Geological interpretation of deep seismic reflection line 11GA-SC1: Narryer Terrane to Southern Carnarvon Basin

Russell Korsch, M. Doublier, S Romano, S. Johnson, A. Mory, L. Carr, Y. Zhan & R Blewett
Aims of the Southern Carnarvon seismic survey

Architecture of the Southern Carnarvon Basin

Potential of Byro Sub-basin for structural and stratigraphic hydrocarbon traps

Architecture and deep structure of Archean Narryer Terrane - contains the oldest known rocks in Australia and detrital zircons up to 4404 Ma: oldest known terrestrial material on Earth

Relationships between basement units: Archean Narryer Terrane, Archean to Proterozoic Glenburgh Terrane of the Gascoyne Province, and Mesoproterozoic to Neoproterozoic Pinjarra Orogen

NOTE: Line acquired mostly on outcrops of Southern Carnarvon Basin and Narryer Terrane
Surface geological control – Yaringa 1:250K map sheet
Surface geological control – Byro 1:250K map sheet

- Hanging wall anticline
- Southern Carnarvon Basin
- Badgeradda Basin (MDA ca. 1080 Ma)
- Narryer Terrane
Seismic Line 11GA-SC1 across the Southern Carnarvon Basin
Southern Carnarvon Basin - stratigraphy

From: Mory and Backhouse (1997)
Southern Carnarvon Basin

Display with no vertical exaggeration
Byro Sub-basin interpretation

Byro Sub-basin

GSWA Ballytharra 1

CDP
10 000
9 000
8 000
7 000
6 000

Permian
Ordovician-Devonian
Fault
Base Cenozoic
Base Coyrie Formation
Base Keogh Formation
Base Callytharra Formation
Base Lyons Group
Base Kopke Sandstone
Base Dirk Hartog Formation
Base Tumblagooda Sandstone
Base Badgeradda Group

0
25 km

Line 11GA-SC1

Y:H=1:5.3

© Commonwealth of Australia (Geoscience Australia) 2013
Woodleigh impact structure

From Iasky et al. (2001)
Note: VE = x4

Woodleigh impact structure

Impact structure ~51 km diameter
Summary of the Southern Carnarvon Basin

Seismic line 11GA-SC1:
Crossed Gascoyne Platform and Byro Sub-basin

Byro Sub-basin

- two relatively thick half graben
- bounded by west-dipping faults
- two distinct sedimentary successions separated by angular unconformity are present in both half graben
- known source rocks present

On the Gascoyne Platform the seismic line crosses southern part of Woodleigh Impact Structure
Basement Terranes

Southern Carnarvon Basin

Glenburgh Terrane

ESZ

Pinjarra Orogen (subsurface)

Barrer Terrane

BG = Badgeradda Group   ESZ = Errabiddy Shear Zone   GT = Glenburgh Terrane
Southern Carnarvon Basin - well imaged
Moho - varies from 30 km to ~40 km depth
Crust – variable reflectivity, mostly only moderate to low
Narryer Terrane - dominated by reflections with apparent dip to west
Southern Carnarvon Basin

Narryer Terrane

Thooloroy Fault

Meeberie Fault

Valgar Fault

Cargarah Shear Zone

Narryer Terrane

Southern Carnarvon Basin
Narryer Terrane
Combined 11GA-SC1 and 10GA-YU1
Basement terranes under Southern Carnarvon Basin

GSWA Woodleigh 1:
Gneissic granite sampled in Woodleigh Impact Structure
Preliminary SHRIMP dates:
  Magmatic - ca. 1300 Ma
  Metamorphic - ca. 1195 Ma

Pinjarra Orogen:
Deformation, metamorphism & magmatism
ca. 1080 Ma to 990 Ma

Glenburgh Terrane:
ca. 2555 Ma to ca. 1945 Ma
(+ younger events)

Narryer Terrane:
ca. 3730 Ma to ca. 2620 Ma
(+ younger rocks)
Aeromagnetic image: Interpretation of key faults and shear zones beneath Southern Carnarvon Basin

East
Narryer Terrane
Badgeradda Basin
Errabiddy Corridor
Glenburgh Terrane
- Carrandibby Inlier
Pinjarra Orogen
West
Southern Carnarvon seismic line – 11GA-SC1
Gravity forward modelling
(James Goodwin)

Two layer model

Three layer model

Domains assigned densities

Density subdivisions within Narryer Terrane
Final gravity forward model

RMS = 3.45

- Southern Carnarvon Basin
- Paradise Zone 2.75
- Pinjarra 2.77
- Adana Fault 2.85
- ESZ 2.70
- Narryer 2.85
- Darling Fault 2.40
- Badgeradda 2.65
- Amphibolite/granulite facies felsic rocks
- Narryer 2.65
- Lower Crust 2.80
- Upper Mantle 3.30

© Commonwealth of Australia (Geoscience Australia) 2013
Possible change in polarity of eastern boundary of Pinjarra Orogen in the north?

- Industry seismic lines
Southern Carnarvon seismic line – 11GA-SC1
Summary

Southern Carnarvon Basin – two deep half graben (>5600 m) bounded by reactivated crustal-scale faults

Narryer Terrane – dominant structure has apparent dips to west

Basement architecture in vicinity of terrane triple junction (Narryer-Glenburgh-Pinjarra) now clarified

Darling-Darling North Fault – possible suture between Pinjarra Orogen and West Australian Craton

Change in trend of Errabiddy Shear Zone – sinistral movement on Darling North Fault

Phone: +61 2 6249 9111
Web: www.ga.gov.au
Email: Russell.Korsch@ga.gov.au
Address: Cnr Jerrabomberra Avenue and Hindmarsh Drive, Symonston ACT 2609
Postal Address: GPO Box 378, Canberra ACT 2601