

Project C7 - Curnamona Craton Deep Seismic Reflection Survey

The Project

This is a predictive mineral discovery Cooperative Research Centre (pmd*CRC) collaborative project between the pmd*CRC, Primary Industry and Resources SA, Office of Minerals and Energy Resources (PIRSA) and Geoscience Australia (GA). The project is funded by PIRSA and pmd*CRC with logistical and in-kind support from Geoscience Australia.

In the early stages of planning, the pmd*CRC and AMIRA prepared a project proposal that sought industry contributions and collaboration to a larger scoped Curnamona project, to allow this larger, more regionally focused, project to run. This AMIRA proposal was unsuccessful and a cut-down version of the Curnamona proposal was prepared.

The Curnamona project involved the collection of regional deep seismic reflection data along a 120 km east-west orientated seismic traverse as shown in the maps below (Figures 1 and 2). Gravity data was also collected along the seismic traverse.

Torrential rain in 2003 forced the cancellation of the initial Curnamona seismic survey after only 40 km of seismic was acquired. The collaborating parties reviewed the project and, with the injection of additional funds that allowed the collection of additional line kilometres, completed the Curnamona seismic project in 2004.

The final line kilometres of seismic recorded as part of the Curnamona Craton Deep Seismic Reflection Survey was 195 km. This is shown in Figure 2.

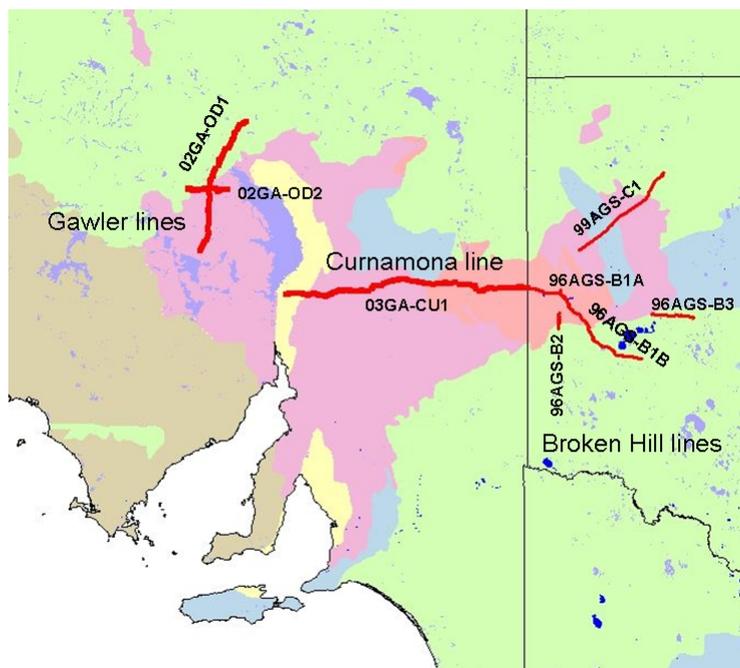


Figure: Map of SA showing the location of the Curnamona deep seismic reflection survey in relation to the Gawler and Broken Hill seismic traverses.

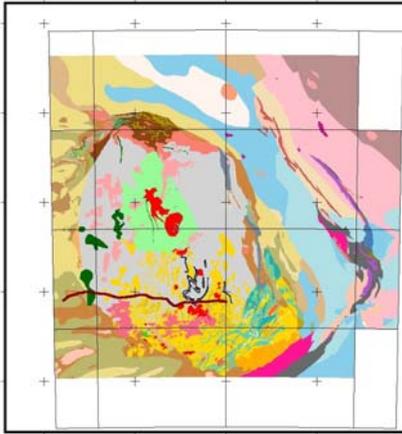


Figure: Geological map of Curnamona region, showing the location of the Curnamona deep seismic reflection survey within the Curnamona region. To download a larger version of this map - click [curnamona_seis_map.jpg](#): (file 355kB)

The Project Parties

The parties involved in this project are:

- Primary Industry and Resources SA, Office of Minerals and Energy Resources (PIRSA),
- predictive mineral discovery Cooperative Research Centre (pmd*CRC), and
- Geoscience Australia (GA).

Visionary Goal

Reflection seismic data will be used to make a significant impact on Australia's understanding of the Meso-palaeoproterozoic basement architecture of the Curnamona Craton, South Australia. The seismic data will be used to constrain basement structure of the Curnamona Province and cratonic nucleus and provide implications for hydrothermal fluid flow and Pb-Zn and iron oxide Copper-Gold (IOCG) mineralisation.

Project Background

The Curnamona Craton of South Australia is a poorly exposed yet well mineralised province that to date has failed to deliver a major deposit in spite of significant encouragement from discoveries including the Hunters Dam Zn-Pb prospect and the Portia Cu-Au prospect.

Much of the Meso-palaeoproterozoic sequences that host the mineralisation are weakly metamorphosed and shallowly dipping in contrast to the exposed parts of equivalent sequences in the Broken Hill Block to the east. The lack of exposure has meant that there is a poor understanding of the basin and explorers have had to rely on magnetic and gravity data analysis and interpretation that have limitations in this particular low-grade terrane.

Seismic data offers to deliver the required step change in understanding of the controls on the architecture of the sequences and the contained mineralisation in the Curnamona Craton required to drive a new phase of exploration under cover in South Australia.

Geoscience Australia, in conjunction with the Office of Minerals and Energy Resources, South Australia, had scheduled a seismic survey in the Gawler Craton centred over Olympic Dam that was to commence in late July 2003 and will take approximately one month to complete. For more information on the Gawler Seismic, please check out:

- http://www.pir.sa.gov.au/pages/minerals/geology/gawler/gc_sop.htm.

There was a window of opportunity to conduct an additional seismic survey over the Curnamona Craton by running them sequentially. The Curnamona Line could be done for effectively half price because of the significant savings through piggybacking on the Gawler seismic work. Acquisition costs for the Curnamona Craton seismic work would be significantly reduced through savings made in the setup costs and mobilisation and demobilisation of people and equipment, which significantly reduce the marginal cost of any additional seismic work.

Project Overview

The Proterozoic Curnamona Province contains the Broken Hill lodes and a number of significant Iron-Oxide Cu-Au (IOCG) deposits. Both styles of deposit are believed to be controlled by extensive deep fracturing. Surface mapping and geophysical interpretation through the area has allowed a structural history to be developed, however repeated reactivation of structures makes interpretation at the surface difficult. The crustal structure obtained from the seismic data will contribute important information about basement architecture, and hopefully basin architecture. It is intended that the data be used to enhance exploration investment and targeting strategies.

The proposed seismic work is to be carried out within a framework of an ongoing program of seismic data acquisition initially across the Curnamona Province, and eventually southern Australia. The resultant extensive transects across the Curnamona Province and surrounding Neoproterozoic 'Delamerian mobile belts' will enhance the geological and metallogenic framework, and help our understanding of the crustal evolution of southern Australia.

Initially, the program will focus on the prospective Palaeoproterozoic Curnamona Province which contains the Broken Hill lodes and a number of significant IOCG deposits. Both styles of deposit are expected to be controlled to a greater or lesser degree by extensive fracturing. Outcrop is poor, but a combination of surface mapping and geophysical interpretation has allowed solid geology maps to be constructed and a structural history for the area to be interpreted with a moderate degree of success, however, repeated reactivation of structures makes interpretation at the surface difficult.

This first deep seismic profile within the region will contribute important information about basement architecture, and hopefully basin architecture. Recent geochronology ties the Curnamona Province to Mount Isa Block, which shares the attributes of world class Pb-Zn mineralisation, and lesser but important IOCG mineralisation. It is expected that a full seismic transect across the Curnamona Province will prove of

similar value to the traverse across the Eastern and Western Successions. It is intended that the data be used to enhance exploration investment and targeting.

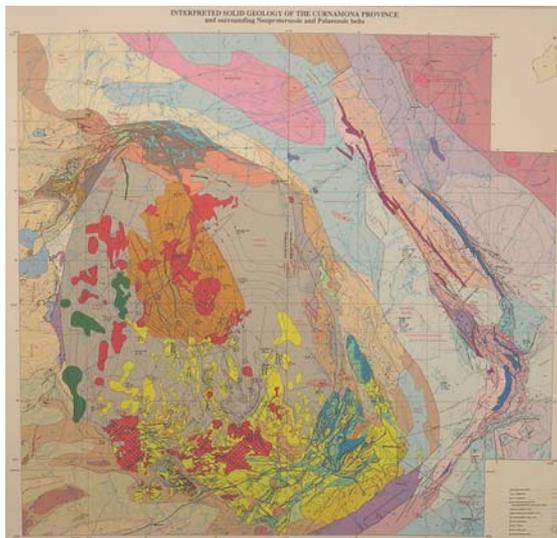
The project aims to provide the potential for a breakthrough in understanding the relationship between crustal structure, orogenesis, and mineralisation in the Curnamona Craton. To this end, an experienced team of geophysicists and geologists from Geoscience Australia and the Office of Minerals and Energy Resources, South Australia will be responsible to plan, acquire, process and interpret the seismic data.

The proposed Curnamona seismic programme consists of acquiring a single east-west orientated deep seismic reflection traverse as shown in the map above (Figure 1). The eastern end of the traverse is located near the SA/NSW border where it ties to the 1996 Broken Hill deep seismic reflection traverse. From this point, the Curnamona seismic traverse heads westward following shire roads and station tracks. The seismic traverse, as planned, passes near the mines of Kalkaroo and Honeymoon. The total length of line to be acquired as part of the original project was approximately 120 km. Figure 2 (shown above) shows the final line length collected and a possible future westwards extension (dotted line) that would investigate the relationship of the Curnamona Craton to the Adelaide Geosyncline.

The final location was determined after consultation with the local land owners and an analysis of topographical constraints.

Geological Information

The reader is referred to PIRSA's web site on the Curnamona Craton for descriptions of the regional geology and geological units.



Photograph of the PIRSA/GA/GS NSW **Interpreted Solid Geology of the Curnamona Province and surrounding Neoproterozoic and Palaeozoic belts** map. To download a larger version of this photograph - click [Curnamona Province Map](#): (file 1663kB)

A map of the geology of the Curnamona Province is also available for downloading from PIRSA's web site.

- <http://www.pir.sa.gov.au/dhtml/ss/section.php?sectID=825>

Seismic Objectives

The objectives of the Curnamona Deep Seismic Survey are to:

- Determine the depth, geometry and distribution of the Meso-Proterozoic basement, and unconformably overlying Neoproterozoic, Cambrian, Mesozoic and Tertiary sediments,
- Determine the geometry, extent at depth and crustal significance of major structures,
- Determine which structures controlled the original volcano-sedimentary basin geometry and the changes in sedimentary and volcanic facies across the region and which offset stratigraphy,
- Investigate the geometry of known and potential major fluid conduits and determine their role in the development of a) hydrothermal IOCG deposits (eg. Benagerie Ridge, Portia), and b) growth faults controlling potential syngenetic Pb-Zn metal deposition. The principal objective being vectoring to economic mineralisation under areas of barren cover.
- Continue the seismic section westward from the present Broken Hill section, with the view of eventual east-west continuation across the Adelaide Geosyncline and the Gawler Craton.

The Activities

This project involved the acquisition, processing and interpretation of deep seismic reflection data across the Curnamona Craton, South Australia. The seismic traverse crosses the eastern half of the Curnamona Craton (Figures 1 and 2 above). The seismic traverse started at the SA/NSW border and extends for 195 km to the west to the western edge of the shallower Meso-palaeoproterozoic basement that is mapped on the magnetics and into the middle of the regional gravity low. It passes the Kalkaroo, Honeymoon and Hunters Dam mineral prospects and as well as crossing several basement structures. The seismic traverse then crosses the western margin of the Curnamona Craton and into the Adelaide Geosyncline (possible future extension shown by dotted line, Figure 2).

The seismic traverse is referred to as 03GA-CU1.

The seismic traverse followed existing roads and station tracks. Seismic experimentals were undertaken at the start of the traverse to determine data acquisition parameters.

Activities identified as part of the Curnamona project were to:

- Undertake a regional seismic survey in the Curnamona Craton, SA for the pmd*CRC pursuant to ANSIR proposal 03-02R (see above).
- Undertake in-field seismic data QA/QC to assist in field data acquisition parameters.
- Undertake preliminary processing of the seismic field data on-site for data acquisition QC purposes.
- Produce a Field Operations Report.

Key Deliverables

The key deliverable's are:

- Digital seismic data for a deep seismic reflection traverse located within the Curnamona Craton.
- Seismic sections as final stack section and migrated section (in both paper and digital formats).
- Interpretation of the above seismic section.
- Final report describing the acquisition, processing procedure and interpretations.

It is also hoped that one or more scientific paper outlining geological interpretations and implications will be prepared and published once the confidentiality period has expired.

Project Leader

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Key Staff: The following staff will contribute to the project on an as required basis. Additional staff will contribute as needed.

- Stuart Robertson (PIRSA),
- Russell Korsch (pmd*CRC @ GA),
- Andrew Shearer (PIRSA) and
- Dave Johnstone (pmd*CRC @ GA and ANSIR).

Supporting Documentation

AMIRA Proposal

- [AMIRA Proposal.pdf](#): Click here to download the AMIRA Proposal.

ANSIR Proposal: The project is further described in ANSIR proposal 03-02R.

- [ANSIR Proposal 03-02R.pdf](#): Click here to download the ANSIR Proposal.

Data Confidentiality Period

Confidentiality began on the date of the signing of the initial agreement and ends on the date fifteen (15) months after the completion of data collection of the Project Raw Data in the Project or at an earlier date if agreed to by the parties.

The date of completion of data collection of the Project Raw Data is 11 July 2004, hence, confidentiality nominally expires on 11 October 2005 unless an earlier time is agreed.

At the end of the confidentiality period all Intellectual Property becomes public domain.

For the purpose of this project there will be free exchange of data between the parties as listed above in the Project Parties. This activity is not deemed to be commercialising. ANSIR agrees to allow the parties to publish results using these project data with due acknowledgement of ANSIR's involvement.

Outputs and Ownership

- Final seismic sections (stack and migration) of the seismic reflection traverse : PIRSA, pmd*CRC and GA.
- A set of field tapes archived and stored in Geoscience Australia data repository - ANSIR through Geoscience Australia and PIRSA.
- A set of processed tapes (of final stack and migrated stack) archived and stored in Geoscience * Australia data repository - ANSIR through Geoscience Australia and PIRSA.
- Interpretations of the above seismic reflection sections - PIRSA, pmd*CRC and GA.
- Various reports and papers will be prepared as a result of the research - PIRSA, pmd*CRC and/or GA as determined by levels of research input.

Results

Results are divided into the following sections

- Seismic acquisition related, including surveying data, operations report and related material,
- Digital Seismic data of both stacked and migrated sections in SEG-Y format (Note: Raw shot-ordered data can be obtained from Geoscience Australia, see below for contact details)
- Images of both stacked and migrated sections,
- Gravity data along the seismic traverse,
- Images of interpretation of seismic data as of 4 March 2005.
- Images of final interpretation of seismic data as of 11 October 2005.
- Reports, including documents, posters and talks, prepared as part of the project.
- Material for the Curnamona Seismic workshop meeting (date TBA but planning a meeting in December 2005).

Seismic acquisition related

The Curnamona deep seismic reflection survey operations report titled **Curnamona, SA, 2003 & 2004 seismic survey (L164) operations report**, has been produced,

though not released as yet. A draft copy of this report is attached - for sponsor use only.

- [L164_ops_rep.pdf](#): Click here to download the draft operations report.

Curnamona Traverse CDP coordinates: The surveying coordinates for the CDP (Common Depth Point) line, in GDA94 - MGA94 eastings and northings are given in the text file `cdp_03_04ga-cu1.txt`.

- [cdp_03_04ga-cu1.txt](#): Click here to download the CDP coordinates file.

Digital Seismic data

For copies of the raw shot-ordered data, please contact
Mr Tim Barton,
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