

Geophysical Services for the Environmental, Engineering and Ordnance Industries



PROJECT: **GEOPHYSICAL SURVEY**
Seismic and Total Magnetic Field Survey

AREA: **Gladstone, N-E Tasmania,
Australia.**
Endurance and Scotia mine sites

CLIENT: **Van Dieman Mines Ltd.**

PROJECT NO: **AG-143**

CLIENT P/O: **Email of 17/12/06**

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REPORT

**Geophysical Survey
Gladstone N-E Tasmania, Australia**

for

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Date: 17 December 2006

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1 INTRODUCTION

Alpha Geoscience Pty. Limited (Alpha), based in Sydney, NSW, was contracted by Van Dieman Mines Limited to undertake a Seismic Refraction and Total Field Magnetic study at two of the company's mining leases near Gladstone, N-E Tasmania, Australia.

The objectives of the study were to determine:

- If seismic techniques would be useful in delineating basement structures within the Deep Leads in the area, particularly the interface between the compacted gravel, alluvium layer and the weathered basement material.
- If a total field magnetic signature existed that would allow mapping of the extent of the Deep Leads.

2 AUTHORITY

Mr. Graeme McIntyre of Van Dieman Mines provided the authority to proceed with this project by way of email on September 28, 2006.

3 SURVEY RATIONALE

3.1 Refraction Seismic Survey

The deep leads are deposits of gravels, sands and clays, high in tin and heavy metals. The deep leads have formed along the course of an ancient river system (Keuneke, O., 1957). These paleochannels hence confine the mineral deposit to depressed zones in the weathered basement material. Whilst direct delineation of the mineral deposits may not be possible using geophysical techniques, detection of paleochannels would define the extent of the regions of the deposits.

3.2 Total Field Magnetic Survey

Current technology in total field magnetic surveying is acknowledged for producing accurate magnetic map images at very high production rates. The method does depend on averaging the magnetic signature over large subsurface volumes and thus cannot accurately image internal geological bedding structures. The advantage is that, if a magnetic signature exists over the deep leads, mapping of the extent of the zone could be achieved at a minimal cost.

The use of total field magnetic surveying may be attractive to Van Dieman Mines as a way of mapping the extent of the deep leads within the prospect. If the technology is proven to be useful in the local environment and geology, it will significantly reduce the cost of the overall geophysical mapping program across the Van Dieman Mines mining tenements. Not only are the production rates very rapid, local Van Dieman Mines personnel with very limited training can also acquire the data.

4 EQUIPMENT

4.1 Seistronix RAS-24 Seismic Acquisition System

Data collection was achieved using a Seistronix RAS-24 seismic system, acquiring 48 active channels. Eight and 30Hz geophones were trailed. A 2.5m geophone spacing was employed at the Scotia site and 5m used at the Endurance site.

Various seismic energy sources were employed, 50gr of cartridge explosive, 12 gauge shotgun and stacking of 5, 20 lb sledgehammer blows.

4.2 GPS Positioning

A Trimble DGPS AG114 Global Positioning System Receiver, employing real time correction from the Omni Star satellite system, was used for positioning of the individual survey lines. The GPS provides accurate positioning in the field and was used for marking waypoints at one second intervals along the individual lines.

With an accuracy of better than +/- one metre, the backpack mounted unit provides a reasonable level of accuracy.

4.3 Geometrics G-858 MagMapper

The G-858 MagMapper uses a graphical interface to make survey design and data acquisition quick and efficient. Various modes of operation allow the user to custom design a survey grid for their particular needs. The operator also has the ability to view his/her position on the grid and the current data profile during the survey. Sensitivity, resolution, and recording rate of the cesium magnetometer are user selectable (<http://www.geometrics.com/858-d.html>).

G-858 data acquisition offers either continuous or discrete station recording. The high sampling rate of the instrument in continuous mode allows the operator to survey an area at a fast walking pace. (<http://www.geometrics.com/858>).

Datasheets for all instruments are available in Appendix 1.

5 SURVEY AND DATA PROCESSING

5.1 Survey Areas

Two survey lines were selected for the evaluation of the refraction seismic method; Line 1 at both the Endurance and Scotia sites were investigated.

Maps showing the location of the seismic lines the two magnetic survey areas and are available in Appendix 2.

The Endurance site was wet and boggy underfoot, in the Eastern portion, with up to 500mm of standing water in places. This site was generally open with low bushes and tall grass.

The Scotia survey site was dry, with a hard packed clay pan. Generally the site is heavily vegetated with a mix of large solid trees and relatively dense undergrowth. Some areas had very dense tea tree vegetation, which was almost impossible to penetrate. Recent bushfires had cleared some areas, which improved access.

There were no major topographic features within either survey area.

5.2 Survey Parameters

Seismic data was collected along predefined lines at the Endurance and Scotia sites as documented in the maps in Appendix 2.

The total field magnetic survey at the Endurance site was conducted along five lines, as shown on the Endurance site magnetic survey results.

At the Scotia site the total field magnetic survey was conducted along four lines, as shown on the Scotia site magnetic survey results.

Positioning on each magnetic data line was recorded using a DGPS, collecting continually along each survey line. DGPS data was recorded directly into the digital magnetic data file.

5.3 Field Procedures

5.3.1 Seismic Refraction Profiling

A geophone spacing of 2.5m was employed at the Scotia site, with 5m spacing used at the Endurance site.

Seismic energy sources trialled were

- 50gr of cartridge explosive,
- 12 gauge shotgun,
- and stacking of 5, 20 lb sledgehammer blows.

5.3.2 Total Magnetic Survey

The following outlines the field procedures deployed during the magnetic survey.

- a) The individual instrument components were assembled and tested.
- b) GPS waypoints were recorded at one second intervals along the magnetic data lines.
- c) The data was filtered and evaluated on the fly for quality and consistency.
- d) The raw data was saved to the Magnetometers Data logger for positioning of the data points.
- e) Post collection processing was carried out in our Sydney office.

5.4 Data Processing

The following steps were taken in the processing of the data:

5.4.1 Seismic Profiling

- a) Data was downloaded from the seismograph.
- b) Data was checked for integrity.
- c) First arrivals were picked.
- d) Refraction modelling was preformed.
- e) Tomographic modelling was preformed.
- f) The resulting image was printed in hard copy and electronic copy.
- g) Reflection processing was preformed.

5.4.2 Total Magnetic Survey

- h) Data was downloaded from the data logger.
- i) Data was checked for integrity.
- j) Data was checked for data spikes and drop-outs.
- k) Data was gridded and plotted using Surfer Software.
- l) The resulting image was printed in hard copy and electronic copy.

6 RESULTS

6.1 Reflection Seismics

The data from all energy sources is of reasonable quality, with the shotgun appearing to give less high frequency noise. This is of interest, as the explosive source would normally be expected to return the best results.

Reflection processing of the data from both sites was undertaken. The fold of the data was too low to alleviate the strong ground roll and enable the removal of refractions from the data.

A possible reflector is present in the Scotia line, but with the low fold of the data (4 to 5), and the strong ground roll it is likely to be an artefact of the processing.

6.2 Refraction Seismics

6.2.1 Endurance Site

There is evidence of only three refractors in the seismic data acquired on the Endurance site.

1. A shallow slow velocity layer, ~ 600 to 700m/sec - interpreted as recent sedimentation and topsoil, 0.5 to 5m thick.
2. A faster layer, ~ 1700m/sec – interpreted as alluvium and weathered basement material, 10 to 55m thick.
3. A fast base layer ~ 3000 to 3500m/sec – interpreted as the unweathered basement granite material.

The alluvium and weathered basement material appear to both have similar seismic velocities. Hence the boundary between the two is not delineated in the seismic line acquired.

A second approach used on the data for this site is seismic tomography. This form of data interpretation uses arrival times, and involves plotting the velocities of materials to a cross section and gridding and smoothing the data.

The tomographic section shows correlation with the results of the drill holes along this line.

Both modelled cross sections and travel time plots are presented in Appendix 3 below.

6.2.2 Scotia Site

There is evidence of only three refractors in the seismic data acquired on the Endurance site.

1. A shallow slow velocity layer, ~ 700 to 800m/sec - interpreted as recent sedimentation, alluvium and topsoil, 0.5 to 30m thick.
2. A faster layer, ~ 1200 to 1300m/sec – interpreted as Tertiary gravels, clays and sands, 1 to 30m thick.
3. A fast base layer ~ 2300 to 2600m/sec – interpreted as the weathered shale and sandstone.

Tomographic modelling was performed on this seismic line. Both modelled cross sections and travel time plots are presented in Appendix 4 below.

Both the standard refraction modelling and tomographic section show correlation with the results of the dill holes along this line.

6.3 Total Field Magnetics

6.3.1 Endurance Site

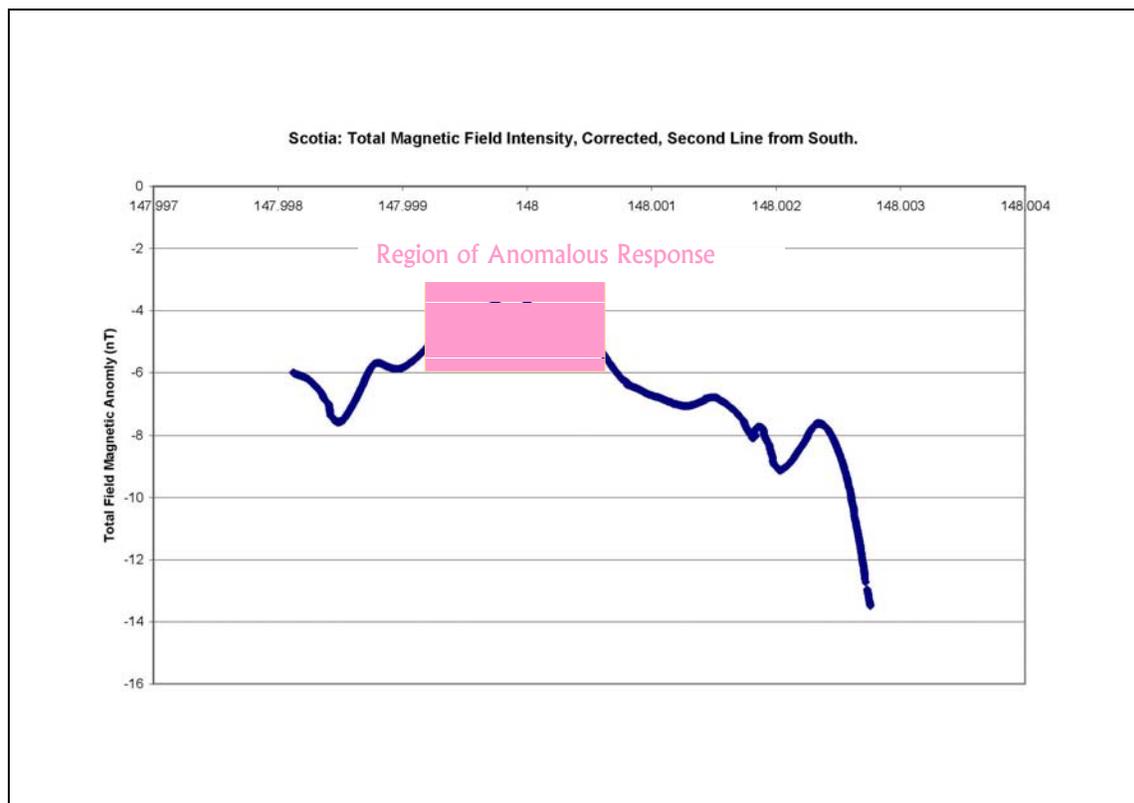
The magnetic data acquired across the Endurance site does not appear to show a mappable anomaly. The results are consistent with regional magnetic trend related to the regional geology, rather than localized geomorphologic palaeo-processes.

Gridded data plot is presented in Appendix 5 below.

6.3.2 Scotia Site

The gridded magnetic data from the Scotia site shows a subtle anomaly. This aligns with the deep lead plotted from drill results. The anomalous region is wider than the mapped deep lead at this location. An example of the response is shown below. As can be seen the response is only two nT.

Example of the magnetic response across the Scotia site:



Gridded data plot is presented in Appendix 6 below.

7 COMMENTS ON RESULT

7.1 Refraction Seismics

The interpretation of the current data set is in agreement to previous seismic work conducted on this site. The current testing programme revealed a layered model, with velocities that are similar to those found by Keunecke in the survey conducted in 1957.

Tomographic sections show isovelocity layers with sharp increases of velocity as depth increases; these are interpreted as layer boundaries. This approach appears to give a correlation with the borehole logs. More data and fully documented logs would be required to gain a definitive answer as to the advantages, if any, over traditional seismic refraction methods for either of these sites.

7.1.1 Endurance Site

The alluvium and weathered basement material appear to both have similar seismic velocities. Hence the boundary between the two is not delineated in the seismic line acquired on the Endurance site.

The unweathered basement material is not defined in the data set

The refraction seismic technique relies on the existence of a seismic velocity contrast between materials of the earth. Some limitations of the technique are:

- One requirement for successful modelling is that seismic velocities increase with depth. That there is a discrete velocity contrast present, not a zone of variation. (Department of the Army. 1979).
- Dips of layers (or subsurface features) must be in the order of 15 degrees or less (Department of the Army. 1979).
- Zones of saturated material may present with a unrealistically high velocity e.g. saturated sands and alluvium may have a recorded seismic velocity of 1500m to 2000m/sec, whilst dry unconsolidated sands and alluvium will have a seismic velocity of 350 to 600m/sec (Reynolds. 1997).
- A blind zone exists above each layer. This zone is dependent on the depth and velocity distribution (Department of the Army. 1979).
- Hidden layers may exist that cannot be detected by the use of refraction seismic techniques. These hidden layers may be present within each blind zone (Reynolds. 1997).

Also thin layers will not be detected. The thickness of the layer that can be discerned is from one quarter to one half of the transmitted wavelength (Reynolds. 1997).

The investigation at the Endurance site was hampered by a high watertable, this would increase the seismic velocity of the subsurface materials, and may be the cause of the lack of variation between the layers defined in the drilling operations.

7.1.2 Scotia Site

The interpretation of the current data set is in agreement to previous seismic work conducted on this site. The current testing programme revealed a layered model, with velocities that are similar to those found by Longman in the survey conducted in 1969. However this investigation did not define the unweathered basement material.

Tomographic modelling of these seismic lines has produced results that are in reasonable agreement with the boreholes undertaken along these lines.

The surface along the seismic line acquired on the Scotia site was a hard packed pan. The presence of the pan resulted in a higher than normal surface wave. With the offsets utilized during this phase of data collection and the high velocity ground roll reflections from deeper structures were obscured.

7.2 Total Field Magnetics

7.2.1 Endurance Site

The magnetic survey did not map the position of the deep leads on the Endurance site. Only two of the traverses crossed the entire site. Tighter line spacing and longer profile lengths may resolve an anomaly. But as stated above the results appear to be consistent with regional rather than localized geology.

7.2.2 Scotia Site

The limited survey undertaken at the Scotia site has shows a subtle anomaly. The anomaly trends in the direction of the inferred deep lead in this portion of the site. With a measured response of two nT the anomaly prove to be the result of a deep lead, but may also be the result of localized near surface processes.

8 CONCLUSIONS

8.1 Seismics

Traditional refraction modelling and interpretation do not, and have not in the past, successfully mapped the top of the weathered basement profile at the Endurance site. At the Scotia site where the top of the weathered basement has been defined, correlation with the results of drilling is fair.

Seismic tomography has enabled isovelocity regions to be mapped, at both locations, and demonstrates the presence of regions displaying steeply increasing velocity with depth. This technique has enabled a layer to be defined that correlates in part to the borehole results.

Increasing the fold of the data by employing different acquisition geometry, increased shot offsets with more internal shots, may enable processing as seismic reflection data, as well as refraction data.

Another approach that may be worth investigating is to use surface wave frequency analysis, (SASW).

The use of a shotgun seismic source proved to be successful on both sites. Good coupling was achieved and good energy transmission resulted.

8.2 Total Field Magnetics

The Endurance site may warrant a small scale data collection undertaking, to evaluate if the lack of mappable anomalies are the result of limited data, or as a result of the deep leads not having a measurable magnetic response.

The Scotia site appears to have mineralization associated with the deep leads that has a, albeit it subtle, response that will enable the surface mapping of the deep leads on this site.

9 LIMITATIONS OF REPORT

This report has been prepared for the use of **Van Dieman Mines** in accordance with general accepted Consulting practice. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for the use by parties other than the client,

the owner and their respective consulting advisors. It may not contain sufficient information for purposes of other parties or for other uses.

This report was prepared on completion of the field work and is based on conditions encountered and reviewed at the time of preparation. Alpha Geoscience disclaims responsibility for any changes that might have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

Whilst to the best of our knowledge, information contained in this report is accurate at the date of issue; conditions on the site (including the depositing and removal of contamination) can change in a limited time. This should be borne in mind if the report is used after a protracted delay.

10 APPENDIX 1 – INSTRUMENT DATA SHEETS

SEISTRONIX RAS-24 Seismic Acquisition System

TRIMBLE DGPS AG 114 Global Positioning System Receiver.

GEOMETRICS G-858 MagMapper

-Attached

11 APPENDIX 2 – LOCATION OF SEISMIC LINES AND MAGNETIC TEST AREAS

Endurance Seismic Line Layout

Scotia Seismic Line Layout

Endurance Map

Scotia Map

-Attached

(Map material provided by Van Dieman Mines)

12 APPENDIX 3 –ENDURANCE SEISMIC INTERPRTATIONS

Modelled Refraction Seismic Section

Tomographic Seismic Section

Travel Time Plot

-Attached

13 APPENDIX 4 – SCOTIA SEISMIC INTERPRTATIONS

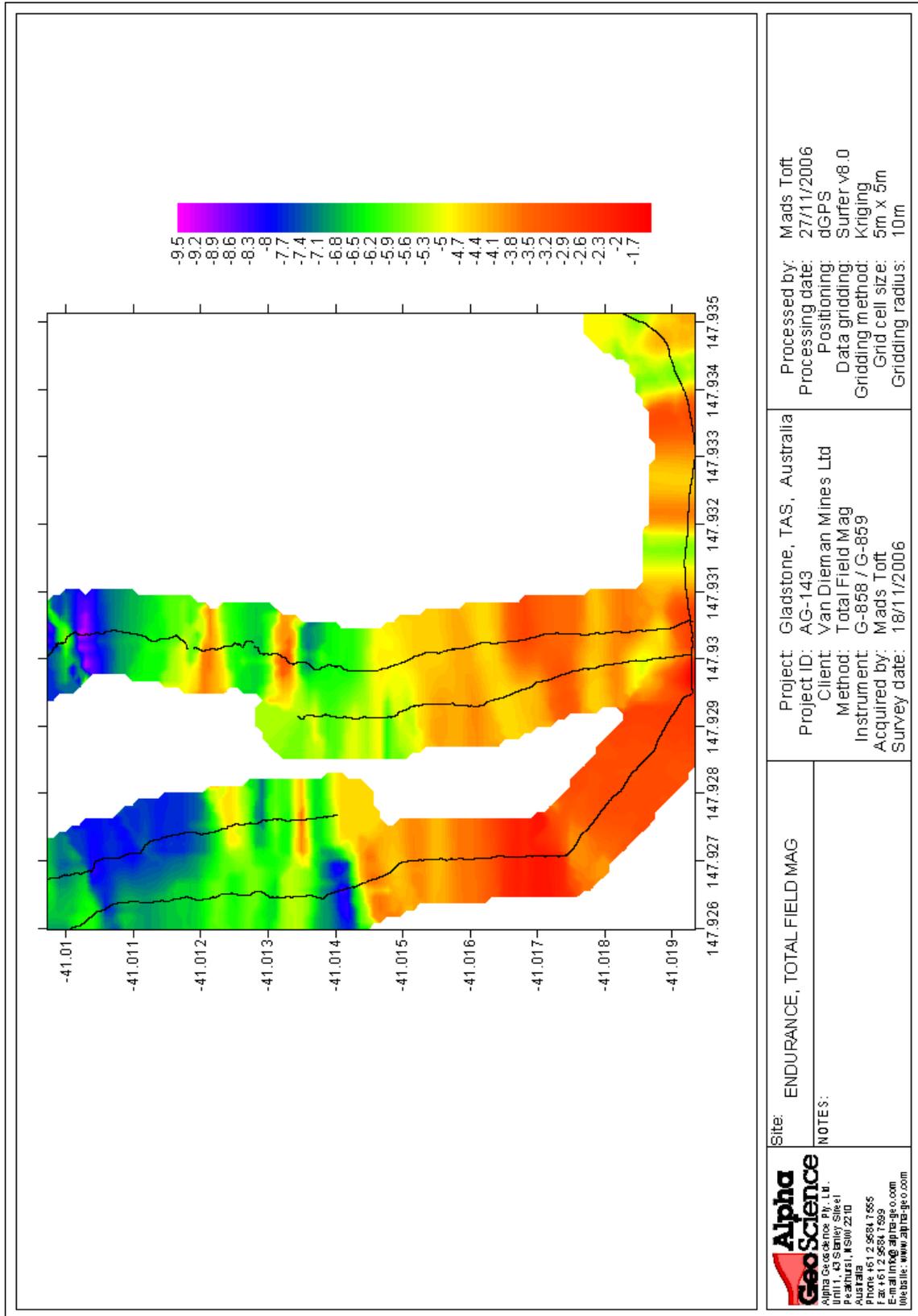
Modelled Refraction Seismic Section

Tomographic Seismic Section

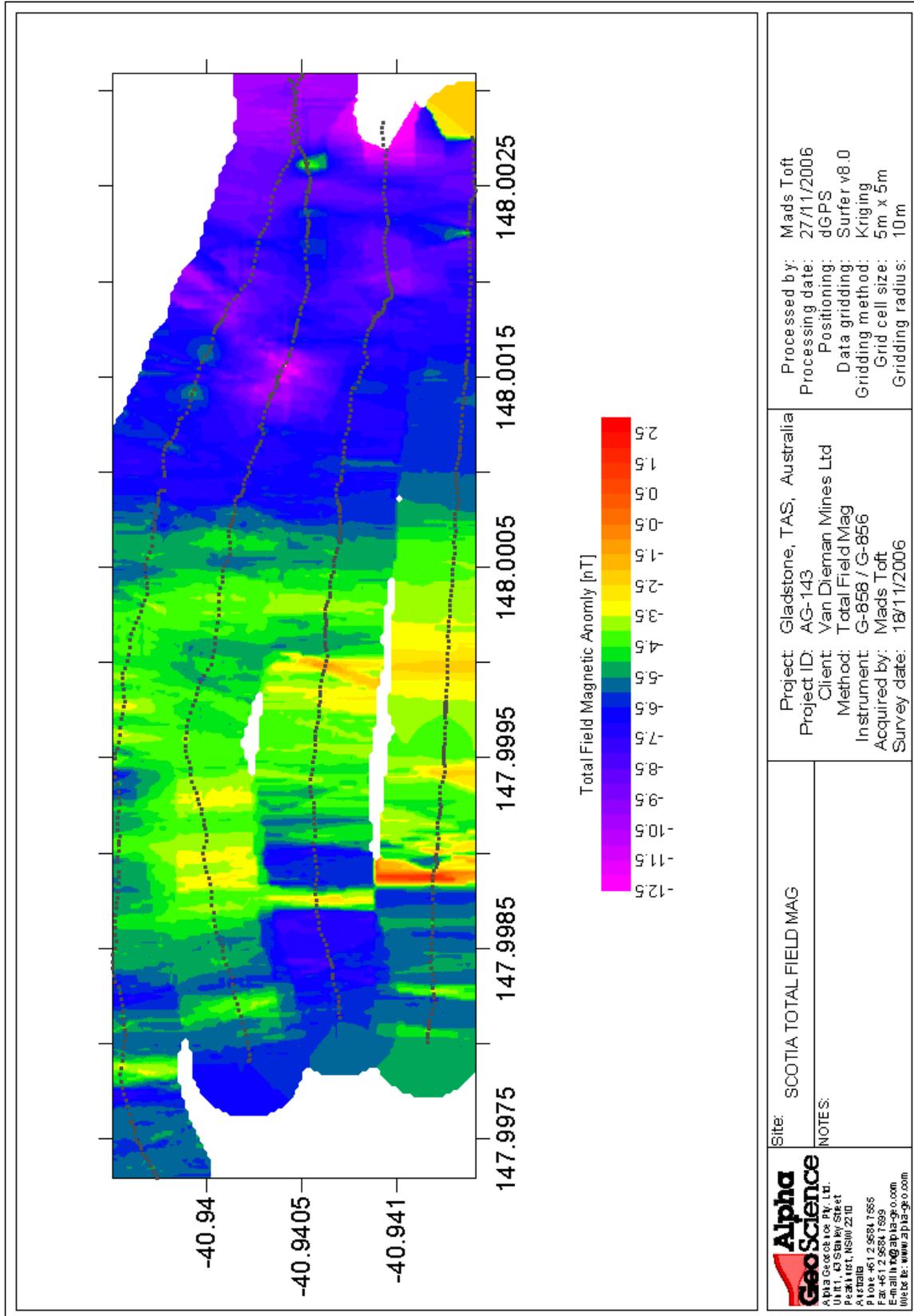
Travel Time Plot

-Attached

14 APPENDIX 5 – ENDURANCE TOTAL FIELD MAGNETIC DATA PLOT



15 APPENDIX 6 – SCOTIA TOTAL FIELD MAGNETIC DATA PLOT



16 APPENDIX 7 – ALPHA GEOSCIENCE - CURRICULUM VITAE

Alpha Geoscience was established in 1997 to offer high sensitivity geophysical tools and expertise as an alternative to intrusive investigations in the following areas:

- **Environmental Services** Including the mapping of buried structures, site assessments and the detection of chemical pollutants.
- **Ordnance Services** The location of buried unexploded ordnance (UXO), site assessments and sample surveys to determine extent of pollution. Alpha Geoscience is a member of the Defence UXO Panel.
- **Engineering Services** Assisting civil mining and construction engineers with sub surface investigations, especially where intrusive investigation is difficult and costly to undertake.
- **Forensic Geophysics** The location of buried gravesites and other buried objects for the police and other crime agencies.
- **Mining and Exploration** Assist mining and exploration companies with near surface investigations.
- **Training** Provides training courses in high-resolution magnetics, electro-magnetics, seismic refraction and ground-penetrating radar for clients who wish to undertake surveys themselves.
- **Project Management** Is an intricate part of all projects and Alpha Geoscience has expertise and experience in setting up, running and reporting on both major and minor projects worldwide.
- **Research and Development** Alpha Geoscience has been involved in running a number of research and development projects including the development of a multi-sensor geophysical instrumentation package for the horizon control of a coal-mining machine.

The types of techniques offered by Alpha Geoscience include high sensitivity magnetics, ground penetrating radar, time or frequency domain electro-magnetics, resistivity mapping and seismic refraction and reflection techniques. These services combined with the digital processing of the data to produce colour images of the site and the interpretation of the data gives high-resolution detail of the sub surface on the site. This data can be imported into Geographical Information Systems (GIS) for future reference and auditable documentation.

Alpha Geoscience also offers the services of processing and interpretation of data in Sydney with the data being downloaded from the field via the Internet.

Alpha Geoscience is based in Sydney Australia and is capable of mobilising to any part of the world with very short notice. We have experience in operations throughout Australia, North America, Europe and South East Asia.

Alpha Geoscience is offering its services and consultation so that the client obtains the best technology for the particular target being investigated. Whether it is an ordnance item or environmental pollution plumes, it has the technical expertise to provide the right solution.

17 APPENDIX 8 - REFERENCES:

Department of the Army. *Engineering and Design - Geophysical Exploration for Engineering and Environmental Investigations* (Google search identifier: EM 1110-1-1802). US Army Corps of Engineers. Washington, DC 20314-1000. 1979.

Keunecke O., *Geophysical Survey at Endurance Tin Mine, South Mount Cameron, Tasmania*. Commonwealth of Australia Department of National Development Bureau of Mineral Resources, Geology and Geophysics. 1957.

Longman M.J., *Seismic Traverse - Line 14, Great Northern Plains*. Tech. Rep. Department of Mines, Tasmania. 1969.

Reynolds J.M., *Introduction to Applied and Environmental Geophysics*, John Wiley & Sons Ltd., Chichester. 1997.

Taylor C.P. and Gunn P.J., *Geophysical Surveys Monach Tin Prospect, Tasmania*. Raw Materials And Exploration Department, The Broken Hill Proprietary Company Limited. 1965.