

Seismic Data Re-Processing Report in the Zeehan Region

Report Prepared for

**Department of Infrastructure, Energy and
Resources, Mineral Resources Tasmania**



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 **srk** consulting

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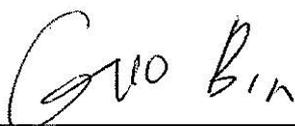
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Executive Summary

In 2009 SRK completed the reinterpretation of five Zeehan seismic lines shot in 2007, integrating the interpretation with modelling of magnetic data. The work was carried out for CREAT Pty Ltd (formerly Zeehan Zinc Pty Ltd). As part of the task, one of the seismic lines, TB02B_ZF, was reprocessed, using both reflection and scattering imaging technology to evaluate if the reprocessing could improve the seismic imaging quality. The processing results are very promising and considerably improved the structural interpretation of the seismic line. The remaining four seismic profiles (TB02b-ZA, TB02b-ZB, TB02b-ZC, and TB02b-ZD) were not reprocessed owing to a limited budget for the work funded by the CREAT.

In early August, 2010, Mineral Resources Tasmania engaged SRK to reprocess the remaining seismic reflection lines from the Zeehan area using the methods used for the CREAT project, i.e. both seismic scattering imaging and reflection imaging. The work was undertaken by Dr Bin Guo, SRK Senior Consultant and Dr Yun Wang, an SRK associate. Seismic data re-processing was completed by Dr Yun Wang and his research team (Guangming Yu and Jun Lu) from the institute of multi-component seismic technology, Beijing, China (<http://www.3d3c.com.cn>). Dr Bin Guo quality-controlled the seismic re-processing and compiled the report, and inputted geological expertise on the immediate Zeehan area, based on his previous seismic/potential field interpretation in 2009. The final report was peer-reviewed by Dr Peter Stuart-Smith.

The processing results indicate that scatter imaging processing technique generates a better model showing the subsurface geology in more detail, compared to the conventional seismic post-stack migration methods. However, there are null signals in cdps of the scatter imaging lines TB02B-ZB, TB02B-ZD and TB02B-ZF due to significant topography variations and the zigzag nature of the lines, which detracts from the reconstruction of the subsurface structures.

Action points

- Develop a 3D structural and geological model of the Zeehan region to better understand the distribution of mineralisation and lower exploration risk in the area.

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (Australasia) Pty Ltd (SRK) by Department of Infrastructure, Energy and Resources, Mineral Resources Tasmania. The opinions in this Report are provided in response to a specific request from Department of Infrastructure Energy and Resources, Mineral Resources Tasmania to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this Report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

1 Introduction

In 2009 SRK completed the reinterpretation of five Zeehan seismic lines shot in 2007, integrating the interpretation with modelling of magnetic data. The work was carried out for CREAT Pty Ltd (formerly Zeehan Zinc Pty Ltd). As part of the task, one of the seismic lines, TB02B_ZF, was reprocessed, using both reflection and scattering imaging technology by SRK associate, Yun Wang from Institute of multi-component seismic technology, Beijing, China, to evaluate if the reprocessing could improve the seismic imaging quality. The processing results are very promising and considerably improved the structural interpretation of the seismic line. The remaining four seismic profiles (TB02b-ZA, TB02b-ZB, TB02b-ZC, and TB02b-ZD) were not reprocessed owing to a limited budget for the work funded by the CREAT.

In early August, 2010, Bob Richardson of Mineral Resources Tasmania expressed an interest in engaging SRK to reprocess the remaining seismic reflection lines from the Zeehan area using the methods used for the CREAT project, i.e. both seismic scattering imaging and reflection imaging.

This report details the reprocessing procedure and final outcomes.

2 Project team

The Project was undertaken by Dr Bin Guo, SRK Senior Consultant and Dr Yun Wang SRK associate. Seismic data re-processing was completed by Dr Yun Wang and his research team (Guangming Yu and Jun Lu) from the institute of multi-component seismic technology, Beijing, China (<http://www.3d3c.com.cn>). Dr Bin Guo quality-controlled the seismic re-processing and compiled the report, and inputted geological expertise on the immediate Zeehan area, based on his previous seismic/potential field interpretation in 2009. The final report was peer-reviewed by Dr Peter Stuart-Smith.

3 Seismic Data Acquisition

3.1 Data Acquisition

A total of 5 lines of seismic data in the Zeehan region were acquired by Terrex seismic crew 401 in April and May 2007. The seismic data was originally processed by Fugro Seismic Imaging Pty Ltd in 2007. Location and survey details of the 5 lines are given in the following sections (sections 3.1-4) (Fugro Seismic Imaging, 2007).

3.2 Acquisition Parameters

Table 3-1: Acquisition parameters (Adapted from Fugro Seismic Imaging Pty Ltd, 2007)

<i>2006 Tasmanian Seismic Survey</i>	
<i>Data recorded by:</i>	Terrex seismic crew 401
<i>Date recorded:</i>	April 2007
<i>Seismic source:</i>	3 vibrators in line
<i>Source type:</i>	Paystar
<i>Vibe spacing:</i>	12.5 m pad to pad
<i>Vibe move up:</i>	Standing sweeps
<i>Sweeps per vp:</i>	2
<i>Sweep frequency:</i>	6-140 Hz
<i>Sweep type:</i>	Linear 200 ms taper
<i>Vp interval:</i>	20 m
<i>Recording system:</i>	Sercels sn 388
<i>Record length:</i>	5 sec sweep + 6 sec listen
<i>Sample rate:</i>	2 milliseconds
<i>Tape format:</i>	SEG-D 3490 zero phase
<i>Field filters:</i>	6-140 Hz
<i>Data channels:</i>	300
<i>Coverage:</i>	150 fold
<i>Geophone type:</i>	SM4 10 Hz
<i>Geophone array:</i>	12 in line over 18.3 m
<i>Element spacing:</i>	1.125 m
<i>Group interval:</i>	20 m
<i>Split spread:</i>	2990-10-vp-10-2990m

3.3 Survey Map

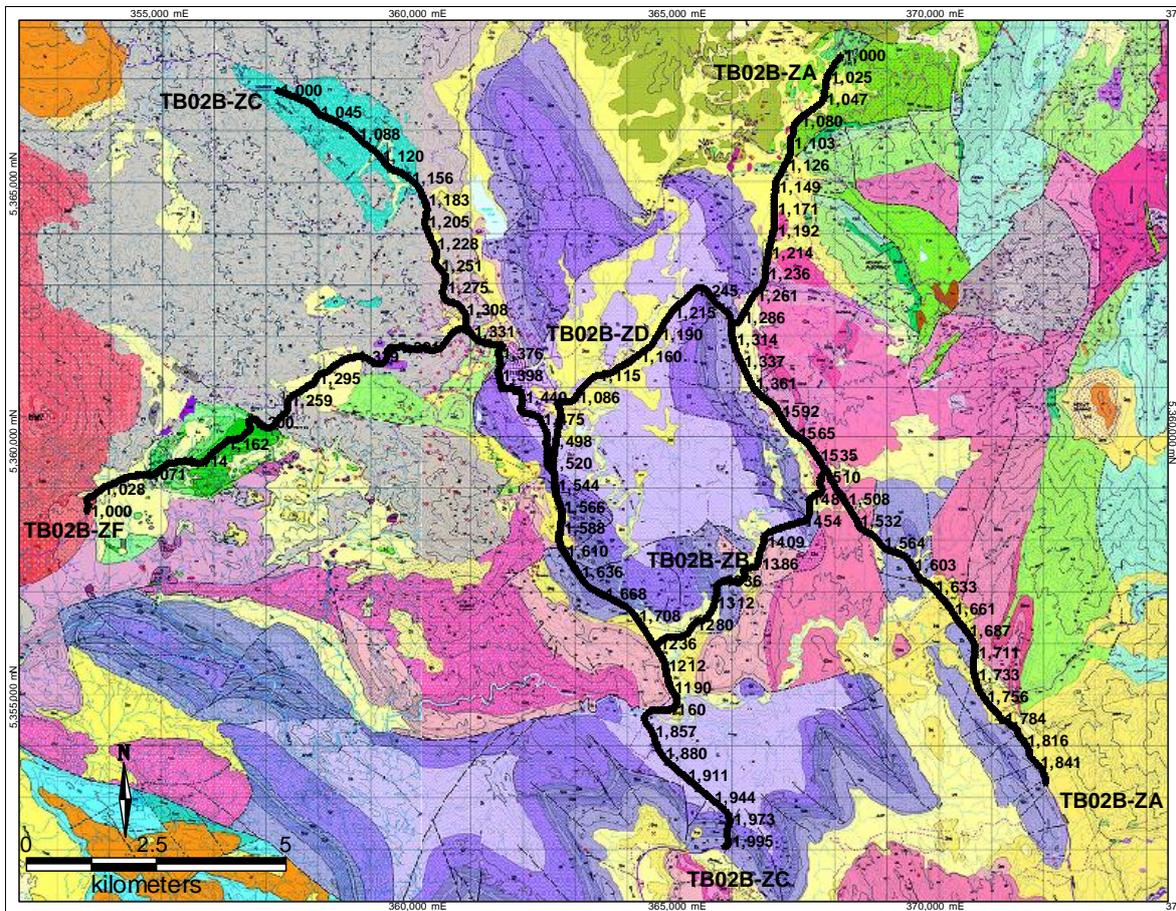


Figure 3-1: Seismic lines acquired by the Zeehan Zinc Limited in 2007, shown on the geological map

3.4 Line Summary

LINE	SP's	CDP's	Length (km)
TB02B-ZA	1000-1864	1-1642	17.28
TB02B-ZB	1160-1600	1-817	8.80
TB02B-ZC	1000-2002	1-1775	20.04
TB02B-ZD	900-1400	1-854	10.00
TB02B-ZF	1000-1572	1-966	11.46

4 Processing Workflow

4.1 Processing Methods

The seismic line data were processed using the methods used for the CREAT project in 2009, to reproduce the high processing quality. Both conventional reflection imaging with normal post-stack migration and seismic scattering imaging techniques (Yun Wang, 2009; Bancroft et. al., 1995) were applied.

4.2 Conventional Processing Sequence

Processing involved the following sequence:

- **Transcription:** Field data were converted from SEG-D format to SEG-Y format.
- **Head given and source-receiver position test:** Trace headers were extracted and compiled from the SEG-D files and the field survey report. The position of every source and receiver was examined to ensure its accuracy.
- **Seismic datum and refraction statics:** Refraction first breaks were picked using the Green Mountain Refraction Statics Delay Time Method which estimates the refractor velocities to model the weathering thickness. A Seismic Datum of 220 m above sea level was chosen.
- **Phase conversion:** Zero phases were all converted to minimum phases.
- **Deleting dead traces**
- **Depressing 50Hz electrical noise by filtering**
- **Gain recovery:** A spherical divergence gain function was used where $\text{Gain (db)} = 3.0t + 26 \text{ Log}(t) + 110$.
- **Amplitude compensation of surface consistence:** Amplitude compensation was executed based on the assumption of surface consistence between traces.
- **Q compensation:** A reverse Q filter with the following parameters was applied.

Time windows:	Q value:
0s-3.0s	100
3.0s-6.0s	150
- **Filter out correlated noises:** Through cross-correlation of traces.
- **Frequency scanning and testing:** Filtering of noise with band-pass filters in the following parameters.

Time windows:	Frequency range:
0.0s-2.0s	Low: 8Hz-12Hz
	High: 100Hz-110Hz
2.0s-4.0s	Low: 6Hz-10Hz
	High: 90Hz-100Hz
4.0s-6.0s	Low: 4Hz-8Hz
	High: 70Hz-80Hz

- **Deconvolution:** Sing two windows:

Operator	120	120	ms
Gaps	20	24	ms
Whitenoise	0.1	0.1	%
Design	0-3000	0-3000	ms

- **Filtering:** To remove high frequency noises.
- **CDP gather:** Shot records were sorted into common depth point gathers.
Nominal fold=150 CDP interval=10 m
- **Velocity analysis:** Velocity analysis comprised a 20 CDP stacked panel and was iterated 3 times jointly with the following residual statics.
- **Surface:** Surface-consistent residual statics was corrected 3 times jointly with the upper velocity analysis.
- **DMO:** Log stretch DMO using Hale algorithm.
- **F-X domain de-noise:** Depression of random noises in F-X domain.
- **Post-stack migration:** 2-D post-stack migration in the F-X domain.
- **Filtering:** Application of band-pass filters as follows:

Time windows:	Frequency range:
0s-3s	Low: 8Hz-10Hz High: 90Hz-100Hz
3s-6s	Low: 4Hz-8Hz High: 60Hz-70Hz
- **Trace balance:** Trace balance is a procedure of energy balance with time window 500 ms.
- **Depress tilt linear noises:** Filtering out tilt linear noise in the F-K domain.
- **Output:** Saving the processing results into files with SEG-Y format.

4.3 Scattered Wave Imaging Sequence

Scattered wave migration was executed after pre-stack processing, following the four steps:

- Sorting of common scatter points (CSP) gathers based on the equivalent-offset method (Bancroft, 1995).
- Analysis of velocity in the CSP gathers to obtain a velocity model.
- Stacking of all scattered waves from the same CSP at a time variant radius and obtaining imaged profiles.
- Execution of trace energy balance processing, with a time window of 1000 ms.

4.4 Final Displays

Displays of final and migrated stacks were exported as CGM+ format files with CDP coordinates, a horizontal scale of 1: 20,000 (50.8 traces per inch), and a vertical scale of 5 cm/sec.

PDF files were also created for a quick review of the processed seismic data.

4.5 Archives

Final migrated stacks, final stacks, and a final scattered wave imaging profile for each line were written into file in SEG-Y format. Details of the headers and files are given below.

Trace headers summary:

BYTE	DESCRIPTION
009-012 (32-bit)	Elevation
181-184 (32-bit)	CDP x (easting)
021-024 (32-bit)	CDP number
185-188 (32-bit)	CDP y (northing)
115-116 (16-bit)	Number of samples
117-118 (16-bit)	Sample interval (unit: ms)

Table 4-1: File Summary

Line Number	Final stack SEG-Y files	Post-stack migration files	Scattered wave imaging files
TB02B-za	TB02B-za-stk.sgy	TB02B-za-mig.sgy	TB02B-za-scatter.sgy
TB02B-zb	TB02B-zb-stk.sgy	TB02B-zb-mig.sgy	TB02B-zb- scatter.sgy
TB02B-zc	TB02B-zc-stk.sgy	TB02B-zc-mig.sgy	TB02B-zc- scatter.sgy
TB02B-zd	TB02B-zd-stk.sgy	TB02B-zd-mig.sgy	TB02B-zd- scatter.sgy
TB02B-zf	TB02B-zf-stk.sgy	TB02B-zf-mig.sgy	TB02B-zf- scatter.sgy

5 Conclusions

The conventional seismic processing and scattered wave imaging were applied to 5 seismic lines acquired in the Zeehan region in 2007. The processing results indicate that scatter imaging processing technique generates a better model showing the subsurface geology in more detail, compared to the conventional seismic post-stack migration methods. However, there are null signals in cdps of the scatter imaging lines TB02B-ZB, TB02B-ZD and TB02B-ZF due to significant topography variations and the zigzag nature of the lines, which detracts from the reconstruction of the subsurface structures.

6 Recommendations

The new images provide an excellent basis for a new detailed interpretation and development of a 3D structural and geological model of the Zeehan region. This would greatly assist in understanding the distribution of mineralisation and lowering exploration risk in the area.

7 References

- Yun Wang, Junjie Yin and Bin Guo, The numerical simulation and imaging of seismic scattered wave applied to base metal exploration, *Exploration Geophysics*, 40(4): 320-324, 2009.
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