ACQUISITION & PROCESSING OF THE 2013 ALBANY-FRASER SEISMIC SURVEY

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Acquisition and Processing

Acquisition
• Logistics
• Recording Parameters
• Field QC and data management

Processing
• Hardware and Software
• Processing Overview

Testing Program

Data availability
Acquisition

Logistics

672 km deep seismic reflection data – 4 lines

Acquired 23 April – 6 June 2012. Other data acquired: MT, Gravity
Acquisition

Logistics - Camp
Acquisition

Recording – IVI Hemi-50 Vibes on AF2
Acquisition

Recording - Dogbox
Acquisition

Logistics - Traffic Control

28 APR 2012
Acquisition

Logistics - Traffic Control
Acquisition

Recording - Planting geophones

28 APR 2012
Acquisition

Recording - Picking up geophones
Acquisition

Recording - Pulling in cable
Acquisition

Recording - Vibes on AF3
Acquisition

Recording – Loading cables and geophones at end of survey
Acquisition Parameters

- 3 IVI Hemi-50 vibes
- 15 m pad-pad, 15 m moveup
- VP interval 80 m
- 300 channel
- 75 fold
- 20 s @ 2ms
- Group interval 40 m
- 12 phones 3.3 m apart
- 3 x 12 s sweeps
- 6 - 64 Hz
- 10 - 96 Hz
- 8 - 80 Hz

Albany-Fraser Orogen Acquisition and Processing Data Release, April 2014
Acquisition

Recording – Acquisition Parameters – Source array

3 Vibes - 60 m centred between pegs : 15 m pad/pad :15 m move up

Vibe Point (VP) Interval: 80 m
Acquisition

Recording – Acquisition Parameters – Source array

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Vibe Point (VP) Interval: 80 m
Acquisition

Symmetrical split spread, offset: minimum 20 m, maximum 6 km
300 channels at 40 m intervals, 75 nominal fold data
80 m VP interval
Symmetrical split spread – shot record

Back crew

Vibrators

12 km Live Spread

Front crew

Offset (km)

Time (s)
Acquisition

Field QC and data management
Daily - field data on USB disk loaded on QC laptop
Shot records viewed
Brute stack created

At end of line – LTO tapes created containing all data
Total data volume from Albany-Fraser survey – 93.8 GBytes
Acquisition

Field QC and data management

Brute stack
Processing

Hardware and Software

Field - HP Elitebook laptop

- 8 GB memory
- 1 x quad-core CPU (4 cores)
- Redhat Linux - Paradigm Echos software

Office – HP DL585 rack mount server

- 384 GB memory
- 8 x dual-core processors (16 cores)
- Redhat Linux – Paradigm Echos software
- Some testing on SeismicUNIX
Processing

Overall Goal

To produce an image of the sub-surface by

Enhancing and correctly positioning reflections and

Reducing undesired energy (noise)
Processing

Crooked line geometry
Processing

Crooked line geometry
Processing

Crooked line geometry
Processing

Crooked line geometry – CDP sort - sort data into CDP bins
Processing and interpretation

Refraction Statics

Corrects for variable time delays in the regolith
Processing and interpretation

Refraction Statics

Corrects for variable time delays in the regolith

Refractor model displayed on top of section plots

Indicative of regolith thickness, but not exact

Primary use is for statics corrections to seismic data
Processing and interpretation

Spectral Equalisation

Noise  Reflections  AF3 shot 100
Processing and interpretation

Spectral Equalisation

Suppresses low frequency noise
Processing and interpretation

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Suppresses low frequency noise
Processing and interpretation

Normal Moveout (NMO)
Corrects for source-receiver offset differences
Velocity analysis
Processing and interpretation

Normal Moveout (NMO)
Corresponds to source-receiver offset differences
Velocity analysis
Processing and interpretation

Dip Moveout (DMO)

Corrects for dipping reflectors

Allows stacking of different dips at same location

\[ T^2 = T_0^2 + X^2 \cos^2 \alpha/V^2 \]

Stacking Velocity (m/s)

<table>
<thead>
<tr>
<th>Dip (degrees)</th>
<th>0</th>
<th>30</th>
<th>60</th>
<th>90</th>
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<tbody>
<tr>
<td>6000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12000</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>18000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24000</td>
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<td>30000</td>
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<tr>
<td>36000</td>
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</tbody>
</table>

Need Dip Moveout Correction (DMO)
Processing and interpretation

Dip Moveout (DMO)
Corrects for dipping reflectors
Allows stacking of different dips at same location
Processing and interpretation

Common midpoint stack
Improves signal to noise ratio by $\sqrt{\text{fold}}$
Fundamental idea behind CDP method

CDP gather is stacked (summed) into one trace
Migration of a dipping reflection

Energy reflected from a dipping event is plotted directly beneath the geophone station that it is received.
Migration of a dipping reflection

Before migration
Migration of a dipping reflection

Correct migration
Migration of a dipping reflection

Over migration stretches and smears reflections

Over migration
Energy reflected from a point reflector (differactor), e.g. fault edge is plotted directly beneath the geophone station that it is received.
Migration – collapse diffractions

Before migration
Migration – collapse diffractions

Correct migration
Migration – over migration

Over migration
Processing

Stack

Migration
Processing

Final Migration

12GA-AF1
Processing

Final Migration

12GA-AF2
Processing

Final Migration

12GA-AF3
Processing

Final Migration

12GA-T1
Testing Program
Testing Program

AF3

4.5 Hz geophones vs 10 Hz geophones

Linear sweeps vs non-linear sweeps
## Testing Program

<table>
<thead>
<tr>
<th>Test</th>
<th>VP Range</th>
<th>Sweep Type</th>
<th>Sweep Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10675.5 – 10910.5</td>
<td>Linear</td>
<td>3-48 Hz 3-24 Hz 3-16 Hz</td>
</tr>
<tr>
<td>2</td>
<td>10824.5 – 10848.5</td>
<td>Linear</td>
<td>3-64 Hz 10-96 Hz 8-80 Hz</td>
</tr>
<tr>
<td>3</td>
<td>10824.5 – 10844.5</td>
<td>Non-linear - 9dB/Oct</td>
<td>3-48 Hz 3-24 Hz 3-16 Hz</td>
</tr>
<tr>
<td>4</td>
<td>10824.5 – 10833.5</td>
<td>Non-linear - 9dB/Oct</td>
<td>3-64 Hz 10-96 Hz 8-80 Hz</td>
</tr>
</tbody>
</table>
Testing Program

AF3

4.5 Hz geophones vs 10 Hz geophones

Linear sweeps vs non-linear sweeps

Results - Existing parameters as good as other tests

- Plan future surveys using existing acquisition parameters

Eucla-Gawler survey since collected – extending from AF3 across Eucla Basin to the Gawler in South Australia.
Summary

Albany-Fraser seismic lines provide good images of the entire crust over the Yilgarn – Albany-Fraser – Eucla regions and provides insights into the structural relationships between the terranes.

Data available from Geoscience Australia


Albany-Fraser Orogen Acquisition and Processing Data Release, Perth WA, April 2014