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Interpretation of Airborne Magnetic Survey Data for the Shining Tree Property, Ontario

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Executive Summary

In January 2022, Mr. Joe Hinzer representing P. Dirks engaged Paterson, Grant & Watson Limited (PGW) for a geophysical data compilation and interpretation of a small area of eight claims located approximately 5 km north of Shining Tree, Ontario.

The main objective of the geophysical interpretation program is to better define structural controls of mineralization in the area, and to define follow-up targets for ground geophysical and/or geochemical work.

Geophysical data from one regional airborne geophysical survey covering the Shining Tree area was analyzed and a number of qualitative interpretation products were generated. Structures and magnetic anomalies within the property and its surroundings were interpreted and described as part of the qualitative interpretation. The interpreted structures and anomalies were then compared to geological mapping, geochemical data, IP pseudosections and interpreted cross sections that were collected within the property.

Mineralization from previous studies appears closely related to NNW-trending shear-faulting occurring within the property. The qualitative interpretation showed two major dykes trending NNW that exhibit magnetic highs, which surround the shear faulting. A major ENE-trending fault is seen to cut the NNW-trending dykes which crosses the property in its central to north portion.

Future work is recommended for two targets located in the northern end of the property, namely for follow-up geophysical and/or geochemical data collection. Drone-based or ground magnetic data acquisition is recommended due to the lack of available high-resolution data in the Shining Tree area.

1. Introduction

In January 2023, Joe Hinzer representing P. Dirks engaged Paterson, Grant & Watson Limited (PGW) for a geophysical data compilation and interpretation of a small area of eight claims located approximately 5 km north of Shining Tree, Ontario. The company intends to option the claims through Letter of Intent by February 5, 2023. Paterson, Grant & Watson Limited (PGW) was contacted to prepare a data compilation and a preliminary interpretation to provide selected targets for follow-up surveying.

The main goal of the geophysical interpretation program is to better define the structural and lithological controls of mineralization in the area, and to define follow-up targets for ground geophysical and/or geochemical work. This includes identification of major regional structures and extension of intrusives beneath the surficial cover.

2. Shining Tree Property

2.1. Property Description

The Shining Tree project comprises of an area approximately 1.75 km^2 located in NTS Sheet 041P11, approximately 5 km north of Shining Tree, Ontario (Figure 2.1). The property is accessible from a logging road by turning north off Highway 560 approximately 20 km northeast from the intersection between Highway 560 and Highway 560A.

Topography of the area exhibits gentle relief with elevations ranging from 373 m to 401 m above sea level. The area contains extensive outcrop exposure in most parts, with other areas being forested with mixed vegetation. The property is part of a managed forest harvest area, which varies the amount of tree density on the property

The property contains eight single cell mining claims with varying tenure IDs held by P. Dirks. Mining claims are listed in Table 2.1.

Table 2.1 List of claims contained within the property owned by P. Dirks.

Legacy Claim Id	Township/Area	Tenure ID	Tenure Type	Anniversary Date
3007649	Churchill	135763	Single Cell Mining Claim	2020-02-05
3007649	Churchill	187899	Single Cell Mining Claim	2020-02-05
3007649	Churchill	199911	Single Cell Mining Claim	2020-02-05
3007649	Churchill	199912	Single Cell Mining Claim	2020-02-05
3007649	Churchill	199913	Single Cell Mining Claim	2020-02-05
3007649	Churchill	207925	Single Cell Mining Claim	2020-02-05
3007649	Churchill	303781	Single Cell Mining Claim	2020-02-05
3007649	Churchill	310533	Single Cell Mining Claim	2020-02-05

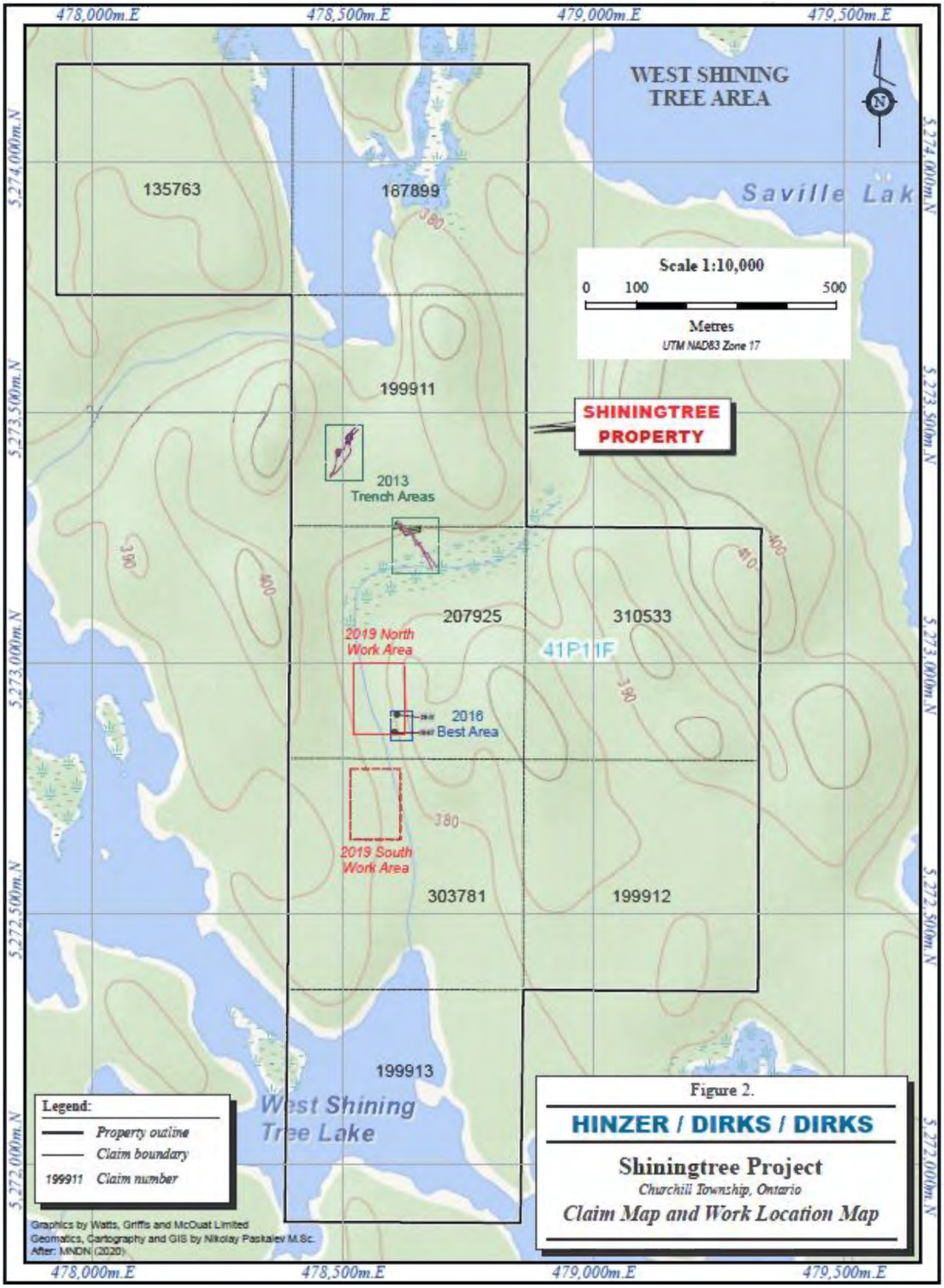

Figure 2.1 Claim layout of the Shining Tree Project with the associated claim numbers

2.2. Property History

The Shining Tree property was originally optioned in 1990 by Northgate Mines Ltd, where a series of geological mapping, geochemical soil sampling, and ground geophysical surveys were conducted. The option was relinquished in 1992 as part of Northgate undergoing company restructuring. The property was then optioned in 1999 by Hinzer/Dirks/Dirks in 1999 when the anomalous gold sites were re-visited and sampled in detail.

The current iteration of the property covers the most prospective area was retained in 2002, while the remaining claims were relinquished. Three IP lines were surveyed in 2004 trending E-W parallel to the original Northgate survey, which revealed promising chargeability zones that correlated with gold and silver mineralization. Rock and trench sampling occurred from 2006-2008 which led to the discovery of a mineralized shear zone with anomalous gold mineralization. Follow-up sampling in 2012 revealed more extensive mineralization along the shear zone.

Recent work on the property includes prospecting work tracing the mineralized shear zone along strike during 2015-2018. Results from the field program led to sampling in 2019 which confirmed mineralization along the length of the shear zone, with anomalous mineralization occurring towards the south end of the property.

3. Geological Setting

3.1. Regional Geology

The Shining Tree property is located in the southwestern part of the Abitibi Subprovince. The Archean mafic to felsic volcanic rocks are cut by NNW-trending Proterozoic diabase dikes and several faults of similar orientation which also are present in early Proterozoic Huronian strata. The volcanic rocks are classified as tholeiitic, calc-alkalic and komatiitic.

The Ontario Geological Survey described the area surrounding the property as “Basaltic and andesitic flows, tuffs and breccias, chert, iron formation, minor metasedimentary and intrusive rocks, related migmatites” (OGS 2011). The mafic to intermediate metavolanics are Archean in age. Within the property and surrounding area are a series of NNW-trending faults and dykes that are associated with a significant shear zone. The NNW-trending dykes are dated at 2454 Ma (OGS, 2011). No significant faults are mapped cutting through the property, but to the northwest there is a NE-trending fault. Overprinting the NNW-trending dykes is a NW-trending dyke dated 1235 Ma.

3.2. Property Geology

The Shining Tree property is dominated by mafic volcanics with pillowed flows in the eastern side of the property, whereas the west is dominated by massive volcanics. In the central part of the property, quartz porphyries occur as dykes and intrusives.

The primary feature of interest on the property is a NNW-trending shear-fault zone with outcropping in the northern half of the property. Along these outcrops, anomalous gold mineralization has been encountered. Gold mineralization here is associated with elevated As and Pb, and are often depleted in Cr and Cu (Hinzer, 2015). The central part of the shear-zone contains exposed rock that is sheared, silicified and porphyritic.

4. Geophysical Data

Geophysical data for this interpretation was compiled from government geological survey archives as well as data supplied from Mr. Hinzer. Regional aeromagnetic data was sourced from the Ontario Geological Survey (OGS) archive (OGS, 2009), which resulted in two datasets covering the project area. Airborne electromagnetic data was also sourced from the OGS archive. IP pseudosections were supplied by the client that were conducted within the property. All data compiled was supplied in Universal Transverse Mercator (UTM) Zone 17N, datum NAD83.

4.1. Magnetic Data

4.1.1. Ontario Geological Survey GDS 1064

The primary regional magnetic survey was collected by the Ontario Geological Survey for the Discover Abitibi project. The Shining Tree Area survey – code GDS 1064 – was a regional magnetic survey conducted in 2008 that consisted of five blocks of varying traverse line orientation totalling 23,660 line km of horizontal gradient magnetic data. The survey contained is on the border between Blocks 2 and 3, as shown in Figure 4.1.

Table 4.1 OGS 1064 line spacing and direction

Area	Traverse		Control	
	Spacing (m)	**Direction**	**Spacing (m)**	**Direction**
1	150	160°	1000	070°
2	150	000°	1000	090°
3	150	045°	1000	135°
4	150	000°	1000	090°
5	150	000°	1000	090°

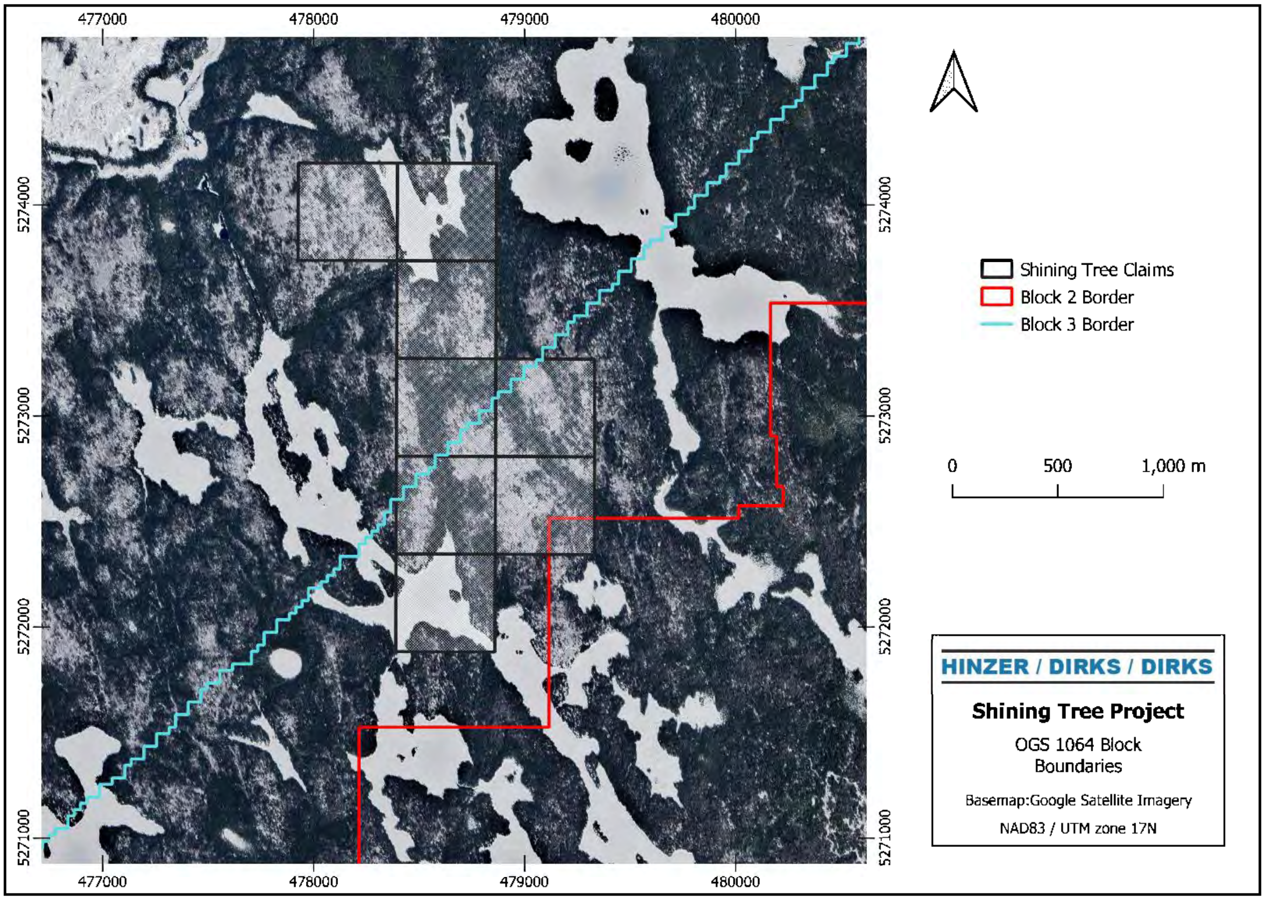

Figure 4.1: Location of the Shining Tree property with the borders of Blocks 2 and 3 from OGS Geophysical Data Set 1064

4.1.1.1. Specifications of Survey

- Traverse Line Spacing
  - Block 2: 150 m, N000°
  - Block 3: 150 m, N045°
- Control Line Spacing
  - Block 2: 1000 m, N090°
  - Block 3: 1000 m, N135°
- Aircraft Speed: 75 m/s
- MTC: 80 m
- Total Line km flown (all 5 blocks): 23,661.8 km
  - Block 2: 2,331.7 km
  - Block 3: 9,775.7 km

4.1.1.2. Data Files Attached

4.1.1.2.1. Whole Block

- Databases/Flight Path: DASTFPATH83.dxf
- Grids
  - DASTDEM83.grd: Digital Elevation Model

  - DASTMAG83.grd: GSC-levelled residual magnetic field from the tail sensor.
  - DAST1VD83.grd: First vertical derivative of GSC-levelled residual magnetic field
  - DAST2VD83.grd: Second vertical derivative of GSC-levelled residual magnetic field
  - DASTGMAG83.grd: GSC-levelled, gradient enhanced residual magnetic field from the tail sensor
  - DASTG1VD83.grd: First vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DASTG2VDG83.grd: Second vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DASTLAG83.grd: Measured lateral horizontal gradient
  - DASTLOG83.grd: Measured longitudinal horizontal gradient

- GeoTIFFs
  - DASTGMAG83.tif: Colour gradient-enhanced residual magnetic field on a planimetric base
  - DASTG2VD83.tif: Colour shaded relief of the second vertical derivative of the gradient-enhanced residual magnetic field on a planimetric base

4.1.1.3. Block 2

- Databases:
  - DAST2MAG.gdb
  - DAST2MAG.xyz
- Grids:
  - DAST2DEM83.grd: Digital Elevation Model
  - DAST2MAG83.grd: GSC-levelled residual magnetic field from the tail sensor.
  - DAST21VD83.grd: First vertical derivative of GSC-levelled residual magnetic field
  - DAST2VD83.grd: Second vertical derivative of GSC-levelled residual magnetic field
  - DAST2GMAG83.grd: GSC-levelled, gradient enhanced residual magnetic field from the tail sensor
  - DAST2G1VD83.grd: First vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DAST2G2VDG83.grd: Second vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DAS2TLAG83.grd: Measured lateral horizontal gradient
  - DAS2TLOG83.grd: Measured longitudinal horizontal gradient

4.1.1.4. Block 3

- Databases:
  - DAST3MAG.gdb
  - DAST3MAG.xyz
- Grids:
  - DAST3DEM83.grd: Digital Elevation Model
  - DAST3MAG83.grd: GSC-levelled residual magnetic field from the tail sensor.
  - DAST31VD83.grd: First vertical derivative of GSC-levelled residual magnetic field
  - DAST3VD83.grd: Second vertical derivative of GSC-levelled residual magnetic field

  - DAST3GMAG83.grd: GSC-levelled, gradient enhanced residual magnetic field from the tail sensor
  - DAST3G1VD83.grd: First vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DAST3G2VDG83.grd: Second vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
  - DAS2TLAG83.grd: Measured lateral horizontal gradient
  - DAS2TLOG83.grd: Measured longitudinal horizontal gradient

4.1.2. Ontario Geological Survey GDS 1003

The OGS conducted an extensive aeromagnetic and electromagnetic geophysical compilation and reprocessing of 32 airborne surveys flown from 1975 to 1992 (OGS, 2003). The deliverables for the magnetic portion of the study are as follows:

4.1.2.1. Specifications of Survey

- Traverse Line Spacing: 200 m, N045°
- Control Lines Spacing: 5000 m, N135°
- Aircraft Speed: 60 m/s
- MTC: 120 m
  - EM Sensor Height:40 m
  - Mag Sensor Height: 120 m
- Total Line km flown (all 5 blocks): 20,805.1 km

4.1.2.2. Data Files Attached

4.1.2.2.1. Whole Block

- Databases/Flight Path: STMagEM.gdb
- Grids in UTM Easting NAD83 Zone 17
  - STMAGONL83.grd: Total Magnetic Field levelled to Ontario Single Master Grid
  - STMAGOLS83.grd: Smoothed Total Magnetic Field levelled to Ontario Single Master Grid
  - STMAG2VD83.grd: Second vertical derivative of the Total Magnetic Field
  - ST2VDS83.grd: Second vertical derivative from the smoothed Total Magnetic Field grid
- GeoTIFFs
  - STKC.tif: Keating Correlation Coefficient of Survey Area

4.2. Electromagnetic Data: Ontario Geological Survey GDS 1003

The OGS conducted an extensive aeromagnetic and electromagnetic geophysical compilation and reprocessing of 32 airborne surveys flown from 1975 to 1992 (OGS, 2003). The deliverables from the electromagnetic surveys are as follows:

4.2.1.1. Specifications of Survey

- TDEM Systems: INPUT, GEOTEM I and GEOTEM II
- Traverse Line Spacing: 200 m, N045°
- Control Lines Spacing: 5000 m, N135°
- Aircraft Speed: 60 m/s
- MTC: 120 m

  - EM Sensor Height: 40 m
  - Mag Sensor Height: 120 m
- Total Line km flown (all 5 blocks): 20,805 km

4.2.1.2. Data Files Attached

4.2.1.2.1. Whole Block

- Databases/Flight Path: STMagEM.gdb
- Grids in UTM Easting NAD83 Zone 17
  - STDC83.grd: Decay Constant
  - STDCDE83.grd: Decay Constant Deherringboned
  - STDCDEF83.grd: Decay Constant Deherringboned and Filtered
  - STRES83.grd: Resistivity
  - STRESDE83.grd: Resistivity Deherringboned
  - STRESDEF83.grd: Resistivity Deherringboned and Filtered

4.3. IP Data

An IP-Resistivity survey was conducted in 2004 on the Shining Tree Property to locate follow-up targets (Matrix GeoTechnologies, 2004) . The survey was conducted along three lines at 25m station intervals using a Pole-Dipole Array. Line locations can be seen in Table 4.2.

Table 4.2: Pole-Dipole Survey Coverage

Line	Min Extent	Max Extent	Total (m)
L1+75N	300W	275E	575
L0N	100W	350E	475
L1+00N	250W	175E	425
Total Distance		**1475**	

Deliverables for the project included pole-dipole pseudosections of combined total chargeability and apparent resistivity and interpreted cross sections. The pseudosections and cross sections were provided to us by Joe Hinzer.

5. Data Processing Techniques

The magnetic data were inspected for any residual acquisition related noise and microlevelling, in addition to what was performed by the survey contractor. The compiled geophysical data sets from the OGS had been processed to a satisfactory level for this interpretation. Microlevelling was attempted on GDS1064, but the result did not improve the quality of the data. All magnetic data processing was performed using Oasis Montaj v2022.1 and the products are converted to ERMapper *.ers grid formats for easy importing to multiple software packages.

The following products were prepared and use for the qualitative interpretation:

- Residual magnetic intensity reduced to the magnetic pole (RTP)
- First vertical derivative of the residual magnetic intensity reduced to the pole (RTP1VD)
- Second vertical derivative of the residual magnetic intensity reduced to the pole (RTP2VD)
- Tilt derivative of the residual magnetic intensity reduced to the pole (RTPTD)

- Analytic signal of the total magnetic intensity (ANS)

A background summary of each product is provided in Appendix A – Explanation of Magnetic Filters. Maps of the magnetic products are shown in Appendix B – Processed Magnetic Maps.

All products described were imported into a GIS environment (QGIS v3.22.10) and used for the qualitative magnetic interpretation.

6. Magnetic Interpretation

6.1. Structural Interpretation

The magnetic structural interpretation is shown in Figure 6.1.

Regionally, the area is dominated by positive linear anomalies associated with dykes from the Matachewan mafic dyke swarm. The majority of the dykes trends NNW and are associated with magnetic anomalies in the 50-200 nT range. The two major dykes that cross the property are each associated with a magnetic anomaly of approximately 55 nT in amplitude. Within the property, the western dyke is twice the length of the eastern dyke, with the western dyke being 5 km long and the eastern dyke being 2.5 km. The ages of the two dykes are approximately 2450 Ma (OGS, 2011). There is another dyke that occurs in the northeastern corner of the property but a short segment of 250 m is situated within a single-cell mining claim. The section of dyke within the claim has an amplitude of 80 nT.

The Shining Tree area is in the middle of a shear zone, meaning that there are many faults in the area. Close to and within the Shining Tree property, there are a series of shear faults oriented WNW, NW, and NE. While there is not a distinctive signature for all faults in the area, the faults around the Shining Tree Property area show a reduced magnetic amplitude the surrounding features and are oriented approximately perpendicular to the dyke swarm and disrupt the trend of the NNW-trending anomalies. Where movement is apparent, it is typically dextral.

On the north end of the property between the two NNW-trending dykes there is a strong circular magnetic anomaly. It’s centred at 478419E 5273758N and has a magnetic anomaly of approximately ~300 nT in the OGS magnetic data. There is no outcropping geology to explain the source of the strong magnetic anomaly. It may indicate a small mafic intrusion, and due to its proximity to known mineralization, could play a role in the associated mineral system.

There are lineaments in the area that occur as magnetic highs with an amplitude of ~50-100 nT. The magnetic highs, while similar amplitude to the highs associated with Matachewan dykes, do not share the same trend as the rest of the dyke swarm. The age is not confirmed as these features have not been mapped and dated by the OGS, but they appear to be older than the dyke swarm as the lineaments are overprinted by the dyke swarm.

There is a magnetically quiet area to the west of the Shining Tree property that is lacking dykes. It is possible that this is an extensional corridor, but the majority of the area is outside the present mining claims. A portion of it cuts the southwest corner of the southernmost claim (Tenure ID 199913) which was to be further investigated with additional field work.

Approximately 2.3 km north of the property there is a major break in magnetic response while the area north of the break exhibits lower magnetic intensity than the area surrounding the Shining Tree property.

This could be a major lithological boundary(e.g. between mafic/intermediate and felsic volcanics), but cannot be confirmed without further investigation; however, this is outside the property where the claims are owned by Platinex Inc.

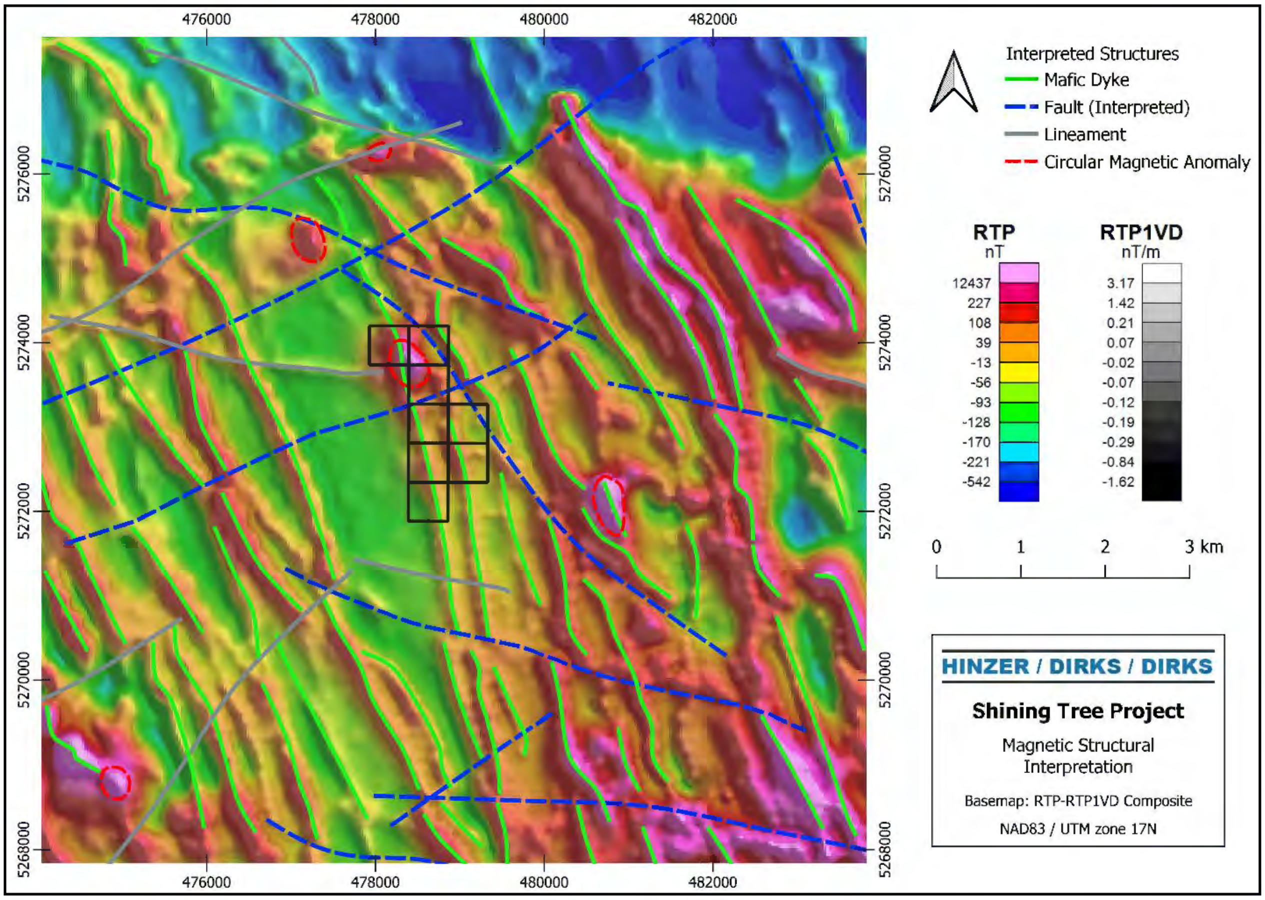

Figure 6.1: Magnetic structural interpretation map

6.2. Correlation with Geochemical Data and Geological Mapping

A map containing Au assay results from samples taken within the Shining Tree property was georeferenced and used to compare with the structural interpretation. The mineralization zones outlined in Figure 6.2 coincide spatially at the intersection between a NNW-trending dyke and a NE-trending interpreted fault.

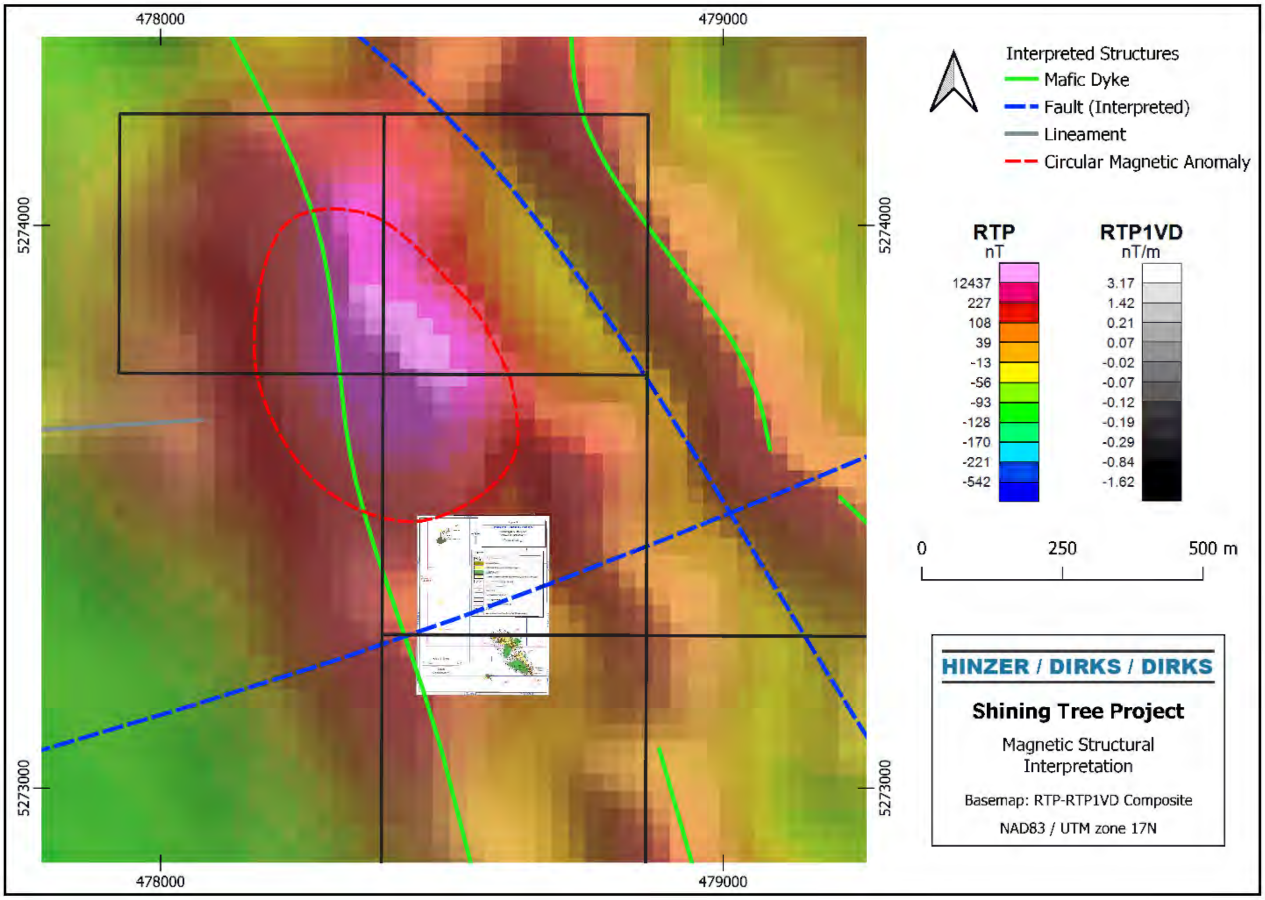

Figure 6.2: Magnetic structural interpretation overlain on geochemical assay results

6.3. Correlation with IP Geophysical Data

The location of IP lines from the 2004 survey (Figure 6.3) was georeferenced to correlate structural trends with IP anomalies. The ENE-trending interpreted fault correlates with a strong resistivity anomaly located from 100-200E in Line 0+0N. That anomaly was targeted for follow-up in 2004. The intersection described in Section 6.2 is located approximately 200 m west of the anomaly in Line 0+00N. The westernmost dyke correlates spatially with a moderate resistivity anomaly on Line 1+75N. High resistivity can indicate silicification, which dykes can provide when intruded into bedrock.

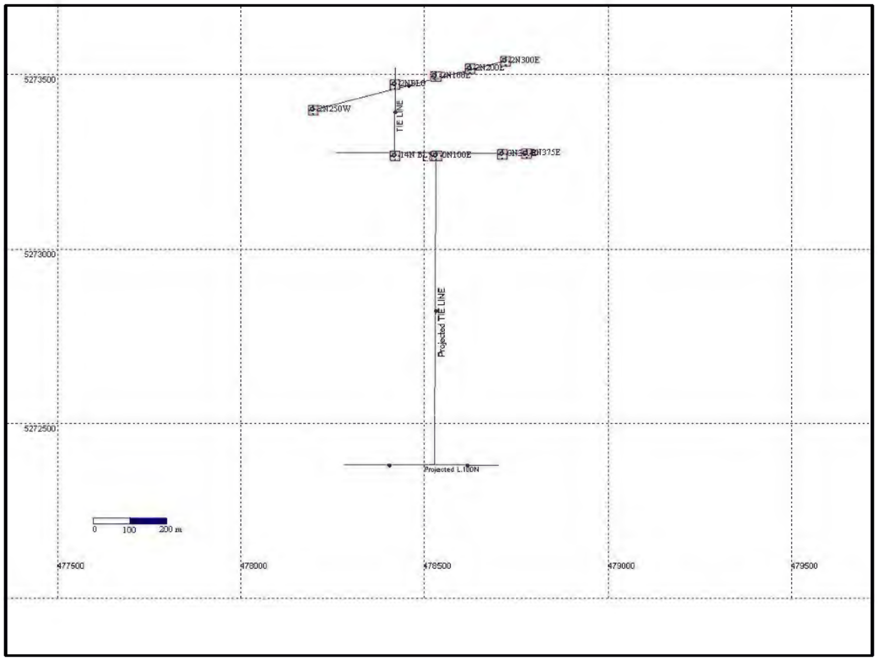

Figure 6.3: Line locations from the IP survey conducted on the Shining Tree Property. From Matrix GeoTechnologies LTD, 2004

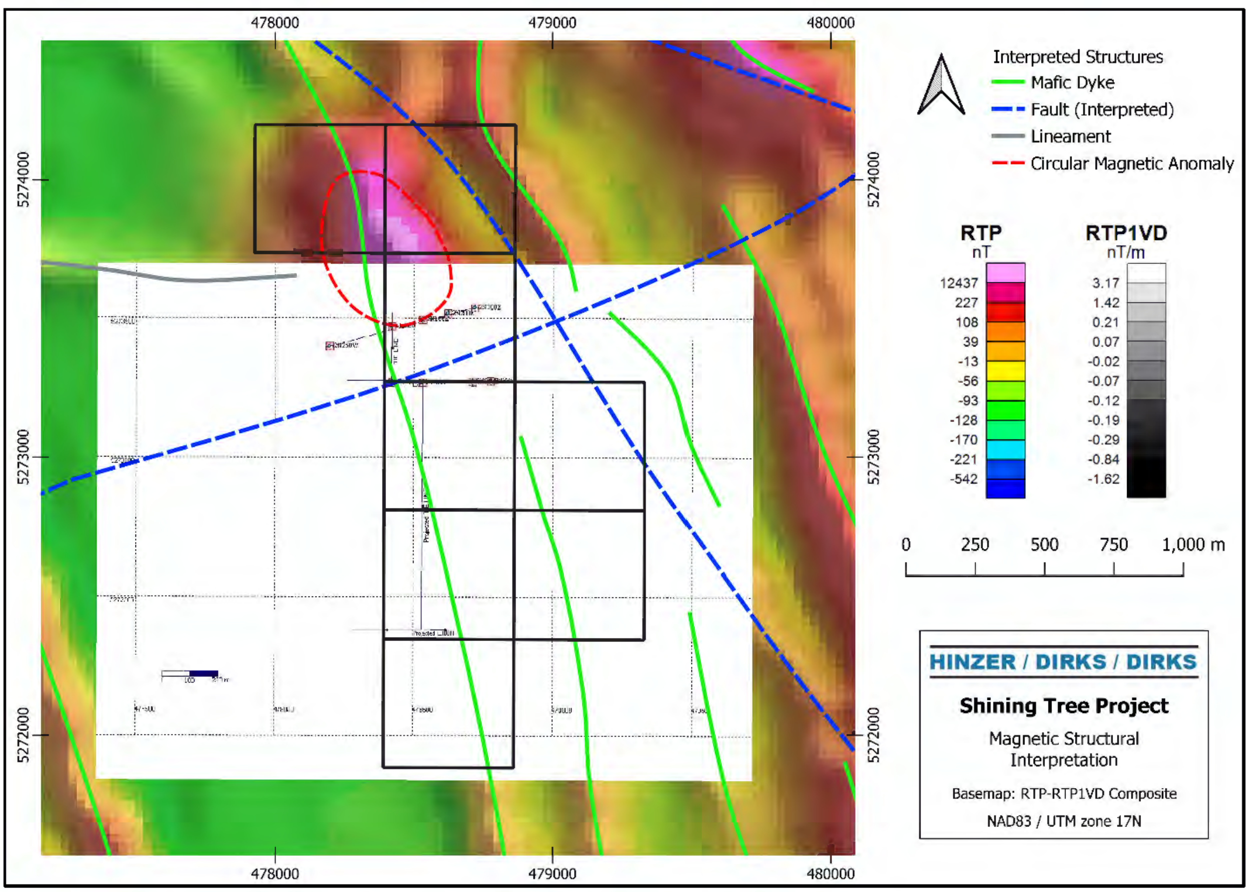

Figure 6.4: Magnetic structural interpretation overlain on IP survey lines

6.4. Lithological description

Due to the size of the property and the lack of high-resolution geophysical data available, lithology could not be subdivided from the airborne geophysical; data. From the OGS and previous surveys, the lithology of the area is primarily mafic volcanic rocks with quartz and quartz-feldspar porphyries occurring as dykes.

7. Summary

The geophysical interpretation showed NNW-trending magnetic highs associated with the Matachewan mafic dyke swarm, with three major dykes cutting through the Shining Tree property. A series of faults were interpreted using breaks in the magnetic highs throughout the area, two of which are present in the Shining Tree property: one trending NNW parallel to the Matachewan mafic dyke swarm, and one trending ENE perpendicular to the dyke swarm. No lithology could be interpreted on the property due to the resolution of regional data. Interpreted magnetic highs correlate with anomalies found in the IP psuedosections.

8. Recommendations

Processing and interpretation of the Shining Tree property magnetic data has defined certain basement magnetic anomalies and structures. The magnetic data compiled was of too low-resolution to determine sub-units within the property and its surroundings. The following recommendations result from the current work:

- The intersection of the NNW-trending dyke and ENE-trending interpreted fault show good correlation with the areas of mineralization outlined in the 2015 geochemical mapping. That intersection provides a good opportunity for follow-up targeting, either in the form of additional geophysical or geochemical surveying.
- The strong circular magnetic high on the northern end of the property bordering Claim Tenures 135763, 187899, and 199911 presents a good area for additional geophysical or geochemical surveying. Extension of the 2004 IP survey to tie-in the sections to the south is recommended as the study has shown success in finding follow-up targets in the past.
- Higher resolution ground or drone-borne magnetic data could be acquired across the shear zone and across the central and northern portions of the property to help better delineate the associated magnetic anomalies where they correlate with areas of high geochemical Au concentration. It is recommended that the line spacing be approximately 25 m with a maximum of 50 m if budget is a concern. The lack of high-resolution data over the area made interpretation and targeting difficult; a high-resolution survey could help with future follow-up work. It is recommended that a feasibility study be conducted to determine which platform – ground or drone – will provide the most value.

Respectfully Submitted,

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9. References

Hinzer, J. (2015). *Geotechnical report on the Hinzer, Dirks, Dirks Shining Tree base and precious metals property, Churchill Township, Ontario*. Private logistics report.

Hinzer, J. (2020). *Geotechnical report on the Hinzer, Dirks, Dirks Shining Tree base and precious metals property, Churchill Township, Ontario*. Private logistics report.

Matrix GeoTechnologies Ltd. (2004). *Assessment Report Regarding the IP | Resistivity Surveys at the Shining Tree Property, Shining Tree, Ontario*. Private logistics report

Ontario Geological Survey. (2003). *Shining Tree Area, Ontario airborne magnetic and electromagnetic surveys, processed data and derived products, Archean and Proterozoic "greenstone" belts*. Geophysical Data set CD-ROM 1003-Revised.

Ontario Geological Survey. (2009). *Airborne magnetic survey, magnetic data, Shining Tree area.* Ontario Geological Survey, Geophysical Data Set 1064.

Ontario Geological Survey. (2011). *1:250 000 scale bedrock geology of Ontario*; Ontario Geological Survey, Miscellaneous Release – Data 126 - Revision 1.

Appendix A – Explanation of Magnetic Filters

Reduction to the Magnetic Pole (RTP)

The direction (inclination and declination) of the geomagnetic field varies over the Earth and influences the shape of the magnetic responses over geological sources. At the North Magnetic Pole, the inducing magnetic field is vertical (i.e. inclination of 90° and declination of 0°), which results in the magnetic response being a symmetric positive magnetic peak over a source, in the absence of dip and magnetic remanence. Transforming the measured magnetic field to a pole reduced magnetic field simplifies the interpretation, particularly to determine the location and geometry of the sources (Baranov, 1957).[1]

The RTP filter, computed from the residual magnetic field after it is transformed to the Fourier domain, is defined as follows in equation 1 as:

$$L(\theta) = \frac{[\sin(I) - i \cdot cos(I) \cdot \cos(\mathrm{D} - \theta)]^2}{[\sin^2(I_a) + \cos^2(I_a) \cdot \cos^2(D - \theta)] \cdot [\sin^2(I) + \cos^2(I) \cdot \cos^2(D - \theta)]}$$

$$if\ (|I_a| < |I|), I_a = I \qquad (equation\ 1)$$

where:

L(θ) = pole-reduced magnetic anomaly for wavenumber θ
I = geomagnetic inclination
I_a = inclination for amplitude correction (never less than I)
D = geomagnetic declination
i = imaginary number in the Fourier domain

Since the study area is fairly small, constant magnetic inclination and declination values of 75.6°N and 0.15°W, respectively, were used.

First Vertical Derivative of the Pole Reduced Field (1VD)

The vertical derivative is commonly applied to the RTP magnetic field grid in the Fourier domain to enhance shallower geologic sources in the data. This is particularly useful for locating contacts (e.g. the anomaly texture is revealed) and mapping structure (Telford et al., 1990).[2] It is expressed in equation 2 as:

$$1VD = dRTP/dZ \qquad (equation\ 2)$$

where Z is the vertical offset.

Computing the vertical derivative enhances high frequency noise in the data which can produce ringing artefacts emanating from large amplitude, sharp magnetic anomalies. These effects were apparent in several places in the data and in order to eliminate it, a 40 m 8^{th} order Butterworth filter was applied. This filter is equal to the length of four grid cells and was applied to all higher frequency magnetic grids.

Second Vertical Derivative of the Pole Reduced Field (2VD)

The second vertical derivative is commonly applied to the RTP magnetic field data in the Fourier domain to further enhance shallower geologic sources in the data. This is particularly useful for locating contacts (i.e. at the location of the zero contour) and mapping structure close to surface (Telford et al., 1990). It is expressed in equation 3 as:

[1] Baranov, V. 1957. A new method for interpretation of aeromagnetic maps: pseudo-gravimetric anomalies. Geophysics, 22, 359-383.
[2] Telford, W. M., Geldart, L. P. and Sheriff, R. E. 1990. Applied Geophysics Second Edition. Cambridge University Press, 792 p.

$$2VD = d^2RTP/dZ^2 \qquad (equation\ 3)$$

where Z is the vertical offset.

Tilt Angle of the Pole Reduced Field
The tilt angle (Miller and Singh, 1994)[3] has been applied to the RTP magnetic field data to enhance the weaker magnetic signals in the dataset; it effectively applies an automatic gain control such that deep and shallow sources are resolved equally well. The tilt angle also transforms the magnetic data such that the tilt angle is positive over a magnetic source, passes through zero over or near the edge, and is negative outside of the body. These properties make the tilt angle particularly useful for mapping texture, structure and edge contacts of weakly magnetic sources. It is expressed in equation 4 as:

$$TILT = \tan^{-1}\left\{\frac{\frac{dRTP}{dZ}}{\sqrt{\left[\frac{dRTP}{dX}\right]^2+\left[\frac{dRTP}{dY}\right]^2}}\right\} \qquad (equation\ 4)$$

where X and Y are the horizontal offsets in the east and north directions.

There first vertical derivative is computed in the Fourier domain whereas the horizontal derivatives in the X and Y directions are computed in the space domain.

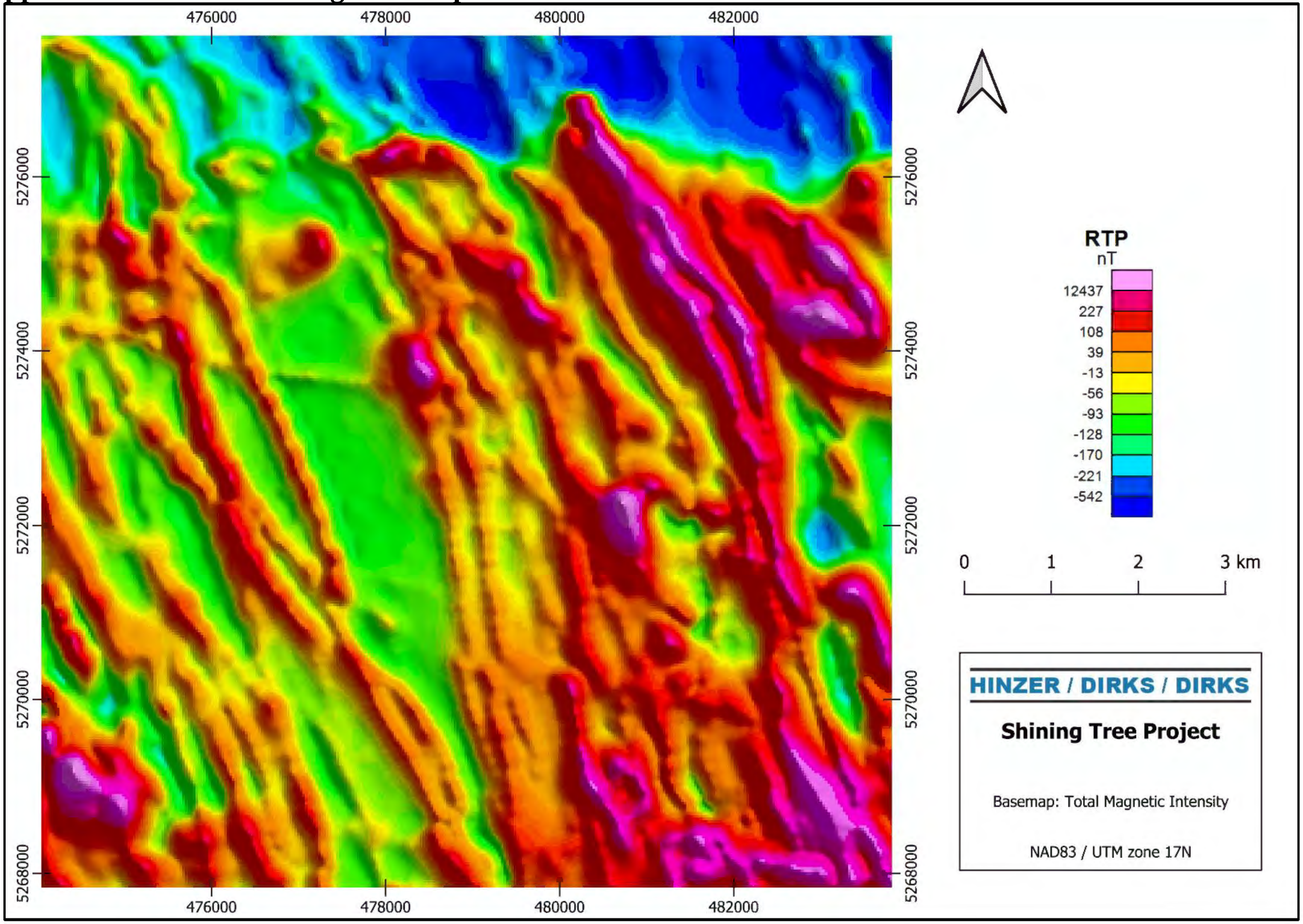
Analytic Signal Amplitude
The amplitude of the analytic signal (AS) is the square root of the sum of the squares of the derivatives in the horizontal (X and Y) and vertical (Z) directions (i.e. the Fourier domain first vertical derivative and the space domain horizontal derivatives in X and Y), computed from the total magnetic field (Nabighian, 1972)[4] in equation 5 as:

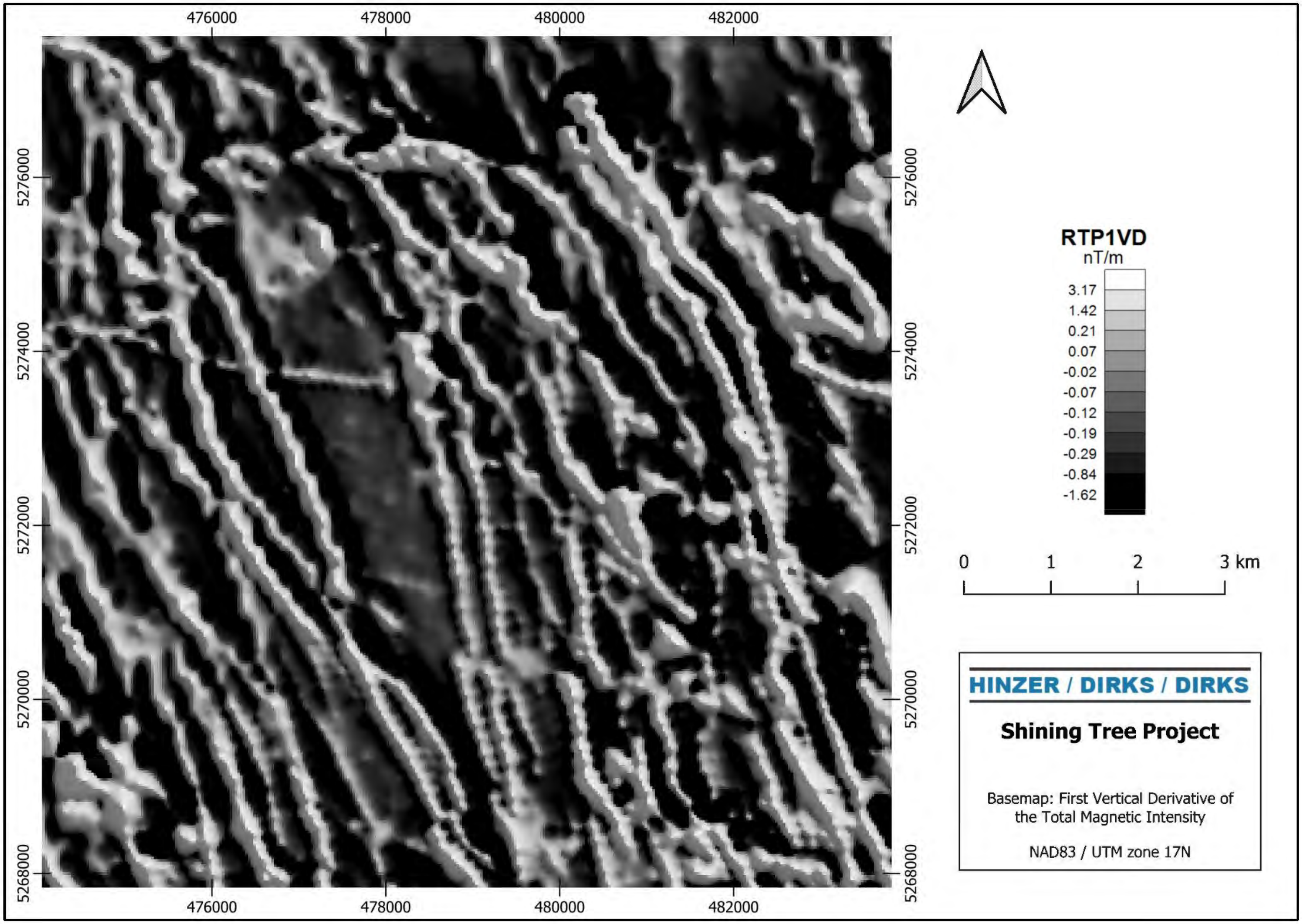
$$AS = \sqrt{\left(\left[\frac{dT}{dX}\right]^2 + \left[\frac{dT}{dY}\right]^2 + \left[\frac{dT}{dZ}\right]^2\right)} \qquad (equation\ 5)$$

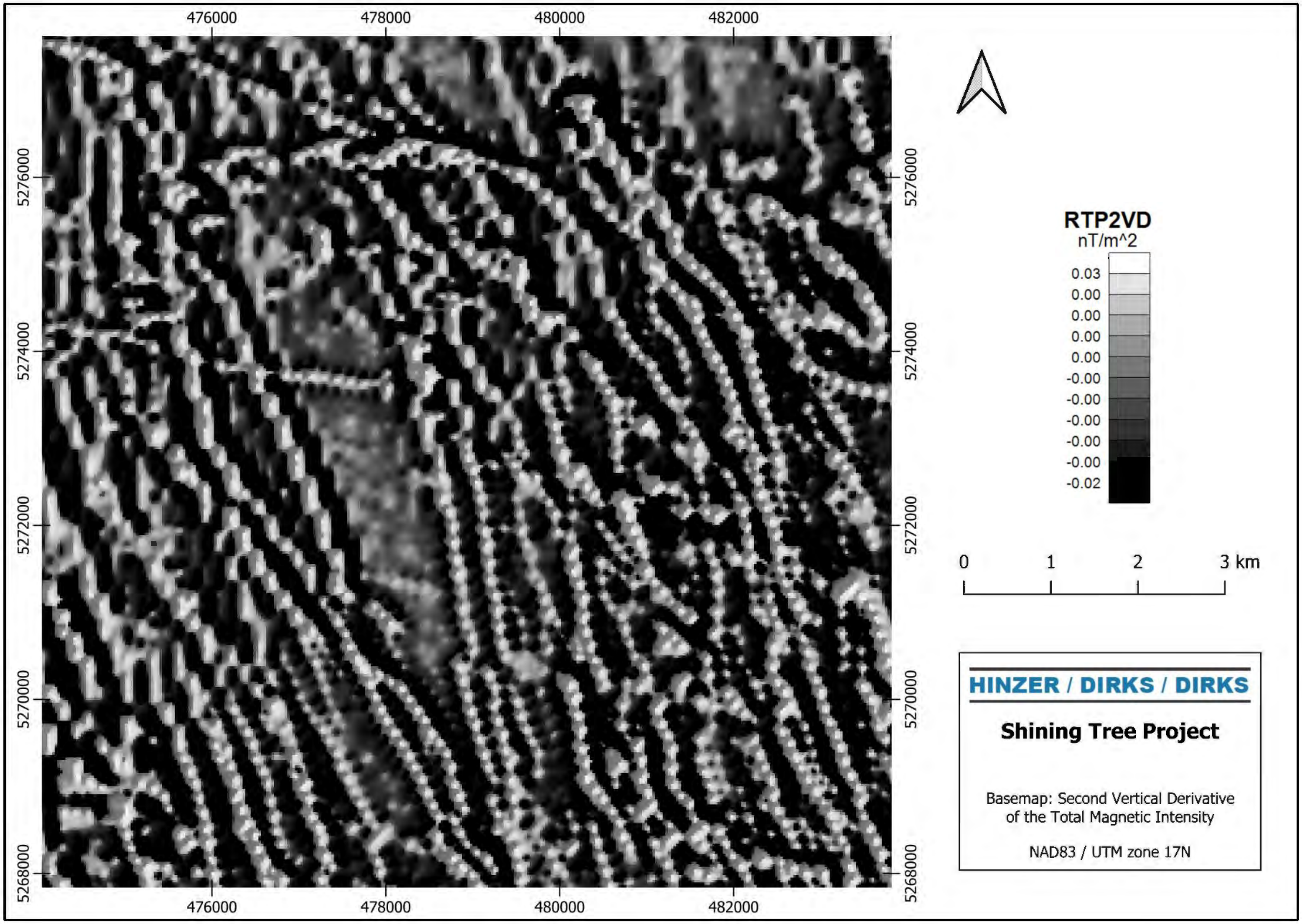
The analytic signal is useful in locating the edges of magnetic source bodies, particularly where magnetic remanence complicates interpretation. It is especially useful to interpret the contacts of intrusions.

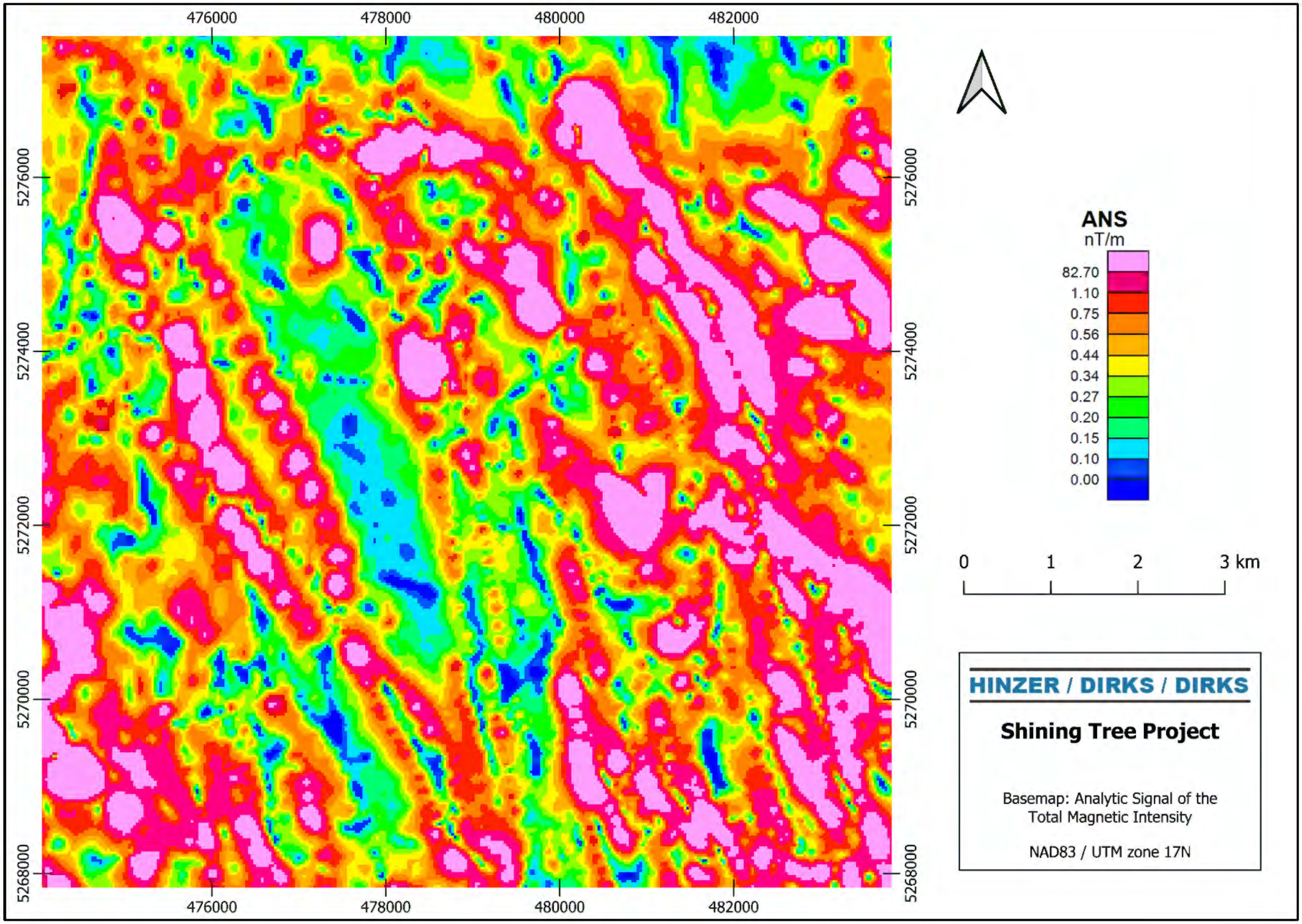
[3] Miller, H.G. and Singh, V. 1994. Potential field tilt - a new concept for location of potential field sources, Journal of Applied Geophysics, 32, 213-217.
[4] Nabighian, M.N. 1972. The analytic signal of two-dimensional magnetic bodies with polygonal cross-section: Its properties and use for automated anomaly interpretation. Geophysics, 37, 507-517.

Appendix B – Processed Magnetic Maps




476000
478000
480000
482000
5276000
5274000
5272000
5270000
5268000
RTP1VD
nT/m
3.17
1.42
0.21
0.07
-0.02
-0.07
-0.12
-0.19
-0.29
-0.84
-1.62
0
1
2
3 km
HINZER / DIRKS / DIRKS
Shining Tree Project
Basemap: First Vertical Derivative of the Total Magnetic Intensity
NAD83 / UTM zone 17N


476000
478000
480000
482000
5276000
5274000
5272000
5270000
5268000
RTP2VD
nT/m^2
0.03
0.00
0.00
0.00
0.00
-0.00
-0.00
-0.00
-0.00
-0.00
-0.02
0
1
2
3 km
HINZER / DIRKS / DIRKS
Shining Tree Project
Basemap: Second Vertical Derivative
of the Total Magnetic Intensity
NAD83 / UTM zone 17N



476000
478000
480000
482000
5276000
5274000
5272000
5270000
5268000
ANS
nT/m
82.70
1.10
0.75
0.56
0.44
0.34
0.27
0.20
0.15
0.10
0.00
0
1
2
3 km
HINZER / DIRKS / DIRKS
Shining Tree Project
Basemap: Analytic Signal of the Total Magnetic Intensity
NAD83 / UTM zone 17N

Appendix C – List of Deliverables

Interpretation raster grids and vectors have been supplied as part of a QGIS project. The project file is ***FirstClassMetals-2022.qgz***. QGIS is an opensource geographic information system (GIS) software however the raster and vector data has been supplied in formats compatible with most modern GIS and geophysical software packages.

Vectors

Name	Format	Description
Shining_Tree_Interpretation	*.shp	Qualitative magnetic interpretation
Shining Tree - Claims	*.shp, *.ply	Shining Tree
OGS 1064 Flight Path	*.shp	OGS Shining Tree survey flight path

Grids

Name	Format	Unit	Description
GDS1064_DEM	*.ers, *.tif	m	Digital Elevation Model
GDS1064_MAG	*.ers, *.tif	nT	GSC-levelled residual magnetic field from the tail sensor
GDS1064_MAG_1VD	*.ers, *.tif	nT/m	First vertical derivative of GSC-levelled residual magnetic field
GDS1064_MAG_2VD	*.ers, *.tif	nT/m^2	Second vertical derivative of GSC-levelled residual magnetic field
GDS1064_GMAG	*.ers, *.tif	nT	GSC-levelled, gradient enhanced residual magnetic field from the tail sensor
GDS1064_GMAG_1VD	*.ers, *.tif	nT/m	First vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
GDS1064_GMAG_2VD	*.ers, *.tif	nT/m^2	Second vertical derivative of GSC-levelled, gradient enhanced residual magnetic field
GDS1064_MAG_LongGrad	*.ers, *.tif	nT/m	Measured longitudinal horizontal gradient
GDS1064_MAG _LatGrad	*.ers, *.tif	nT/m	Measured lateral horizontal gradient
GDS1064_MAG_ANS	*.ers, *.tif	nT/m	Analytic Signal of GSC-levelled, gradient enhanced residual magnetic field