333 ms (B-field)
6.125 ms (B-field)
7.036 ms (B-field)

57186, 57185, 57184, 57183, 57182, 57181, 57181, 57180, 57180, 57179, 57179, 57178, 57178, 57178, 57177, 57177, 57176, 57176, 57176, 57175, 57175, 57175, 57174, 57173, 57173, 57172, 57171, 57170, 57169, 57168, 57167, 57166, 57165, 57164, 57163, 57161, 57159, 57154

TMI (nT)

TOPOGRAPHIC LEGEND:

Streams / Rivers
Contours
Lakes / Ponds
Wetlands
Mining Claims

Scale 1:20000
250 0 250 500 750 1000
(meters)
NAD83 / UTM zone 10N

The topographic data base was derived from 1:50000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM(Shuttle Radar Topography Mission) data.
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database.
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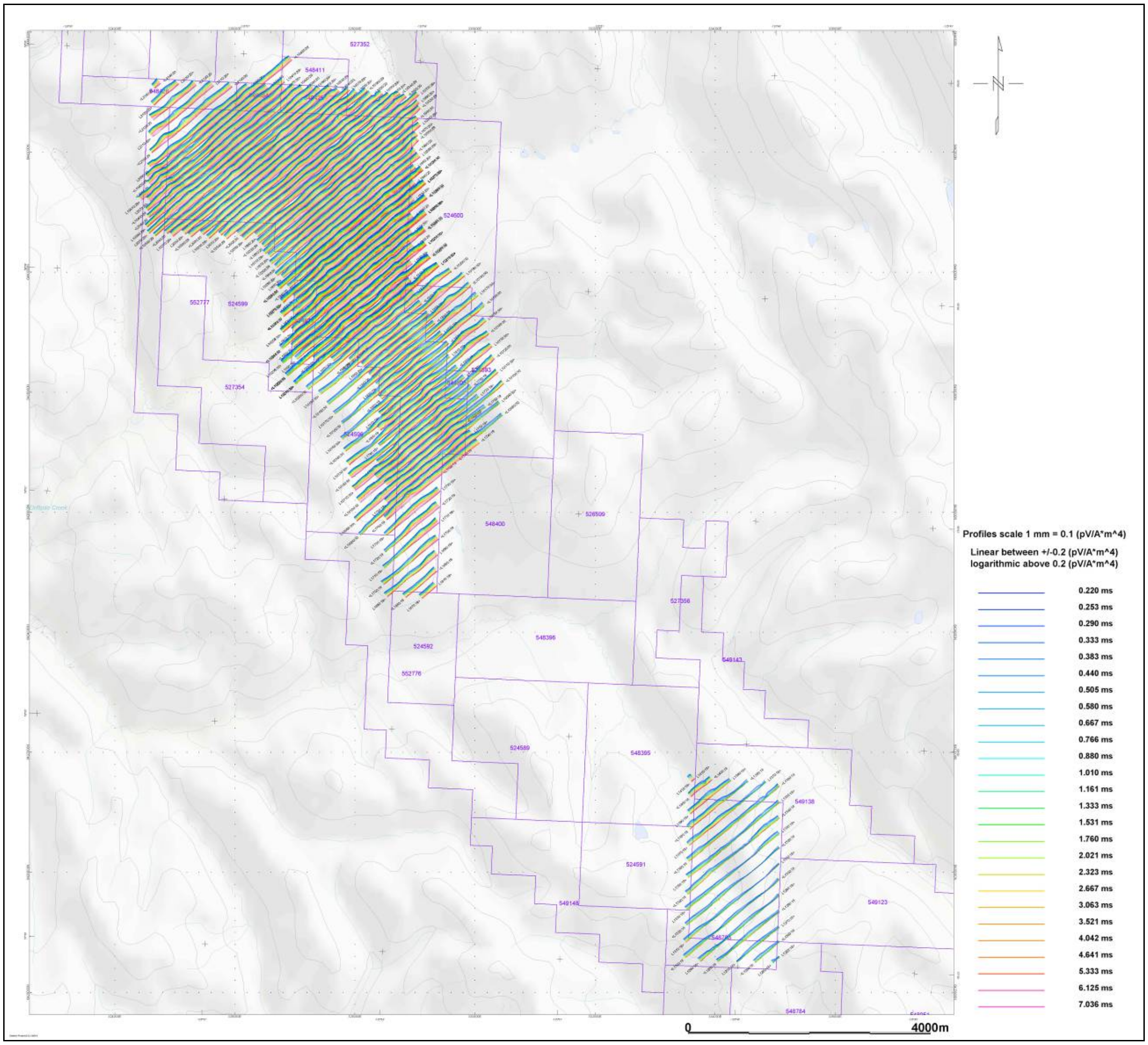
(www.geocomm.com)(www.geogratis.ca)(https://apps.gov.bc.ca/pub/dwds/home.so)

Teck Resources Limited
Driftpile and SI Blocks
Kechika Regional Project

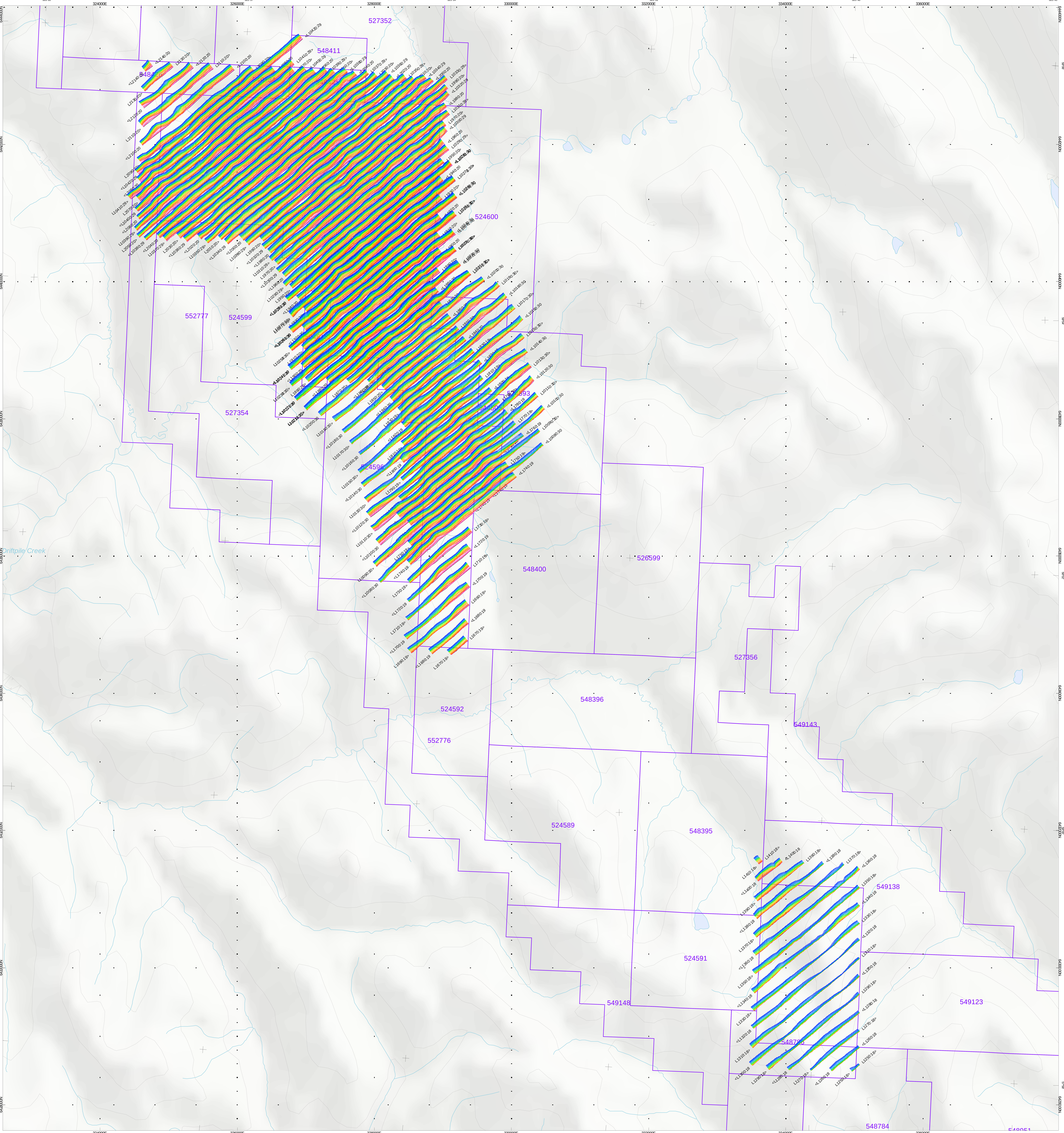
Geotech VTEM System
VTEM B-Field Z Component Profiles
Time Gates 0.220 - 7.036 ms
over Total Magnetic Intensity

Flown and processed by Geotech Ltd.
245 Industrial Parkway North,
Aurora, Ontario, Canada L4G 4C4
www.geotech.ca

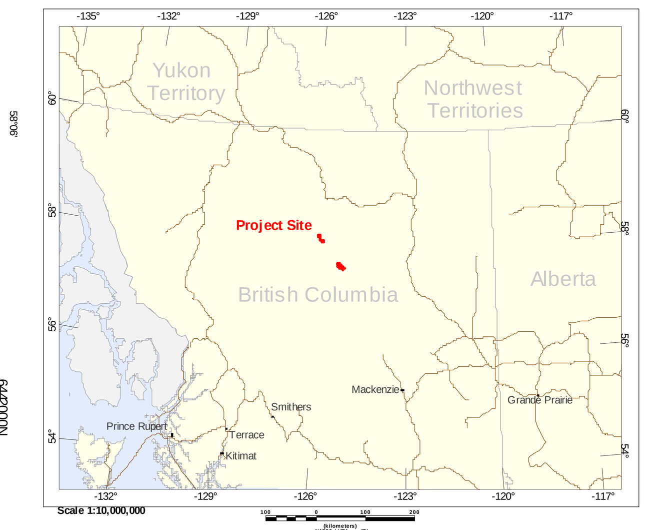
October 2013



VTEM dB/dt Z Component Profiles, Time Gates 0.220 to 7.036 ms Driftpile and SI



GEOTECH LTD.



SURVEY SPECIFICATIONS:
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- Survey Line Direction: N 50° E / N 230° E
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- Concentric Rx/Tx Geometry
- Z-Coil Diameter 1.2m
- Transmitter Loop: Diameter 17.6 Meters
- Dipole Moment: 239,358 nIA
- Transmitter Wave Form: Trapezoid, Pulse Width 3.40 ms, Base Frequency 30 Hz
- Geometrics High Sensitivity Cesium Magnetometer
- Mag Resolution: 0.02 nT at 10 samples/sec

MAP PROJECTION
- Datum: NAD83
- Projection: Universal Transverse Mercator
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- Central Scale Factor: 0.9996
- False Easting/Northing: 500,000m/0m
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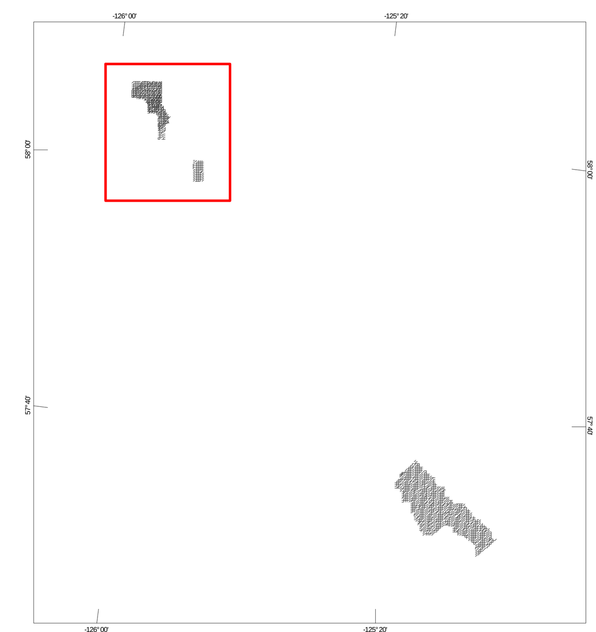
- NTS: 094F12, 094F11, 094F10, 094F06, 094F07



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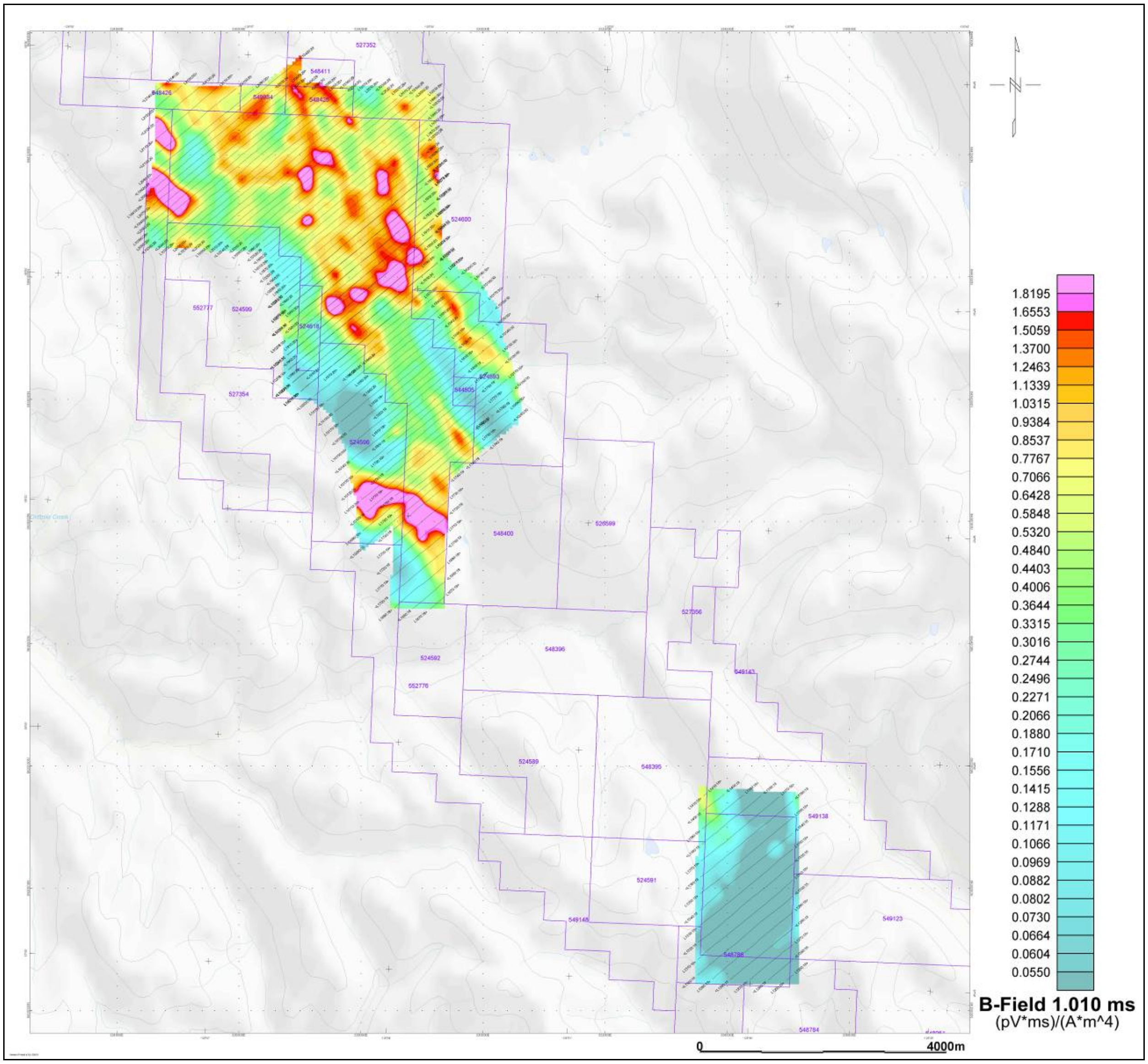
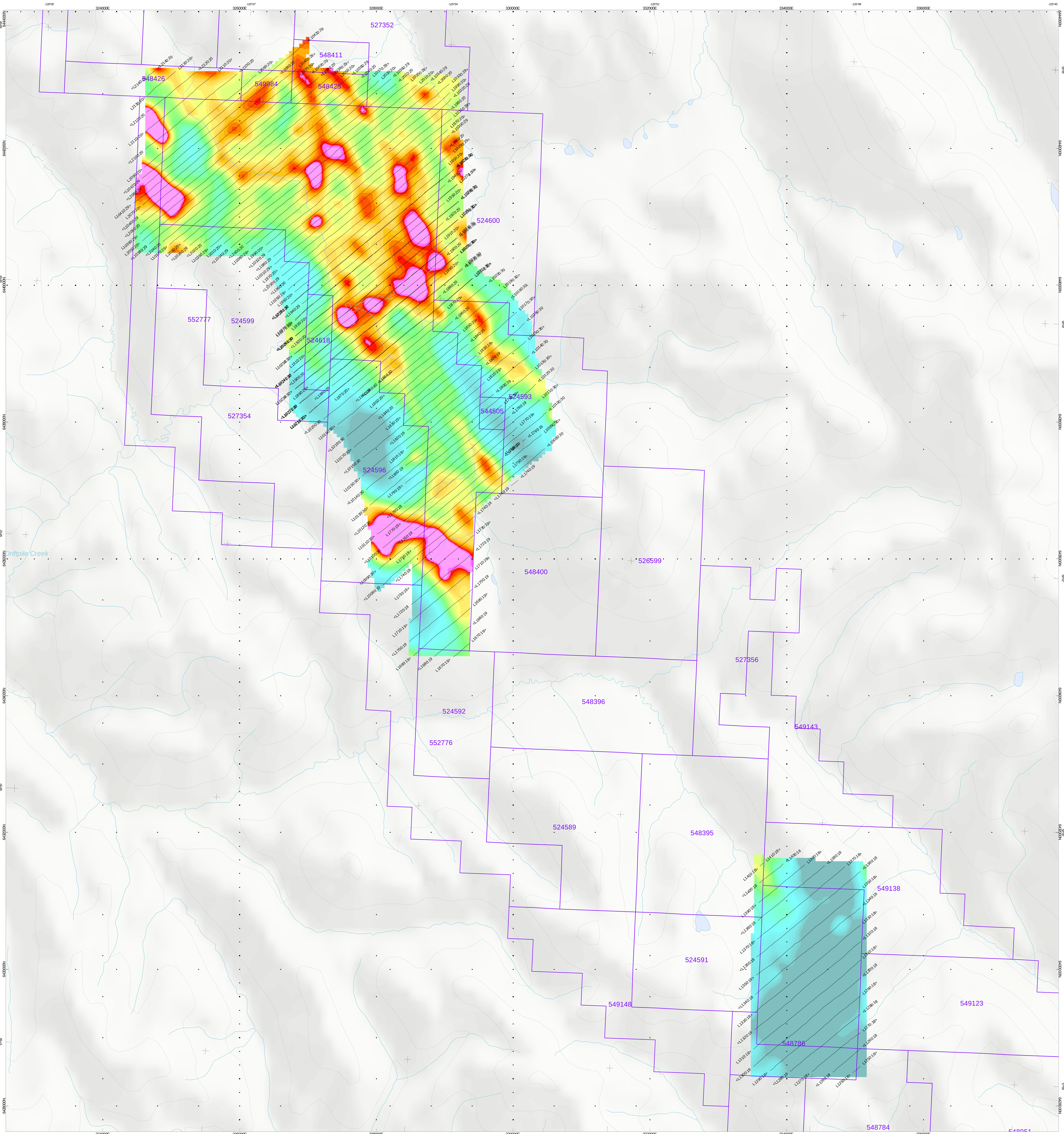
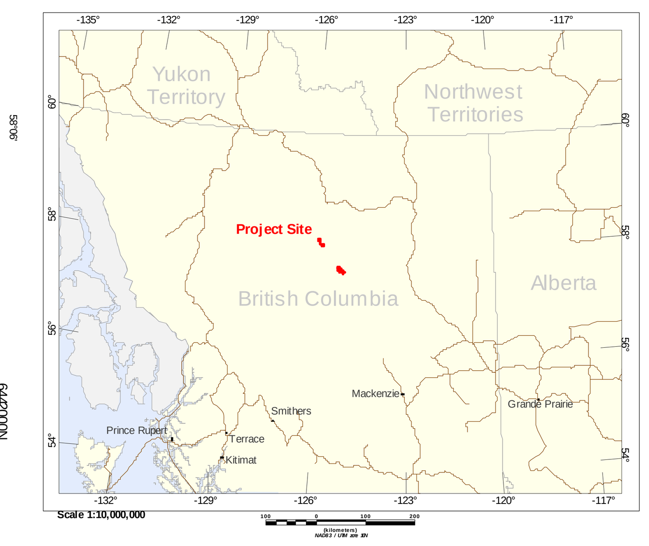


VTEM B-Field Channel 31, Time Gate 1.010 ms Driftpile and SI

GEOTECH LTD.





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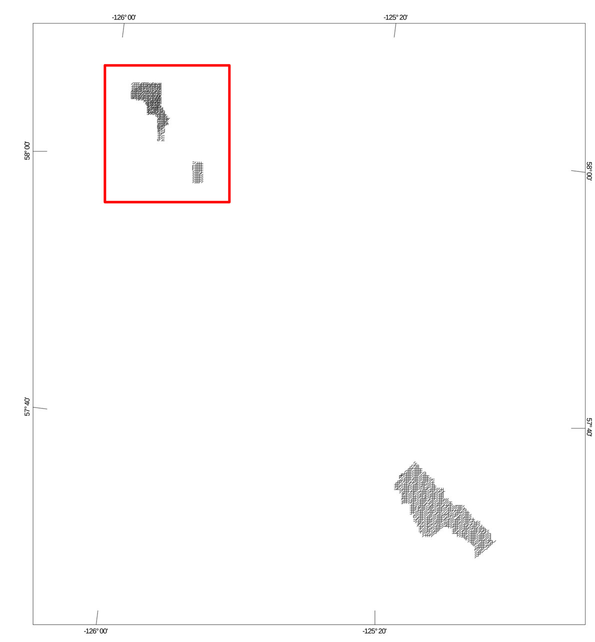
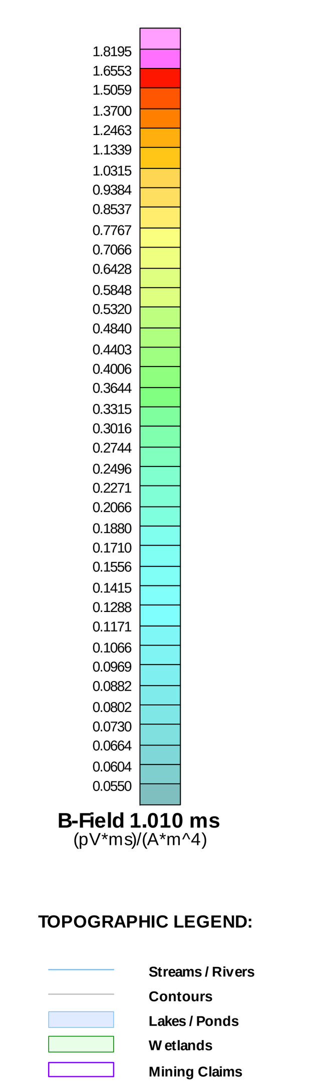
NTS: 094L08, 094K05, 094L01, 094K04, 094F13, 094F14
NTS: 094F12, 094F11, 094F10, 094F06, 094F07





Scale 1:20000

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(meters)

NAD83 / UTM zone 10N

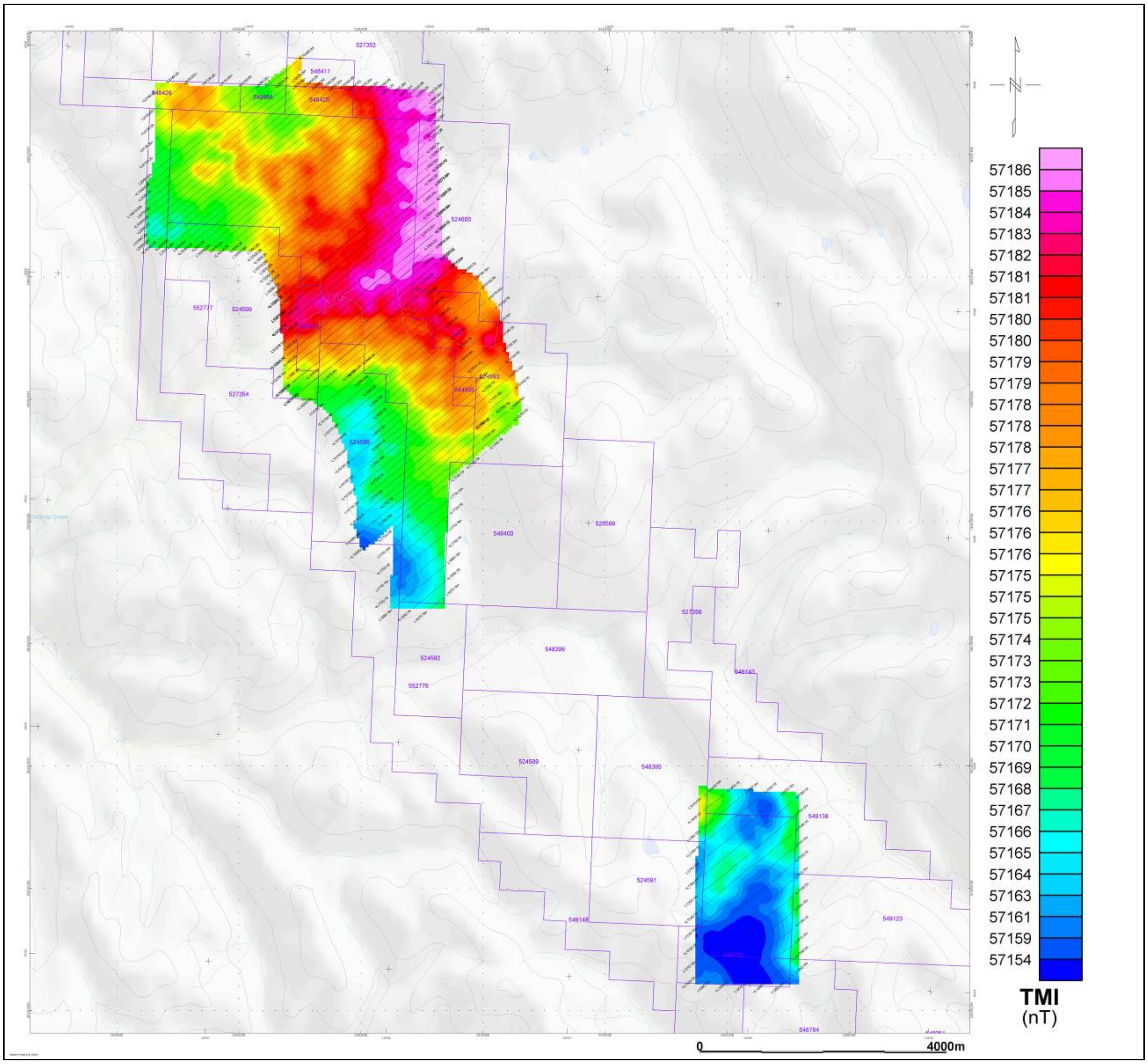
The topographic data base was derived from 1:50000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) data.
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database.
Mining Claims are derived from the Province of British Columbia Land and Resource Data Warehouse.
(www.geocomm.com)(www.geogratis.ca)(https://apps.gov.bc.ca/pub/dwds/home.so)

Teck Resources Limited
Driftpile and SI Blocks
Kechika Regional Project

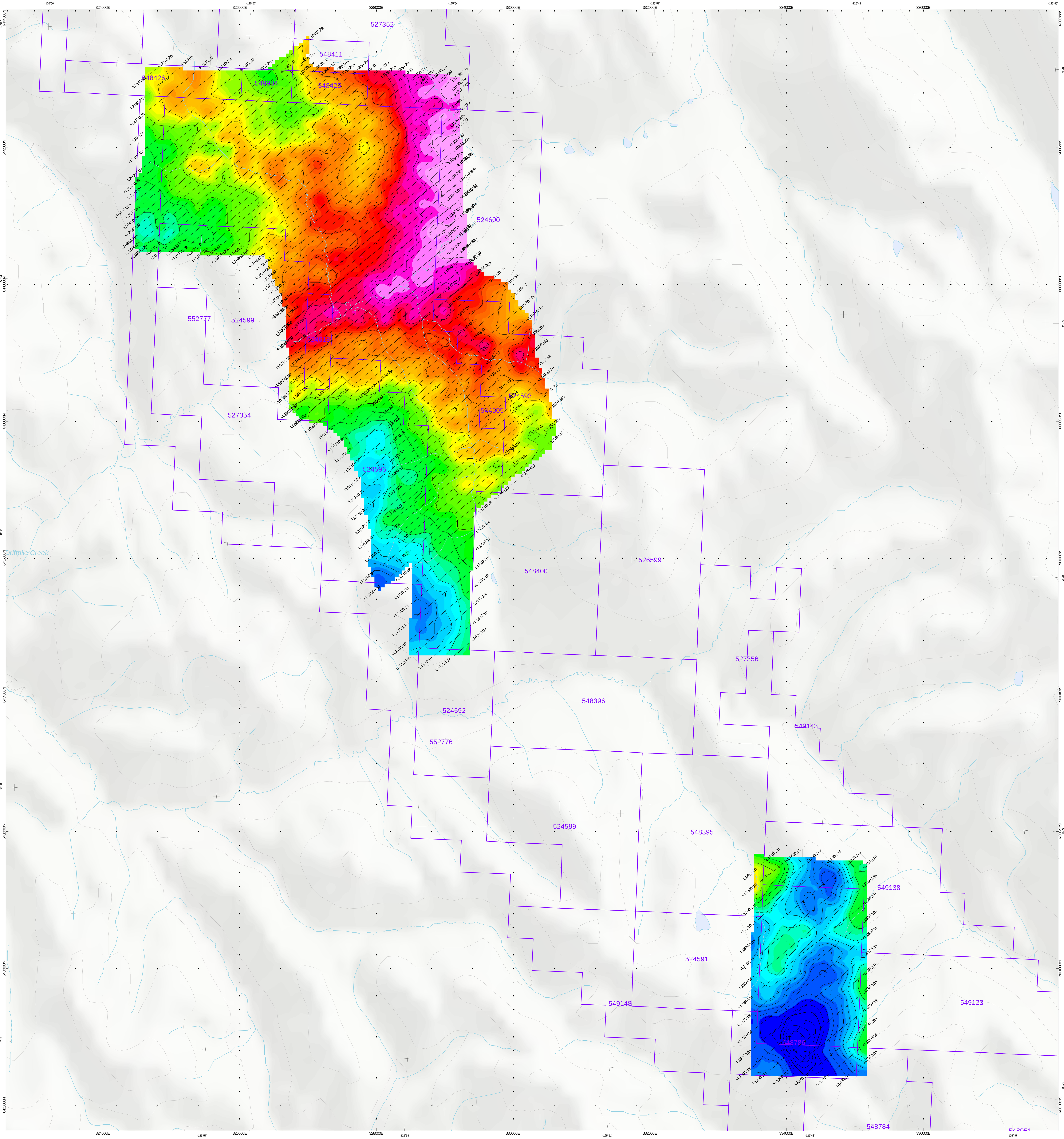
Geotech VTEM System
VTEM B-Field Z Component
Channel 31, Time Gate 1.010 ms
over Total Magnetic Intensity

Flown and processed by Geotech Ltd.
245 Industrial Parkway North,
Aurora, Ontario, Canada L4G 4C4
www.geotech.ca

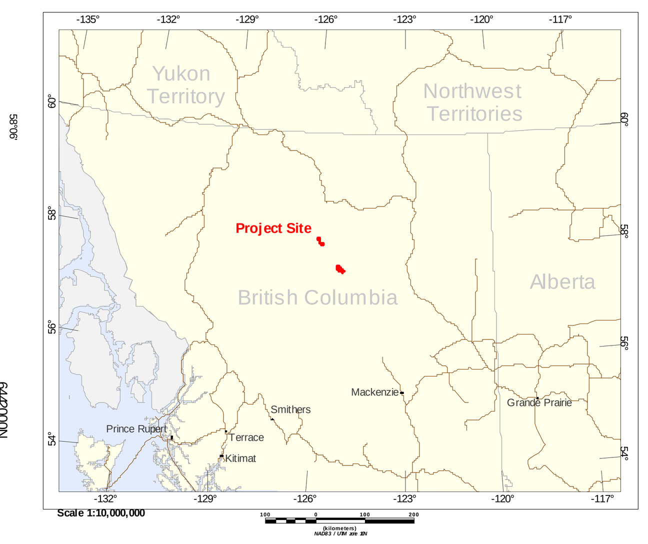
October 2013



Total Magnetic Intensity (TMI) Driftpile and SI



GEOTECH LTD.



SURVEY SPECIFICATIONS:

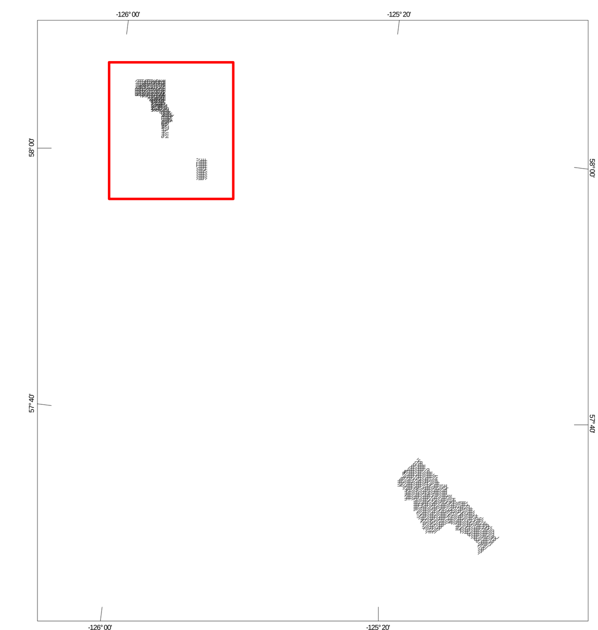
Survey Date: June 17th to July 17th, 2013
Survey Base: Akie Camp, British Columbia
Aircraft: Aerospatiale A-Star 350 B3 (C-FVTM)
Survey Line Spacing: 200 Meters
Survey Line Direction: N 50° E / N 230° E
Actual Average Terrain Clearance: 96 Meters
EM Transmitter Loop: Towed at an average terrain clearance of 35 meters below the helicopter
Magnetic Sensor: Towed at an average terrain clearance of 13 meters below the helicopter

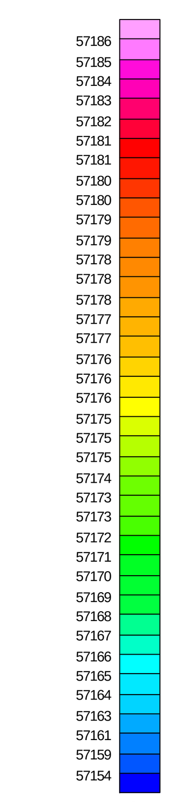
INSTRUMENTS

Geotech Time Domain Electromagnetic System (VTEM)
Concentric Rx/Tx Geometry
Z-Coil Diameter 1.2m
Transmitter Loop: Diameter 17.6 Meters
Dipole Moment: 239,358 nIA
Transmitter Wave Form: Trapezoid, Pulse Width 3.40 ms, Base Frequency 30 Hz
Geometrics High Sensitivity Cesium Magnetometer
Mag Resolution: 0.02 nT at 10 samples/sec

MAP PROJECTION

Datum: NAD83
Projection: Universal Transverse Mercator
Central Meridian: 123°W (Zone 10N)
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378137.000
Inverse Flattening: 298.25722
NTS: 094L08, 094K05, 094L01, 094K04, 094F13, 094F14
NTS: 094F12, 094F11, 094F10, 094F06, 094F07





TMI (nT)

TMI Contour Intervals:
2 nT
50 nT
250 nT

TOPOGRAPHIC LEGEND:
Streams / Rivers
Contours
Lakes / Ponds
Wetlands
Mining Claims

Scale 1:20000
250 0 250 500 750 1000
(meters)
NAD83 / UTM zone 10N

The topographic data base was derived from 1:50000 NRC (Natural Resources Canada) NTDB data.
Background shading is derived from NASA SRTM (Shuttle Radar Topography Mission) data.
Inset data derived from Geocommunities 1:250,000 Canadian National Topographic database.
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Teck Resources Limited
Driftpile and SI Blocks
Kechika Regional Project

Geotech VTEM System
Total Magnetic Intensity (TMI)

Flown and processed by Geotech Ltd.
245 Industrial Parkway North,
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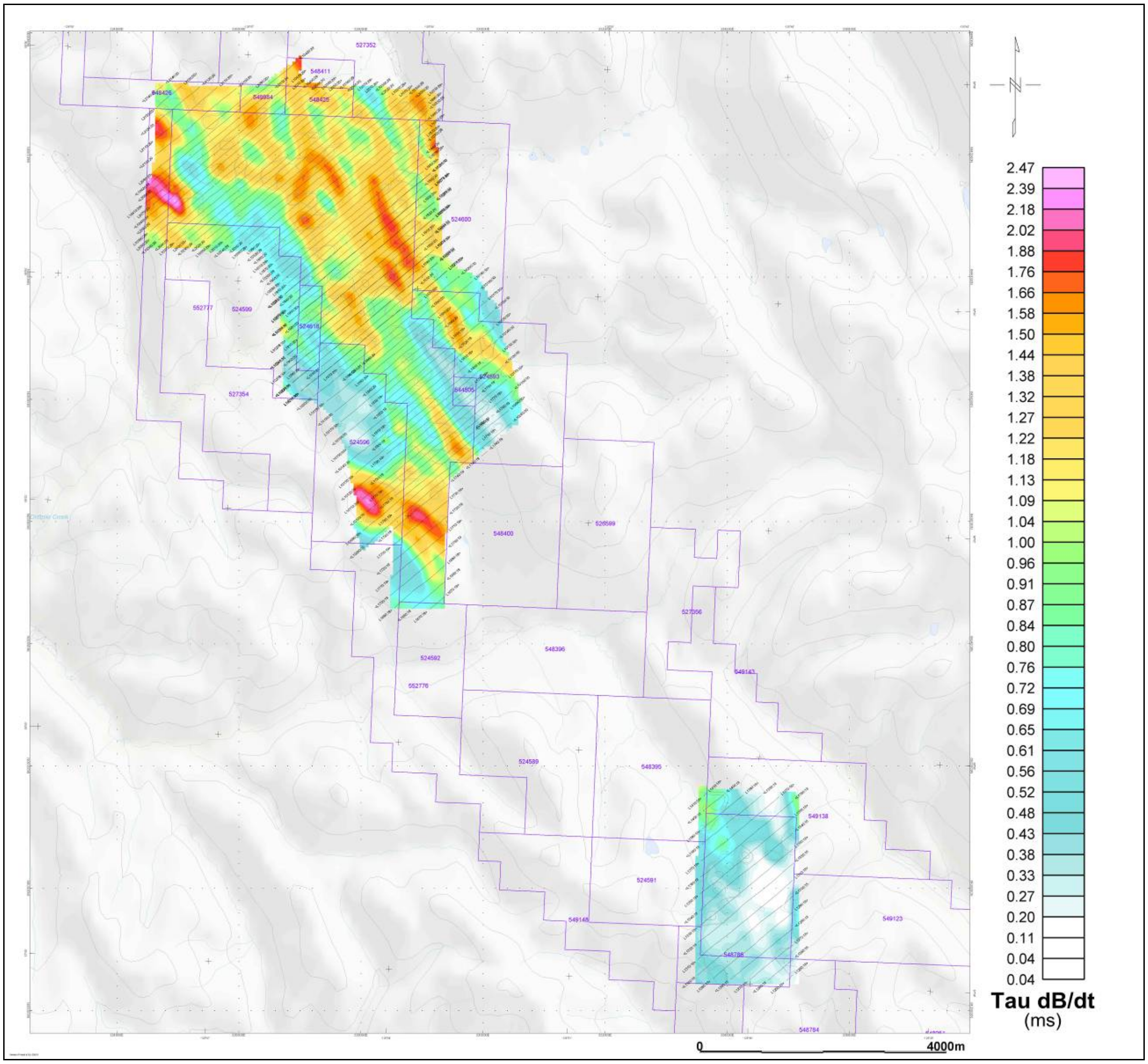
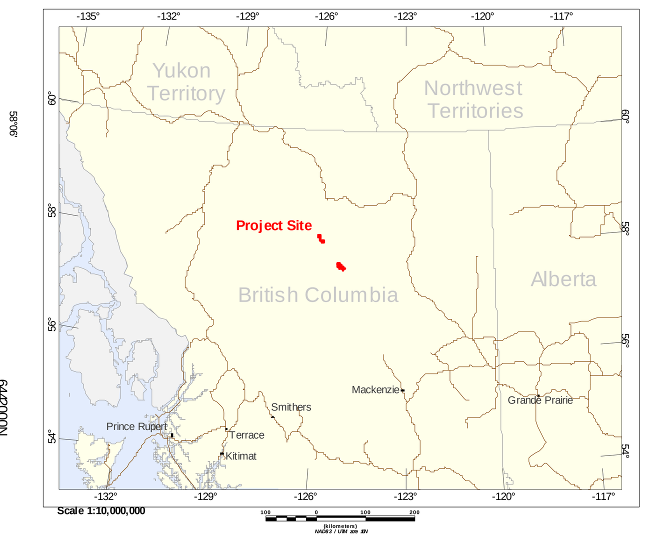
October 2013



VTEM dB/dt Calculated Time Constant (TAU) with contours of anomaly areas of the Calculated Vertical Derivative of TMI Driftpile and SI

GEOTECH LTD.



SURVEY SPECIFICATIONS:

Survey Date: June 17th to July 17th, 2013
Survey Base: Akie Camp, British Columbia
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Mag Resolution: 0.02 nT at 10 samples/sec

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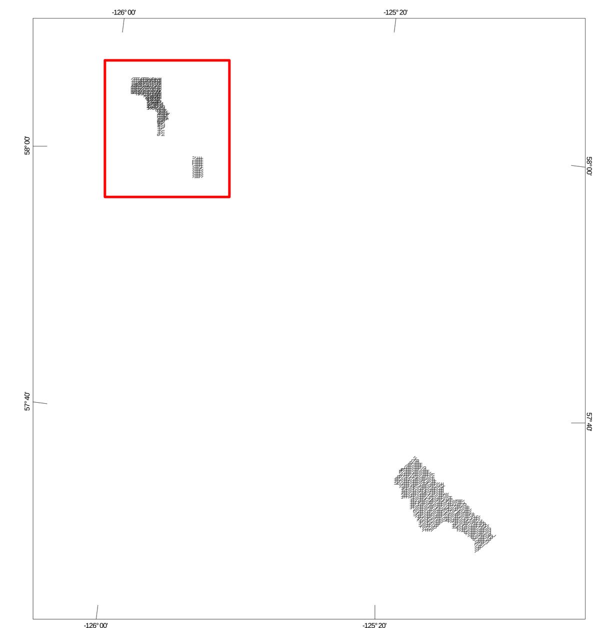
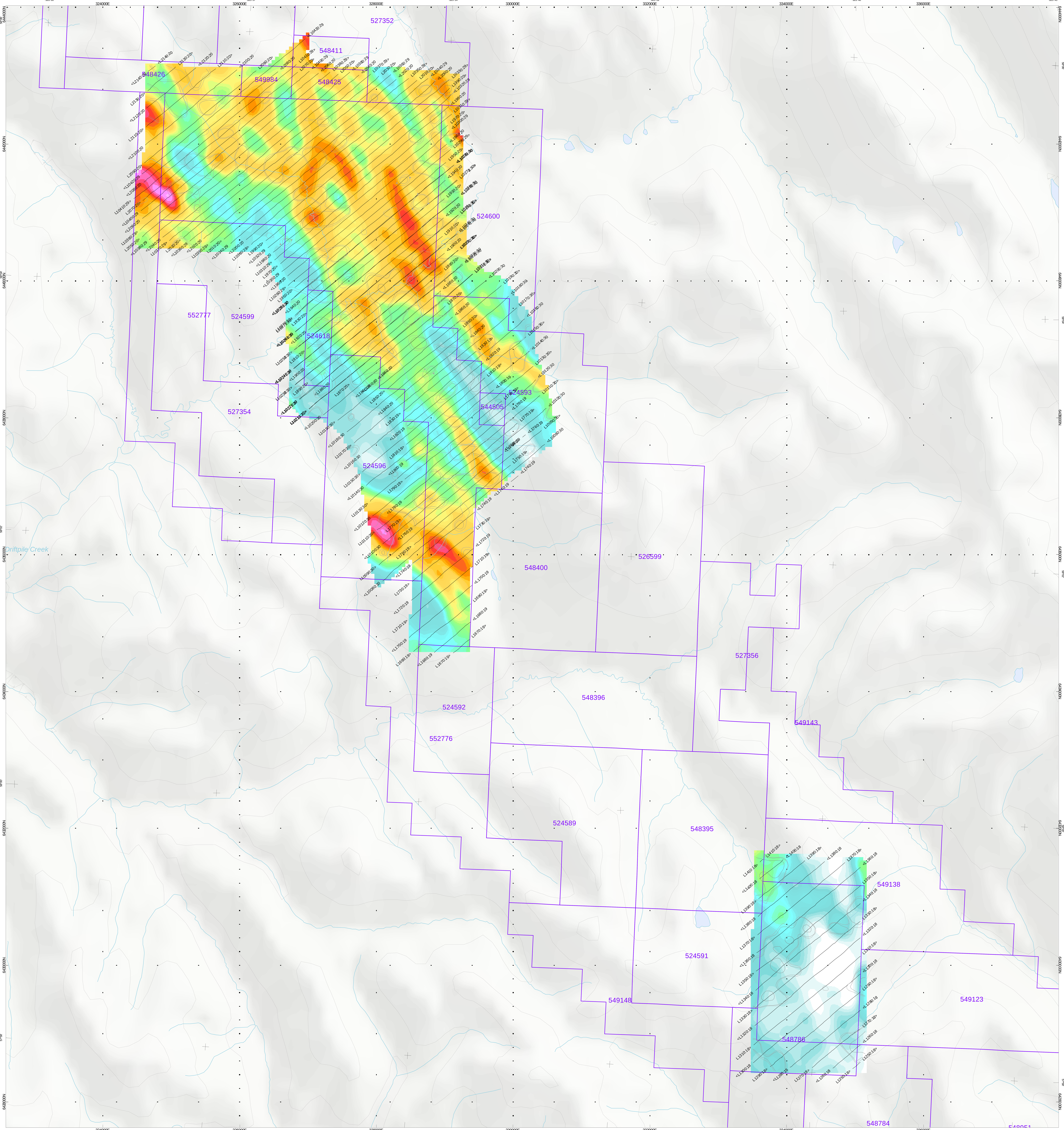
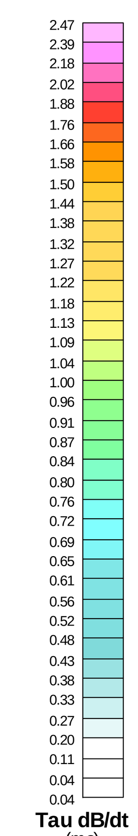
Central Scale Factor: 0.9996
False Easting/Northing: 500,000m/0m
Major Axis: 6378137.000
Inverse Flattening: 298.25722
NTS: 094L08, 094K05, 094L01, 094K04, 094F13, 094F14
NTS: 094F12, 094F11, 094F10, 094F06, 094F07







TOPOGRAPHIC LEGEND:

- Streams / Rivers
- Contours
- Lakes / Ponds
- Wetlands
- Mining Claims

Scale 1:20000

250 0 250 500 750 1000

(meters)

NAD83 / UTM zone 10N

The topographic data base was derived from 1:50000 NRC (Natural Resources Canada) NTDB data.
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Teck Resources Limited
Driftpile and SI Blocks
Kechika Regional Project

Geotech VTEM System
dB/dt Calculated Time Constant (Tau) with contours of anomaly areas of the Calculated Vertical Derivative of TMI

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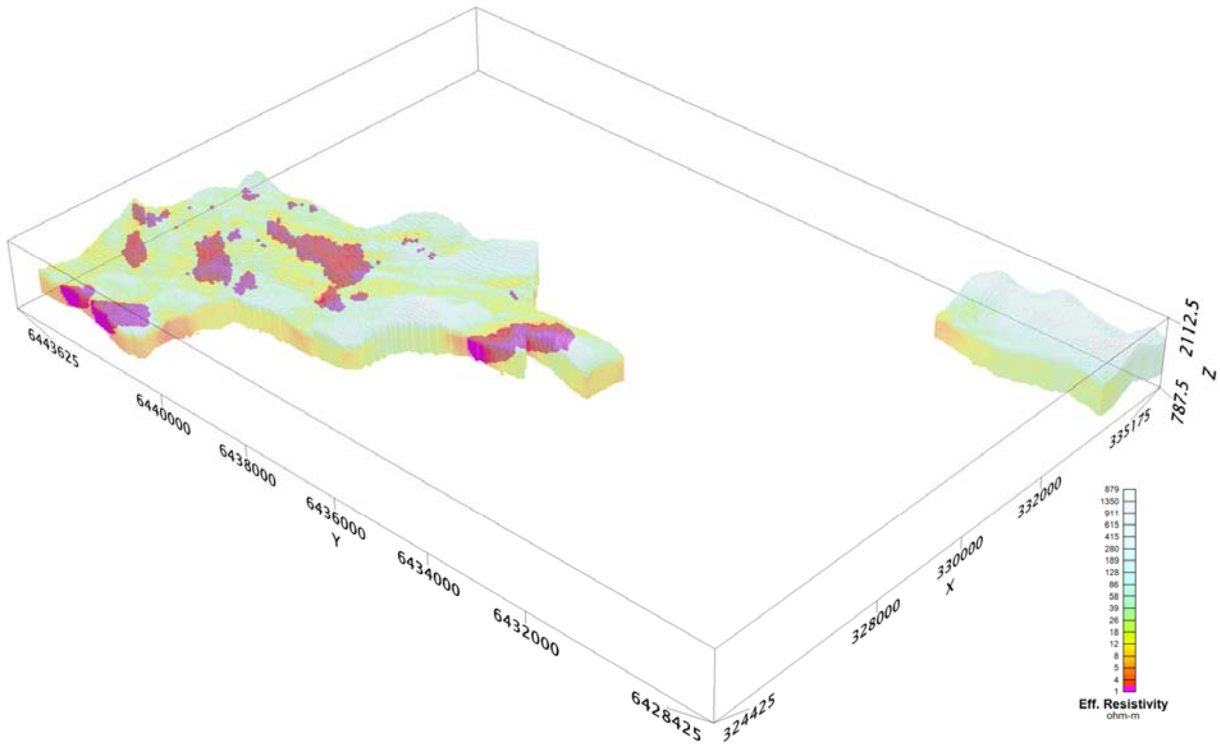
October 2013

Resistivity Depth Image (RDI) MAPS



3D Resistivity-Depth Image (RDI) Driftpile & SI

APPENDIX D

GENERALIZED MODELING RESULTS OF THE VTEM SYSTEM

Introduction

The VTEM system is based on a concentric or central loop design, whereby, the receiver is positioned at the centre of a transmitter loop that produces a primary field. The wave form is a bi-polar, modified square wave with a turn-on and turn-off at each end.

During turn-on and turn-off, a time varying field is produced (dB/dt) and an electro-motive force (emf) is created as a finite impulse response. A current ring around the transmitter loop moves outward and downward as time progresses. When conductive rocks and mineralization are encountered, a secondary field is created by mutual induction and measured by the receiver at the centre of the transmitter loop.

Efficient modeling of the results can be carried out on regularly shaped geometries, thus yielding close approximations to the parameters of the measured targets. The following is a description of a series of common models made for the purpose of promoting a general understanding of the measured results.

A set of models has been produced for the Geotech VTEM® system dB/dT Z and X components (see models D1 to D15). The Maxwell ™ modeling program (EMIT Technology Pty. Ltd. Midland, WA, AU) used to generate the following responses assumes a resistive half-space. The reader is encouraged to review these models, so as to get a general understanding of the responses as they apply to survey results. While these models do not begin to cover all possibilities, they give a general perspective on the simple and most commonly encountered anomalies.

As the plate dips and departs from the vertical position, the peaks become asymmetrical.

As the dip increases, the aspect ratio (Min/Max) decreases and this aspect ratio can be used as an empirical guide to dip angles from near 90º to about 30º. The method is not sensitive enough where dips are less than about 30º.

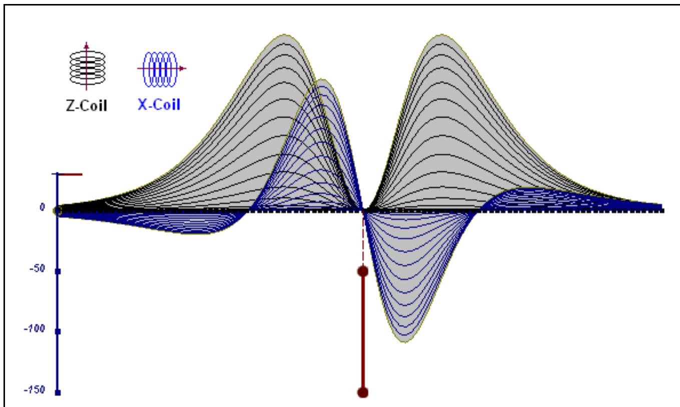


Figure D-1: vertical thin plate

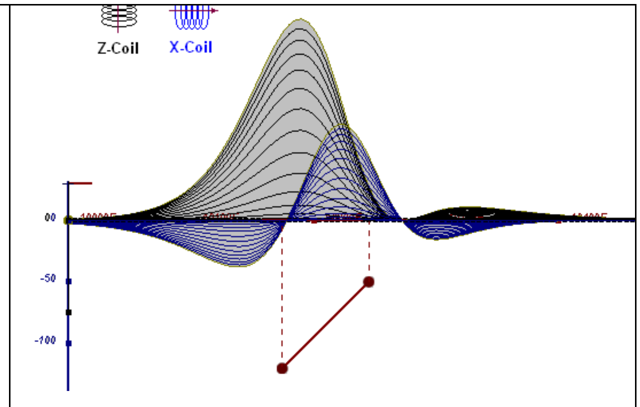


Figure D-2: inclined thin plate

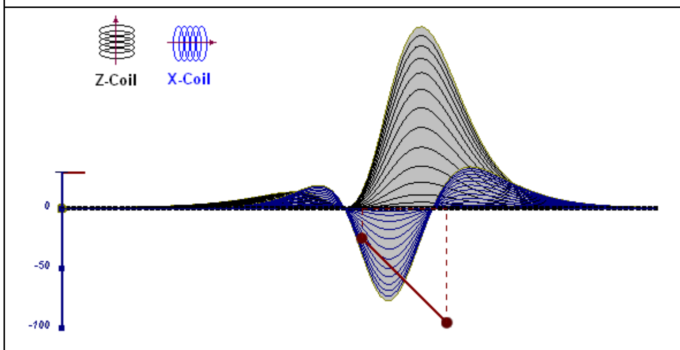


Figure D-3: inclined thin plate

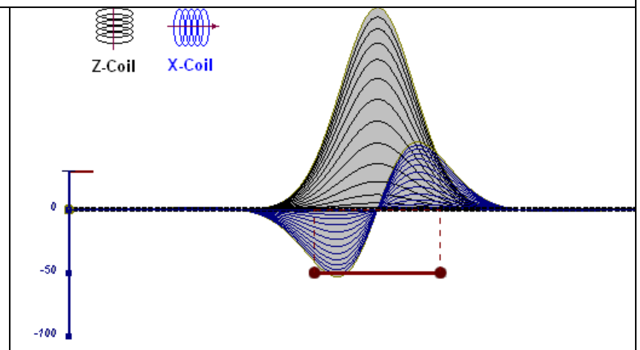


Figure D-4: horizontal thin plate

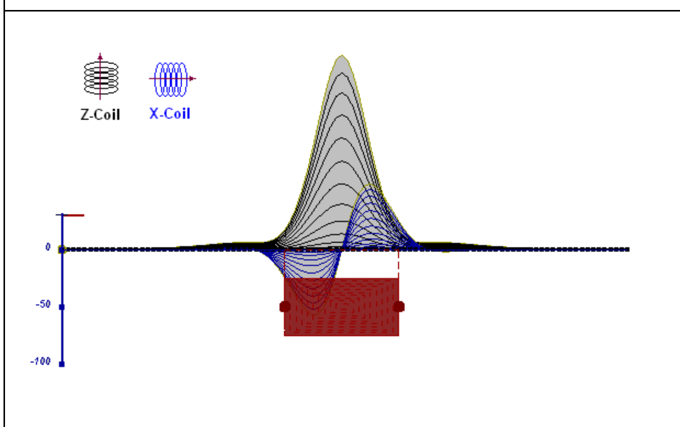


Figure D-5: horizontal thick plate (linear scale of the response)

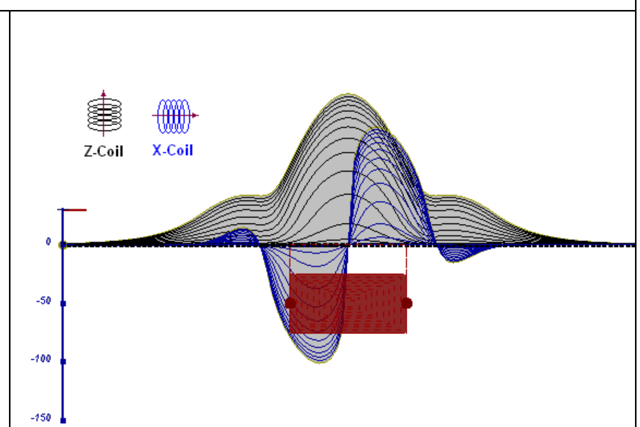


Figure D-6: horizontal thick plate (log scale of the response)

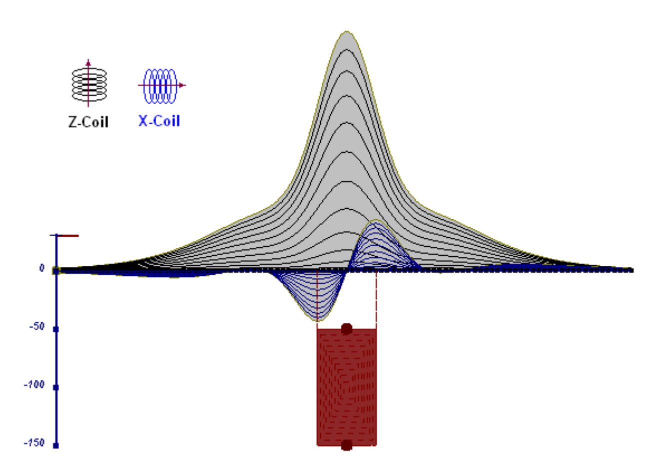


Figure D-7: vertical thick plate (linear scale of the response). 50 m depth

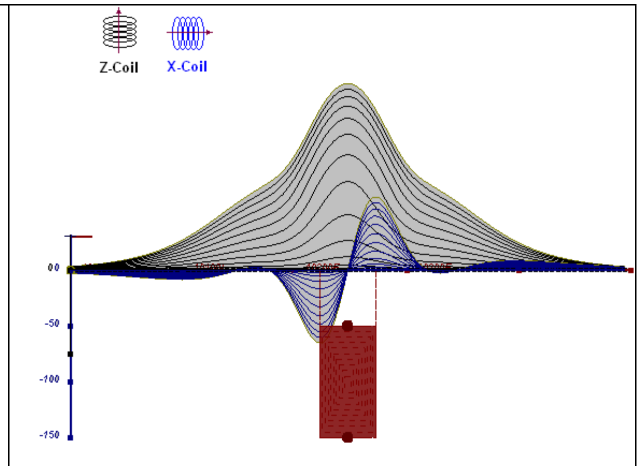


Figure D-8: vertical thick plate (log scale of the response). 50 m depth

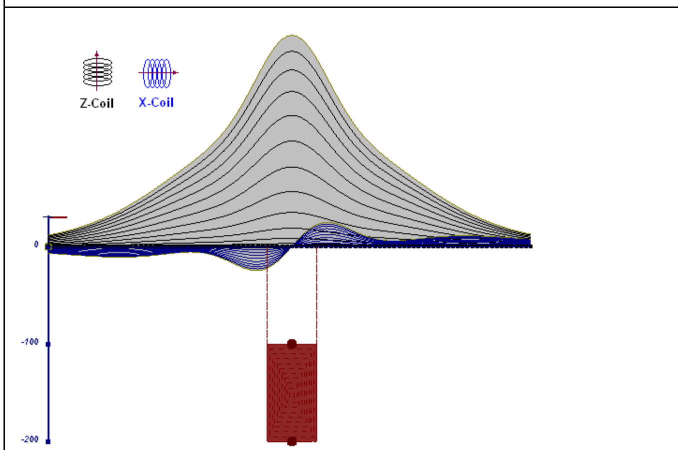


Figure D-9: vertical thick plate (linear scale of the response). 100 m depth

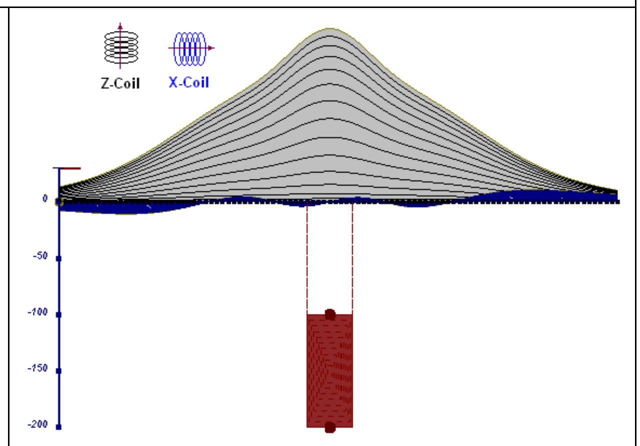


Figure D-10: vertical thick plate (linear scale of the response). Depth/hor.thickness=2.5

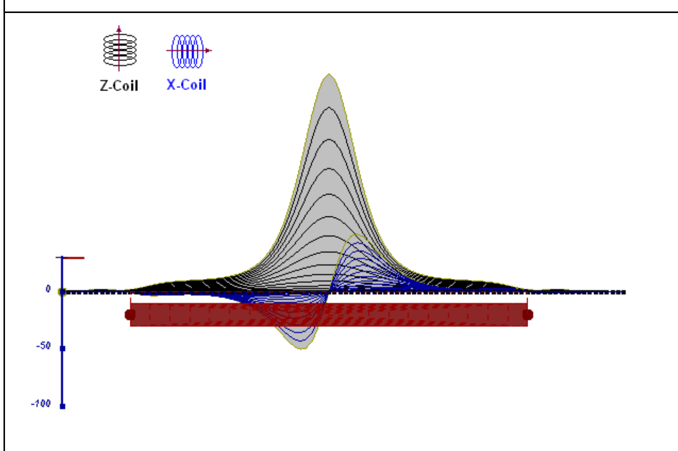


Figure D-10: horizontal thick plate (linear scale of the response)

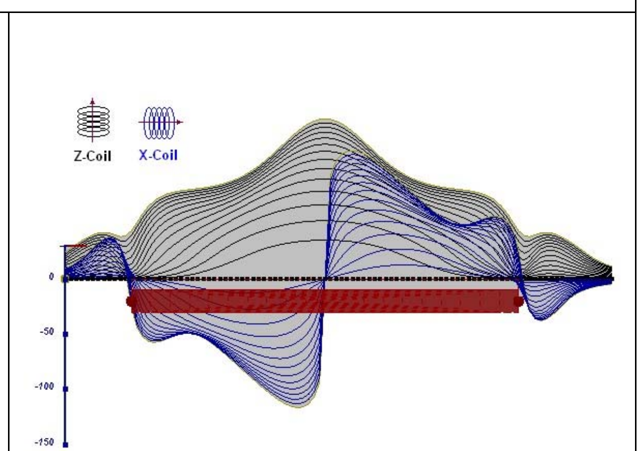


Figure D-11: horizontal thick plate (log scale of the response)

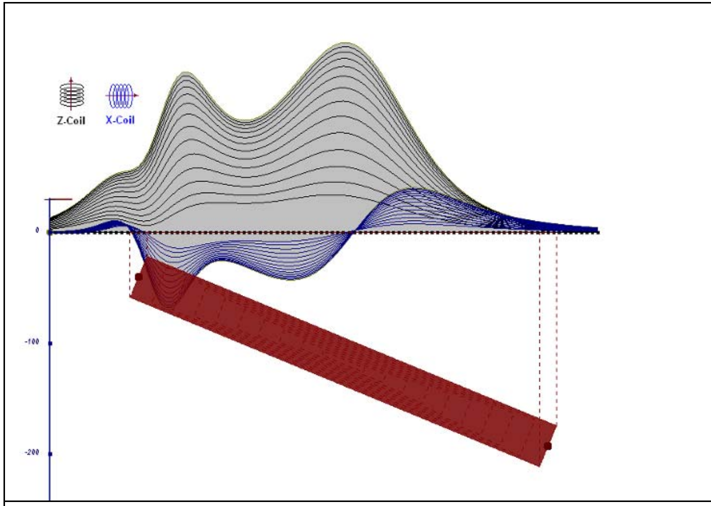


Figure D-12: inclined long thick plate

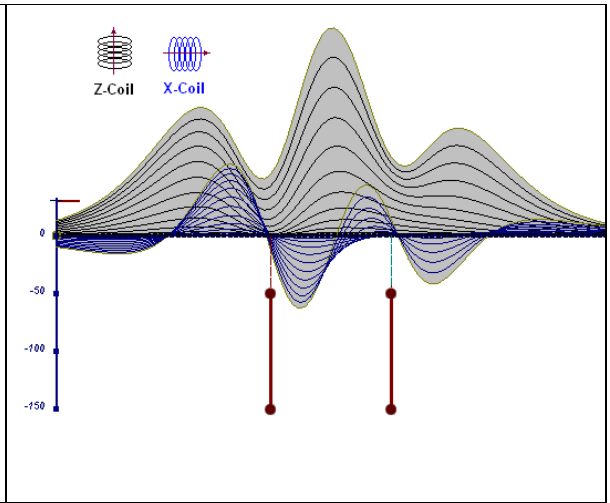


Figure D-13: two vertical thin plates

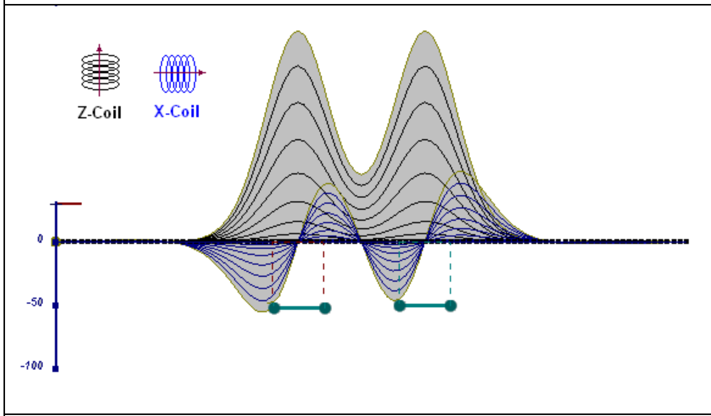


Figure D-14: two horizontal thin plates

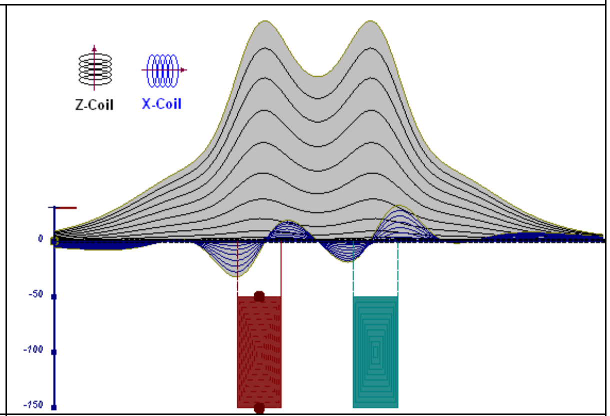


Figure D-15: two vertical thick plates

The same type of target but with different thickness, for example, creates different form of the response:

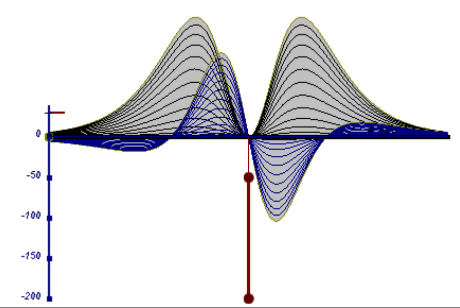
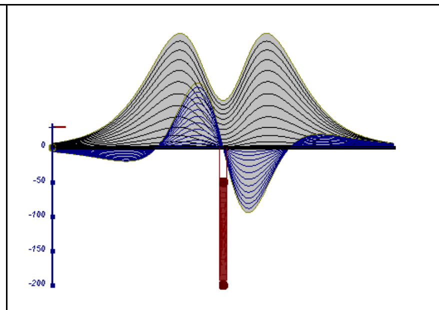
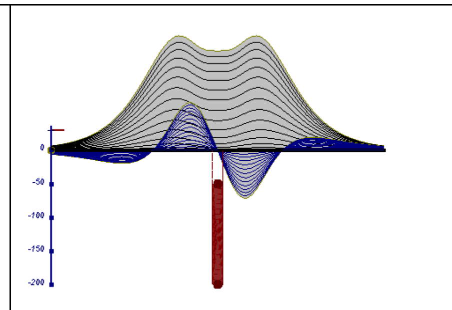
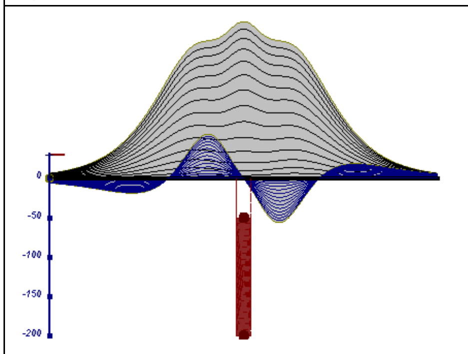
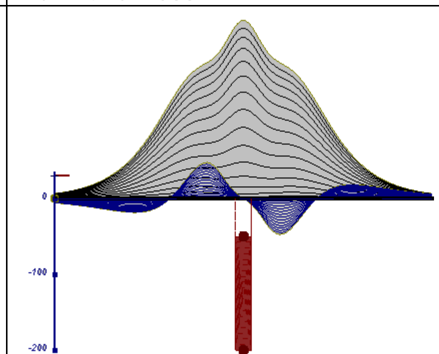
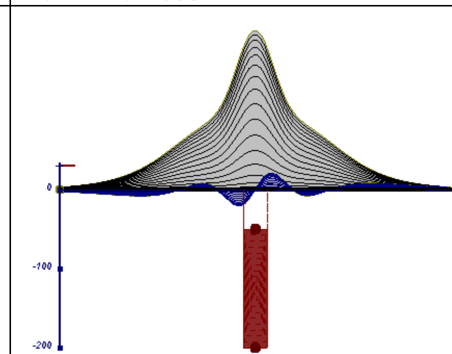
		
"thin"	10 m thickness	15 m thickness
		
18 m thickness	20 m thickness	30 m thickness

Figure D-16: Conductive vertical plate, depth 50 m, strike length 200 m, depth extend 150 m.

Alexander Prikhodko, PhD, P.Geo
Geotech Ltd.

September 2010

APPENDIX E

EM TIME CONSTANT (TAU) ANALYSIS

Estimation of time constant parameter[1] in transient electromagnetic method is one of the steps toward the extraction of the information about conductances beneath the surface from TEM measurements.

The most reliable method to discriminate or rank conductors from overburden, background or one and other is by calculating the EM field decay time constant (TAU parameter), which directly depends on conductance despite their depth and accordingly amplitude of the response.

Theory

As established in electromagnetic theory, the magnitude of the electro-motive force (emf) induced is proportional to the time rate of change of primary magnetic field at the conductor. This emf causes eddy currents to flow in the conductor with a characteristic transient decay, whose Time Constant (Tau) is a function of the conductance of the survey target or conductivity and geometry (including dimensions) of the target. The decaying currents generate a proportional secondary magnetic field, the time rate of change of which is measured by the receiver coil as induced voltage during the Off time.

The receiver coil output voltage (**e_0**) is proportional to the time rate of change of the secondary magnetic field and has the form,

$$e_0 \; \alpha \; (1 / \tau) \; e^{-(t/\tau)}$$

Where,
τ = L/R is the characteristic time constant of the target (TAU)
R = resistance
L = inductance

From the expression, conductive targets that have small value of resistance and hence large value of τ yield signals with small initial amplitude that decays relatively slowly with progress of time. Conversely, signals from poorly conducting targets that have large resistance value and small τ, have high initial amplitude but decay rapidly with time[1] (Figure E-1).

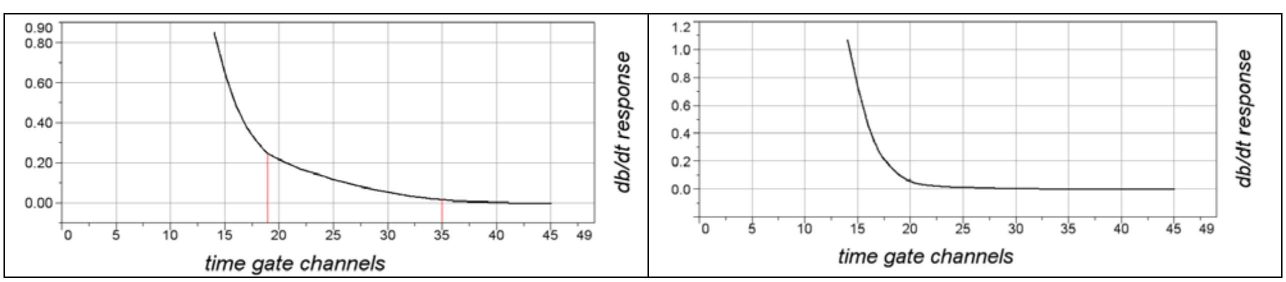


Figure E-1: Left – presence of good conductor, right – poor conductor.

[1] McNeill, JD, 1980, "Applications of Transient Electromagnetic Techniques", Technical Note TN-7 page 5, Geonics Limited, Mississauga, Ontario.

EM Time Constant (Tau) Calculation

The EM Time-Constant (TAU) is a general measure of the speed of decay of the electromagnetic response and indicates the presence of eddy currents in conductive sources as well as reflecting the "conductance quality" of a source. Although TAU can be calculated using either the measured dB/dt decay or the calculated B-field decay, dB/dt is commonly preferred due to better stability (S/N) relating to signal noise. Generally, TAU calculated on base of early time response reflects both near surface overburden and poor conductors whereas, in the late ranges of time, deep and more conductive sources, respectively. For example early time TAU distribution in an area that indicates conductive overburden is shown in Figure 2.

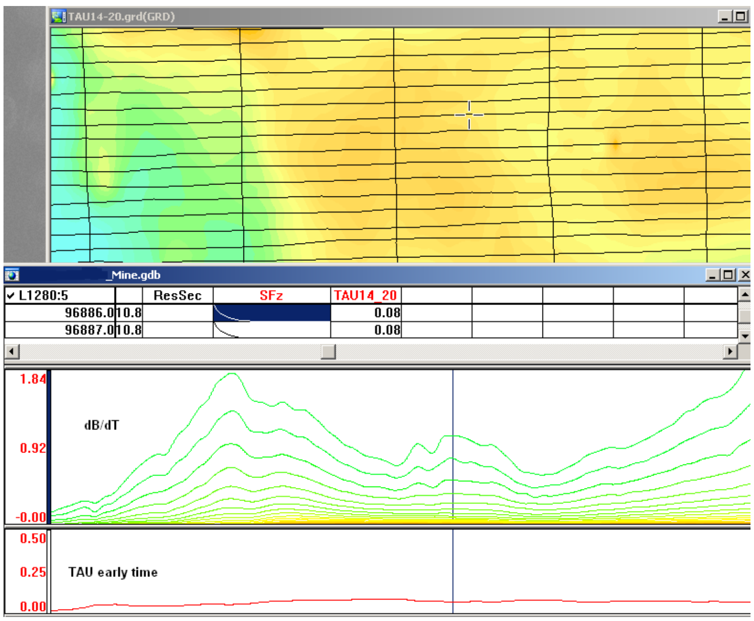


Figure E-2: Map of early time TAU Area with overburden conductive layer and local sources.

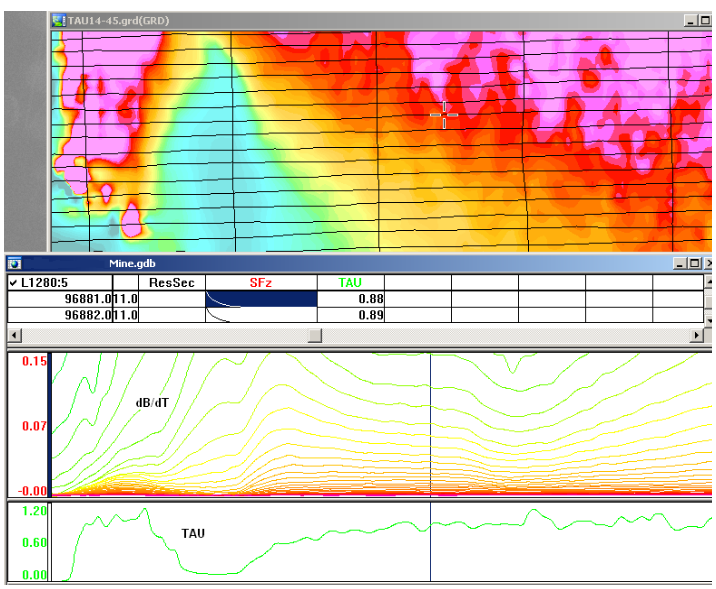


Figure E-3: Map of full time range TAU with EM anomaly due to deep highly conductive target.

There are many advantages of TAU maps:

- TAU depends only on one parameter (conductance) in contrast to response magnitude;
- TAU is integral parameter, which covers time range and all conductive zones and targets are displayed independently of their depth and conductivity on a single map.
- Very good differential resolution in complex conductive places with many sources with different conductivity.
- Signs of the presence of good conductive targets are amplified and emphasized independently of their depth and level of response accordingly.

In the example shown in Figure 4 and 5, three local targets are defined, each of them with a different depth of burial, as indicated on the resistivity depth image (RDI). All are very good conductors but the deeper target (number 2) has a relatively weak dB/dt signal yet also features the strongest total TAU (Figure 4). This example highlights the benefit of TAU analysis in terms of an additional target discrimination tool.

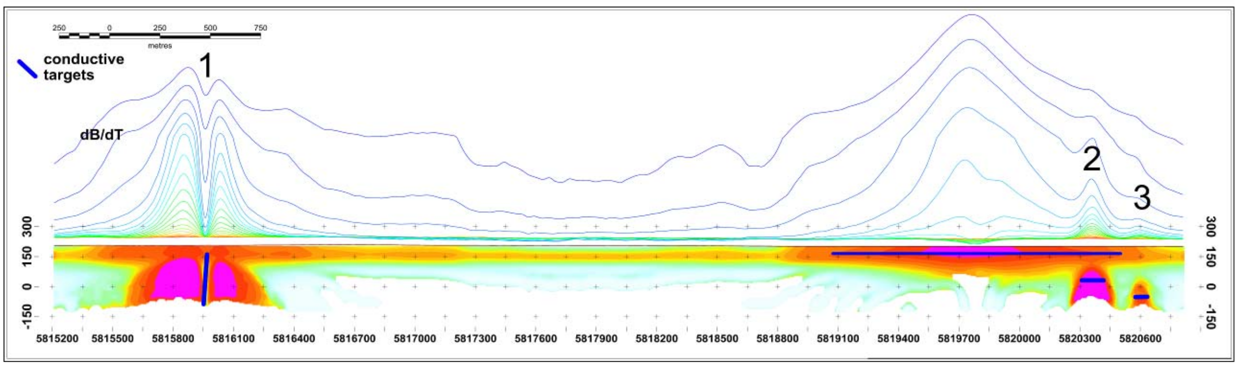


Figure E-4: dB/dt profile and RDI with different depths of targets.

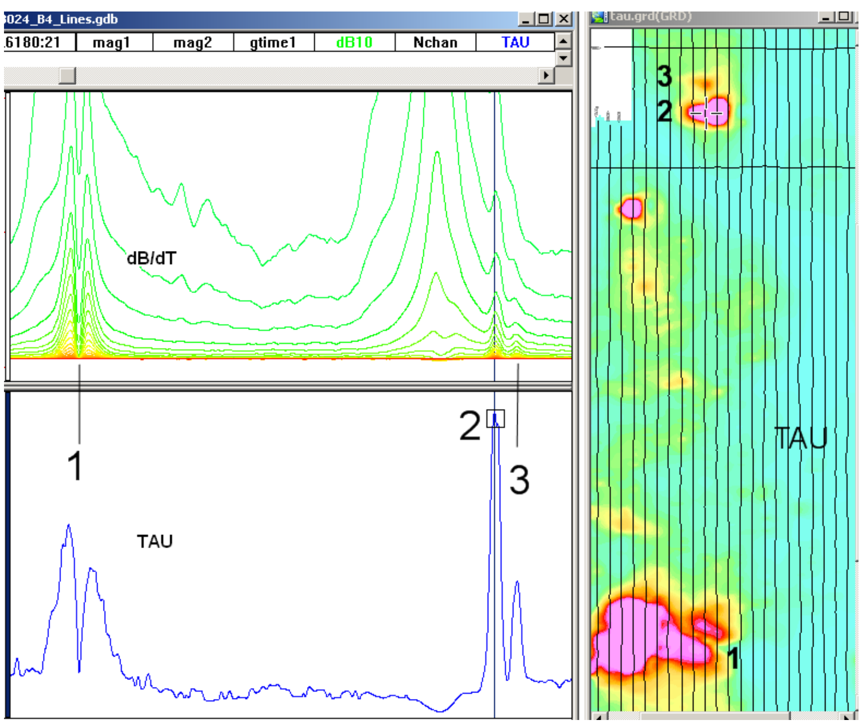


Figure E-5: Map of total TAU and dB/dt profile.

The EM Time Constants for dB/dt and B-field were calculated using the "sliding Tau" in-house program developed at Geotech[2]. The principle of the calculation is based on using of time window (4 time channels) which is sliding along the curve decay and looking for latest time channels which have a response above the level of noise and decay. The EM decays are obtained from all available decay channels, starting at the latest channel. Time constants are taken from a least square fit of a straight-line (log/linear space) over the last 4 gates above a pre-set signal threshold level (Figure E-6). Threshold settings are pointed in the "label" property of TAU database channels. The sliding Tau method determines that, as the amplitudes increase, the time-constant is taken at progressively later times in the EM decay. Conversely, as the amplitudes decrease, Tau is taken at progressively earlier times in the decay. If the maximum signal amplitude falls below the threshold, or becomes negative for any of the 4 time gates, then Tau is not calculated and is assigned a value of "dummy" by default.

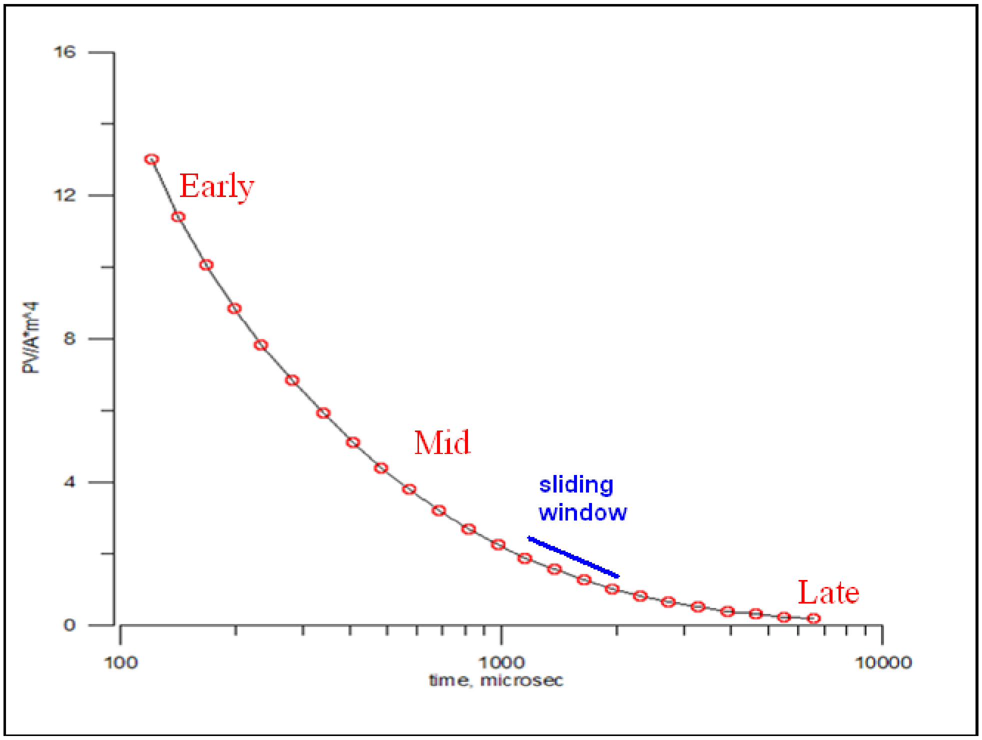


Figure E-6: Typical dB/dt decays of VTEM data

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Geotech Ltd.

September 2010

[2] by A.Prikhodko

APPENDIX F

TEM RESISTIVITY DEPTH IMAGING (RDI)

Resistivity depth imaging (RDI) is technique used to rapidly convert EM profile decay data into an equivalent resistivity versus depth cross-section, by deconvolving the measured TEM data.
The used RDI algorithm of Resistivity-Depth transformation is based on scheme of the apparent resistivity transform of Maxwell A.Meju (1998)[1] and TEM response from conductive half-space. The program is developed by Alexander Prikhodko and depth calibrated based on forward plate modeling for VTEM system configuration (Fig. 1-10).

RDIs provide reasonable indications of conductor relative depth and vertical extent, as well as accurate 1D layered-earth apparent conductivity/resistivity structure across VTEM flight lines. Approximate depth of investigation of a TEM system, image of secondary field distribution in half space, effective resistivity, initial geometry and position of conductive targets is the information obtained on base of the RDIs.

Maxwell forward modeling with RDI sections from the synthetic responses (VTEM system)

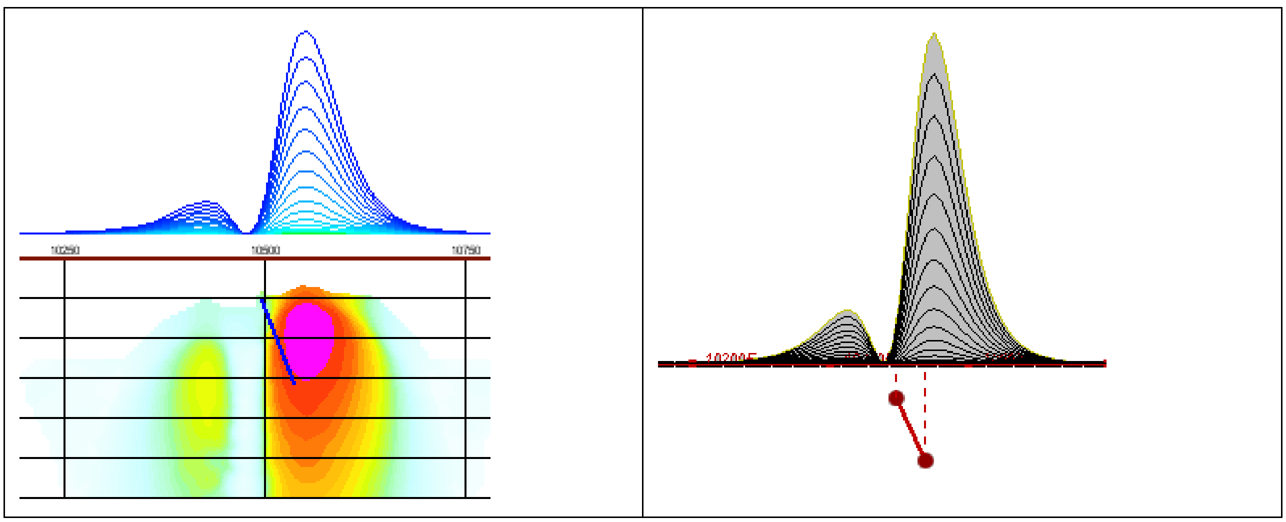


Figure F-1: Maxwell plate model and RDI from the calculated response for conductive “thin” plate (depth 50 m, dip 65 degree, depth extend 100 m).

[1] Maxwell A.Meju, 1998, Short Note: A simple method of transient electromagnetic data analysis, Geophysics, **63**, 405–410.

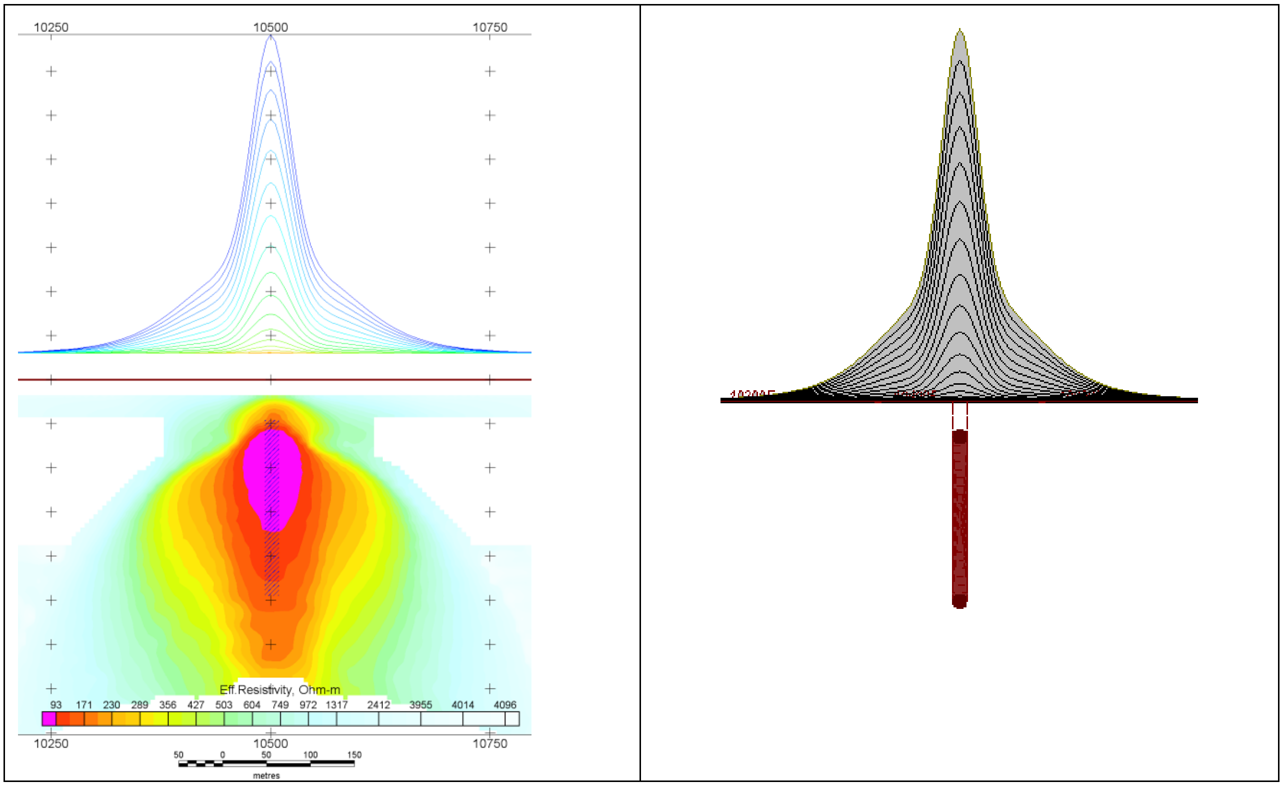


Figure F-2: Maxwell plate model and RDI from the calculated response for "thick" plate 18 m thickness, depth 50 m, depth extend 200 m).

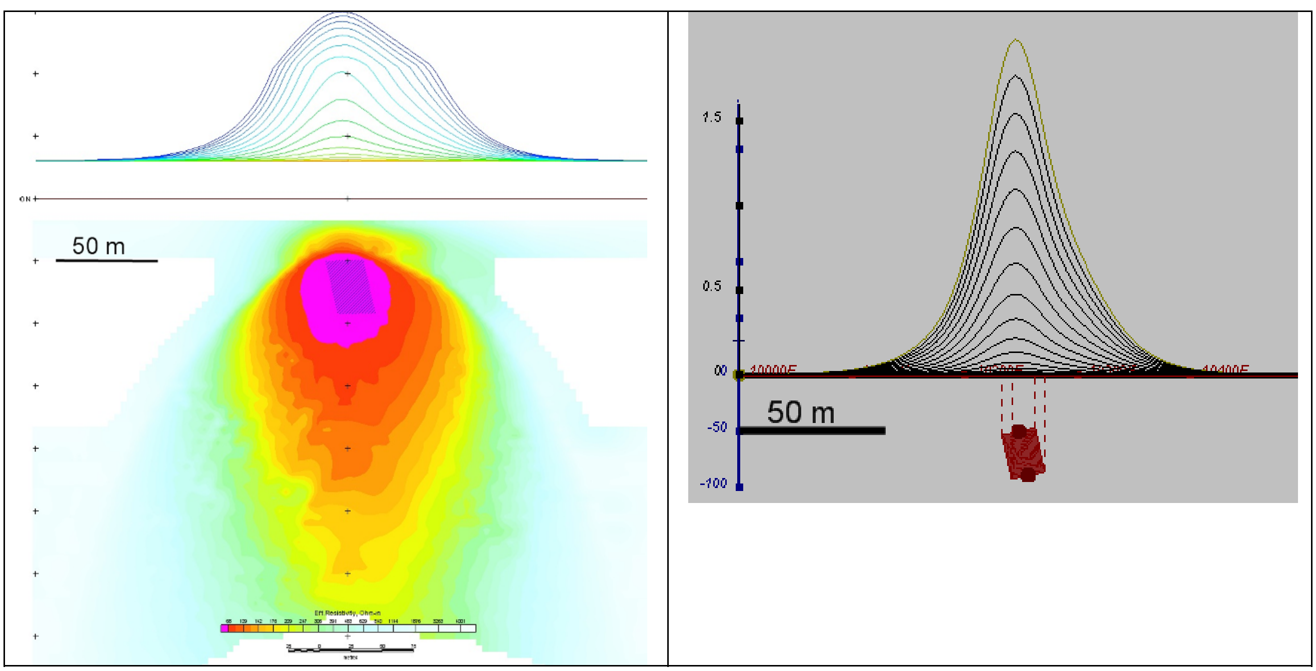


Figure F-3: Maxwell plate model and RDI from the calculated response for bulk ("thick") 100 m length, 40 m depth extend, 30 m thickness

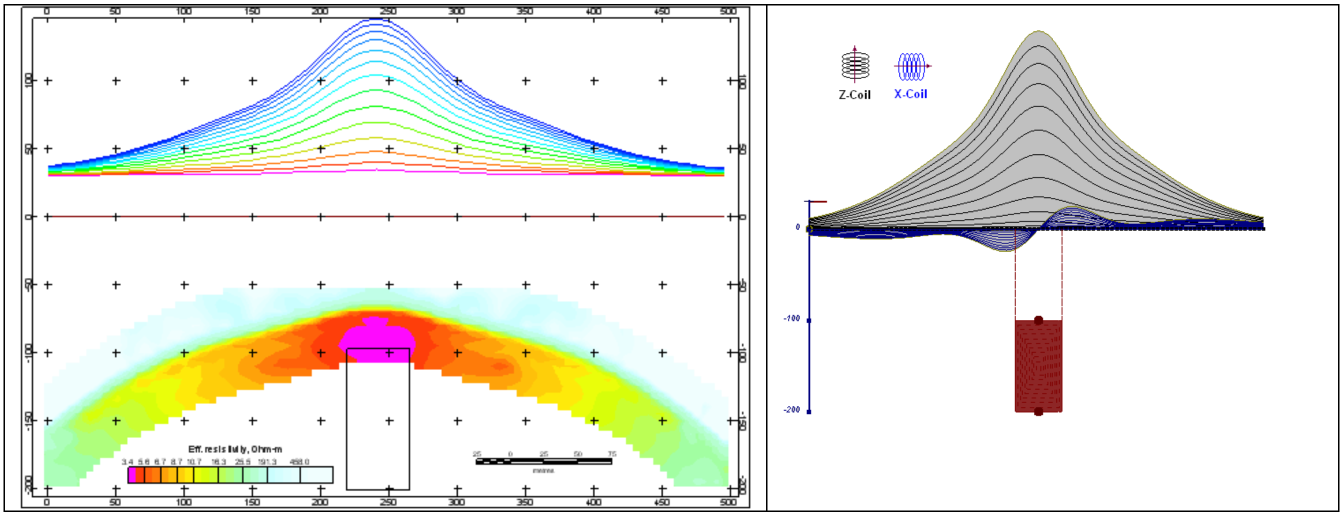


Figure F-4: Maxwell plate model and RDI from the calculated response for "thick" vertical target (depth 100 m, depth extend 100 m). 19-44 chan.

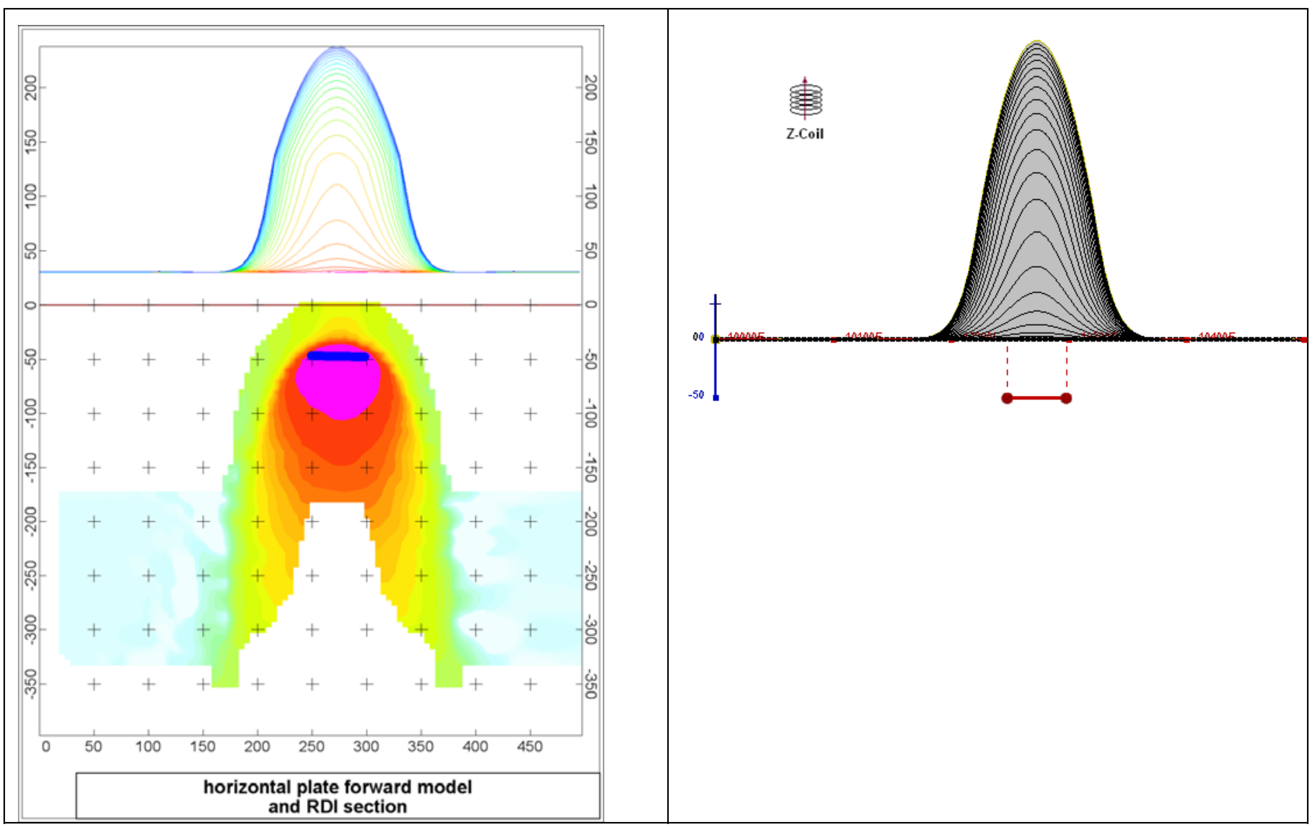


Figure F-5: Maxwell plate model and RDI from the calculated response for horizontal thin plate (depth 50 m, dim 50x100 m). 15-44 chan.

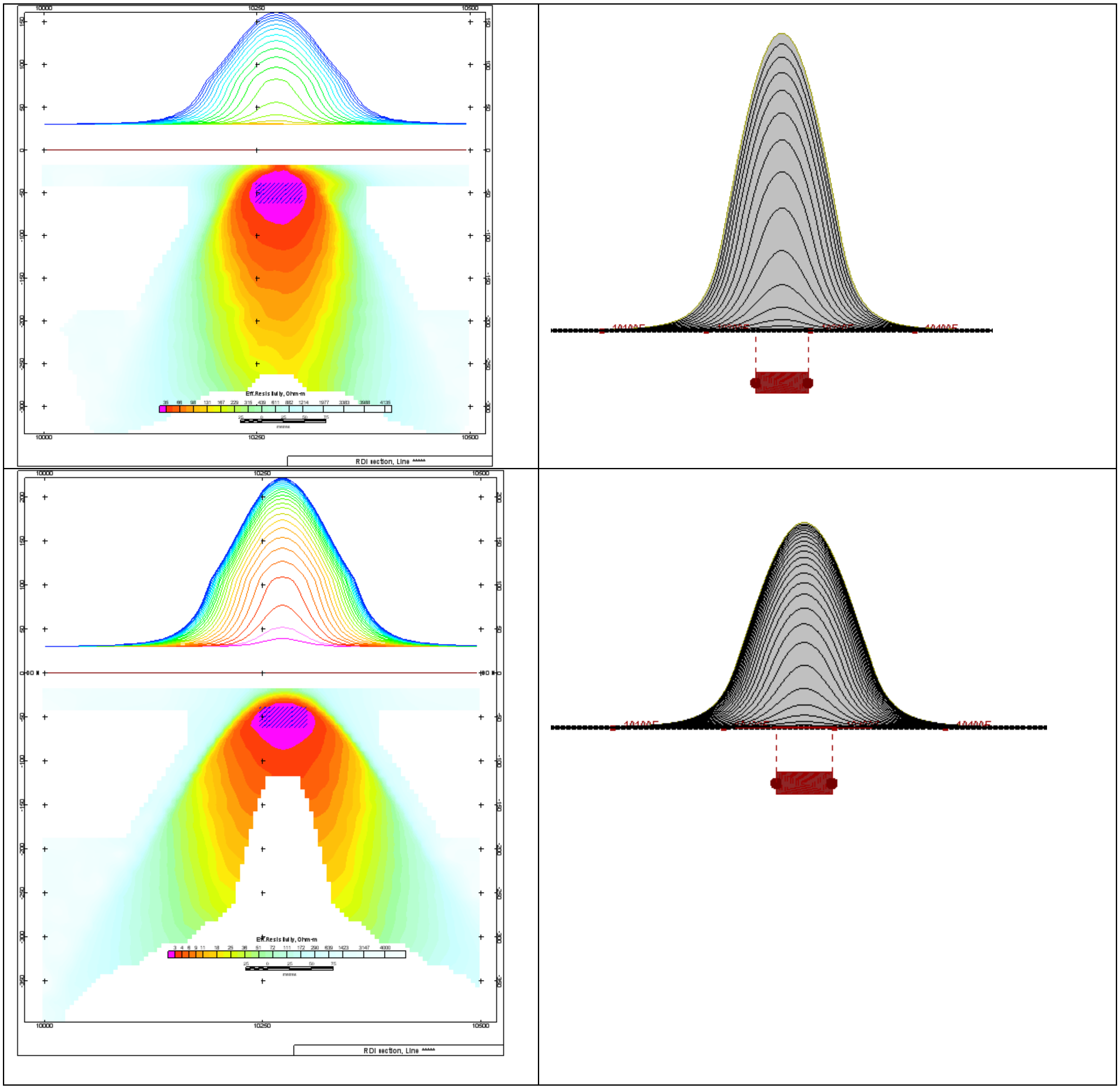


Figure F-6: Maxwell plate model and RDI from the calculated response for horizontal thick (20m) plate – less conductive (on the top), more conductive (below)

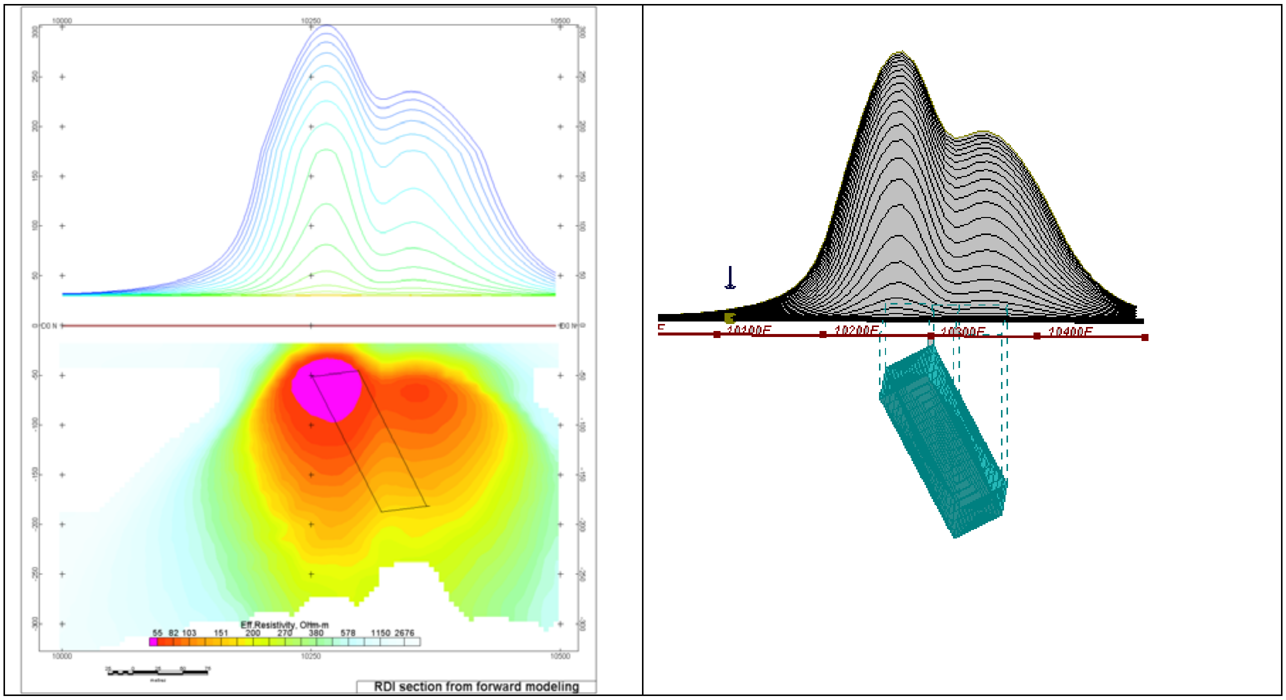


Figure G-7: Maxwell plate model and RDI from the calculated response for inclined thick (50m) plate. Depth extends 150 m, depth to the target 50 m.

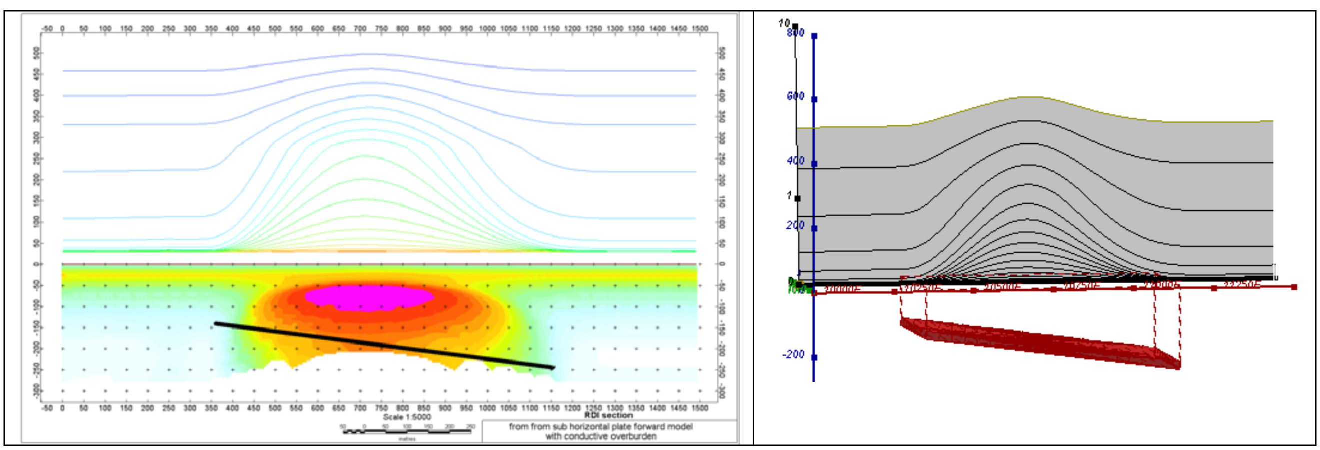


Figure F-8: Maxwell plate model and RDI from the calculated response for the long, wide and deep subhorizontal plate (depth 140 m, dim 25x500x800 m) with conductive overburden.

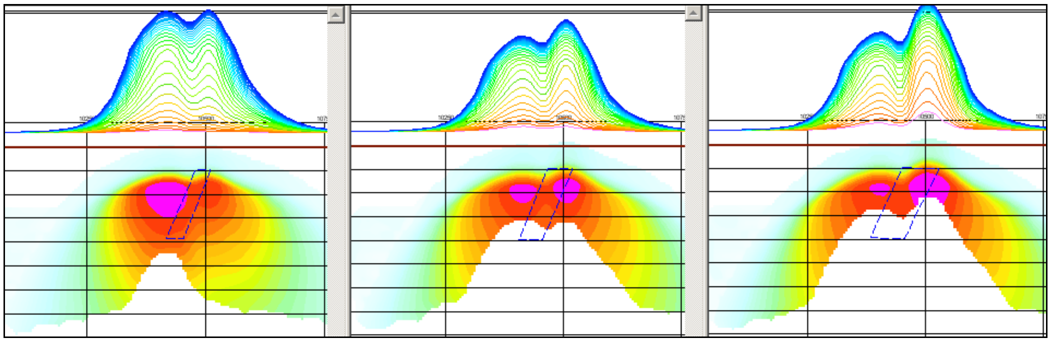


Figure F-9: Maxwell plate models and RDIs from the calculated response for “thick” dipping plates (35, 50, 75 m thickness), depth 50 m, conductivity 2.5 S/m.

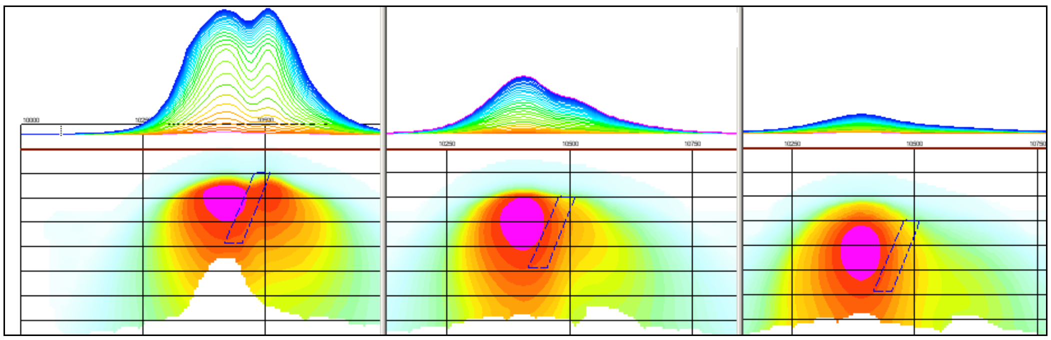


Figure F-10: Maxwell plate models and RDIs from the calculated response for “thick” (35 m thickness) dipping plate on different depth (50, 100, 150 m), conductivity 2.5 S/m.

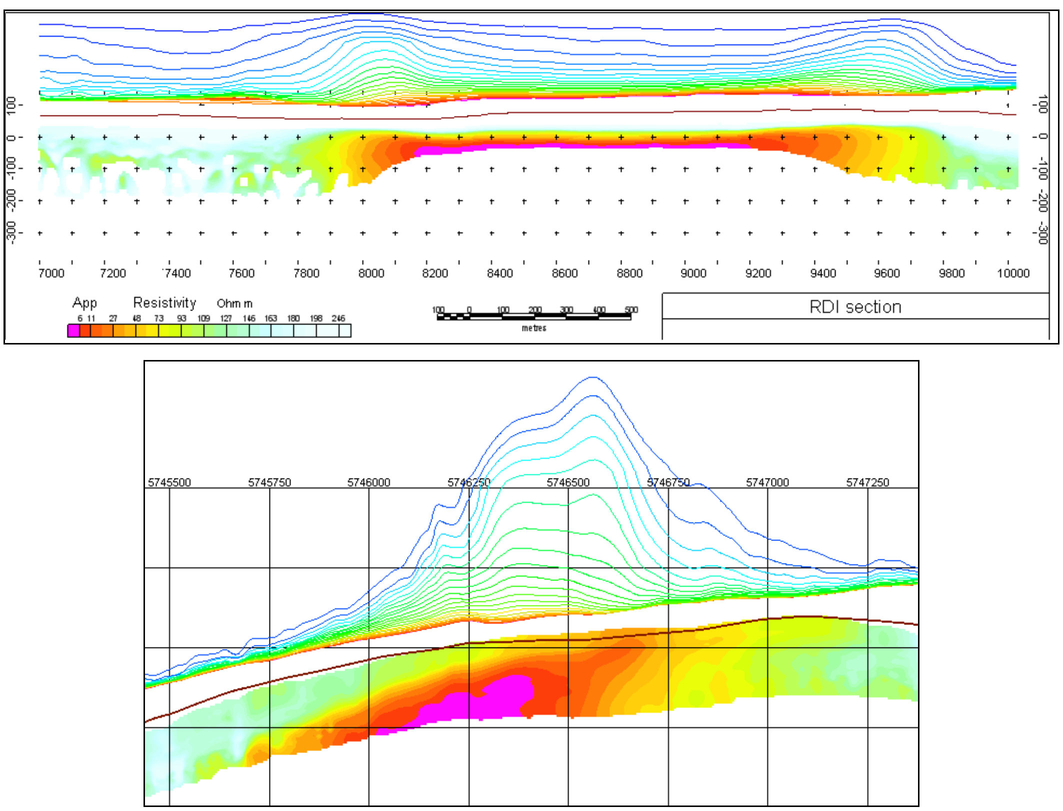
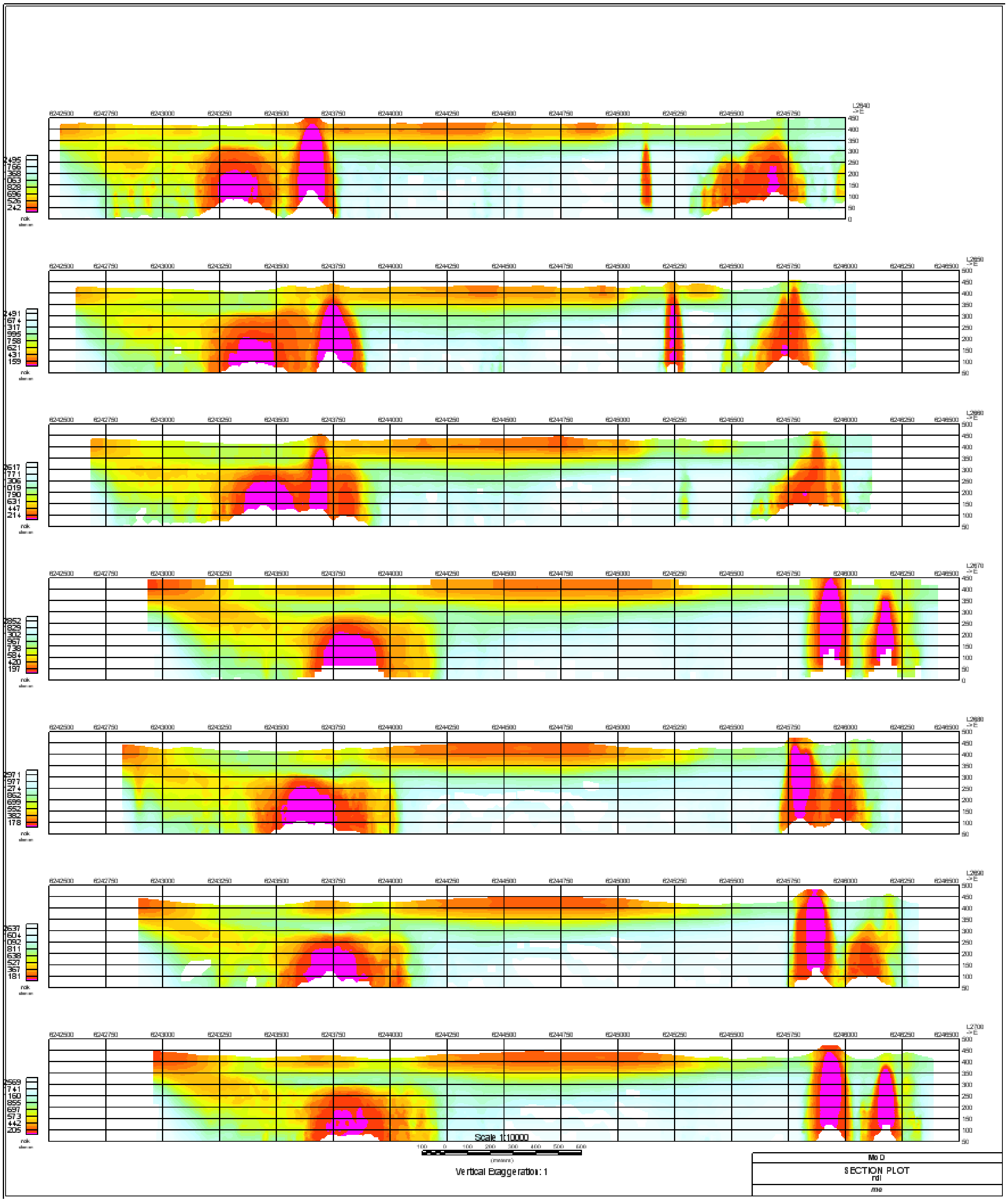


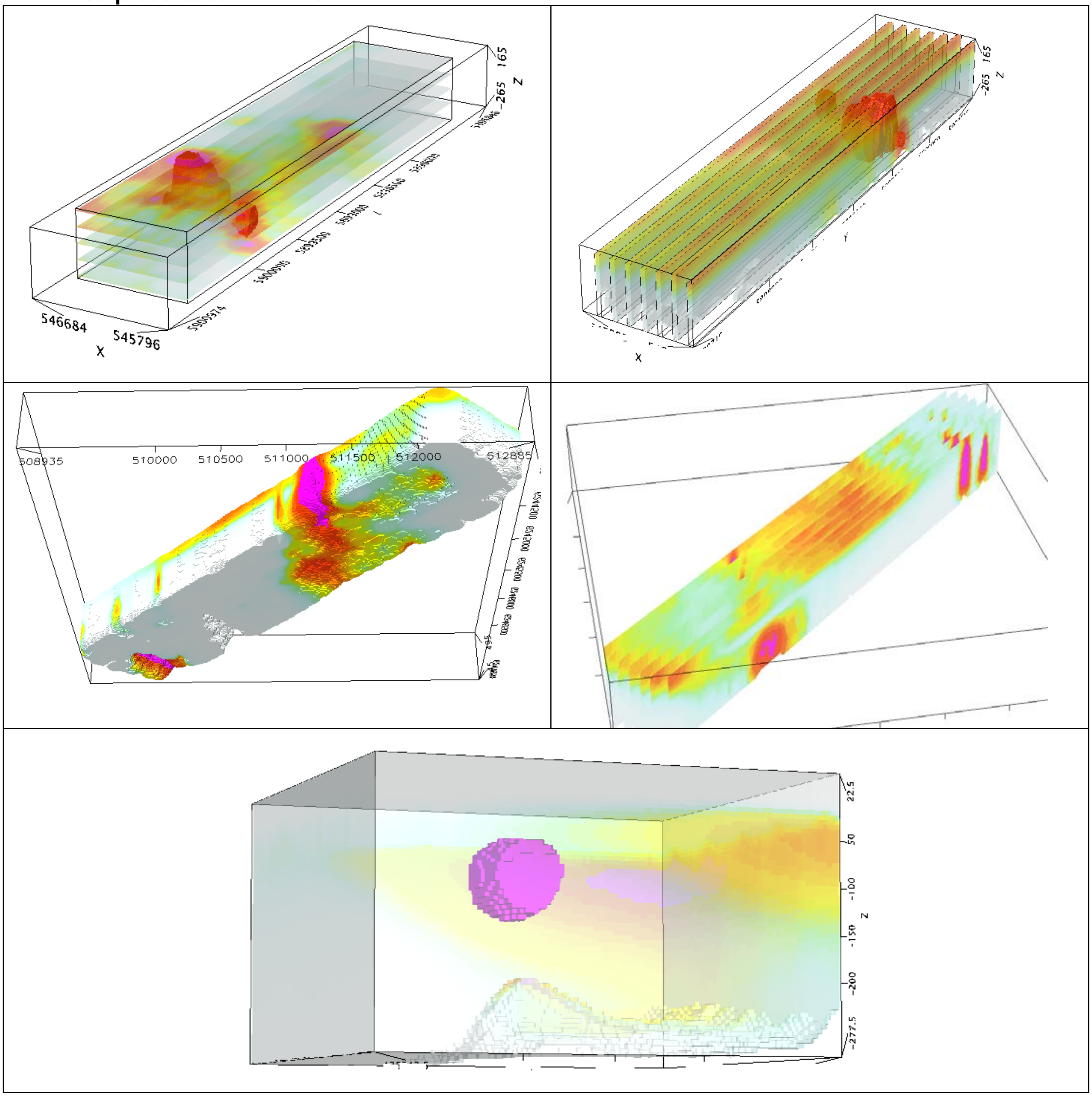
Figure F-11: RDI section for the real horizontal and slightly dipping conductive layers

FORMS OF RDI PRESENTATION

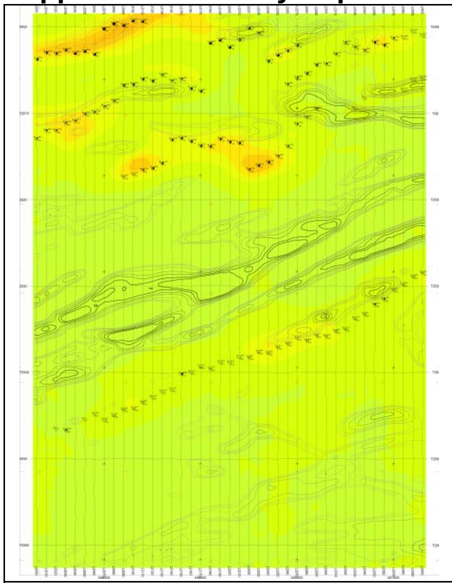
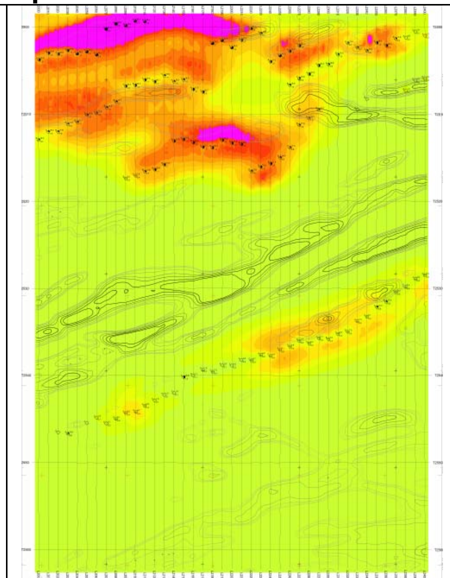
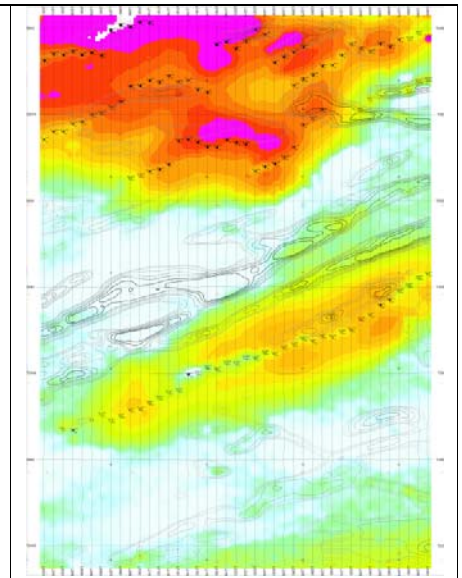
Presentation of series of lines



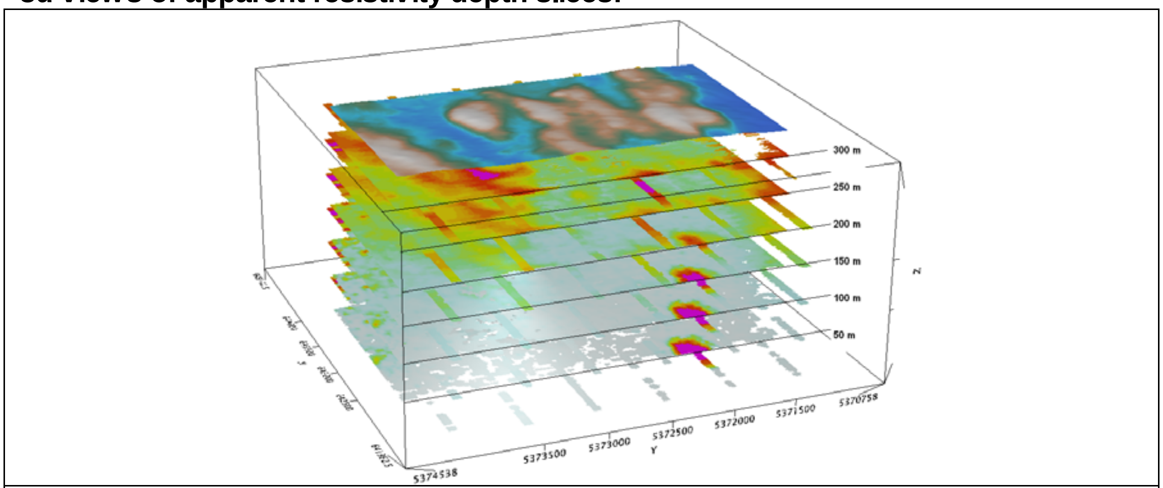
3d presentation of RDIs

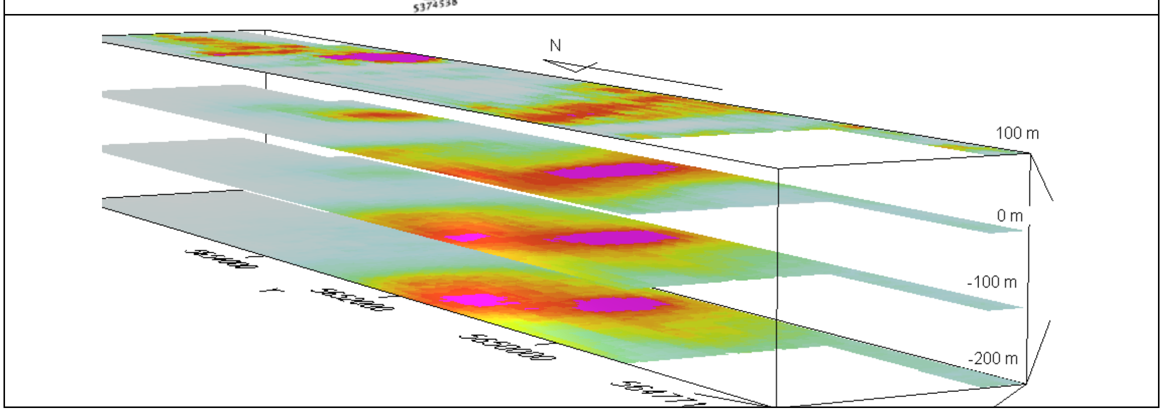


Apparent Resistivity Depth Slices plans:

		
0 m (surface)	-100 m	-200 m

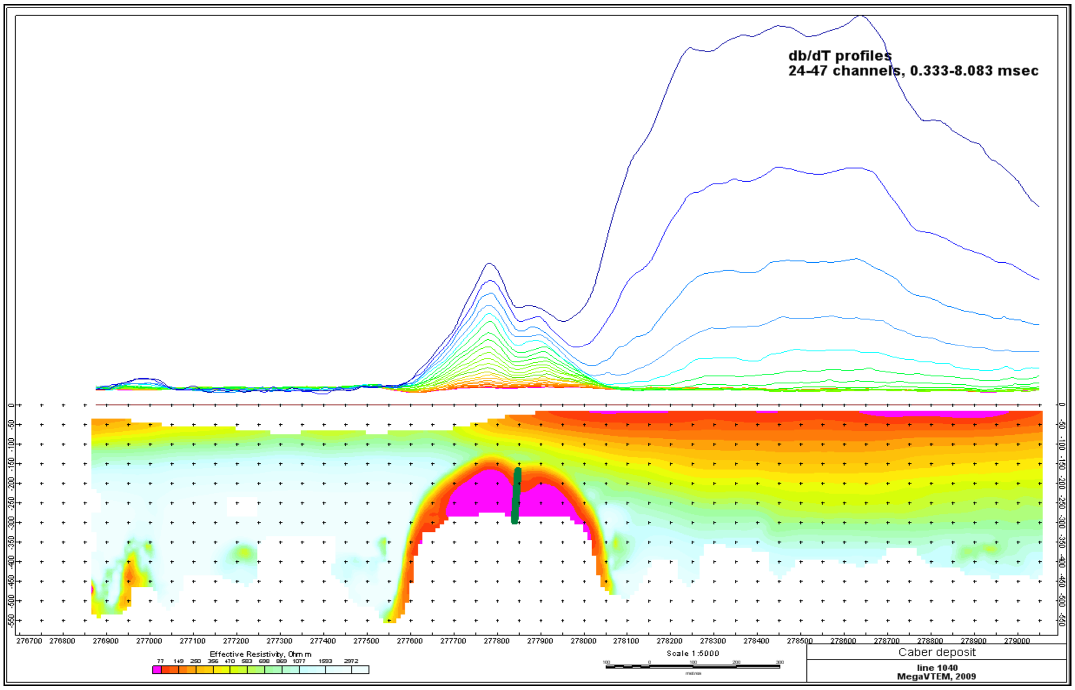
3d views of apparent resistivity depth slices:



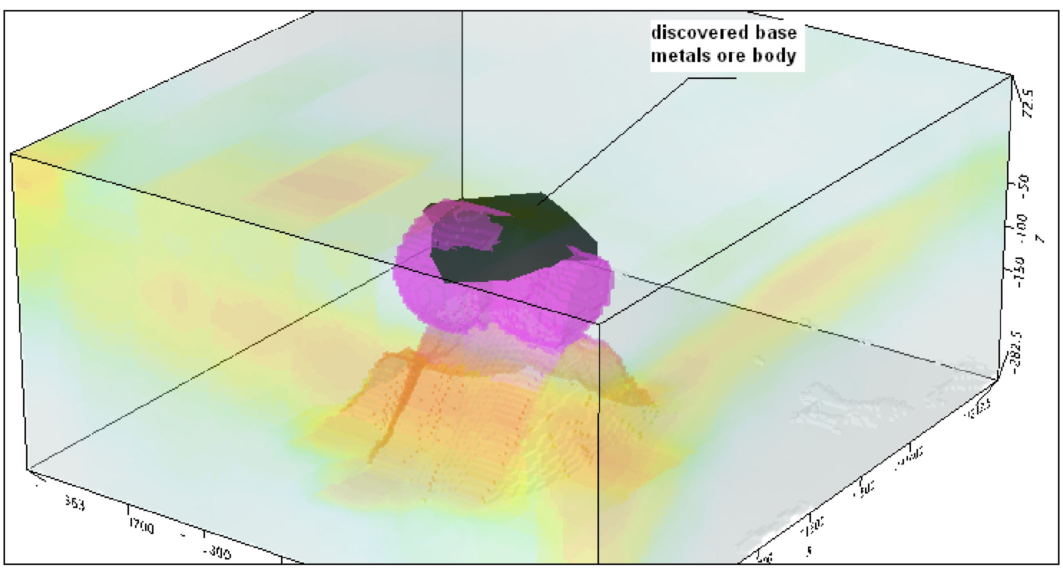


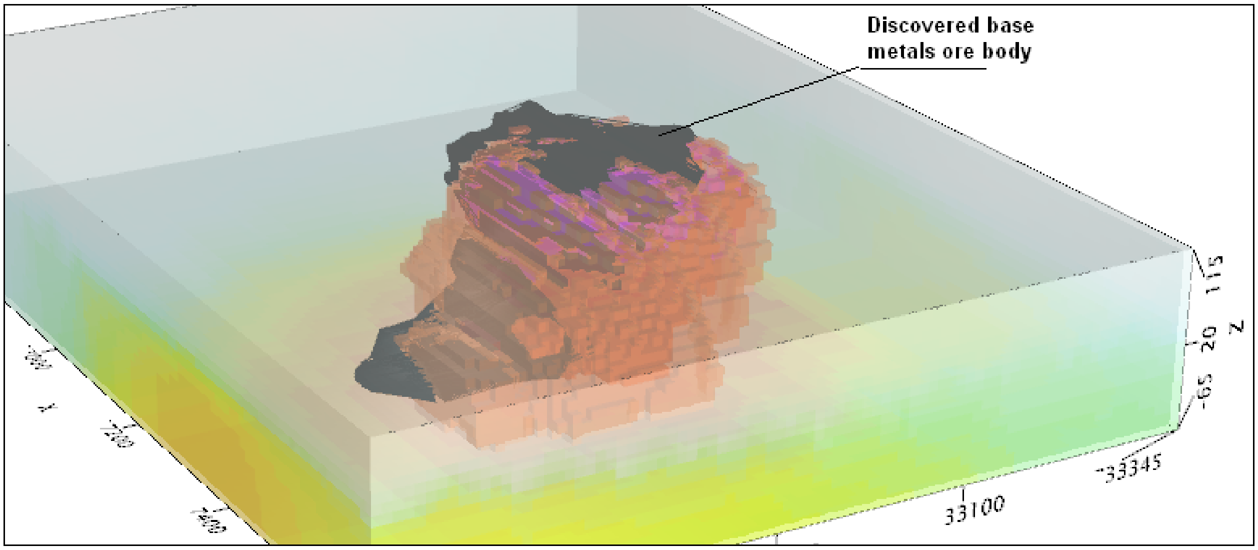
Real base metal targets in comparison with RDIs:

RDI section of the line over Caber deposit (“thin” subvertical plate target and conductive overburden).



3d RDI voxels with base metals ore bodies (Middle East):





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Geotech Ltd.
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