ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TITLE OF REPORT: 2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion
TOTAL COST: $28,340

AUTHOR(S): B. Armstrong,
SIGNATURE(S): B. Armstrong

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): M-232, Mx-1-355 Issued 21st January 2011.
STATEMENT OF WORK EVENT NUMBER(S)/DATE(S): 5458209, 10th July 2013

YEAR OF WORK: 2013

PROPERTY NAME: Tulsequah Chief

CLAIM NAME(S) (on which work was done): 590422 TCMINE; 513813; 513814; 1011222, 513819; 1017199; 513820;

COMMODITIES SOUGHT: Au, Ag, Cu,Pb, Zn

MINERAL INVENTORY MINFILE NUMBER(S),IF KNOWN: 104K 002; 104K 006; 104K 007; 104K 008

MINING DIVISION: Atlin
NTS / BCGS: 104K/12
LATITUDE: 58° 44’ 25"
LONGITUDE: 133° 35’ 24" (at centre of work)
UTM Zone: NAD83 8N EASTING: 581,600 NORTHING: 6,512,000

OWNER(S): Chieftain Metals Inc.
MAILING ADDRESS: 2 Bloor Street West, Suite 2000, Toronto, Ontario, M4W 3E2

OPERATOR(S) [who paid for the work]: Chieftain Metals Inc.
MAILING ADDRESS: 2 Bloor Street West, Suite 2000, Toronto, Ontario, M4W 3E2

REPORT KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude. **Do not use abbreviations or codes**)
Stikine Assemblage, Mt. Eaton Suite, island arc volcanic, limestone, Devono-Mississippian, Permian, Llewellyn Fault, Chief Fault, Chief Cross Fault, Mount Eaton Anticline, quartz sericite pyrite alteration, polymetallic volcanogenic massive sulphide, Kuroko type, Geophysics, Induced Polarization, Magnetics, Tulsequah Chief, Big Bull, Potlatch, Sparling, Banker, Mira Geoscience.

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:
8933; 9825; 11018; 17054; 17137; 19453; 20423; 20901; 23762; 23763; 23951; 24183; 24188; 27385; 27659; 31030; 33468; 33482.

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			
Other			
Airborne			
GEOCHEMICAL (number of samples analysed for …)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres, number of holes, size, storage location)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling / Assaying			
Petrographic			
Mineralographic			
Metallurgic			
Geophysical Processing	73km Magnetics;16.7km Induced Polarization	590422; 513813; 513814; 1011222; 513819; 1017199; 513820;	$28,340
PROSPECTING (scale/area)			
PREPATORY / PHYSICAL			
Line/grid (km)			
Topo/Photogrammetric (scale, area)			
Legal Surveys (scale, area)			
Road, local access (km)/trail			
Trench (number/metres)			
Underground development (metres)			
Other			
		TOTAL COST	$28,340

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

Work performed: April 15th – May 31st 2013

BC Geological Survey
Assessment Report
34358

On mineral claims:	590422 TCMINE
	513813
	513814
	1011222
	513819
	1017199
	513820

Statement of Work Event Number: 5458209; 10th July 2013

B. D. Armstrong P.Geo

Report Submitted October 3rd, 2013

SUMMARY

The Tulsequah Chief Project is a development stage polymetallic volcanogenic massive sulphide (VMS) project situated in Northwestern British Columbia 100 km south of Atlin, B.C. and 64 km northeast of Juneau, Alaska. The Tulsequah property is 100% owned by Chieftain Metals Inc. and covers 30,580.7ha including 30 Mineral Claims and 25 Crown Granted Mineral claims. The property includes the past producing Tulsequah Chief and Big Bull mines, and a number of earlier stage prospects.

The Tulsequah Chief deposit was discovered in 1923 and the nearby Big Bull deposit was discovered in 1929. Cominco Ltd. acquired the properties in 1946 and operated the Tulsequah Chief mine from 1951-1957, mining 575,463 tonnes at a grade of 3.43g/t Au, 108 g/t Ag, 1.8% Cu, 1.3% Pb and 6.7% Zn. The mine closed with a reserve of 707,616 tonnes in 1957 due to low metal prices at the time, and the operation was placed on care and maintenance.

In the 1980's Cominco re-commenced exploration on the property using the new volcanogenic hosted massive sulphide 'Kuroko' genetic model, rather than hydrothermal veins or replacement models. Cominco conducted surface mapping and geophysical surveys and entered into a joint venture with Redfern Resources Ltd, commencing diamond drilling in 1987. Seasonal drilling and surface programs continued until 1992 when Redfern purchased Comino's remaining 60% interest and assumed the site legacy environmental remediation obligations, Cominco retained a dry tonne royalty. Redfern continued to develop the property and completed a positive feasibility study by Rescan in 1995. No technical work was conducted between 1994 and 2002

Redfern re-commenced exploration in 2003, with a significant drill program in 2004 to update the 1995 resource to the current NI43-101 criteria. Subsequent resources were published by AMEC in 2005 and reserves by Wardrop in 2007 with a positive feasibility study using river access from Juneau. Redfern commenced mine development in 2008 with the construction of 19km of exploration road, an air strip and 2 camp facilities. In early 2009 Redfern notified it's creditors it would not be able to forfill it's financial obligation and they placed it into receivership.

Chieftain Metals acquired the property from the receiver in October 2011 and initiated transfer of Redfern's permits and began consultation with the Taku River Tlingit First Nation. Chieftain executed a 31,000m drilling program in 2011 which was successful in increasing the indicated resources and published in the 2012 JDS Energy and Mining Feasibility Study.

The 2012 JDS feasibility study stated a resource 6,762,00 tonnes in the indicated category with a grade of 2.4g/t Au, 85 g/t Ag, 1.19% Cu, 1.1% Pb and 5.89% Zn; and in the inferred category of 204,000 tonnes at 1.81g/t Au, 62 g/t Ag, 0.67% Cu, 0.76% Pb and 4.02% Zn. The mineral reserve is stated as 6,447,098 tonnes at 2.30g/t Au, 81.39 g/t Ag, 1.13% Cu, 1.04% Pb and 5.59% Zn.

This report discusses Mira Geoscience's geophysical re-processing of legacy magnetics and induced polarization data collected by Delta Geoscience for Redfern Resources in 1994. The 3d inversion produced magnetic and chargeability isoshells that can be easily interpreted in 3 dimensions and correlated with geology to generate drill ready exploration targets.

Table of Contents

List of Figures

List of Tables

List of Appendixes

Appendix I	**MIRA GEOSCIENCE: Third Party Data Distribution Permission**
Appendix II	**Interpretation of Unconstrained Inversion Modelling of Magnetic and IP data**
Appendix III	**Magnetic 3D Modelling: Tulsequah Project, BC**
Appendix IV	**3D Induced Polarisation Modelling:**
Appendix V	**Computer Software**
Appendix VI	**Statement of Expenditures**

1. INTRODUCTION

The Tulsequah Chief deposit is an advanced stage polymetallic massive sulphide deposit, located in northern British Columbia, Canada. The deposit is located on the banks of the Tulsequah River 100 kilometres south of the town of Atlin.

This reports documents Chieftain Metals Inc. 2013 geophysical re-processing of legacy magnetics and induced polarization data collected by Delta Geoscience for Redfern Resources in 1994. The 3d inversion and initial interpretation referenced in this report was produced by Mira Geoscience.

Property, history and geology information was well summarized in the recent assessment reports by Armstrong 2012a an 2012b, and the reader is referred to these reports.

Concurrent to this report Chieftain is conducting a 2013 Fall drilling program at Tulsequah, following up on the results of this interpretation, which will be reported in future assessment reports.

2. PROPERTY DESCRIPTION AND LOCATION

The Tulsequah property is situated along the Tulsequah River in northwestern B.C. centered on latitude 58°43' N and longitude 133°35' W (NTS 104K/12 and 104K/13, Figure 2.1.) The property is accessible by air from Atlin BC 100 km to the north, from Whitehorse YT 230 km to the north, or from Juneau Alaska 64 km to the southwest.

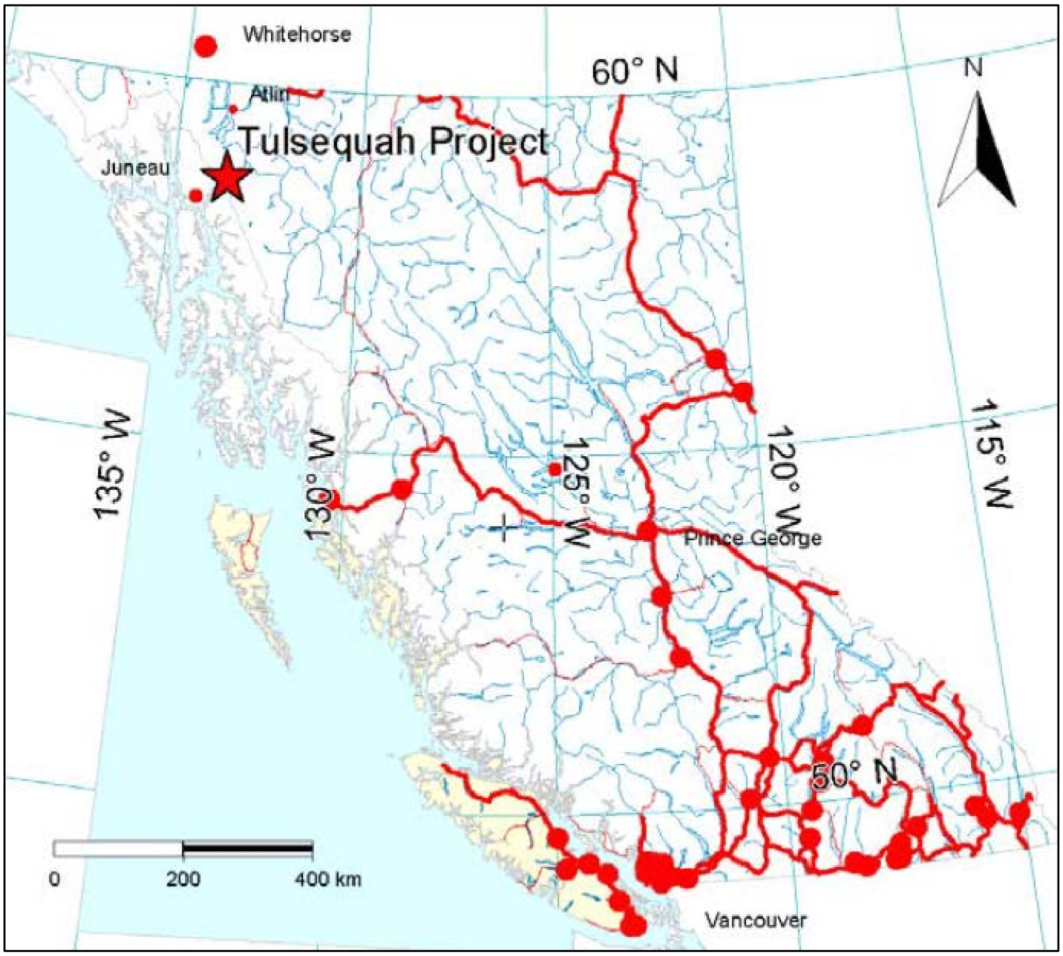

Figure 2.1: Tulsequah Property Location

The Tulsequah Property comprises 30 mineral cell claims totaling 30,580.7ha (Table 2.1 and Figure 2.2) and 25 crown granted mineral claims totaling 438.69 ha (Table 2.2) The property is owned 100% by Chieftain Metals Inc.

With acceptance of this report all mineral claims will be in good standing until the good to dates listed in Table 2.1. The July 1, 2012 revisions to the Mineral Tenure Act Regulations reset the zero anniversary of all current claims, to that date. The expenditure requirement to maintain claims in good standing is: $5 per hectare of exploration work per year to extend the good to dates for years 1-2; $10 per hectare for the years 3-4; $15 per hectare for years 5-6; and $20 per hectare for all subsequent years; upto a maximum of 10 years. Crown granted claims are maintained through the payment of annual taxes on July 2nd each year. The crown granted claims at Tulsequah have been legally surveyed. At the time of writing Mineral Claim

513828 was expropriated under the Park Act on July 6th 2012 with the establishment of the Taku River/T'ak̲ú Téix̲' Conservancy, compensation pending.

Table 2.1: Mineral Tenure Cell Claims

Tenure Number	Claim Name	Owner	Tenure Type	Tenure Sub Type	Area (ha)	Good To Date
513806		248384 (100%)	Mineral	Claim	1241.297	2022/Dec/31
513807		248384 (100%)	Mineral	Claim	1242.293	2022/Dec/31
513809		248384 (100%)	Mineral	Claim	1393.208	2022/Dec/31
513812		248384 (100%)	Mineral	Claim	621.526	2022/Dec/31
513813		248384 (100%)	Mineral	Claim	806.766	2022/Dec/31
513814		248384 (100%)	Mineral	Claim	1160.494	2022/Dec/31
513815		248384 (100%)	Mineral	Claim	1310.797	2022/Dec/31
513818		248384 (100%)	Mineral	Claim	1615.841	2022/Dec/31
513819		248384 (100%)	Mineral	Claim	841.076	2022/Dec/31
513820		248384 (100%)	Mineral	Claim	1094.34	2022/Dec/31
513821		248384 (100%)	Mineral	Claim	842.324	2022/Dec/31
513828		248384 (100%)	Mineral	Claim	0	2022/Dec/31
590422	TCMINE	248384 (100%)	Mineral	Claim	419.996	2022/Dec/31
1011222	Banker	248384 (100%)	Mineral	Claim	151.48	2015/Oct/31
1017199	Big Bull	248384 (100%)	Mineral	Claim	16.83	2015/Oct/31
1017642	STAPLER1	248384 (100%)	Mineral	Claim	1507.934	2014/Aug/15
1017643	STAPLER2	248384 (100%)	Mineral	Claim	1593.551	2014/Aug/15
1017644	STAPLER3	248384 (100%)	Mineral	Claim	1658.844	2014/Aug/15
1017645	STAPLER4	248384 (100%)	Mineral	Claim	1506.430	2014/Aug/15
1017646		248384 (100%)	Mineral	Claim	837.5422	2014/Aug/15
1017647	STAPLER6	248384 (100%)	Mineral	Claim	1673.042	2014/Aug/15
1017696	STAPLER7	248384 (100%)	Mineral	Claim	1670.960	2014/Aug/15
1017697	STAPLER8	248384 (100%)	Mineral	Claim	1618.919	2014/Aug/15
1017699		248384 (100%)	Mineral	Claim	167.990	2014/Aug/15
1017700		248384 (100%)	Mineral	Claim	420.403	2014/Aug/15
1017701		248384 (100%)	Mineral	Claim	84.156	2014/Aug/15
1017702		248384 (100%)	Mineral	Claim	202.106	2014/Aug/15
1017907	STRONG1	248384 (100%)	Mineral	Claim	1532.82	2014/Aug/15
1017909	STRONG2	248384 (100%)	Mineral	Claim	1632.61	2014/Aug/15
1017910	STRONG3	248384 (100%)	Mineral	Claim	1681.59	2014/Aug/15
1022381	ICE FALL 2	248384 (100%)	Mineral	Claim	33.49	2014/Sep/16
Total				**30**	**30580.7**	

Table 2.2: Crown Granted Mineral Claims

Claim Name	Record	Units	Area (Ha)	Expiry Date
Tulsequah Chief Crown Grants				
Tulsequah Bonanza	5668	1	20.9	July 3, 2014
River Fr.	5669	1	7.99	July 3, 2014
Tulsequah Chief	5670	1	20.9	July 3, 2014
Tulsequah Bald Eagle	5676	1	14.16	July 3, 2014
Tulsequah Elva Fr.	5679	1	9.7	July 3, 2014
Big Bull Crown Grants				
Big Bull	6303	1	20.65	July 3, 2014
Bull No. 1	6304	1	16.95	July 3, 2014
Bull No. 6	6305	1	17.22	July 3, 2014
Bull No. 5	6306	1	14.57	July 3, 2014
Jean	6307	1	17.02	July 3, 2014
Hugh	6308	1	20.71	July 3, 2014
Banker Crown Grants				
Vega No. 1	6155	1	20.9	July 3, 2014
Vega No. 2	6156	1	17.62	July 3, 2014
Vega No. 3	6157	1	18.97	July 3, 2014
Vega No. 4	6158	1	19.85	July 3, 2014
Vega No. 5	6159	1	14.94	July 3, 2014
Janet W. No. 1	6160	1	18.95	July 3, 2014
Janet W. No. 2	6161	1	18.75	July 3, 2014
Janet W. No. 3	6162	1	16.6	July 3, 2014
Janet W. No. 4	6163	1	20.76	July 3, 2014
Janet W. No. 5	6164	1	18.2	July 3, 2014
Janet W. No. 6	6165	1	19.02	July 3, 2014
Janet W. No. 7	6166	1	18.78	July 3, 2014
Janet W. No. 8	6167	1	17.98	July 3, 2014
Joker	6169	1	16.6	July 3, 2014
Total		**25**	**438.69**	

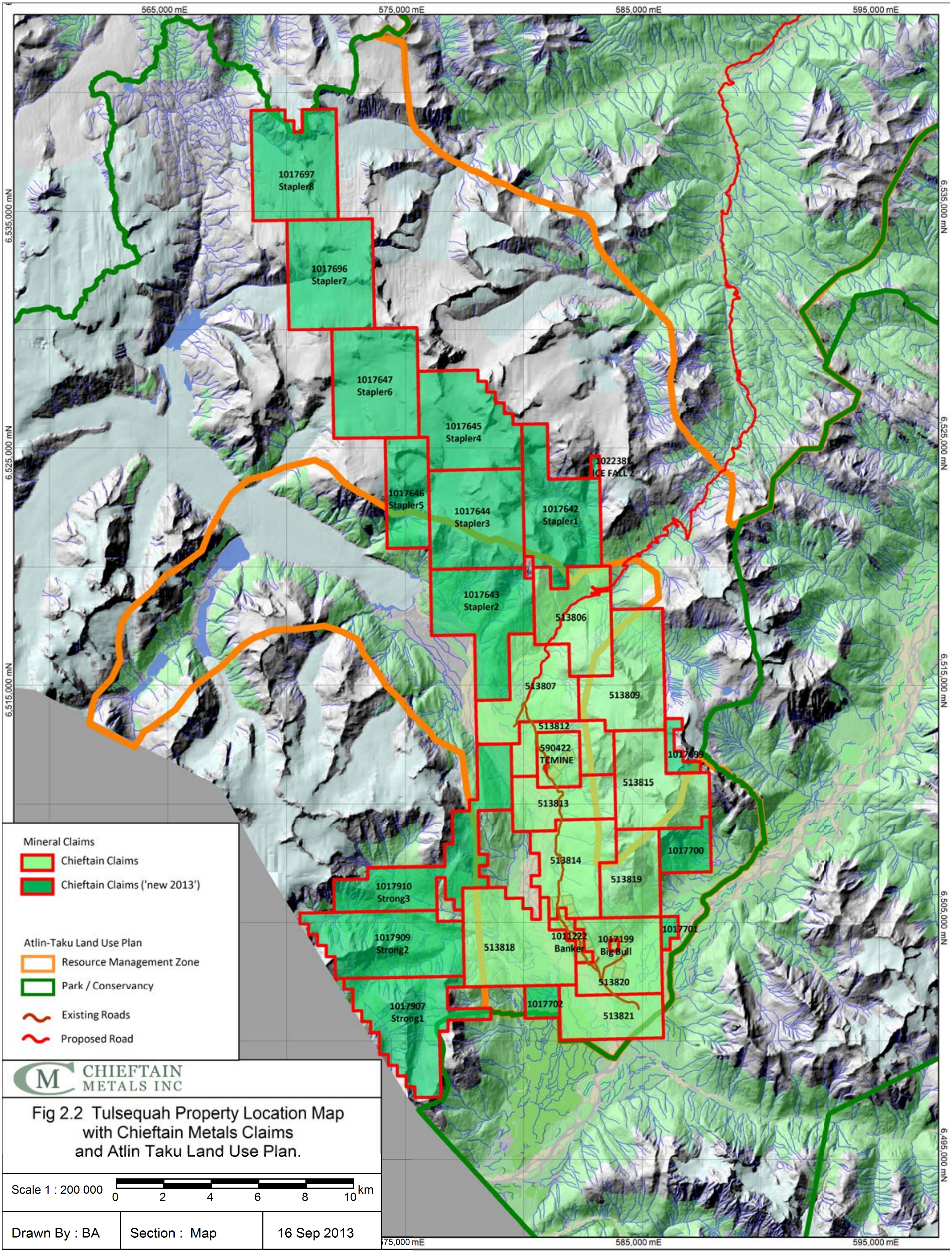

Fig 2.2 Tulsequah Property Location Map with Chieftain Metals Claims and Atlin Taku Land Use Plan.

Drawn By : BA
Section : Map
16 Sep 2013

3. ACCESSIBILITY, LOCAL RESOURCES, INFRASTRUCTURE, CLIMATE AND PHYSIOGRAPHY

The Tulsequah Chief property is accessible only by air or water. The most direct access is by charter fixed wing or helicopter from Atlin or Whitehorse to the Shazah Camp Airstrip. The Shazah gravel airstrip is 1,030m long, situated on the eastern side of the Tulsequah River just north of the confluence with Shazah Creek. The airstrip was constructed in 2008 and is utilized mostly by chartered Cessna 207 and Shorts Sky Van aircraft from Atlin, but has accommodated aircraft as large as De Havilland Buffalo.

Conventional water access using the Taku River is possible with shallow draft vessels from Juneau to Chieftain's temporary barge landing site on the Taku River, 1.6km NE of the confluence with the Tulsequah River. This transportation method is seasonally limited to higher water flows during the spring freshet in early Summer and extended rainfall periods in the Fall.

Site roads include the 19 km gravel exploration access road from the temporary Barge Landing to the Shazah Camp via the Tulsequah Chief Mine completed in November 2008 by Redfern, routine maintenance was conducted during 2011. A spur road 2km north of the Barge Landing continues 3km to the Big Bull mine site, the last 400m is unfinished and passable only with all-terrain vehicles.

The 30,580.7ha property is roughly an area of 40km north-north west and 7km east-west extending from the confluence of the Tulsequah and Taku Rivers in the south, to the Atlin Provinicial Park in the north. Topographic elevations on the property range from 50m at river level to over 1800m at the top of Mount Eaton. The Tulsequah and Taku River valleys are glacial in origin with broad flat floodplains, several kilometers wide, and moderate to steep valley walls. The north of the property is heavily glaciated with the Tulsequah River originatig at the toe of the Tulsequah Glacier, immediately west of the Property. Coarse glaciofluvial sands, gravels and cobbles fill the Tulsequah valley with little vegetative cover. The Tulsequah River is noted for annual jökulhlaup glacial outburst flood events.

The climate at Tulsequah is typical of inland areas of the north coast of BC. It is characterized by high precipitation and generally moderate winter temperatures due to the influence of the Pacific ocean. The closest towns for which climate data are available are Juneau, Alaska and Atlin, BC. At the river level, snow cover typically lasts from mid-November to early May. Vegetation ranges from wet coastal rain forest with thick canopy at the lower elevations to dense sub-alpine scrub at the higher elevations. Two major ice fields; Mount Eaton and Manville, cover approximately 15% of the present property area.

4. HISTORY

The 1994 geophysical data used in this report was collected by Delta Geoscience with 73km of magnetics data in 5 grids: Tulsequah Chief Grid, Southeast Grid, Banker Grid, Big Bull Grid, and Big Bull extension Grid; 65 line km of Induced Polarization data from the Tulsequah Chief Grid, Southeast Grid, Banker Grid, Big Bull Grid; Hendrickson 1994.

The exploration history of the project was recently summarized by Armstrong 2012a and 2012b, and the current mineral resource and reserve in Doerksen et al 2012, the reader is referred to these reports.

5. GEOLOGICAL SETTING AND MINERALIZATION

Geological Setting of the Tulsequah Chief area is well understood with the regional geology mapped by Milalynuk et al 1994, and deposit geology well summarized by Armstrong 2012a and 2012b and the reader is referred to these report.

6. 2013 GEOPHYSICAL DATA REPROCESSING

Chieftain Metals retained Mira Geoscience to construct and interpret 3d magnetic and chargeability isoshell models from legacy geophysical data, collected in 1994 by Delta Geoscience for Redfern Resources. The Mira Geoscience reports are included in Appendixes II, III, and IV.

Two magnetic susceptibility physical property 3D models were produced, with the Tulsequah and Southeast grids modeled in one block, and the Banker, Big Bull and Big Bull extension in the other block. Mira Geoscience used the UBC-GIF MAG3D software with compactness algorithm to model and create 3d inversions of the magnetic susceptibility physical properties.

One chargeability 3D model was produced for the 25 lines of the Gradient Array Induced Polarization data from the Tulsequah Chief grid only. Mira Geoscience again used the UBC-GIF MAG3D software with compactness algorithm to model and create 3d inversions of the chargeability physical properties.

7. INTERPRETATION AND CONCLUSIONS

The main objective of the 2013 Mira Geoscience 3D magnetic susceptibility and induced polarization 3D inversions was to fully utilize the legacy 1994 ground geophysical line data with new interpretation and modeling techniques, extending the interpretation below the surface and providing a direction and 3D shape to the anomalies. The 3D physical properties models produced for magnetic susceptibility and chargeability can be easily viewed in the gems software and interpreted with the existing drillhole database with known mineralization.

In general the magnetics susceptibility physical models identifies the felsic volcanics as having low magnetic susceptibility and the basaltic volcanic rocks have high magnetic susceptibility. Making this useful to assist in defining the geological contact between the mafic foot wall and felsic hanging wall. The gabbro syn-volcanic intrusion has low magnetic susceptibility in the Tulsequah Chief area, but in southern block Banker/Big Bull area the gabbro has high magnetic susceptibility.

At the Tulsequah Chief area the chargeability IP inversion correctly identified the known massive sulphide deposit as having lower chargeability, with the higher chargeability adjacent representing the disseminated pyrite alteration halo. The interpretation also identified several IP anomalies at the eastern edge of the interpretation extending at depth, and also re-enforced the significance of the large IP anomaly to the west of the current deposits and adjacent to the existing underground workings, this anomaly has not been successfully drill tested or explained.

8. RECOMMENDATIONS

Additional geophysical 3d inversion modeling of the legacy IP data for the Big Bull, Southeast and Banker grids is recommended. Geophysical measurements of the rock physical properties (eg. magnetic susceptibility, resistivity) is also recommended to characterize the geologic units, to be used to constrain future 3D geophysical modeling.

Exploration drilling is recommended at the Tulsequah project to test the larger IP anomalies identified in the altered felsic zones, in the nearby Tulsequah deposit area. A drill program consisting of 6,500 meters of surface and underground drilling should with be sufficient to initiate these objectives, with a modest budget of $1.5m-$2.0m.

9. REFERENCES

Armstrong, B 2012a, *2011 Exploration Program: Diamond Drilling on the Tulsequah Chief Mine*, Chieftain Metals Inc. Assessment Report [ARIS database: 33468].

Armstrong, B 2012b, *2011 Exploration Program: Diamond Drilling on the Big Bull Mine*, Chieftain Metals Inc. Assessment Report [ARIS database: 33482].

Doerksen, G *et al* 2012, *NI 43-101 Technical Report for theTulsequah Chief Project of Northern British Columbia, Canada*, JDS Energy and Mining Inc. [SEDAR database: Chieftain Metals Inc. Jan 25 2013].

Hendrickson, G 1994, *Report on the Geophysical Surveys at the Tulsequah Project, Northwest B.C. NTS 104K for Redfern Resources*, Delta Geoscience Ltd. Unpublished Report, Redfern Resources.

Mihalynuk, MG, Smith, MT, Hancock, KD & Dudka, S 1994, *Regional and Economic Geology of Tulsequah River and Glacier Areas (104K/12 & 13)*, in Grant, B & Newell, JM (Eds), *Geological Fieldwork 1993*, B.C. Ministry of Energy, Mines and Petroleum Resources, Paper 1994-1.

10. STATEMENT OF QUALIFICATIONS

I, Brett Armstrong of North Vancouver, British Columbia, do hereby certify that as the Author of this Assessment Report "2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion", dated October 3rd, 2013, I hereby make the following statements:

1. I am employed as Exploration Manager for Chieftain Metals Inc. with a business address at Unit 118, 1515 Broadway Street, Port Coquitlam, BC, V3C 6M2.
2. I am a qualified person as defined by National Instrument 43-101
3. I am a graduate of the University of Tasmania, Australia 1995 with a Bachelor of Science degree, double major in Geology.
4. I am a member in good standing of the Association of Professional Engineers and Geoscientists of British Columbia, Licence No. 37985.
5. I have practiced my profession in mineral exploration since 2004, including work on volcanogenic massive sulphide deposits in British Columbia and Portugal.
6. I am responsible for all sections of this Assessment report.
7. I have had prior involvement in the Property from 2004-2009 as an Exploration Geologist for Redfern Resources, the previous owner.
8. As of the date of this certificate, to my knowledge, information and belief, this Assessment Report contains all scientific and technical information that is required to be disclosed to make the Assessment report not misleading.
9. I am not independent of Chieftain Metals Inc.

Original Document, signed and sealed by

"Brett D. Armstrong, P.Geo."
3rd, October 2013
Exploration Manager
Chieftain Metals Inc.

CM CHIEFTAIN METALS INC.

October 3rd 2013

Avaleigh Hicks
Titles Technician
Mineral Titles Branch
Ministry of Energy and Mines and Natural Gas
3rd Floor
865 Hornby Street
Vancouver, BC V6Z 2G3

RE: Statement of Work Event Number 5458209, 10th July 2013

Uploaded are the following files for the Technical Report : *2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion ,* Tulsequah River Area, Northwestern BC, NTS 104K/12, Atlin Mining Division. Work performed: April 15th – May 31st 2013 on mineral claims: 540422 TCMINE 590422; 513813; 513814; 1011222513819; 1017199; 513820.

This is to complete the obligation to submit a technical report of the work conducted to extend the good to dates on the claims with the Statement of Work Event Number 5458209.

File Name	PDF Paper Size	Pages	File Size KB
00_TC2013a_Submittal_Letter.pdf	Letter Portrait	1	123
01_TC2013a_ MTO_Confirmation_5458209_20130710.pdf	Letter Portrait	2	169
02_TC2013a_ ARTitlePageSum.pdf	Letter Portrait	2	56
03_TC2013a_Assessment_Report.pdf	Letter Portrait	16	897
04_TC2013a_Assessment_Report_Appendix_I_II.pdf	Letter Portrait / Landscape	49	6,883
05_TC2013a_Assessment_Report_Appendix_III.pdf	Letter Portrait / Landscape	33	2,394
06_TC2013a_Assessment_Report_Appendix_IV.pdf	Letter Portrait / Landscape	26	2,771
07_TC2013a_Assessment_Report_Appendix_V_VI.pdf	Letter Portrait / Landscape	4	91

Please contact me if you have any questions,

Kind Regards,

Brett Armstrong P.Geo
Exploration Manager
Chieftain Metals Inc.

ba@chieftainmetals.com
ph. (403) 648 – 3721

Unit 118, 1515 Broadway Street, Port Coquitlam, BC V3C 6M2 ● Tel: (604) 945-5557 ● Fax: (604) 945-5537

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX I
MIRA GEOSCIENCE:

Third Party Data Distribution Permission

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

Mira Geoscience
...modelling the earth

Advanced Geophysical Interpretation Centre

409 Granville, Suite 512B, Vancouver, BC, Canada, V6C 1T2, ph: +1 778 329 0430

April 11, 2013

Brett Armstrong
Exploration Manager
Chieftain Metals, Inc.
Unit 118, 1515 Broadway Street
Port Coquitlam, BC V3C 6M2

Dear Brett,

Mira Geoscience Ltd. hereby grants permission to Chieftain Metals, Inc. to share the results of our study of the Tulsequah project (described in a proposal dated April 11, 2013) with the provincial government of British Columbia as part of a mineral exploration assessment report. Mira Geoscience understands that this would place our work in the public domain.

Yours truly,

Jeff Witter

Jeff Witter

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX II
MIRA GEOSCIENCE REPORT:

Interpretation of Unconstrained Inversion Modelling of Magnetic and IP data
Chieftain Metals Inc.
Tulsequah Project, British Columbia

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

Mira Geoscience
...modelling the earth

Interpretation of Unconstrained Inversion Modelling of Magnetic and IP data

Chieftain Metals Inc.

Tulsequah Project, British Columbia

Advanced Geophysical Interpretation Centre

Project : 4004

Jeff Witter

10 May 2013

Outline

- Introduction
- Geophysical Modelling Overview
- Interpretation of the IP and magnetic modelling results for the Tulsequah Chief grid with comparison to geology
- Interpretation of the magnetic modelling results for the Southeast, Banker, Big Bull Extension, and Big Bull grids with comparison to geology
- Comparison of model results with 2D resistivity contour maps (generated by Delta Geoscience) for the Tulsequah Chief, Southeast, Banker, and Big Bull grids

Mira Geoscience
...modelling the earth

Introduction

Mira Geoscience understands the following about the geology of the study area and targeted mineralization:

- The target resource is polymetallic massive sulphide deposits which have been exploited in the past at both the Tulsequah Chief and Big Bull mines

- The regional geology is characterized by Paleozoic island arc volcanic assemblages of low metamorphic grade and are part of the Stikine Terrane of northwest British Columbia

- Mapped faults are present in the area predominantly oriented N-S, NNW-SSE, and NW-SE with some cross faults oriented NE-SW and E-W

- N-S to NW-SE oriented fold axes have been mapped with some folds identified as overturned

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Introduction

- At the Tulsequah Chief VMS deposit, the volcanic stratigraphy includes rhyolite units sandwiched between mafic volcanic units with associated deposits of stacked sulphide lenses.

- A thick diorite/gabbro sill intrudes the rhyolite above the sulphide deposits. Basaltic dykes that feed the sill cut through this sequence.

- The known Tulsequah Chief VMS deposit dips >60 degrees and has thicknesses from 3 to over 25 m.

- In an April 2, 2013 Press Release, Chieftain Metals states that there are "appreciable untested extensions to the known Tulsequah Chief and Big Bull VMS zones" and that the area is "acutely underexplored".

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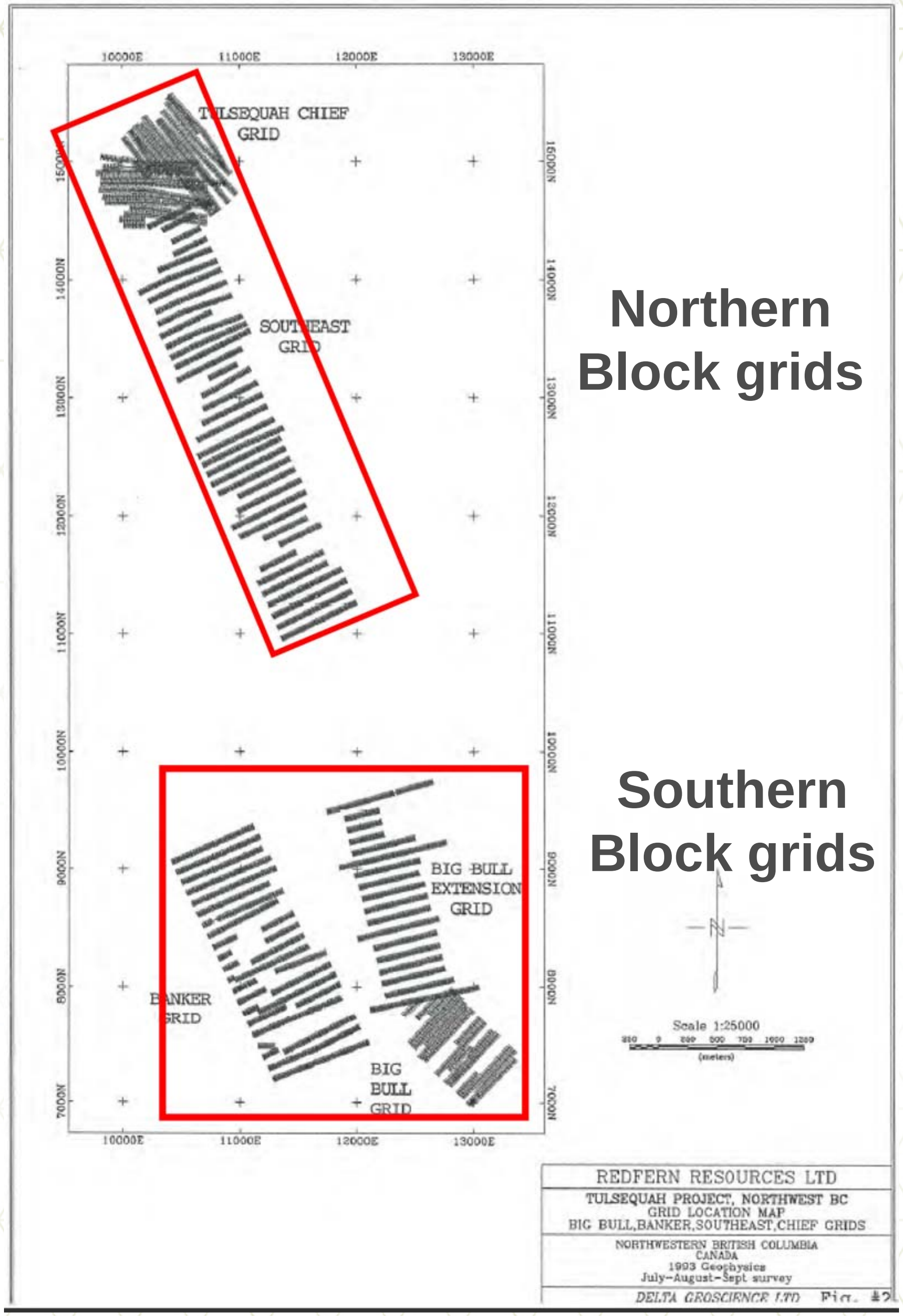
Modelling Overview

- Mira Geoscience performed an unconstrained 3D inversion of IP data collected at the Tulsequah Chief grid using the Compactness algorithm.

- This effort yielded a 3D model of chargeability for the Tulsequah Chief grid.

- Mira Geoscience performed unconstrained 3D inversions of magnetic data collected at all five grids shown at right, also using the Compactness algorithm.

- This effort yielded 3D models of magnetic susceptibility for all five grids.



Northern Block grids

Southern Block grids

Figure 1: Layout of the five geophysical survey grids at the Tulsequah project

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Tulsequah Chief grid – IP modelling

- Results of the Compactness Inversion model are interpreted here. Total range of chargeability values in the recovered 3D model is 0 – 78 mV/V.

- However, ~95% of the data covers the range 0 – 60 mV/V. The 3D model extends to -500 masl but is reliable to only ~500 m below topography.

- A broad, chargeability anomaly of ~40 mV/V lies on the east side of the study area at -100 masl (Fig-2).

- The chargeability model is likely unreliable at levels deeper than about -100 masl on the east side due to the great depth below topography.

- At shallower levels (e.g. +100 masl) on the eastern half of the Tulsequah Chief grid, the observed chargeability anomalies break into smaller 30-40 mV/V features, one of which runs parallel to a mapped surface fault (Fig-3).

Tulsequah Chief grid – IP modelling

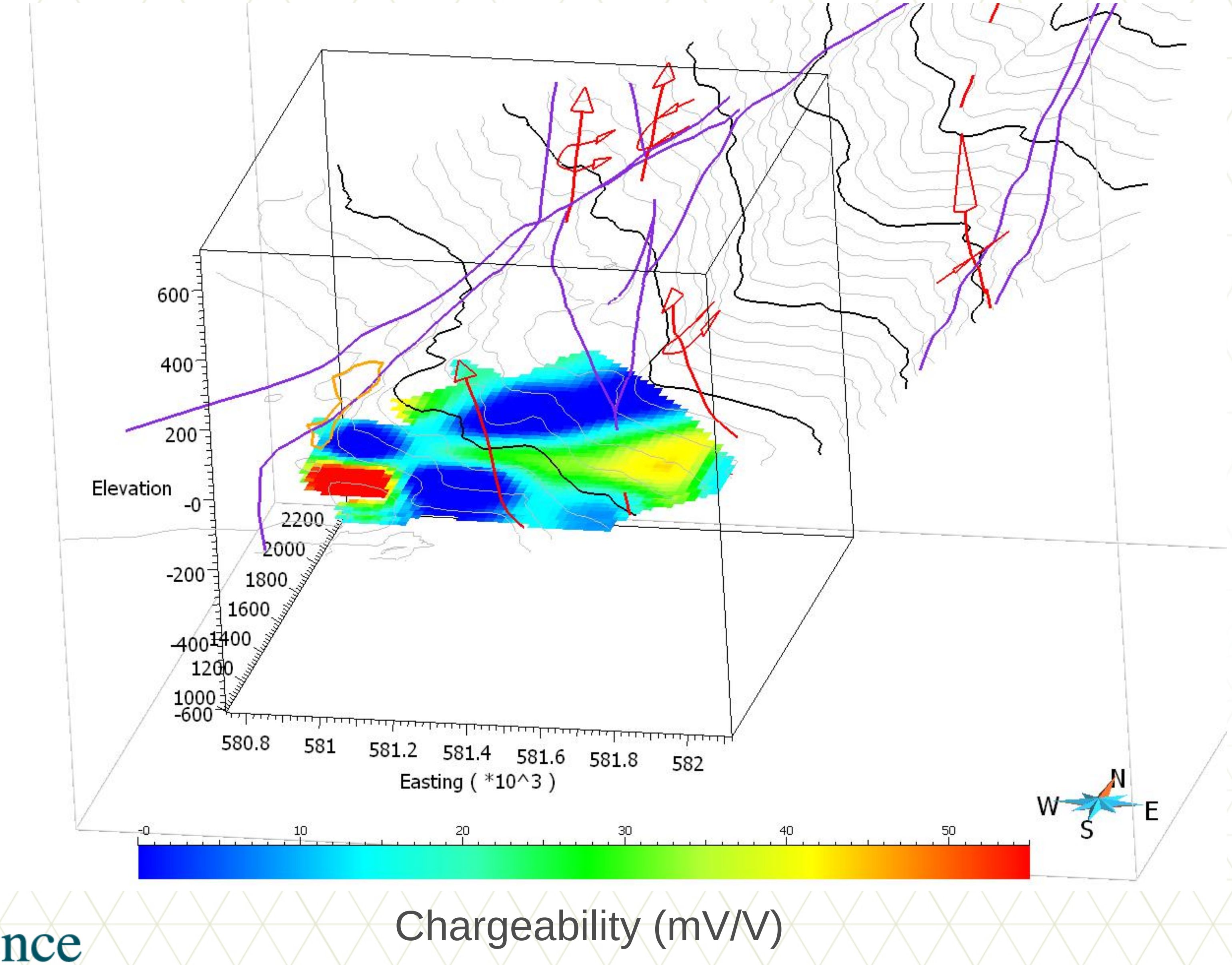
- The strongest observed shallow chargeability anomaly (>50 mV/V) is a vertically-oriented, body extending from the bottom of the model (-500 masl) to +50 masl at the SW corner of the IP survey area (Fig-4).

- This chargeability anomaly also underlies the SW edge of the Tulsequah Chief mine site and is immediately east of a NW-trending, mapped fault.

- The location of the Tulsequah Chief sulphide deposit is identified in a map in the “Technical Report for the Tulsequah Chief Project of Northern British Columbia, Canada” dated January 22, 2013 (obtained from SEDAR). Comparing this map with the model results, it appears that the location of the Tulsequah Chief sulphide deposit lies beneath a zone of low chargeability, immediately adjacent to bodies of high chargeability (Fig-5).

Tulsequah Chief grid – IP modelling

Figure 2: 3D perspective view from the SSE of a slice through the chargeability model at a depth of -100 masl. Warm colours represent high chargeability and cool colours show low chargeability. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



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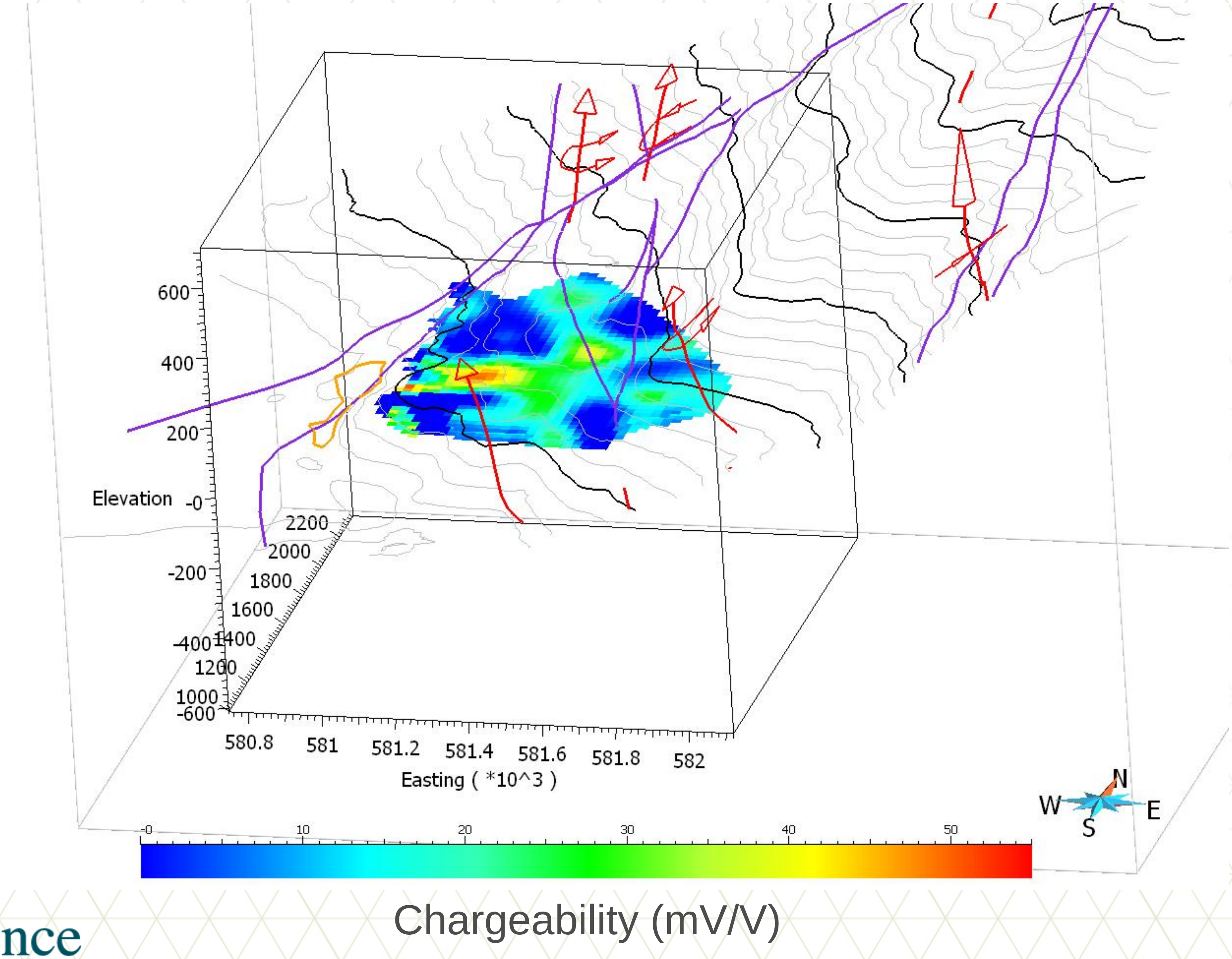
Tulsequah Chief grid – IP modelling

Figure 3: 3D perspective view from the SSE of a slice through the chargeability model at a depth of +100 masl. Warm colours represent high chargeability and cool colours show low chargeability. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



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Tulsequah Chief grid – IP modelling

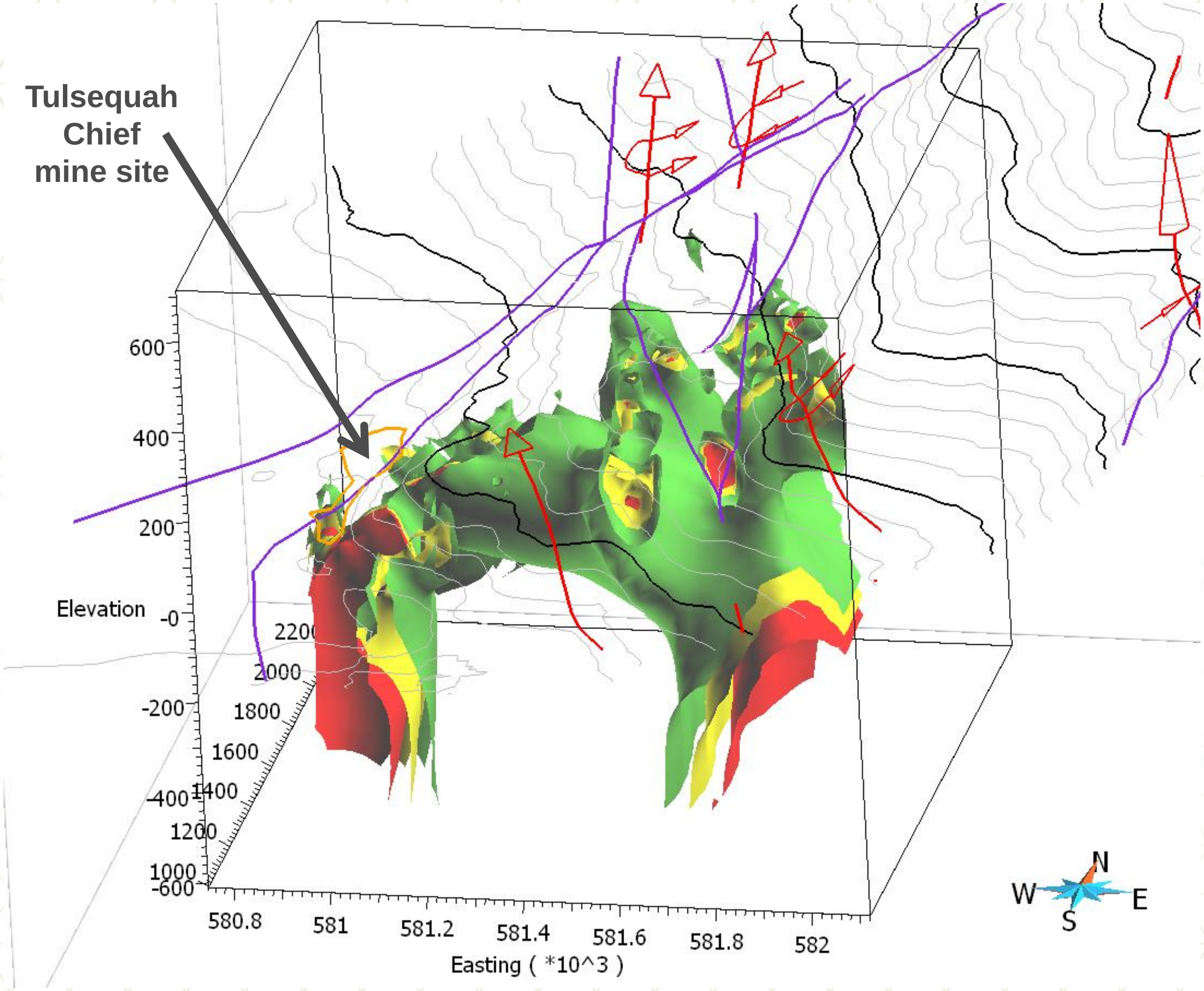

Figure 4: 3D perspective view from the SSE showing isosurfaces of chargeability: 20 mV/V (green), 30 mV/V (yellow), and 40 mV/V (red). Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The Tulsequah Chief mine site is shown as an orange outline. Note the large high chargeability anomaly in the SW corner of the study area.

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Tulsequah Chief grid – IP modelling

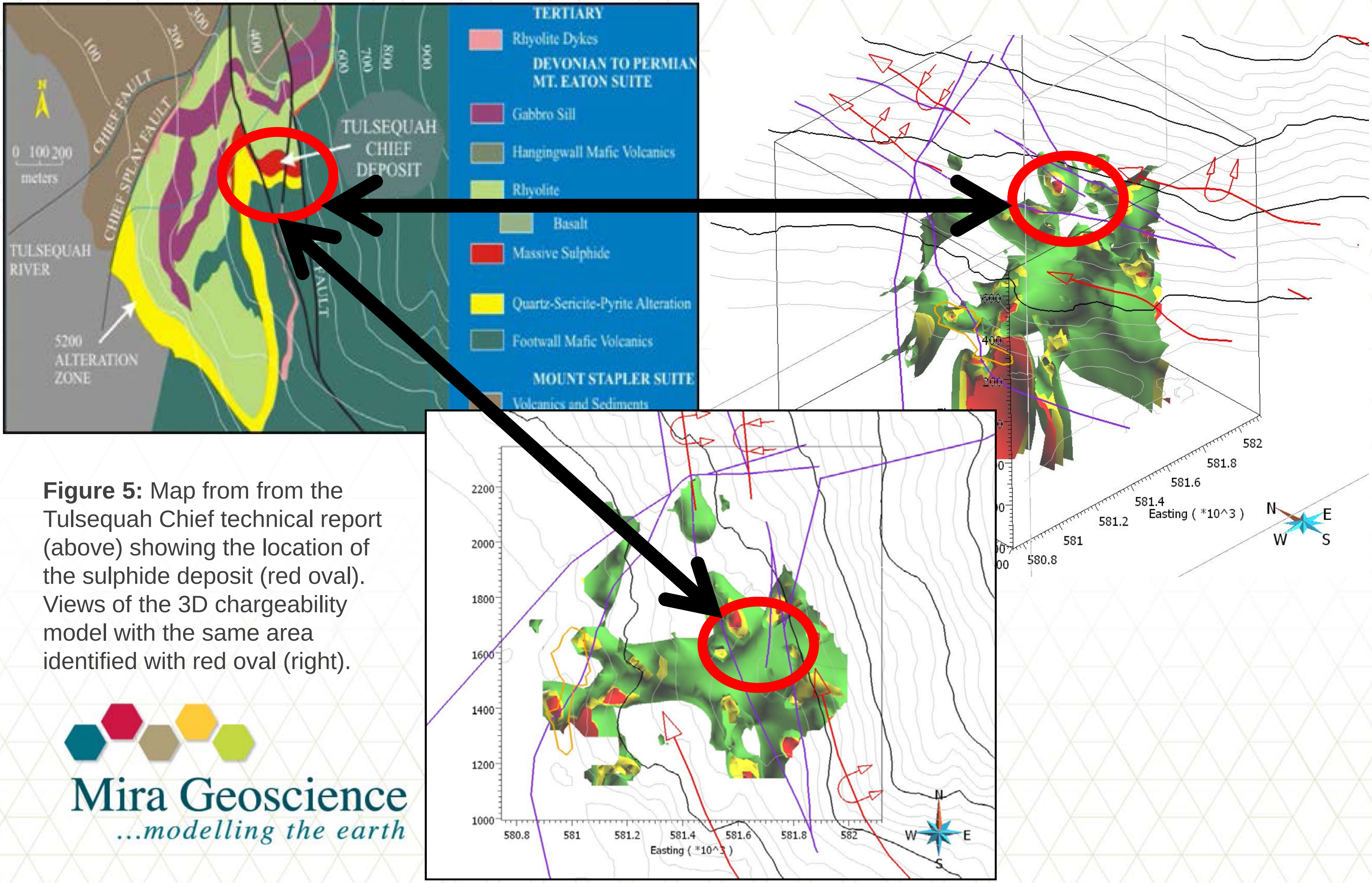

Figure 5: Map from from the Tulsequah Chief technical report (above) showing the location of the sulphide deposit (red oval). Views of the 3D chargeability model with the same area identified with red oval (right).

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Tulsequah Chief grid – Magnetic modelling

- Results of the Compactness Inversion model for the Tulsequah Chief grid are interpreted here. The total range of magnetic susceptibility values in the recovered 3D model is 0 – 0.08 SI units.

- However, ~95% of the data covers the range 0 – 0.04 SI units. The 3D model extends to -500 masl but is reliable to only ~500 m below topography.

- At a depth of -250 masl, the only significant magnetic susceptibility anomaly appears in the SE quadrant. It is strong (>0.04 SI) but may be unreliable because of its great depth under topography (Fig-6).

- Magnetic susceptibility is uniformly low (<0.01 SI) in the N and W quadrants of the survey area at -250 masl (Fig-6).

Tulsequah Chief grid – Magnetic modelling

- At shallower depths (0 masl), the central, northern, and NE portions of the magnetic susceptibility model are dominated by low values (<0.01 SI; Fig-7).

- Exceptions include three high magnetic susceptibility anomalies (>0.03 SI) located at the N, NW, and E extremities of the survey area (Fig-7). These anomalies, however, may be suspect because they lie on the edge of the survey.

- Most of the shallower high magnetic susceptibility anomalies at the Tulsequah Chief grid lie in the depth range 0 - 150 masl in the south-central portion of the survey area. These anomalies, however, do not appear to follow observed structural trends (Figs-7, 8, & 9).

- The Tulsequah mine site (west side) appears to be underlain by uniformly low (<0.01 SI) magnetic susceptibility material (Fig-7).

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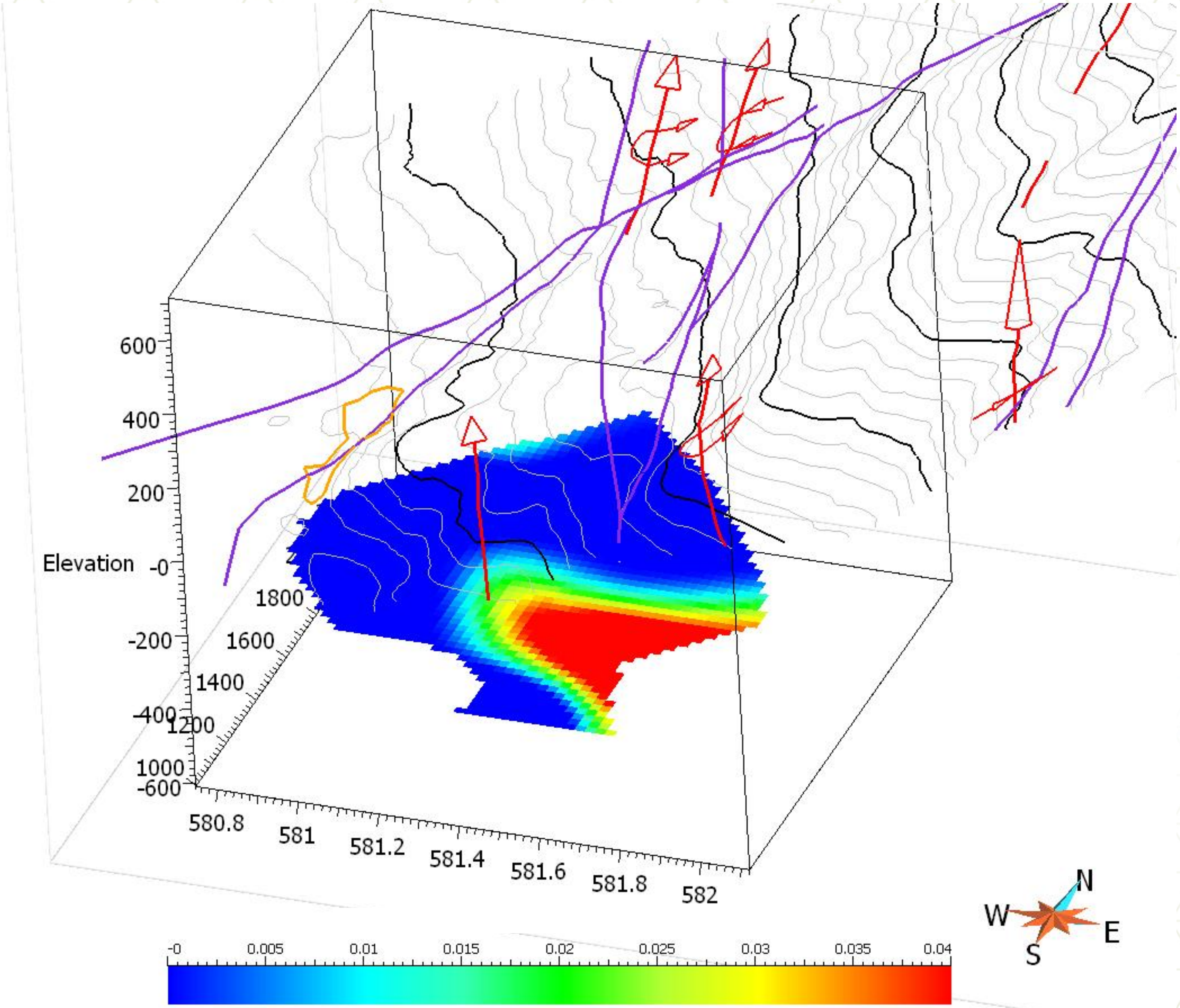
Tulsequah Chief grid – Magnetic modelling

Figure 6: 3D perspective view from the SSE of a slice through the magnetic susceptibility model at a depth of -250 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



Magnetic Susceptibility (SI units)

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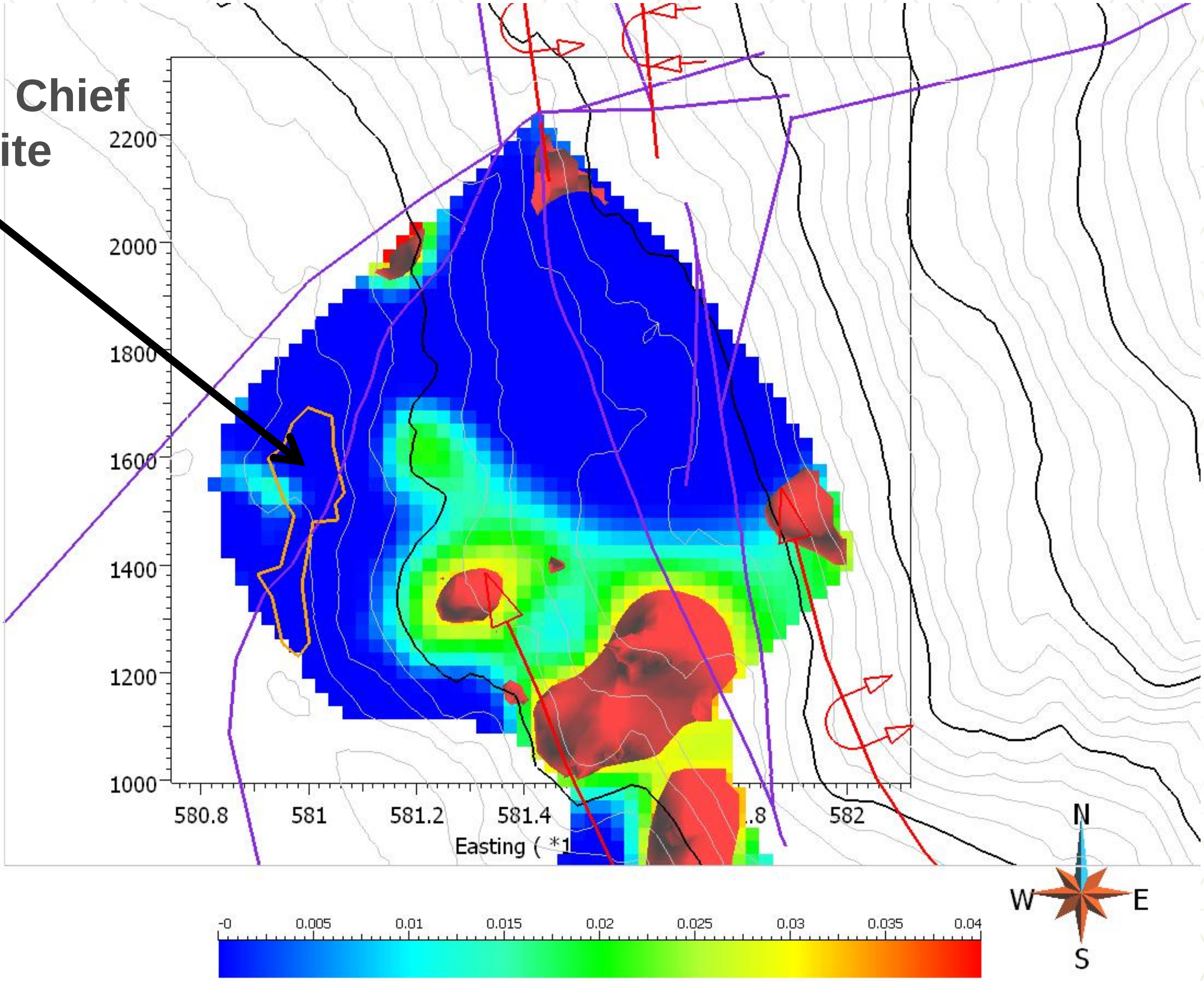
Tulsequah Chief grid – Magnetic modelling



Tulsequah Chief mine site

Figure 7: Map view of a slice through the magnetic susceptibility model at a depth of 0 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Iso-surfaces of 0.03 SI are also shown in red to accentuate the regions of high magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.

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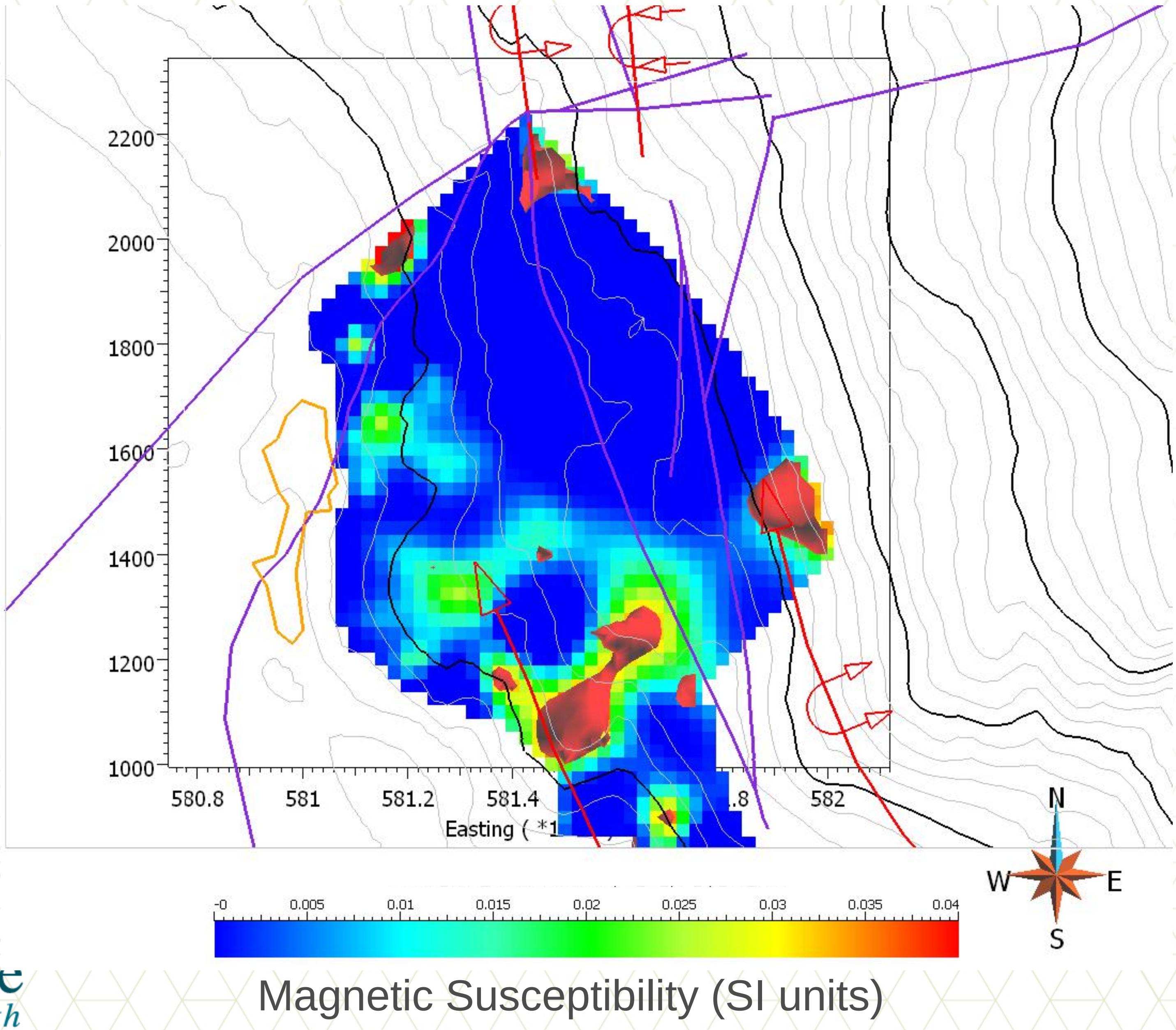
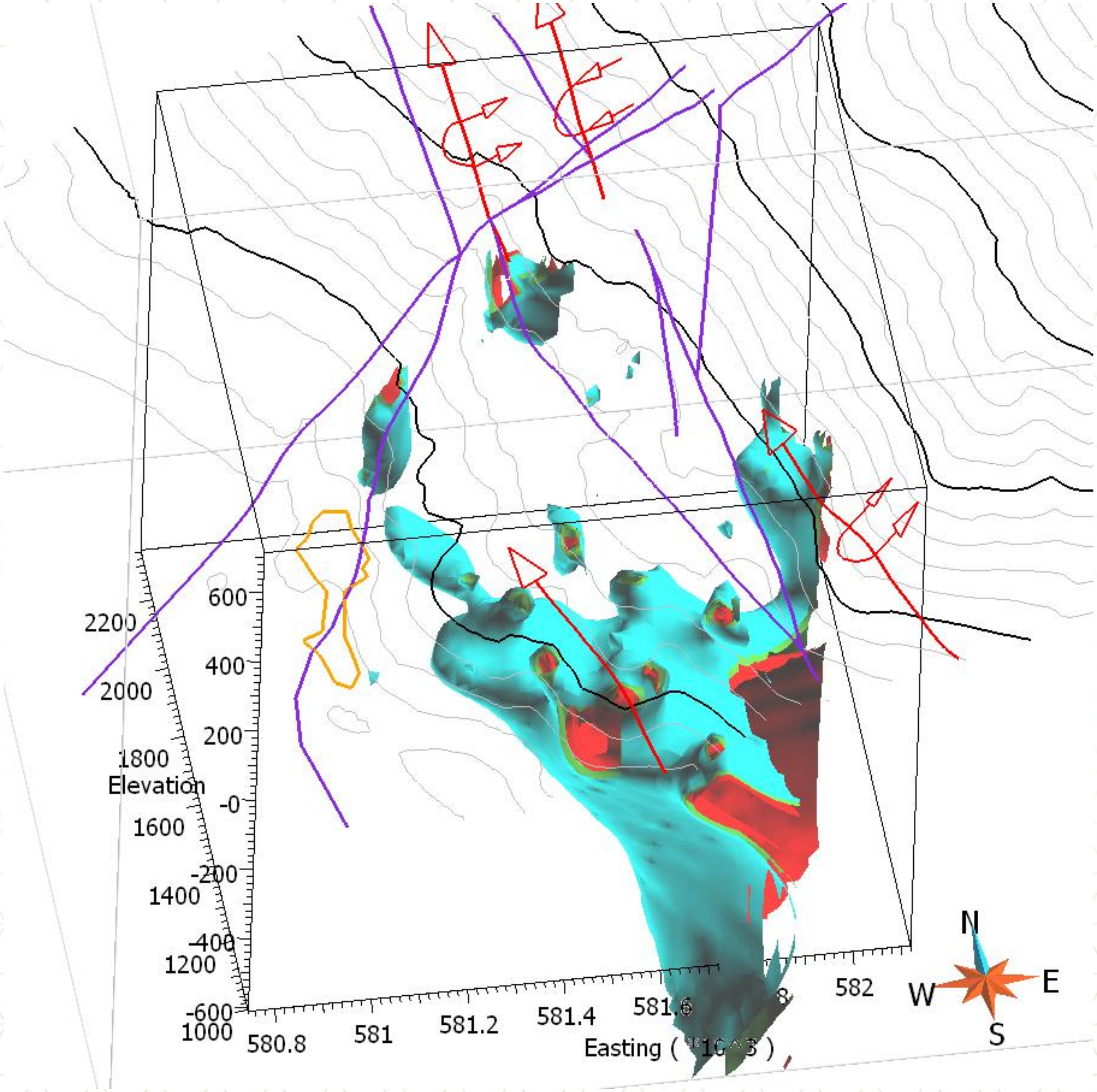
Tulsequah Chief grid – Magnetic modelling

Figure 8: Map view of a slice through the magnetic susceptibility model at a depth of +100 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Iso-surfaces of 0.03 SI are also shown in red to accentuate the regions of high magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



Tulsequah Chief grid – Magnetic modelling

Figure 9: 3D perspective view from the SSW showing isosurfaces of magnetic susceptibility: 0.015 SI (light blue) and 0.03 SI (red). Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The Tulsequah Chief mine site is shown as an orange outline.



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Tulsequah Chief grid – Integrated Model

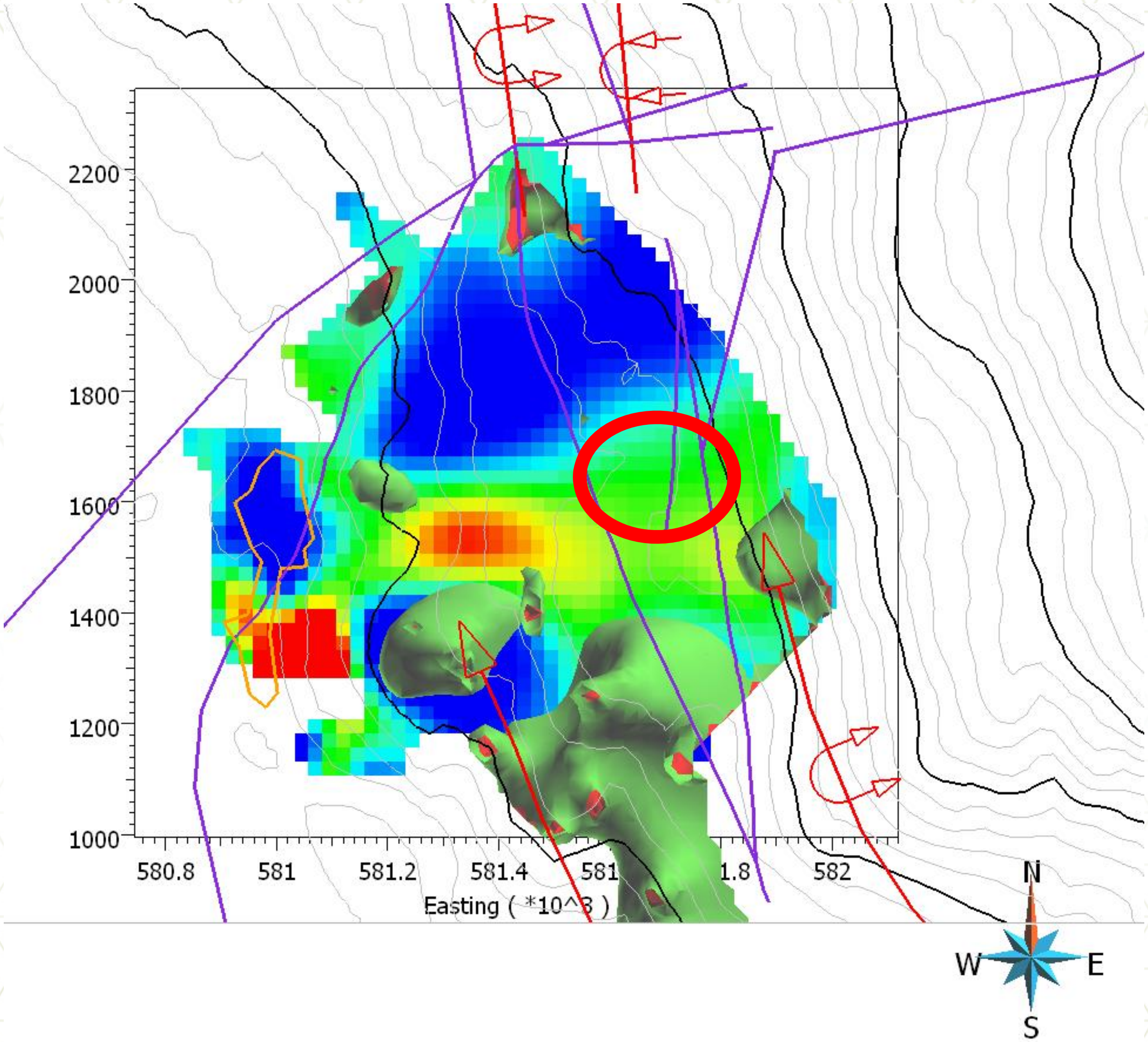
- Integrating the magnetic susceptibility and chargeability models together suggests that the identified Tulsequah Chief sulphide body may lie in a zone that is flanked by high magnetic susceptibility bodies to the south and low magnetic susceptibility to the north (Fig-10).

- According to a schematic cross-section shown in the Tulsequah Chief technical report, the top of the sulphide body may lie at ~100 masl. According to the chargeability model, at a depth of 0 masl, the identified location of the sulphide ore body has a chargeability of ~30 mV/V (Fig-10). Higher chargeability anomalies lie adjacent to the identified sulphide zone.

- At some ore deposits, high chargeability is associated with disseminated sulphides while massive sulphide zones are characterized by lower chargeability values.

Tulsequah Chief grid – Magnetic & IP modelling

Figure 10: Map view of a slice through the chargeability model at a depth of 0 masl. Warm colours represent high chargeability and cool colours show low chargeability. The magnetic susceptibility iso-surface of 0.02 SI is also shown (green) to accentuate regions of elevated magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The location of the known sulphide body is identified with the red oval.



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Tulsequah Chief grid – 2D Resistivity and Geology

- At the Tulsequah Chief grid, the gabbro sill (unit MSgb) appears to be characterized by generally low magnetic susceptibility. Most of this rock unit is also characterized by low chargeability except in the southern portions of the area mapped as gabbro (Fig-11).

- The 2D resistivity contours provided from the Delta Geoscience data acquisition report, show a range in resistivity of 1000 – 10,000 Ohm.m for the Tulsequah Chief grid (Fig-12).

- The identified location of the Tulsequah Chief sulphide body appears to underlie a zone of low to moderate (and changing) resistivity covering a range from 2000 – 5000 Ohm.m (Fig-12).

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Tulsequah Chief grid – Model results & Geology

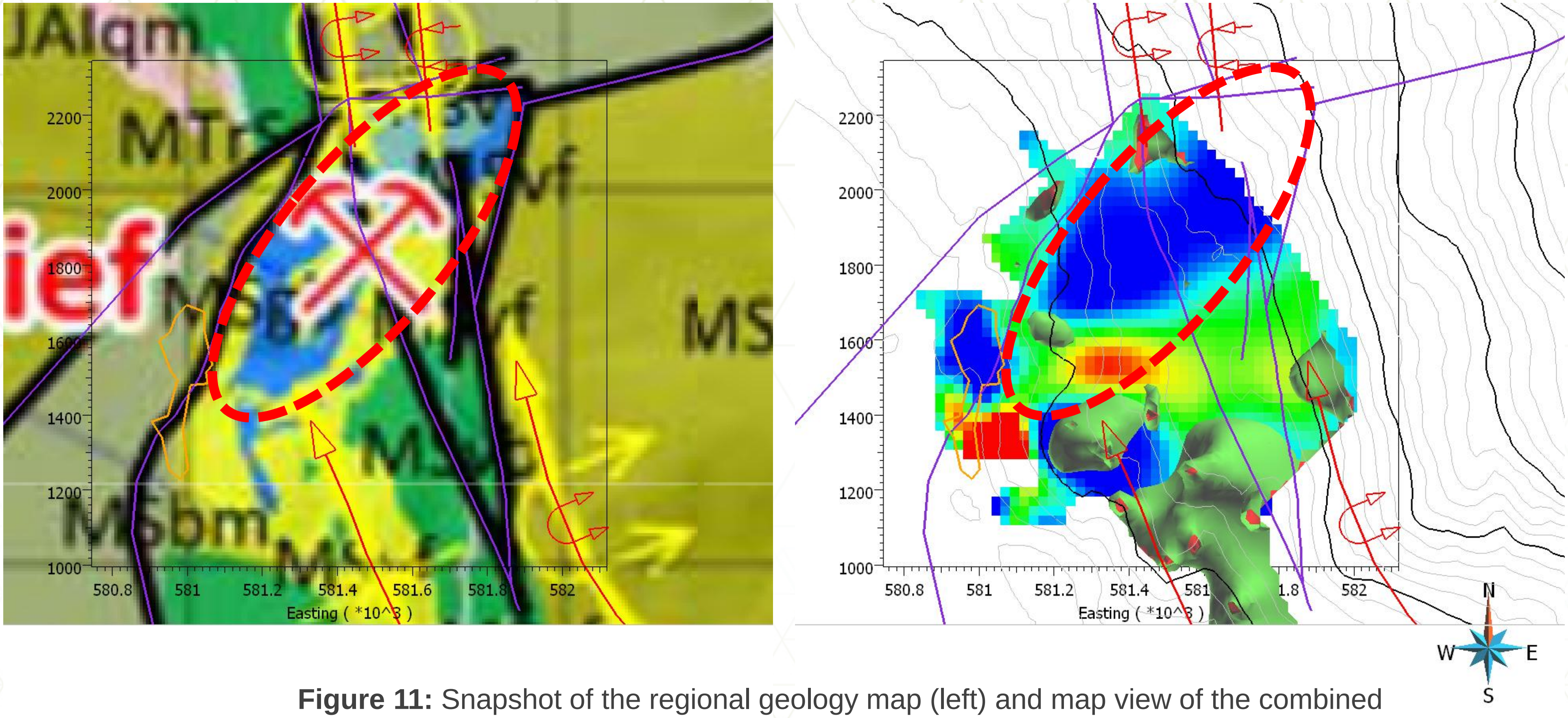

Figure 11: Snapshot of the regional geology map (left) and map view of the combined magnetic susceptibility and chargeability models (right; same as Figure 10). The location of the gabbro sill (unit Msgb) identified by the red dashed oval. MSgb = blue; MSvb = green; MSvf = yellow.

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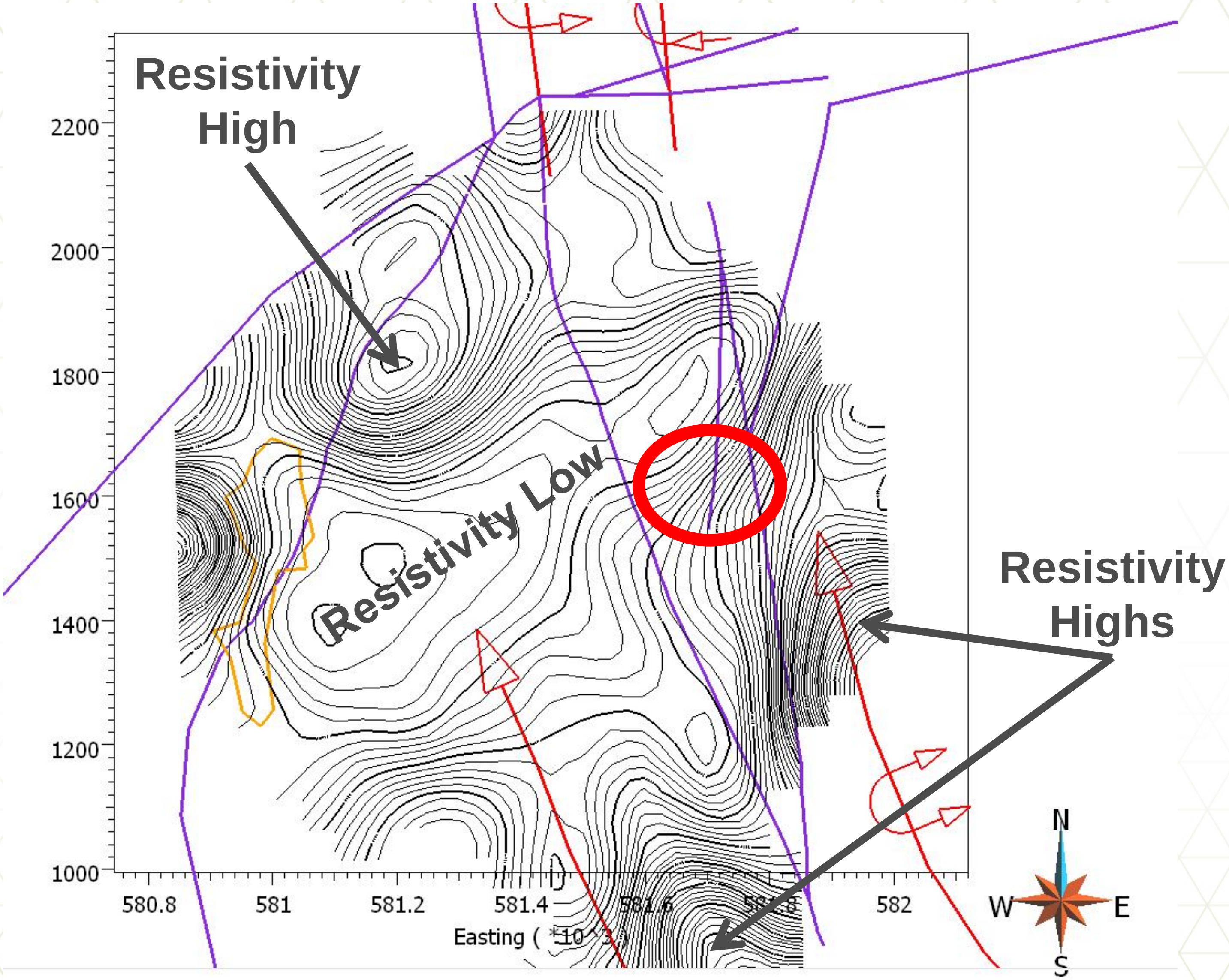
Tulsequah Chief grid – 2D Resistivity contours

Figure 12: Map view of the 2D resistivity contours from the Delta Geoscience data acquisition report. Resistivity lows and highs are identified. Topographic contours have been removed for clarity. Mapped surface faults are shown in purple and fold axes are shown in red. The approximate location of the known sulphide body is identified with the red oval.



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Southeast grid – Magnetic modelling

- Results of the Compactness Inversion model for the Southeast grid are interpreted here. The total range of magnetic susceptibility values in the recovered 3D model is 0 – 0.08 SI units

- However, ~95% of the data covers the range 0 – 0.04 SI units. The 3D model extends to -500 masl but is reliable to only ~500 m below topography.

- At a depth of -300 masl, a broad zone of moderate magnetic susceptibility (0.02 – 0.03 SI units) lies in the north-central and southeast sides of the Southeast grid (Fig-13).

- At a depth of -50 masl, a small but well-defined magnetic susceptibility high (~0.04 SI) appears in the N-central portion of the Southeast grid in associated with an overturned fold (Fig-14).

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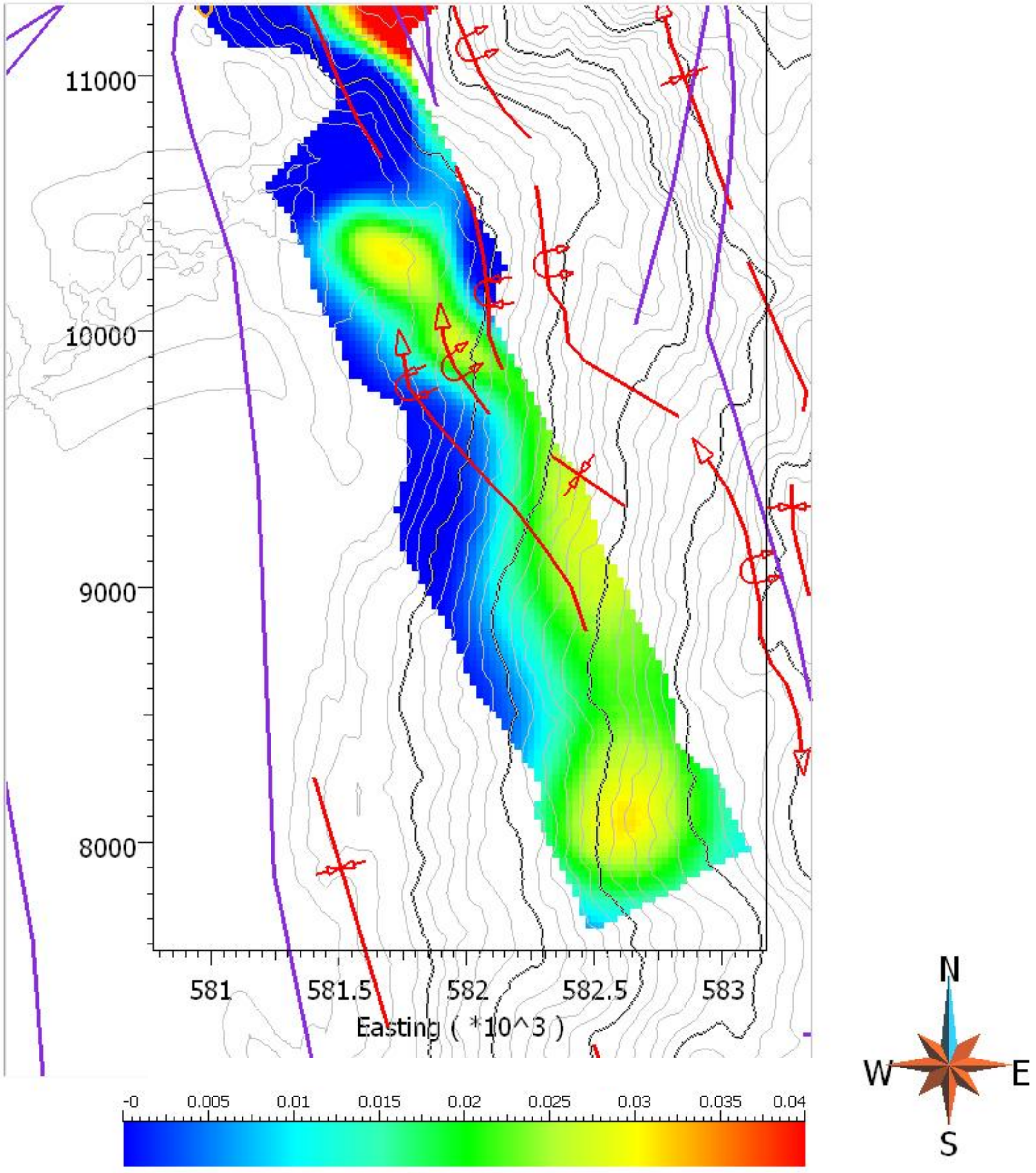
Southeast grid – Magnetic modelling

- At shallower depths (+200 masl), magnetic susceptibility anomalies are small, scattered, and of generally lower magnitude (<0.02 SI; Fig-15).

- The 3D perspective views of the Southeast grid magnetic susceptibility model (shown in Fig-16) reveals a sizeable zone of high magnetic susceptibility at depth with small, narrow bodies of elevated magnetic susceptibility extending up to shallower portions of the subsurface.

Southeast grid – Magnetic modelling

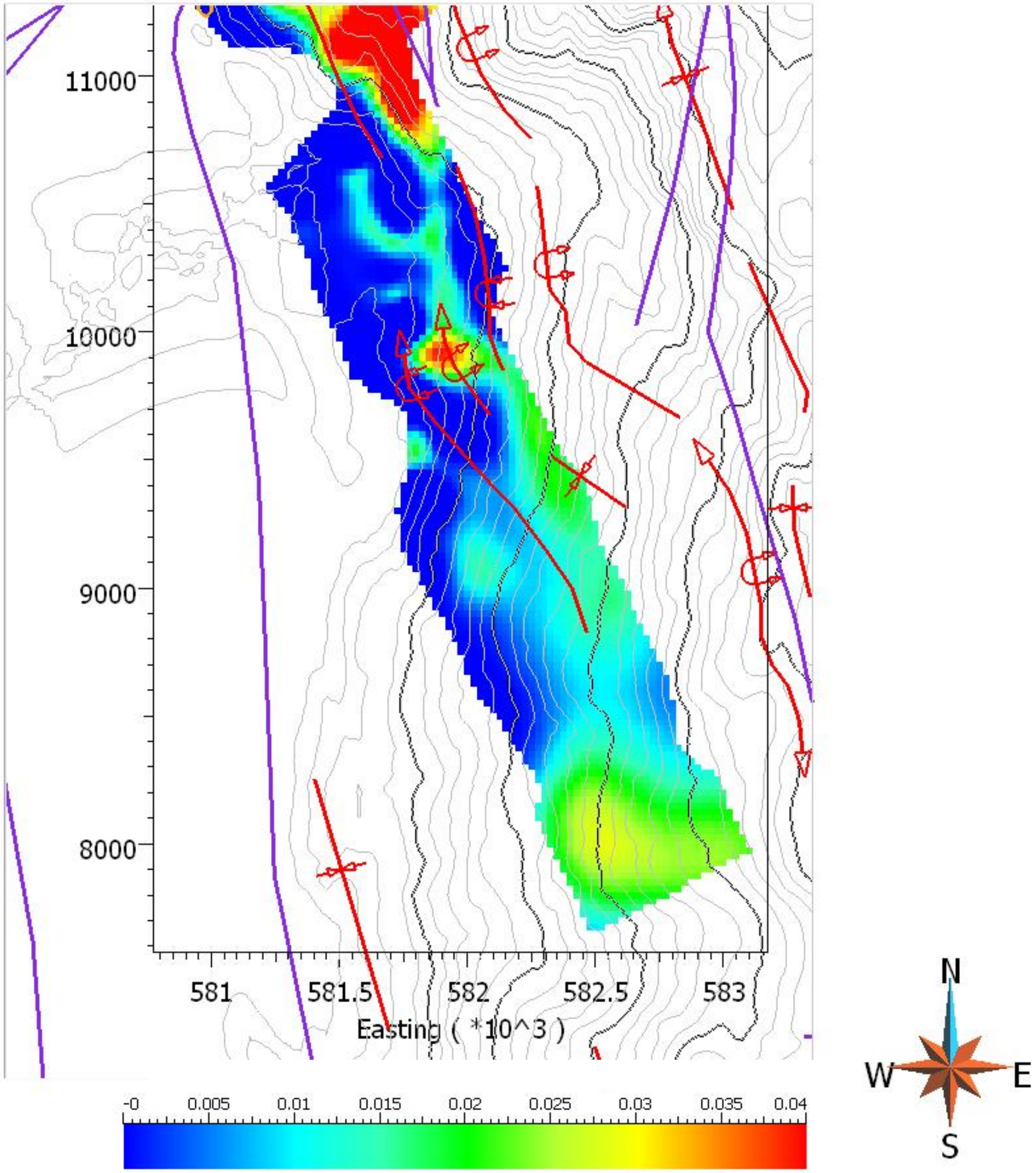
Figure 13: Map view of a slice through the magnetic susceptibility model at a depth of -300 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



Magnetic Susceptibility (SI units)

Southeast grid – Magnetic modelling

Figure 14: Map view of a slice through the magnetic susceptibility model at a depth of -50 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



Magnetic Susceptibility (SI units)

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Southeast grid – Magnetic modelling

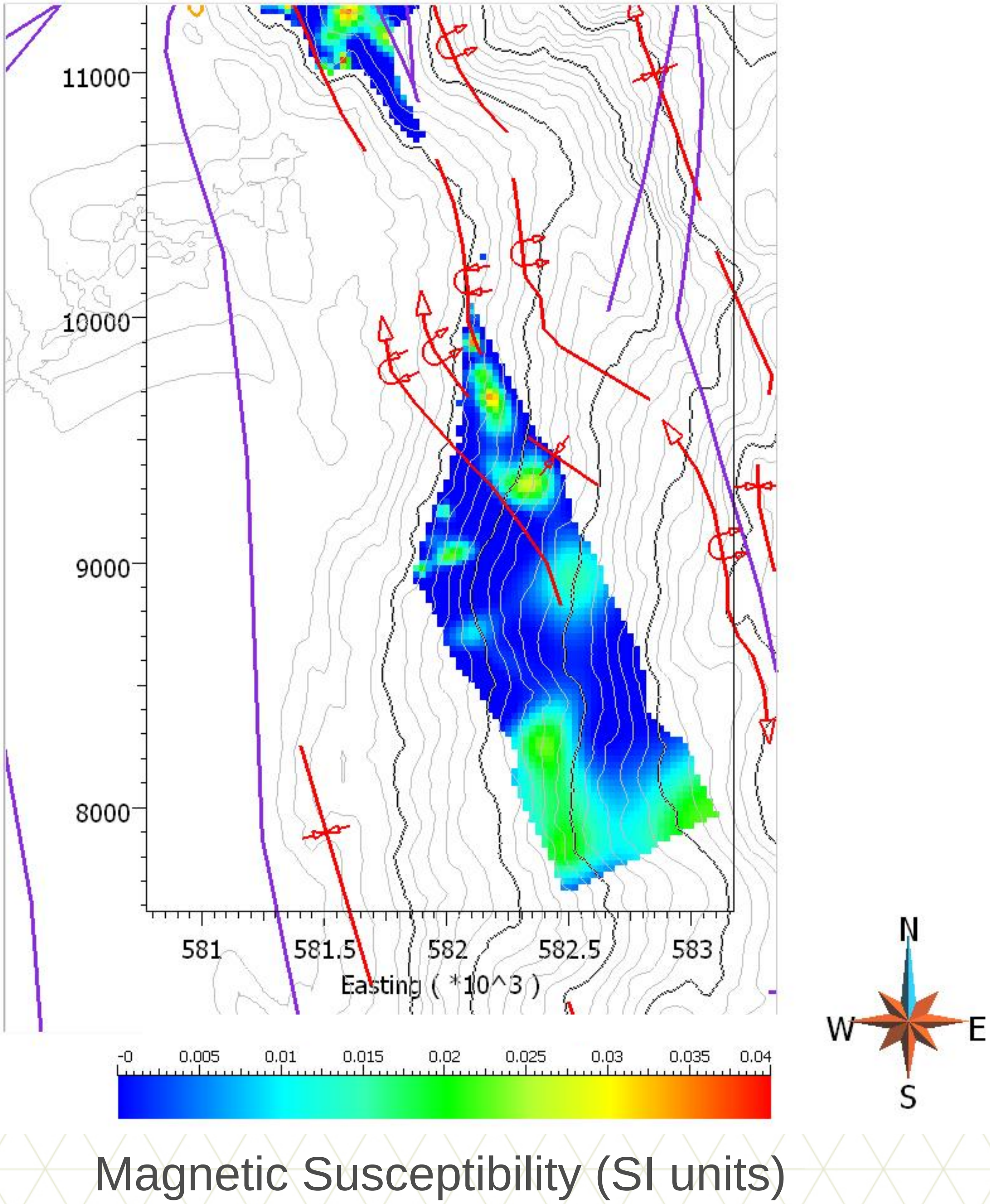


Figure 15: Map view of a slice through the magnetic susceptibility model at a depth of +200 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.

Southeast grid – Magnetic modelling

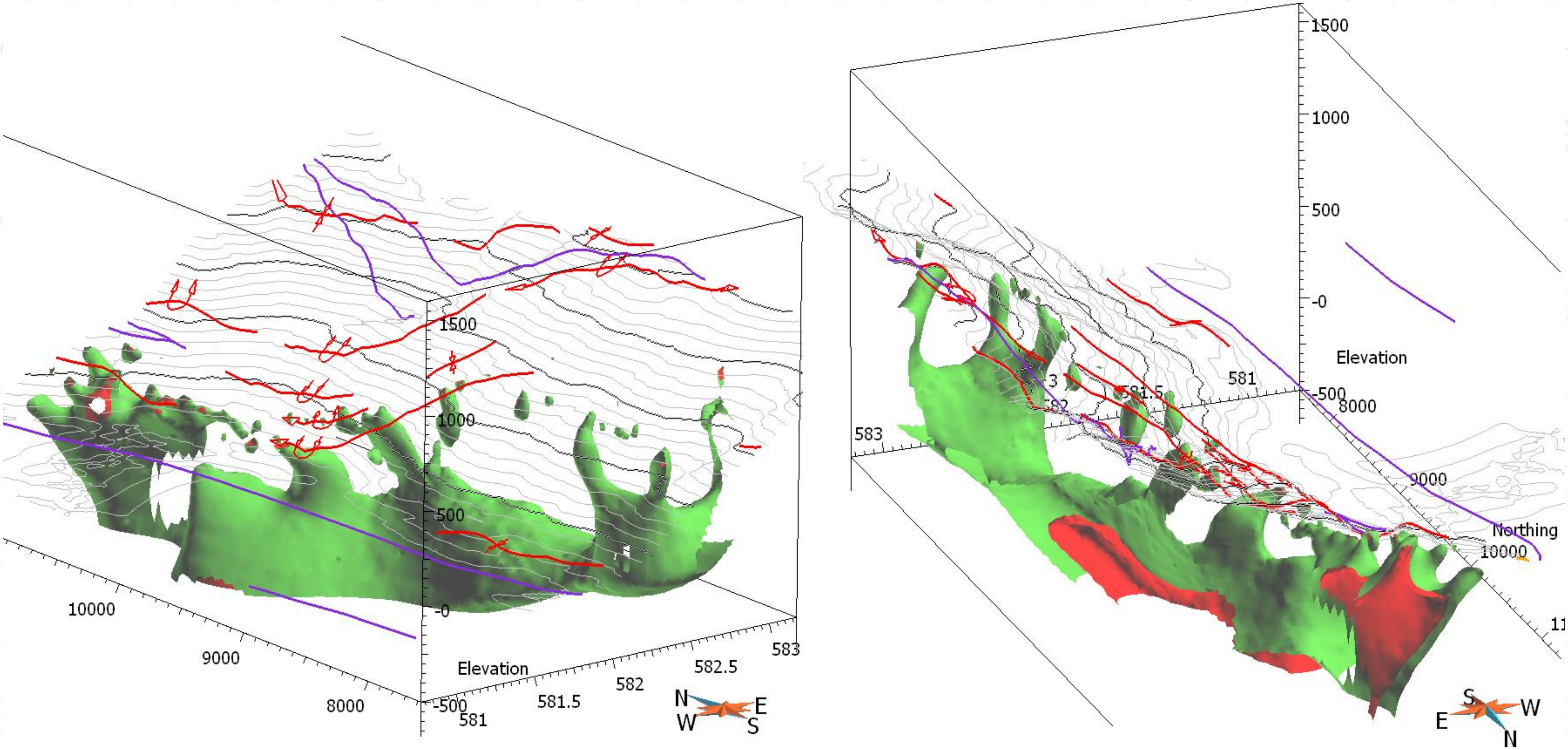


Figure 16: 3D perspective views from the SW and the NNE showing isosurfaces of magnetic susceptibility: 0.02 SI (green) and 0.03 SI (red). Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.

Southeast grid – 2D Resistivity and Geology

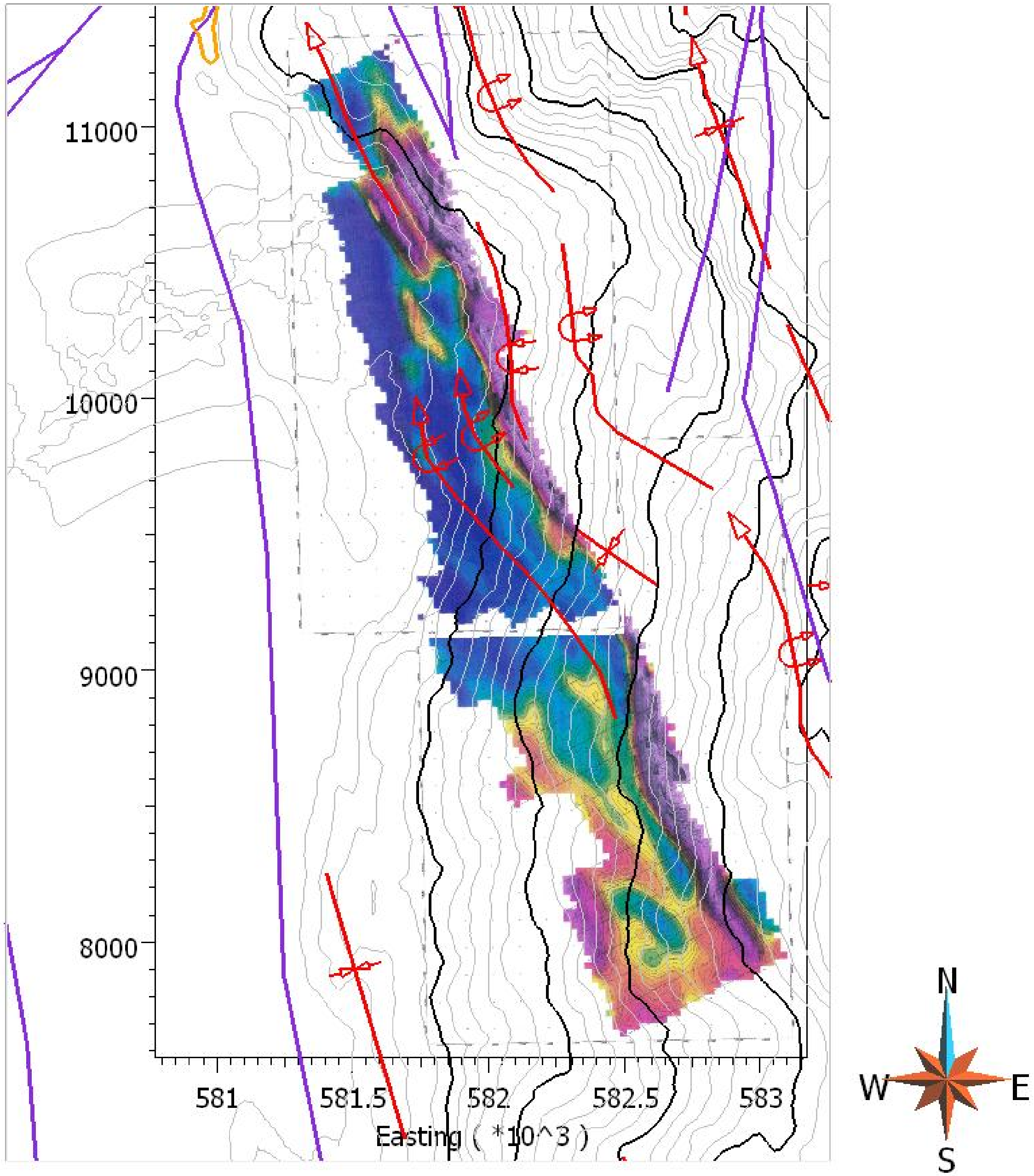
- The 2D resistivity maps from Delta Geoscience show a range in resistivity of 200 – 17,000 Ohm.m for the Southeast grid.

- High resistivity characterizes the eastern border of the Southeast grid with lower values elsewhere. Fold axes appear to follow some resistivity trends (Fig-17).

- The extensive basaltic volcanic rock unit, Msvb, appears to be characterized by low to moderate magnetic susceptibility and low resistivity. Higher resistivity areas in the south and southeast portions of the grid may correspond to some of the younger intrusive rocks of the Eocene Sloko-Hyder Plutonic Suite that outcrop in these areas (Fig-18).

Southeast grid – 2D Resistivity

Figure 17: Map view of the georegistered 2D resistivity maps (north sheet and south sheet) from the Delta Geoscience data acquisition report. Warm colours represent resistivity highs while cool colours represent resistivity lows. Total range in resistivity shown in the map is 200 ohm.m (dark blue) to 17,000 ohm.m (pink). Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.



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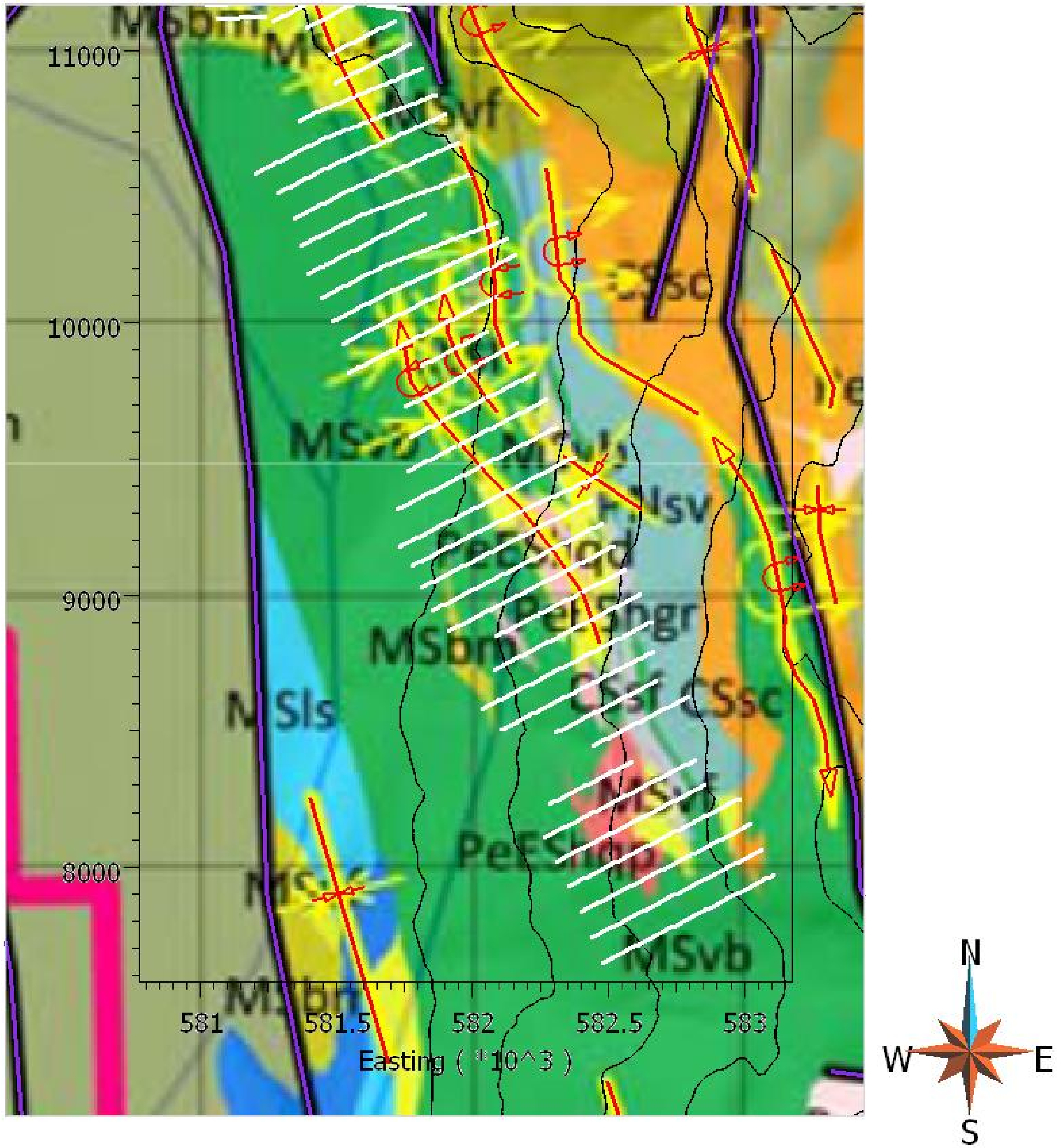
Southeast grid – Geology

Figure 18: Map view of the regional geology covering the area of the Southeast grid. Topographic contours (black lines) are shown with a 200 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The magnetic survey lines (white) for the Southeast grid are also shown.
MSvb = green
MSvf = yellow
Intrusive rocks = shades of pink



Southern Block grids – Magnetic modelling

- Results of the Compactness Inversion model for the Southern Block grids are interpreted here. The total range of magnetic susceptibility values in the recovered 3D model for the Southern Block grids is 0 – 0.19 SI units

- However, ~95% of the data covers the range 0 – 0.05 SI units. The 3D model extends to -500 masl but is reliable to only ~500 m below topography.

- At deep levels (e.g. -300 masl), only three areas of the Southern Block grids are characterized by high magnetic susceptibility (>0.03 SI): the SE corner of the Banker grid, the north end of the Banker grid, and the southern edge of the Big Bull grid (Fig-19). All other areas show low magnetic susceptibility (<0.01 SI).

- At shallower depths (e.g. -50 masl), the eastern border of the Banker grid exhibits high magnetic susceptibility (>0.03 SI). The south, east, and west edges of the Big Bull grid show similarly high values (Fig-20).

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Southern Block grids – Magnetic modelling

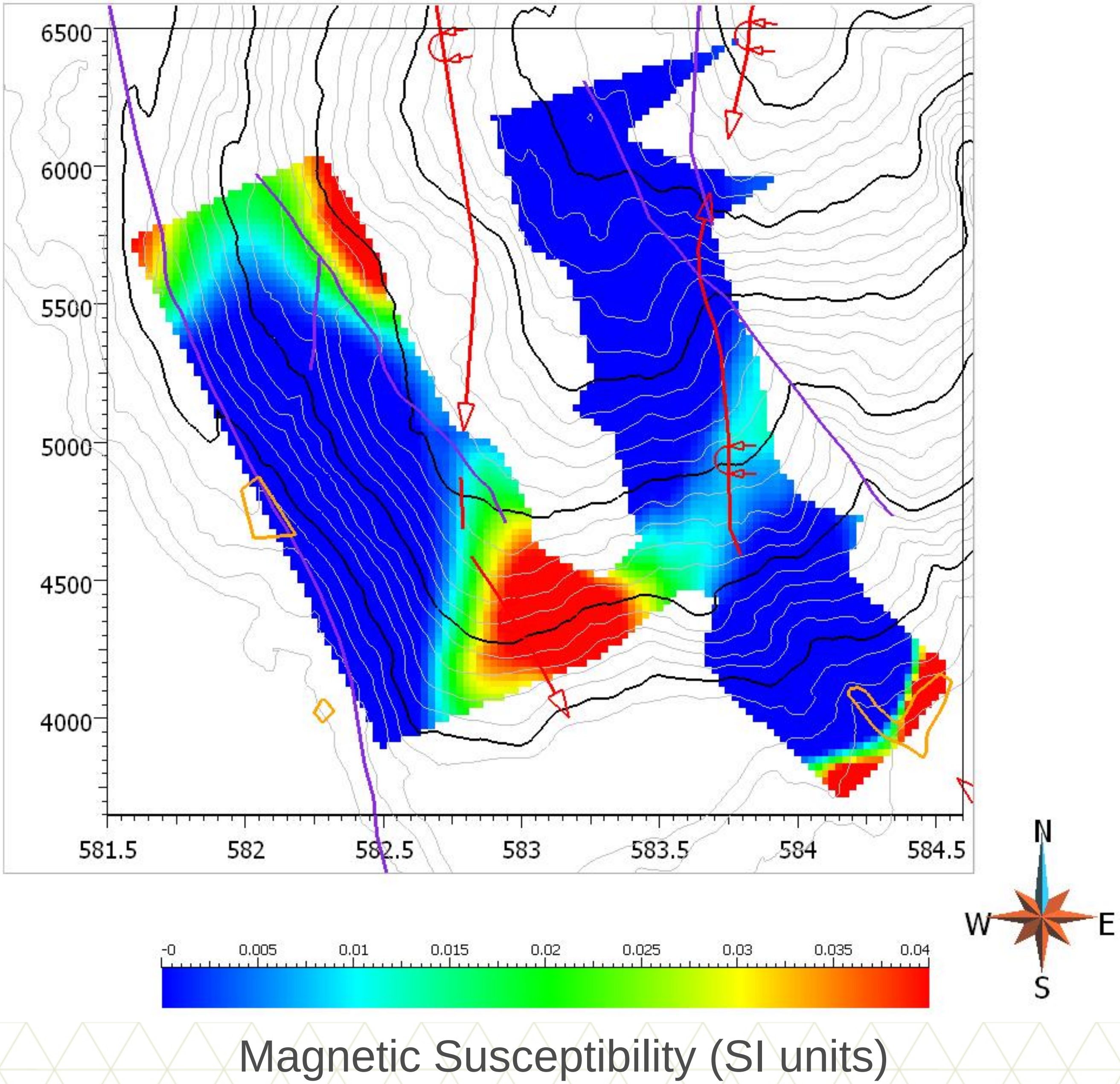
- At +200 masl, the magnetic susceptibility model reveals two distinct magnetic susceptibility high anomalies (>0.03 SI) along the east edge of the Banker grid. Their geometric shape may correspond to geologic structures.

- At +200 masl, the northern end of the Big Bull Extension grid has uniformly low magnetic susceptibility while the southern end shows a N-S trending magnetic susceptibility high which parallels a mapped fold axis.

- Overall, for the Southern Block grids the magnetic susceptibility models reveal low values over much of the surveyed area. A zone of high magnetic susceptibility along the eastern side of the Banker grid is distinct. Other distinct anomalies are seen on the SE corner of the Big Bull Extension grid and around the edges of the Big Bull grid (Fig-22).

Southern Block grids – Magnetic modelling

Figure 19: Map view of a slice through the magnetic susceptibility model at a depth of -300 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The Big Bull mine site is shown in orange outline in the SE corner.



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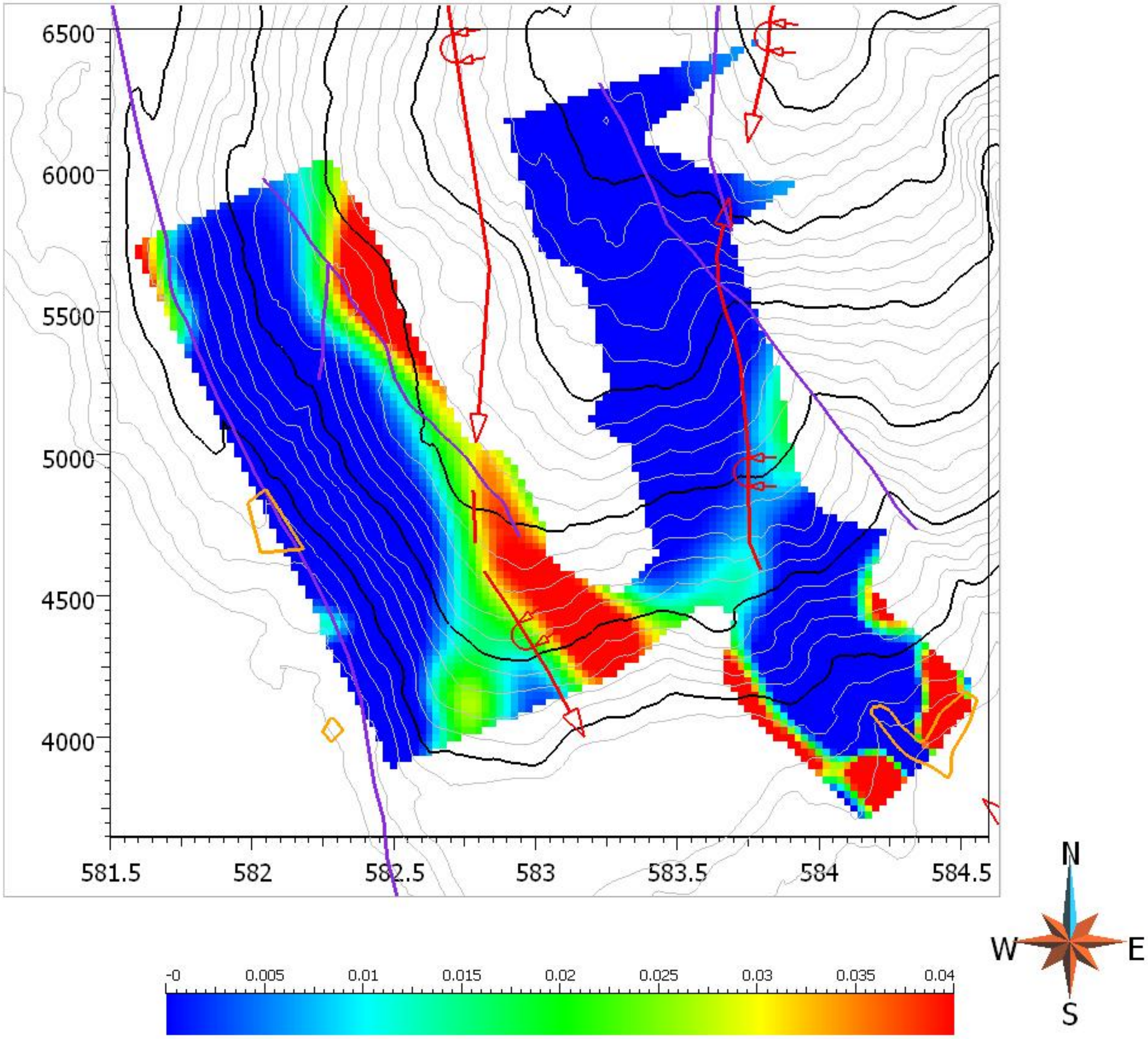
Southern Block grids – Magnetic modelling

Figure 20: Map view of a slice through the magnetic susceptibility model at a depth of -50 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The Big Bull mine site is shown in orange outline in the SE corner.



Magnetic Susceptibility (SI units)

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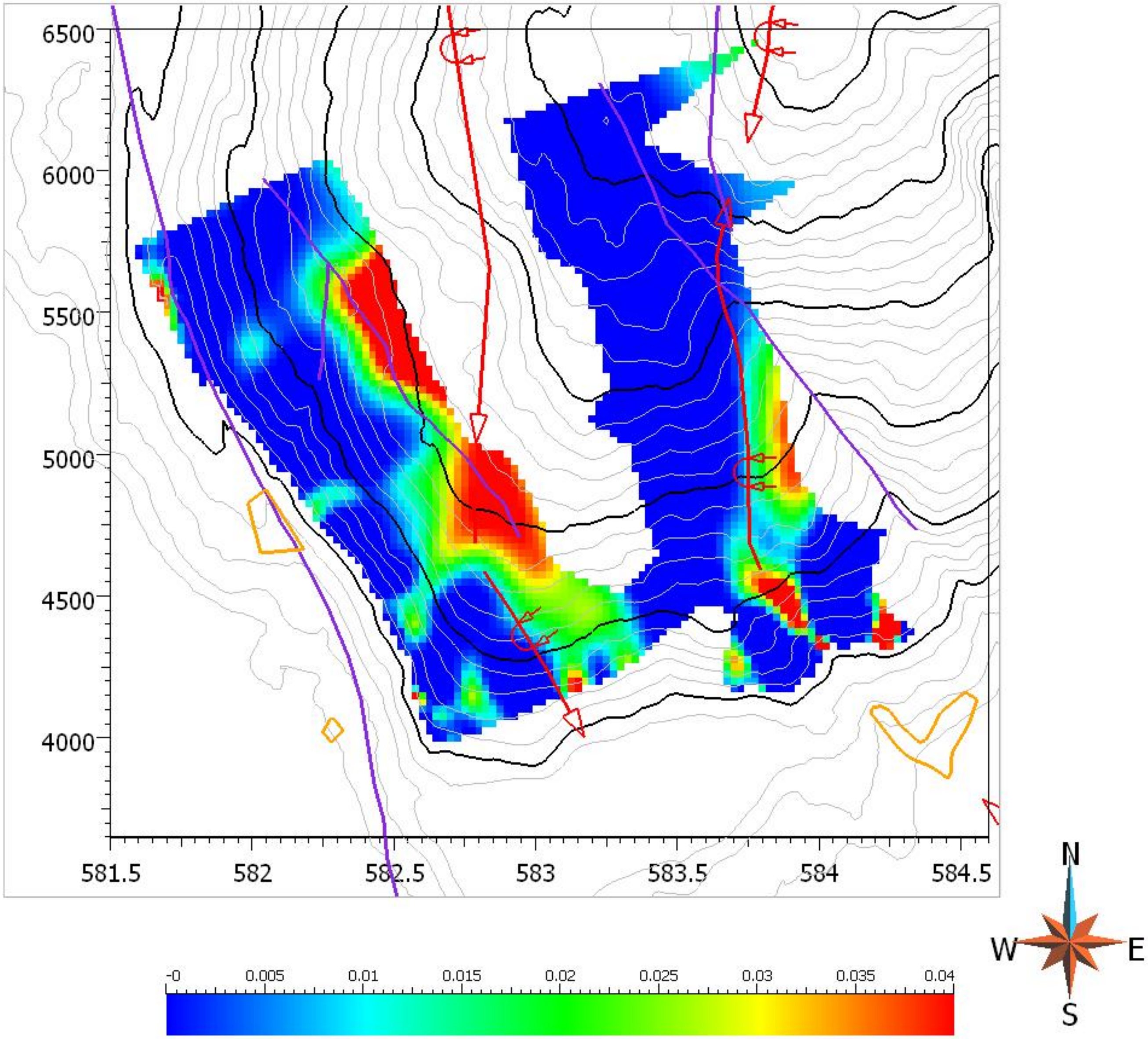
Southern Block grids – Magnetic modelling

Figure 21: Map view of a slice through the magnetic susceptibility model at a depth of +200 masl. Warm colours represent high magnetic susceptibility and cool colours show low magnetic susceptibility. Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. Big Bull mine site shown in orange outline in the SE corner.



Magnetic Susceptibility (SI units)

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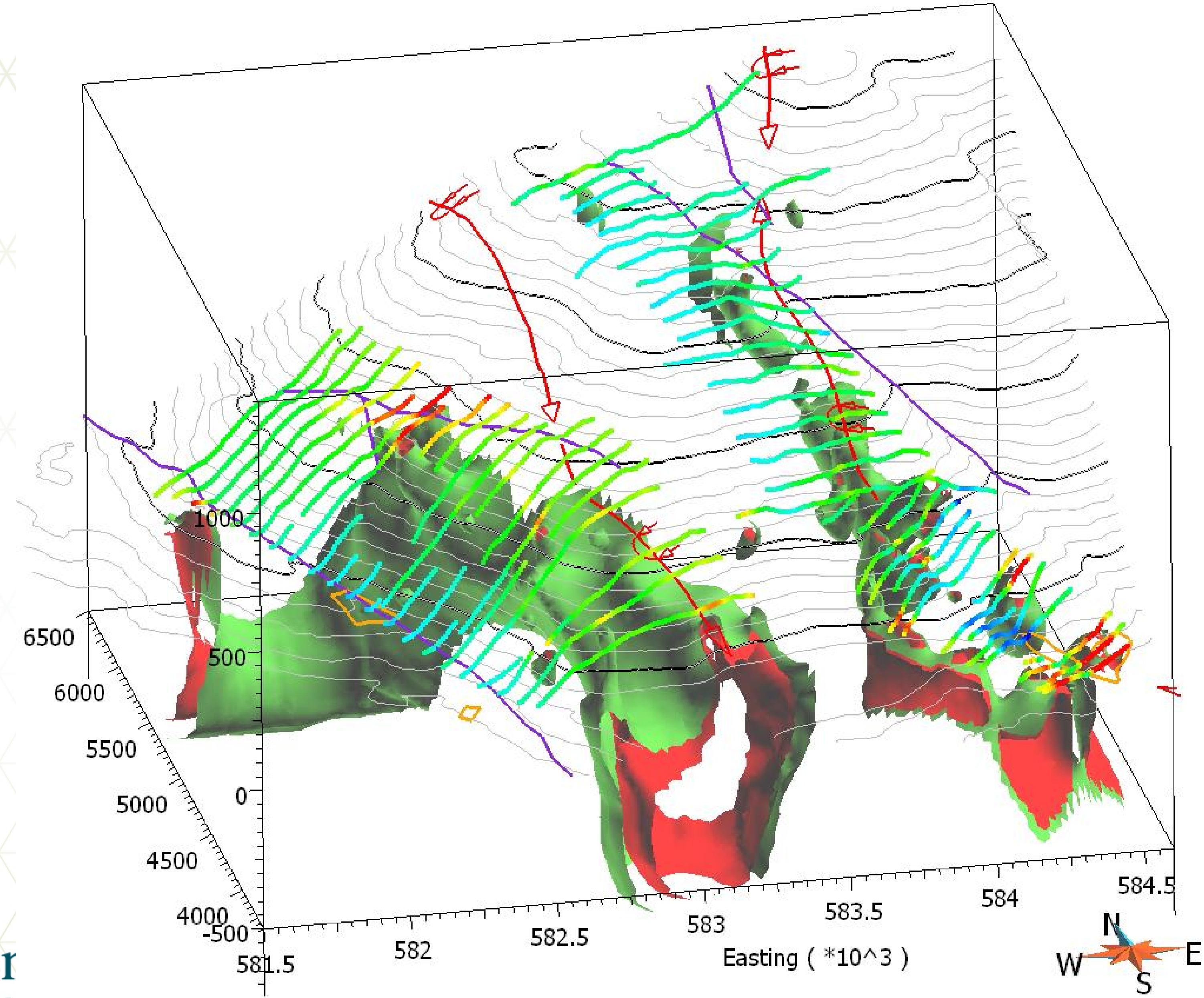
Southern Block grids – Magnetic modelling

Figure 22: 3D perspective view from the SSW showing isosurfaces of magnetic susceptibility: 0.02 SI (green) and 0.03 SI (red). Topographic contours (grey and black lines) are shown with a 40 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The magnetic survey lines for the Southern Block grids are also shown draped on topography as coloured lines (representing the magnetic data values in nT).



Southern Block grids – Geology

- The rock types that dominate the areas covered by the Southern Block grids include (see Fig-23):
    - Felsic volcanic rocks (unit MSvf)
    - Basaltic volcanic rocks (unit MSvb)
    - Gabbro intrusion (unit MSgb)
    - Undivided volcanic rocks and tuff (unit PnSv)

- The felsic volcanic rocks (MSvf) appear to consistently correspond to magnetic susceptibility lows while the basaltic volcanic rocks (MSvb) generally correspond to magnetic susceptibility highs.

- The gabbro intrusion (MSgb) and undivided volcanic rocks (PnSv) appear to exhibit both high and low magnetic susceptibility values.

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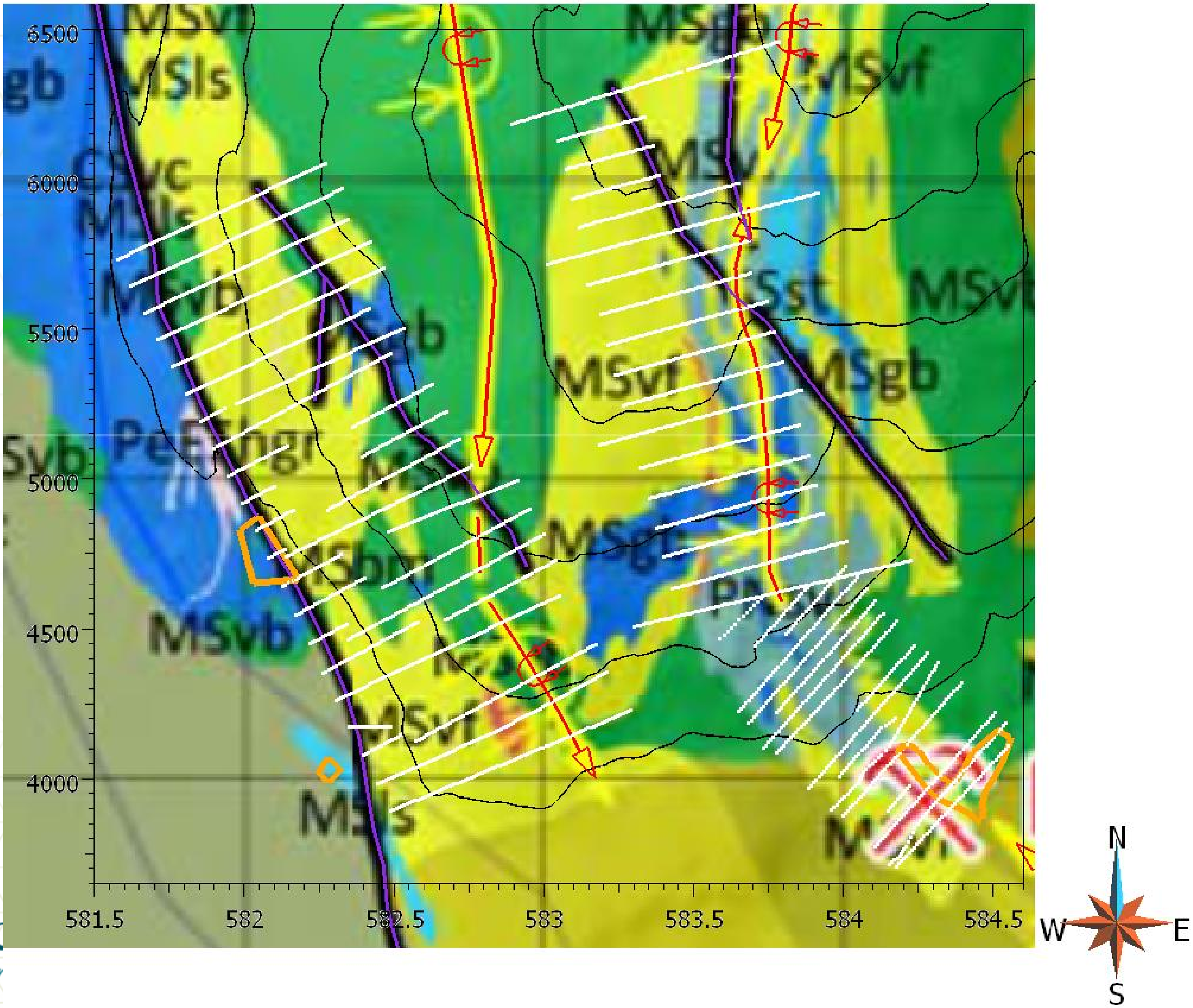
Southern Block grids – Geology

Figure 23: Map view of the regional geology covering the area of the Southern Block grids. Topographic contours (black lines) are shown with a 200 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red. The magnetic survey lines (white) for the Southern Block grids are also shown.
MSvb = green
MSvf = yellow
MSgb = dark blue
PNsv = light blue



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Southern Block grids – 2D Resistivity

- In the Southern Block, the 2D resistivity maps from Delta Geoscience are available only for the Big Bull grid and the Banker grid.

- The 2D resistivity map for the Banker grid only covers the southern half of this grid and has significant “holes” in its centre.

- The 2D resistivity maps show a range in resistivity of 2000 – 10,000 Ohm.m for the Big Bull grid and 500 – 9000 Ohm.m for the Banker grid.

- Comparison of the magnetic susceptibility model and the 2D resistivity maps reveals a possible correlation between highs and lows for these two datasets, especially for the Banker grid (Figs-24 & 25). However, the relationship, if any, is complex.

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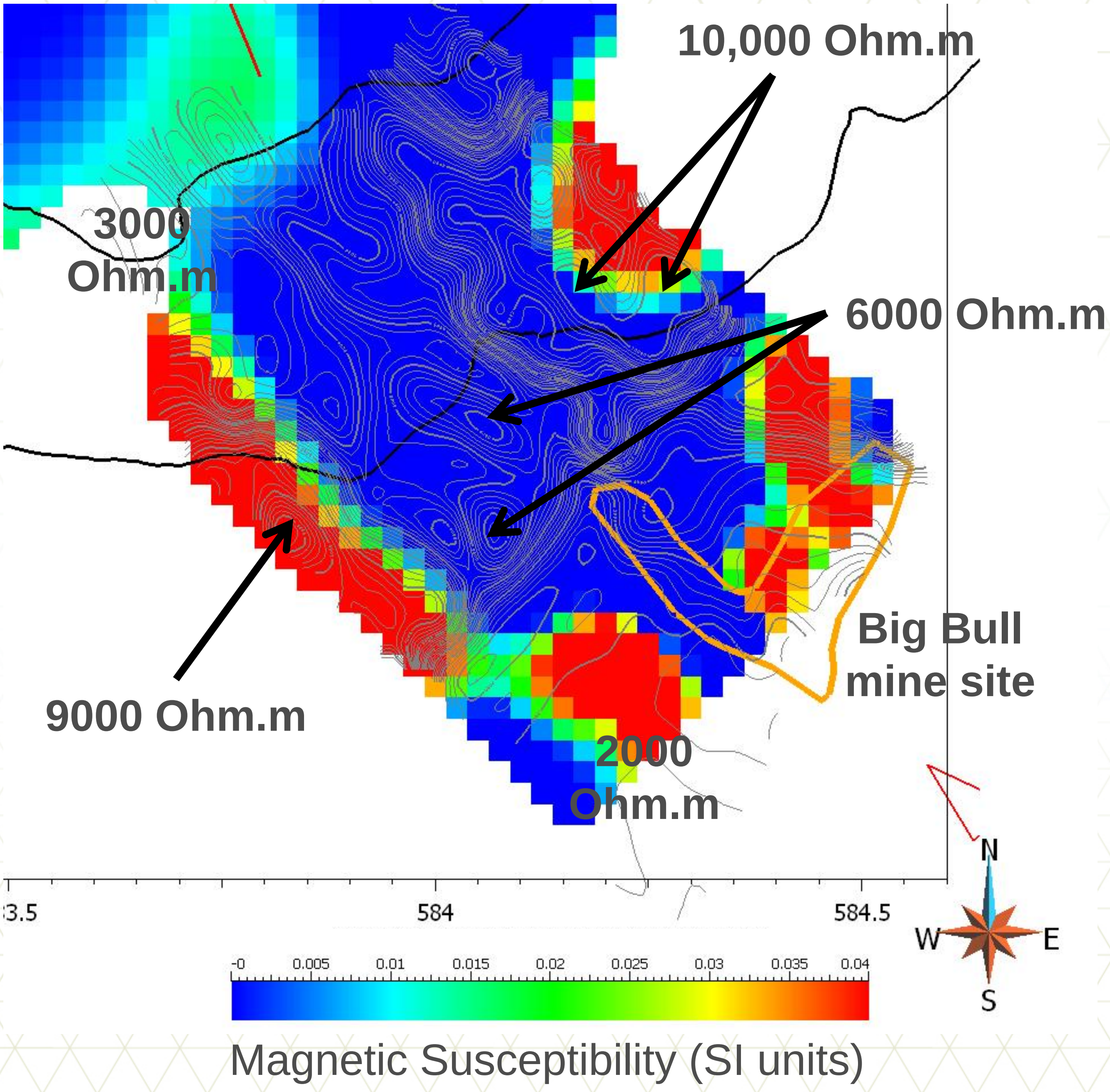
Southern Block – 2D Resistivity and Magnetic Susceptibility on the Big Bull grid

Figure 24: Map view of the 2D resistivity contours (grey) overlain on a horizontal slice of the magnetic susceptibility model at 0 masl. Warm colours represent magnetic susceptibility highs while cool colours represent magnetic susceptibility lows. Resistivity highs and lows are labeled. Topographic contours (black lines) are shown with a 200 m contour interval. Mapped surface faults and fold axes are not present in this area.



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Southern Block – 2D Resistivity and Magnetic Susceptibility on the Banker grid

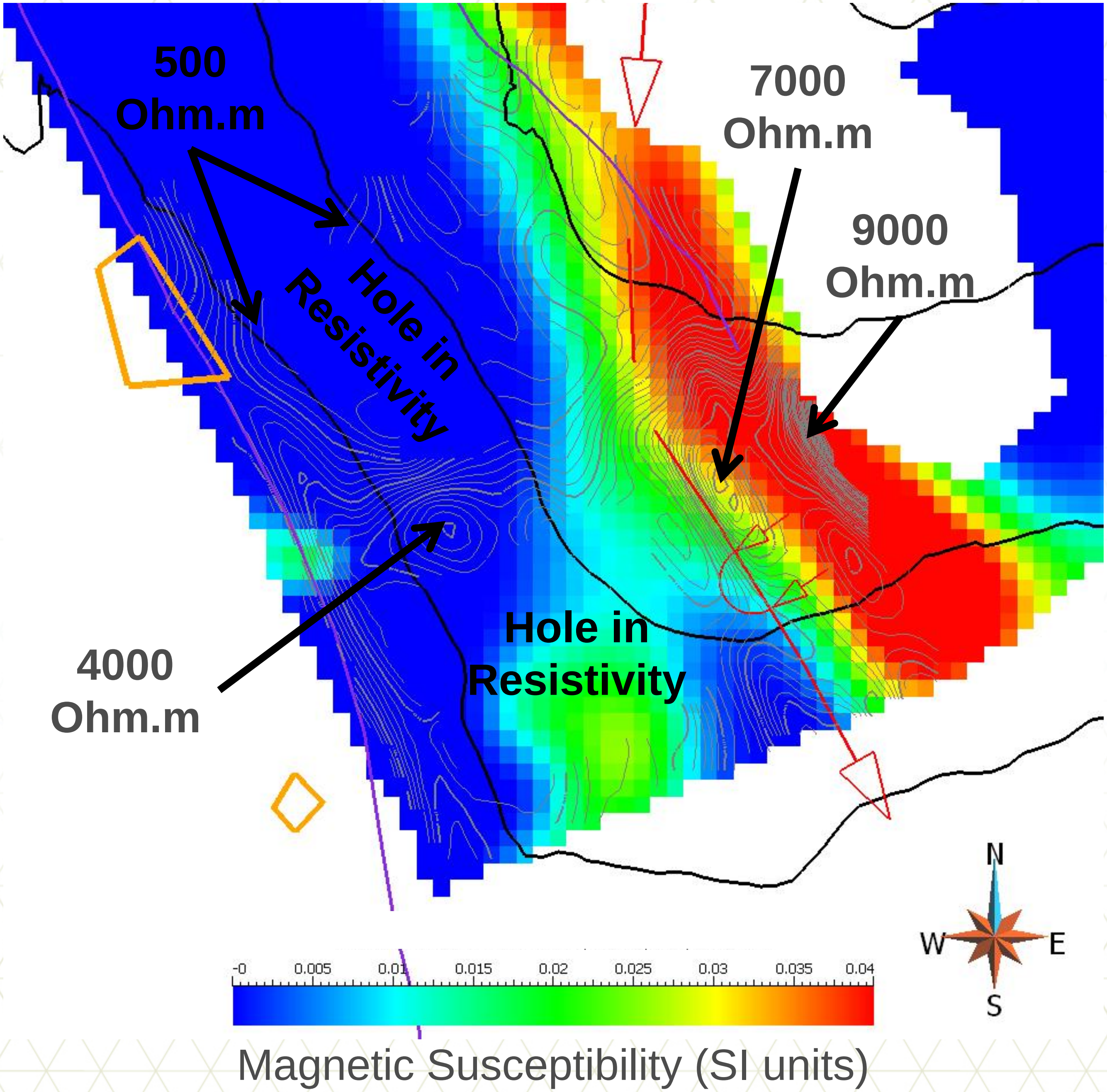

Figure 25: Map view of the 2D resistivity contours (grey) overlain on a horizontal slice of the magnetic susceptibility model at 0 masl. Warm colours represent magnetic susceptibility highs while cool colours represent magnetic susceptibility lows. Resistivity highs and lows are labeled. Topographic contours (black lines) are shown with a 200 m contour interval. Mapped surface faults are shown in purple and fold axes are shown in red.

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Conclusions

- The observed magnetic susceptibility contrast between the mafic and felsic volcanic rocks could be a valuable exploration tool. It may be possible to use magnetics to geophysically characterize the geologic relations of these units in the subsurface in order to help locate the sulphide bodies within.

- At the Tulsequah Chief grid, a relationship may exist between chargeability and the location of the known sulphide body. Chargeability may be a useful tool to help identify other sulphide zones.

- The utility of resistivity in the study area to better understand geologic relations and aid with the targeting of mineralization is unclear.

- The geophysical survey grids are generally long and narrow making it difficult to confidently interpret features located on the edges of the grids.

Recommendations

- A review of the results of the 1980’s era DIGHEM survey would be useful to better assess the value of resistivity for interpreting the geology and mineralization in the area.

- 3D inversion modelling of the IP data (using the compactness algorithm) is recommended for the Big Bull, Southeast, and Banker grids to investigate the relationship, if any, between chargeability, the other geoscience datasets, and mineralization.

- Borehole geophysical measurements of rock physical properties (e.g. magnetic susceptibility, resistivity, etc.) in sufficient quantities would be valuable data to use as constraints in future 3D geophysical modelling. Physical property-constrained geophysical modelling is superior to unconstrained modelling in that it directly relates the measured geophysical responses with the actual physical properties measured in the rocks.

Recommendations

- Surface measurements of rock physical properties are also helpful for physical property-constrained geophysical modelling and collection of such data is also recommended.

- Geologically-constrained geophysical modelling of the existing magnetic and IP data using geological information from the client's 3D Gemcom model may be useful to more confidently relate the actual geology with their geophysical responses. Such an analysis could potentially help predict the geology in areas that have not yet been drilled. Rock physical property data will be required for this effort to be effective.

- A magnetic survey covering the entire study area, followed by 3D geophysical modelling of the collected magnetic data, would be useful to fill in the gaps between the existing ground magnetic datasets and avoid the difficulties of interpreting features on the edges of grids.

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Recommendations

- New ground-based DCIP geophysical surveys, followed by 3D geophysical modelling of the collected data, may be useful to help delineate zones of high and low chargeability in new areas of exploration.

- Due to the high density of massive sulphide deposits, a gravity survey, followed by 3D geophysical modelling of the collected data, may be useful to detect dense, mineralized bodies. The success of this technique, however, would be limited for small/deep dense bodies.

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX III
MIRA GEOSCIENCE REPORT:

Magnetic 3D Modelling:
Tulsequah Project, BC
For Chieftain Metals Inc.

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

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Magnetic 3D Modelling: Tulsequah Project, BC For Chieftain Metals Inc.

Advanced Geophysical Interpretation Centre

Project: 4004

Thomas Campagne
May 10, 2013

Outline

- Introduction
- Data
- Processing
- 3D Inversion
- Results
- Conclusion
- Recommendations
- Deliverables

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Introduction

- The Advanced Geophysical Interpretation Centre (AGIC) at Mira Geoscience has completed 3D inversion of ground magnetic data of the Tulsequah project area, British-Columbia, for Chieftain Metals Inc.
- This project used ground magnetic data collected by Delta Geoscience Ltd.
- The UBC-GIF MAG3Dinv suite of algorithms was used for the inversions. The modelling is carried out for two areas of interest; North and South blocks, delimited over the footprint of the various survey grids (See Figure 1).
- The results are presented in 3D susceptibility physical property models.
- This is a brief presentation which describes the steps of the modelling process.

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Data

- Ground magnetic survey by Delta Geoscience Ltd.:
  - 100 m line spacing,
  - Surveyed in July to September 1993 over the project area (Figure 1),
  - Levelled Total Magnetic Intensity (TMI) data corrected for diurnal variation.

- The topography data were provided by the client in the form of 5 m contoured LIDAR data. For topography surrounding the LIDAR data, 250k scale Canadian Digital Elevation Data (CDED) were used (Figure 2).

- Coordinate system: NAD83 UTM Zone 8N.

Data

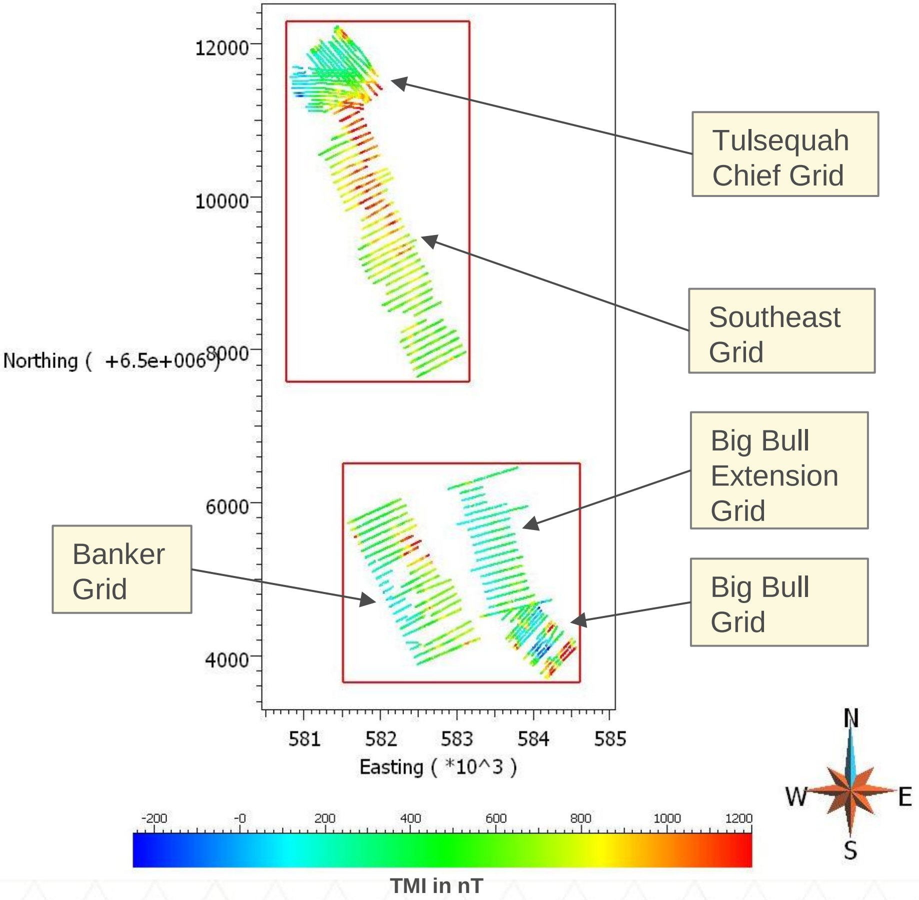

Figure 1: Survey lines with upward continued total magnetic field (nT) and North/South blocks (in red).

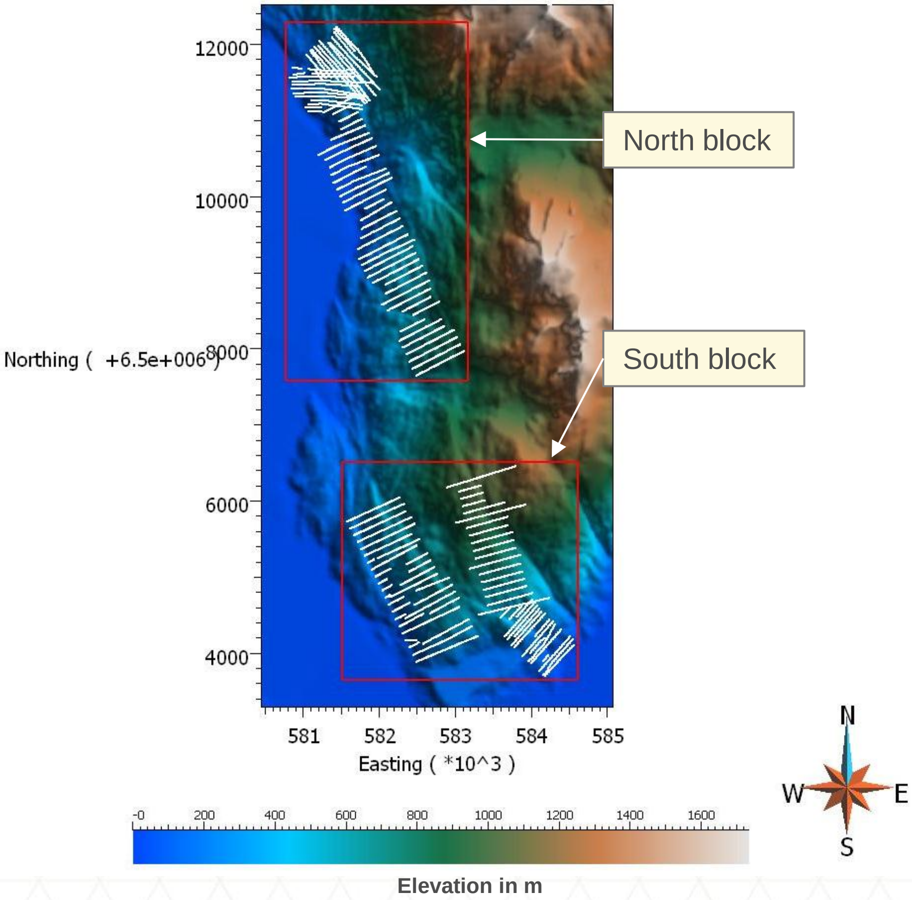

Figure 2: LIDAR topography completed with CDED data with survey lines (in white) and North/South blocks (in red).

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Processing

- A 25 m x 25 m x 25 m grid cell size was used for modelling.
- Observed data consisted of levelled and diurnal corrected TMI data after removal of the ambient magnetic field intensity (IGRF-2011) at the time of the survey and upward continuation to an elevation of 12.5 m above topography (see Table 1).
- Regional and residual magnetic signals from the surveys needed to be separated due to the lack of regional data around the project area. This was performed based on the method described in: *Separation of regional and residual magnetic field data, Y. Li, D.W. Oldenburg, GEOPHYSICS, VOL. 63, NO. 2 (MARCH-APRIL 1998); P. 431–439, 13 FIGS.*
- The regional signal was derived from a volume that did not include a “scooped” volume underlying the magnetic survey footprint. For the north and south blocks, this “scooped” volume extended ~200 m around the survey edges and to depths of 600 m and 700 m, respectively.
- SI units were used for the magnetic susceptibility (see Figures 5 to 11 and 13 to 19).
- A sensitivity matrix calculation was performed.
- Compact unconstrained inversions were completed.

Processing – Magnetic Field Characteristics

IGRF - 2011	
Latitude	58˚ 40’ 47.4” N
Longitude	133˚ 33’ 35.6” W
Mean Elevation	850 m
Surveys Dates	July - August - September 1993 (half-way on August 15th)
Magnetic Field Inclination	75.40˚
Magnetic Field Declination	26.85˚
Magnetic Field Magnitude	57,463.84 nT

Table 1: Inducing Magnetic Field Parameters.

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3D Inversions

- The UBC-GIF MAG3D code was used in combination with the Compactness algorithm for the inversions of the magnetic datasets resulting in more compact susceptible bodies. The parameters are defined in the Table 2.
- Observed data consisted of residual of levelled TMI data after removal of the ambient magnetic field intensity at the time of the survey (IGRF 2011 on Aug 15, 1993). The regional signal was then removed with the separation method previously mentioned and standard deviations were assigned to the data (3% of the signal amplitude with a floor value of 26 nT for the North block data and 74 nT for the South block data).
- The observed residual magnetic data (separated from the regional signal) were inverted without constraints.
- Figures 3 and 4 shows the observed and predicted data from the North and South inverted models.
- Figures 6 to 12 show different views of the resulting susceptibility model for the North block and Figures 13 to 20 show different views of the resulting susceptibility model for the South block .

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3D Inversions

Inversion	North block	South block
Convergence criteria	Fixed Target Misfit	
Depth Weighting	Distance	
3D mesh	Core mesh fixed horizontal and vertical cell of 25 m x 25 m x 25 m. Slowly expanding padding cells were added around and below the core for processing purposes.	
Number of cells in mesh	3,955,770	2,290,404
Length scales	75, 75, 75 (Le, Ln, Lz)	
Compactness pseudo-model norm	0.7	
Compactness Model to gradient norm scaling	1	
Number of data inverted	3,603	3,246
Achieved misfit	2,817	1,182

Table 2: Inversions modelling parameters for the unconstrained and constrained inversions.

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Results – North Model Data

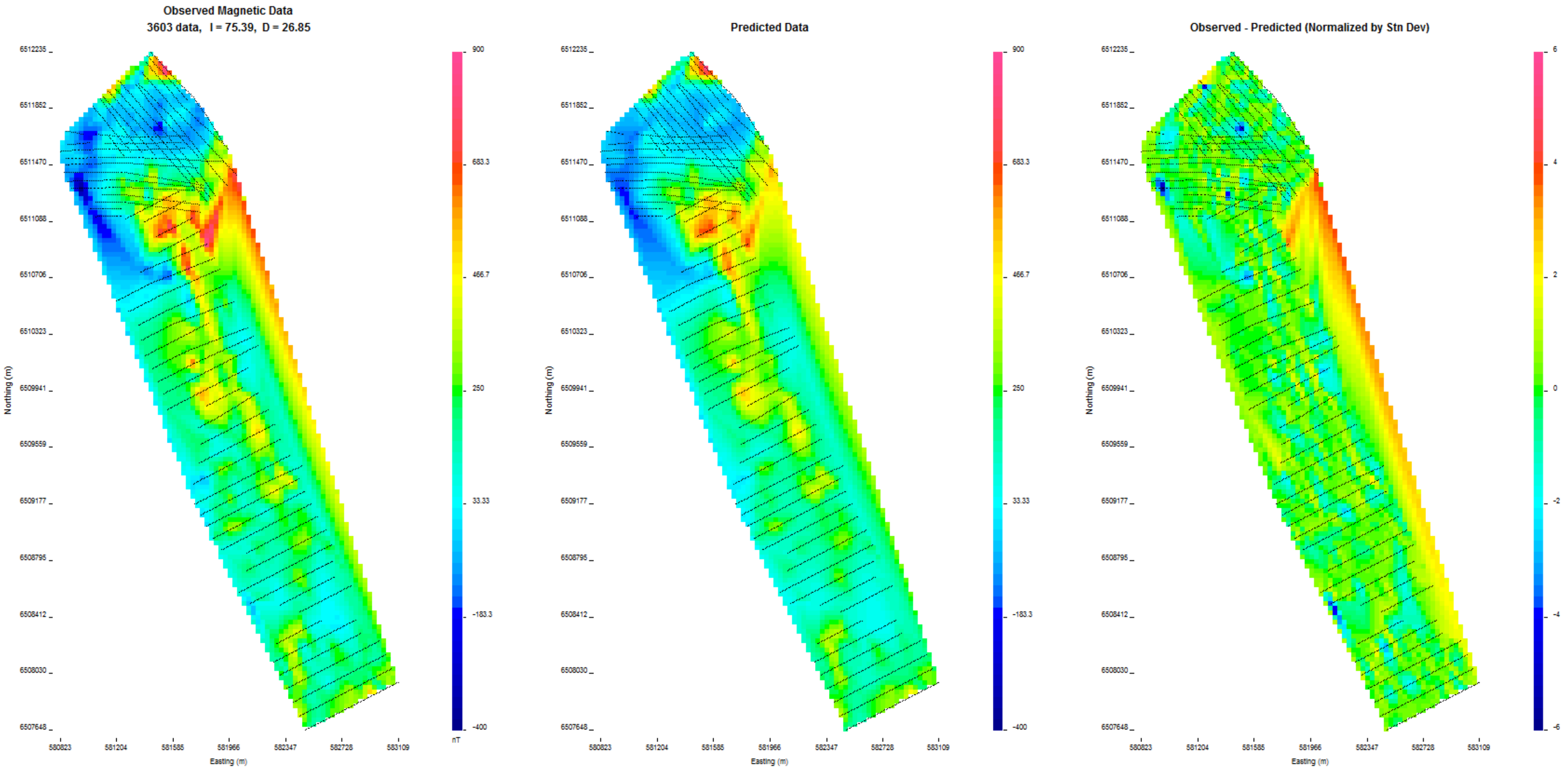

Figure 3: Observed (left), predicted (middle) and the difference normalized by the standard deviation (right) for the unconstrained inversion.

Achieved misfit = 2,817

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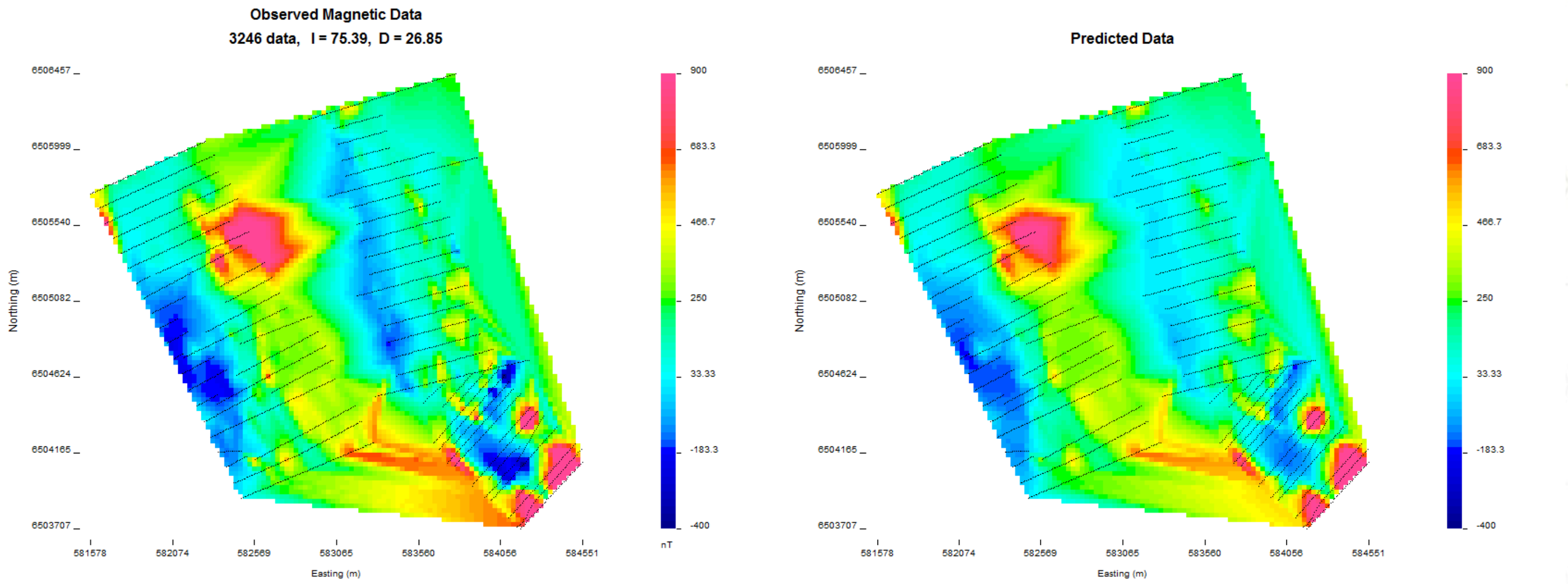
Results – South Model Data

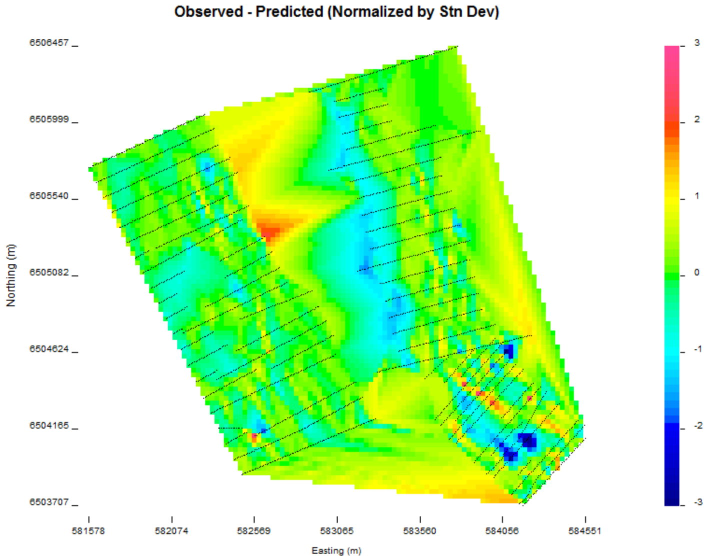


Observed Magnetic Data
3246 data, I = 75.39, D = 26.85

Predicted Data

Figure 3: Observed (left) , predicted (upper right) and the difference normalized by the standard deviation (bottom right) for the unconstrained inversion.

Achieved misfit = 1,182



Observed - Predicted (Normalized by Stn Dev)

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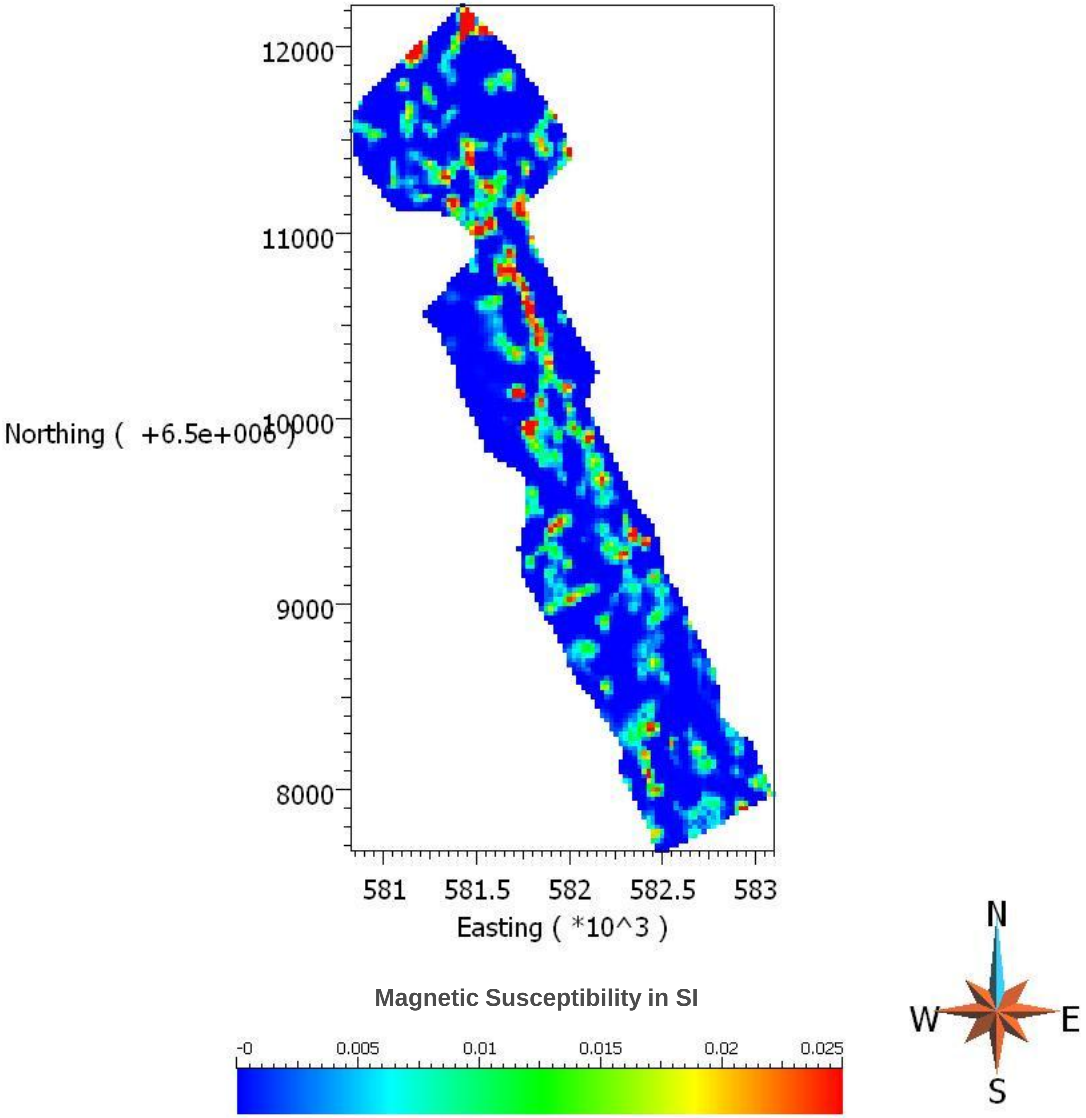
Results – North Model – Depth Slices

Figure 5: Unconstrained model depth slice at 38 m below topography.



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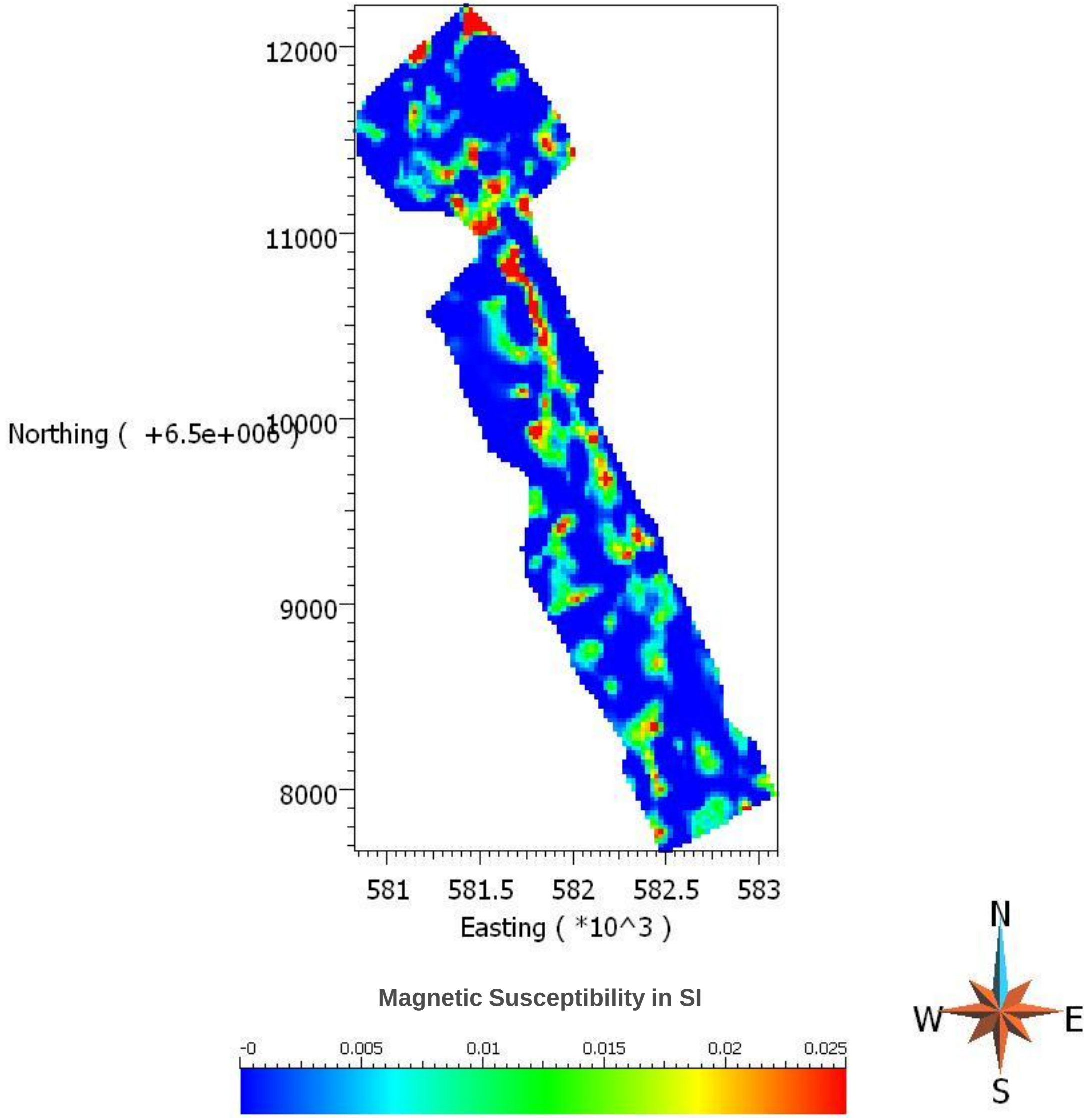
Results – North Model – Depth Slices

Figure 6: Unconstrained model depth slice at 63 m below topography.



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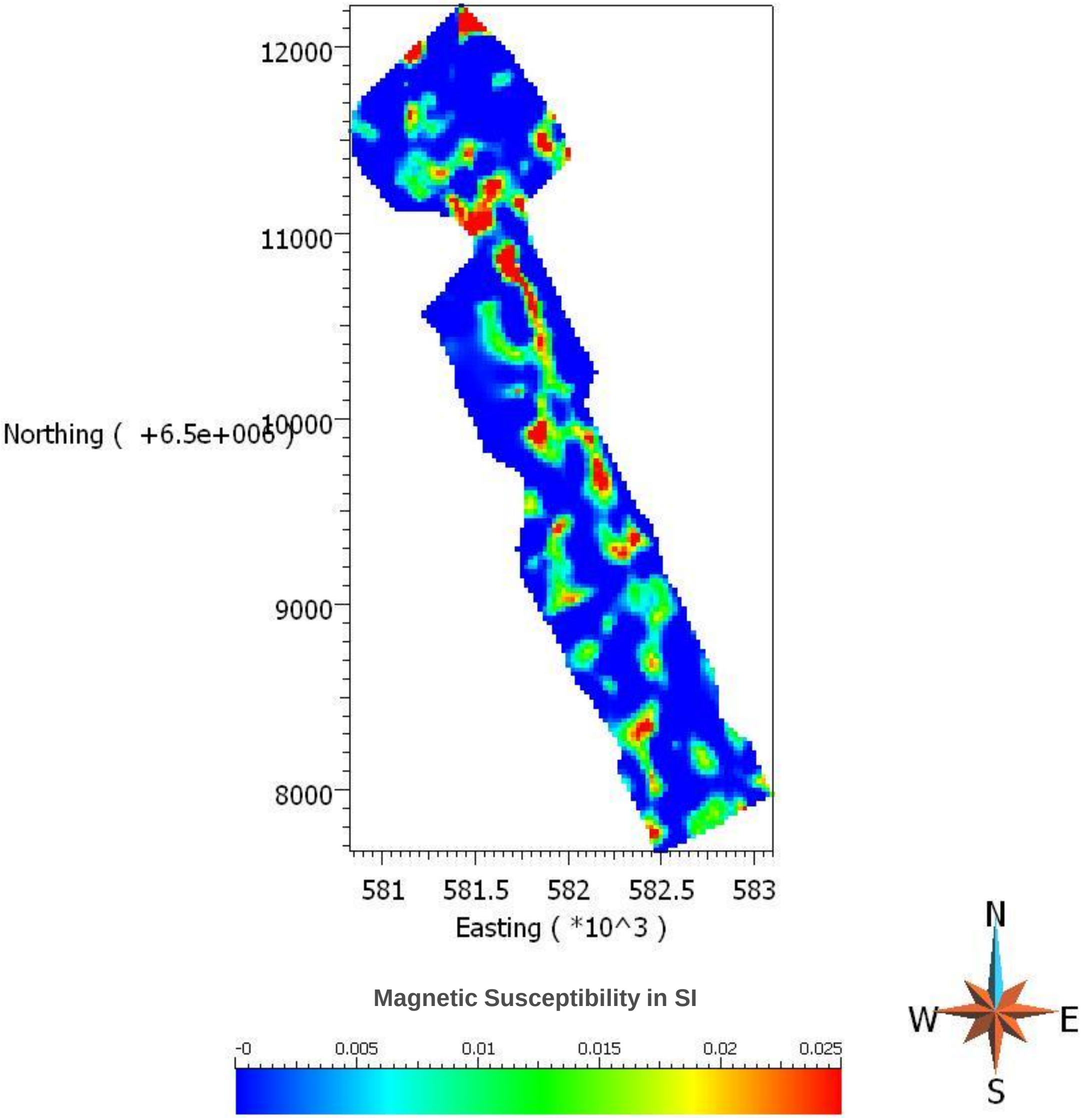
Results – North Model – Depth Slices

Figure 7: Unconstrained model depth slice at 88 m below topography.



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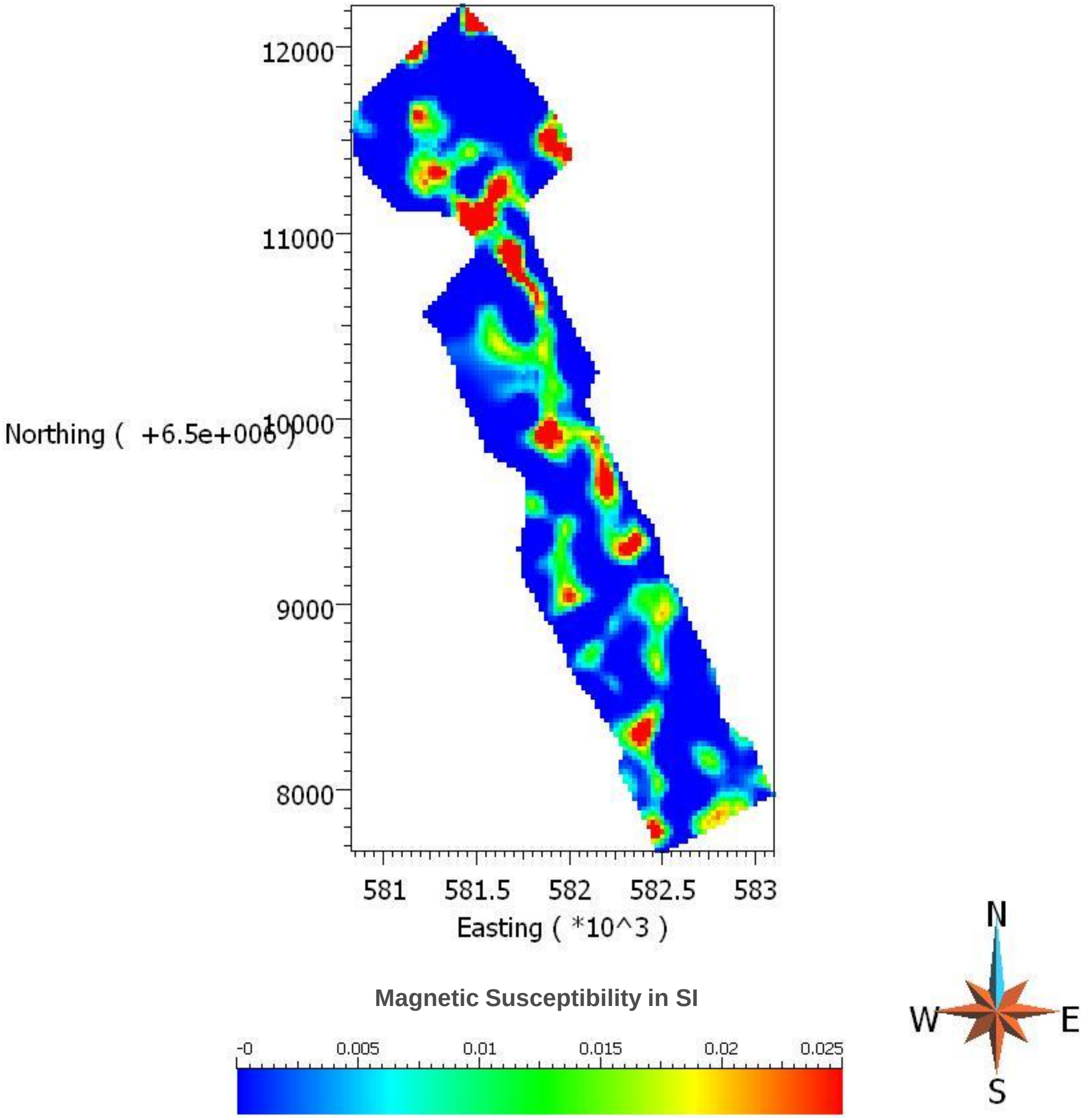
Results – North Model – Depth Slices

Figure 8: Unconstrained model depth slice at 138 m below topography.



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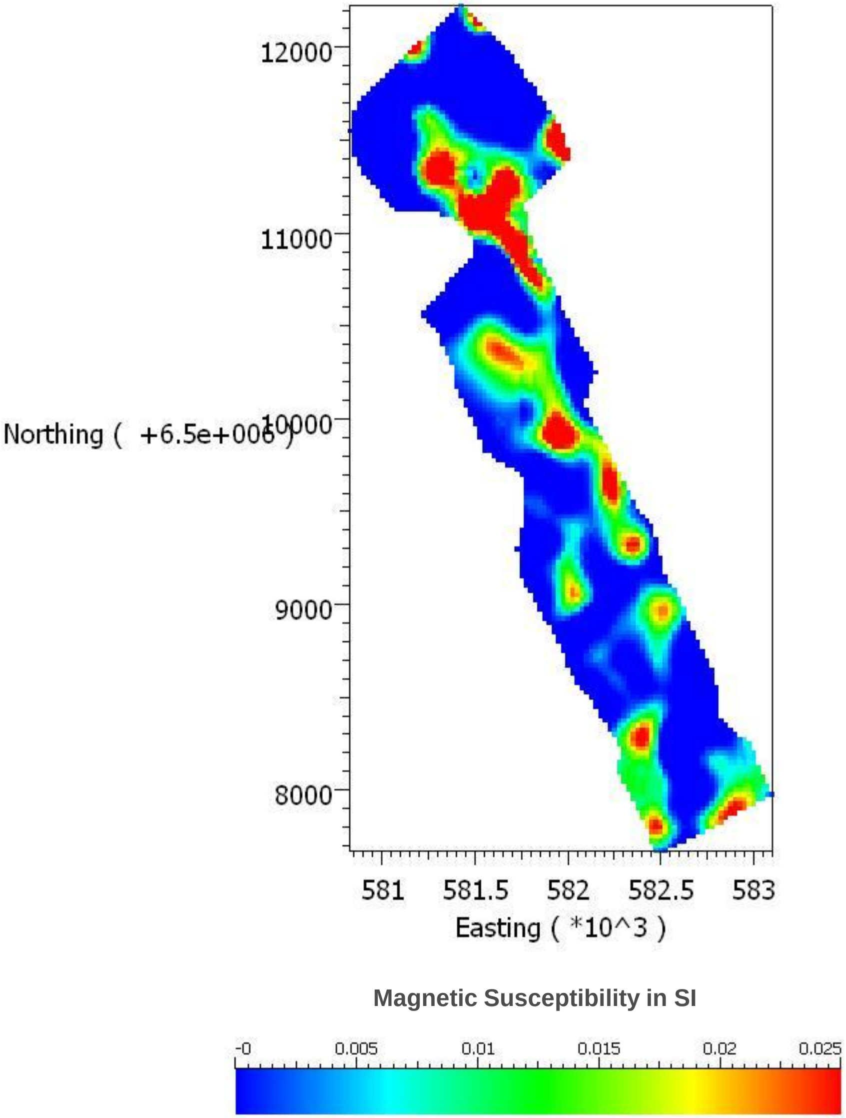
Results – North Model – Depth Slices

Figure 9: Unconstrained model depth slice at 238 m below topography.



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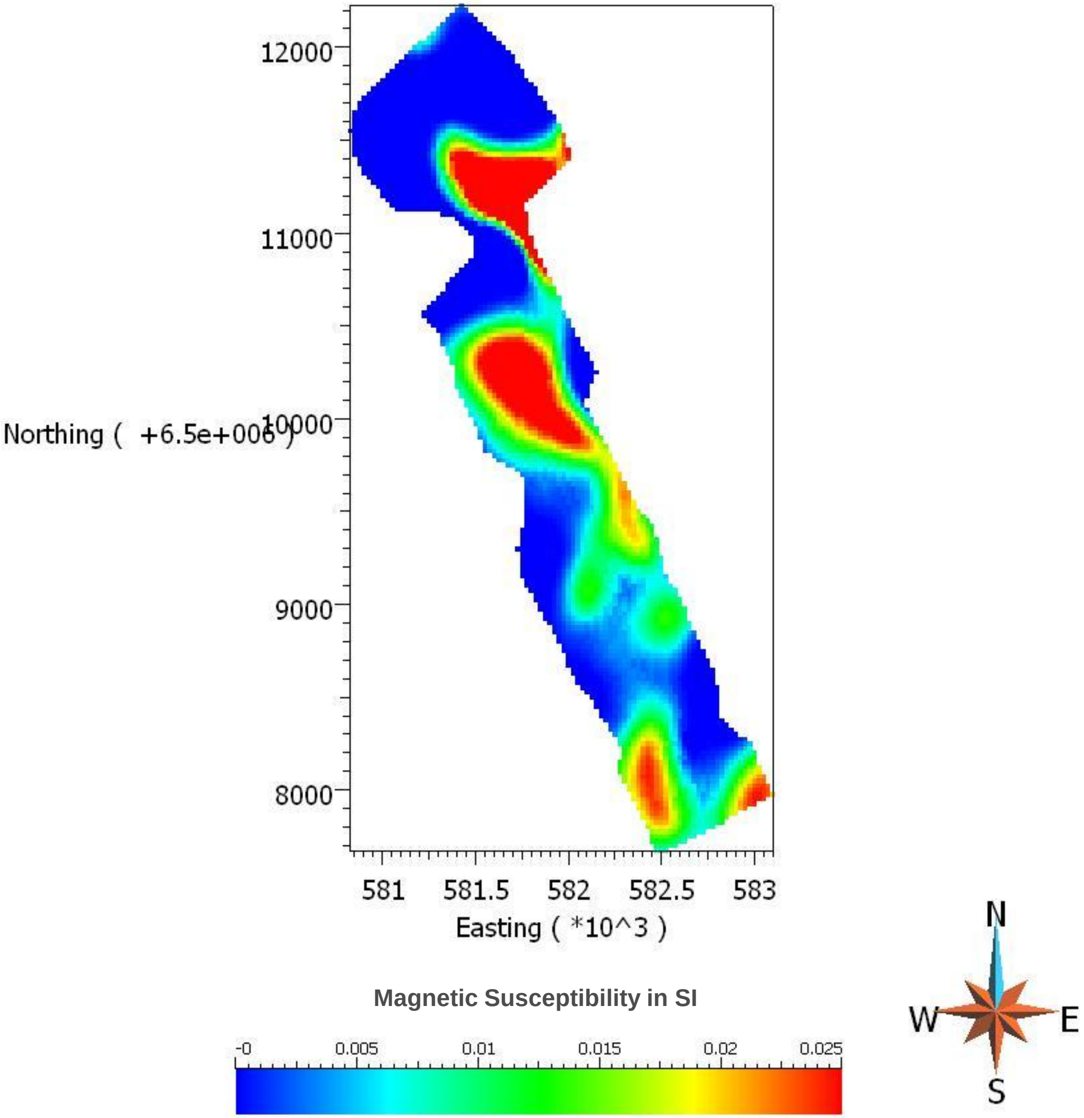
Results – North Model – Depth Slices

Figure 10: Unconstrained model depth slice at 438 m below topography.



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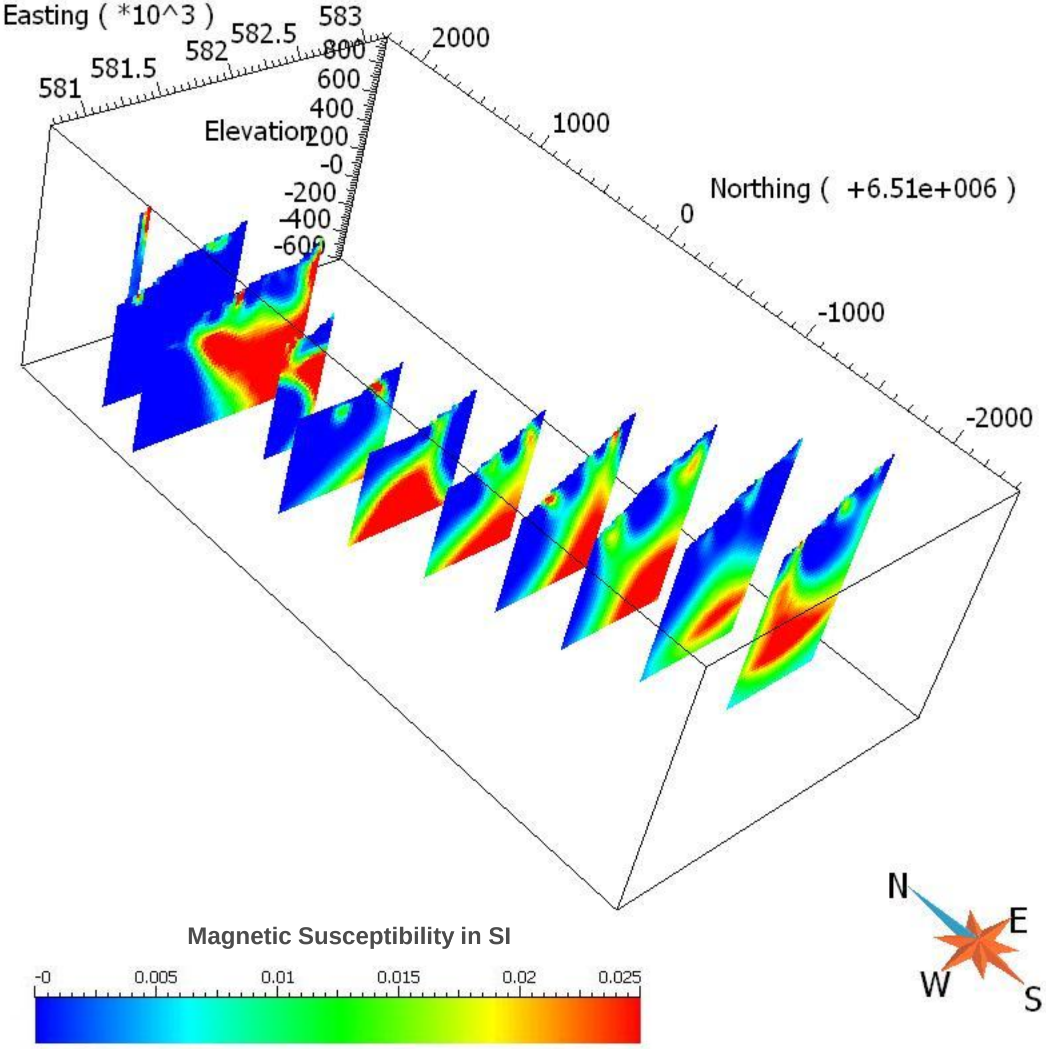
Results – North Model – EW Sections

Figure 11: North model with 400 m spaced sections.



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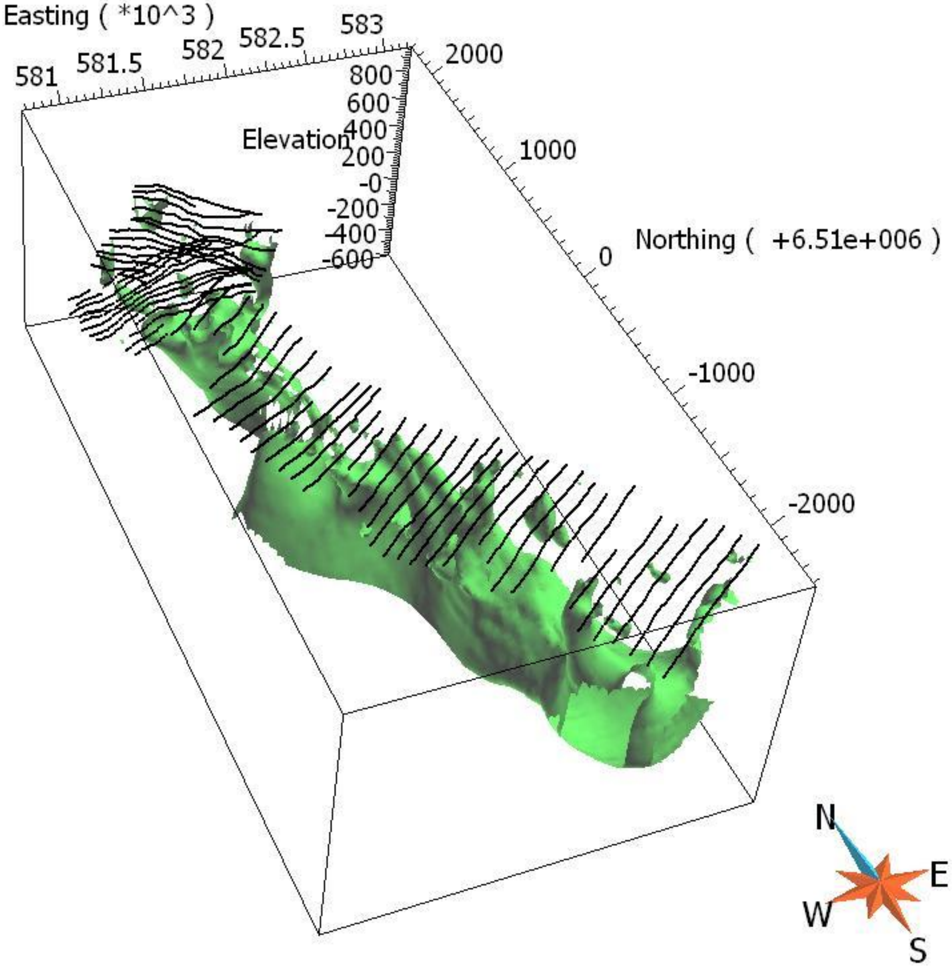
Results – North – 0.015 SI Isosurface

Figure 12: North model isosurface at 0.015 SI with survey lines (in black).



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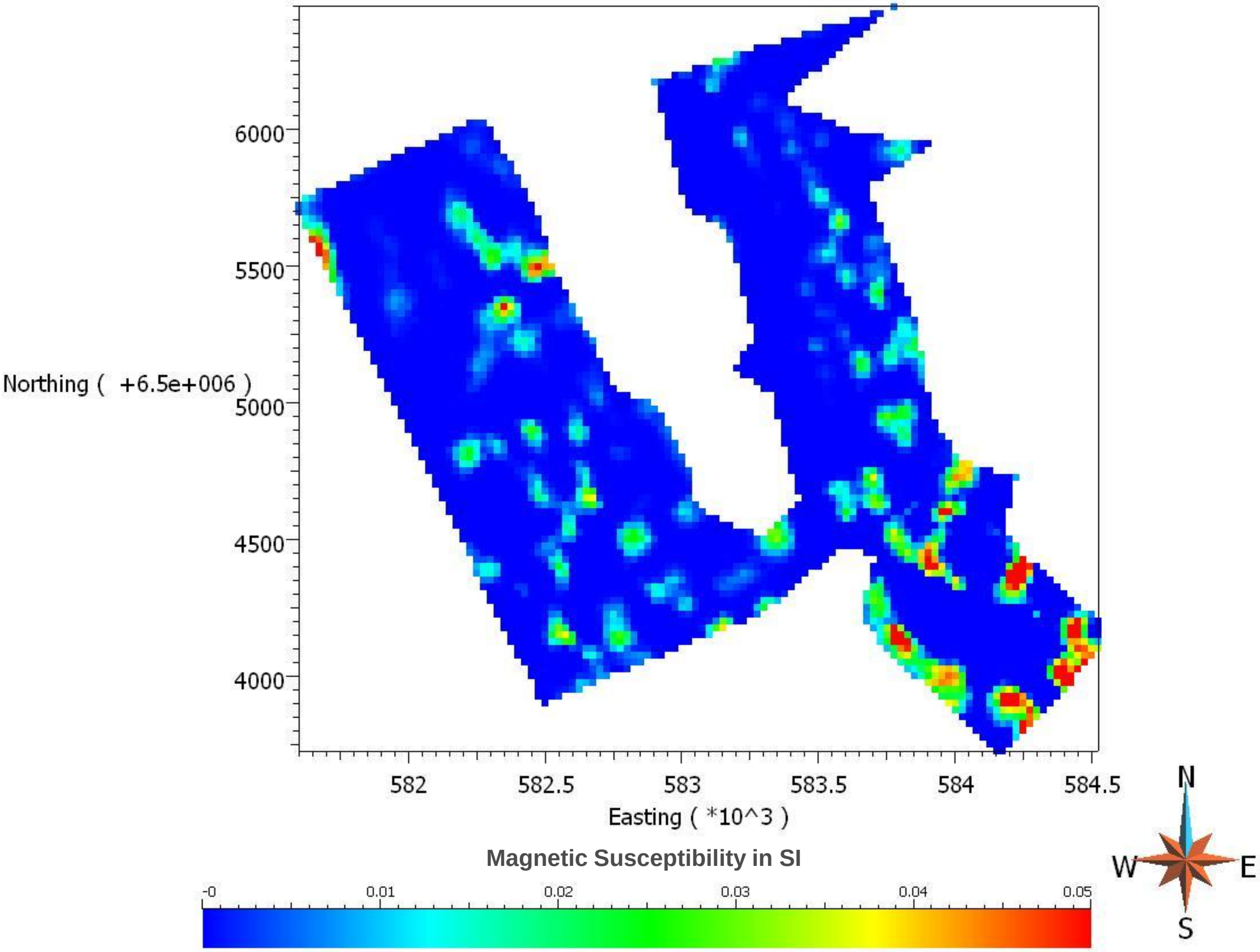
Results – South Model – Depth Slices

Figure 13: South model depth slice at 38 m below topography.



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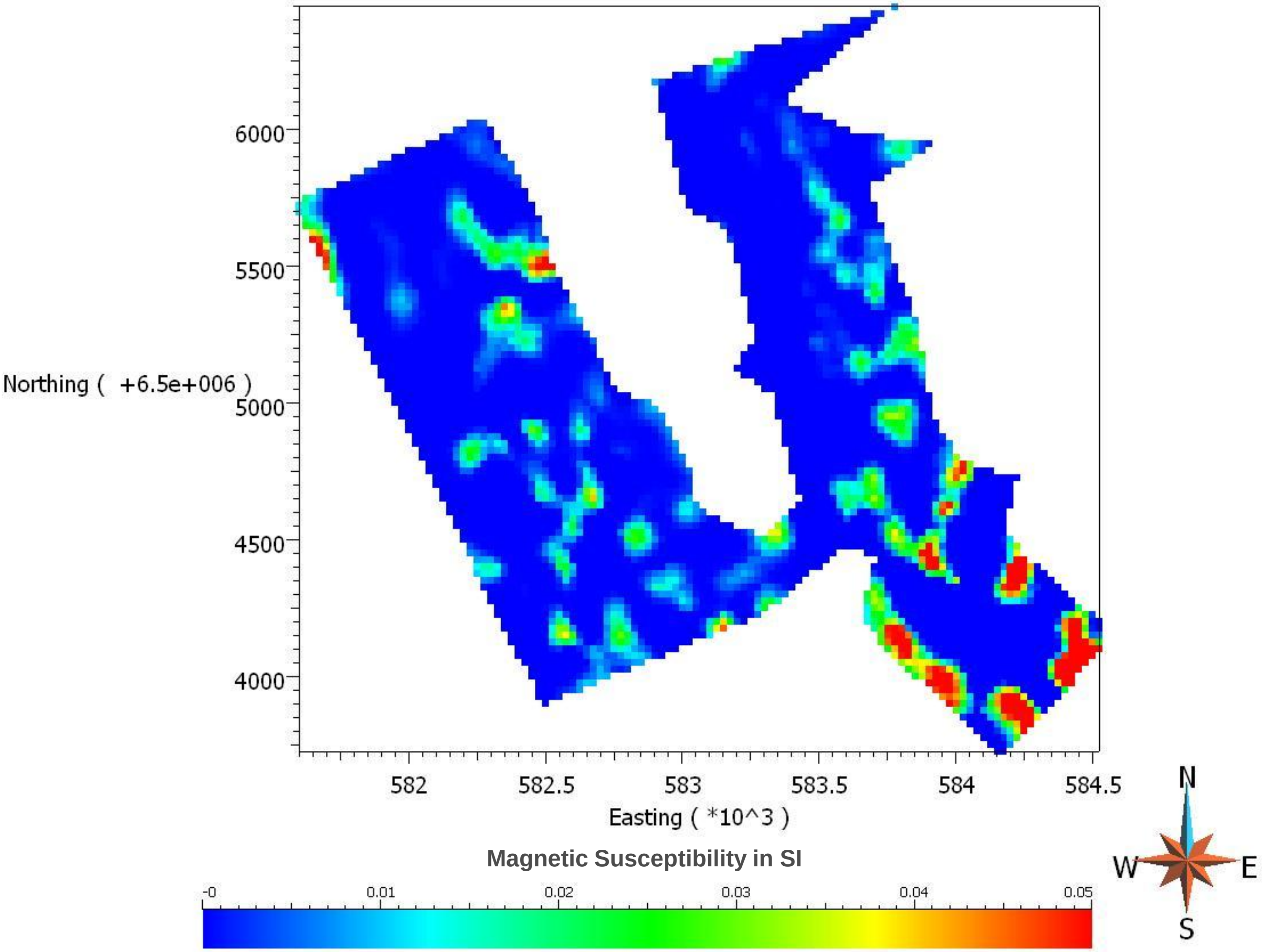
Results – South Model – Depth Slices

Figure 14: South model depth slice at 63 m below topography.



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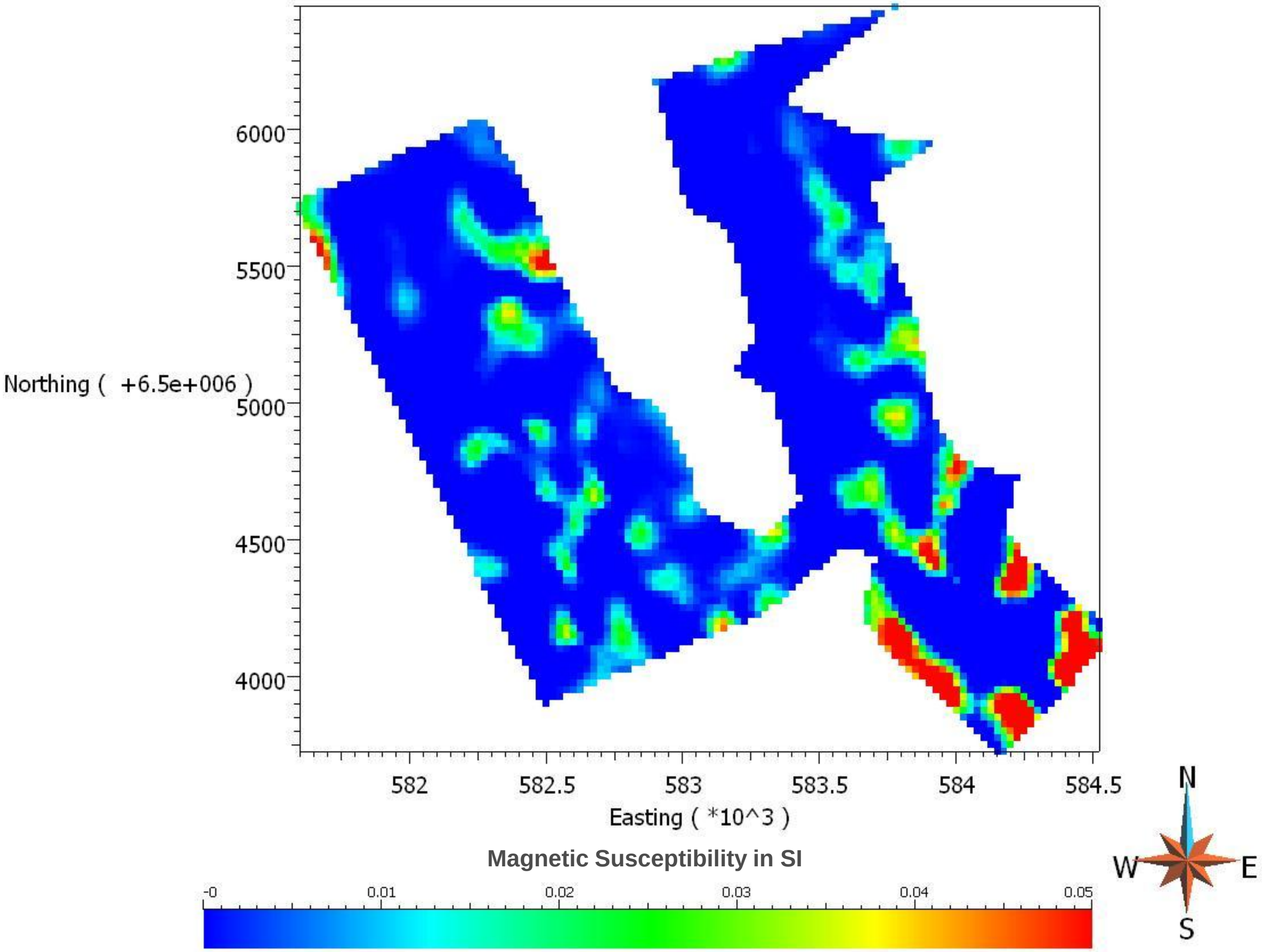
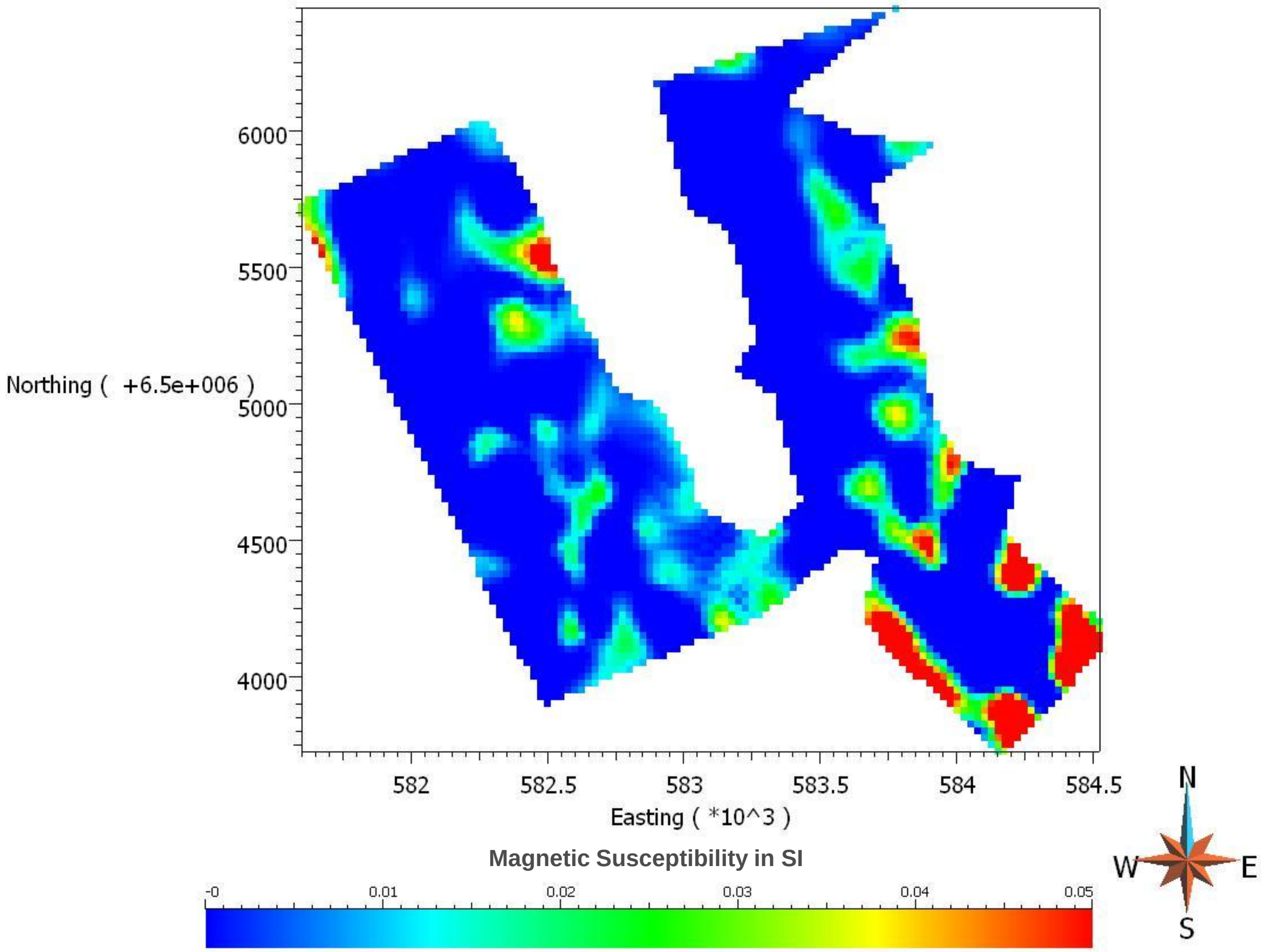
Results – South Model – Depth Slices

Figure 15: South model depth slice at 88 m below topography.



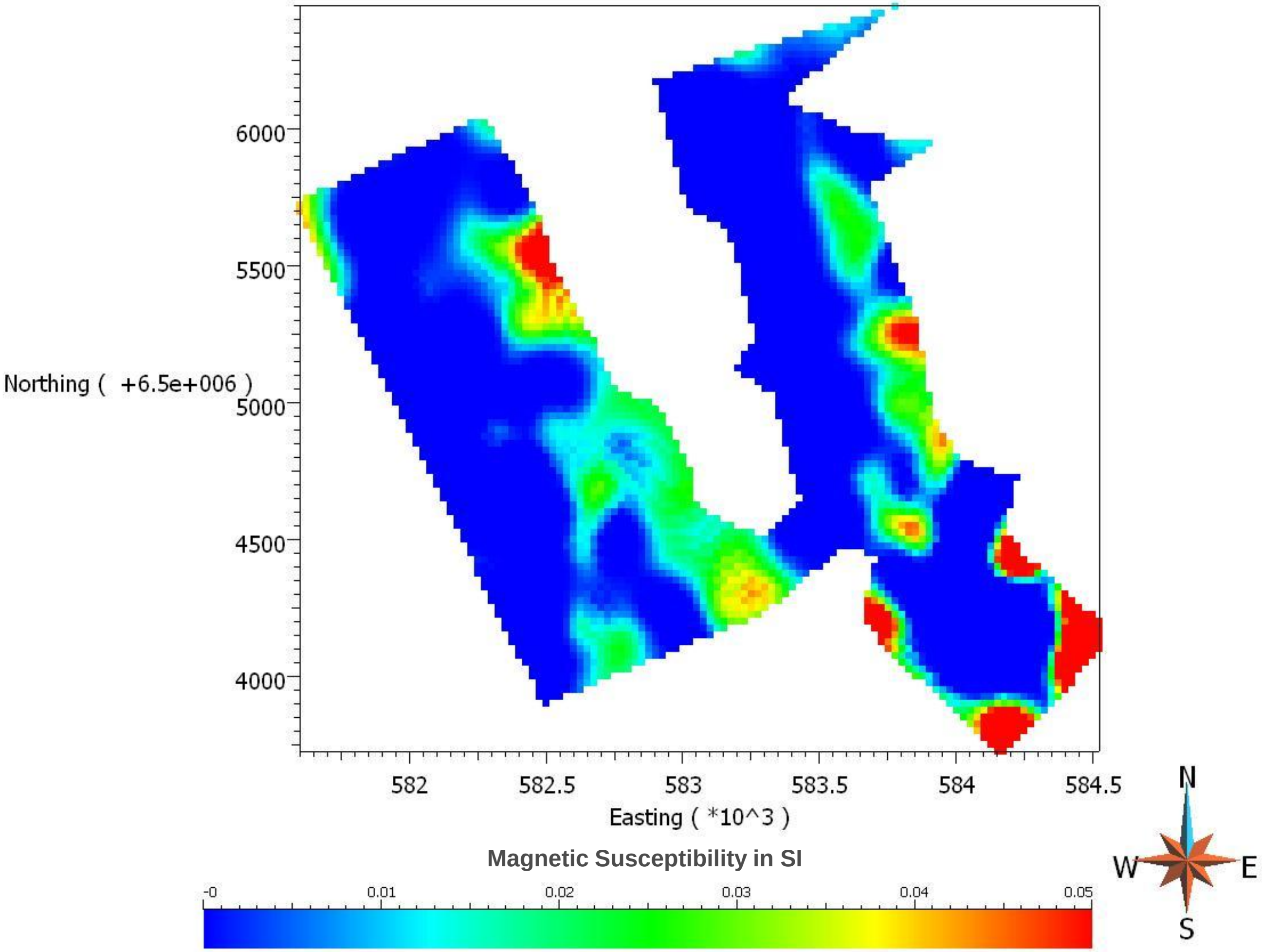
Results – South Model – Depth Slices

Figure 16: South model depth slice at 138 m below topography.



Results – South Model – Depth Slices

Figure 17: South model depth slice at 238 m below topography.



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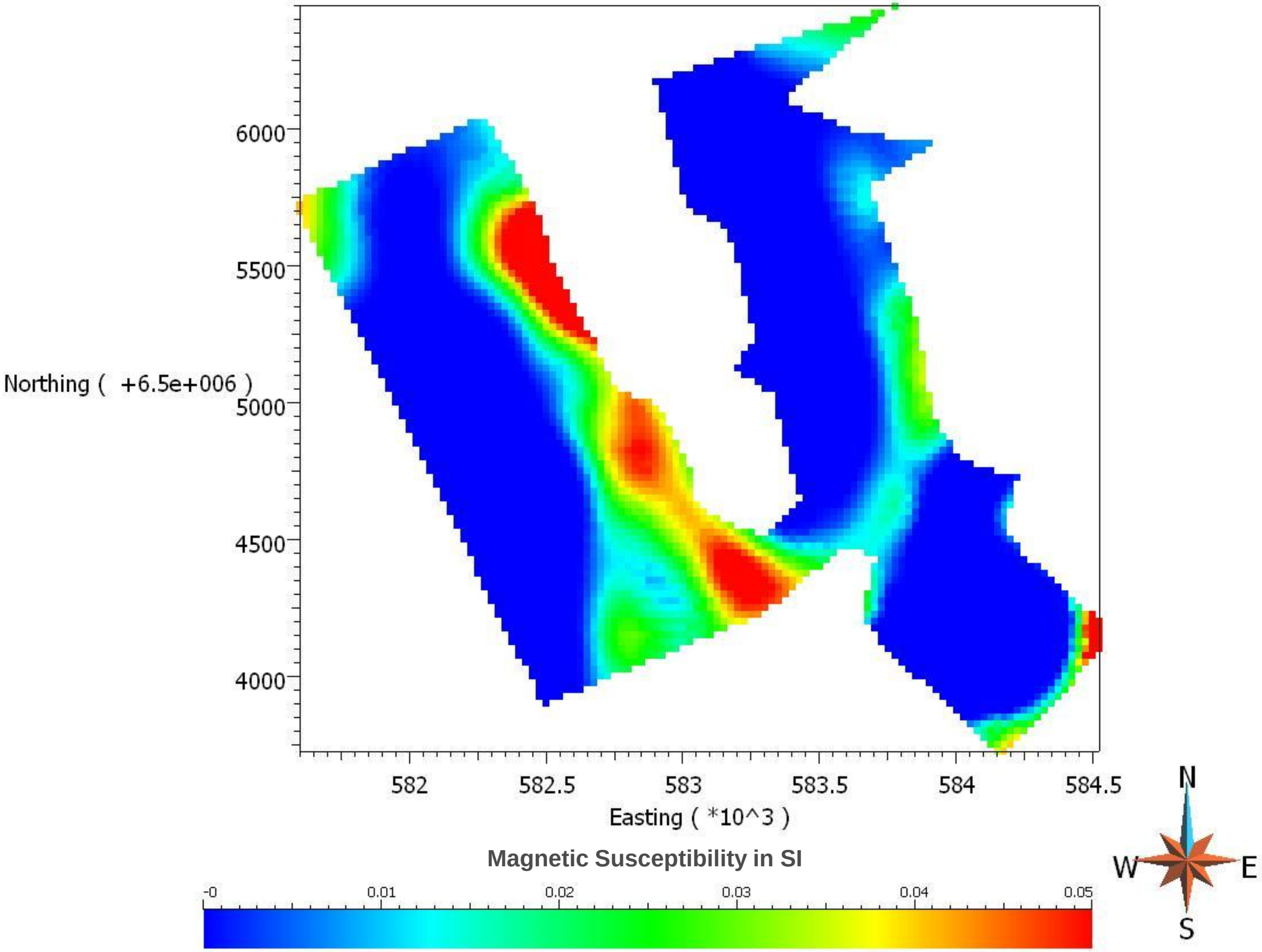
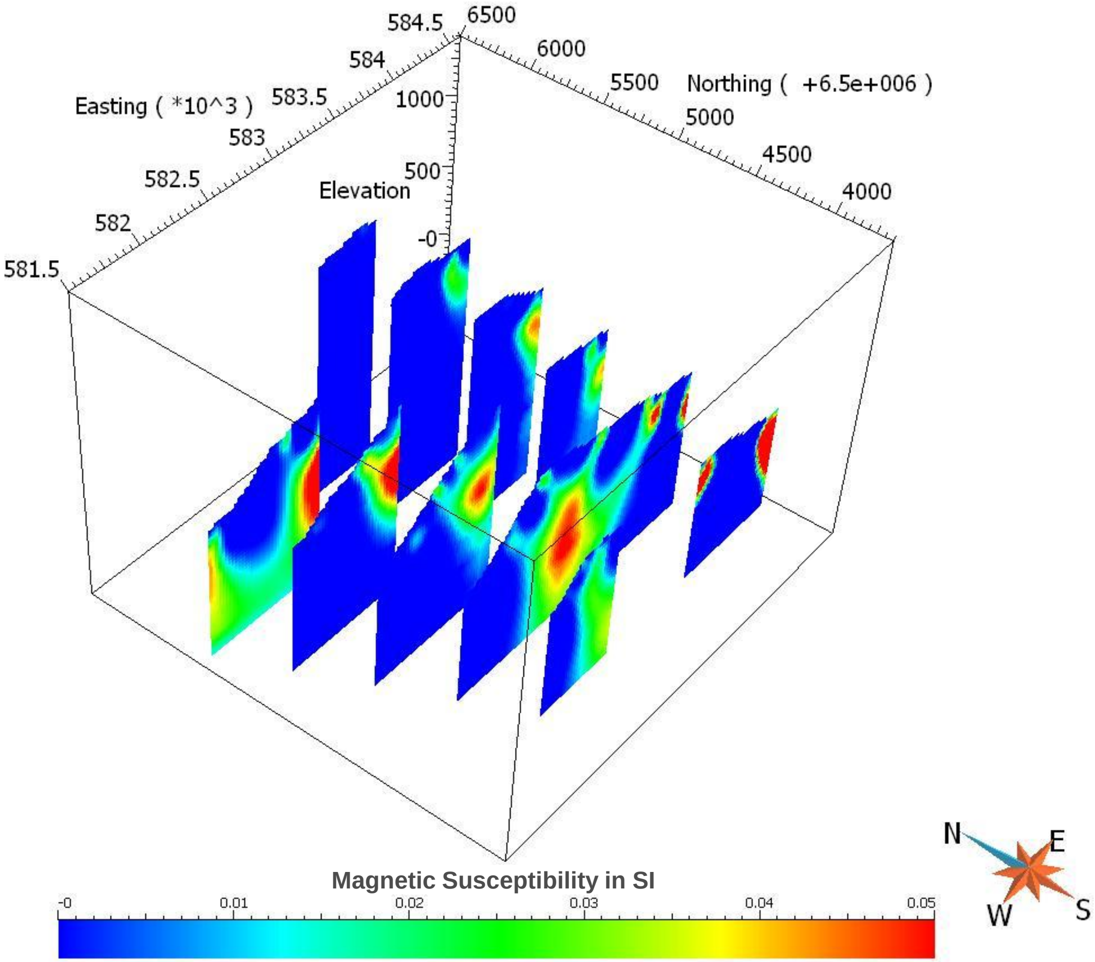
Results – South Model – Depth Slices

Figure 18: South model depth slice at 438 m below topography.



Results – South Model – EW Sections

Figure 19: South model with 400 m spaced sections.



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Results – South – 0.015 SI Isosurface

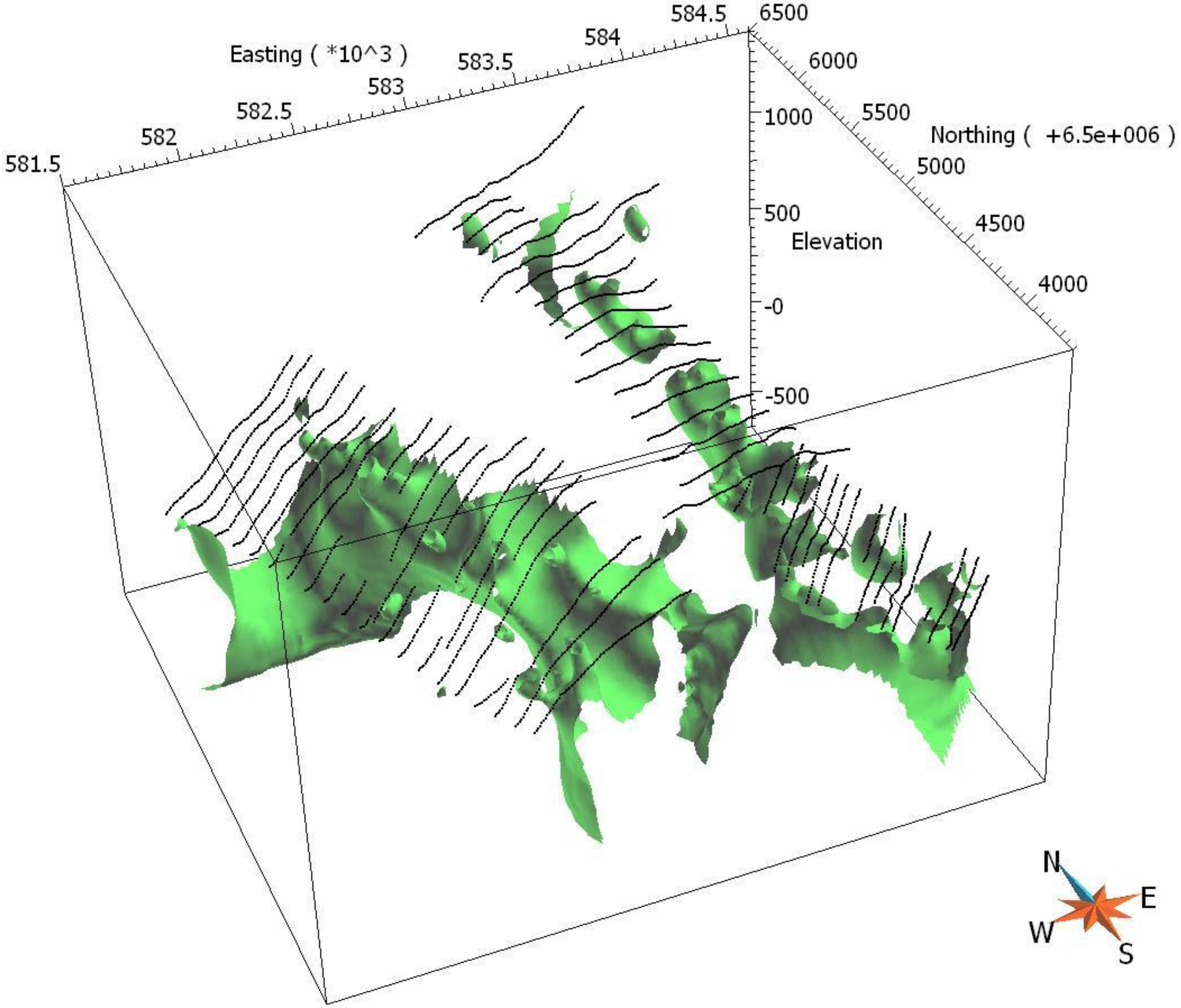

Figure 20: South model isosurface at 0.015 SI with survey lines (in black).

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Notes about the inversion

- The short length of the lines limits the depth resolution of the inversion modelling.

- The lack of data between the Banker and Big Bull grids does not allow for reliable results in areas of the terrain that are not covered by data. These areas were cropped from the model.

- A lack of data beyond the southern edge of the Big Bull grid makes it difficult to fully characterize a strong magnetic susceptibility high in this area.

Conclusions

- Survey lines are short thus limiting the depth resolution of the inversion modelling.
- Near surface (~100 m) modelled susceptibility anomalies extend across multiple survey lines in the North block and seem to be linked to deep and broad anomalies at depth (~240 m).
- A high susceptibility anomaly at depth (~ 240 m) is seen along the northeast edge of both Banker and Big Bull grid but is not present on the southwest edge of or across the Big Bull Extension grid.
- The use of the Compactness algorithm for modelling improved the characterization of the dip of the modeled susceptible bodies.
- Overall, data fit was good for all grids except the Big Bull grid where the inversion had difficulty fitting abnormally high magnetic signal.

Recommendations

- Extend survey lines in areas where better depth resolution is needed.
- Extend survey lines between Banker and Big Bull grids to resolve susceptibility anomaly at depth.
- Extend survey lines to the south of the Big Bull grid to better characterize the observed anomalies.
- 3D magnetic modelling of the Big Bull grid alone would likely improve data fit leading to greater confidence in the model result.
- Caution is to be used when interpreting magnetic data in the immediate vicinity of previously operating mines as the possible presence of large metallic structures will affect the magnetic signal.

Project Deliverables

Format	Name	Description
PDF	Magnetic 3D Modelling: Tulsequah Project, BC For Chieftain Metals Inc.	Procedure report detailing the magnetic inversion process.
Gocad	Chieftain_UBC_Mag_North_Model.gprj Chieftain_UBC_Mag_South_Model.gprj	Gocad projects for North and South blocks
UBC-GIS format	Chieftain_North_25x25x25.msh Chieftain_North_Scooped_Data.obs Chieftain_North_Scooped_UBC_Compactness.pre Chieftain_North_Scooped_UBC_Compactness.sus Chieftain_South_25x25x25.msh Chieftain_South_Scooped_Data.obs Chieftain_South_Scooped_UBC_Compactness.pre Chieftain_South_Scooped_UBC_Compactness.sus	UBC model mesh. Observed data used for the inversion. Predicted data from the inversion. Susceptibility model from the inversion. UBC model mesh. Observed data used for the inversion. Predicted data from the inversion. Susceptibility model from the inversion.
ASCII XYZ	Above mentioned UBC model files Chieftain_North_Scooped_Data_obs.csv Chieftain_South_Scooped_Data_obs.csv	 Observed data, scooping intermediate data and predicted data. Observed data, scooping intermediate data and predicted data.

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Project Deliverables

Format	Name	Description
Geosoft grids	Chieftain_North_Scooped_UBC_Compactness_Easting_xxxxxx.grd	EW sections of the susceptibility model.
	Chieftain_North_Scooped_UBC_Compactness_Northing_xxxxxxx.grd	NS sections of the susceptibility model.
	Chieftain_North_Scooped_UBC_Compactness_DepthOffset_sxxxx.grd	Plan sections of the susceptibility model at various depths.
	Chieftain_South_Scooped_UBC_Compactness_Easting_xxxxxx.grd	EW sections of the susceptibility model.
	Chieftain_South_Scooped_UBC_Compactness_Northing_xxxxxxx.grd	NS sections of the susceptibility model.
	Chieftain_South_Scooped_UBC_Compactness_DepthOffset_sxxxx.grd	Plan sections of the susceptibility model at various depths.
DXF	Chieftain_DEM_merged_Lidar5m_CDED250k_surface.dxf	Topography covering all surveyed areas.
	Chieftain_North_AOI.dxf	North block area of interest outline.
	Chieftain_North_Mag_data_hull.dxf	North block survey outline.
	Chieftain_North_Scooped_UBC_Compactness_sus_0d01.dxf	0.01 SI isosurface from the North block inverted model.
	Chieftain_North_Scooped_UBC_Compactness_sus_0d015.dxf	0.015 SI isosurface from the North block inverted model.
	Chieftain_North_Scooped_UBC_Compactness_sus_0d02.dxf	0.02 SI isosurface from the North block inverted model.
	Chieftain_North_Scooped_UBC_Compactness_sus_0d03.dxf	0.03 SI isosurface from the North block inverted model.
	Chieftain_South_AOI.dxf	South block area of interest outline.
	Chieftain_South_Mag_data_hull.dxf	South block survey outline.
	Chieftain_South_Scooped_UBC_Compactness_sus_0d01.dxf	0.01 SI isosurface from the South block inverted model.
	Chieftain_South_Scooped_UBC_Compactness_sus_0d015.dxf	0.015 SI isosurface from the South block inverted model.
	Chieftain_South_Scooped_UBC_Compactness_sus_0d02.dxf	0.02 SI isosurface from the South block inverted model.
	Chieftain_South_Scooped_UBC_Compactness_sus_0d03.dxf	0.03 SI isosurface from the South block inverted model.

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2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX IV
MIRA GEOSCIENCE REPORT:

3D Induced Polarisation Modelling:
Tulsequah Project, BC
for Chieftain Metals Inc.

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

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3D Induced Polarisation Modelling:
Tulsequah Project, BC
for Chieftain Metals Inc.

Advanced Geophysical Interpretation Centre

Project : 4004

Stanislawa Hickey
May 10, 2013

Outline

- Introduction
- Data
- Processing
- 3D Inversions
- Results
- Conclusion
- Deliverables

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Introduction

- The Advanced Geophysical Interpretation Centre (AGIC) at Mira Geoscience has completed 3D inversion of Induced Polarisation (IP) data of the Tulsequah project area, British Columbia, for Chieftain Metals.

- The modelling is carried out for the 25 lines surveyed over the Tulsequah Chief grid.

- The gradient-array IP data were inverted using the UBC-GIF MAG3D suite of algorithms in order to introduce depth information in the model.

- The gradient-array IP data can be modeled as magnetic data since both inducing fields are generated by a dipole source whose moment is proportional to the current density vector.

- The results are presented as 3D chargeability physical property models.

- This is a brief presentation which describes the steps and results of the modelling.

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Data

- Induced Polarization data collected by Delta Geoscience Inc. in 1994, at the Tulsequah project in northwest BC.

- The 25 gradient-array IP lines surveyed over the Tulsequah Chief Grid were used for the modelling (Figure 1).

- The line spacing is a 100 m.

- The potential electrode spacing is 50m and the current electrode separation is 1400m.

- The topography data (Figure 1) provided by the client were used for the inversion.

- Coordinates system: NAD83 UTM Zone 8N.

Data

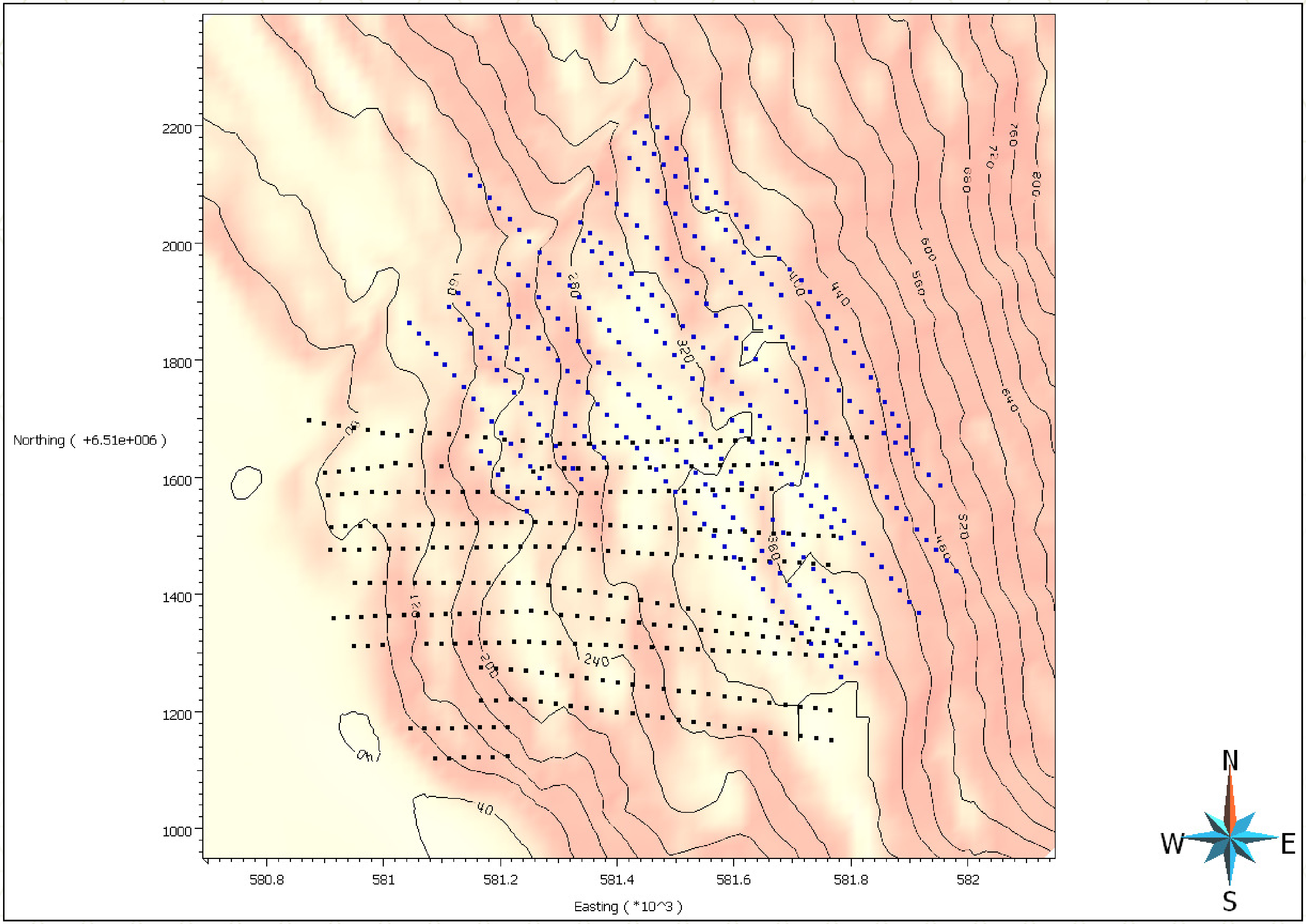

Figure 1: Gradient-array survey stations (blue and black dots) over for the Tulsequah Chief Grid with the topography contours.

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Processing

- The Tulsequah Chief IP survey consists of two overlapping grids with different line orientations (Figure 1). The data from each grid were extracted prior the modelling.

- The data were analyzed for quality control.

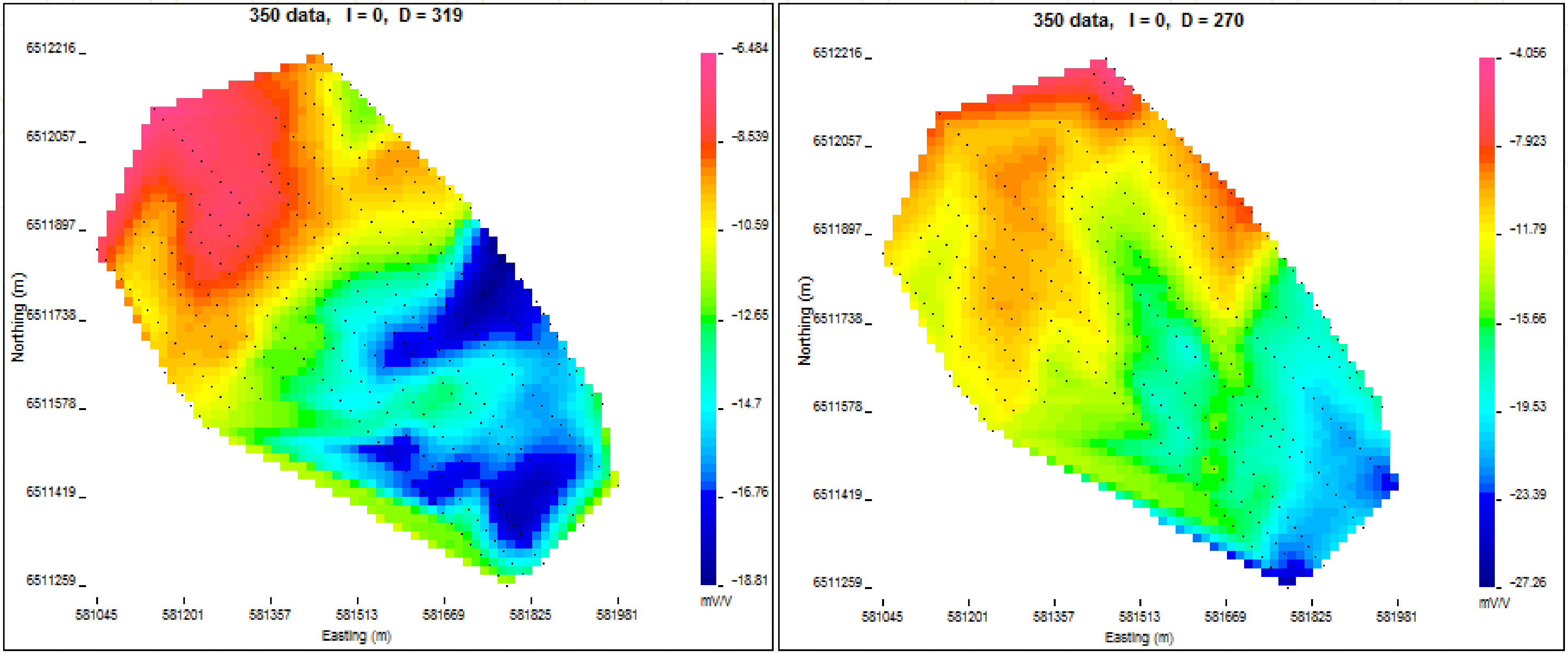
- The data were upward continued a height of 12.5 m to reduce the near surface and discretization effects.

- The IP data from each grid were prepared to be inverted with the MAG3D suite of algorithms. To be modelled as magnetic data, the inducing field is set antiparallel with respect to the location of the current electrodes with an inclination of 0° and a declination depending on the line orientation.

- The south part of the IP grid has an orientation of 270°. The north part of the IP grid has an orientation of 319°.

- In order to be inverted using a common inducing field declination of 270°, the data from both grids were levelled together using the forward modelling algorithm MAGFOR3D (Figure 2).

Processing



a)

b)

Figure 2: Observed data extracted from the north part of the IP survey grid and prepared for the inversion with the MAG3D algorithm: a) with the initial inducing field declination of 319° and b) calculated with the common grid inducing field declination of 270 °.

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Processing

- We observed that a removal of the regional response due to a large scale chargeable feature at depth was necessary. Thus, a regional removal step was applied to the dataset (Figure 3).

- A standard deviation of 2% of the data amplitude with a floor of 3% of the measurements magnitude was assigned to the data for modelling purposes to account for data noise.

Processing

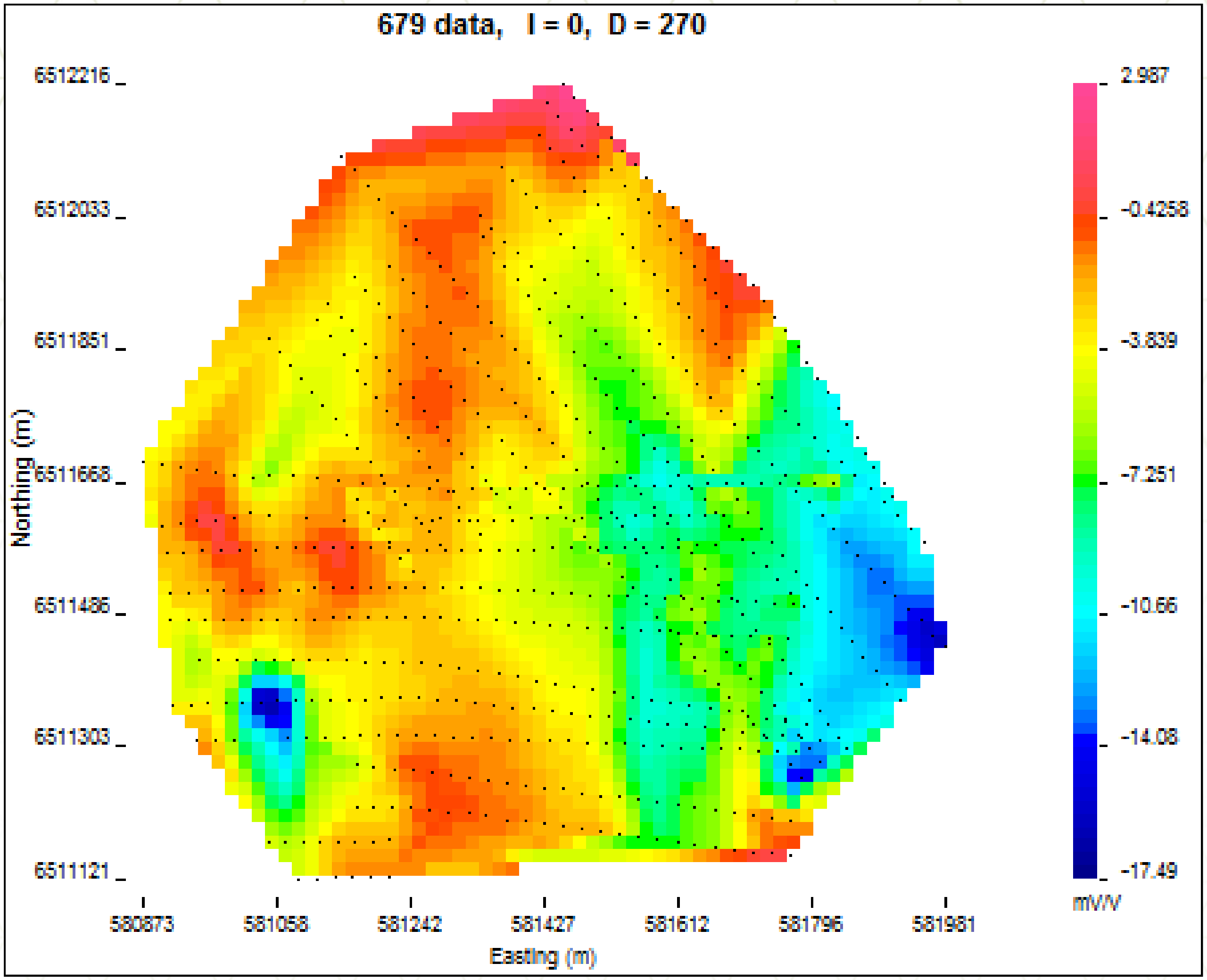

Figure 3: Observed IP data from the two leveled survey grids, after removal of the regional signal (in mV/V).

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3D Inversions

- The 25 lines leveled to the same inducing field parameters were inverted with the MAG3D algorithm on a 25 x 25 x 25 m cell size mesh.
- Using this first inversion result, the signal due to a large scale geological feature at depth was removed from the data and a second inversion was then performed on this new dataset.
- The data that had been corrected for the regional signal were then used in the final modelling effort. This final model used the Compactness algorithm in order to recover anomaly shapes that are more similar to the geology.
- The topography was utilized in the inversions.
- The parameters are defined in Table 1.
- Figures 4 to 6 show the observed and predicted data resulting from the different inversions.
- Figures 7 to 14 show different views of the 3D modelling results.

3D Inversions

Data used in each inversion	Original data	Data with regional signal removed	Data with regional signal removed
Inversion type	UBC standard	UBC standard	UBC with Compactness
Convergence Criteria	Fixed Chi Factor	Fixed Chi Factor	Fixed Chi Factor
3D Mesh	Core 25 m x 25 m x 25 m cell size mesh.	Core 25 m x 25 m x 25 m cell size mesh.	Core 25 m x 25 m x 25 m cell size mesh.
Number of Cells in Mesh	510,272	510,272	510,272
Length Scales	75, 75, 75 (Le, Ln, Lz)	75, 75, 75 (Le, Ln, Lz)	75, 75, 75 (Le, Ln, Lz)
Number of Data Inverted	679	679	679
Achieved Misfit	3.195842E+02	1.585094E+03	1.025393E+03

Table 1: Modelling parameters for the different types of inversions.

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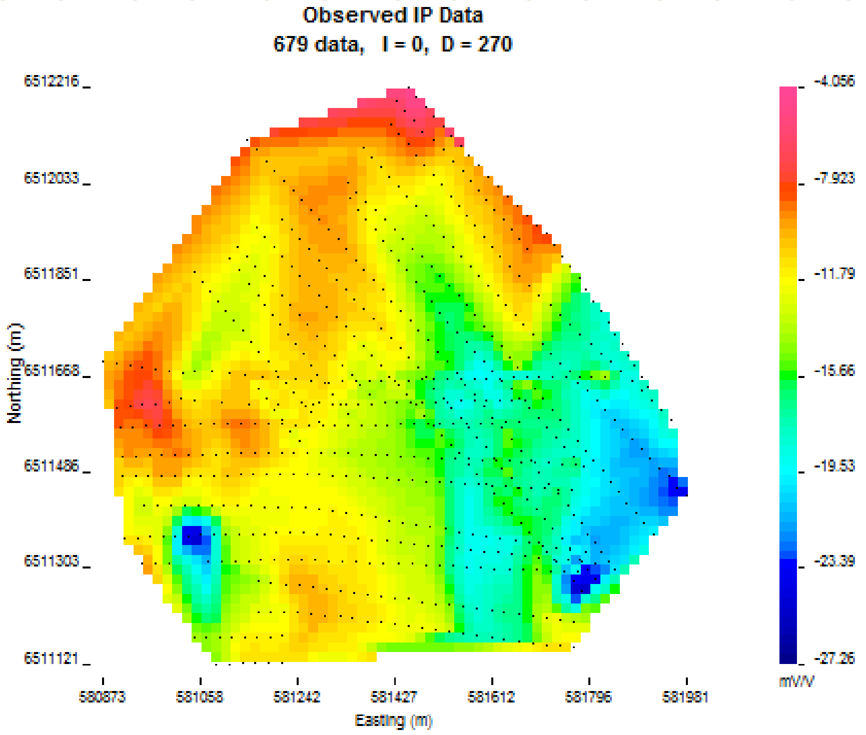
Results


Observed IP Data
679 data, I = 0, D = 270

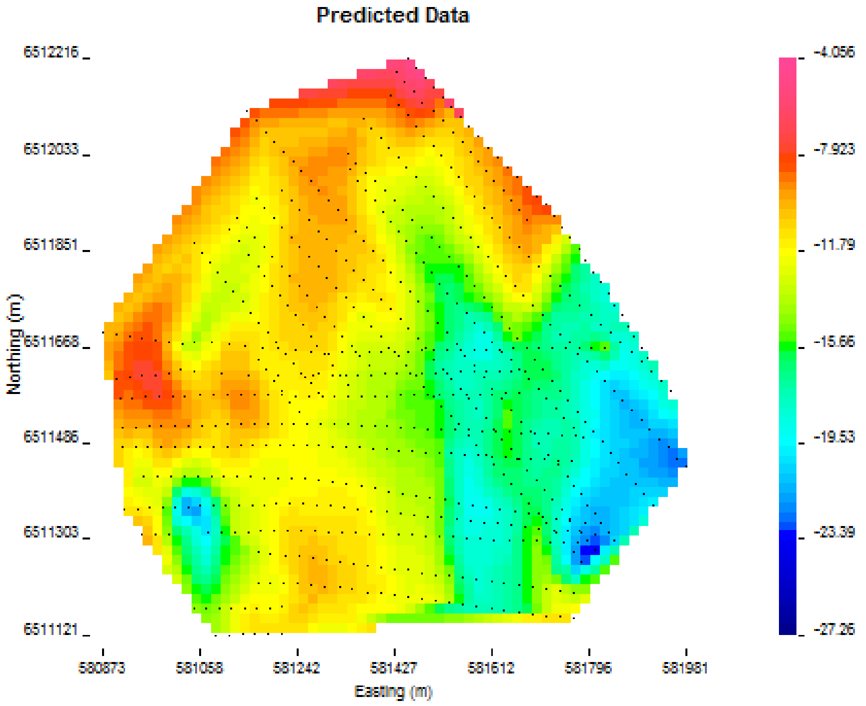
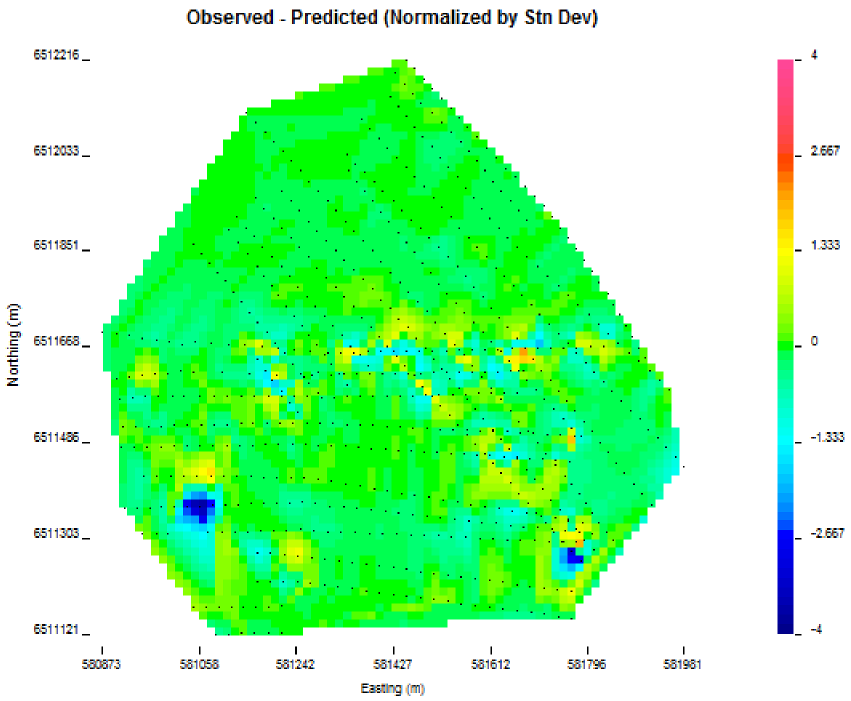

Predicted Data

Figure 4: Observed (left) and predicted (right) IP data from the inversion on the original data with the difference normalized by the standard deviation (bottom) in mV/V.


Observed - Predicted (Normalized by Stn Dev)

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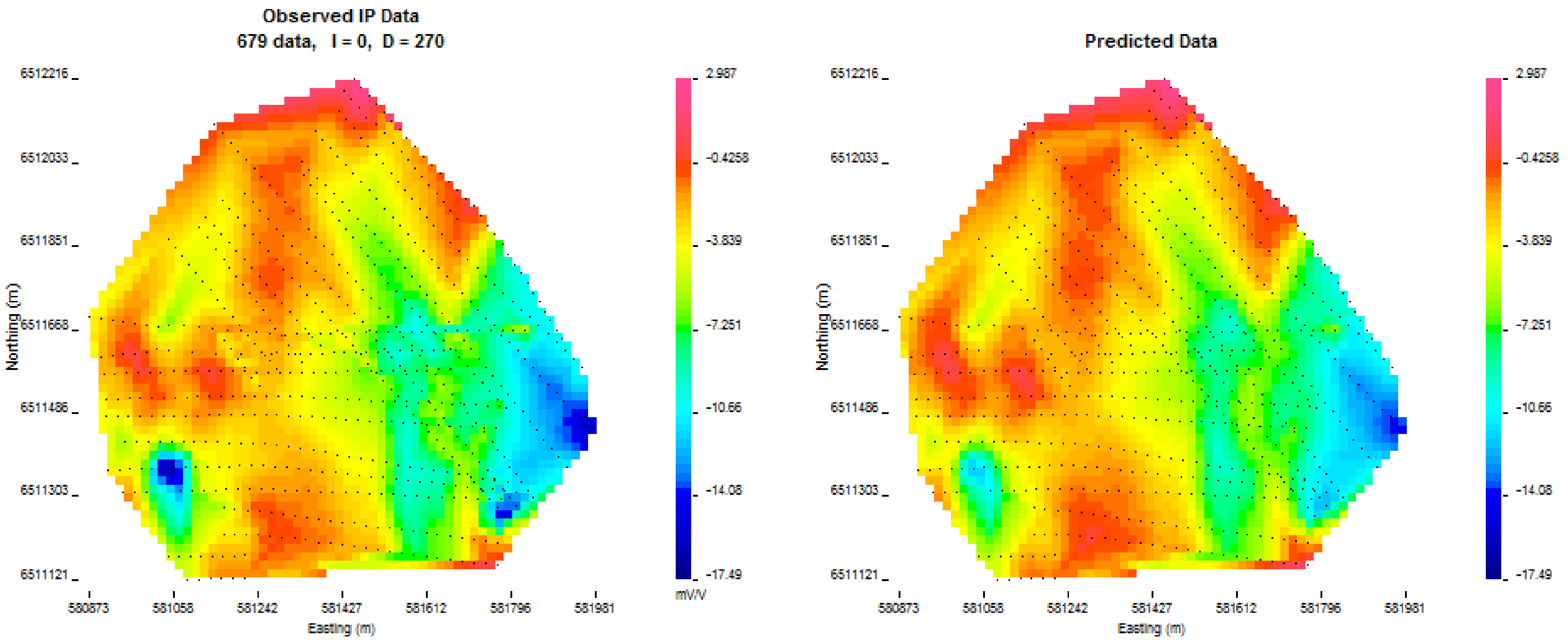
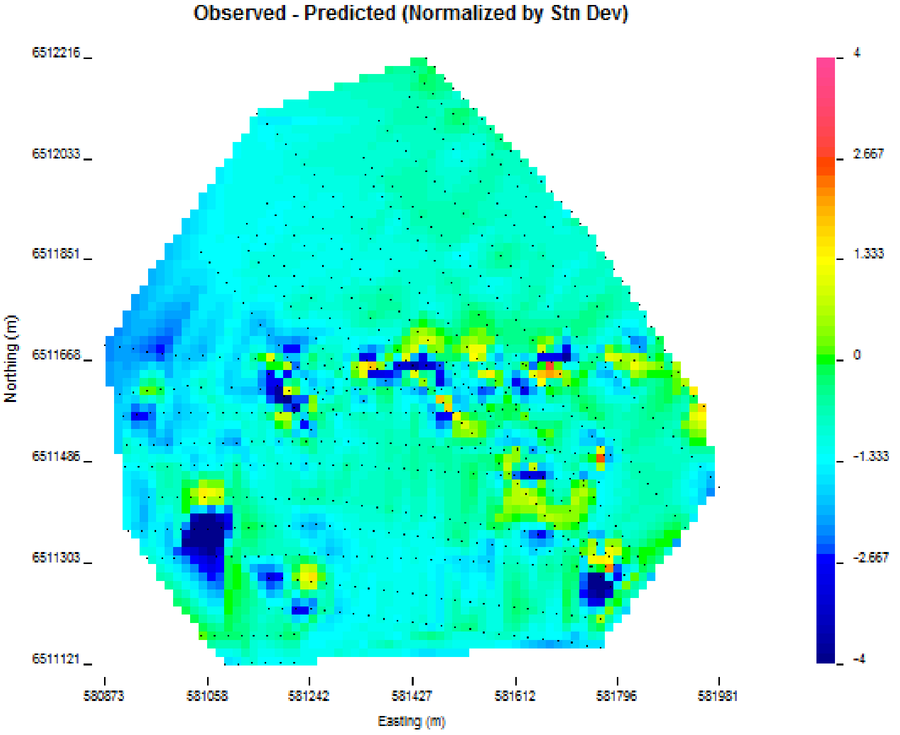
Results


Observed IP Data
679 data, I = 0, D = 270

Predicted Data

Figure 5: Observed (left) and predicted (right) IP data from the inversion with regional signal removed and the difference normalized by the standard deviation (bottom) in mV/V.


Observed - Predicted (Normalized by Stn Dev)

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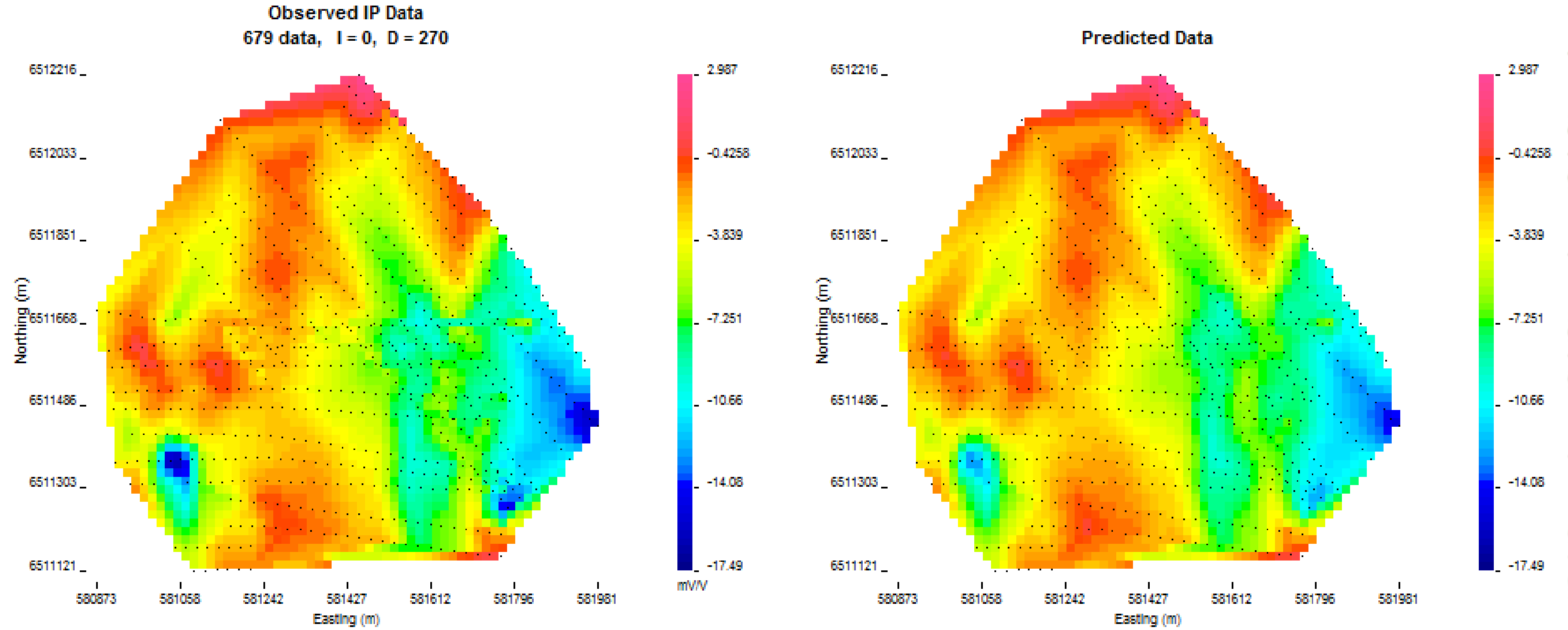
Results



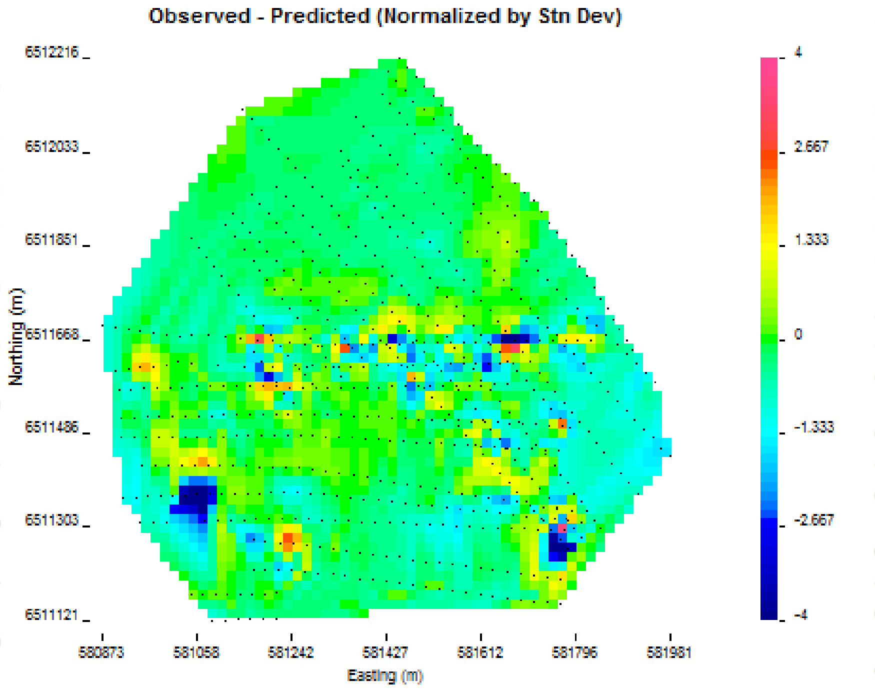


Figure 6: Observed (left) and predicted (right) IP data from the Compactness inversion and the difference normalized by the standard deviation (bottom) in mV/V.

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Results

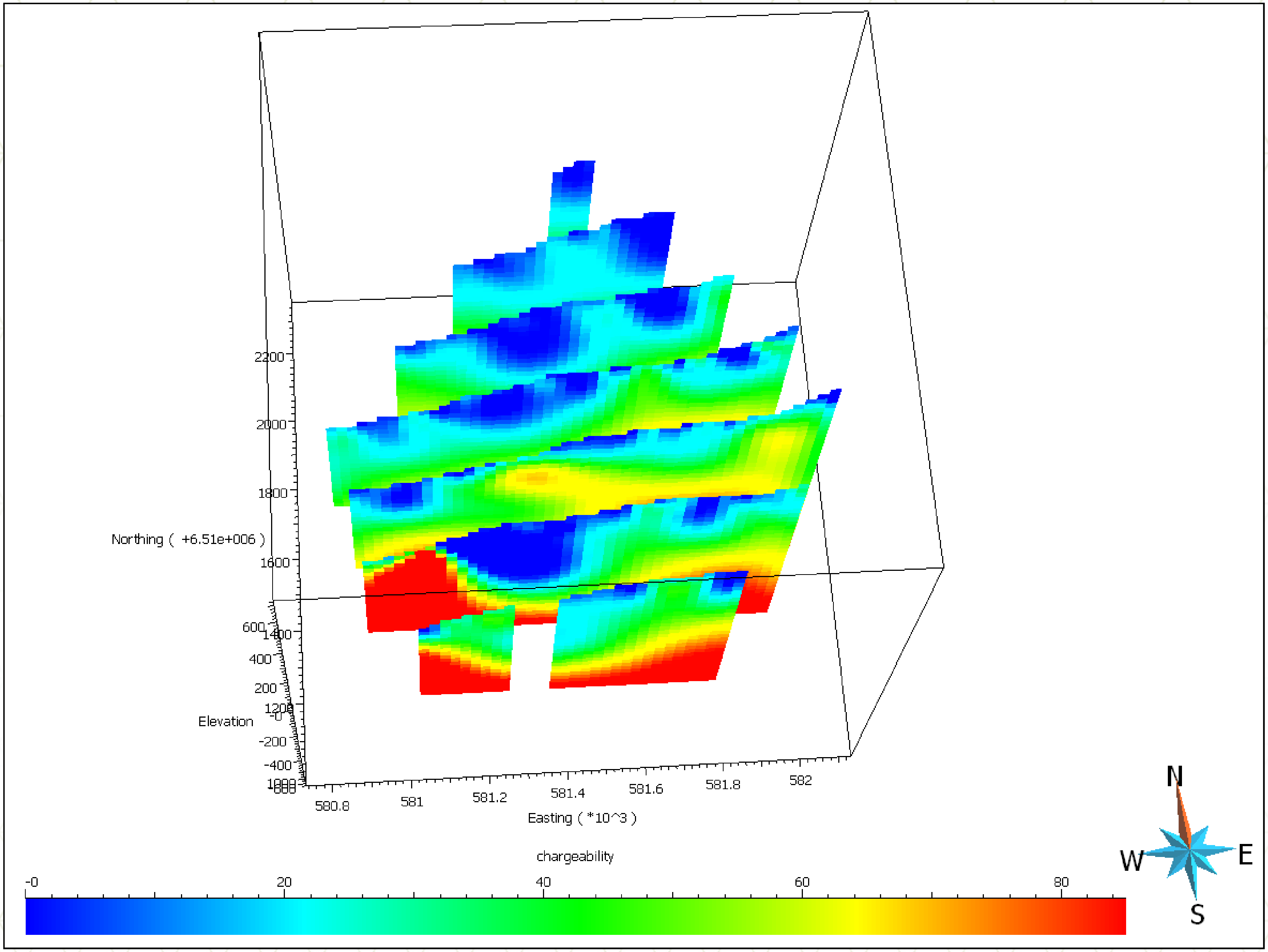

Figure 7: Perspective view showing the chargeability model sections (in mV/V) from the inversion on the original data.

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Results

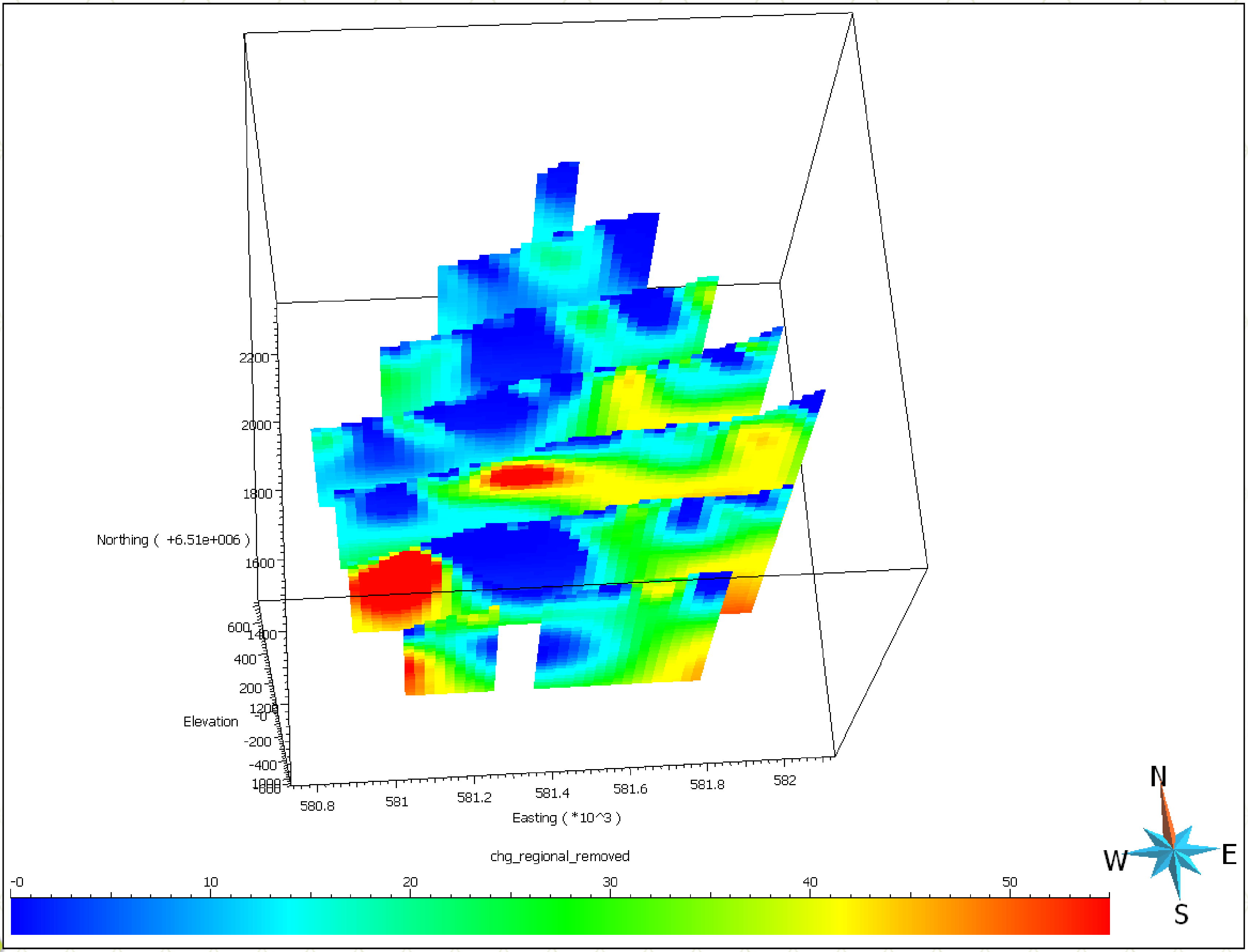

Figure 8: Perspective view showing the chargeability model sections (in mV/V) from the inversion on the data after regional signal removed.

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Results

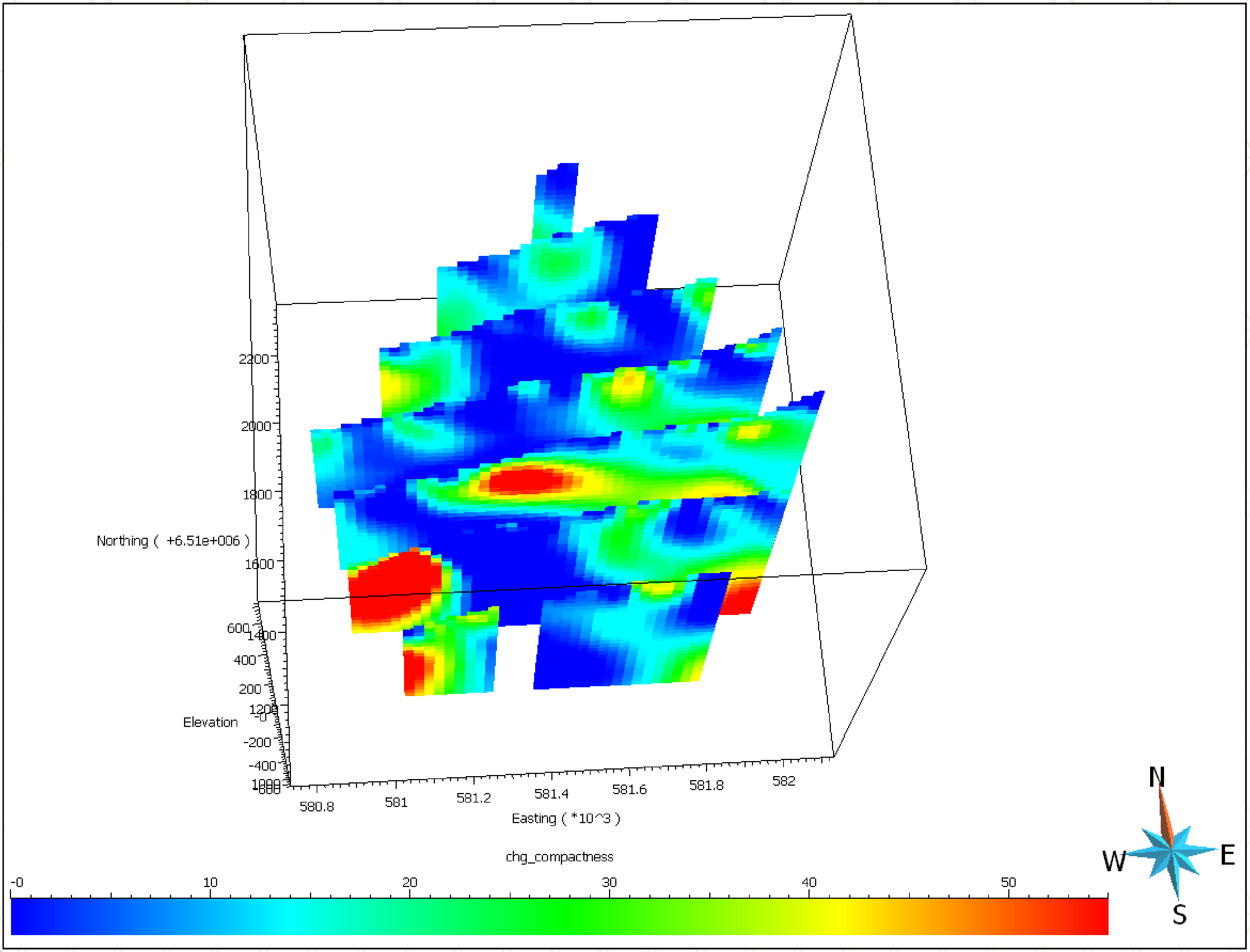

Figure 9: Perspective view showing the chargeability model sections (in mV/V) from the Compactness inversion on the data after regional signal removed.

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Results

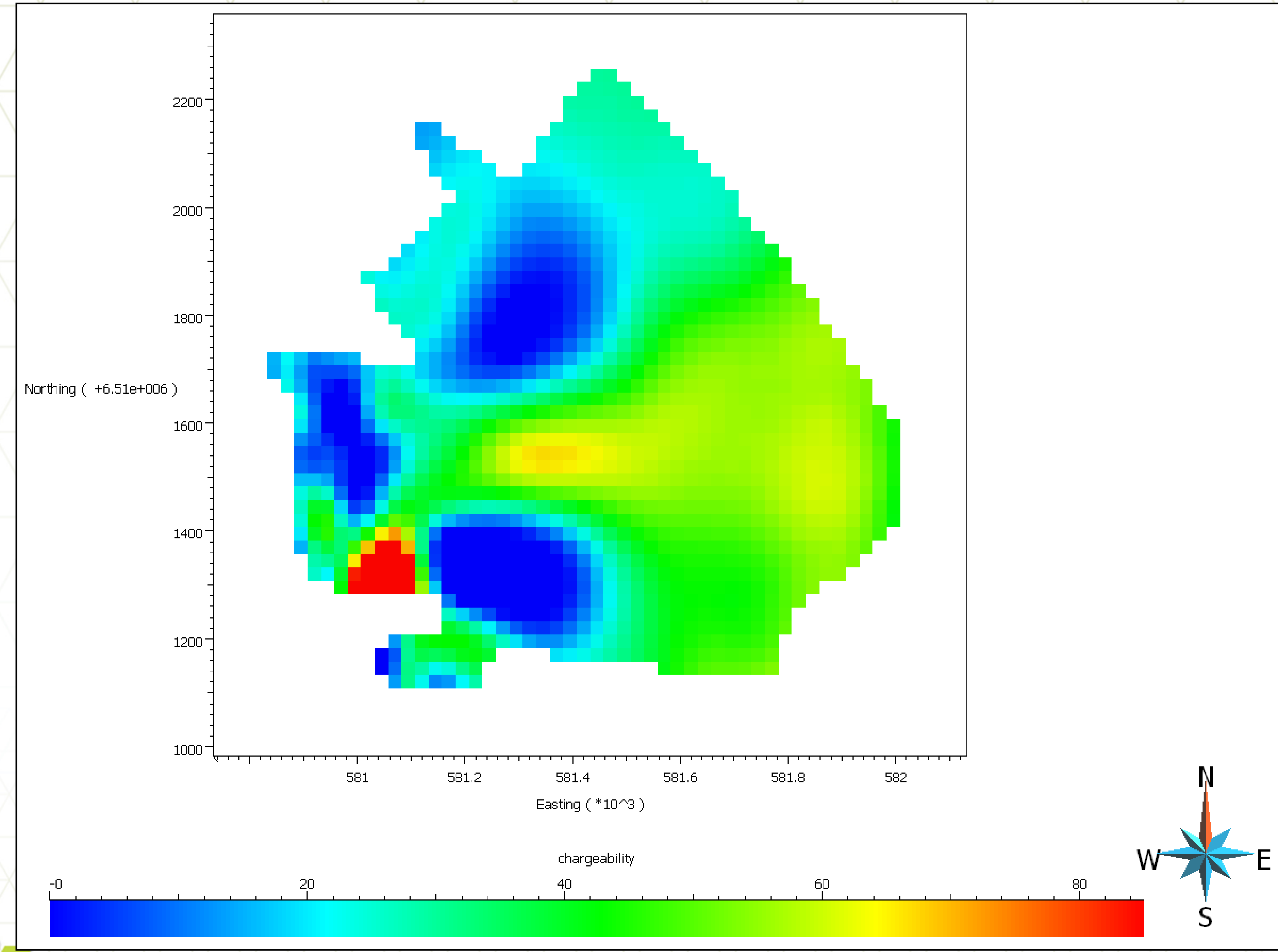

Figure 10: Plan view showing the chargeability model slice (in mV/V) from the inversion on the original data at an elevation of 27.5 m (approximately 317 m under the mean topography) .

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Results

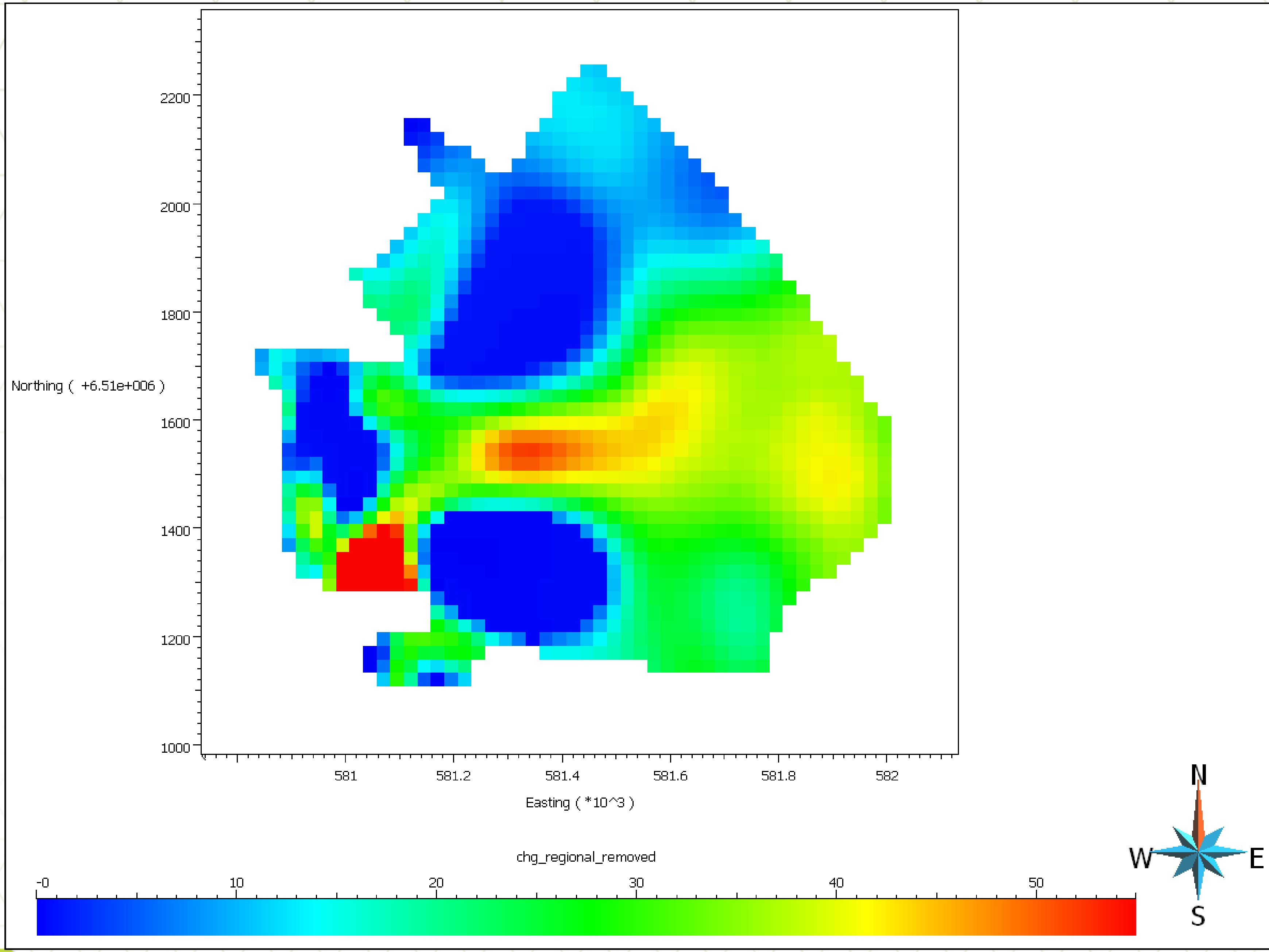

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Figure 11: Plan view showing the chargeability model slice (in mV/V) from the inversion on the data after regional signal removed at an elevation of 27.5 m (approximately 317 m under the mean topography) .

Results

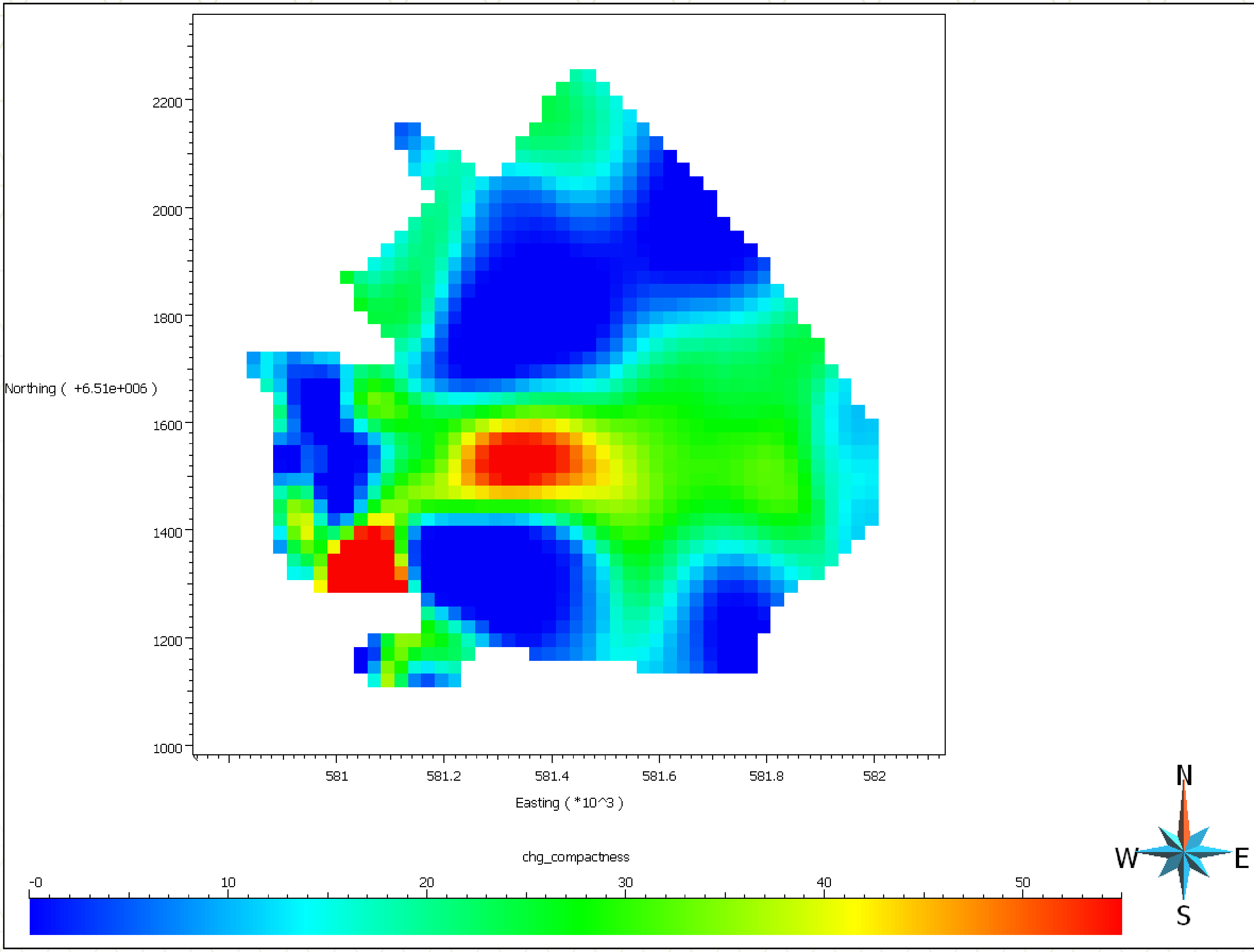

Figure 12: Plan view showing the chargeability model slice (in mV/V) from the Compactness inversion on the data after regional signal removed, at an elevation of 27.5 m (approximately 317 m under the mean topography) .

Results

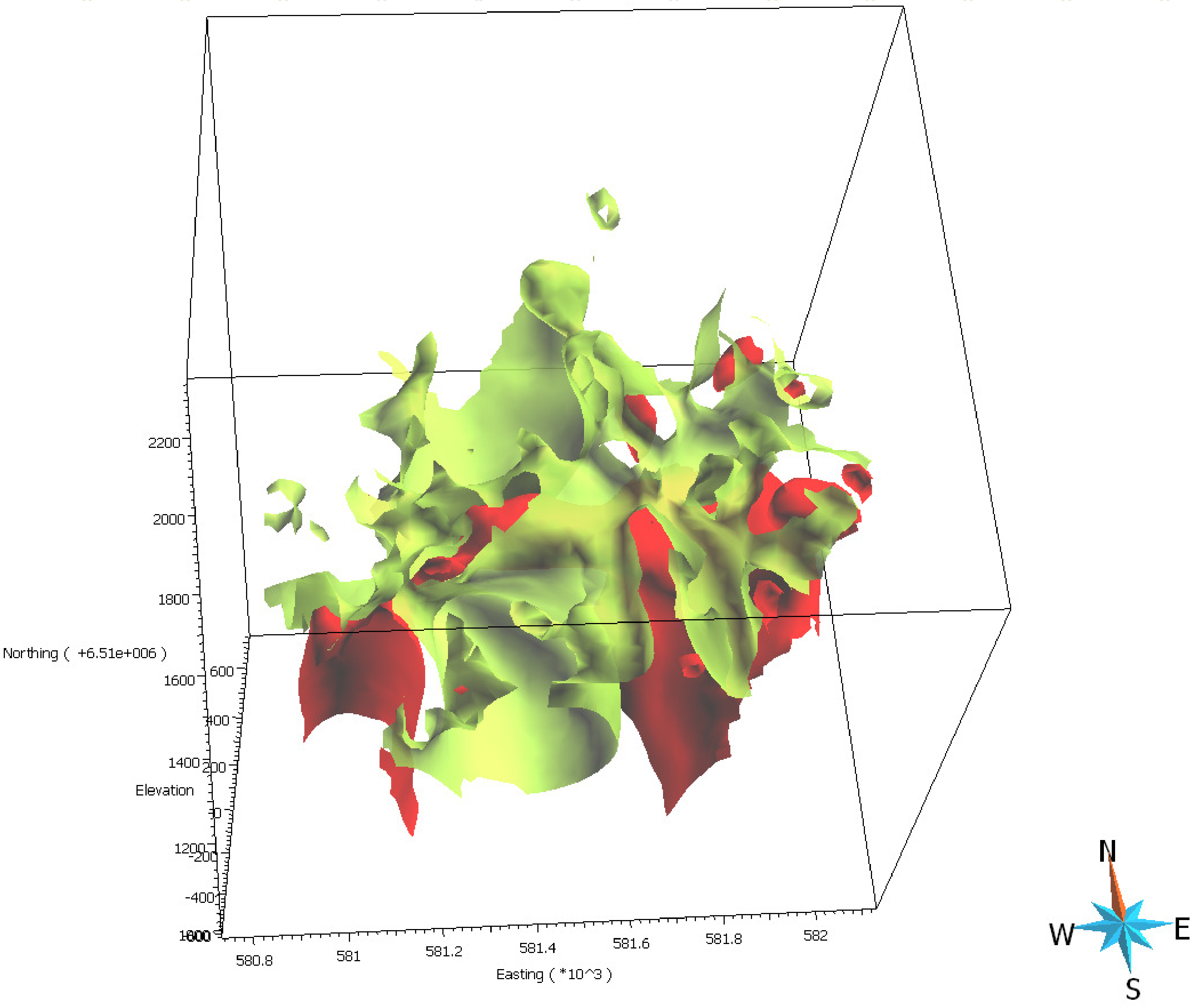

Figure 13: Perspective view showing chargeability iso-surfaces of 15 mV/V (green) and 40 mV/V (red) from the inversion on the data after regional signal removed.

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Results

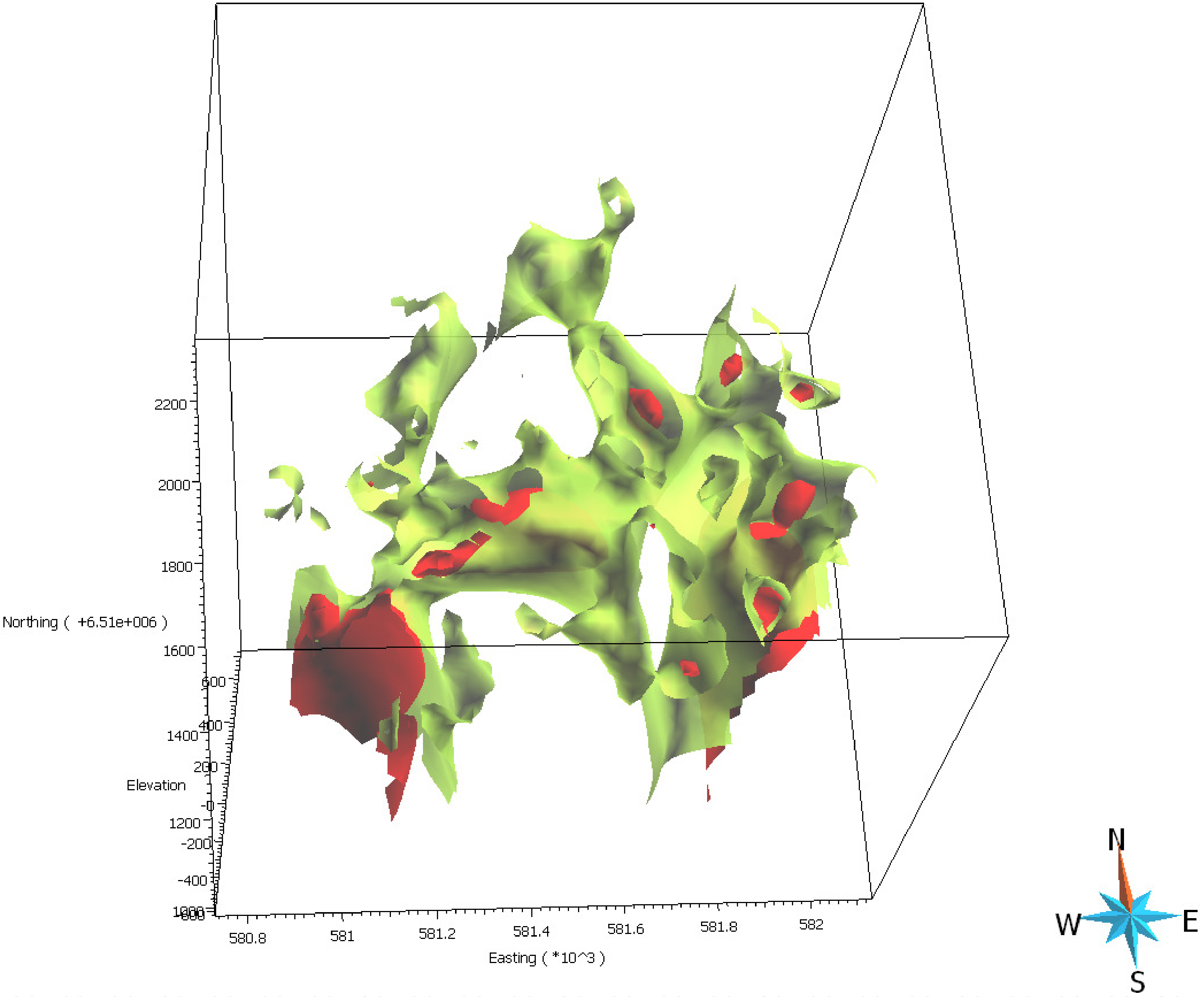

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Figure 14: Perspective view showing chargeability iso-surfaces of 15 mV/V (green) and 40 mV/V (red) from the Compactness inversion on the data after regional signal removed.

Conclusion and Recommendations

- 3D inversions have been performed on the 25 gradient-array IP lines of Tulsequah Chief grid area.

- Apart from small-scale chargeable features, most of the sources have been well represented in the models as shown by the good agreement between the observed field data and the data predicted by the inversions modelling results.

- A large scale chargeable anomaly extending at depth has been defined with the inversions over the eastern side of the survey area. The Compactness inversion enhanced the geometry of shallow chargeable anomalies observed at the Tulsequah Chief grid.

- In order to improve the resolution of the deeper anomalies, further DC and IP survey work is recommended using pole-dipole or dipole-dipole arrays over areas of interest.

- At this stage, any available geologic or physical property information can be included in order to perform constrained inversions, such as mapping and drilling results.

- The inversion models should be correlated with known targets and existing results from past exploration activities such as prospecting, geologic mapping, ground geophysical surveys and drilling.

Project Deliverables

Format	Name	Description
PPT	3D Induced Polarisation Modelling: Tulsequah Project, BC for Chieftain Metals Inc.	Procedure report detailing the unconstrained IP inversion process and results.
DXF	Iso_chg_60mVV.dxf Iso_chg_70mVV.dxf Iso_chg_regionalrem_15mVV.dxf Iso_chg_regionalrem_20mVV.dxf Iso_chg_regionalrem_30mVV.dxf Iso_chg_regionalrem_40mVV.dxf Iso_chg_regionalrem_50mVV.dxf Iso_chg_compactness_15mVV.dxf Iso_chg_compactness_20mVV.dxf Iso_chg_compactness_30mVV.dxf Iso_chg_compactness_40mVV.dxf	Chargeability iso-surfaces (in mV/V) in DXF format from the inversions on the original data, after regional signal removed and from the Compactness inversion.
UBC-GIF - ASCII	Mesh_TC.msh Chargeability.cha cha_regional_rem.cha cha_regional_rem_compactness.cha	Mesh file with the chargeability models from the inversion on the original data, the data corrected from the regional signal and the Compactness inversion in UBC-ASCII format.

Table 2: Project Deliverables

Project Deliverables

Format	Name	Description
Gocad	TulsequahChief_IP_Modelling.gprj	Gocad compilation project.
Geosoft Binary Grid	chg_regional_rem_compactness_Northing_ chg_regional_rem_compactness_Easting_ chg_regional_rem_compactness_Elevation_ chg_regional_rem_Northing_ chg_regional_rem_Easting_ chg_regional_rem_Elevation_	Vertical and horizontal sections through the chargeability model in 2D binary grid file format.

Table 2: Project Deliverables

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX V
COMPUTER SOFTWARE

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

A list of the computer software used in the execution and reporting of the 2013 Tulsequah Project Magnetic and Induced Polarization 3D Inversion study:

Gems 6.5 - Gemcom Software International

General mining package software with Microsoft Access database for storage of drillhole data. Used heavily for interpretations with the drill holes visualized in 3 dimensions and various plan, vertical and inclined sections. The delivered geophysical iso-shells are also modeled in this package

UBC-GIF MAG3Dinv

Used in combination with the compactness algorithm by Mira Geoscience for inversion of magnetic and gradient array induced polarization data sets; producing physical properties models of magnetic susceptibility and chargeability.

Gocad

GIS 3D modeling program used by Mira Geoscience.

2013 Tulsequah Project: Magnetic and Induced Polarization 3D Geophysical Data Inversion

APPENDIX VI
STATEMENT OF EXPENDITURES

Tulsequah River Area
Northwestern BC
NTS 104K/12

Atlin Mining Division

Latitude 58°44'N, Longitude 133°35'W

Owner & Operator:

Chieftain Metals Inc.
2 Bloor Street West, Suite 2000
Toronto, Ontario

The cost statement below lists the exploration expenses incurred for geophysical Data processing producing the 3d inversion models of the Magnetics and Induced polarization data on claims: 590422; 513813; 513814; 1011222; 513819; 1017199; 513820.

Exploration Work type		**Comment**	**Days**			**Totals**
Personnel / Company	**Position**	**Field Days (list actual days)**	**Days**	**Rate**	**Subtotal**	
Office Studies		**List Personnel (note - Office only, do not include field days)**				
Database compilation	Exploration Manager		1	$628	$628	
Reprocessing of geophysical data	Mira Geoscience			$23,500	$23,500	
Computer modelling	Consulting Geologist		2	$850	$1,700	
Computer modelling	Exploration Manager		2	$628	$1,256	
Report preparation	Exploration Manager		2	$628	$1,256	
					$28,340.00	**$28,340.00**

TOTAL Expenditures **$28,340.00**

Work Conducted 2013/apr/15 - 2013/May/31; M-232; Event Number: 5458209 10-Jul-2013