

**EL92013\_201411\_APPENDIX 01**

**THE PRIORY SAPPHIRE FIELD  
McPherson Duncan & Associates**

# **THE DISCOVERY AND EXPLORATION OF THE PRIORY SAPPHIRE FIELD**



## **REPORT FOR RG PROSPECTING**

**25<sup>th</sup> August 2013**

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## **THE PRIORY SAPPHIRE FIELD**

### **1. INTRODUCTION**

This geological and exploration report has been provided exclusively to Ron Gregory Prospecting under a commercial arrangement as part of the exploration program on Licence EL 9/2013. It records geological investigations by D McP Duncan and M Lloyd on the source of sapphires over twenty years in NE Tasmania and led more recently to the discovery of a new sapphire field distinct from that of Weldborough Pass.

### **2. DISCOVERY OF THE PRIORY SAPPHIRE FIELD**

It has been known for some time that the creeks in the Priory area contain sapphires that could not easily be sourced from the Weldborough Volcanic Centre assumed responsible for the main dispersion of sapphires into the Ringarooma River and its tributaries like the Weld and the Wyniford as well as the George and the Great Musselroe Rivers.

The main sapphire field centred on Weldborough has been the focus of studies in the past including McClenaghan et al (1982), Yim et al (1985), Sutherland and Wellman (1986), Zaw et al (2006), and McGee (2006). The project to find the hard rock source of sapphires began in the 1990s with the checking of basalt rock faces particularly at Weldborough Pass and Grays Hill near Branxholm. During the work with the alluvial tin mining companies Mineral Holdings Aust Ltd and Van Dieman Mines Ltd, additional information was gained on sapphire distribution, and basalt cobbles in the drainage of the Weld and Ringarooma Rivers and tributaries were examined for sapphires all without success. (Duncan and Rhodes, 2000).

In 1999, at the top of Weldborough Pass, Tower Hill, to the south with the communication masts, was found to contain basalts with ultramafic and feldspathic nodules and individual spinel grains. In thin sections, several rounded, high relief grains (up to 2mm) with etched surfaces were discovered and when held up to sunlight had a slight blue tinge. Under the electron probe, they disappointingly proved to be apatites and not sapphires (Duncan and Rhodes, 2000).

However, the creeks draining south east into the George River at Priory include Littlechilds Creek, Bread and Butter Gully and other creeks of the Siamese Tin workings, including Bells Marsh Creek (Nisbets Prospect of the Blue Tier Bulletin), as well as those creeks draining north east into the George River along the Priory- St Helens Road were known to contain sapphires (pers. com. M Lloyd, R Lawry and K Richardson).

In the absence of a major volcanic centre in the local geology, the ultimate source of the sapphires remained a mystery with the nearest basic lava field of any size 14km to the northeast on the coast near the Gardens Lagoon in the Bay of Fires.

In recent years, following an airborne geophysical survey of Northeast Tasmania under the TasExplore Project in 2007, Mineral Resources Tasmania have defined about 40 discrete magnetic anomalies between Priory and Ansons Bay in NE Tasmania. This focussed attention on the Priory

area and investigation began about 2009 primarily directed at finding the hard rock source of the sapphires and not specifically at alluvial deposits or palaeochannels of significance for commercial activities.

Some of these anomalies coincided with a few small areas of basalt already mapped and there has been further checking and sampling by the Tasmanian Geological Survey (McClenaghan, 2010) while others have yet to be explained or examined. A complete list of anomalies is provided in the Appendix along with field notes by MP McClenaghan, a brief description of the MRT hand specimens by D McP Duncan and an inventory of all relevant basalt samples in MRT some of which have been thin sectioned. It is considered likely that many of these “bullseye” magnetic anomalies are caused by Tertiary basalt necks or pipes.

Three areas near Priory (Anomalies 29, 30 and 34, Plans 1, 2 and 3) have been examined in some detail and others near Ansons Bay in reconnaissance fashion (Anomalies 12- 16, ML). Detrital sapphires and indicator minerals (spinel and zircons) have been found around Logans Road basalt and more widely in the Ansons River at a weir (MR 601,900mE; 5,455,150mN: AGD 66) about 2km upstream from the Ansons Bay- Priory road crossing.

The two areas of basalt about 8km NE of Priory immediately attracted special attention, the rocks being exposed in quarries and found to be crystal and inclusion rich--- Logans Road Quarry (MR 594,918mE; 5,436,232mN; AGD 66) and the Beak O Day Council Quarry at Halfway Hill (MR 597,171mE; 5,434,824mN; AGD 66).

### **3. LOGANS ROAD QUARRY (Anomaly 29)**

At Logans Road, a small area of basalt occupies about 6ha and has been quarried at its western end for road base to support Forestry Operations. Mining has been discontinued and the quarry rehabilitated, and the surrounding area has been recently logged.

The basalt is sitting on a Devonian granite basement with some local screens of Mathinna sediment immediately to the SW (Plan 1). Using outcrop and float, the basalt may be traced for 400m to the SE of the quarry which is floored in granite. Following rehabilitation, the coarse stockpile of the quarry has now been spread across the quarry floor. Preliminary geophysical modelling suggests that the basalt body may be a pipe or fissure with an associated flow remnant (Nasir et al, 2010). No geological contacts are visible in the field and there is no depth of erosion to confirm this interpretation. A coloured aeromagnetic image has been provided by D. Bombardieri of MRT at 1:40,000 scale (Plan 3) showing the Logans Road and Half Way Hill anomalies which have positive and negative polarity respectively.

The basalt in hand specimen is richly porphyritic with crystals to 1cm of black spinel, olivine, pyroxene, zircon, and feldspar. Numerous inclusions (up to 6cm) are evident with olivine rich nodules (Ilherzolite) being more common than pyroxene variants (websterite) and granite fragments and derived material also occur (Plate 3). White amygdales are found in places and the basalt groundmass may have a curious pelletoid aspect suggesting that magma fragments may have accreted during extrusion (an agglutinate). Pervasive white spots in places suggest there has been subsequent devitrification of a glassy matrix (Plate 3).

Petrological and geochemical details are available on three mantle xenoliths from this quarry as part of larger study of in northeastern Tasmania during which the host basalt has been classified as an alkali basalt or basanite (Nasir et al, 2010) with euhedral phenocrysts of olivine, titaniferous augite and rare plagioclase together with disaggregated lherzolitic material in a very fine-grained groundmass. Mineral chemistry on the nodules suggests that both the pyroxenites and lherzolites fall into the Cr –diopside xenolith suite.

Over the last two years, the headwater creeks immediately adjacent to Gunns Quarry basalt have been prospected for heavy minerals by panning and sieving the active bed-load gravels. This has revealed the detrital minerals to be in order of abundance spinel, pyroxene, zircon, sapphire and olivine (Plate 1). There are two main sites both AGD 66 Datum - Site 1 (594,960mE; 5,436,000mN; Pan con 688069) in a creek immediately to the south west of the basalt outcrop and Site 2 (595,015mE; 5,436,0030mN) a tributary creek to the south east. Both creeks flow into Mother Logans Creek and eventually drain north to the Ansons River.

Some of the detrital mineral grain shapes are juvenile showing faces and edges with little or no alluvial transport abrasion consistent with their origin in the adjacent source basalt. This dispersion pattern is natural and unaffected by any alluvial tin operations although some of the crushed basalt has been spread around the forest tracks as road metal. Microscopic examination of the grains also shows that some have been pitted by the basalt magma particularly the spinels, sapphires and zircons (Plate 1).

During the search for sapphires in the drainage, it became apparent that the creeks were full of brown, oxidised boulders and pebbles of basalt with many mineral grains emergent on the soft weathered surfaces. The common mineral grains present in the freshly broken quarry rock were readily identifiable in the creek bed boulders particularly spinel and pyroxene.

It became clear during the work that there was a tangible chance of finding a sapphire in matrix by the careful checking of all basalt detritus encountered during panning and sieving of the gravels in the drainage courses.

Eventually, with persistence, a 7mm blue to grey sapphire was found at Site 1 in August 2012 by prospector Michael Lloyd of Priory. The sapphire is set in a soft, grey, oxidised pebble (688098) which is either a coherent basalt from the pipe or a fragmental tuff derived from an associated but no longer preserved tuff ring (Plate 1). The sapphire identification was confirmed by gemmologists using a refractometer (RI 1.77).

#### **4. HALF WAY HILL QUARRY (Anomaly 30)**

Break O'Day Council have developed a 50m by 50m and 10m deep pit in basalt, with stockpiles for road base, and conveniently exposed a pipe like basaltic volcanic centre at Half Way Hill. Basalts in most faces of the quarry have steep contacts with the basement granite (Plate 2). There are thin basalt dykes intruding the breccias in most faces.

There are two coherent basalt intrusions with the older basalt being crystal rich with ultramafic inclusions and the younger basalt being crystal poor with inclusions. The younger dyke cuts the older in the north face (Plate 2).

Basalt breccias have granite clasts up to caravan size in the south face. Some parts of the east face have poorly sorted tuffaceous material of varying grain size including blocks of granite that may be occupying a former vent or diatreme (Plate 2).

Boulders of basaltic tuff are displayed at the quarry entrance, have a black friable groundmass and open framework clasts of granite, basalt and ultramafic nodules. They appear to have come from a layer on the top bench which may be capped by an in situ basalt flow on ridge or the whole may be an artefact of the quarrying and piled up excavated overburden.

In summary, the volcanic centre may have a basalt lava flow capping an agglomerate layer which in turn sits on the underlying pipe of basalt breccias and tuffs intruded by at least two ages of basalt dykes.

In hand specimen, the basalts are very similar to Logans Road basalts in phenocryst phases, the olivine and pyroxene inclusions up to 5cm, granite and feldspar fragments and occasional white amygdals.

Initial sieving of adjacent creeks has so far revealed only granite-derived gravels with no detrital heavy minerals.

#### **5. WHITE GUM HILL (Anomaly 34)**

Basalt boulders and sub crop are found over an 150m width on the side of a small hill overlooking Littlechilds Creek. The basalt is somewhat weathered but inclusion-rich with crystals of spinel, olivine and feldspar and fragments of ultramafics (olivine nodules) and granite. The basalt has indications of pock marking and banding which may be a flow foliation or ?bedding. There is no depth of erosion to prove a pipe-like structure for this basalt.

Initial panning in the adjacent creek has produced only small zircons probably derived from the surrounding granites.

#### **6. AGE AND DISTRIBUTION OF THE BASALTS/ANOMALIES**

There is a suggestion that the distribution of some of the magnetic anomalies is not entirely random with a cluster in the Priory area and another near Ansons Bay and that they are associated with WNW- trending magnetic linears (Plan 2).

The Ansons cluster are all negatively polarised and comprise six anomalies 11- 16 and are set across a prominent WNW magnetic lineament (Mlin 1) which is probably due to a magnetic ?intrusive lithology.

The Priory cluster (including both the Logans Rd basalt and the Halfway Hill basalt) comprise six anomalies 27-32 and 34 disposed along a more subtle WNW- trending magnetic lineament (Mlin 3) which may be a structural break like a fault or shear zone. Anomalies 27, 29 and 34 are positive while the remainder are negative. The structure can be traced to the WNW as far as Platts Lookout (MR 589,000mE; 5,439,000mN AGD 66) where a cluster of basalt outcrops have been mapped by MRT (Plan 2).

Another prominent WNW magnetic lineament (Mlin 2) which is in part curvilinear and en echelon occurs between the two previously mentioned lineaments and is closely associated with two strong positive anomalies (one of which is 26, the other 36) and a negative one 22. This magnetic linear also looks to have a lithological perhaps intrusive origin and crosses the coast just south of the largest basalt field in the area at The Gardens (and extends offshore from the magnetic pattern)- a non porphyritic, fine grained hawaite. The eruptive centre for this lava field remains unrecognised.

It is possible that the magnetic lithologies at Mlin 1 and Mlin 2 are feeder dykes giving rise to the possible basaltic volcanic centres represented by the bullseye magnetic anomalies.

There is a suggestion that a NE alignment is also favoured for example by anomalies 19, 23, 26, 27-29 and again anomalies 6, 10 and 28. This alignment is parallel to the trend of a prominent Devonian dolerite dyke swarm in the region and may reflect some degree of structural control by a previous or inherited crustal weakness.

It had been assumed that the basalt pipes are of Tertiary age but the difference in magnetic polarity suggests they are not exactly contemporaneous.

The detrital zircons adjacent to the Logans Road basalt have now been dated radiometrically using Laser Ablation ICP-MS and prove to range from 40-46Ma with an average of 42.11 plus or minus 0.83Ma (results in Appendix). This suggests that the Logans Rd basalt is part of the Older Basalt suite of NE Tasmania as distinct from the Younger Basalts (16Ma) such as those in the Ringarooma Valley near Derby. Two zircon grains record Triassic ages of 242 and 243 Ma, a similar result to the zircons in the Weldborough sapphire study of McGee (2005) which remains unexplained as the nearest known Triassic basalt (233 plus or minus 5Ma) is in the St Marys District.

## **7. CONCLUSIONS**

This investigation was directed at finding the source of sapphires in NE Tasmania particularly in the Weldborough Pass area. In later years the focus of search became localised in the Priory area when it became apparent that the distribution of sapphires and the indicator minerals, spinel and zircon, were not easily explained by dispersion from the Weldborough Pass Field.

The work received a boost when Mineral Resources Tasmania released the 2007 aeromagnetic survey which revealed over 40 "bullseye" anomalies between Priory and Ansons Bay some of which coincided with small areas of mapped basalt which were then suspected of being volcanic pipes. Additional petrographic studies showed that, at two areas just north of Priory, the basalts which were being quarried were crystal and inclusion rich.

Studies of the heavy minerals in the drainage has shown that there are sapphires associated with the Logans Road Basalt but not so far the Half Way Hill Basalt which has been revealed through quarry exposure to be a complex volcanic centre.

Careful and persistent search of the oxidised basalt pebbles found in the drainage of Logans Rd Basalt successfully located the first recorded sapphire in matrix in NE Tasmania. Radiometric analysis of the associated zircons suggest that the basalt is 42Ma in age and hence part of the Older Basalt Suite which is believed to give rise to the sapphires dispersing from Welborough Pass area.

Most of the “bullseye” magnetic anomalies/basalts remain untested for sapphires. However, there is little prospect of developing a hard rock sapphire mine as there is only one operating globally in Montana, USA. The Yogo deposits have produced, from 1898 to 1994, 18.2M carats of rough stones which have yielded more than 500,000 carats of cut gems. Most of the production has come from the soft oxidised parts of a series of lamprophyre dykes and the remainder from the hard unweathered parts. (Mychaluk, 1993).

The Priory Sapphire Field remains untested for alluvial sapphire-bearing gravels in depositional sites or deep leads.

## **8. ACKNOWLEDGEMENTS**

The writers are grateful for information received from and discussions held with Ralph Bottrill, Marcus McClenaghan, John Everard and Daniel Bombardieri of Mineral Resources Tasmania, Lawry Rhodes, retired Mines Department metallurgist and Ron Lawry, retired tin miner. Dick Wright and Rob Long of the Gemmological Association of Australia performed the refractive index measurement on the sapphire in matrix and Sebastien Meffre of CODES, University of Tasmania carried out the radiometric dating of the zircons.

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### **PLANS 1-3**

Plan 1- Aeromagnetic Anomalies and Priory Geology (MRT)

Plan 2- Aeromagnetic Anomalies and Lineaments, Priory (MRT)- interpreted by D McP D

Plan 3- Aeromagnetic Anomalies, Logans Rd and Half Way Hill (MRT)

### **PLATES 1-3**

Plate 1- Selected Detrital Rocks and Minerals, Logans Rd- sapphires, spinel and zircons

Plate 2- Rock Exposures in Volcanic Centre, Half Way Hill Quarry

Plate 3- Logans Rd Rock Specimens and Half Way Hill Exposures.

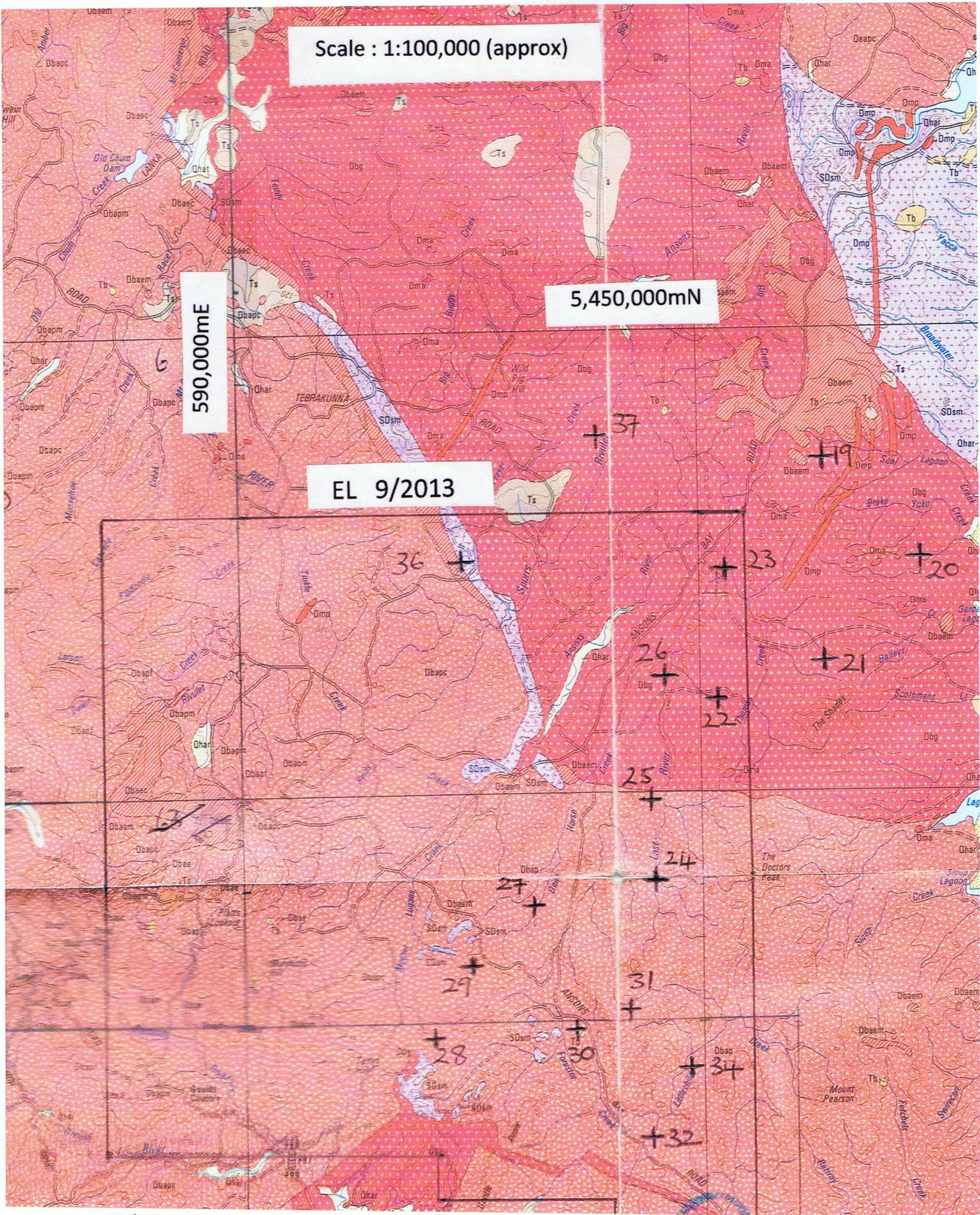
### **APPENDIX**

Analytical Results of Zircon Radiometric Age Dating Pages: pages 1-6

Geological Details of Aeromagnetic Anomalies: pages 1-6

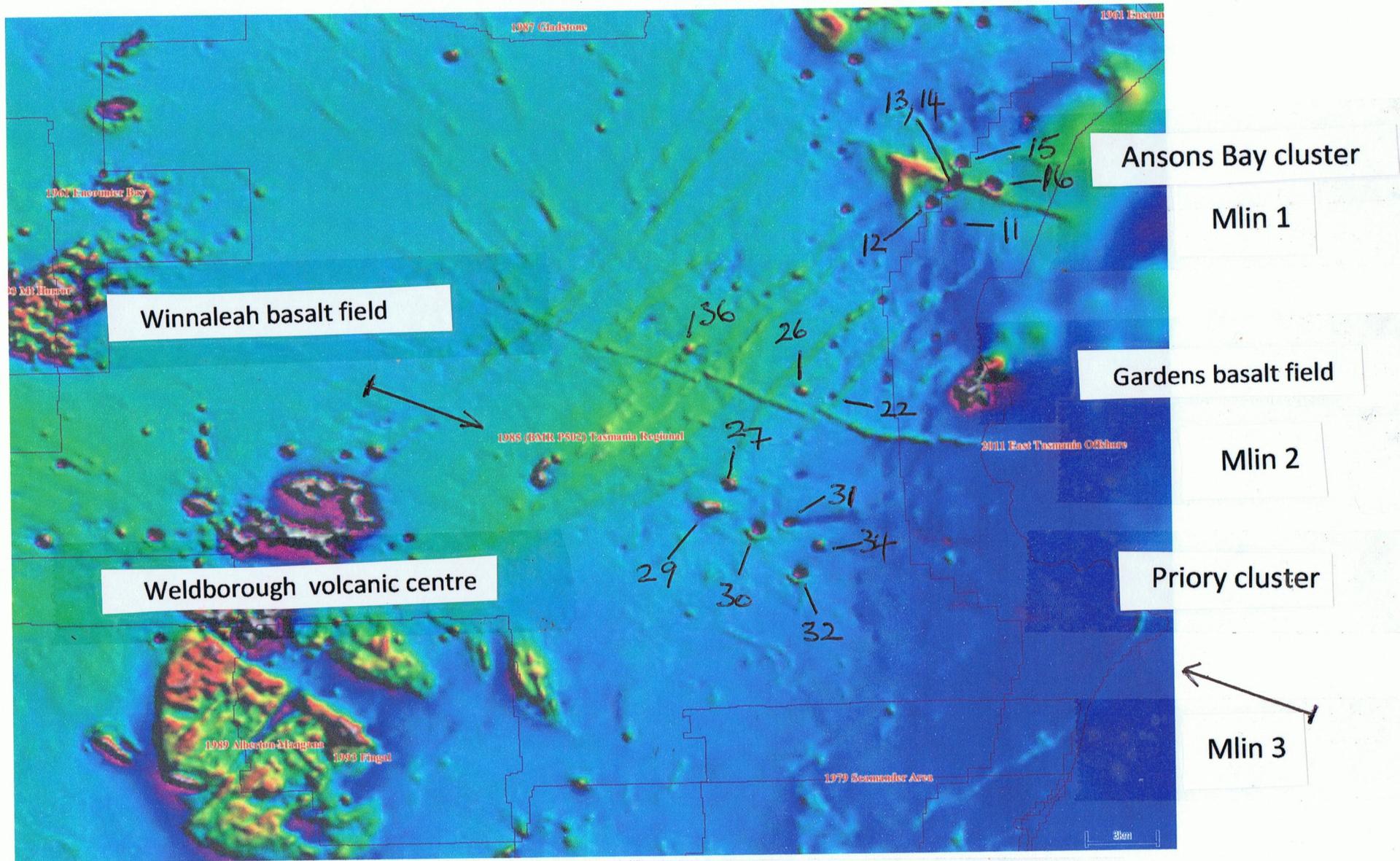
Summary of Rock Samples from Priory Area in MRT Collections





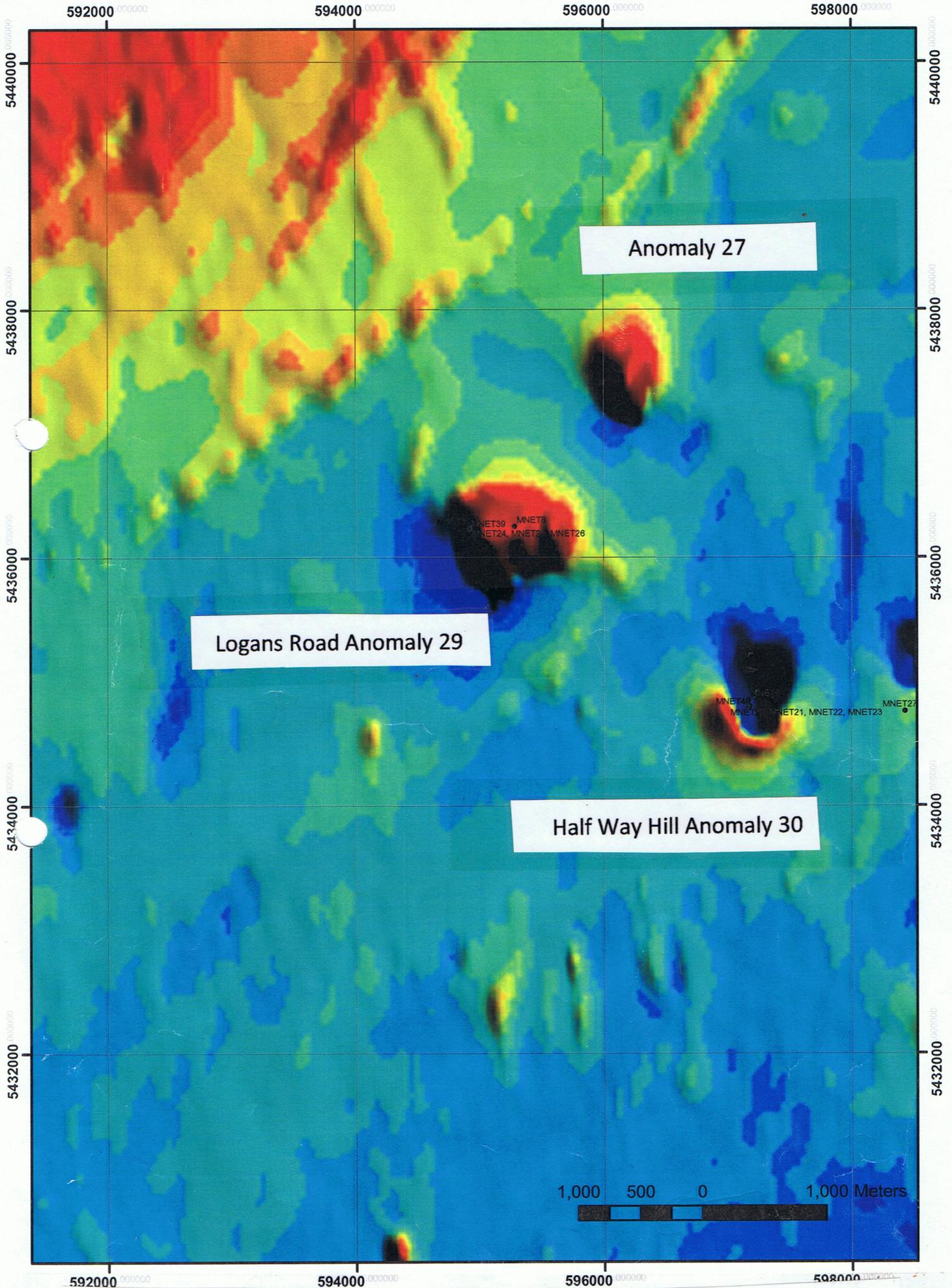
PLAN 1 - Aeromagnetic anomalies and Priory Geology (MRT)

# mlins



PLAN 2 - Aeromagnetic anomalies and lineaments, Priory Area (MRT)

# NE\_Tas\_Plug? TMI, 1:40K scale, AGD 66



PLAN 3—Aeromagnetic anomalies, Logans Rd and Half Way Hill (MRT)

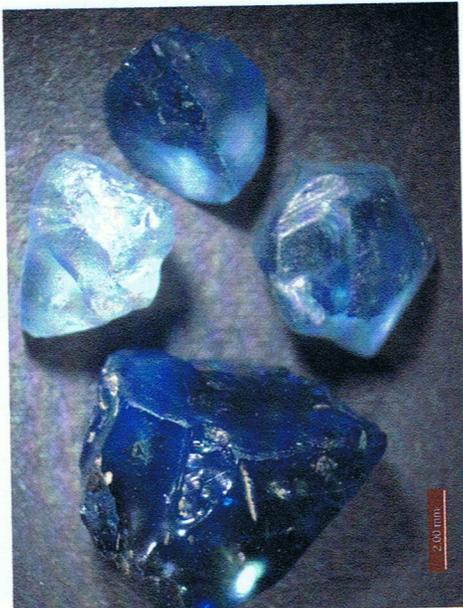
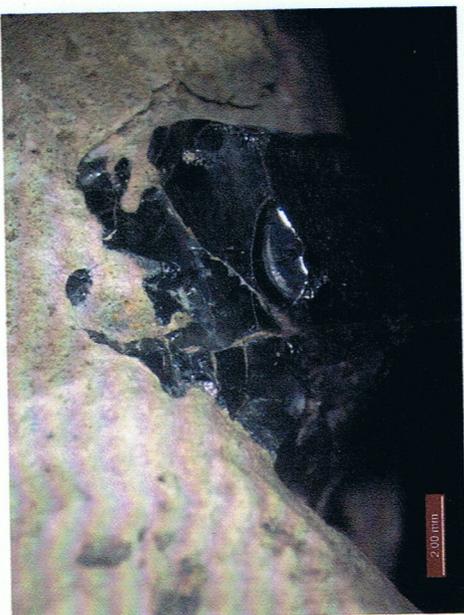
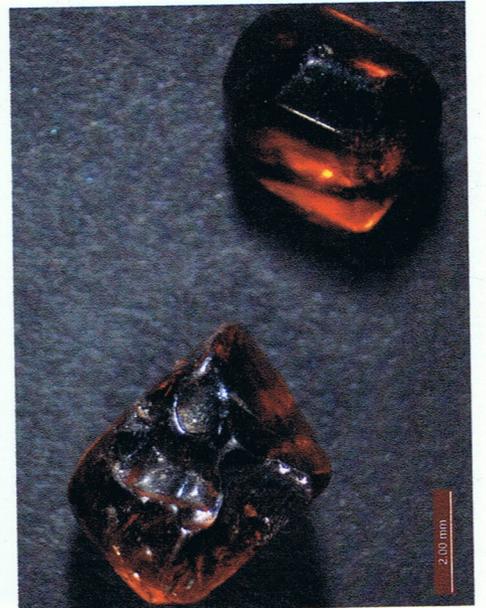
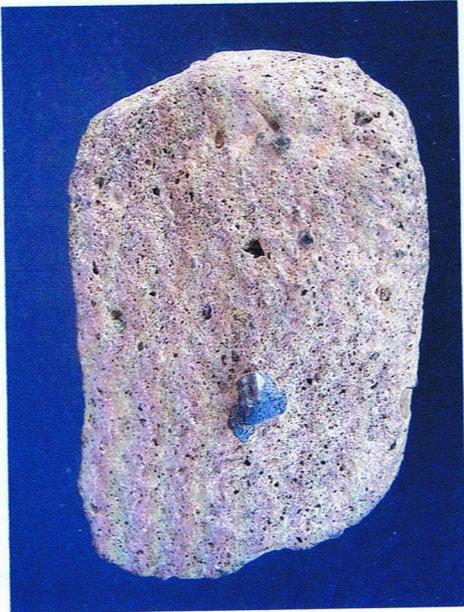
## **PHOTOGRAPH CAPTIONS**

### **PLATE 1---- Detrital Minerals and Rocks, Logans Road Area**

- Sapphire in matrix (oxidised ?basalt pebble)
- Selected sapphires (some showing crystal edges and magmatic pitting)
- Selected zircons (some with crystal edges and magmatic pitting)
- Black spinel (some with resorbtion embayments) in oxidised basalt pebble
- Sapphire and zircon assemblage from Site 1—Logans Road

**Photographs by R.S. Bottrill, MRT**

PLATE 1



## **PHOTOGRAPH CAPTIONS**

### **PLATE 2 --- Half Way Hill Volcanic Centre**

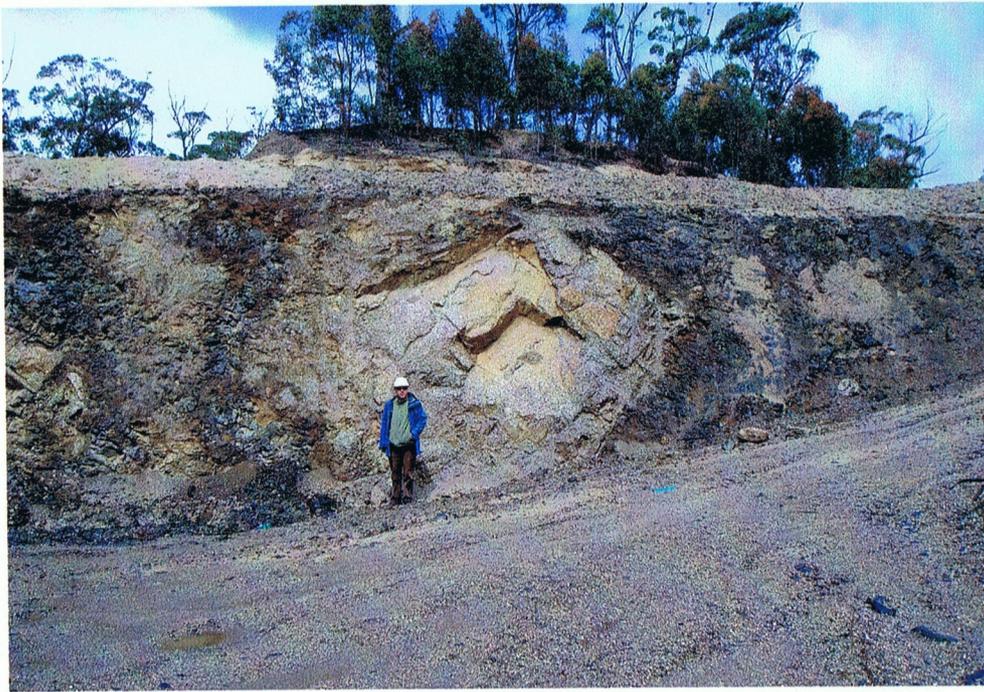
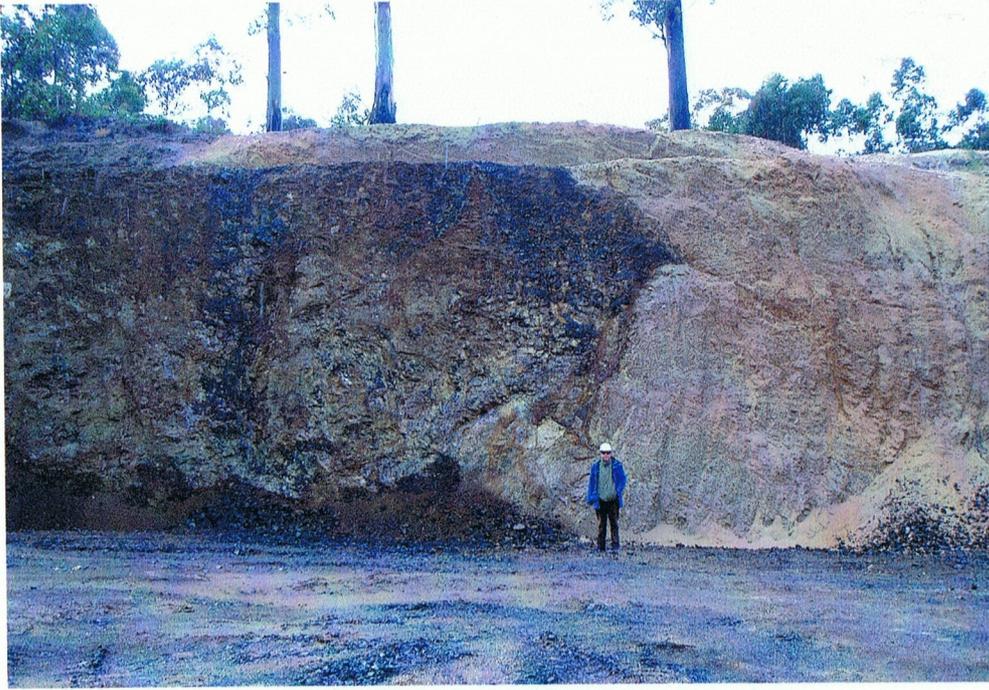
Upper left--- basaltic tuff/ agglomerate with granite and other clasts

Upper right--- sub-vertical edge of volcanic pipe with granite against basalt; a younger basalt intrusion cuts across the older basalt towards the granite contact from the bottom towards the top of the photo.

Lower left--- steep other edge of the volcanic pipe against the granite; the basalt here is mainly breccias cut by vertical basalt dykes.

Lower right--- caravan- sized granite block surrounded by basalt breccias.

**Photographs by D McP Duncan, McPherson Duncan & Associates**



## **PHOTOGRAPH CAPTIONS**

### **PLATE 3 --- - Quarry Rocks and Exposures, Logans Road and Half Way Hill, Priory**

Upper left---- pelletoid basalt (agglutinate?) on left; white spotted basalt (devitrification?) on right, Logans Road Basalt, Priory

Upper right---- poorly sorted tuff/agglomerate with football –sized granite clast; possible diatreme or vent facies in quarry face, Half Way Hill Volcanic Centre, Priory

Lower left--- crystal- and inclusion rich basalt in quarry, Logans Rd Basalt, Priory

Lower right---- Michael Lloyd, Priory and David Blake, Canberra in Half Way Hill Quarry, Priory

**Photographs by D McP Duncan, McPherson Duncan & Associates**

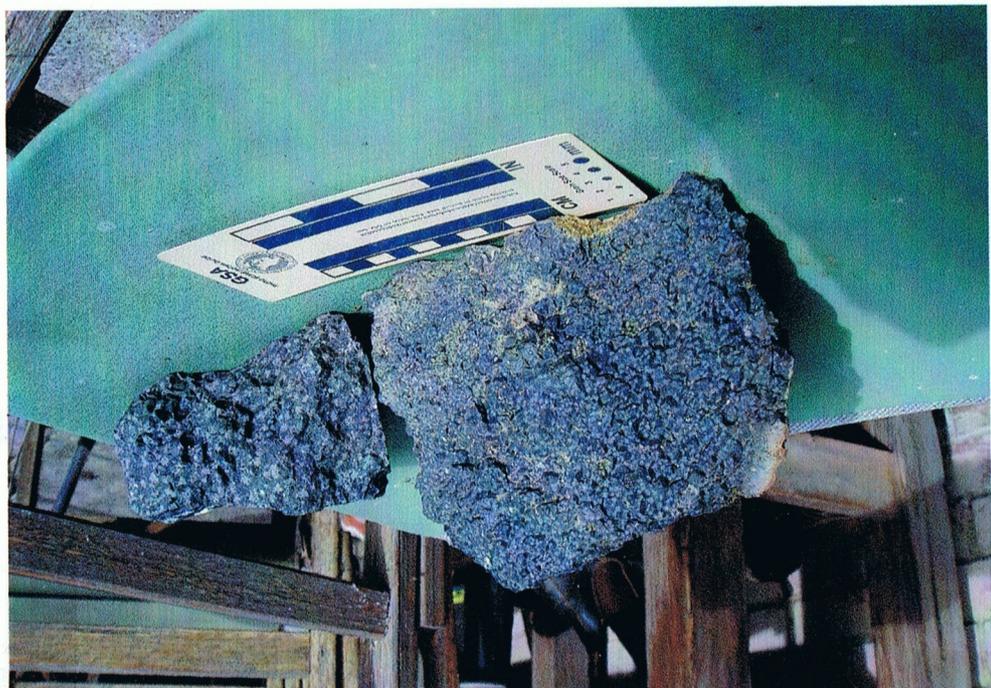
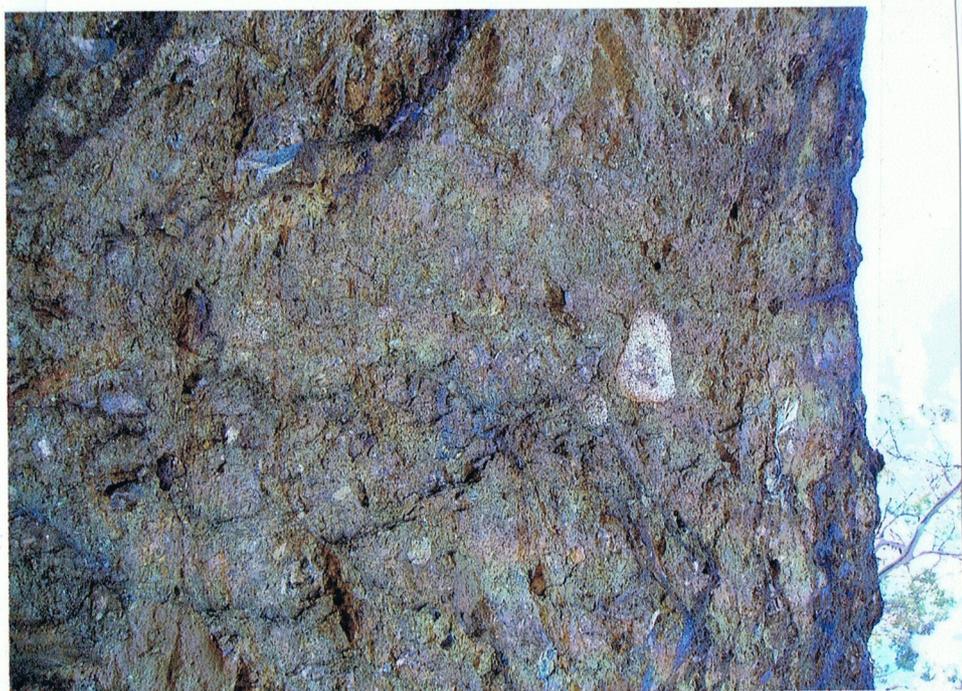
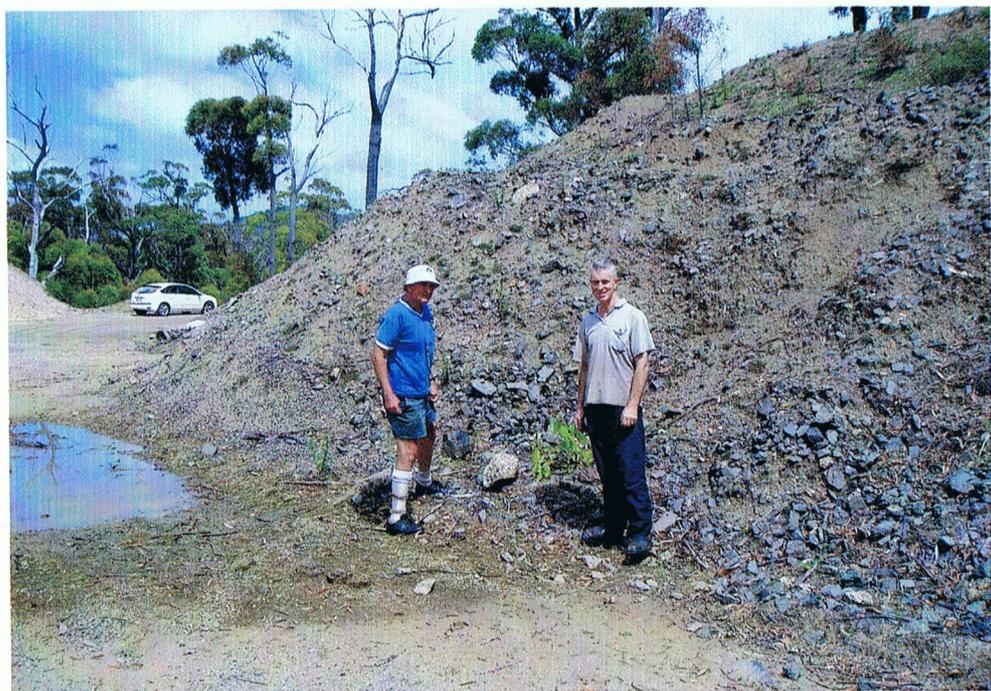


PLATE 3





ANOMALY	LOCATION AGD 66	ACTION BY MRT	FIELD NOTES BY M P MCLENAGHAN JAN 2008	ANOMALY	SAMPLES IN MRT CORE STORE---- COMMENTS BY D MCP DUNCAN 2010	Anomaly
1	591900E;5458700N	not visited	POL -ve	1		1
2	597200E;5456200N	not visited	POLARITY negative	2		2
3	599713E;5459625N	BASALT found	basalt float in small area (20 sq m), mag sus 10-15 SI units, POL -ve	3	mnet 28, R001090 TS - fg basalt, few phenos, some u/mafic olivine nodules	3
4	600100E;5455800N	not visited	POLARITY -ve	4		4
5	600100E;5454600N	not visited	POL +ve	5		5
6	599731E;5450525N	BASALT found	boulders of basalt with small clots olivine over an area 30-40m wide, mag sus 4-16 SI units, POL -ve	6	mnet 15, R001077- fg basalt, some phenos, occ u/mafic and white mineral frags	6
7	600480E;5457150N	basalt not found	no outcrop, could be due to dolerite at 600593E;5457519N, POL -ve	7	mnet 29, R001091 TS	7
8	601150E;5455400N	BASALT already mapped	POL -ve	8		8
9	601300E;5455,000N	not visited		9		9
10	601217E;5452204N	BASALT found	area of very abundant basalt boulders, POL -ve	10	mnet 3 R001065 - fg basalt, occ phenos	10
11	605500E;5451400N	basalt not found	no outcrop or float, plug may not be on surface, POL -ve	11		11
12	604700E;5452400N	BASALT already mapped	POL -ve	12		12
13	605300E;5453000N	basalt not found	POL -ve	13		13
14	605700E;5453500N	basalt found/mapped	basalt boulders on road and in nearby gully, at 605378E;5453564N, mag sus 4-5, POL -ve	14		14
15	606100E;5454600N	BASALT already mapped	parts may be tuffaceous?, POL -ve	15		15
16	607350E;5453400N	BASALT already mapped	POL -ve	16		16
17	608940E;5457015N	basalt not found	no outcrop or float, sand and banksia and small heath, POL -ve	17		17
18	601700E;5449100N	not visited	POL -ve	18		18
19	602727E;5447174N	basalt not found	no outcrop or float, POL -ve	19		19
20	604800E;5445000N	not visited	POL -ve	20		20
21	602678E;5442817N	basalt not found	granodiorite outcrop, POL -ve	21		21
22	600430E;5442006N	BASALT found	basalt boulders in field over 40 sq m, mag sus 24-34 SI units, POL -ve	22	mnet 18 R001080- fg basalt, occ small phenos; mnet 31 R001093 TS -fg basalt, occ amygdale white	22
23	600600E;5444800N	not visited	POL -ve	23		23
24	599030E;5437810N	basalt not found	granite outcrop, POL -ve	24		24
25	598936E;5439827N	basalt not found	no float, POL -ve	25		25
26	599307E;5442466N	BASALT found	40 sq m of basalt boulders, mag sus 21-27 SI units, POL +ve, olivine xtals and small u/mafic nodules	26	mnet 30, R 001092 TS, fg basalt, no phenos, occ grey ?granite material	26
27	596307E;5437498N	basalt not found	dense tea tree and hummock grass, no outcrop, POL +ve, strong mag	27		27
28	594100E;5434600N	BASALT already mapped	POL +ve. Weak mag	28		28
29	594922E;5436236N	BASALT found	<b>Logan Rd Quarry</b> -in basalt with abundant u/mafic nodules, mag sus 5-22 SI units, strong mag POL + Rock friable with frags paler than matrix, common small clots of olivine or u/mafic nodules. Collected number of blocks basalt with nodules up to 3cm. Also sparse feldspar xtals probably from granite	29	mnet 8, R001070- fg basalt, some phenos; mnet 19, R 001081- pelletoid basalt, <5mm, some u/mafic inc gem peridotite and some white frags; mnet 39, R 013501 PTS- basalt, not pelletoid; mnet 24, R001086 TS- pelletoid basal, mnet 25, R001087 TS - as before plus u/mafic nodules with opx; mnet 26, R001088 TS - as before, plus olivine rich nodules;	29
30	597177E;5434800N	BASALT already mapped	<b>Halfway Hill Quarry</b> - on patch of fragmentary basalt with sparse granite boulders plus white blebs, and white amygdalites in basalt as well as u/mafic nodules to 5cm, mag sus 10-22 SI units, POL -ve	30	mnet 6, R001068- fg basalt, abundant phenos plus granite/felds frags ; mnet 20 R001082 TS - fg basalt, plag phenos, opx nodules, few white frags, mnet 21 R001083 TS- as before with u/mafic nodules; mnet 22 R001084 TS- as before with olivine nodules , frags and phenos; mnet 23 R001085 TS- as before with only plag phenos; mnet 40 R 013502 PTS- as before with opx inclusions	30
31	598429E; 5435200N	BASALT not found	Basalt float at 598429E;5434760N to south (with u/mafic nodules); strong mag; POL -ve	31	mnet 27, R001089 TS- on track, in situ? Rock typical Logan Rd Q material so may be track fill	31
32	598800E;5432400N	not visited	strong mag, POL -ve	32		32
33	594300E; 5430400N	not visited	weak mag; POL +ve	33	Apteds Creek, nr Gentle Annie Hill	33
34	599736E;5434001N	BASALT found	<b>White Gum Hill</b> - area of basalt boulders over 150m wide, basalt somewhat weathered with frags of U/mafic material and the basalt may be fragmentary itself; mag sus 20-30 SI units, POL +ve	34	mnet 7, R001069 --fg basalt, many phenos, granite frags and u/mafic nodules	34
35	591300E;5457000N	BASALT?	not visited, weak mag, POL +ve	35		35
36	594750E;5444900N	not visited	strong, POL +ve	36		36
37	597800E;5447600N	not visited	POL -ve	37		37

**SUMMARY OF SAMPLES FROM PRIORY AREA IN MRT COLLECTIONS**

**LOGANS ROAD QUARRY BASALTS (Anomaly 29)**

R001086	MNET 24	TS	
R001087	MNET 25	TS	
R001088	MNET 26	TS	
R013501	MNET 39	PTS	from 5 slabs
R001070	MNET 08	R	
R001081	MNET 19	R	

**HALF WAY HILL QUARRY BASALTS (Anomaly 30)**

R001082	MNET 20	TS	
R001083	MNET 21	TS	
R110084	MNET 22	TS	
R001085	MNET 23	TS	
R013502	MNET 40	PTS	from 5 slabs
R001068	MNET 06	R	

<b>ANOMALY 3</b>	Basalt	R001090	MNET 28	TS
<b>ANOMALY 6</b>	Basalt	R001077	MNET 15	R
<b>ANOMALY 10</b>	Basalt	R001065	MNET 03	R
<b>ANOMALY 22</b>	Basalt	R001080	MNET 18	R
	Basalt	R001093	MNET 31	TS
<b>ANOMALY 26</b>	Basalt	R001092	MNET 30	TS
<b>ANOMALY 31</b>	Basalt	R001089	MNET 27	TS
<b>ANOMALY 34</b>	Basalt	R001069	MNET 07	R

Pyroxene nodule	Half Way Hill Quarry	Jan 2010	D McP D
Oxidised ?basalt pebbles	Logans Road Quarry	May 2010	D McP D
Pelletoid basalt 688075	Logans Road Quarry	Aug 2010	D McP D

**EL92013\_2014\_APPENDIX 2**

**Relinquishment Report  
K. C. Morrison Pty Ltd**

**R. A. Gregory**  
**Exploration Licence 9/2013 Priority**  
**Partial Relinquishment Report**

**Ken Morrison**  
**27 March 2015**

# 1. Introduction

EL 9/2013 is a 205 km<sup>2</sup> Categories 1 and 5 Exploration Licence in the Priory area, northwest of St Helens (Figure 1). The EL was acquired by R.A. Gregory primarily to explore for sapphire and zircon gemstones associated with Tertiary basalts and detrital sediments derived in part from the weathering products of basalts.

Exploration in licence year 1, ending on November 7, 2014, reviewed existing aeromagnetic data and field checked a number of discrete magnetic highs interpreted to potentially be generated by basalt plugs. The results effectively sterilised a substantial portion of the EL and consequently an application for partial relinquishment is being submitted to Mineral Resources Tasmania.

This report documents the area proposed for relinquishment and summarises the exploration completed within that area. A more comprehensive account of all exploration within EL 9/2013 to date is included in the Year 1 Annual Report.

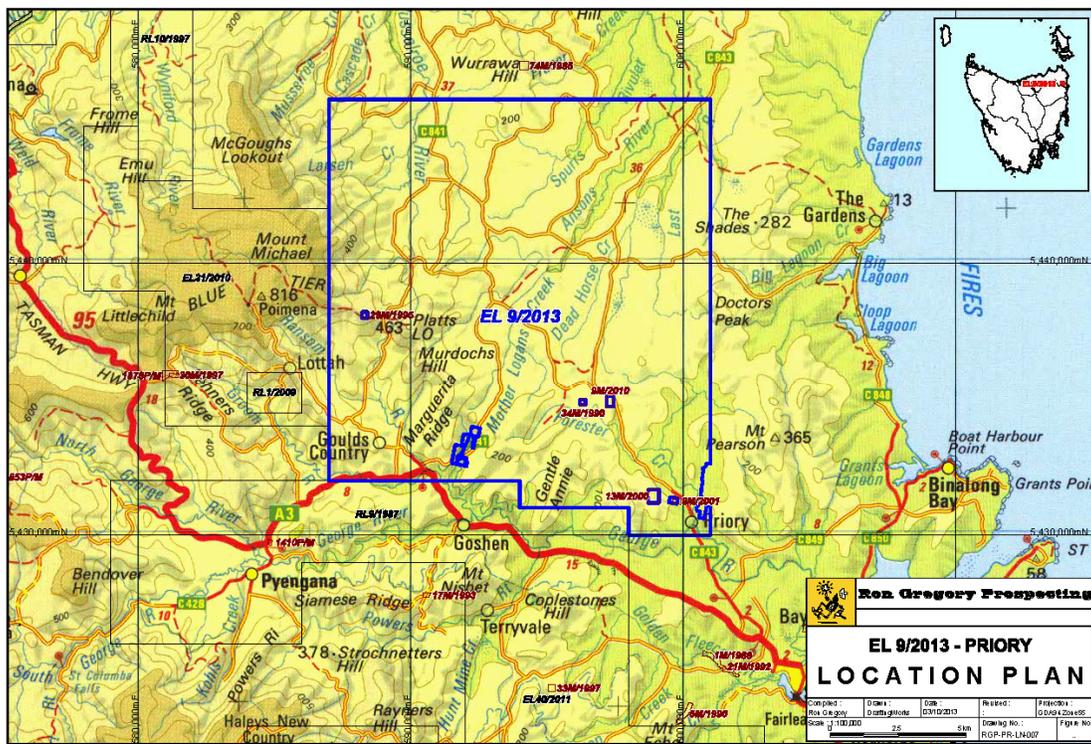
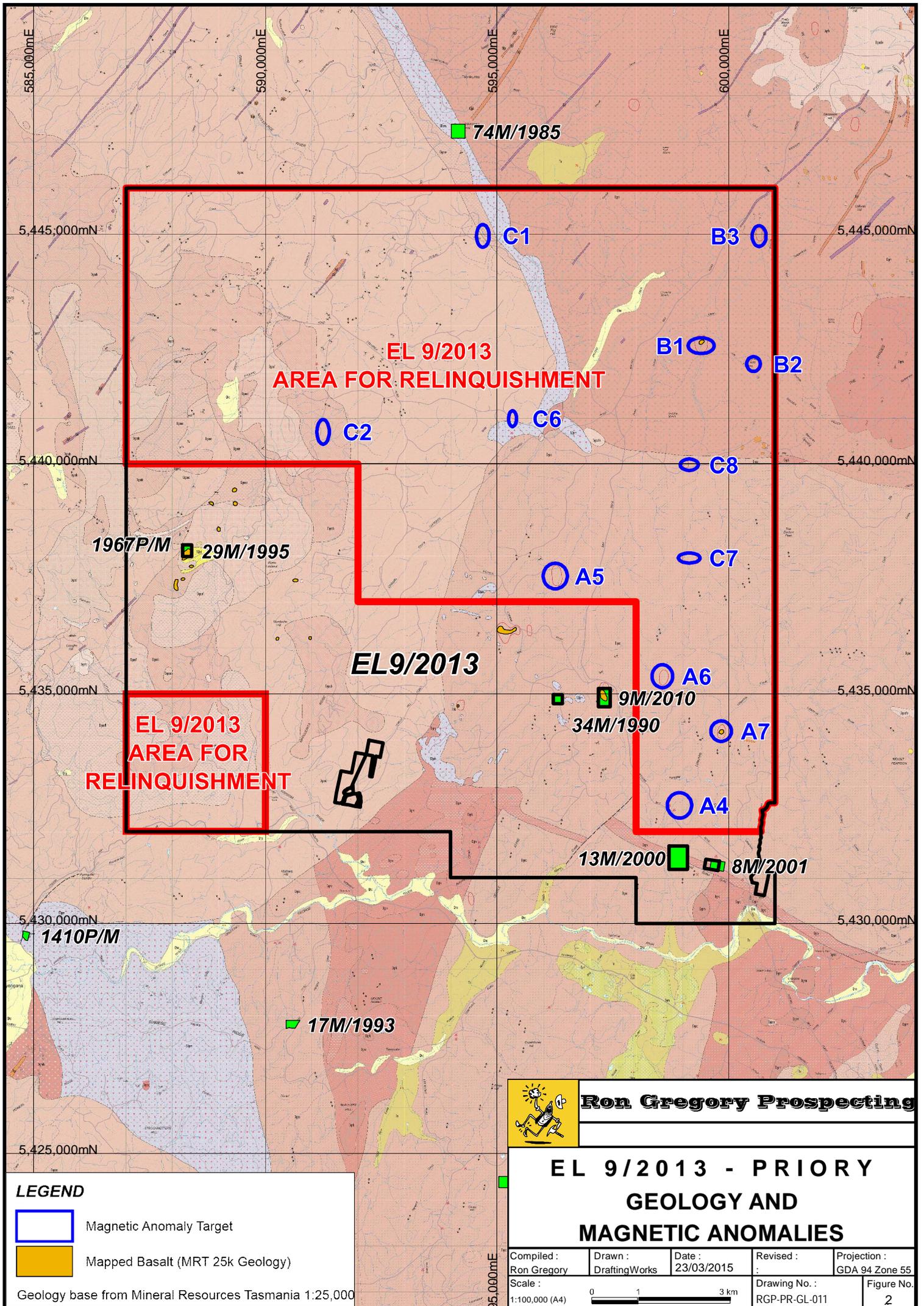


Figure 1. EL 9/2013 Location Map

## 2. Geology

Figure 2 shows the portion of the 1:25,000 MRT Blue Tier and Binalong geology sheets covered by EL 9/2013. Basement rocks are predominantly Devonian granites with minor rafts and roof remnants of contact metamorphosed Mathinna Supergroup meta turbidites, scattered through the central part of the EL. Several small basalt outcrops are mapped and those exposed at Logans and Halfway quarries are pipe-like bodies intruding through the granite, and containing abundant inclusions of olivine and spinel. Based on whole rock and trace element composition the plugs at the Logans and Halfway quarries are assigned an IUGS classification of basanites (John Everard, MRT, pers. comm.). These two sites were used to calibrate the magnetic responses which generated the additional features field checked during 2014 (Figure 2).

A small outcrop of Tertiary sediment exists in the far southeast corner of the EL and is likely to be a distal fragment of the alluvial deep lead system (Thureaus Lead) which hosts the abandoned placer tin mines of the St Helens district. Minor Quaternary alluvial sands, predominantly granite derived, overlie basement around some of the larger creeks. Minor occurrences of detrital sapphire and zircon are known from amateur fossicking in Cenozoic stream gravels in the southeast part of the EL, within the area of EL 9/2013 to be retained.



**EL 9/2013  
AREA FOR RELINQUISHMENT**

**EL 9/2013  
AREA FOR  
RELINQUISHMENT**

**EL9/2013**

**LEGEND**

-  Magnetic Anomaly Target
-  Mapped Basalt (MRT 25k Geology)

Geology base from Mineral Resources Tasmania 1:25,000

 **Ron Gregory Prospecting**

**EL 9/2013 - PRIORY  
GEOLOGY AND  
MAGNETIC ANOMALIES**

Compiled : Ron Gregory	Drawn : DraftingWorks	Date : 23/03/2015	Revised :	Projection : GDA 94 Zone 55
Scale : 1:100,000 (A4)			Drawing No. : RGP-PR-GL-011	Figure No. : 2

### **3. Exploration Results from the area to be Relinquished**

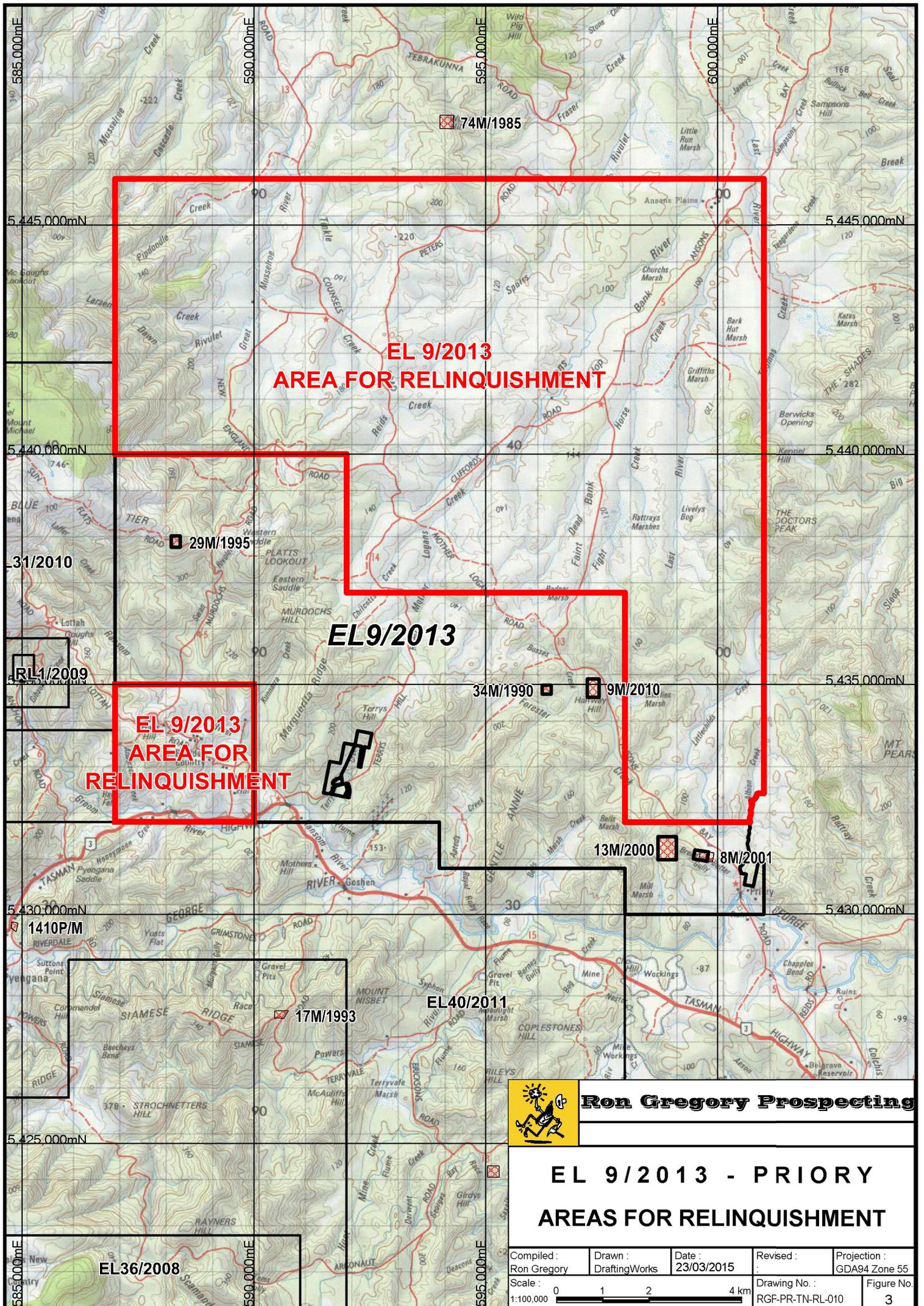
No known gemstone occurrences exist within the area proposed for relinquishment (Figures 2 and 3) and no known reports on exploration for gemstones, prior to the current work, have been identified. During licence year 1, twelve discrete magnetic features interpreted as possible plugs with magnetic signatures similar to the basalts at Logans and Halfway (Figure 2), were field checked. All sites were determined to be unprospective for gemstones on the basis of some combination of; no basalt at surface, basalt interpreted as massive olivine lava, or nearby alluvial sediments showing no indications of a basalt source.

The results are shown on Table 1 and the consequent area to be relinquished is outlined on Figures 2 and 3. A more comprehensive account of the aeromagnetic interpretation which generated the anomalous potential basalt features is included in the EL 9/2013 Annual Report for licence year 1, which will remain under Closed File status for the duration of the EL.

The 9km<sup>2</sup> block to be relinquished in the southwest corner of the EL is considered unprospective on the combined grounds of geology and land use/environmental factors due the location in the Goulds Country area.

**Table 1 EL9/2013 Priory - Magnetic Anomaly Field Check Summary**

<b>Date</b>	<b>Site ID</b>	<b>GDA-E</b>	<b>GDA-N</b>	<b>Geology</b>	<b>Land Use</b>	<b>Pan Con Location</b>	<b>Results</b>
17/02/2014	C6	595350	5441000	granite	regrowth native forest on logged coupe	Ansons River	granite sand, no spinel
17/02/2014	C1	594700	5445000	granite	half grown pine plantation	unnamed creek	granite sand, no spinel
18/02/2014	B3	600620	5445000	granite	private cattle pasture	Last River	granite sand, no spinel
18/02/2014	B2	600500	5442150	sand dunes near granite	private cattle pasture	no close alluvials	n/a
18/02/2014	B1	599400	5442600	basalt on granite	private cattle pasture	Last River	granite sand, no spinel
5/05/2014	A4	599000	5432600	granite	private native bush-firewood logging	no close alluvials	n/a
5/05/2014	A7	599850	5434150	basalt on granite	un-used native bush	Littlechild's Creek	granite sand, no spinel, fine magnetite
5/05/2014	A6	598550	5435400	granite	native bush-firewood hooking	no close alluvials	n/a
17/06/2014	A5	596250	5437601	granite	native bush, some firewood logging	unnamed creek	overgrown creek, granite sand, no spinel
17/06/2014	C2	591251	5440701	biotite granite	pine plantation	no close alluvials	n/a
17/06/2014	C8	599149	5440000	peat cover near granite	native scrub, damp peat, button grass	Last River	granite sand, no spinel
17/06/2014	C7	599200	5437897	granite	un-used native bush	Last River	minor sediment exposed, no spinel
					<b>Anomaly Cause</b>	<b>Gem Potential</b>	
					forestry equipment?	nil	
					forestry equipment?	nil	
					nothing obvious	nil	
					nothing obvious	nil	
					basalt plug or lava patch?	nil	
					nothing obvious	nil	
					basalt plug or lava patch?	nil	
					nothing obvious	nil	
					nothing obvious	nil	
					basalt road gravel?	nil	
					nothing obvious	nil	
					nothing obvious	nil	



**EL 9/2013  
AREA FOR RELINQUISHMENT**

**EL 9/2013  
AREA FOR  
RELINQUISHMENT**

**EL9/2013**



**Ron Gregory Prospecting**

**EL 9/2013 - PRIORY  
AREAS FOR RELINQUISHMENT**

Compiled : Ron Gregory	Drawn : DraftingWorks	Date : 23/03/2015	Revised :	Projection : GDA94 Zone 55
Scale : 1:100,000	0 1 2 4 km		Drawing No. : RGF-PR-TN-RL-010	Figure No. 3

**EL92013\_201411\_APPENDIX 3**

**Report on Geophysical Data Assessment for possible Basalt Pipes and  
Paleochannels**

**Southern Mineral Exploration Geophysics  
(SMEG)**

Report on  
**Geophysical Data Assessment**  
for possible  
**Basalt Pipes and Palaeochannels**  
on exploration licence  
**EL 9/2013**  
Priory area, northeast Tasmania  
August 2013



Report no. : 1313a  
Report date : 16-August-2013  
Author : Phil Muir  
Client contact : Ron Gregory

## **Disclaimer**

Although care was taken during preparation and processing of the data in this report, you are reminded that inaccuracies or omissions may occasionally occur. Any interpretations, recommendations, or conclusions contained in this report are no more than the opinions of the author(s) and are not presented here as proven facts. You accept all risks and responsibility for losses, damages, costs and other consequences resulting directly or indirectly from using the information in this report.

## **Map coordinates**

Unless noted otherwise, coordinates and bearings in this report are for MGA55 (datum: GDA94, projection: Map Grid of Australia zone 55)

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## List of Appendices

- 1 (A3 paper size) Maps at 1:75k scale of various data over the whole of EL9/2013.
- 2 (A4 paper size) Plan view of magnetic model bodies with profiles of observed and modelled data.
- 3 (A4 paper size) Maps at 1:20k scale showing details of individual magnetic models and targets.

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Apx101	airborne survey : magnetics : RTP (Reduction to the Pole)
Apx102	airborne survey : magnetics: Analytic Signal
Apx103	airborne survey : flightpath
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Apx105	Topography
Apx106	Satellite Imagery (Google Earth)
Apx107	airborne survey : digital terrain
Apx108	Geology
Apx109	Gravity : Residual Bouguer Anomaly
Apx110	airborne survey : radiometrics : Total Count
Apx111	airborne survey : radiometrics : K/Th/U ternary image
Apx201	model body and profiles : magnetic anomaly A1
Apx202	model body and profiles : magnetic anomaly A2
Apx203	model body and profiles : magnetic anomaly A3
Apx204	model body and profiles : magnetic anomaly A4
Apx205	model body and profiles : magnetic anomaly A5
Apx206	model body and profiles : magnetic anomaly A6
Apx207	model body and profiles : magnetic anomaly A7
Apx208	model body and profiles : magnetic anomaly B1
Apx209	model body and profiles : magnetic anomaly B2
Apx210	model body and profiles : magnetic anomaly B3
Apx211	model body and profiles : magnetic anomaly C1
Apx212	model body and profiles : magnetic anomaly C4
Apx301	magnetics Analytic Signal image : detail of magnetic anomaly A1, C3
Apx302	magnetics Analytic Signal image : detail of magnetic anomaly A2, A3, A5
Apx303	magnetics Analytic Signal image : detail of magnetic anomaly A4, A6, A7
Apx304	magnetics Analytic Signal image : detail of magnetic anomaly B1, B2, B3
Apx305	magnetics Analytic Signal image : detail of magnetic anomaly C1
Apx306	magnetics Analytic Signal image : detail of magnetic anomaly C2
Apx307	magnetics Analytic Signal image : detail of magnetic anomaly C4, C5
Apx308	magnetics Analytic Signal image : detail of magnetic anomaly C6
Apx309	magnetics Analytic Signal image : detail of magnetic anomaly C7, C8
Apx310	magnetics RTP image : detail of magnetic anomaly A1, C3
Apx311	magnetics RTP image : detail of magnetic anomaly A2, A3, A5
Apx312	magnetics RTP image : detail of magnetic anomaly A4, A6, A7
Apx313	magnetics RTP image : detail of magnetic anomaly B1, B2, B3
Apx314	magnetics RTP image : detail of magnetic anomaly C1
Apx315	magnetics RTP image : detail of magnetic anomaly C2
Apx316	magnetics RTP image : detail of magnetic anomaly C4, C5
Apx317	magnetics RTP image : detail of magnetic anomaly C6
Apx318	magnetics RTP image : detail of magnetic anomaly C7, C8
Apx319	topography image : detail of magnetic anomaly A1, C3
Apx320	topography image : detail of magnetic anomaly A2, A3, A5
Apx321	topography image : detail of magnetic anomaly A4, A6, A7
Apx322	topography image : detail of magnetic anomaly B1, B2, B3
Apx323	topography image : detail of magnetic anomaly C1
Apx324	topography image : detail of magnetic anomaly C2
Apx325	topography image : detail of magnetic anomaly C4, C5
Apx326	topography image : detail of magnetic anomaly C6
Apx327	topography image : detail of magnetic anomaly C7, C8

## 1. Summary

Aeromagnetic data over EL9/2013 near Priory in northeast Tasmania show several discrete anomalies, many of which may indicate the presence of basalt pipes. One strong magnetic anomaly corresponds to the known basalt at Logans Road Quarry. There are at least five other anomalies of similar significance. Only two of these have basalt outcrop mapped in the current Mineral Resources Tasmania 1:25k scale geology; the remaining three are likely to be unknown and/or poorly known basalts. A number of other discrete but weaker magnetic anomalies on the tenement could also be related to basalt pipes.

Magnetic models were produced for a number of these magnetic anomalies in order to estimate the depths of the magnetic sources. The observed magnetic data over these anomalies are all consistent with the top of the magnetic sources being at or very close to the topographic surface.

Radiometric and gravity data are also available but do not appear to be of any assistance in defining either basalt pipes or palaeochannels.

## 2. Introduction

Public geophysical data available from Mineral Resources Tasmania was assessed for its usefulness in defining possible basalt pipes or palaeochannels on exploration licence EL9/2013. These geological features may respectively contain the source rock and detrital material carrying sapphires and other heavy minerals. Data assessed comprises the *2007 Northeast Tasmania (GA P1143)* airborne survey (magnetics, radiometrics, digital terrain) flown for Mineral Resources Tasmania, and the *Tasmanian Gravity Database*.

The magnetics data proved to be the most useful of the datasets because it defines a number of magnetic anomalies that are candidates for basalt pipes, however it does not show any features that are suggestive of palaeochannels. The magnetics is discussed in detail below.

Unfortunately neither the radiometrics nor the gravity data show any recognisable features that might be related to possible basalt pipes or palaeochannels; the only features of this nature that can be recognised with any clarity are some modern drainage channels in the radiometrics (figures [Apx110](#), [Apx111](#)). The average gravity station spacing is about 1km and far too coarse to define any of the features of interest ([Apx109](#)).

## 3. Airborne Survey Data

Between March and September 2007 an airborne geophysical survey totalling about 52,000 line-km was flown over much of northeast Tasmania for Mineral Resources Tasmania. Flightlines were flown east-west at a 200m spacing with a terrain clearance of 80 metres. Data collected comprised magnetics, radiometrics and digital terrain. This is by far the best magnetic survey available over EL9/2013, with the only other survey being one flown in 1985 with a 1500m flightline spacing.

Magnetic data from the 2007 airborne survey was first processed using several different methods to assess which ones would be most useful in defining possible basalt pipes and/or palaeochannels. Processing with Reduction To The Pole (“RTP”) and Analytic Signal proved to be the best.

#### 4. Magnetic Data – Processing Basics

The earth's magnetic field is not vertical but is instead inclined at an angle to the horizontal that is related to the latitude. In Tasmania this angle of inclination is about 70 degrees. The consequence of this non-vertical angle is that magnetic anomalies do not lie directly above their respective magnetic bodies but are instead shifted to the north by a distance that depends on both how deep they are buried and the flying height of the magnetic survey. A processing technique called Reduction To The Pole ("RTP") is used to transform magnetic data so that magnetic anomalies lie vertically above their source bodies.

The total magnetic response of a body comprises a contribution from two different physical properties. The first contribution is *induced magnetisation* and is caused by the earth's present magnetic field interacting with the body; this response is in the same direction as the earth's present magnetic field. The second is *remanent magnetisation* (eg. "palaeomagnetism") and is a property of the body that is related to the earth's past magnetic field; this response is usually in an uncertain direction because the direction of that past magnetic field is unknown unless rock property measurements are made on rock samples. The strength of the induced magnetisation can be calculated from the strength of the earth's field and the body's *susceptibility*. The strength of the remanent magnetisation, usually expressed as a *Koenigsberger Q ratio* of remanent-to-induced magnetisation, can only be properly determined by physical measurements on rock samples.

The remanent magnetisation "Q ratio" value can vary greatly from one rock unit to another. If Q is well below 1 then induced magnetisation dominates; modelling magnetics by comparing observed and calculated responses generally results in [simple] model bodies whose properties are generally well determined. If on the other hand Q is around 1 or greater then remanent magnetisation dominates; in this case modelling magnetics by comparing observed and calculated responses, without knowing the body's true Q ratio and the direction of the remanent magnetisation, results in model bodies with at least some properties that are poorly determined.

Magnetic bodies whose induced magnetisation dominates show positive magnetic anomalies (positive polarity). However those bodies whose remanent magnetisation dominates can show magnetic anomalies that vary from "normal" positive type anomalies through to completely negative anomalies (negative polarity). One way of mapping magnetic anomalies where remanence is suspected is to process the observed magnetic data using the technique called Analytic Signal. This processing produces a positive anomaly around the edge of a magnetic body even if the observed magnetic anomaly is negative. For bodies with proportionally small or narrow upper surface dimensions in relation to other distance parameters, such as depth and flying height, the Analytic Signal anomaly tends to coalesce into a single positive anomaly.

#### 5. Magnetic Data – Priory Area

Data from the 2007 airborne survey was processed and plotted using RTP and Analytic Signal techniques. Anomalies were assessed as candidates for possible basalt pipes using an "A, B, C" classification; "A" meaning a strong anomaly, "B" meaning moderate, and "C" meaning weaker but still worthy of consideration. A total of 18 anomalies have been defined (Table 1).

Figure [Apx101](#) shows the classified anomalies on an image of RTP magnetics. Anomalies **A1, A2, A5, A7** are strong positives. By contrast **A3, A4, A6** are strong but negative and are obviously dominated by remanent magnetisation. After the application of Analytic Signal processing (figure

[Apx102](#)) the dominance of all seven anomalies clearly shows. They have been given the highest classification both because of their strength and because they are clearly separate entities to the more linear NE and NW anomaly trends in the magnetic data. All except **A1** have an approximately circular appearance as would be expected for a basalt pipe. The shape of the **A1** anomaly could still represent a basalt pipe that for some structural reason has had an unusual intrusion trajectory through the host rock.

Anomalies **A1**, **A2**, **A3**, **A7** each have small areas of basalt shown on MRT 1:25k geology mapping. **A2** corresponds to the basalt occurrence at Logans Road Quarry and it is in headwater creeks immediately adjacent to this basalt that detrital minerals including sapphires as well as a sapphire in an oxidised basalt pebble have been found (see Mineralogica Tasmanica).

Anomalies **B1**, **B2**, **B3** are notably less intense than the A-series anomalies and this may be due to the source bodies being physically smaller or to them having lower magnetisation (induced or remanent). [Figure 1](#) shows these and other selected anomalies on flightline profile plots of observed magnetic data. The anomalies for these three bodies, although less intense, still clearly stand out from the surrounding magnetics and remain good candidates for possible basalt pipes.

The C-series anomalies are a selection of magnetic anomalies that are either weaker than the A-series and B-series anomalies, or are moderately strong but not clearly separate to other magnetic features like the linear NE and NW anomaly trends. Anomalies range from the more prominent **C1** through to those like **C4** and **C5** ([Apx101](#), [Apx102](#), [Figure 1](#)). Inspection of [Apx101](#) and [Apx102](#) shows that more of the currently unclassified anomalies could be added to this series but it is often difficult to decide if any given anomaly is a separate pipe-like anomaly or just part of another more linear magnetic trend. Where a linear magnetic trend crosses flightlines at a low angle it shows on the images as a series of discrete anomalies that look similar to pipe-like anomalies, however they are not; this is clearly illustrated by the NW linear trend just SW of anomaly **B1** (compare [Apx101](#) and [Apx103](#)).

The reasons for selecting C-series anomalies are varied. Anomaly **C1** for example was selected because it is distinct and moderately strong and looks similar to the B-series anomalies, even though its location may suggest an origin more related to the linear magnetic trends rather than a basalt pipe. Smaller C-series anomalies (and even currently unclassified ones) may still be indicative of basalt pipes, for example **C5** is not a strong magnetic anomaly but nonetheless there is mapped basalt at this location – so the weaker anomalies cannot be discounted as not of interest just because they are weak.

## 6. Magnetics – Modelling

Magnetic models were generated for the A-series and B-series anomalies as well as two of the C-series anomalies; **C1** because it is moderately strong and well defined and **C4** because it is representative of some of the other small but well-defined C-series anomalies (see [Figure 1](#) for a magnetic profile plot that includes **C1** and **C4**). An overview of the final model bodies in plan is shown in figure [Apx104](#).

The main aim of the modelling was to estimate the depth-to-top of each causative body and define the approximate extent of its top surface. Values for other body parameters (dip, susceptibility, etc) were generated from the modelling but not all of these parameters are reliable due largely to the presence of remanent magnetisation in many bodies. In particular the susceptibility values for the negatively polarised anomalies (**A3**, **A4**, etc) are not physically meaningful because these anomalies

are heavily dominated by remanence rather than by induced magnetism. In effect the negative susceptibility values are just a convenient mathematical way of matching the calculated anomaly amplitude to the observed anomaly amplitude, which in these cases are negative anomalies. Even though model susceptibilities are negative the depth-to-top and position-of-top of these bodies is still estimated reasonably well because these properties are more closely related to the “sharpness” and location of the magnetic anomaly edges, not to the intensity of the anomaly.

The first-pass modelling used automated fitting of calculated model data to observed profile data and this resulted in nearly all models having a depth-to-top within about +/-10m of the ground surface. Given that the model bodies used were simple dipping slabs and thus *unlikely* to be very accurate representations of the real source body shapes, plus the fact that the magnetic sensor was nominally 80m above ground level, the +/-10m value was regarded as indicating that the body tops were not significantly different from being at ground level. To verify that this was the case each model body was manually adjusted to have its top at the ground surface and then the model response recalculated.

Most modelling used single dipping slab bodies and these were each sufficient to explain their respective observed anomalies. In the cases of **A2** and **B1**, three and two slabs respectively were required; for each anomaly this may indicate the presence of either susceptibility/remanence variations within one actual magnetic body, or some kind of separation of a magnetic body into physically separate parts.

Anomaly **A1** is quite different because of its elongated shape and modelling it with a single dipping slab is not appropriate. Instead its complex shape was modelled using a sequence of dipping slabs. Due to the complexity of this magnetic anomaly, and the uncertainty about what contribution remanence is making to it, the slabs were each fixed to have a vertical dip. The final set of slabs taken as a whole approximates, at least near the surface, the actual **A1** magnetic source body.

## 7. Magnetics – Model Bodies

Models were generated for 12 of the 18 magnetic anomalies ([Table 1](#)).

Appendix 2 figures [Apx201](#) to [Apx212](#) show modelling software output of model plan views with superimposed profiles of calculated (red) and observed (black) data. For model bodies that are dipping the top flat surface is indicated by **TOP** in red lettering.

Appendix 3 figures show enlarged views of the model bodies superimposed on three different data layers; on Analytic Signal ([Apx301](#) to [Apx309](#)), on RTP ([Apx310](#) to [Apx318](#)) and on Topography ([Apx319](#) to [Apx327](#)). These figures also show enlarged views of the anomalies that weren't modelled.

The positions of the magnetic body tops (or the anomaly centres for those without models) should be regarded as the best estimate of where on the ground to expect outcrop of magnetic source rock, which is presumably basalt. [Table 1](#) gives the coordinates of the centres of the body tops (or anomaly centres).

Dip directions, as indicated by the magnetic bodies' dipping sides seen in Appendix 2 and Appendix 3, should not be treated as reliable due to the uncertain influence of magnetic remanence.

## 8. Conclusions and Recommendations

Several magnetic anomalies are good candidates for basalt pipes. Magnetic modelling indicates that all of the modelled anomalies are compatible with source bodies that reach the topographic surface, so field checking of the interpreted source locations should be undertaken to see if likely sources can be found at surface. Field checking should be centred on the magnetic body tops and anomaly centres whose coordinates given in [Table 1](#) and are shown in the plots of Appendices 2 and 3.

Basalt has been mapped at some of the magnetic anomaly locations and it would be a fair assumption that at these locations basalt is the magnetic source. Whether or not these basalts, and those that may be discovered at other magnetic anomalies, are true pipe structures can't be definitively predicted from the available geophysical data.

The A-series and B-series magnetic anomalies are all significant and all are certainly worthy of field inspection.

The significance of C-series anomalies is not so clear-cut; some appear to be reasonable candidates for basalt pipes but for others this is much more debatable. As the amplitude of these anomalies becomes smaller they start to blend into the magnetic "background" or become confused with (or possibly associated with or part of) some of the linear magnetic features evident in the magnetic data. It becomes difficult to decide whether or not these are genuine candidates for basalt pipes; in addition there remain a number of unclassified small magnetic anomalies at this end of the confidence range that could be added to the current set of C-series anomalies.

Small anomalies are often defined only on a single flightline and there remains a possibility that some of these may be due to cultural (non-geological) sources.

## 9. Bibliography

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The Mineralogical Society Of Tasmania Inc. Journal & Newsletter  
No. 83, May 2013, pp 15-17.

Leaman, D.E.

Assessment of Selected Features in the 2007 Magnetic Surveys of North East Tasmania.  
Report for Mineral Resources Tasmania, February 2008  
MRT Report number GPCR2008\_01

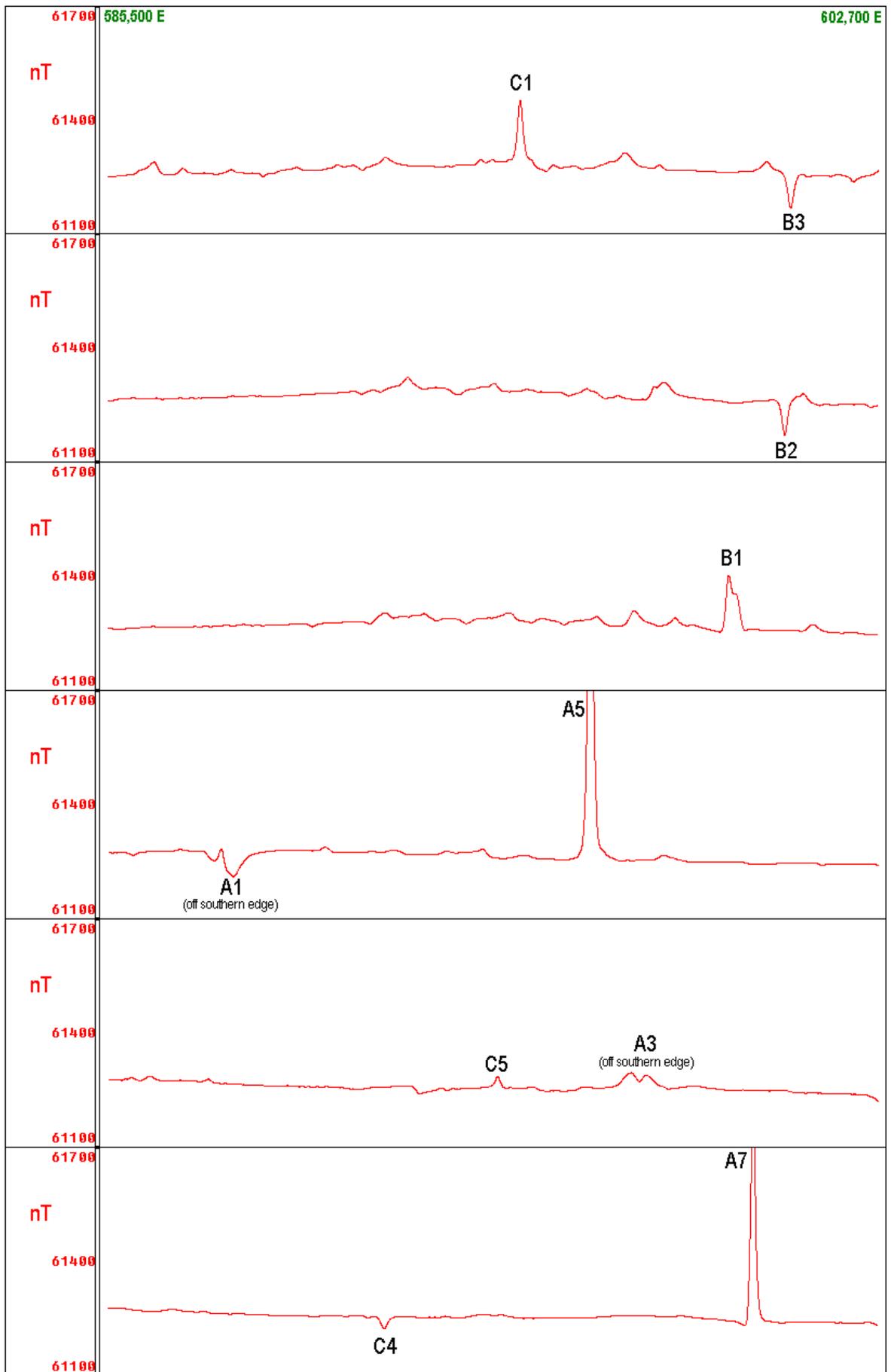
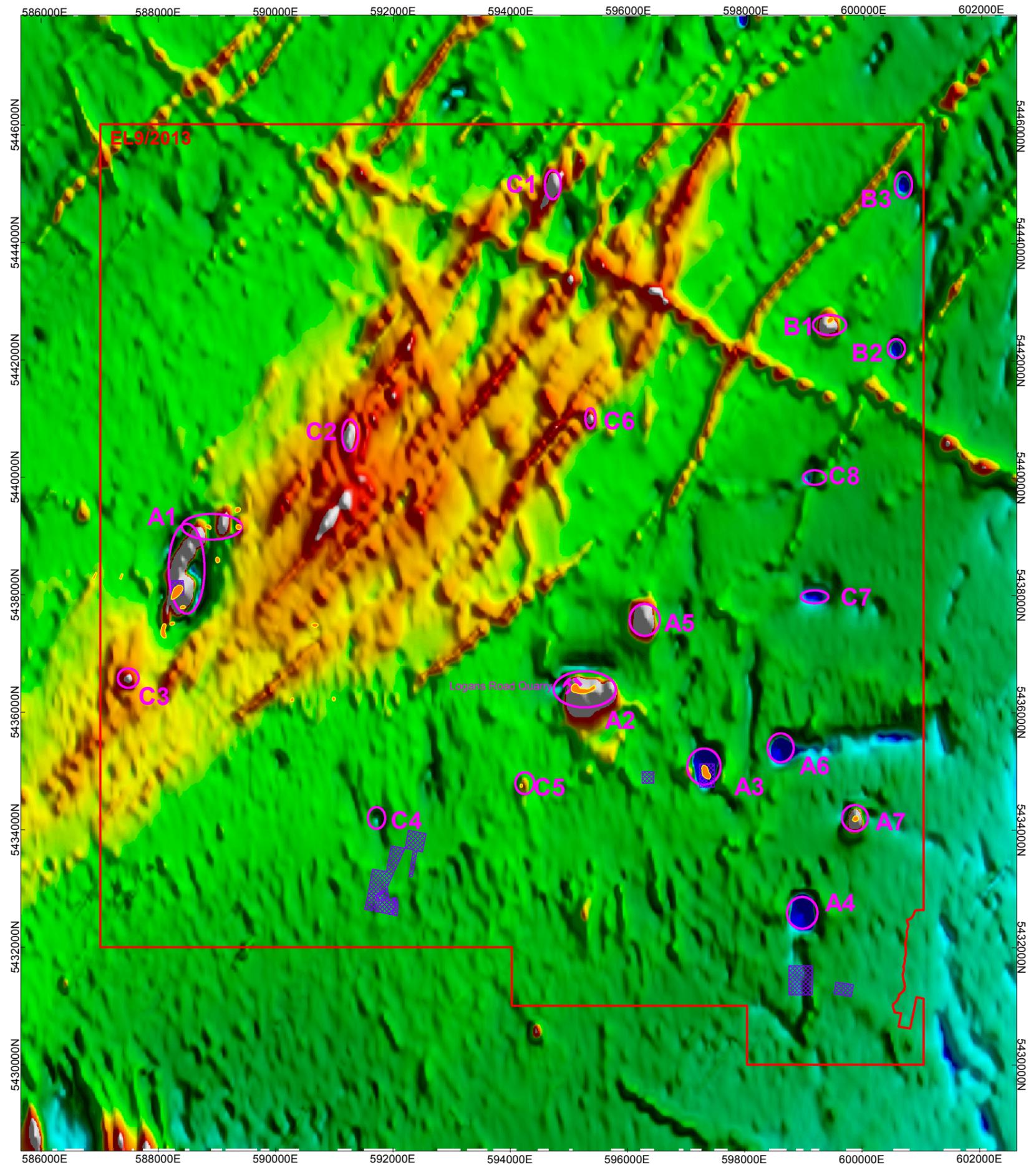


Figure 1 – Profiles of observed magnetic data, showing selected anomalies.

Anomaly	modelled	top centre: MGA East	top centre: MGA North	magnetic anomaly polarity	nominal magnetic susceptibility (SI) from modelling	existing mine lease	MRT 25k mapped basalt	priority for field inspection	notes
A1	yes	588510	5438650	normal	varies : +0.025 to +0.176	part	parts	2	complex anomaly - not a simple "vertical pipe" in character
A2	yes	595220	5436350	normal	three zones : +0.028 to +0.091	quarry	yes	2	Logans Road Quarry (deirital basalt with sapphire found in creek adjacent to here)
A3	yes	597290	5435090	reversed	-0.114	yes	yes	2	distinct pipe-like anomaly, but mine lease exists over modelled source
A4	yes	598980	5432580	reversed	-0.297	-	-	1	distinct pipe-like anomaly
A5	yes	596190	5437650	normal	+0.136	-	-	1	distinct pipe-like anomaly
A6	yes	598570	5435400	reversed	-0.094	-	-	1	distinct pipe-like anomaly
A7	yes	599850	5434220	normal	+0.130	-	yes	1	distinct pipe-like anomaly
B1	yes	599390	5442620	normal	two zones : +0.063 to +0.019	-	yes	2	distinct pipe-like anomaly, though less intense than A1 to A7
B2	yes	600540	5442210	reversed	-0.068	-	-	2	pipe-like anomaly, rated higher due to reversed polarity like A3, A4, A6
B3	yes	600640	5445000	reversed	-0.016	-	-	2	pipe-like anomaly, rated higher due to reversed polarity like A3, A4, A6
C1	yes	594730	5445000	normal	+0.091	-	-	2	possible pipe-like anomaly, but may be related to linear NE or NNW trends
C2	-	591250	5440700	normal	-	-	-	3	possible pipe-like anomaly, but may be more related to linear NE or NNW trends
C3	-	587460	5436600	normal	-	-	-	3	weaker pipe-like anomaly
C4	yes	591740	5434200	reversed	-0.006	-	-	3	weaker pipe-like anomaly
C5	-	594250	5434810	normal	-	-	yes	3	weaker pipe-like anomaly
C6	-	595370	5441030	normal	-	-	-	4	possible pipe-like anomaly, but may be more related to linear NE or NNW trends
C7	-	599180	5437980	reversed	-	-	-	3	weaker pipe-like anomaly, rated higher due to reversed polarity like A3, A4, A6
C8	-	599160	5440060	reversed	-	-	-	4	weak pipe-like anomaly, rated higher due to reversed polarity and B3 similarity

Table 1 – Magnetic Anomalies – model bodies and notes

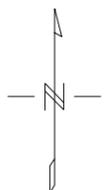
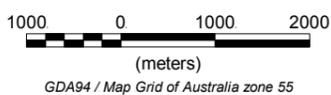
## **APPENDICES**

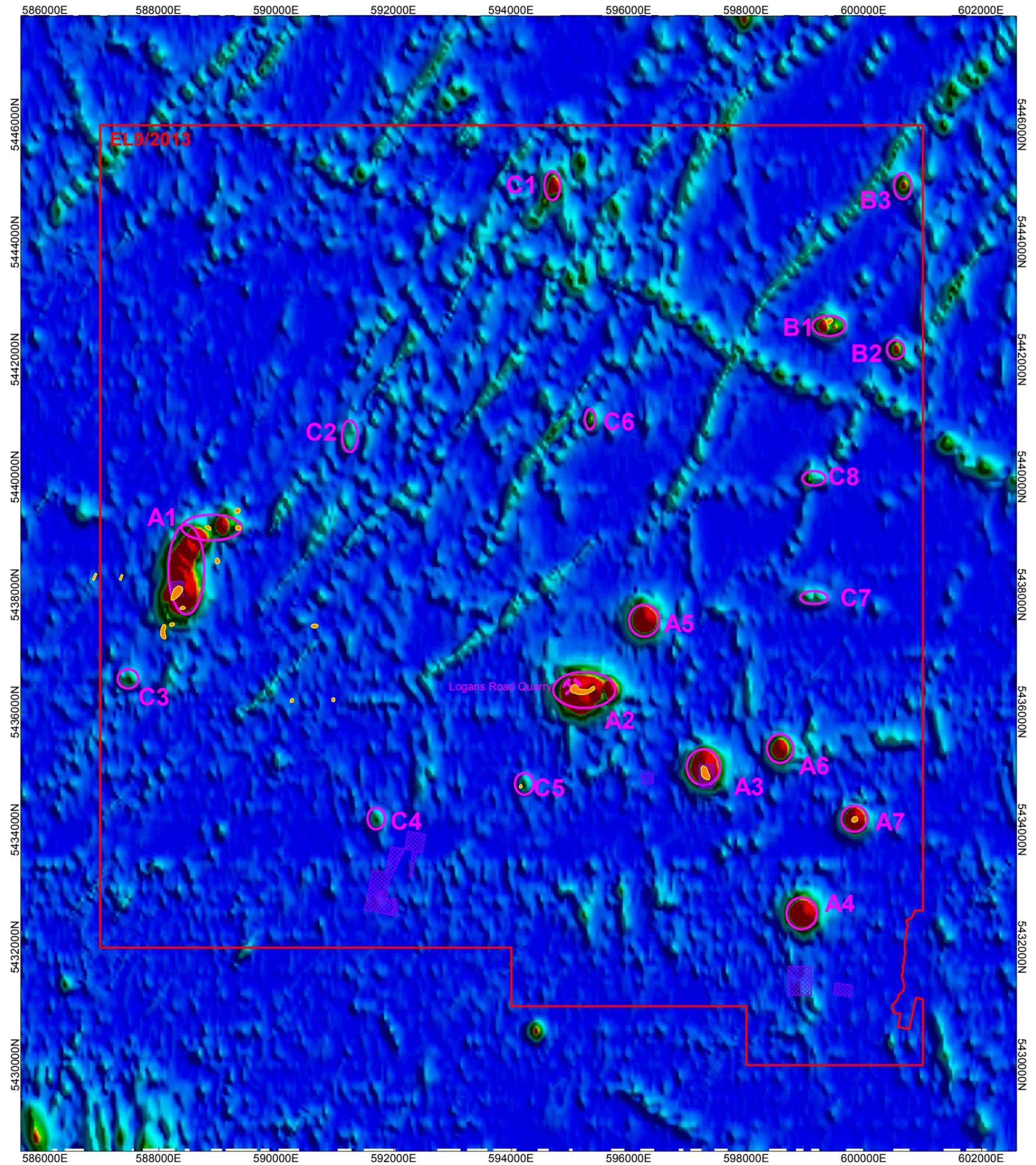


-  mine lease (existing)
- B3**  magnetic anomaly target
-  mapped basalt (MRT 25k geology)

**Magnetics - "RTP" Reduction to the Pole  
(MRT 2007 airborne)**

**EL9/2013 - Priory  
Potential Basalt Plugs**

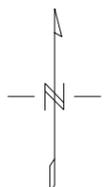
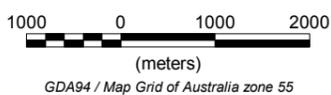


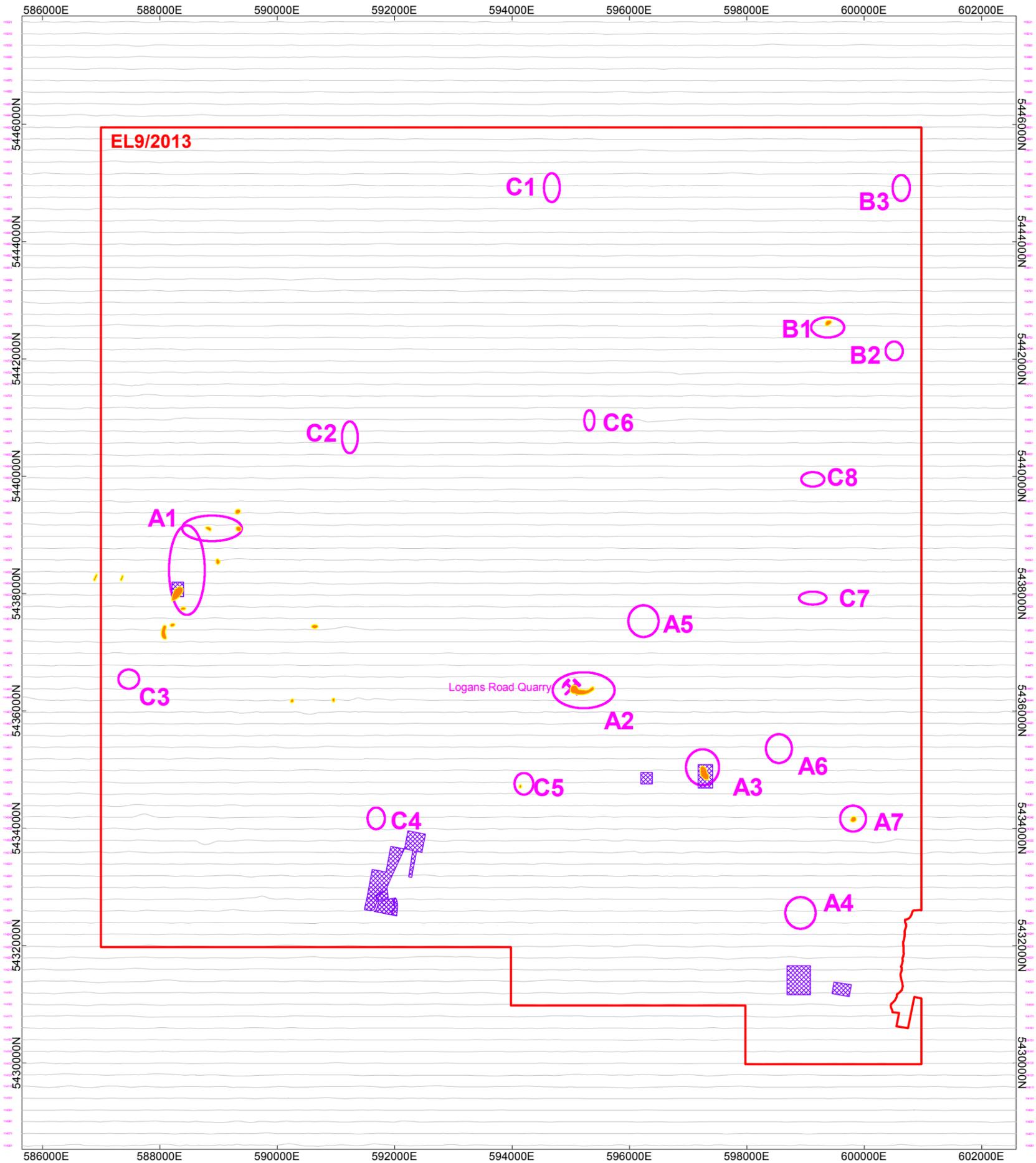


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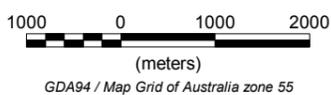


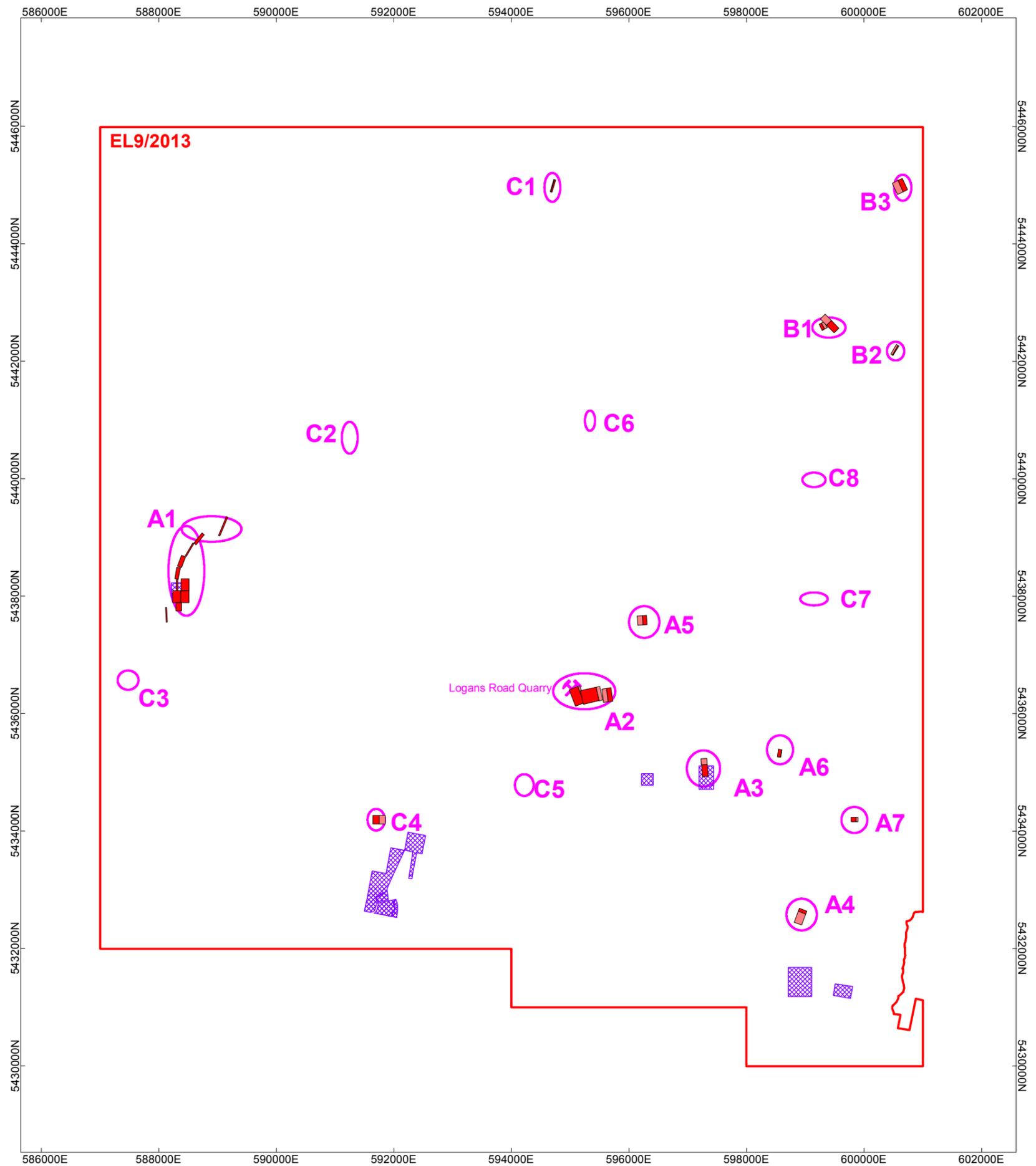


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**Flight Path  
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**EL9/2013 - Priory  
Potential Basalt Plugs**

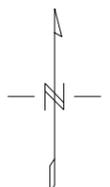
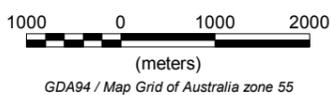


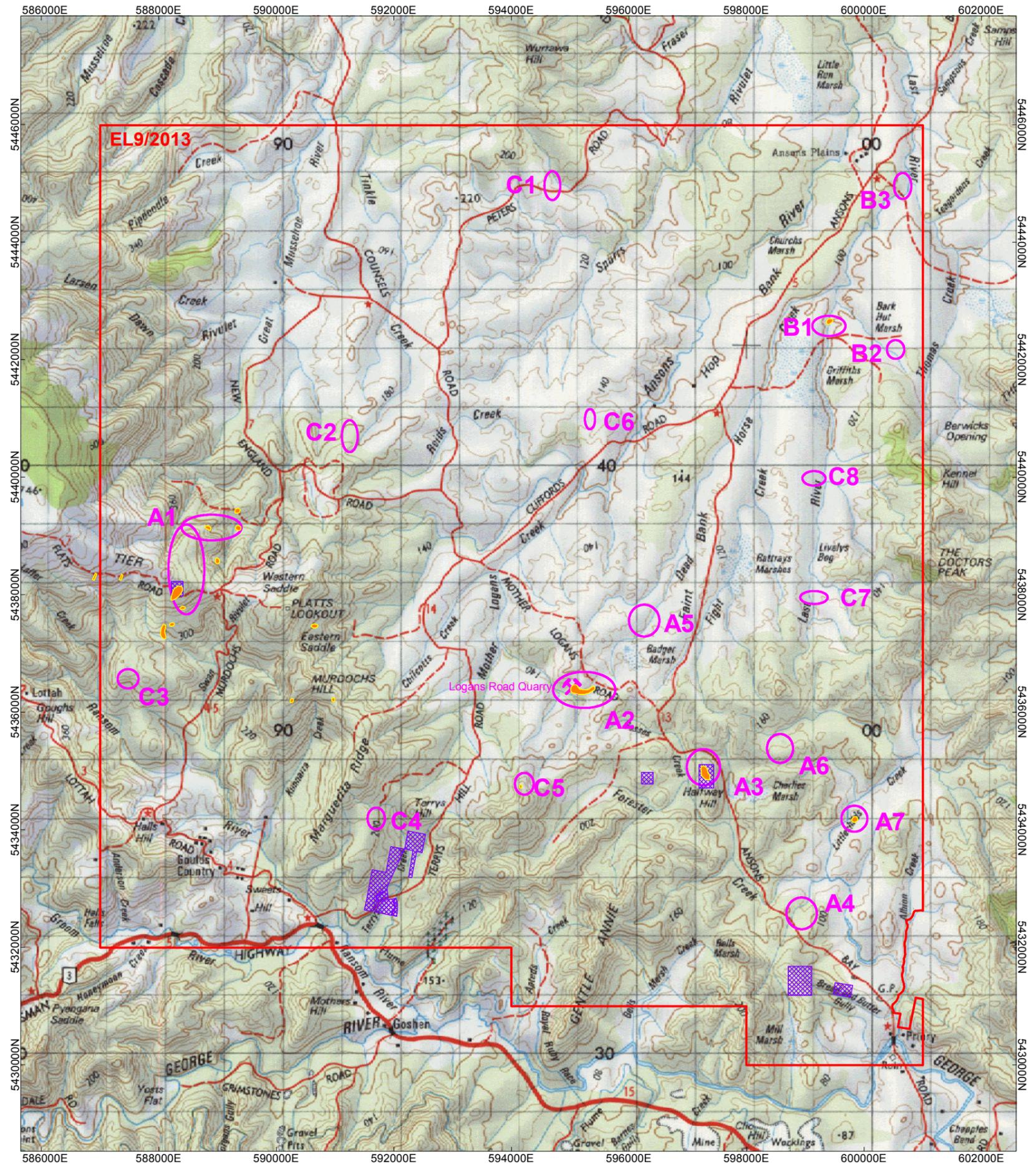


-  mine lease (existing)
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-  magnetic model body (top surface)
-  magnetic model body (dipping side)

### Magnetic Model Bodies

EL9/2013 - Priory  
Potential Basalt Plugs

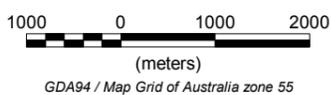




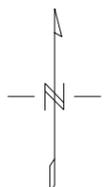
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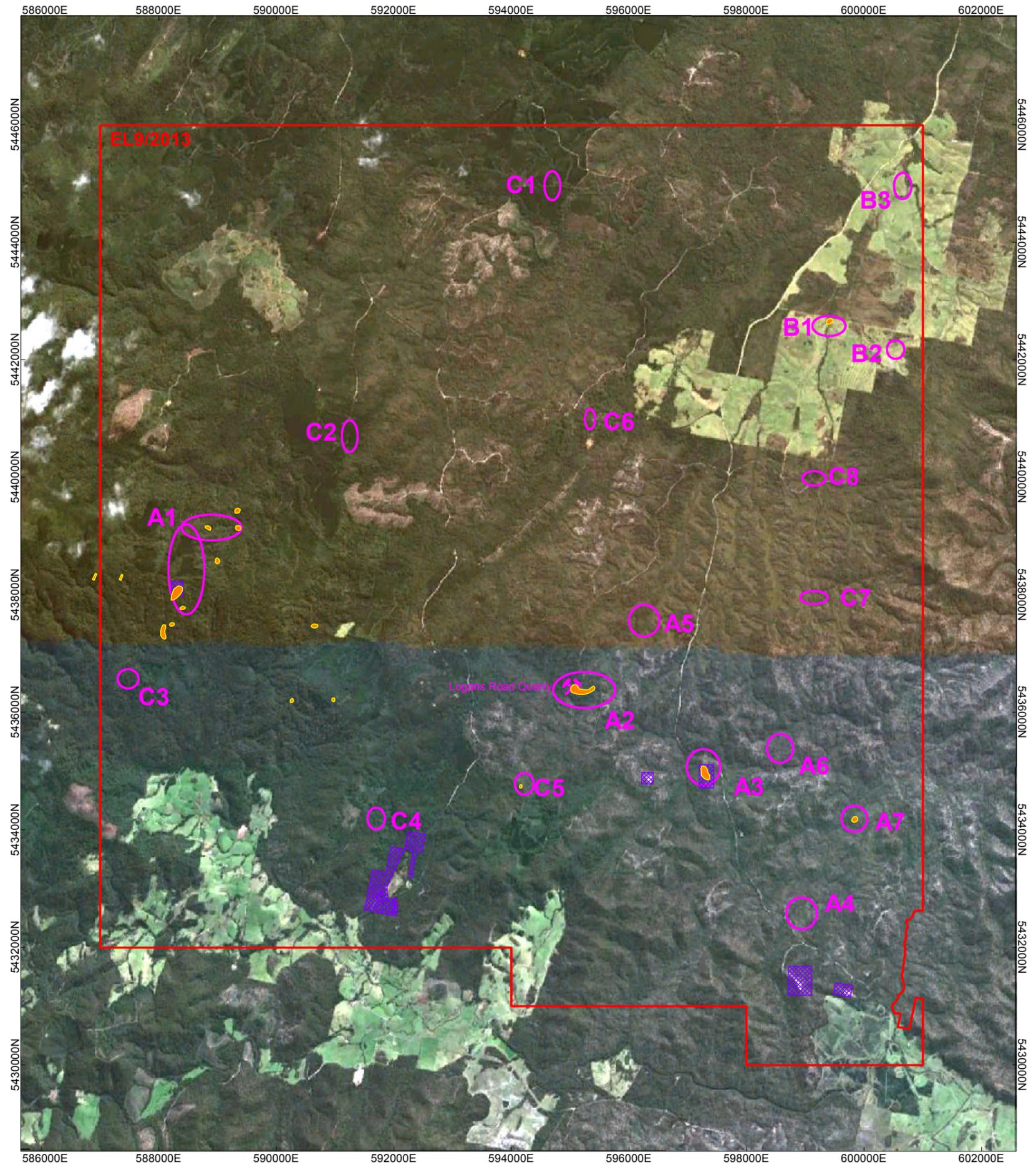
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EL9/2013 - Priory  
Potential Basalt Plugs



GDA94 / Map Grid of Australia zone 55

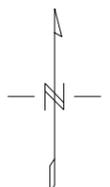
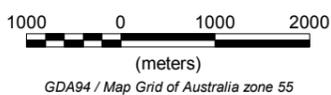


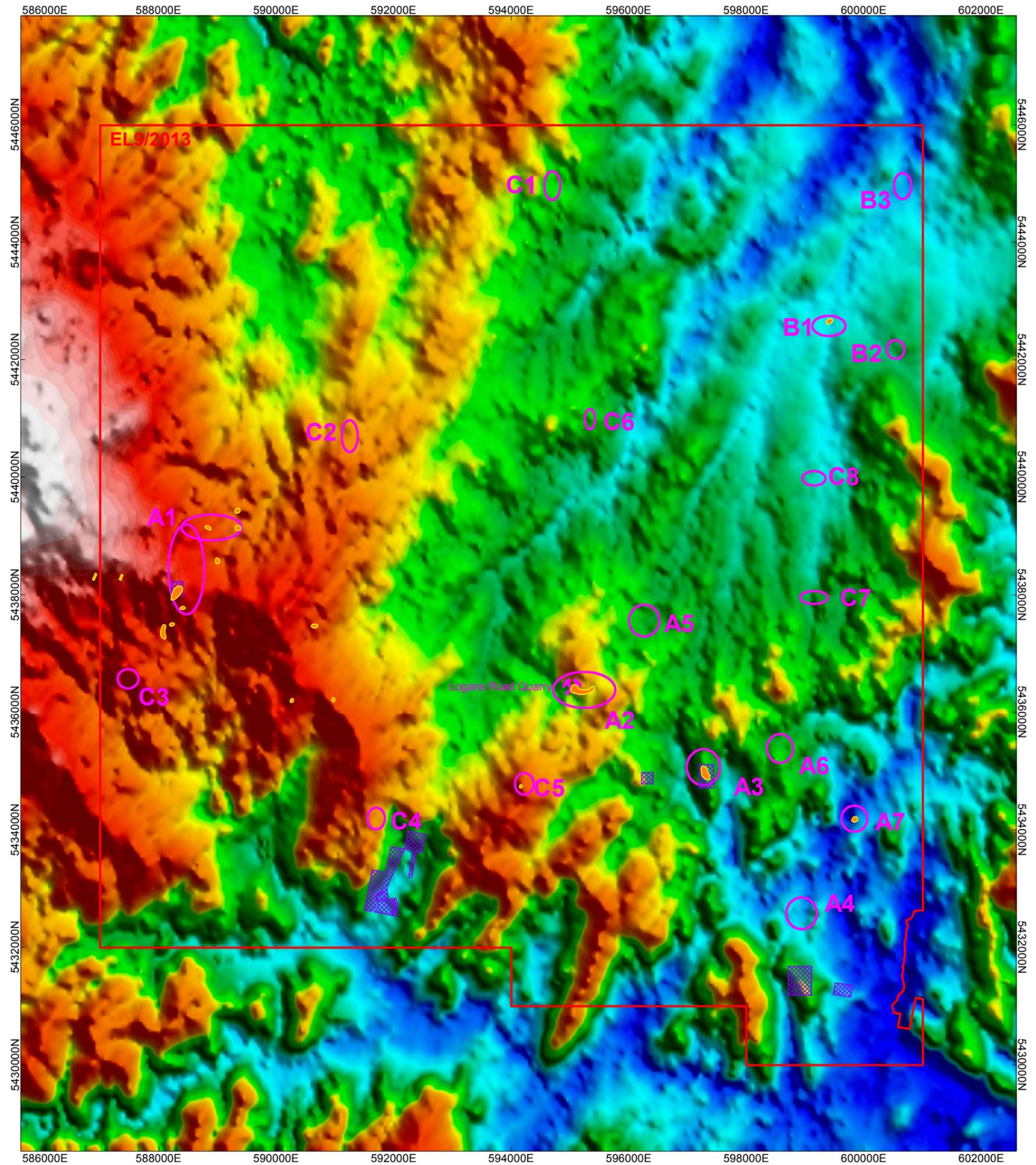


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**Google Earth photography**

**EL9/2013 - Priory  
Potential Basalt Plugs**

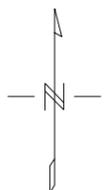
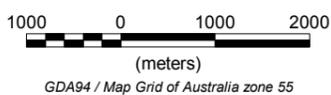


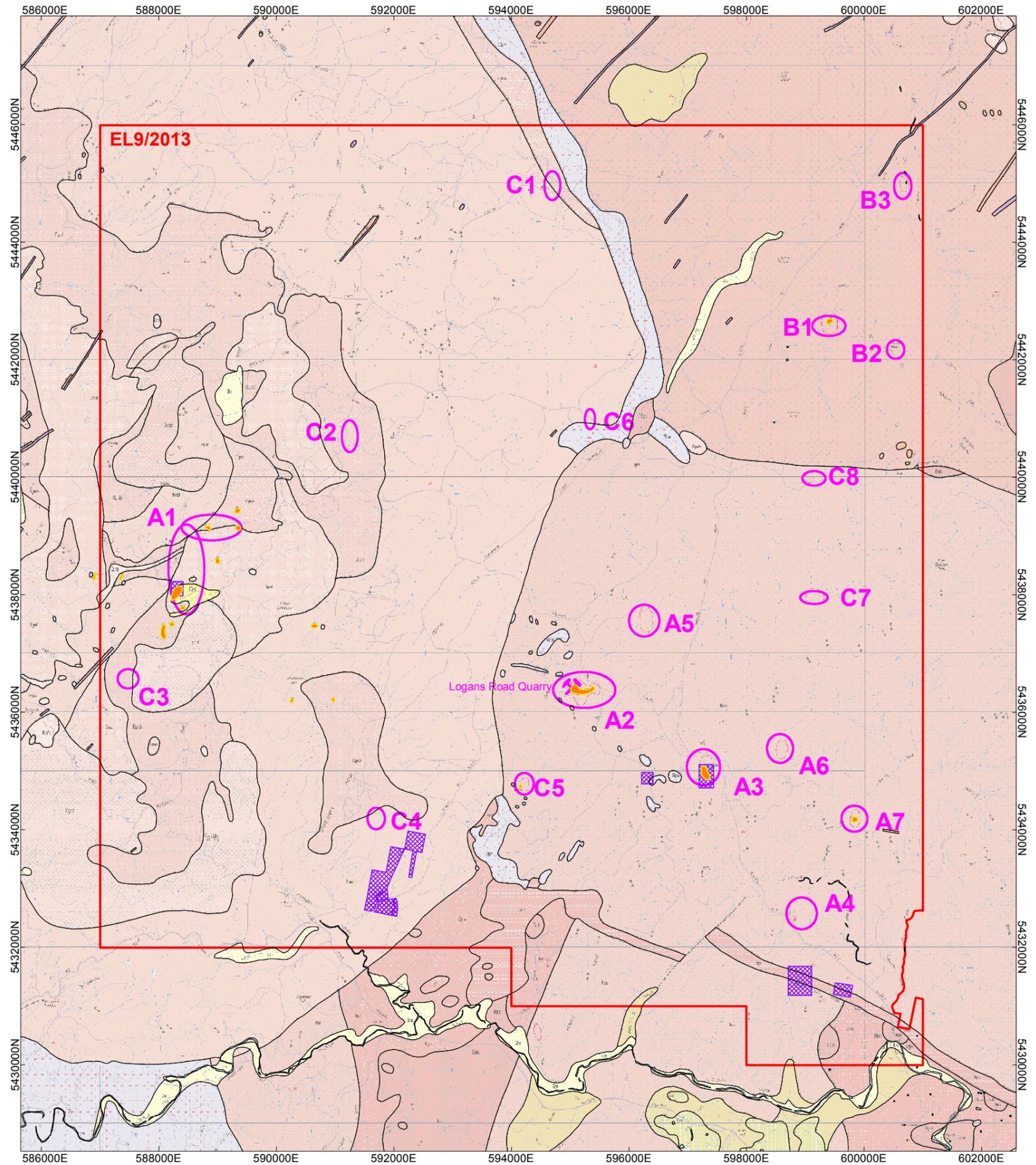


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**EL9/2013 - Priory  
Potential Basalt Plugs**

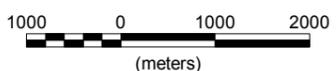




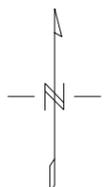
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-  mapped basalt (MRT 25k geology)

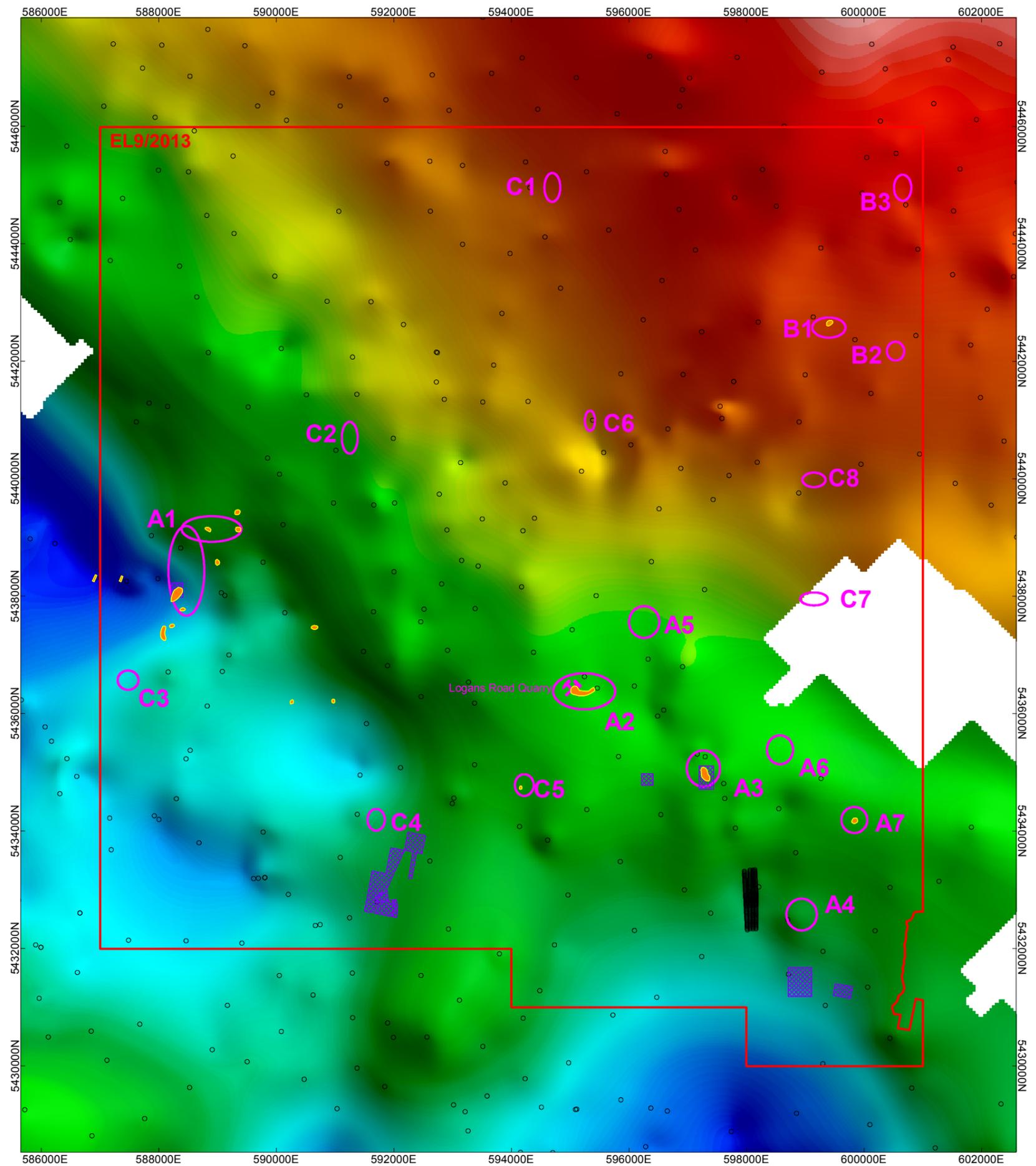
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EL9/2013 - Priory  
Potential Basalt Plugs



GDA94 / Map Grid of Australia zone 55

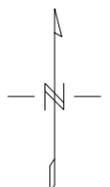
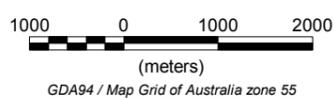


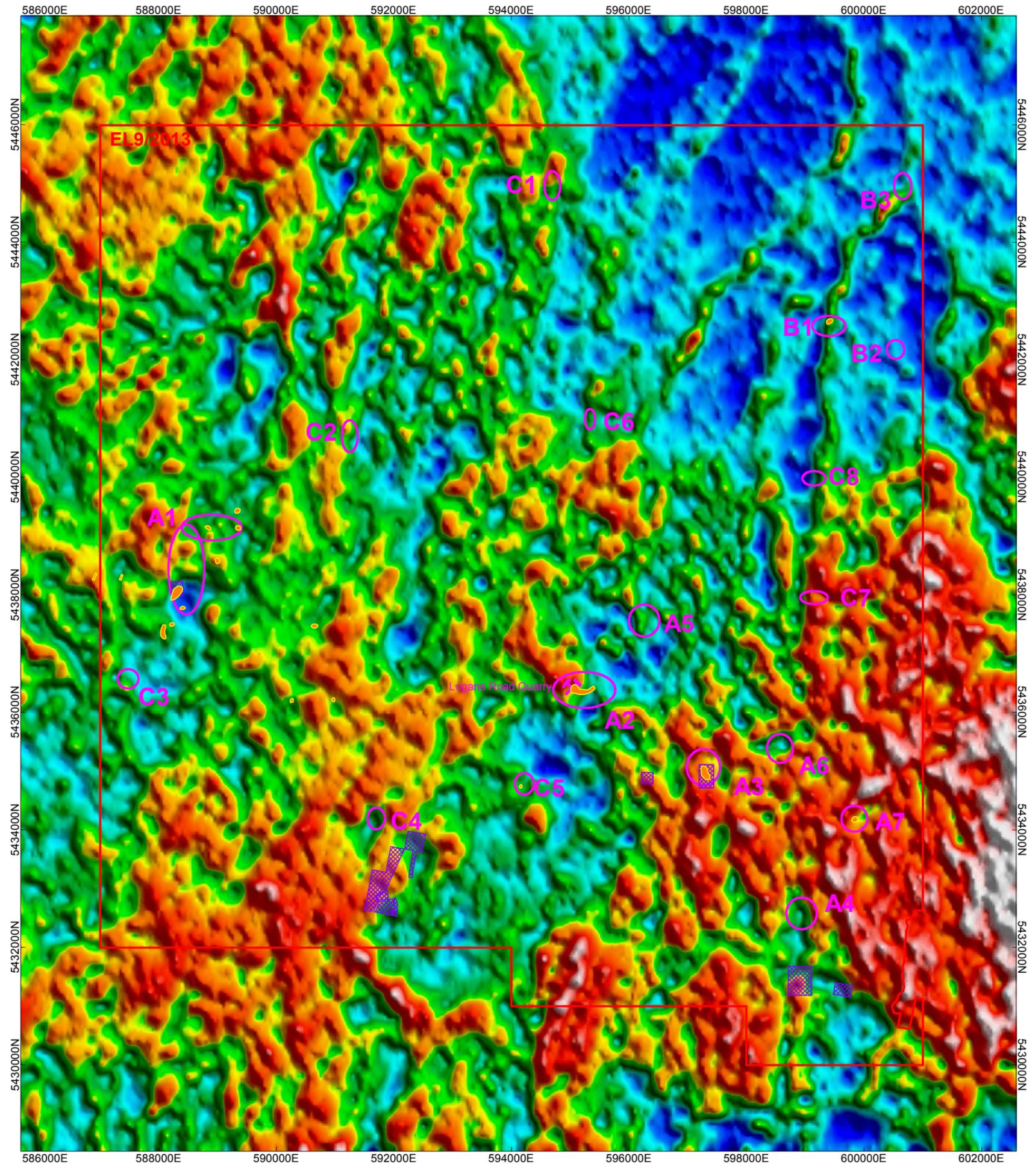


-  mine lease (existing)
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EL9/2013 - Priory  
Potential Basalt Plugs

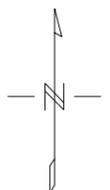
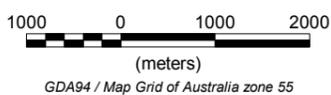


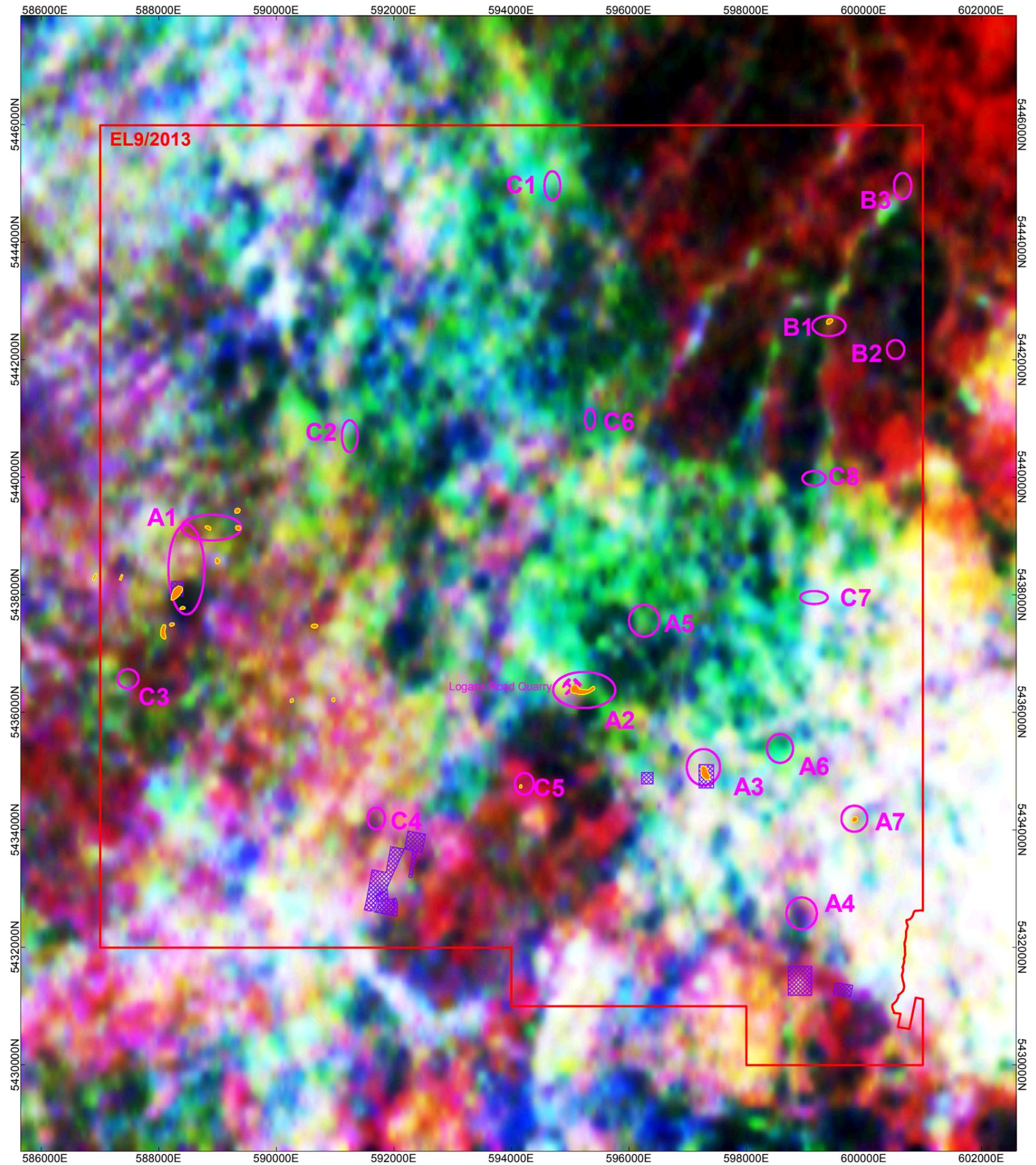


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- B3**  magnetic anomaly target
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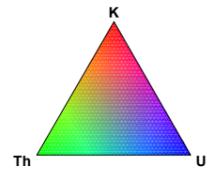
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**EL9/2013 - Priory  
Potential Basalt Plugs**



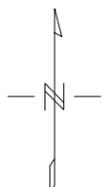
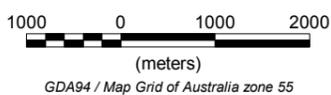


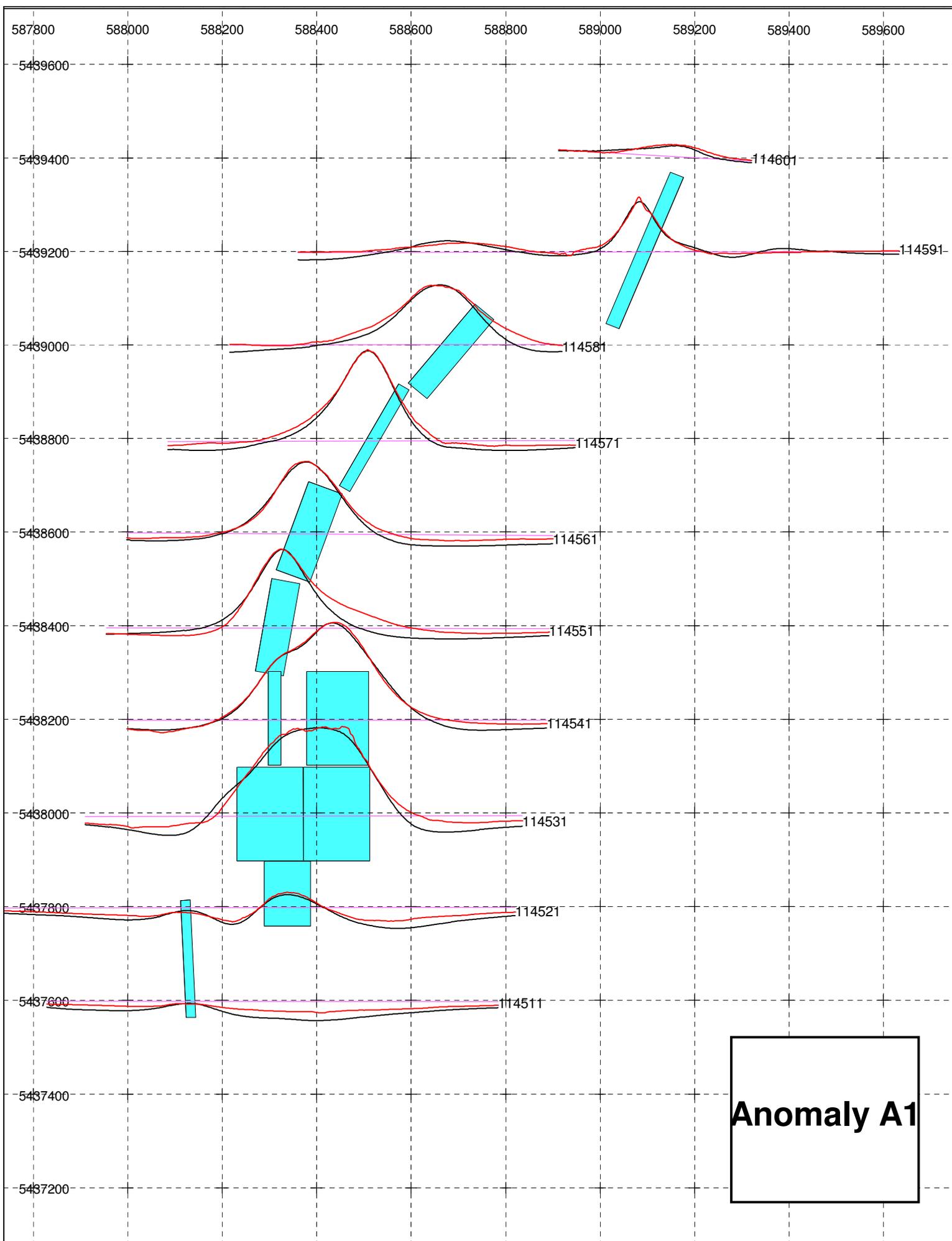
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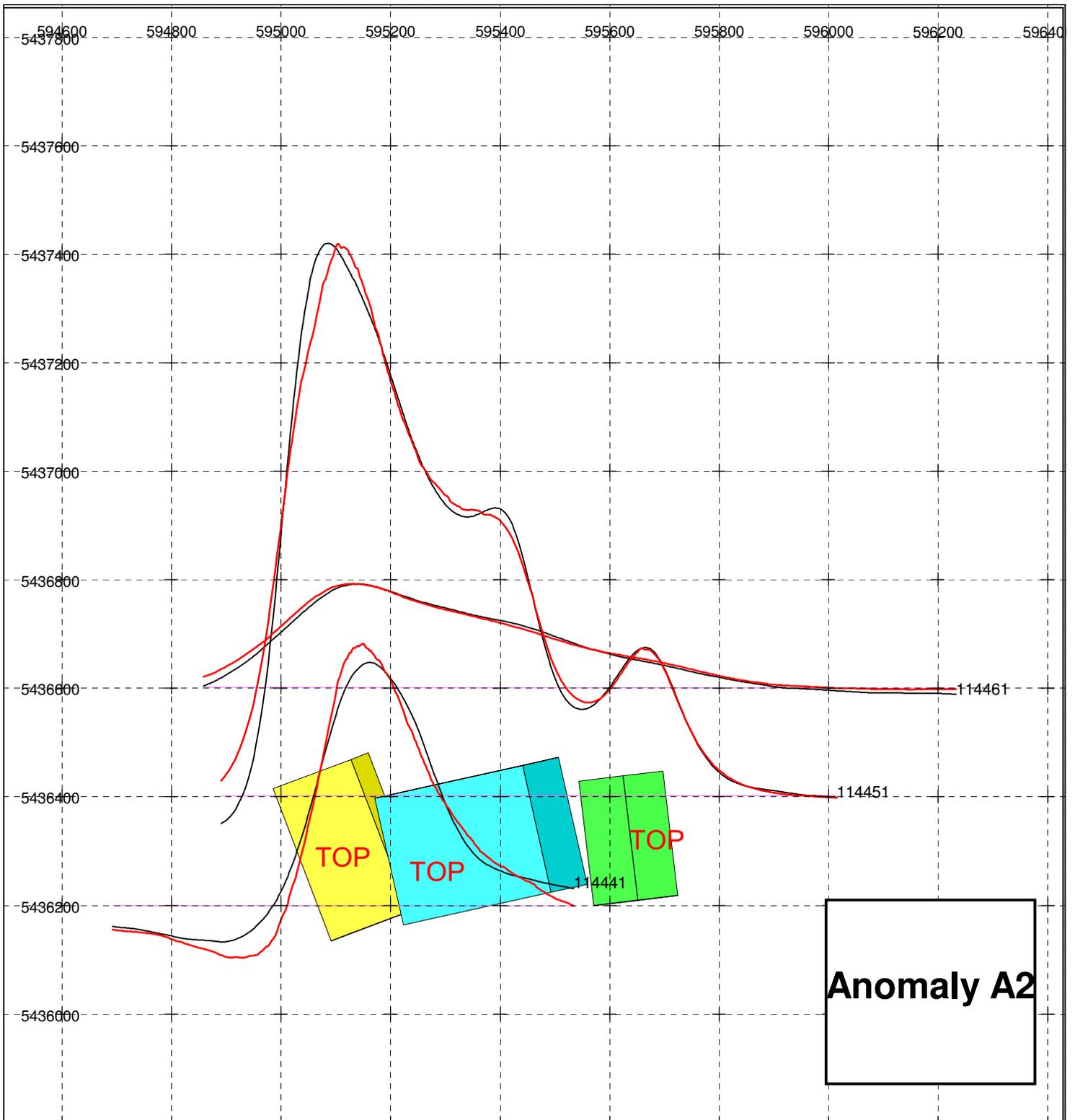


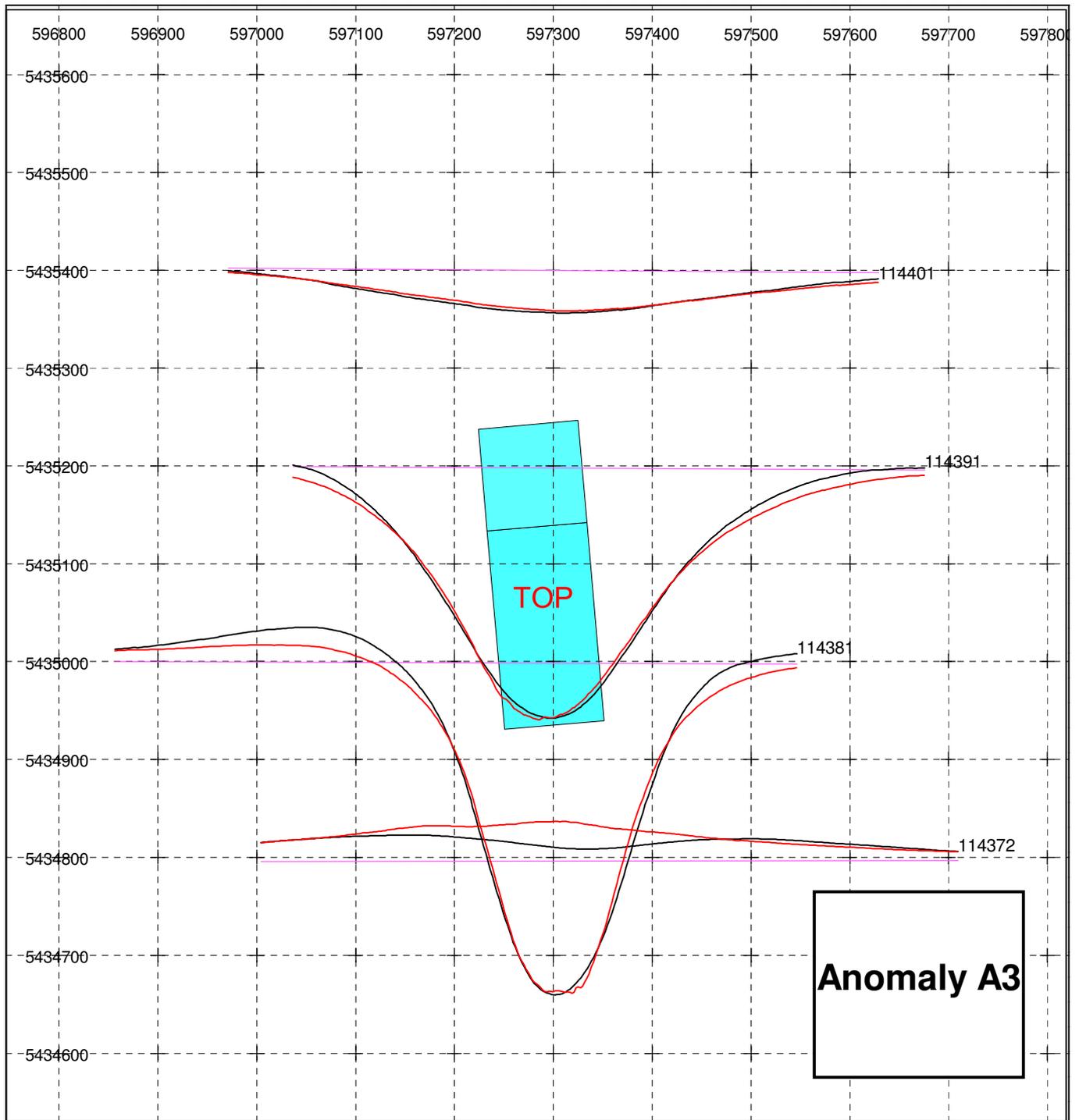
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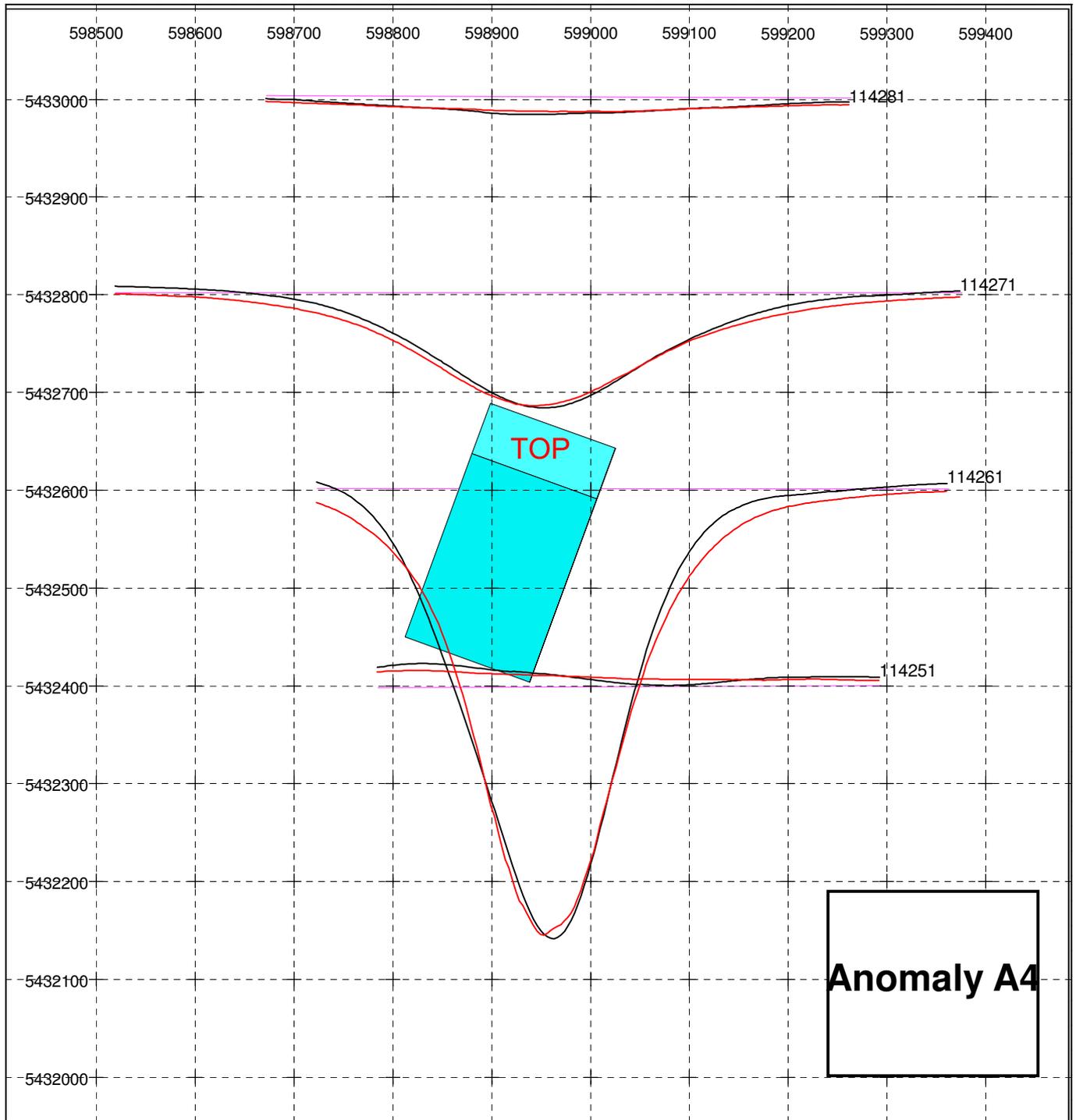
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Potential Basalt Plugs**

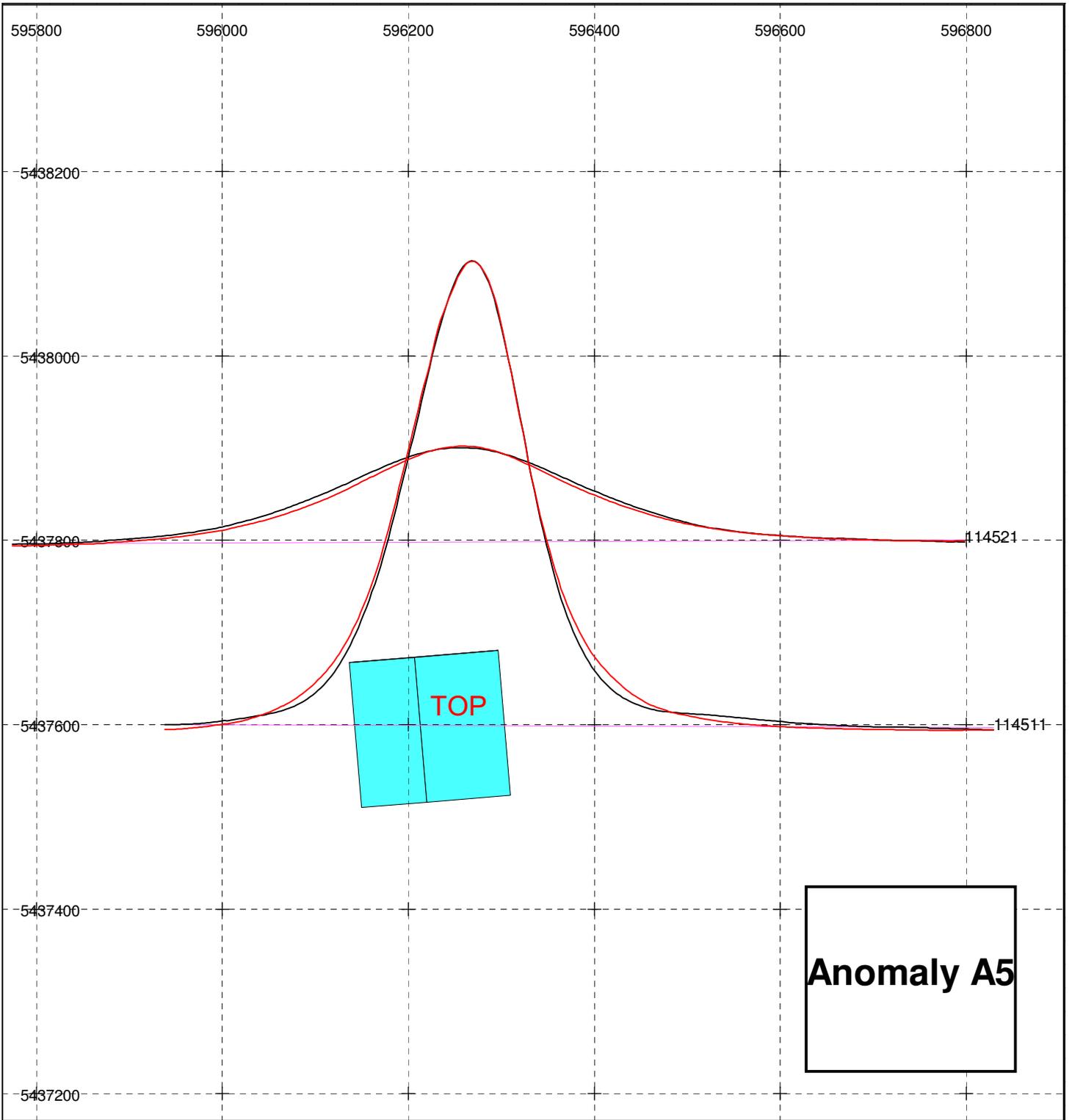


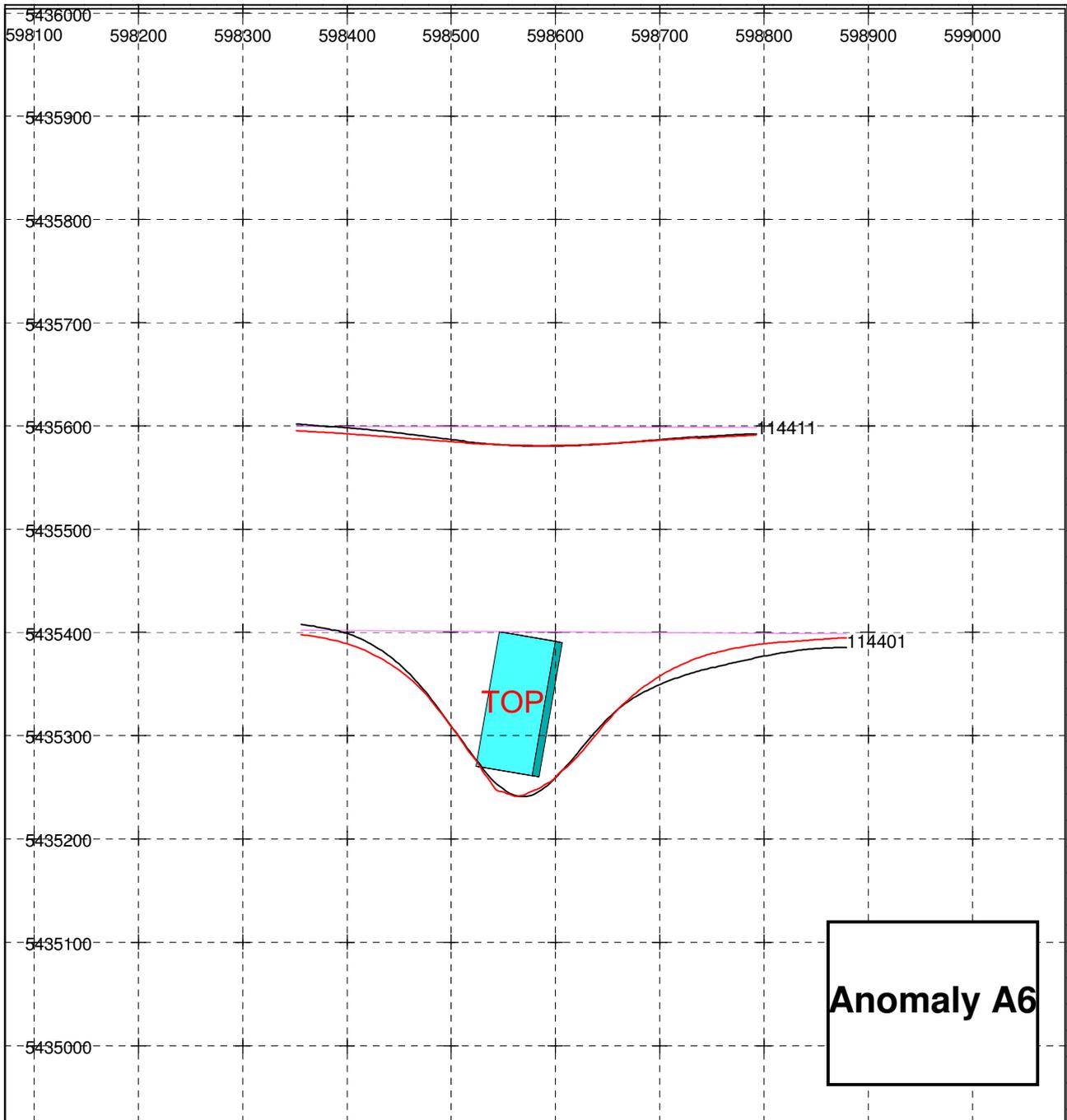


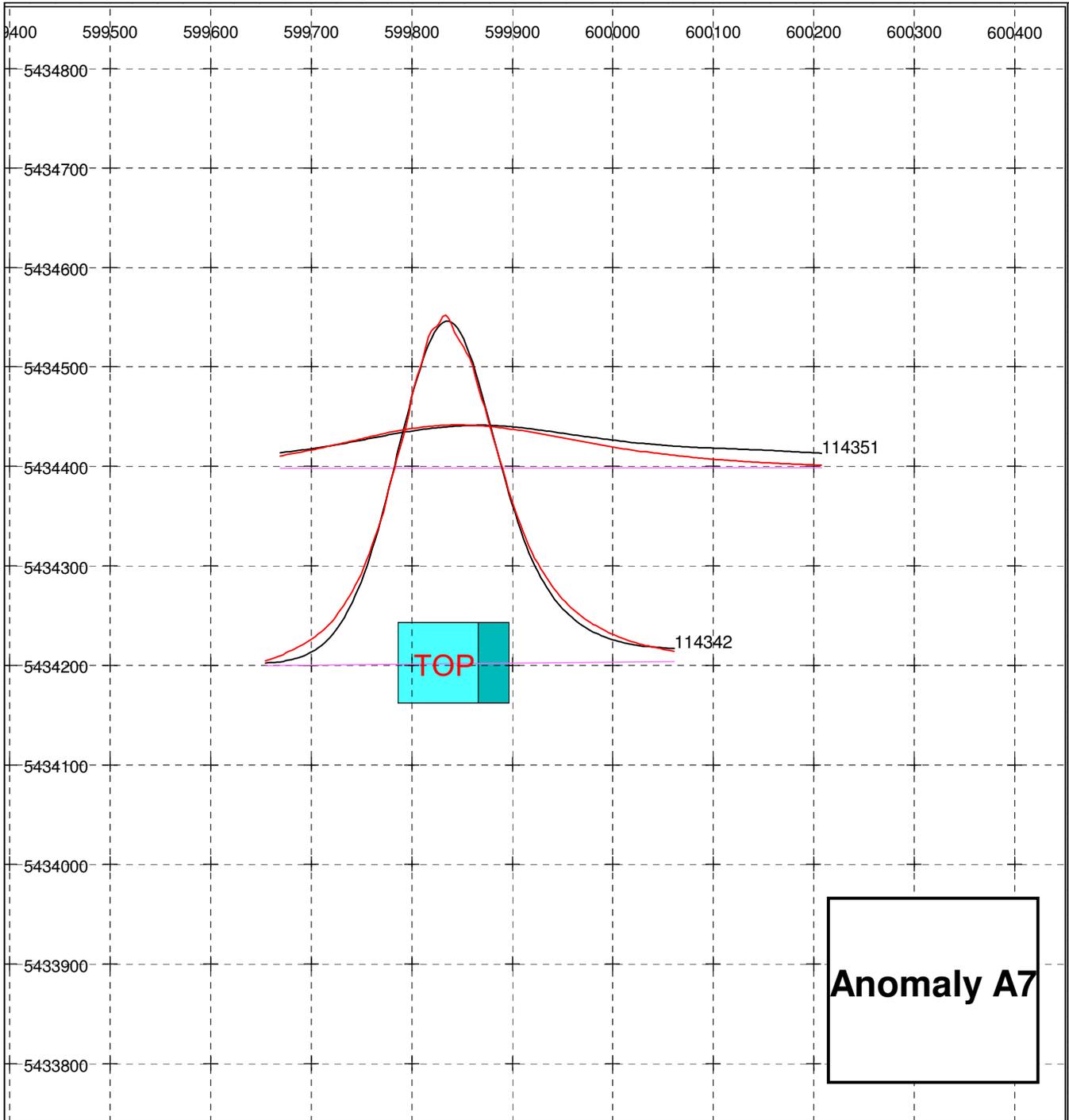


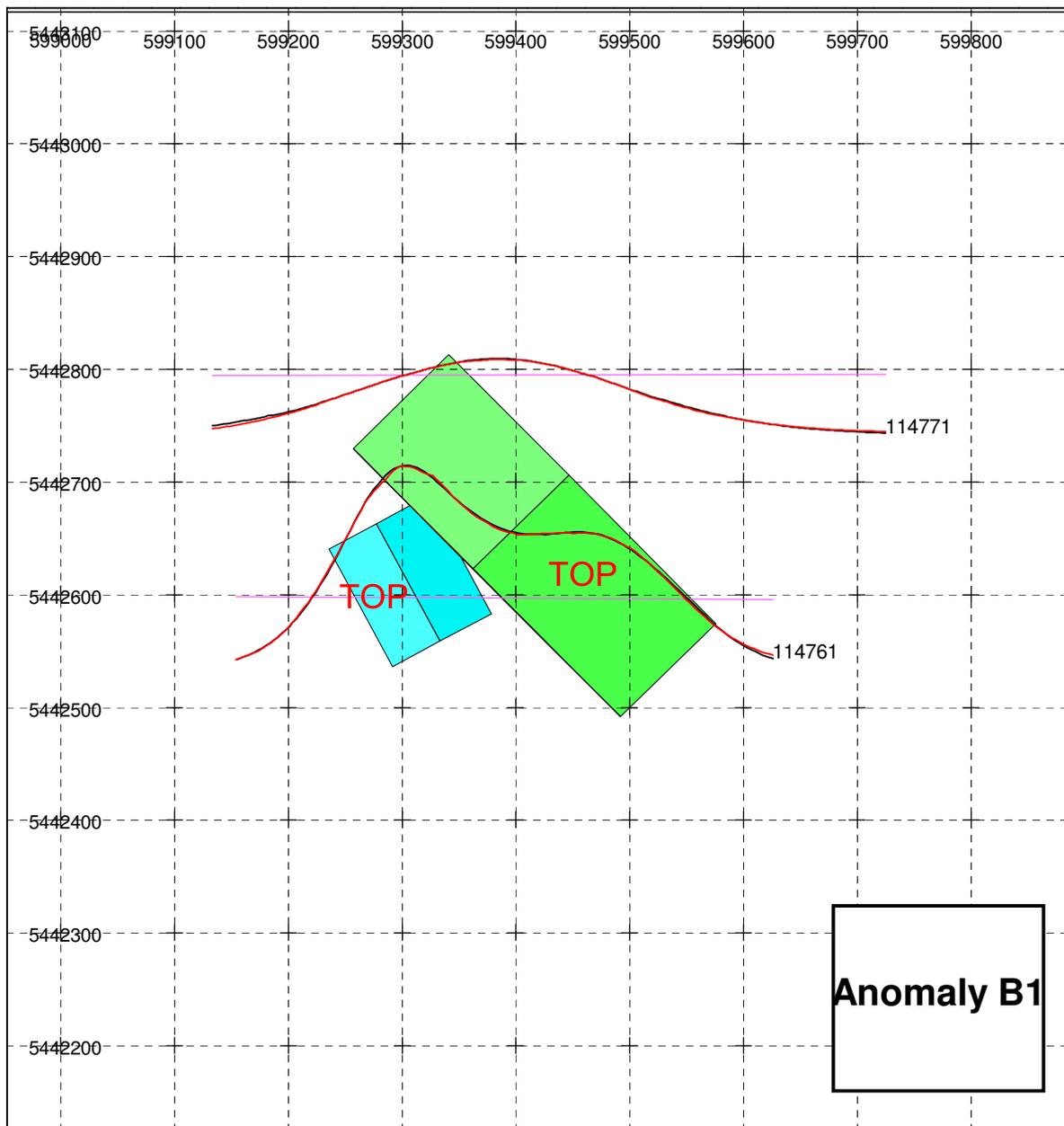


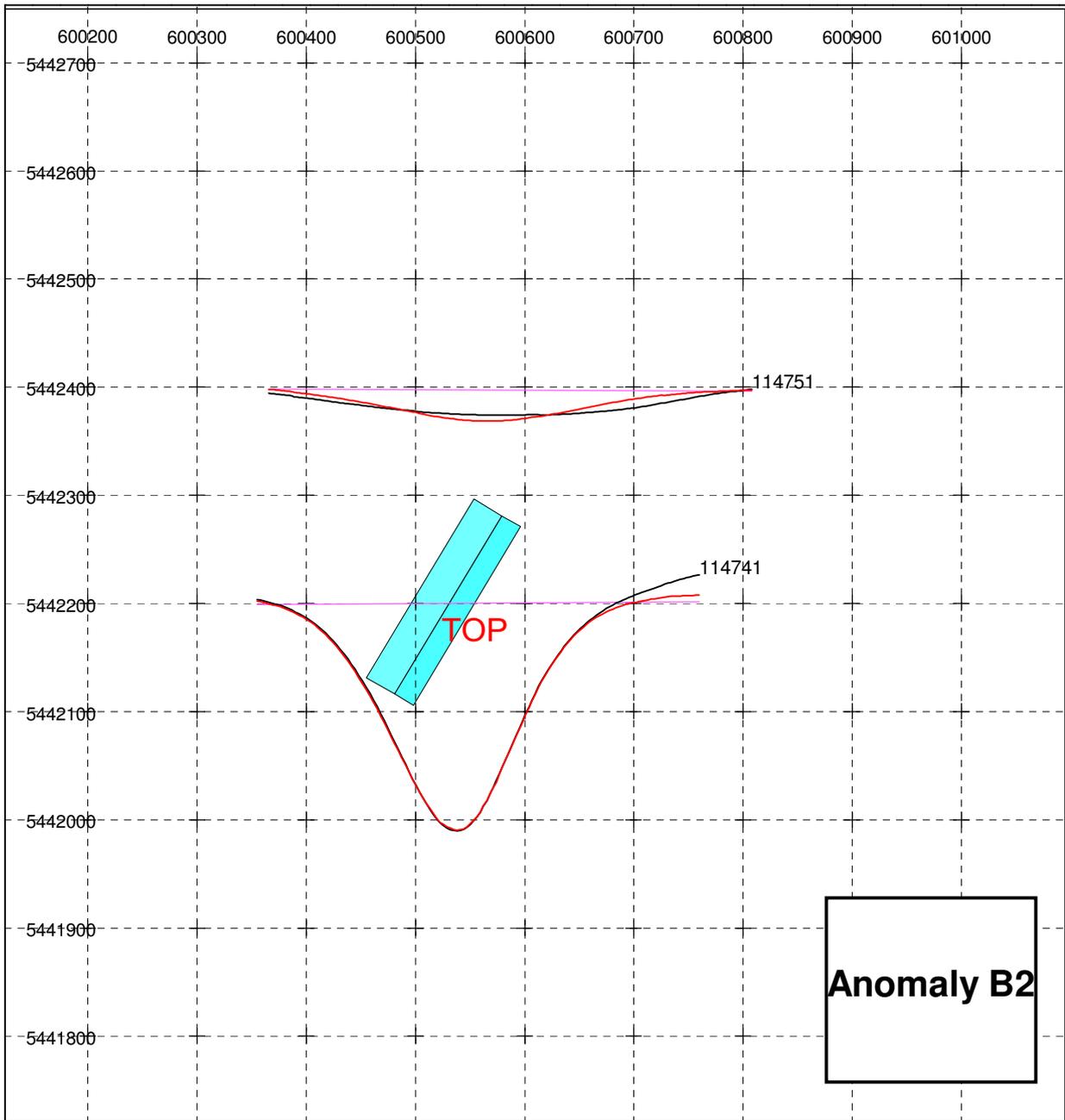


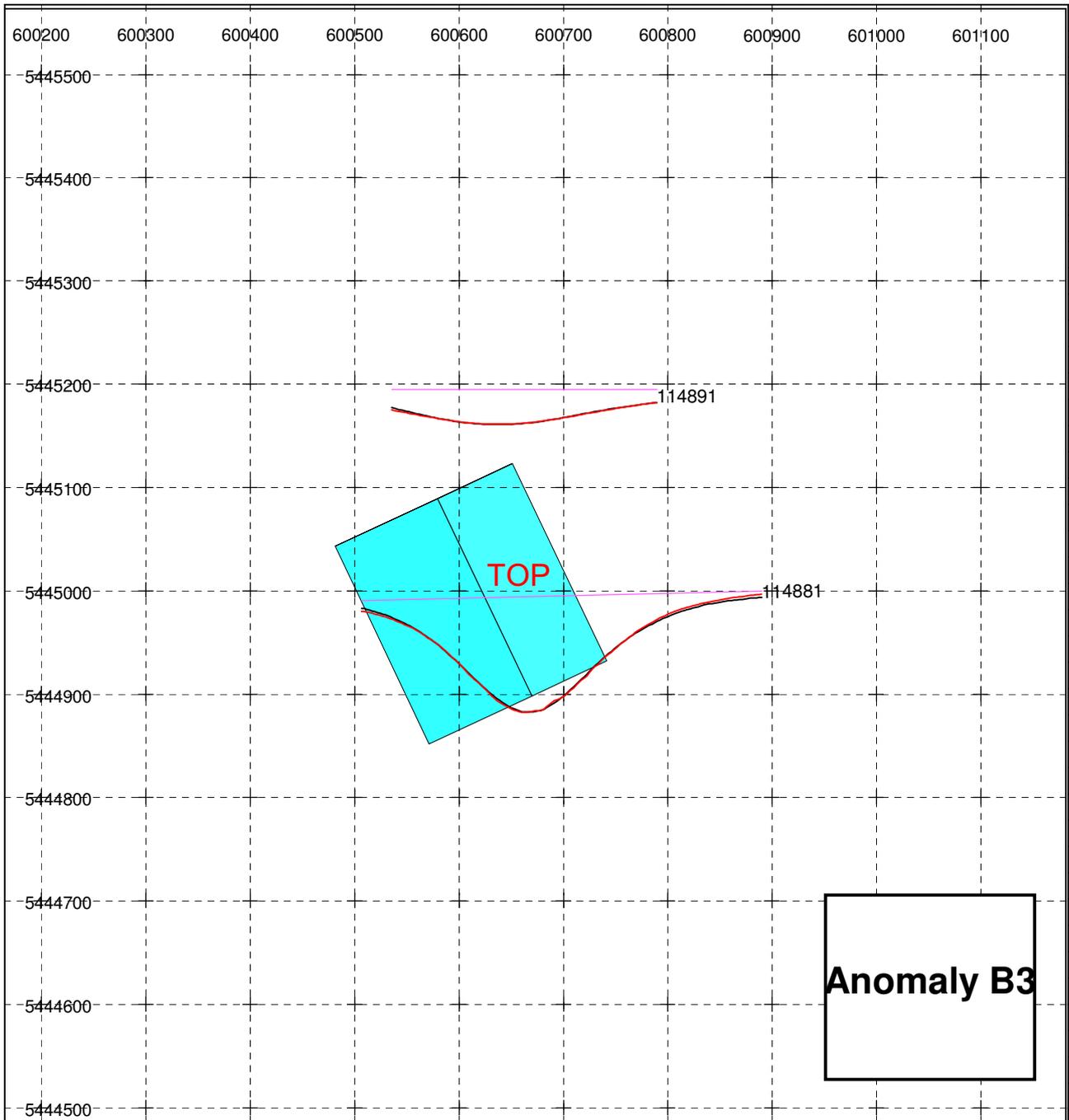


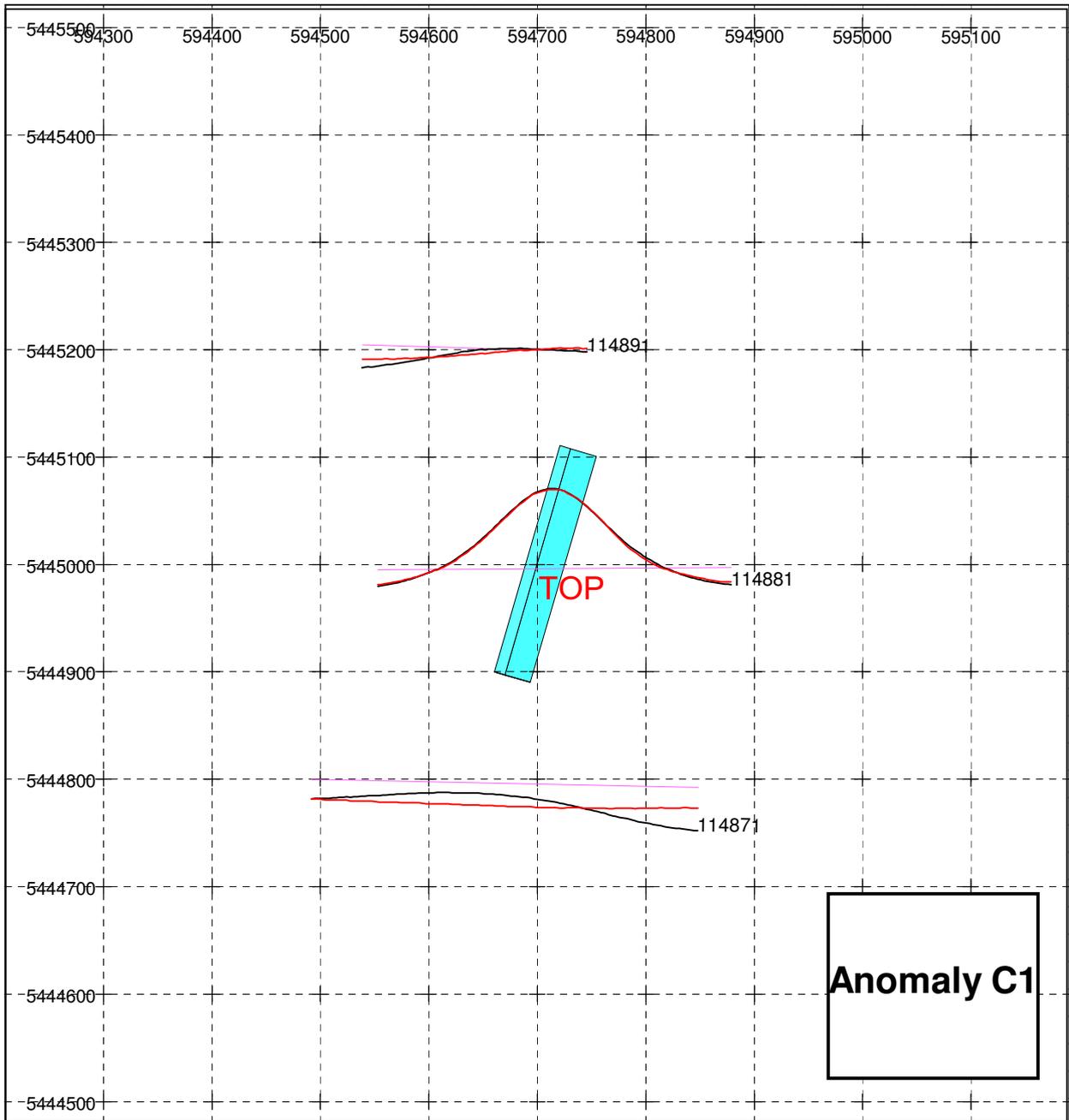


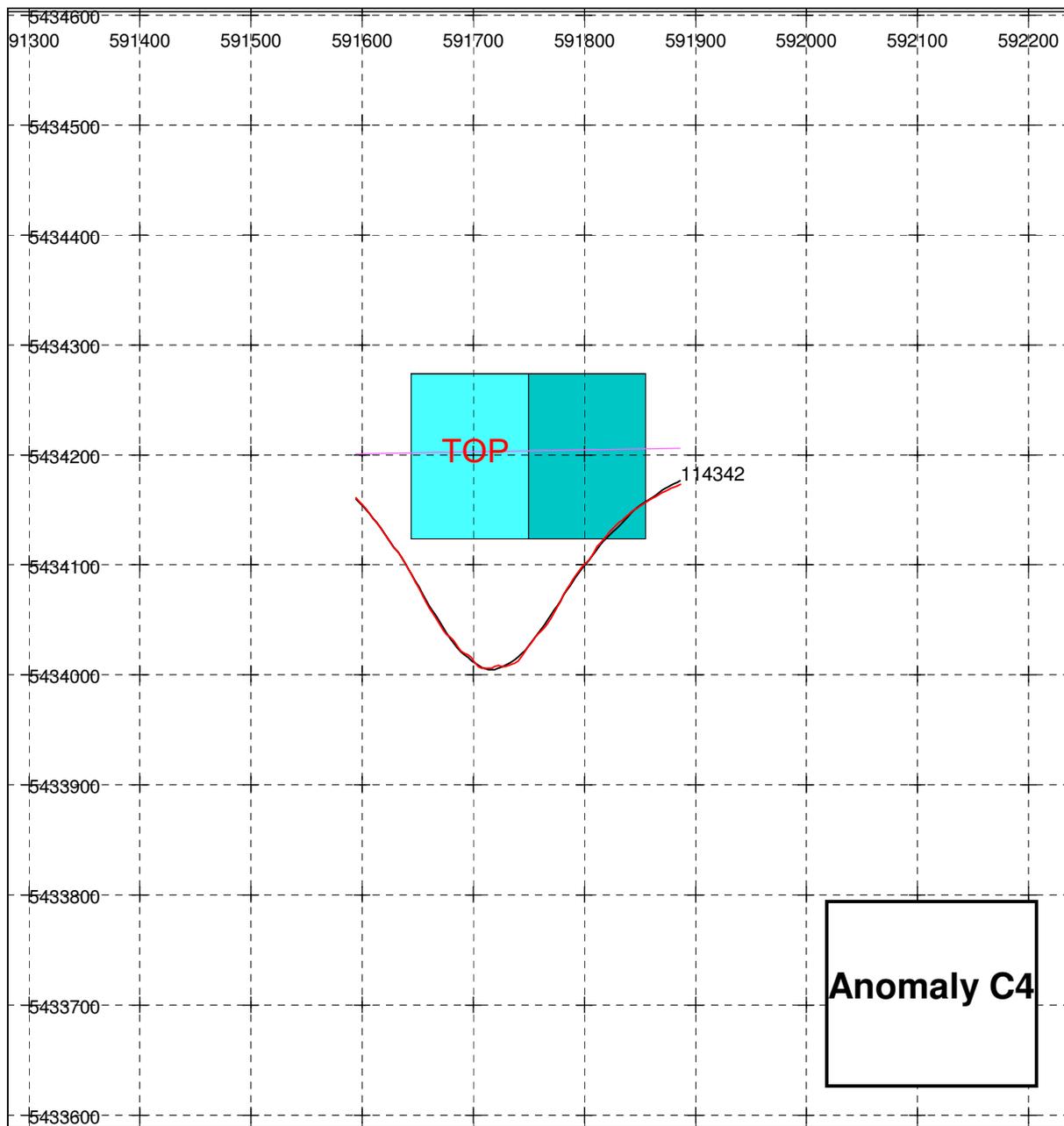












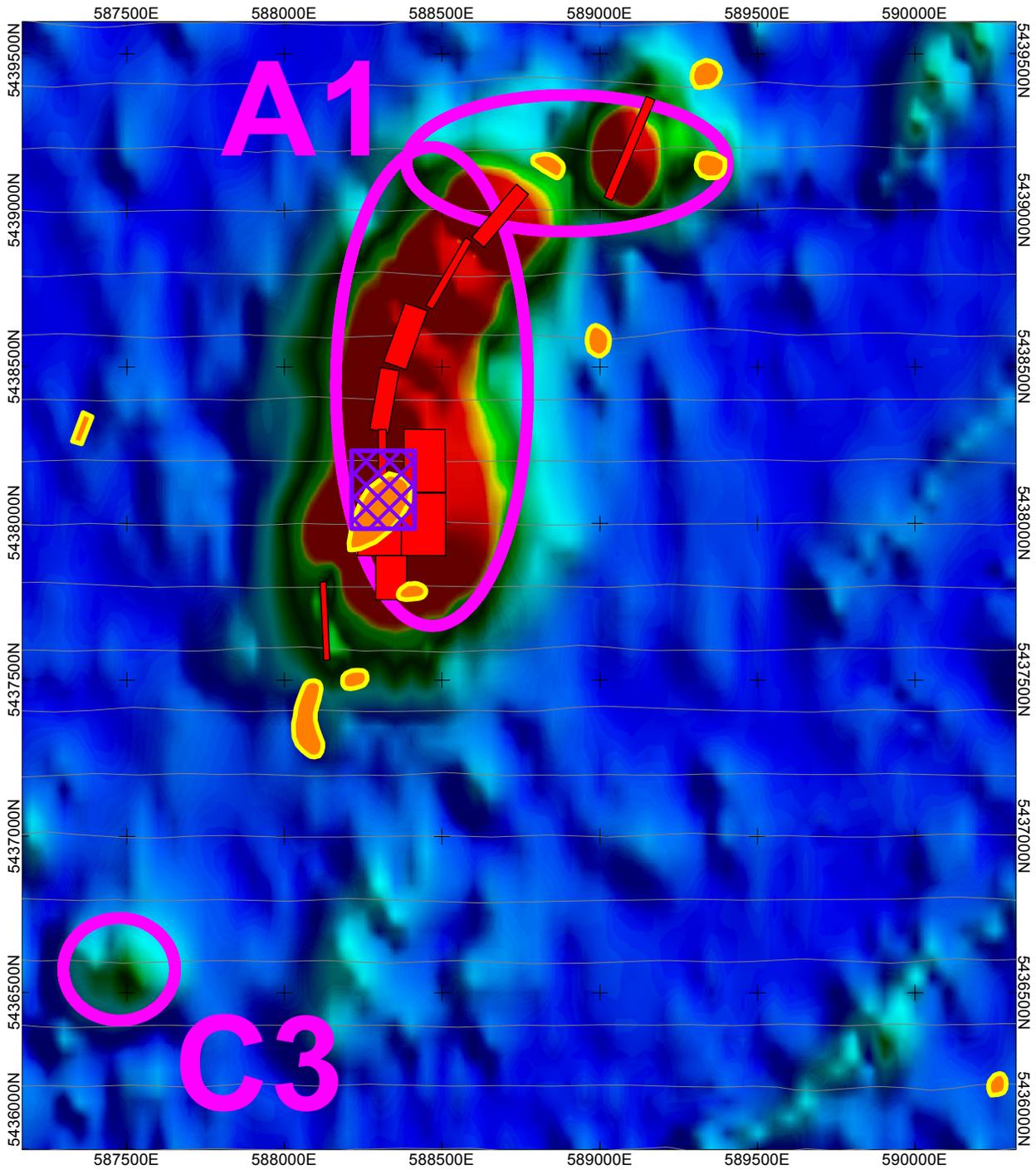
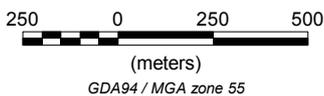
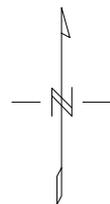


image : magnetics Analytic Signal  
from MRT 2007 airborne survey

-  mine lease (existing)
-  magnetic model body (top surface)
-  magnetic model body (dipping side)
-  mapped basalt (MRT 25k geology)



**EL9/2013 - Priory**  
Potential Basalt Plugs  
Selected Targets and Modelling



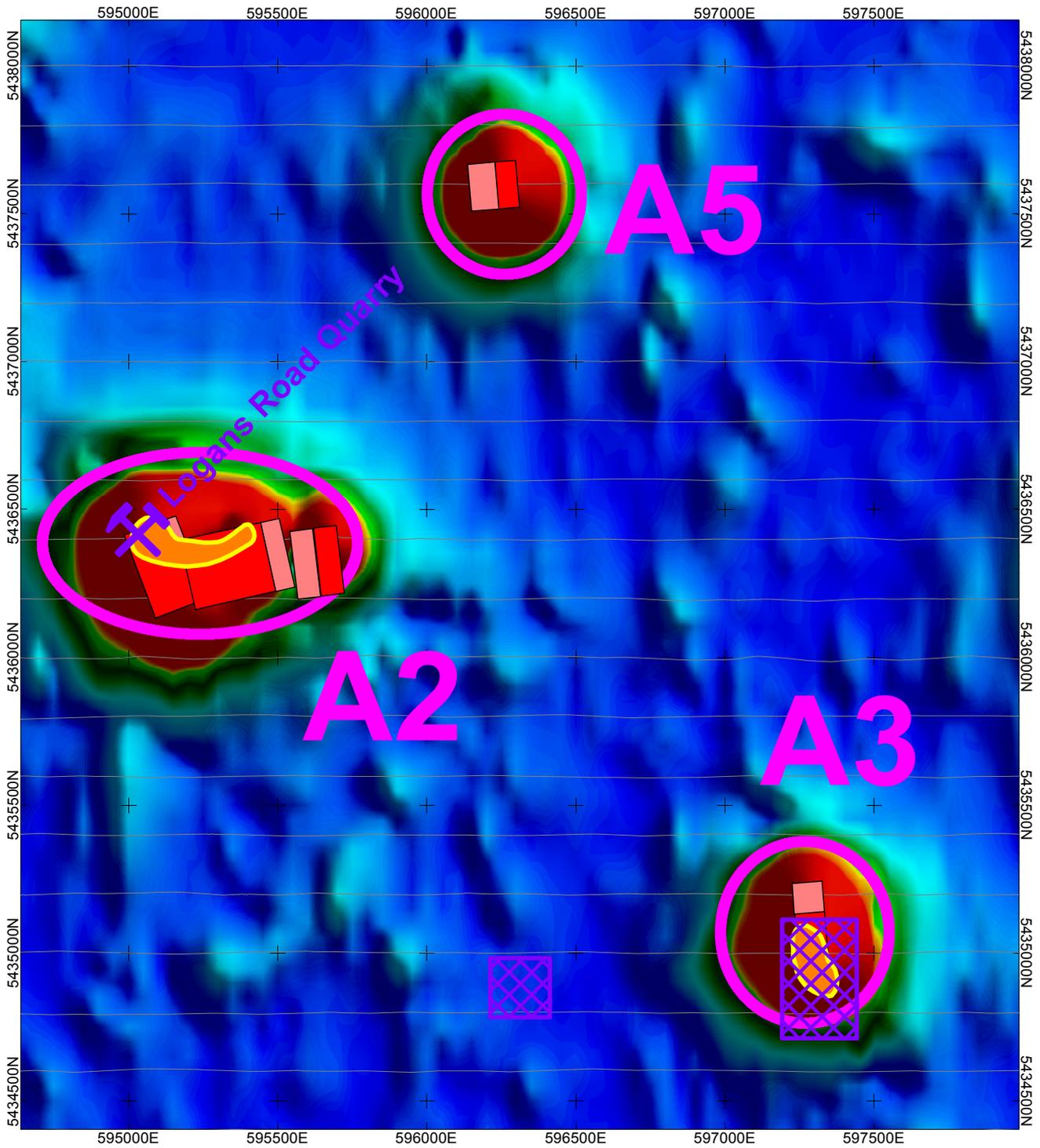
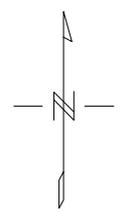


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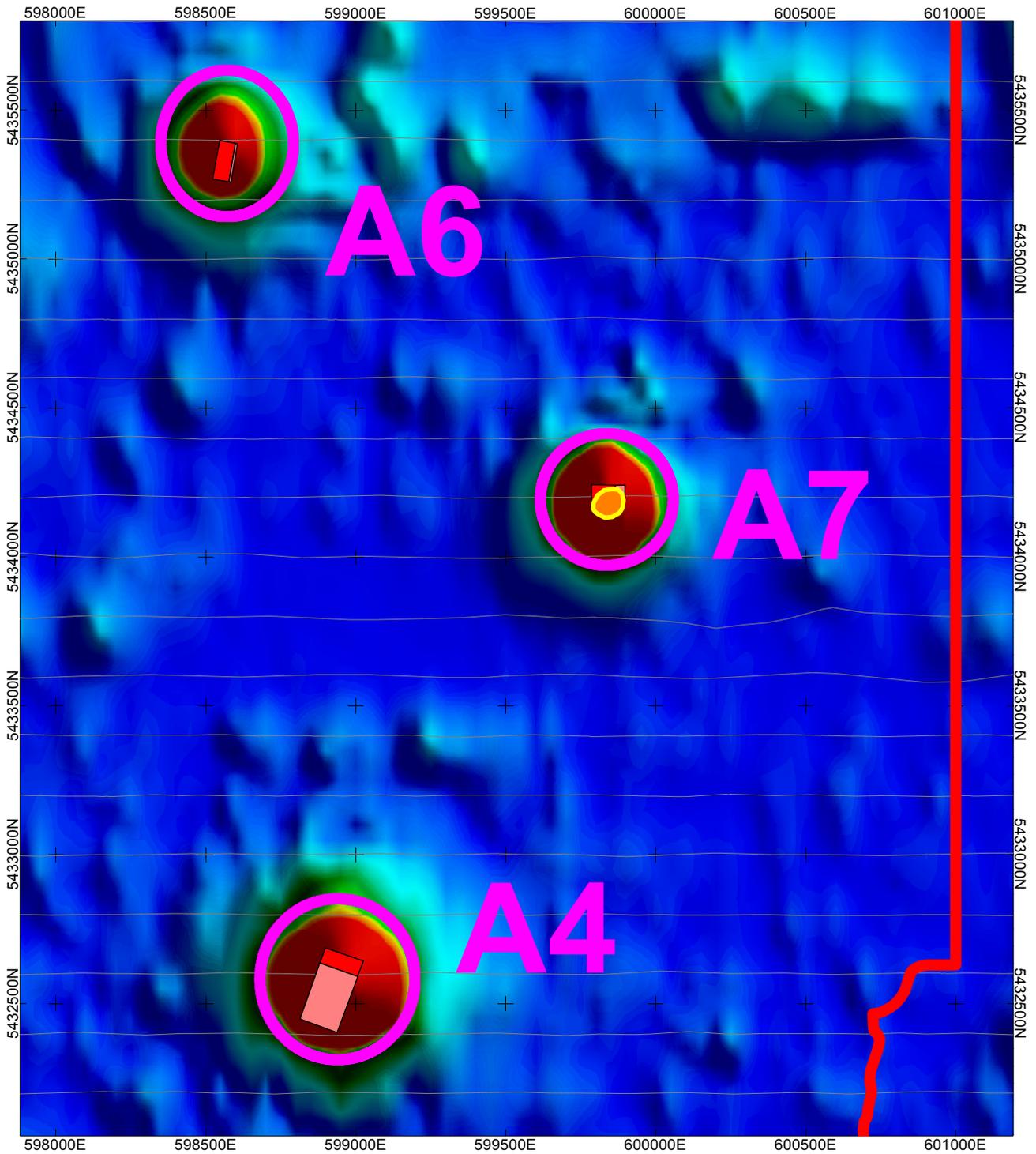
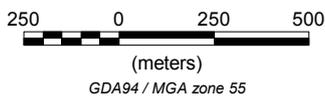
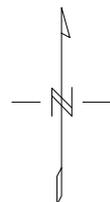


image : magnetics Analytic Signal  
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**EL9/2013 - Priory**  
Potential Basalt Plugs  
Selected Targets and Modelling



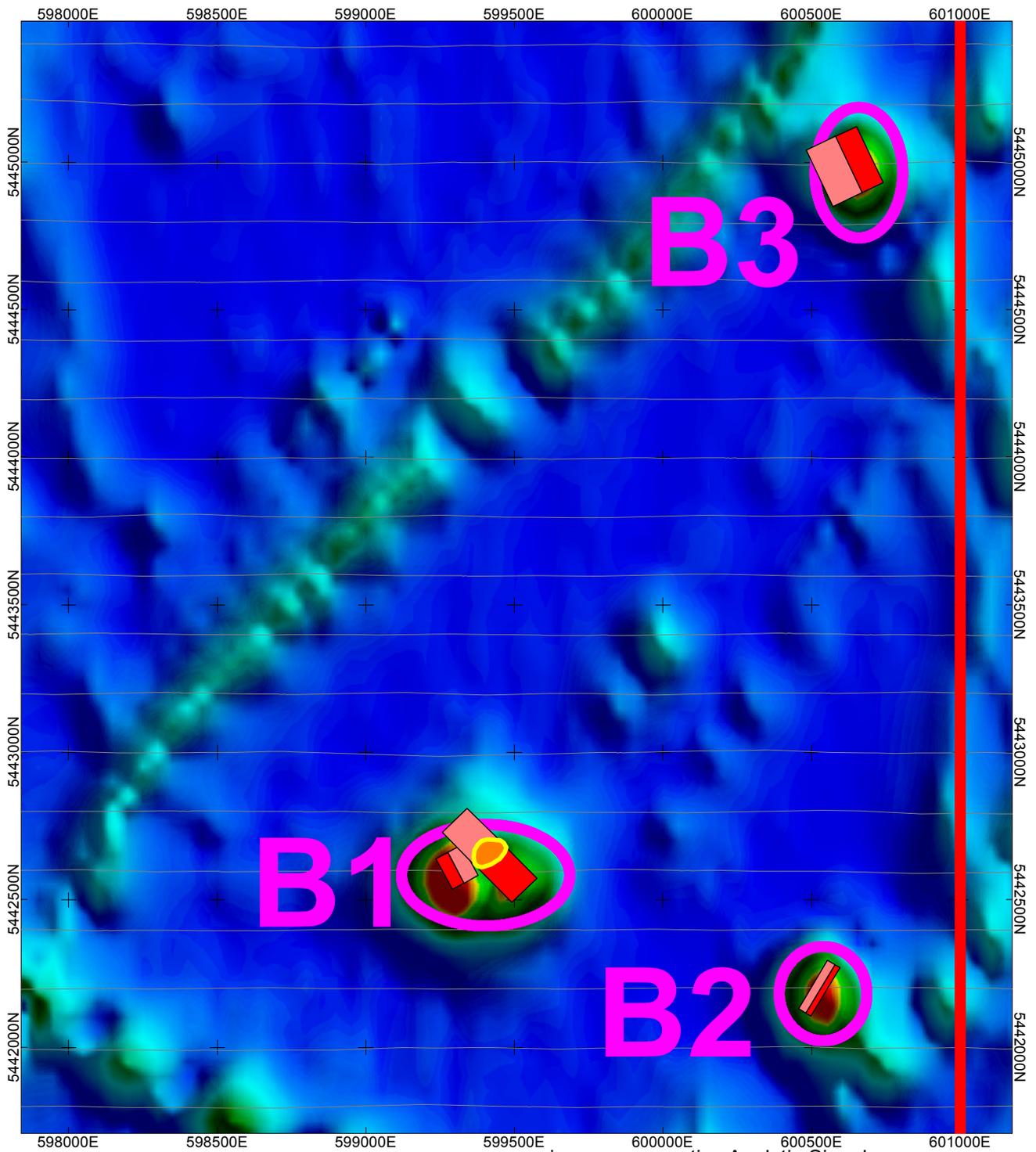
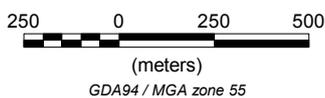
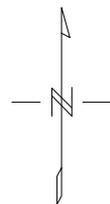


image : magnetics Analytic Signal  
from MRT 2007 airborne survey

-  mine lease (existing)
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**EL9/2013 - Priory**  
Potential Basalt Plugs  
Selected Targets and Modelling



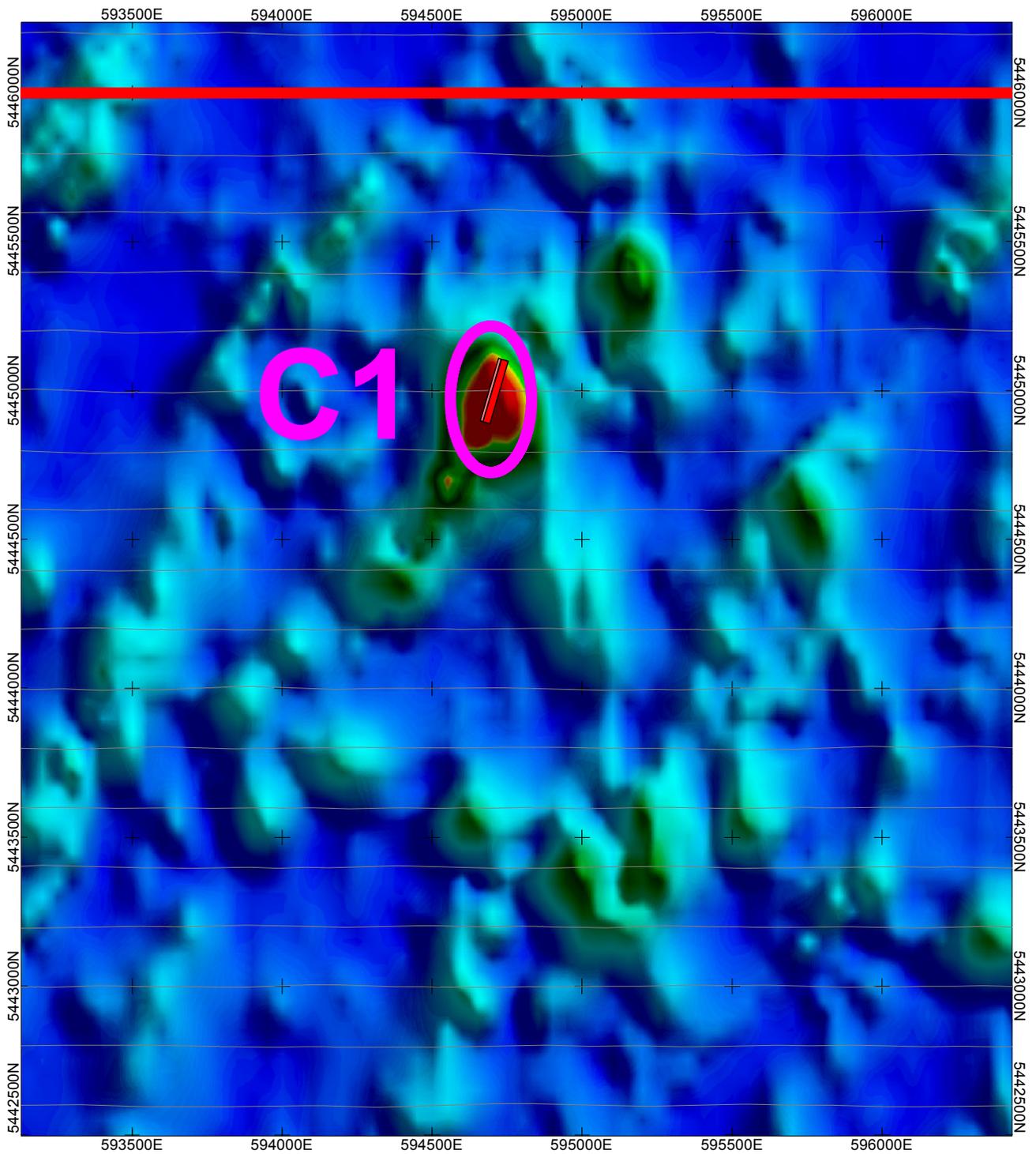
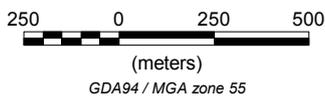
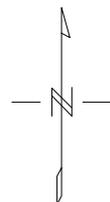


image : magnetics Analytic Signal  
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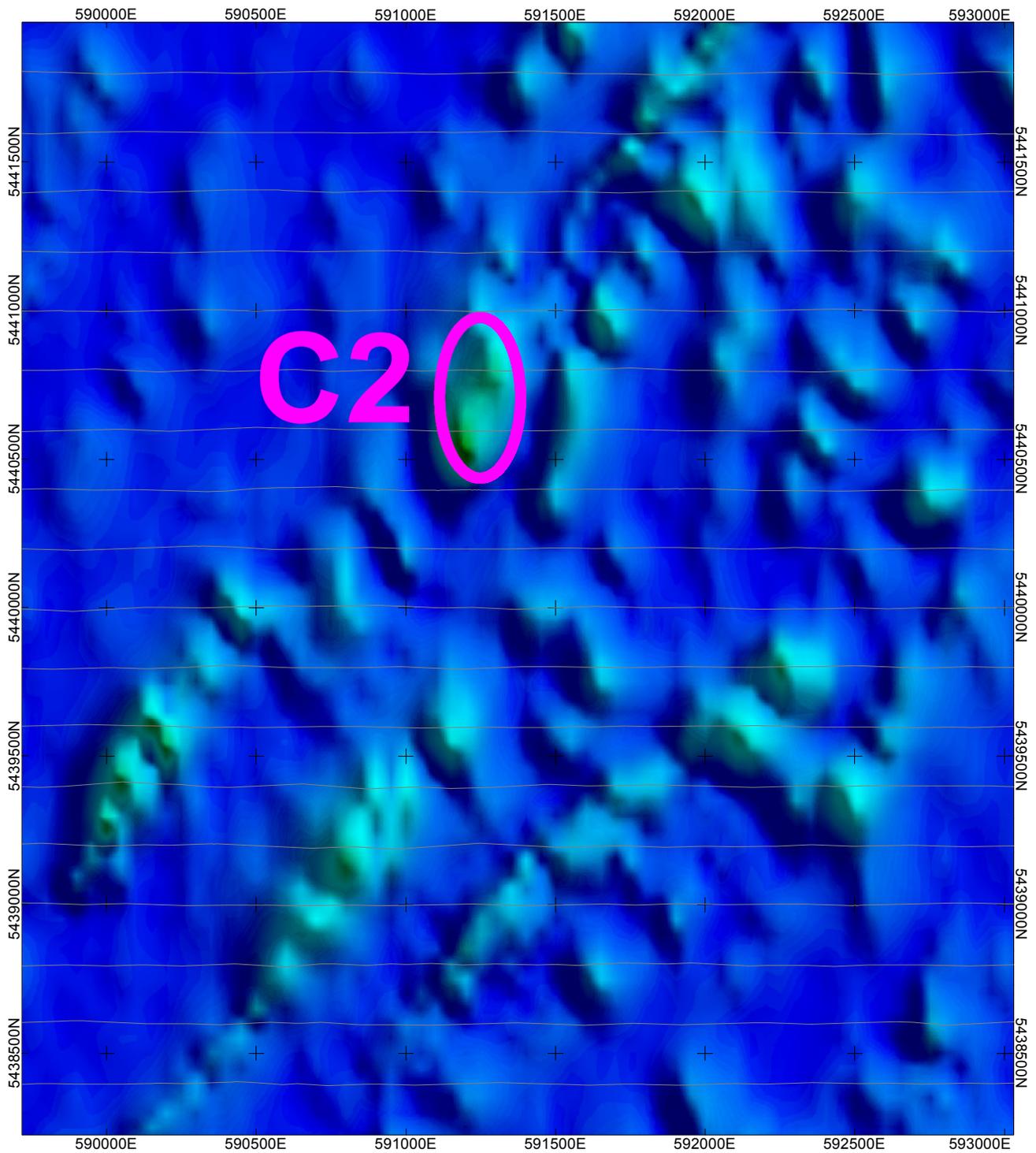
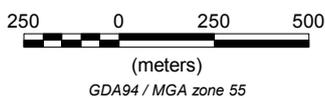
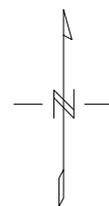


image : magnetics Analytic Signal  
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**EL9/2013 - Priory**  
Potential Basalt Plugs  
Selected Targets and Modelling



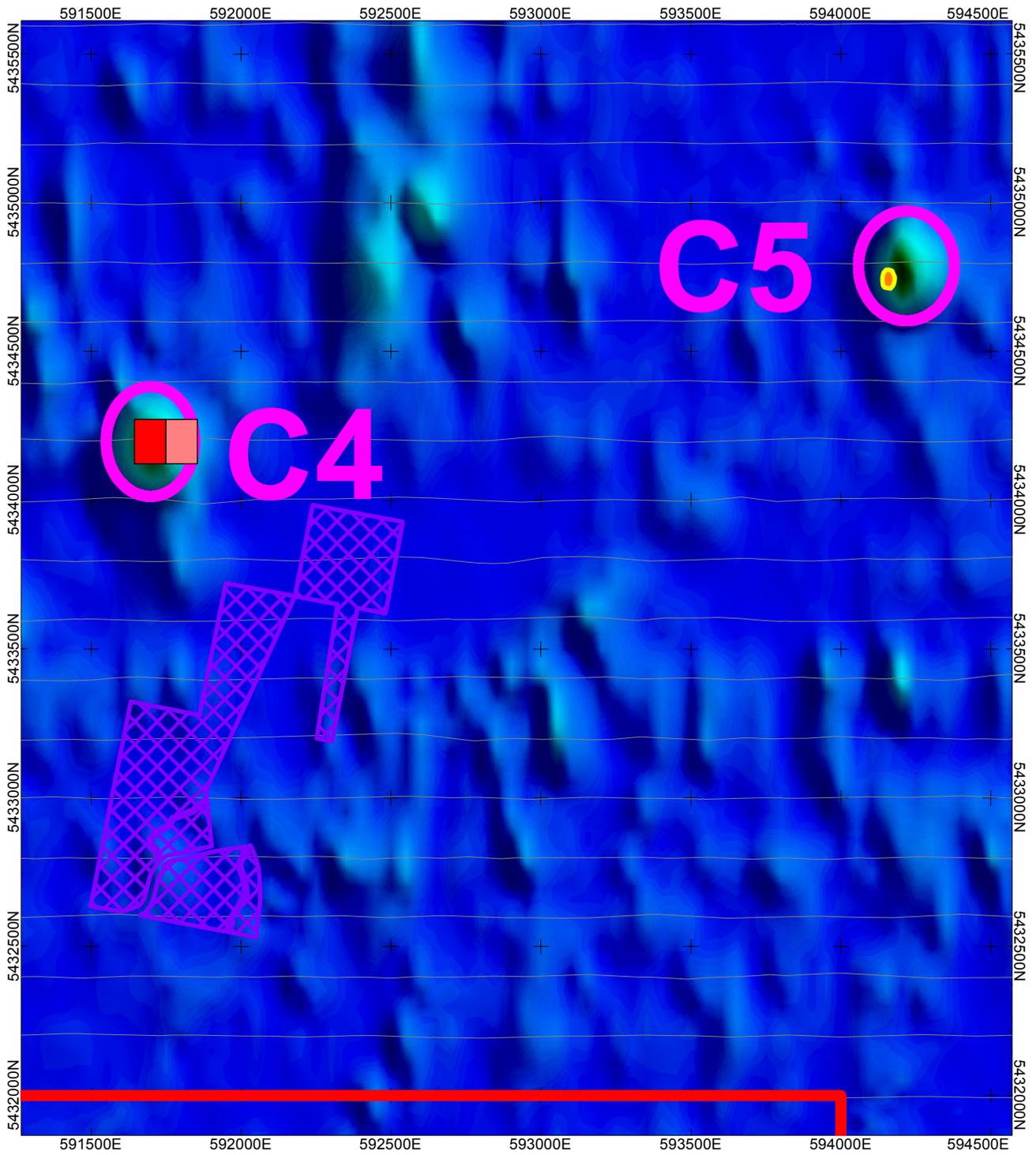
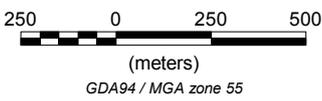
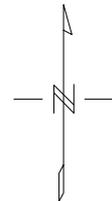


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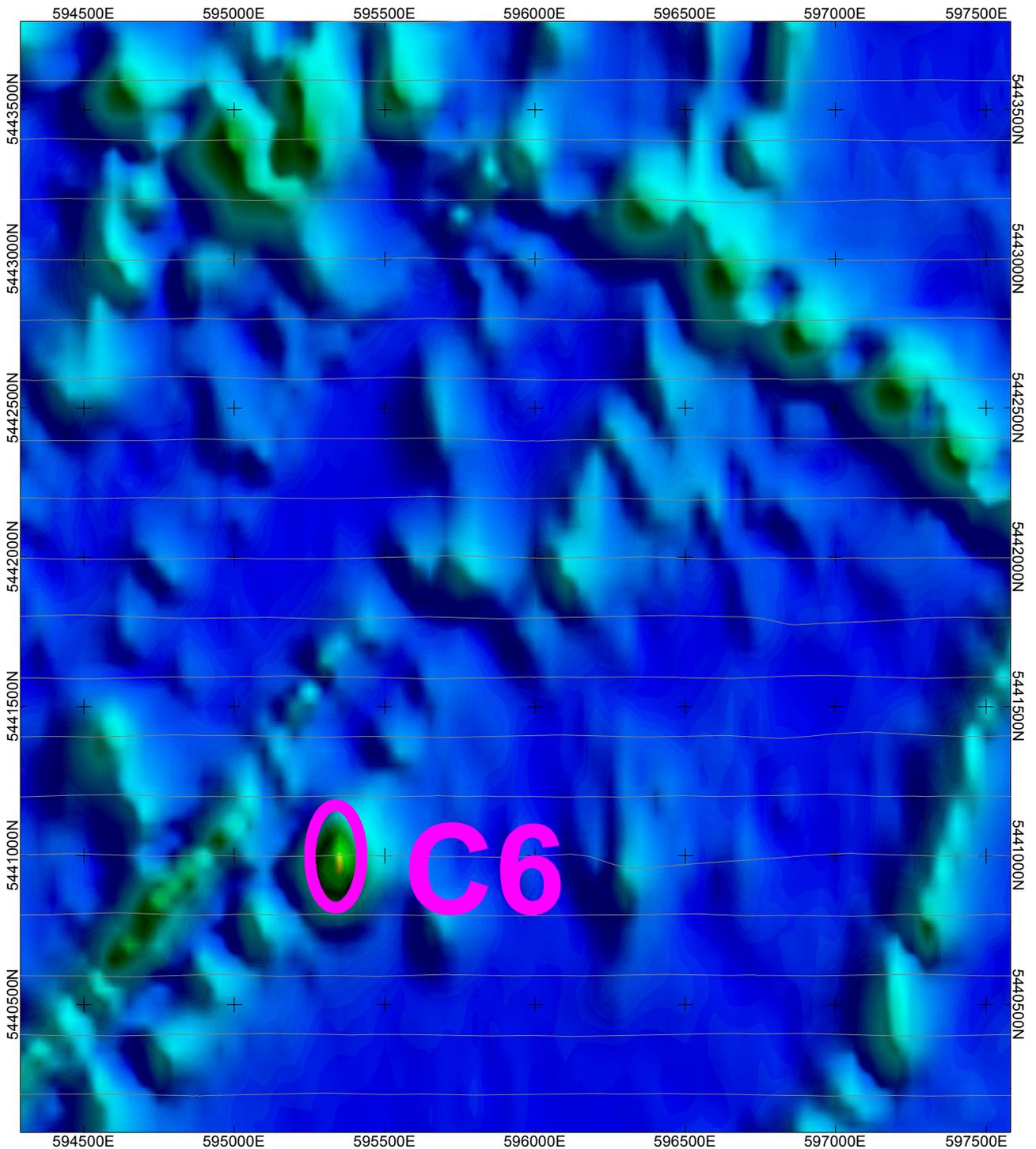
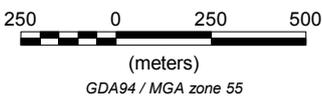
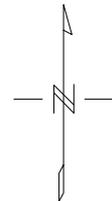


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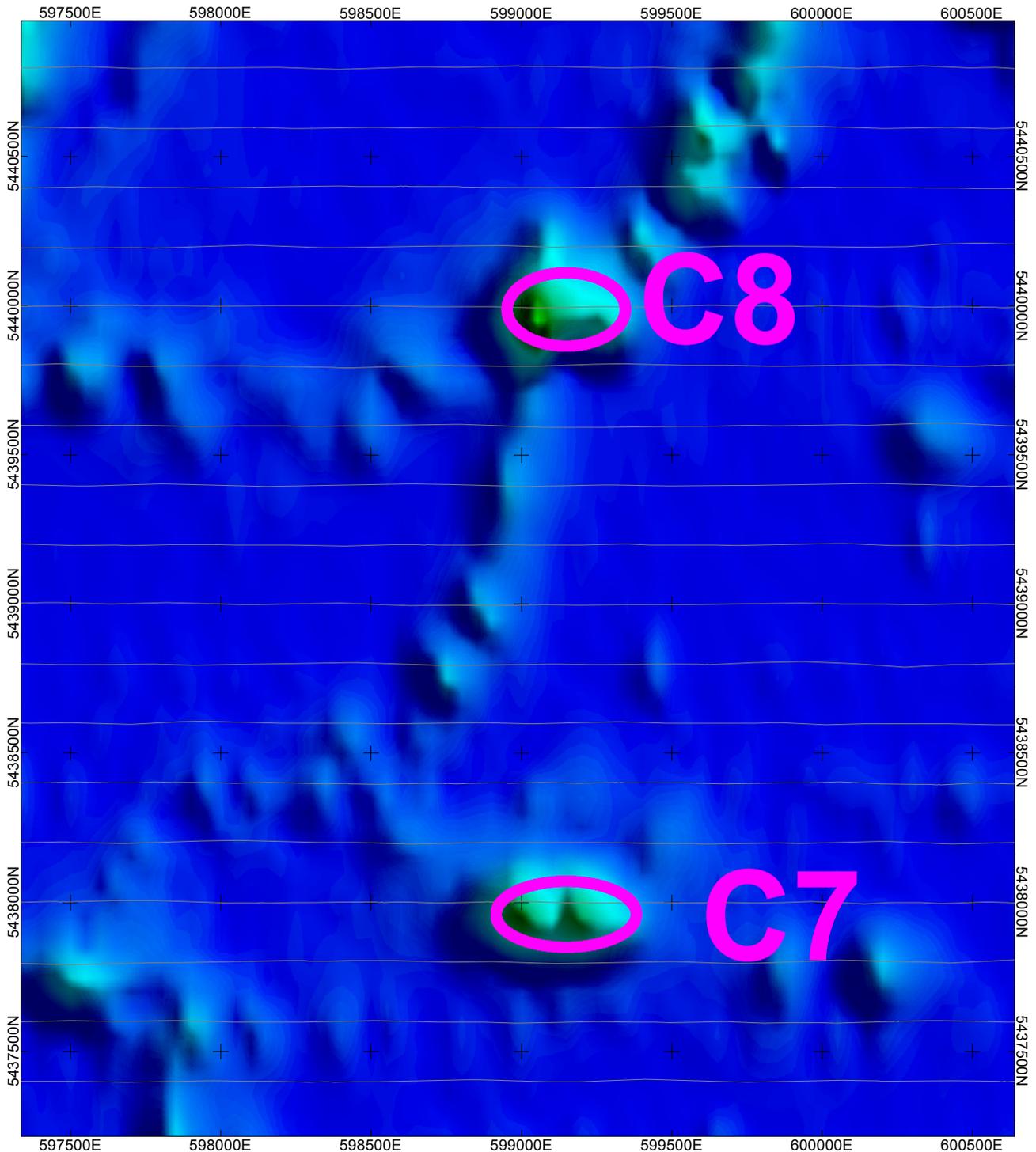
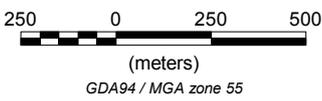
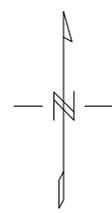


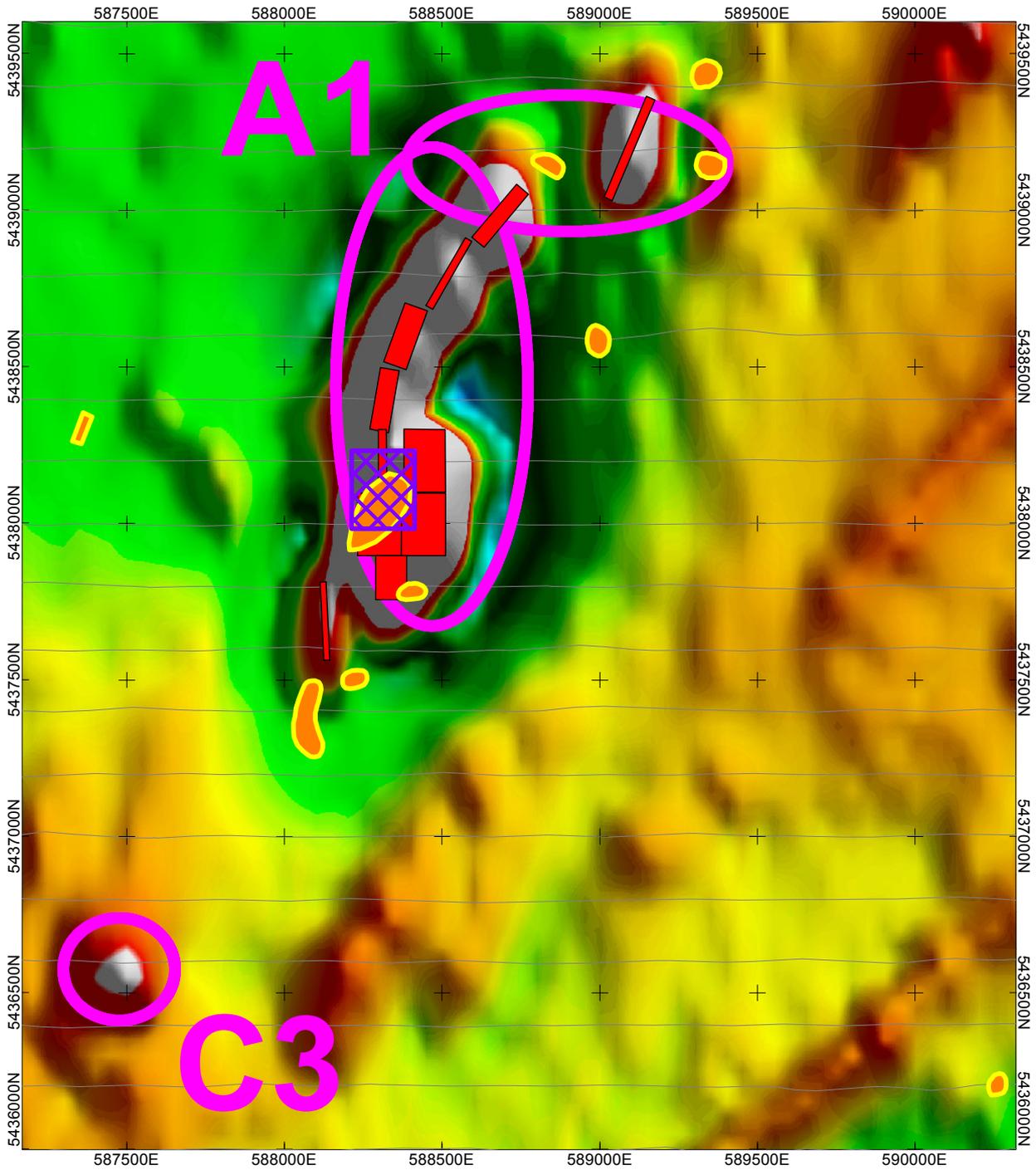
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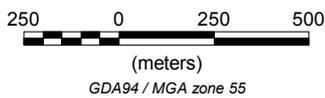
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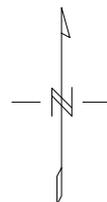


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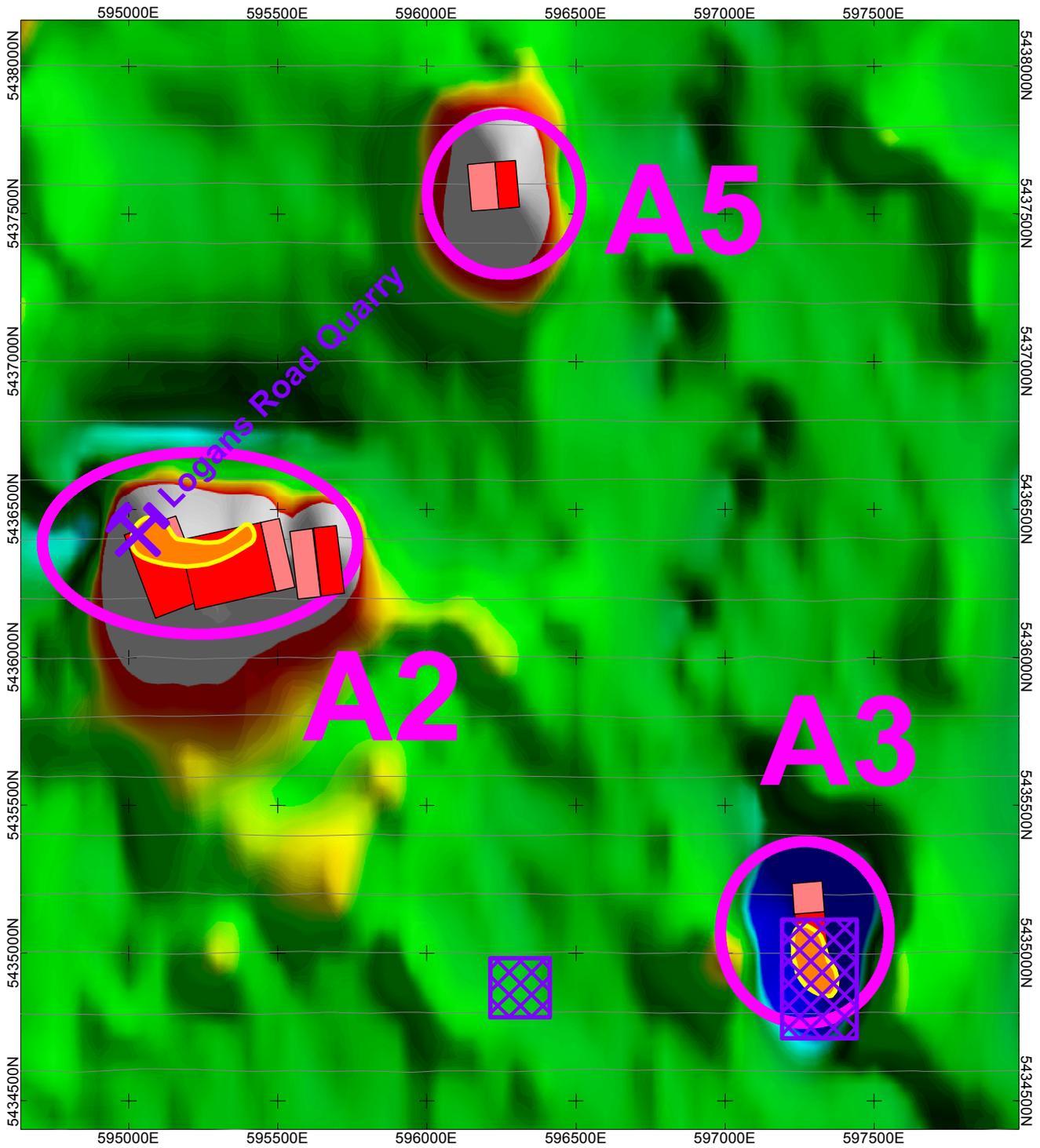
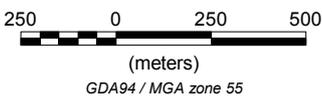
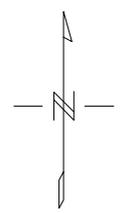


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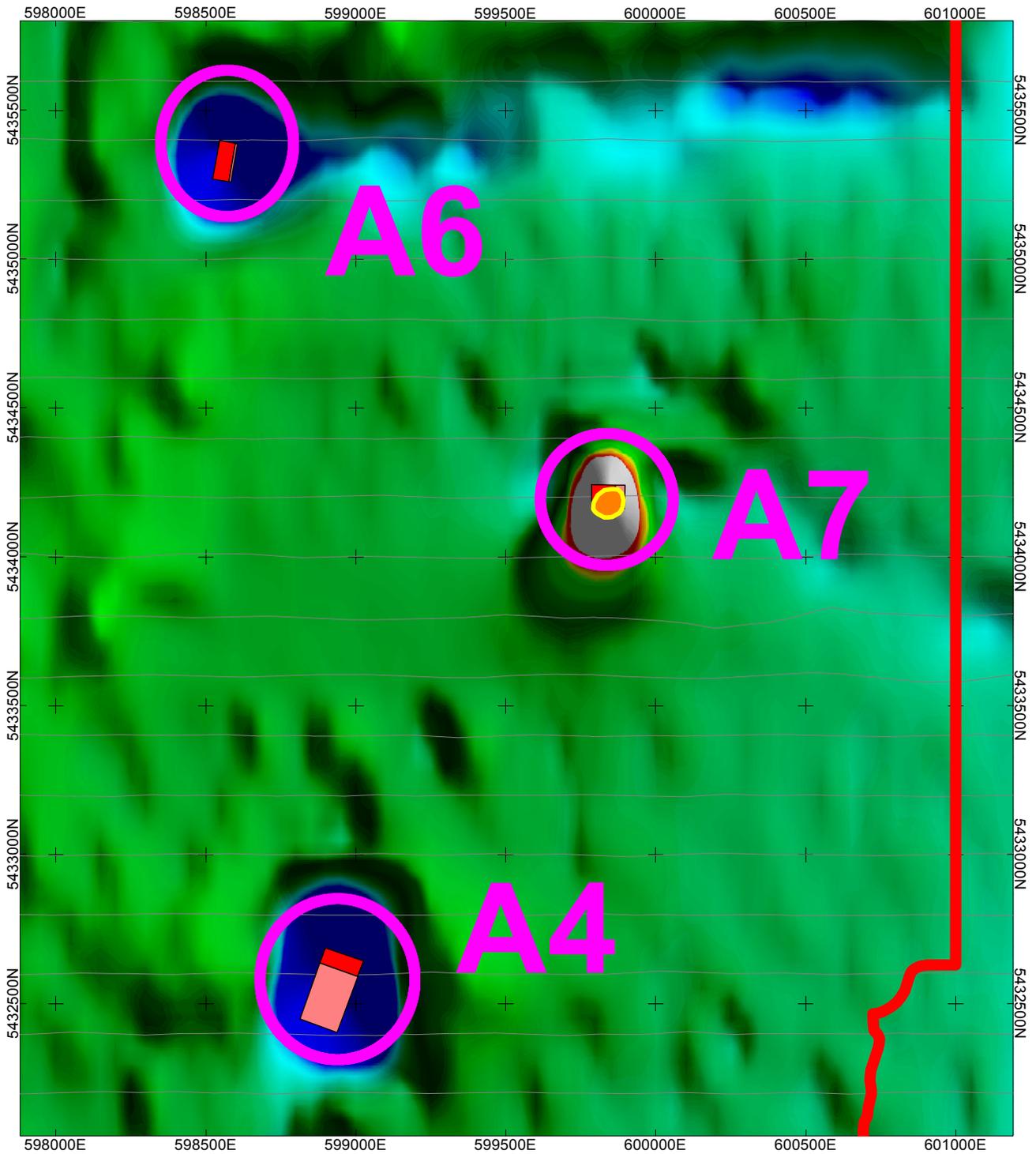
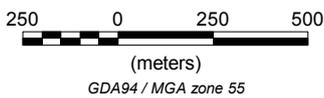
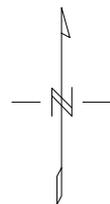


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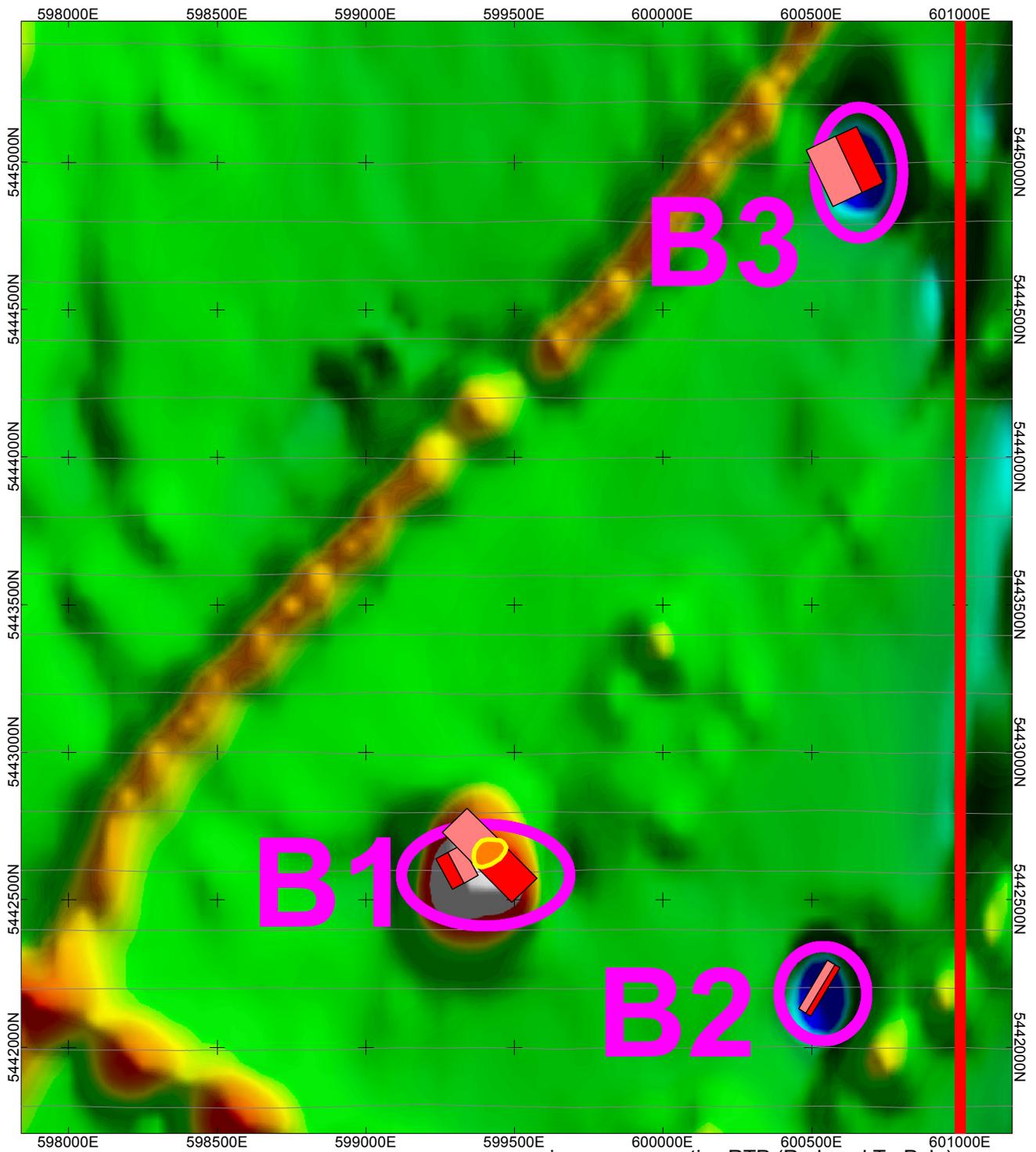
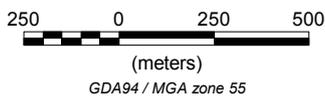
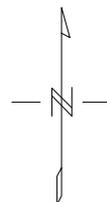


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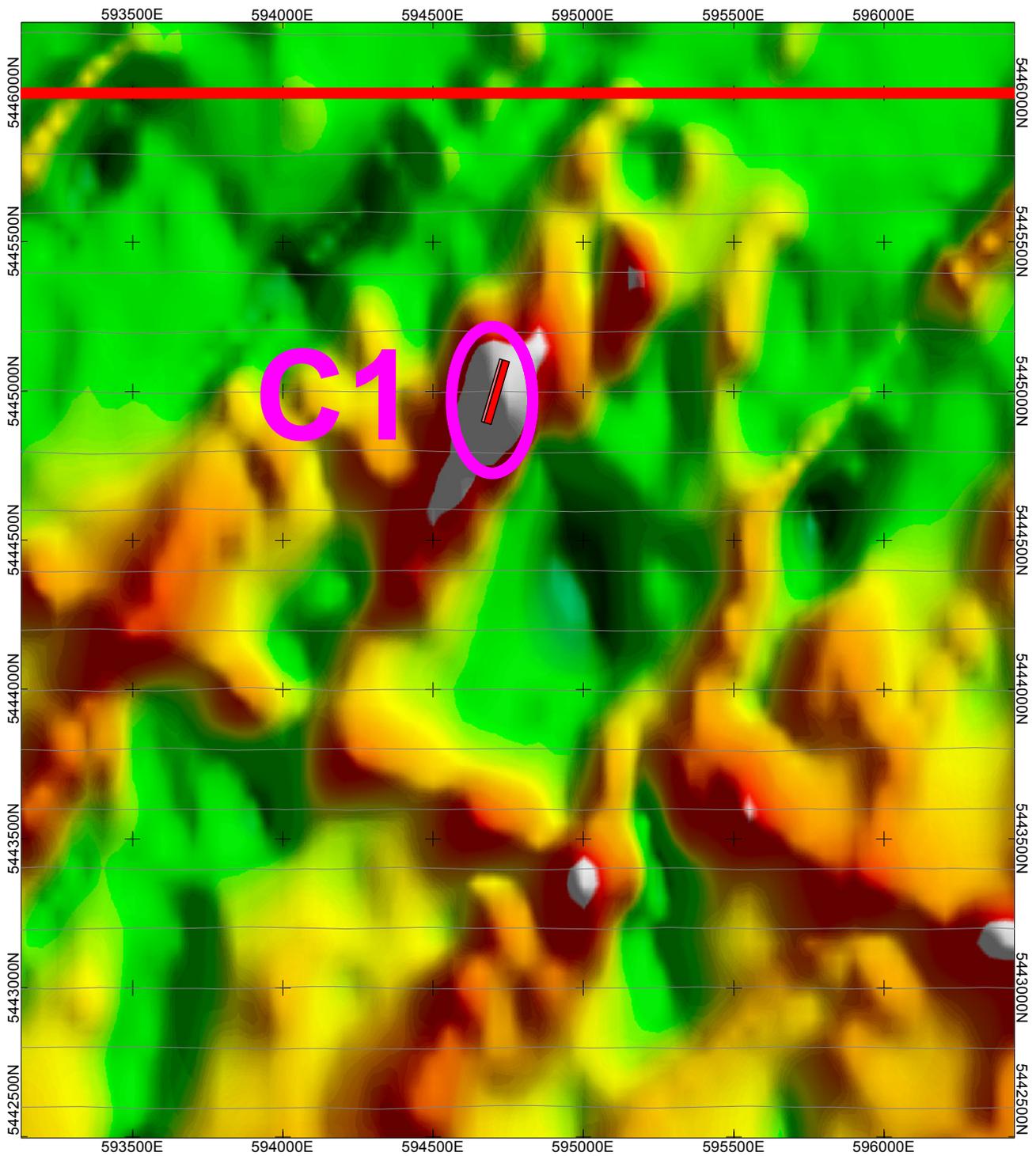
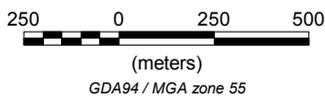
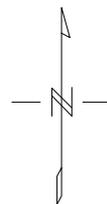


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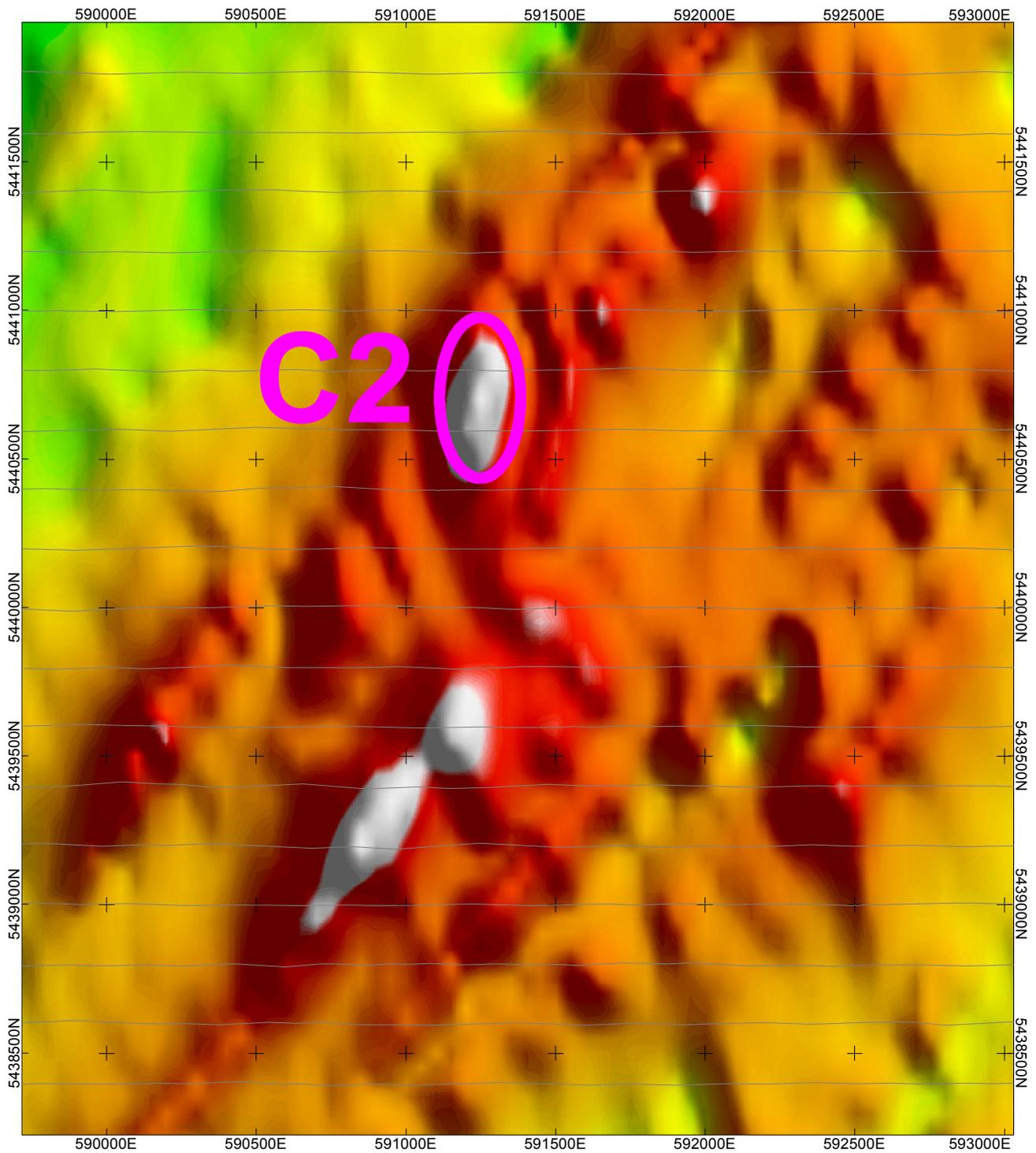
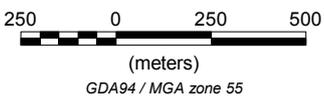
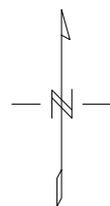


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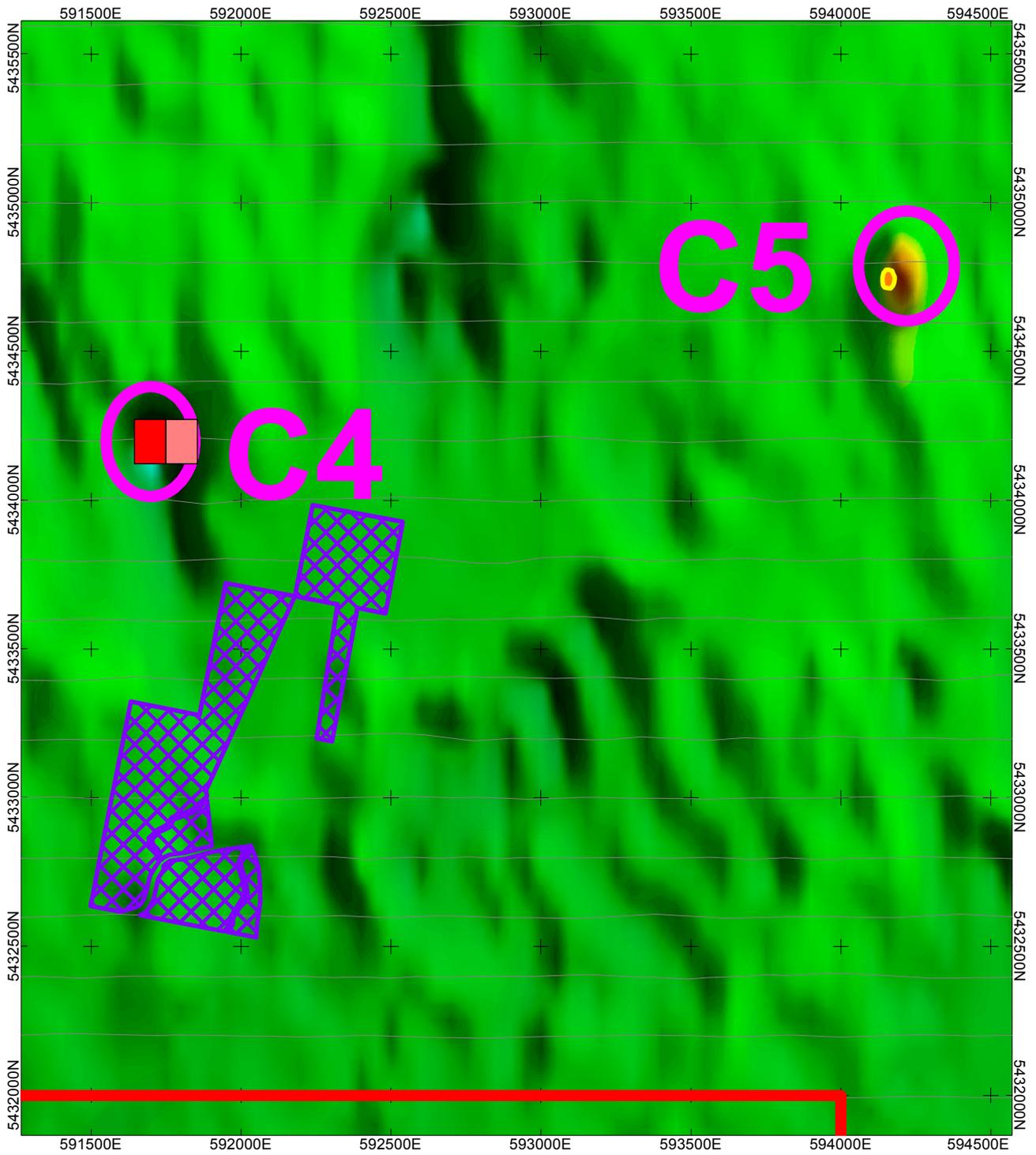
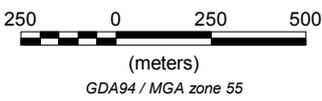
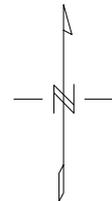


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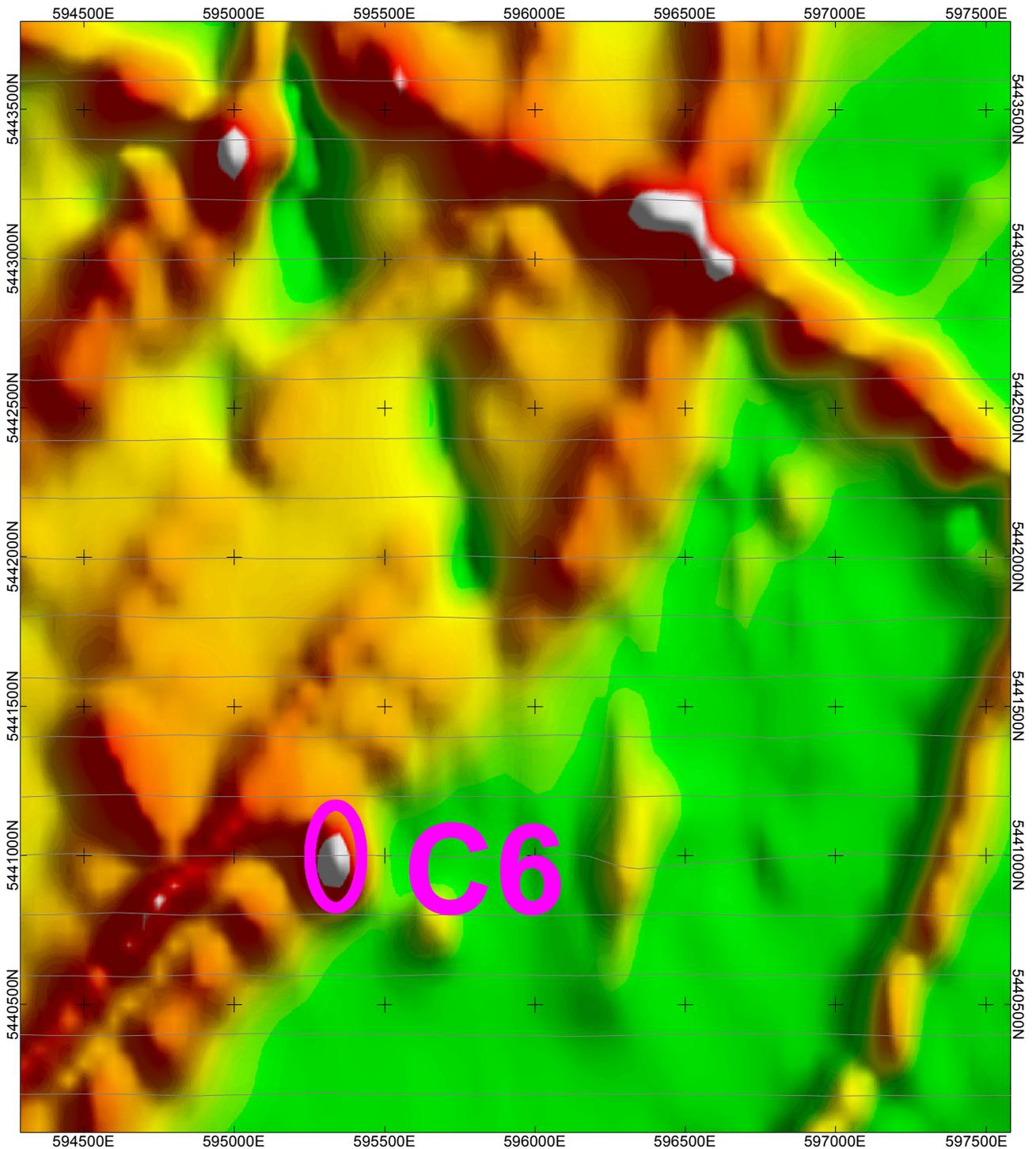
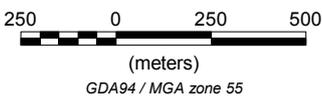
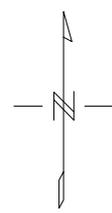


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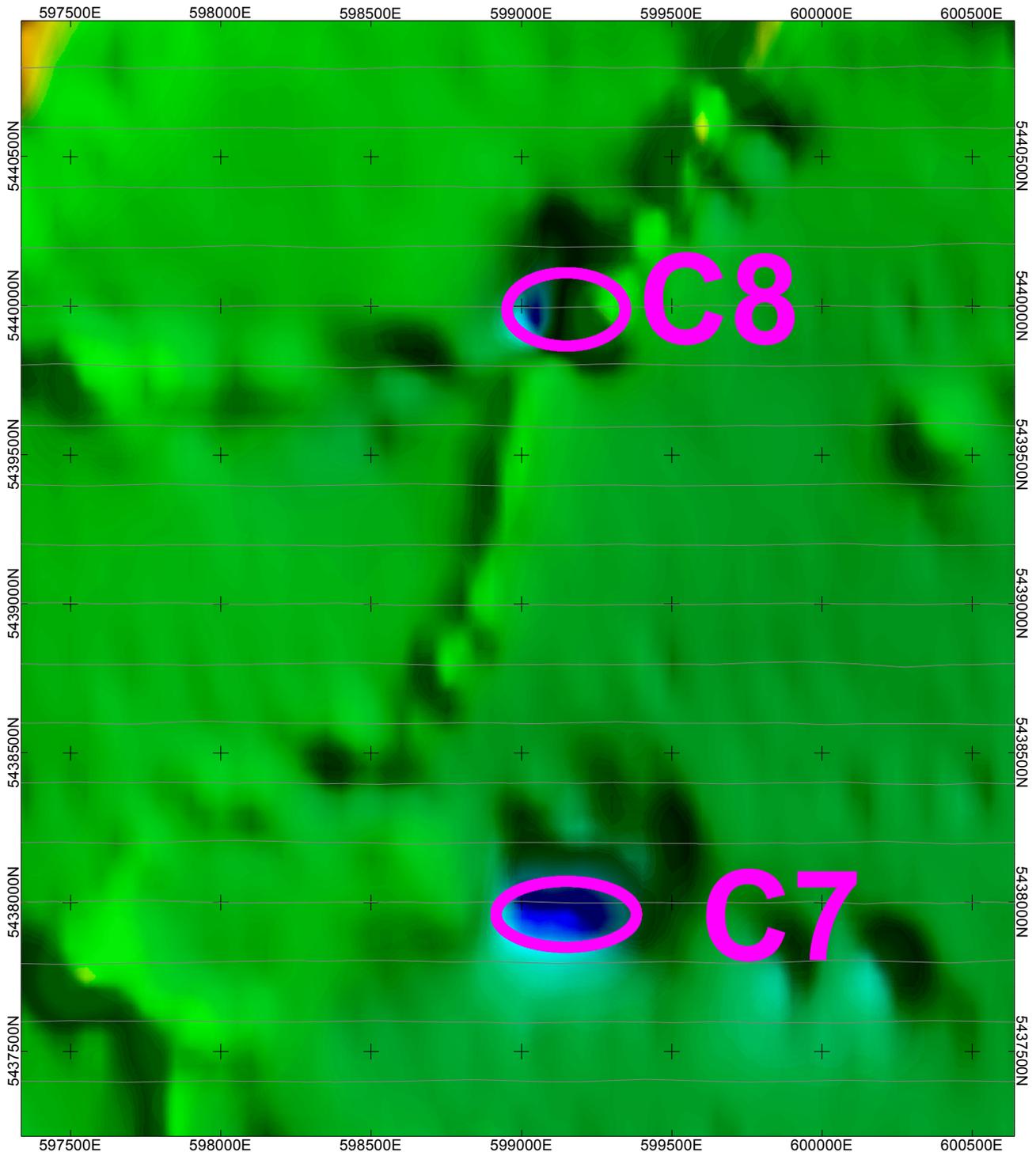
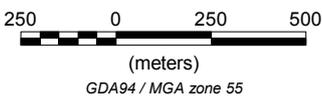
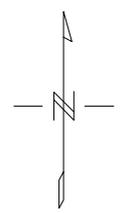


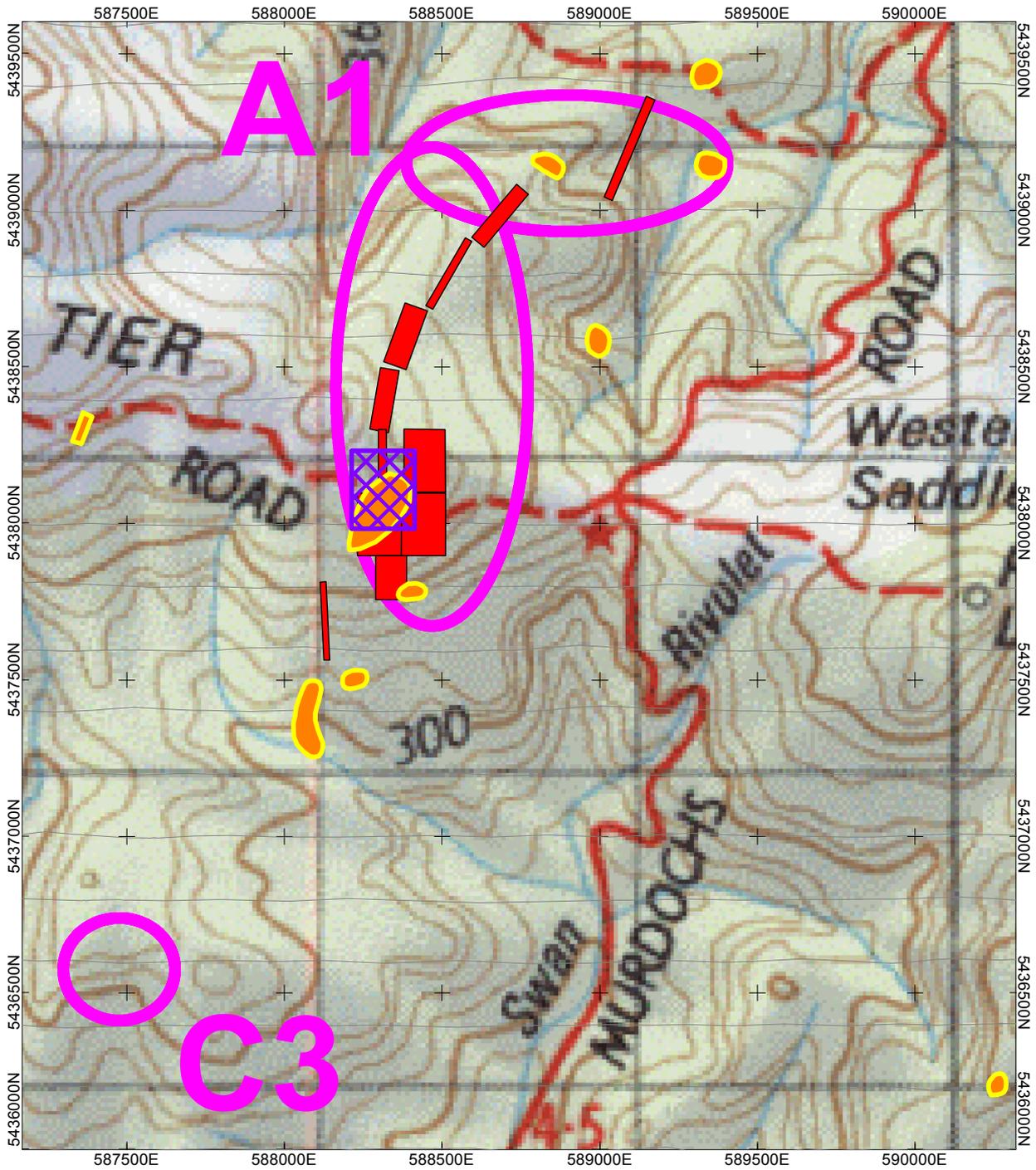
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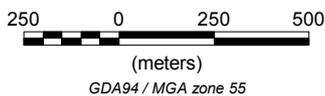
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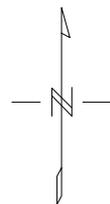


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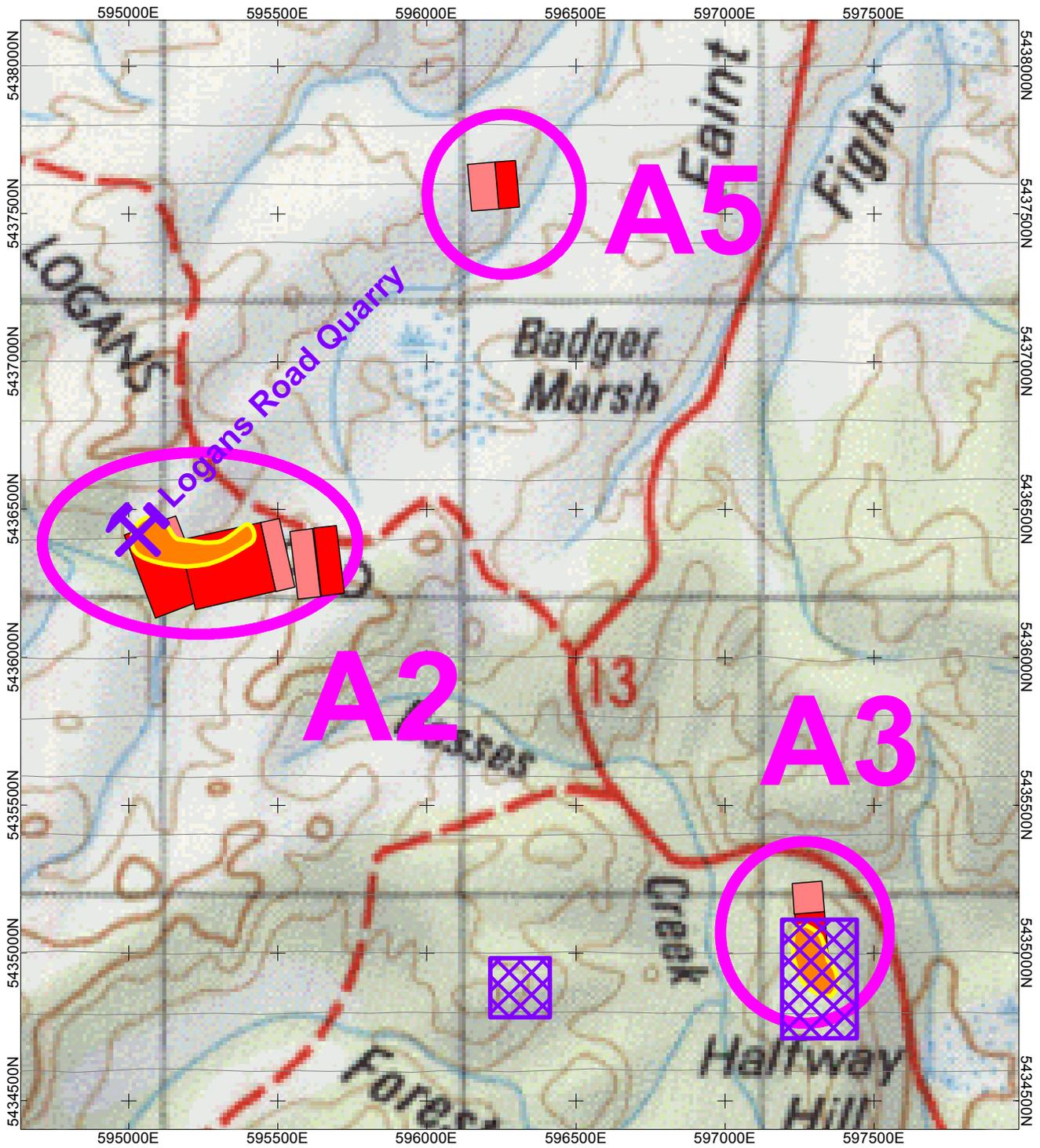
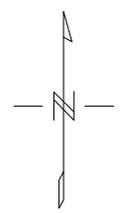


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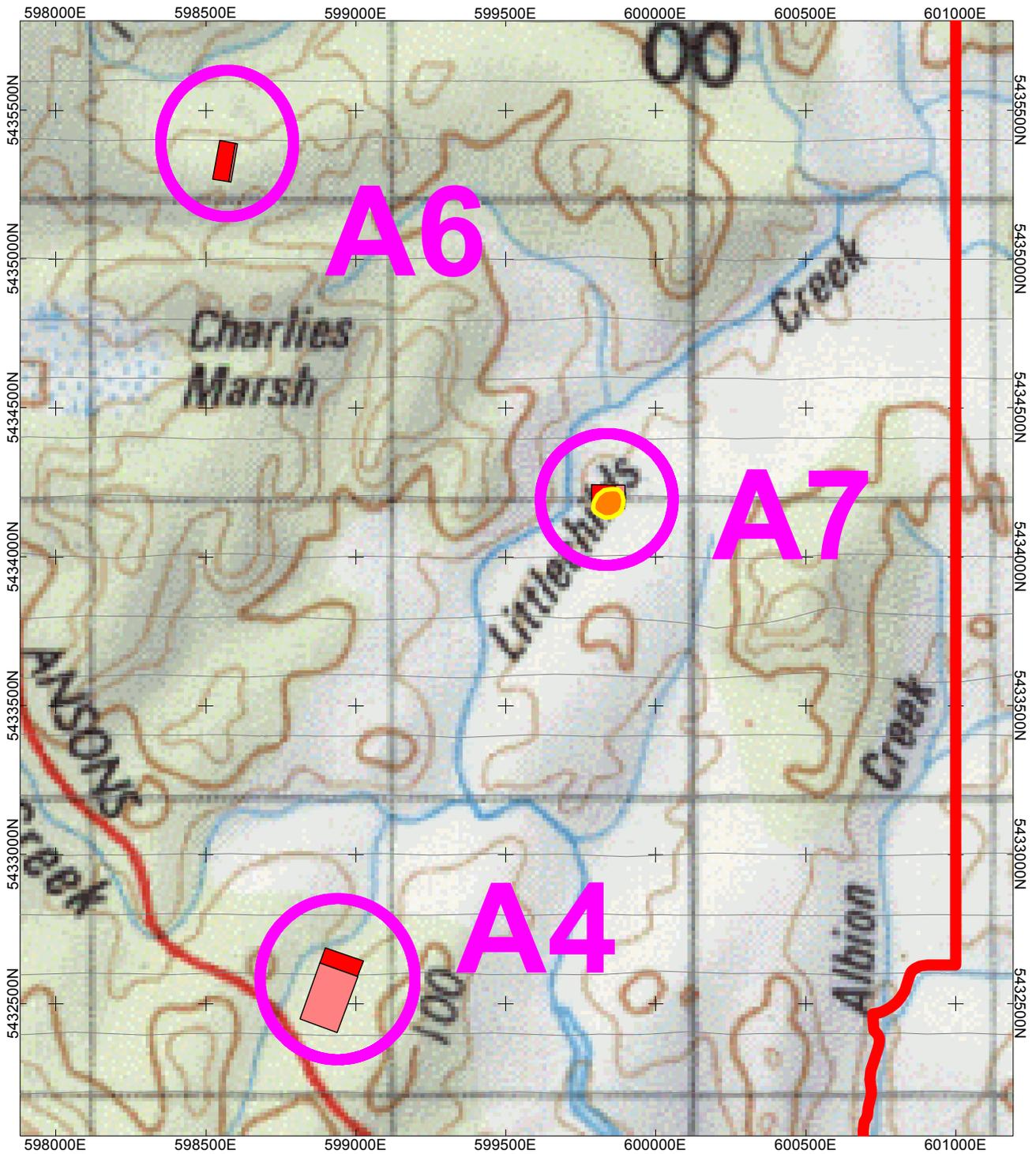
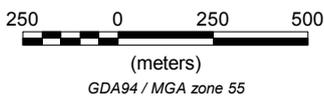
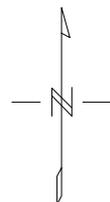


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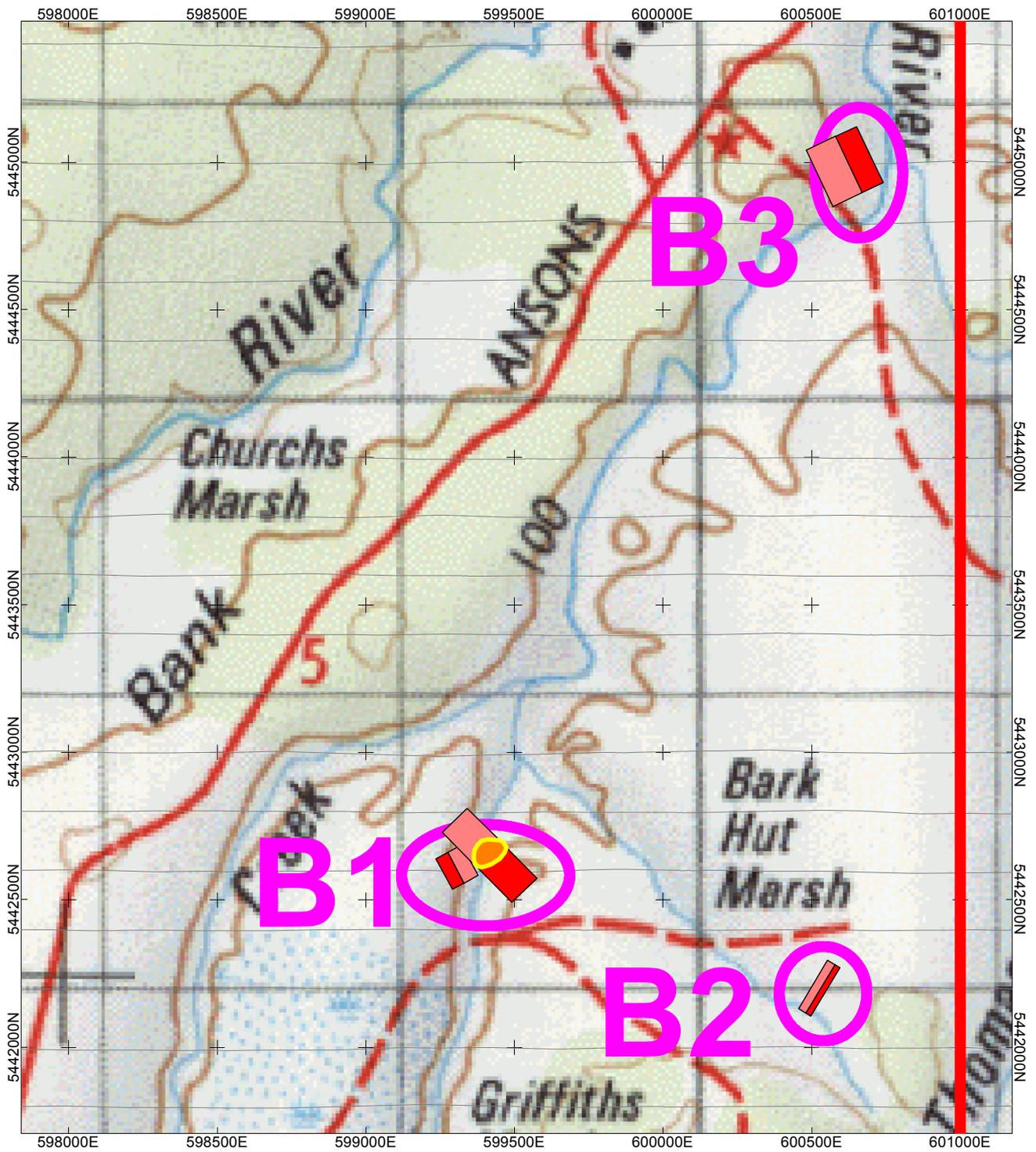
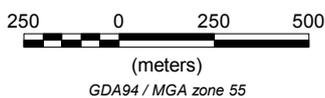
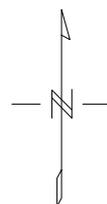


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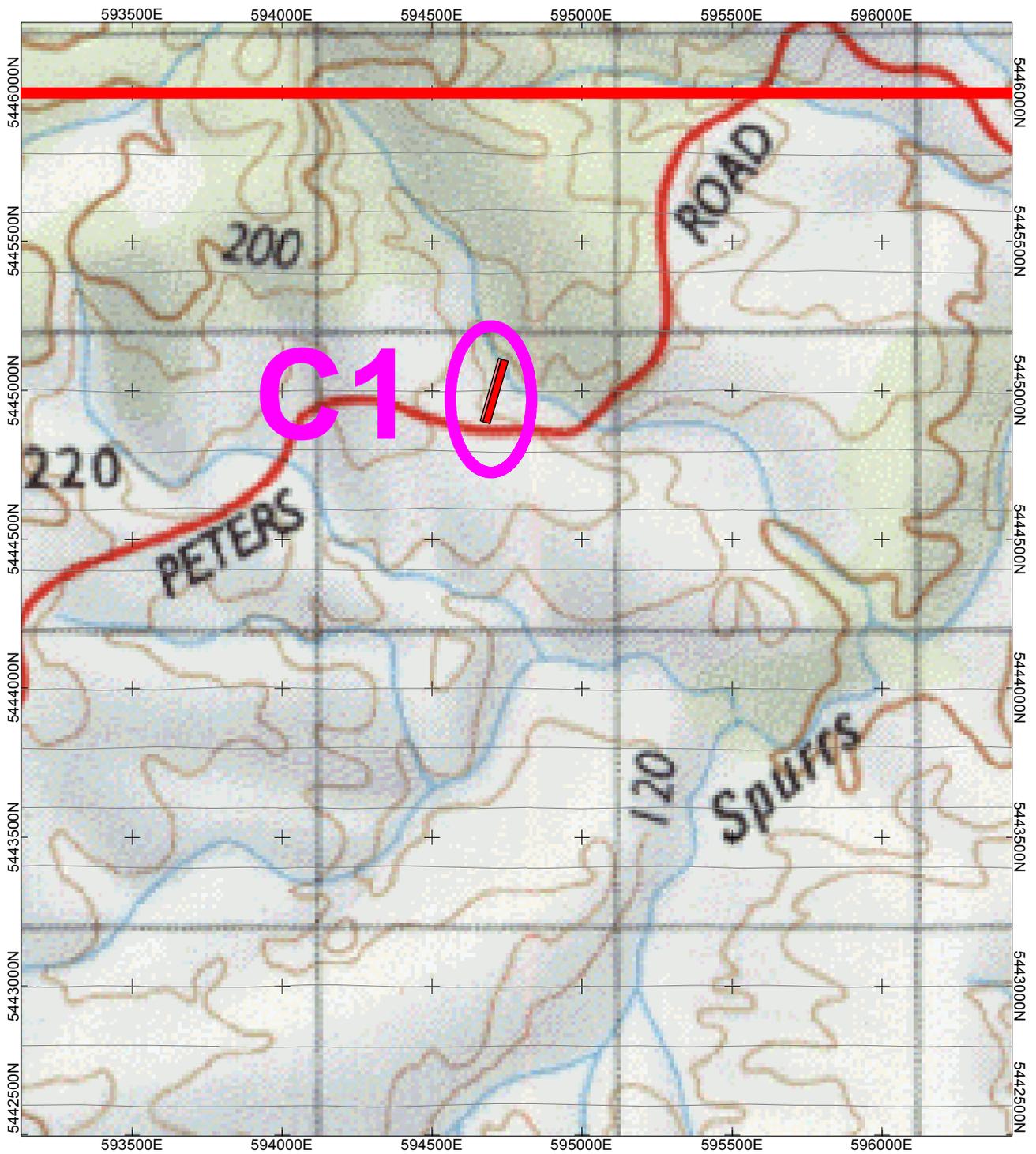
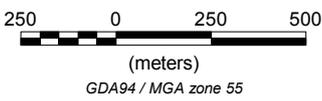
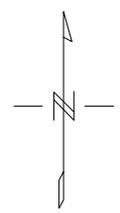


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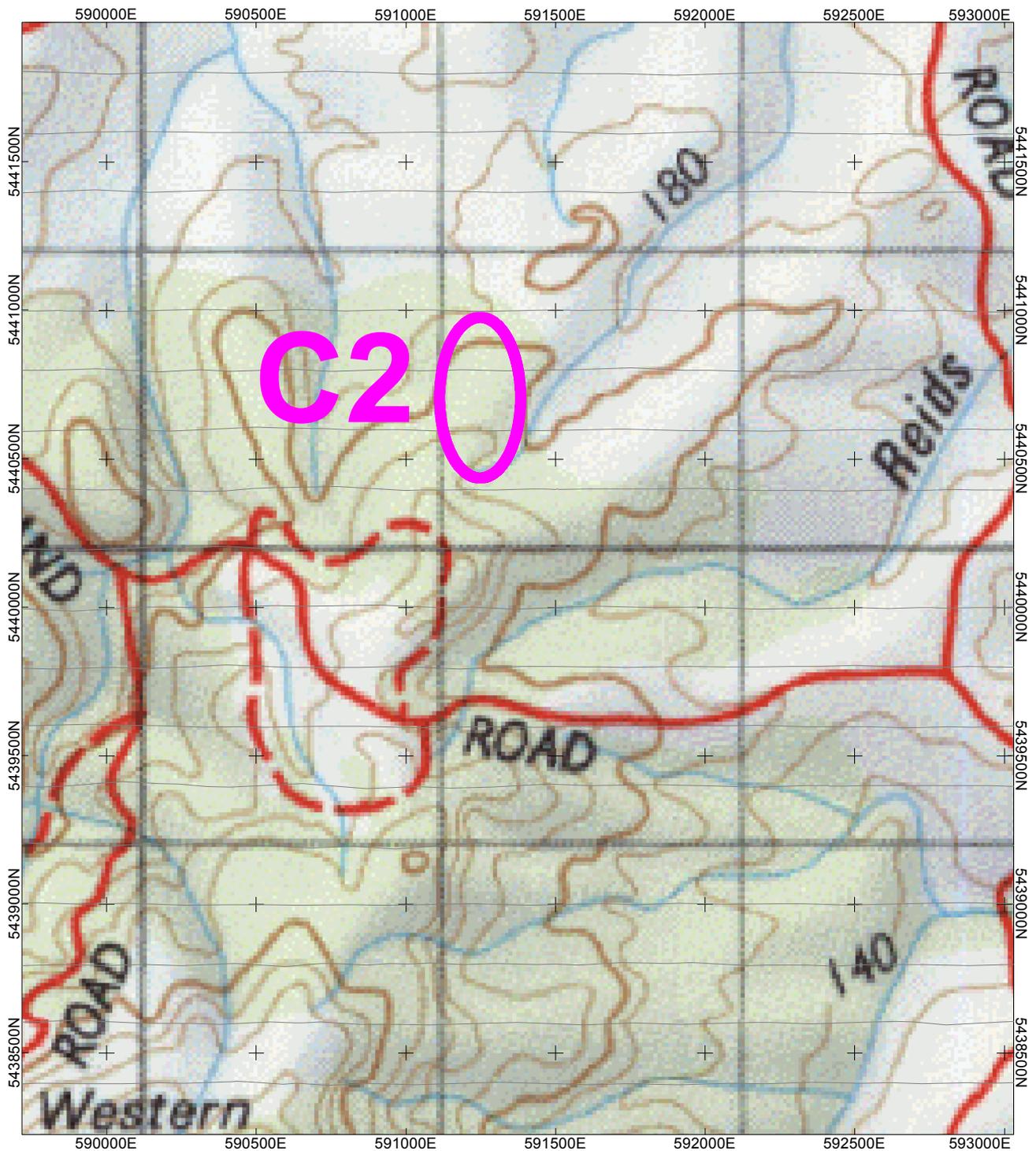
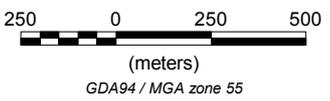
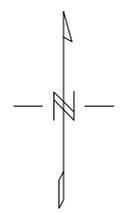


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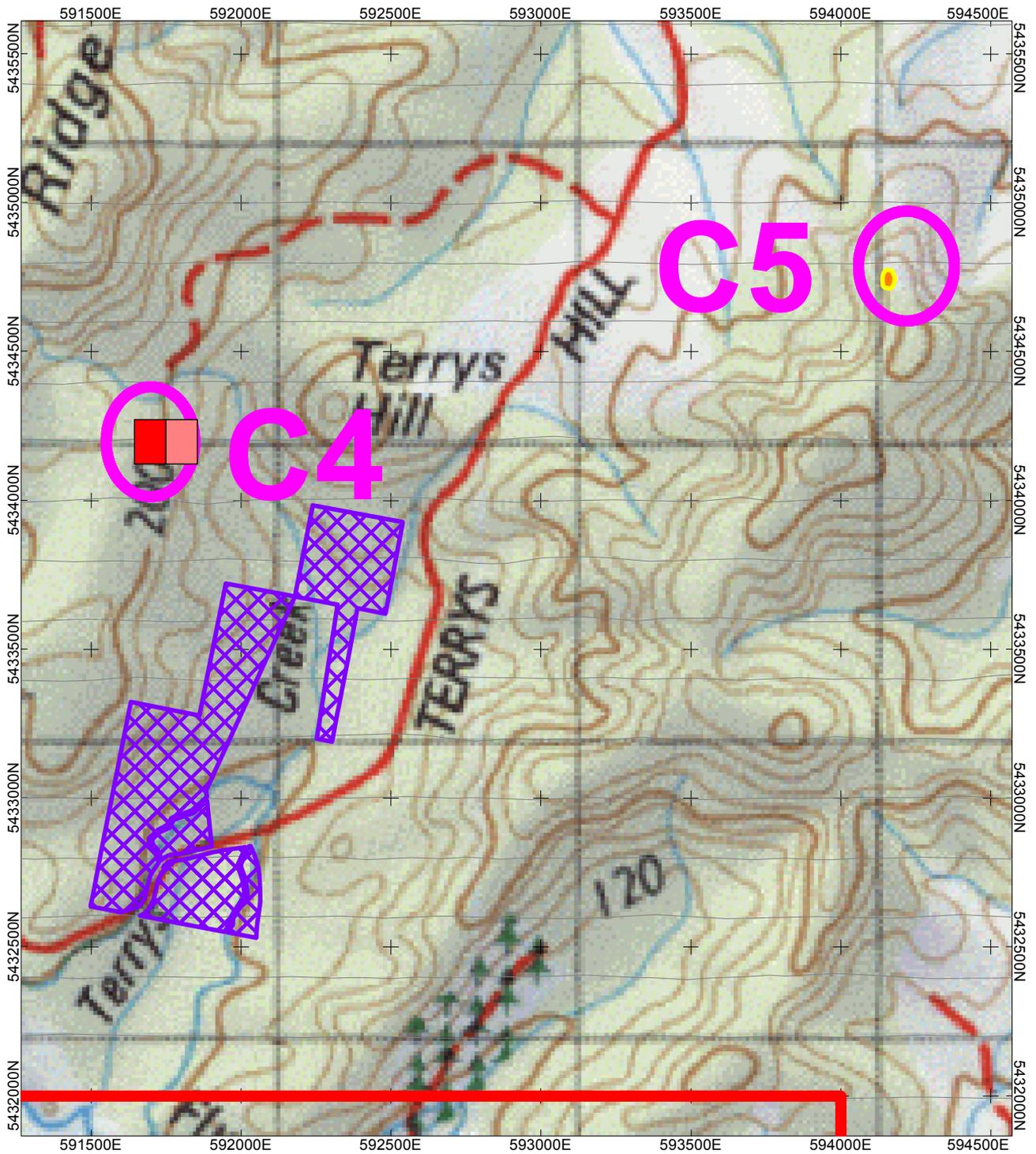
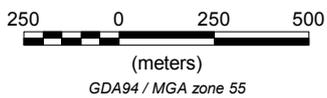
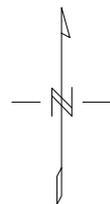


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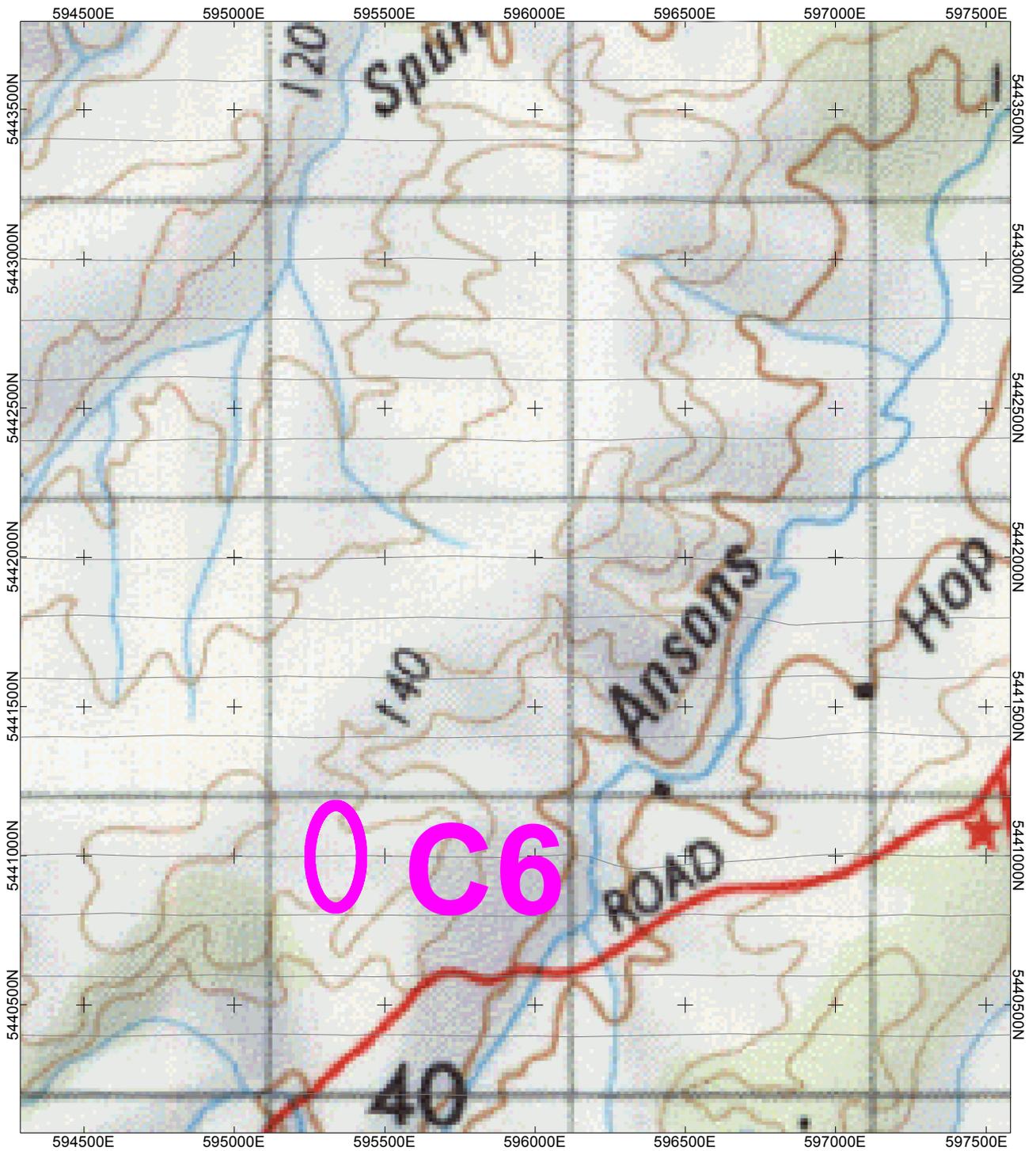
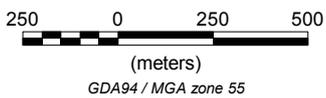
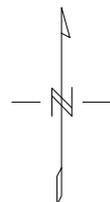


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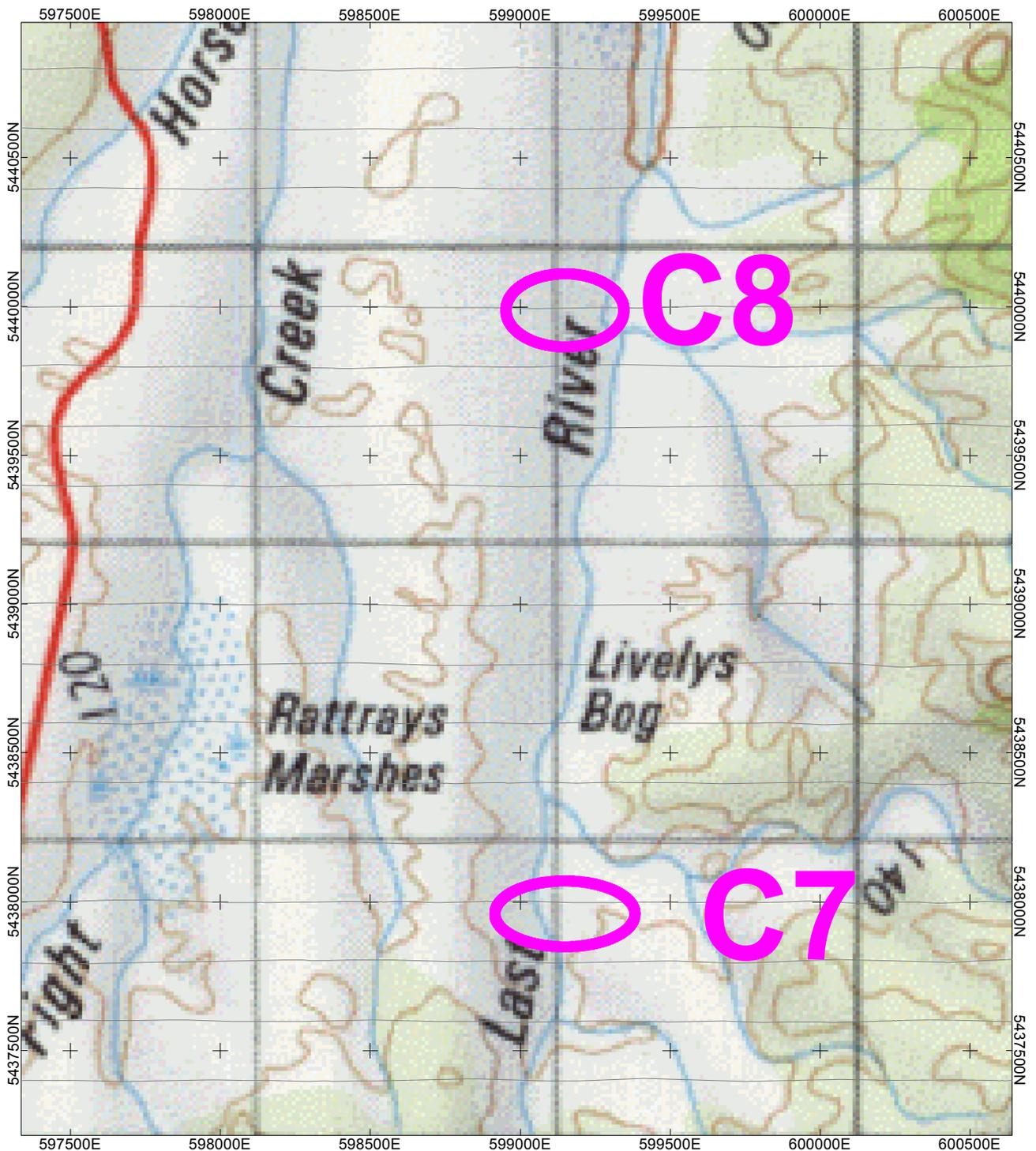
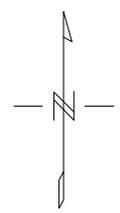


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**EL92013\_201411\_APPENDIX 4**

**Brief Report on Deep Lead potential on EL9/2013**

**Southern Mineral Exploration Geophysics  
(SMEG)**

## PALAEOCHANNEL GEOPHYSICS

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Hi Ron,

Geophysics suitable for palaeochannel detection really depends on the physical properties of the palaeochannel material. I've seen various methods used successfully; magnetics, gravity, electromagnetics, resistivity for example (and of course seismic as you mentioned). A few random comments/examples:

### MAG

- Where channels contain detrital magnetic material they can often be traced in the aeromag data. (eg. see attached MAG1 image; Wyalong district, Lachlan Fold Belt, New South Wales: The channels show as dendritic patterns in the aeromag data. Palaeo drainage is purple pattern indicating flowing to the NE)
- Basalt flows that have filled old drainage channels (but generally not where there's blanket coverage of basalt as well). The magnetic basalt in the palaeochannels is detectable under cover from the magnetic survey data. For example deep leads in central Victoria have been mapped well using magnetics. [see PS: below]

### GRAV

- If palaeochannel fill material is less dense (eg. less compacted for example) than the rock the channel cuts through then there may be a gravity low associated with the channel.
- Conversely if channels are basalt filled there may be a gravity high associated with the channel. Basalt tends to be towards the higher end of the rock density scale. The greater the difference between the densities of the basalt and the rock that surrounds it the better any gravity anomaly; best chances are where the surrounding rocks are sedimentary because these are generally at the lower end of the scale.

### E/M and RESIS

- Electromagnetics ("e/m") and resistivity methods both respond to changes in conductivity of the rocks. The conductivity is significantly determined by porosity, so if the palaeochannel material is more porous than the surrounding rock (ie. contain a higher proportion of pore fluid) you would expect the palaeochannel to show as more conductive. The effect will be stronger if the pore fluid is saline.
- In my experience e/m has been quite successful for groundwater exploration in the flat monotonous terrain of the Eastern and North Eastern Goldfields in Western Australia. Palaeochannels could often be detected and quite well defined using e/m methods.

Most of these will be more successful on ground that is fairly flat where palaeo drainage patterns is preserved intact to a reasonable degree and buried/disguised under/by more recent surface material deposits.

It will probably be hard to recognise palaeo drainage in areas like Priory where topographic variations are significant. For example if there is indeed some palaeo drainage still present in an area like this it may only be there as isolated remnants and that would be unlikely to exhibit an extensive/continuous pattern that is recognisable.

Tracing palaeochannels in a given area is likely to be more successful if there is a known example on which you can test different geophysical methods. Once you know what method best detects the palaeochannel then you can use that method to [hopefully] trace hidden extensions knowing what the expected geophysical signature looks like.

The last thing I can think of that needs a mention is the need for good data resolution with respect to the size/scale of the palaeochannel being looked for. For example in the Priory case the available gravity data is useless because the ~1km station spacing is much too coarse to define palaeochannels of the size that you'd be interested in.

...Phil.

PS:

After writing this I stumbled across a 1963 description by R.Jack of "Thureau's Deep Lead, St Helens" which I think I must have downloaded from MRT. Out of curiosity I looked at mags extended to cover Jack's map (south of your Priory tenement) and there's an obvious correlation between an approximately 5km long mag anomaly and the position of the deep lead. See attached images and PDF.

Jack's sections 3 & 4 contain substantial basalt and these sections are over the mag anomaly, while sections 2 & 5 only show a tiny bit of basalt, and 1 shows none. So here's an example of where mag is convincingly detecting basalt in a covered deep lead. There may also be a shorter length of mag response just to the east of Constable Creek where the deep lead arcs around at its furthest south.

Unfortunately I can't see anything similar within the Priory tenement that makes me suspect there's a similar mag signature from a covered deep lead or palaeochannel. Doesn't mean the channels aren't there, but like Thureau's Deep Lead the magnetics doesn't necessarily show a signature over a channel.

Logans Road Quarry



A2

C5



A3



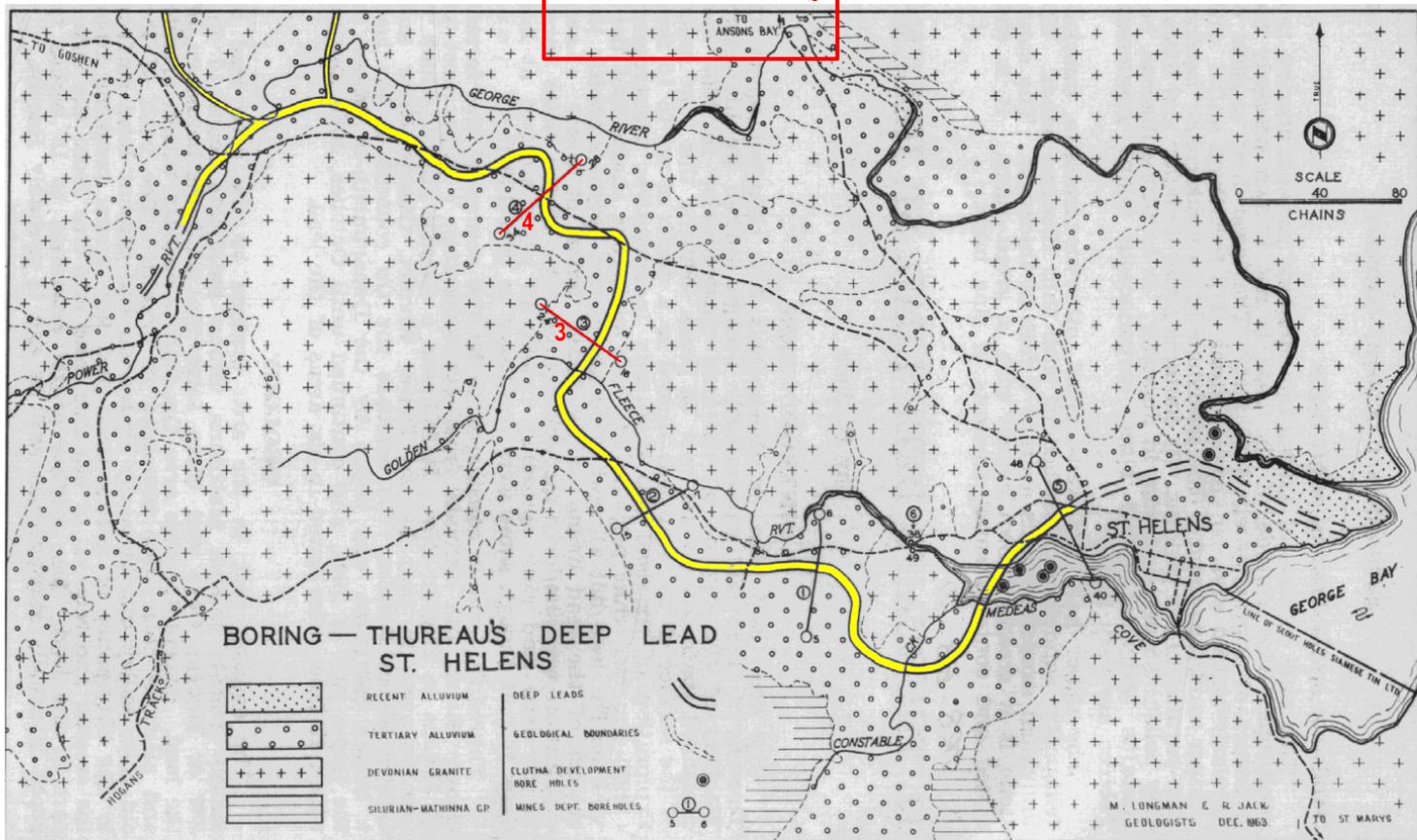
A6

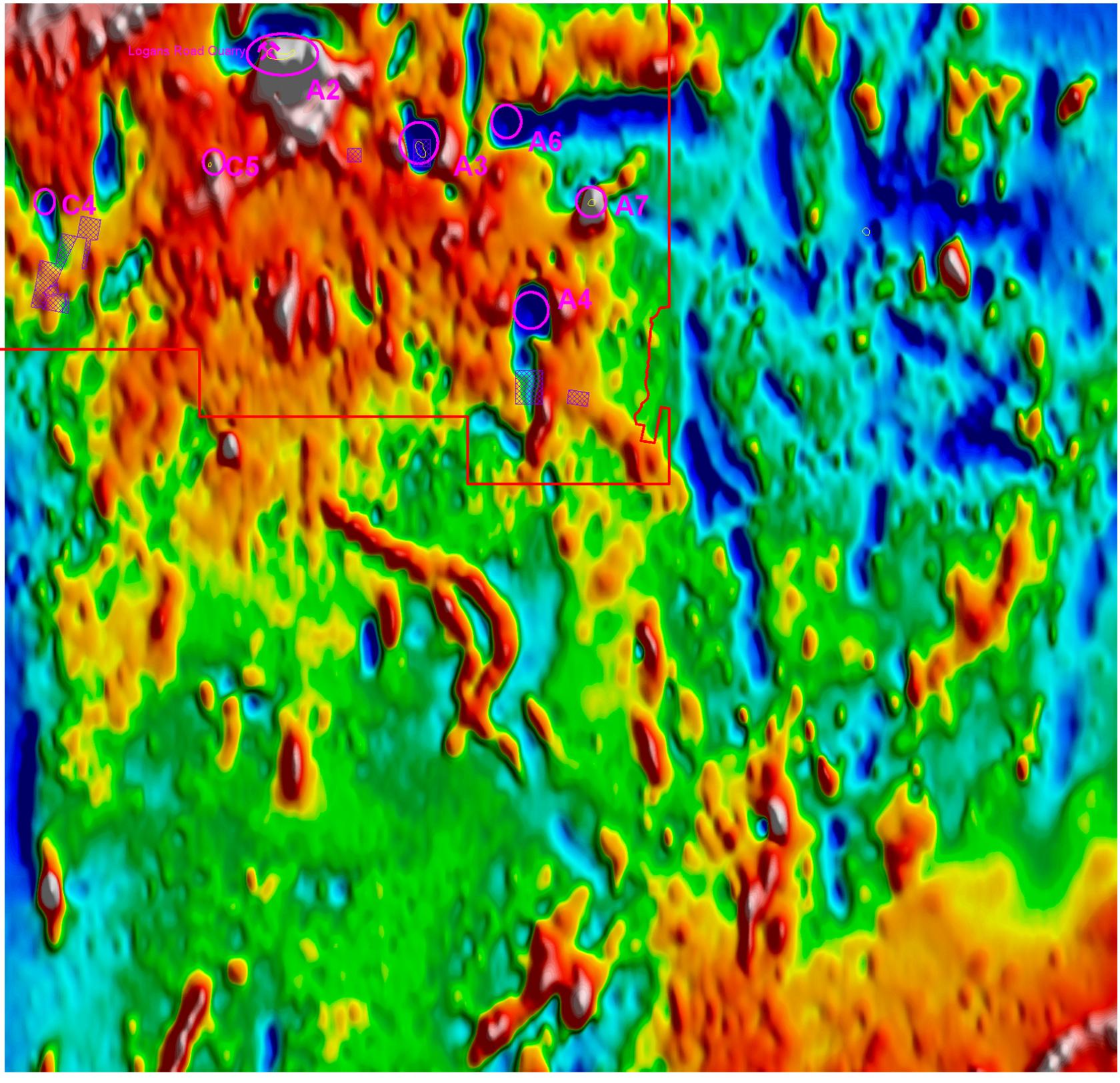
A7

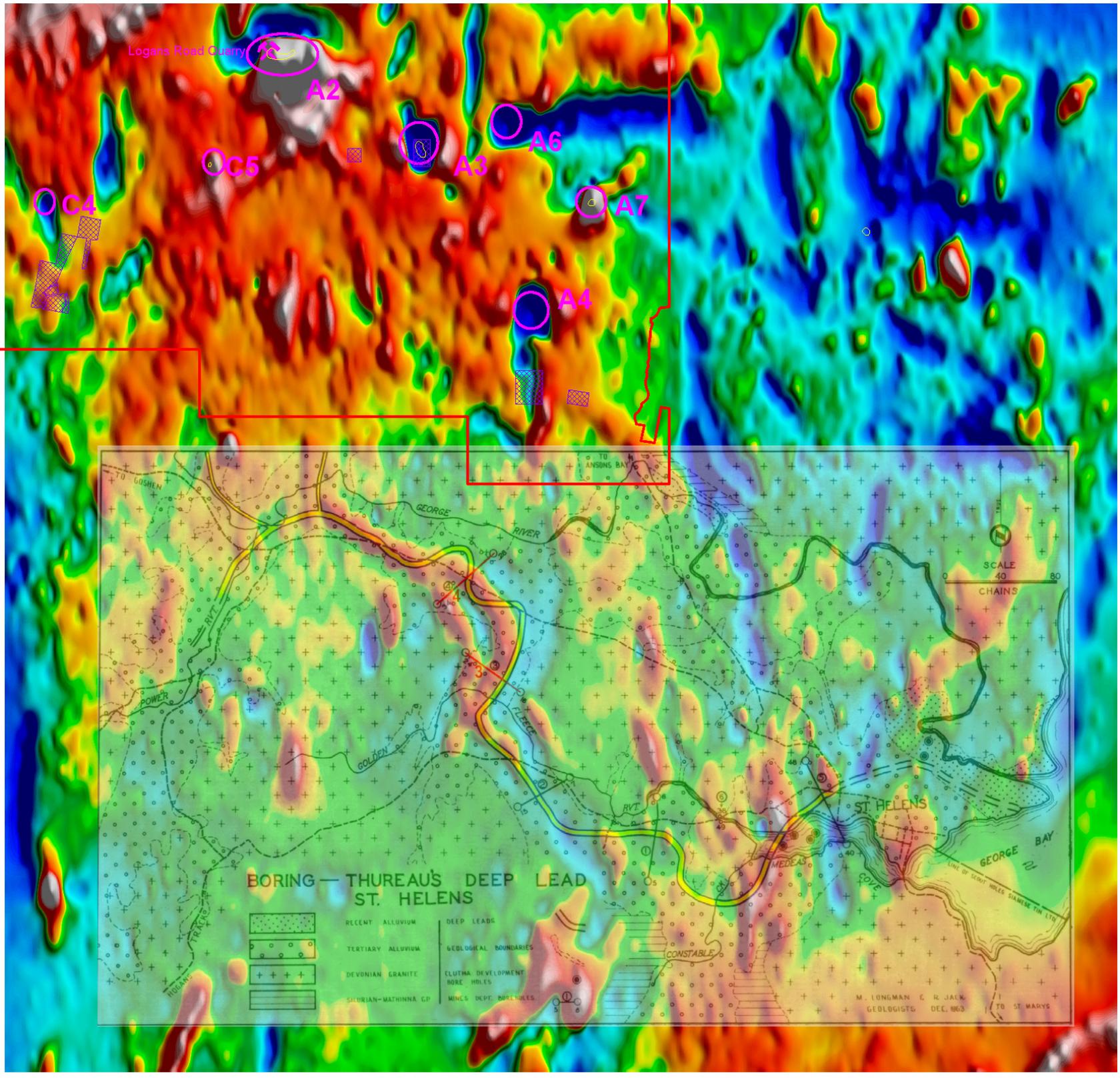
C4



A4







Logans Road Quarry

A2

A3

A6

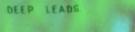
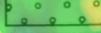
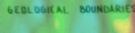
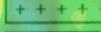
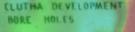
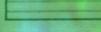
A7

C5

C4

A4

### BORING - THUREAU'S DEEP LEAD ST. HELENS

- |   |                      |   |                               |
|---|----------------------|---|-------------------------------|
|  | RECENT ALLOVIUM      |  | DEEP LEADS                    |
|  | TERTIARY ALLOVIUM    |  | GEOLOGICAL BOUNDARIES         |
|  | DEVONIAN GRANITE     |  | CLUTMA DEVELOPMENT BORE HOLES |
|  | STURIAN-MATHINNA GP. |  | MINGS DEPT. BOREHOLES         |

M. LONGMAN & J. JACK  
GEOLOGISTS DEC. 1863