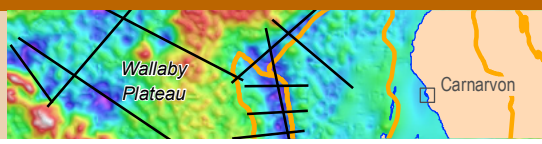
Australian Government
Geoscience Australia

AUSGEO news
ISSUE 94 June 2009

Southwest Margin surveys completed

Surveys investigate basin structure, hydrocarbon potential and marine habitat



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Two significant offshore data acquisition surveys along Western Australia's continental margin (*AusGeo News 92*) were recently completed by Geoscience Australia. They form part of the agency's ongoing collection of fundamental pre-competitive data and information to understand Australia's offshore frontier basins, and assist with planning and management of Australia's marine environments. These datasets will:

- support assessments of the petroleum potential of offshore frontier sedimentary basins located along Western Australia's continental margin
- underpin any subsequent petroleum acreage release in the area
- assist with planning and management of these marine environments.

Both surveys are part of Geoscience Australia's Offshore Energy Security Program which commenced in 2006 and extends to 2011. The Program has funding of $75 million over this period to provide geoscience data and information to help stimulate exploration for petroleum resources in Australia's frontier offshore areas, and contribute to the increasingly vital quest to find a new oil province (*AusGeo News 90*).

The seismic survey involved the collection of approximately 7300 kilometres of commercial 2D seismic data. The marine reconnaissance survey involved swath mapping, gravity and magnetic data collection and seabed sampling. Further information on both surveys is provided below while reports on some early results from the marine reconnaissance survey are included in two other articles in this issue. The seismic survey data will need more than four months processing before it will be available for interpretation and distribution.

To support these surveys, Geoscience Australia completed an Ocean Bottom Magnetometer profile by acquiring ocean bottom magnetic readings, recording land magnetic readings from both permanent and temporary base stations and undertaking shipboard to land gravity reading ties. The Ocean Bottom Magnetometer profile coincided with one of the survey's long regional transects, which extended from north of Geraldton to the Wallaby Plateau. Some of this transect was located within Australia's recently confirmed extended continental shelf.

The shipboard gravity and magnetic data acquired along the marine reconnaissance and 2D seismic lines will be integrated into existing potential field coverage, and used to provide an understanding of the structure and shape of these offshore frontier basins.

These datasets and their interpretation will assist in understanding the petroleum prospectivity of the region and, eventually, underpin Australia's future offshore petroleum acreage release. They will also increase our knowledge of seabed environments and marine habitats.

2D seismic reflection survey

Geoscience Australia conducted the 2D seismic reflection, gravity, and magnetics survey between 26 November 2008 and 24 February 2009, using CGGVeritas's marine seismic vessel MV *Duke*.

This survey was Geoscience Australia's first regional seismic survey carried out in Australia's Exclusive Economic Zone (EEZ) and extended continental shelf in frontier areas off the Western Australian coast. It will provide critical information to support a better understanding of the regional geology, sediment thickness and hydrocarbon prospectivity of the area.

The seismic survey acquired approximately 7300 kilometres of industry-standard 2D reflection

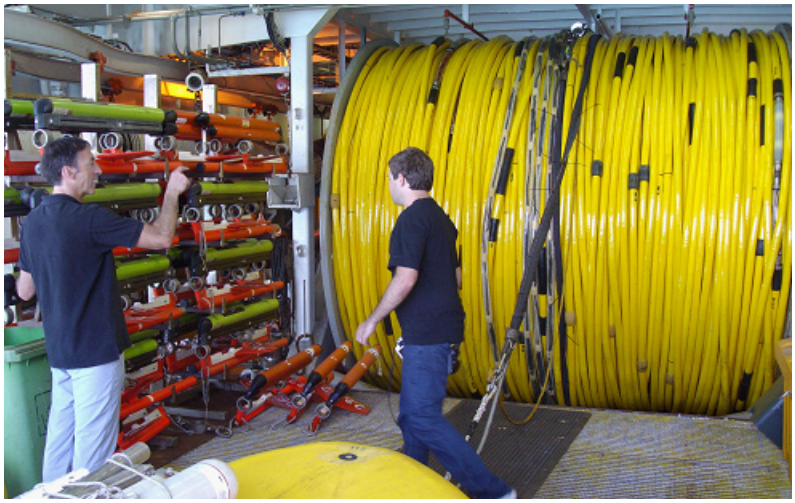

Figure 1. The 8 kilometre solid streamer, tail buoy and stabilizer 'birds' being inspected prior to the start of the Southwest Margin 2D seismic survey.

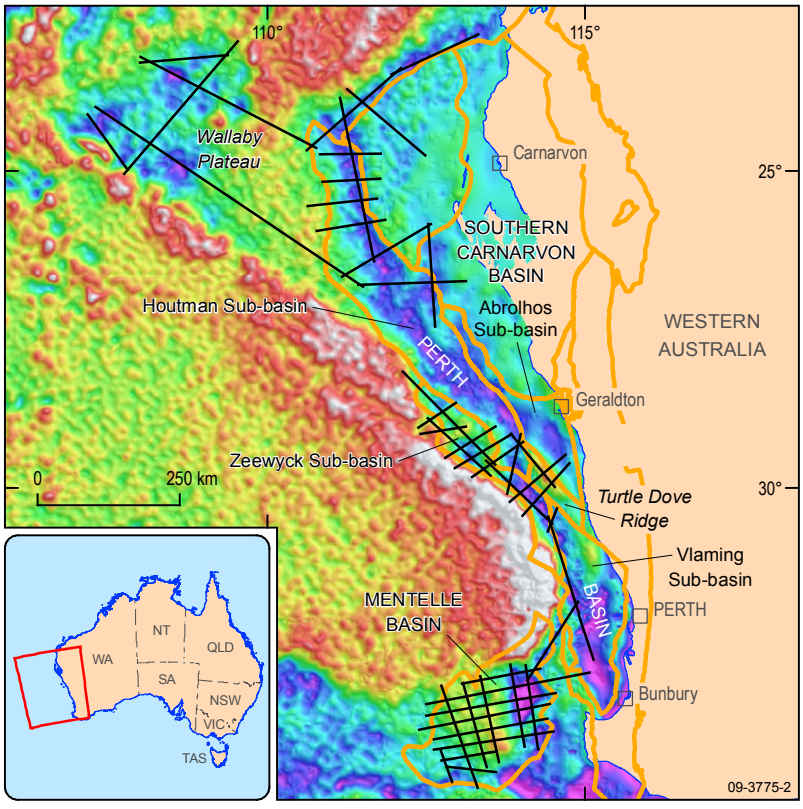

Figure 2. Seismic lines acquired during the Southwest Margin 2D seismic survey by the MV *Duke*. The background image is Bouguer-corrected satellite gravity data.

"The seismic survey acquired approximately 7300 kilometres of industry-standard 2D reflection seismic data."

seismic data using an 8 kilometre solid streamer (figure 1) of 12.5 metre groups (106-fold), 4290 cubic inch airgun array and the returned signal is recorded for 12 seconds. Ship-based gravity and magnetic data were also acquired along all seismic lines and transits while ocean-bottom and land-based magnetometers were deployed to better understand the magnetic field.

The 91-day seismic survey extended from Northwest Cape in the north to Cape Leeuwin in the south and acquired seismic data along 45 lines. These were over the deep-water underexplored areas of the Mentelle Basin, the Houtman/ Zeewyck sub-basins of the Perth Basin and the southern Carnarvon Basin, as well as over the Wallaby Plateau which is further offshore (figure 2). The Wallaby Plateau was recently added to Australia's extended continental shelf under the United Nations Convention on the Law of the Sea (see *AusGeo News 93*). Seismic data acquired will be used to understand the structure of the region and investigate the possible presence of areas of major sediment accumulation (or depocentres) capable of producing and preserving hydrocarbons.

The industry standard 2D seismic traverses were acquired both along dip (across the geological structures) and strike (along the main geological structural grain) lines. Wherever possible, these traverses tied into existing industry seismic grids,

regional seismic lines or surveys providing well ties. Interpretation of this new dataset will help scientists to better understand the regional stratigraphy of the surveyed areas.

The survey data is currently being processed and will be available from Geoscience Australia's repositories at the cost of transfer in the latter part of 2009. The newly acquired and existing geophysical data will assist Geoscience Australia's Southwest Margin project team to:

- map the extent and depth to basement of the main sedimentary depocentres
- determine the nature of the crust underlying these depocentres
- better define the structure and stratigraphy of the frontier basins along the western Australian margin
- better understand the tectonic evolution of the margin
- understand petroleum system elements, maturation and potential trapping mechanisms in these basins.

Marine Reconnaissance Survey

The marine reconnaissance survey used the German research vessel RV *Sonne* and was conducted between 22 October 2008 and 15 January 2009. This survey focused on the underexplored areas of the Zeewyck and Houtman Sub-basins (part of the Perth Basin), the southern Carnarvon Basin (figure 3) and on the Wallaby Plateau.

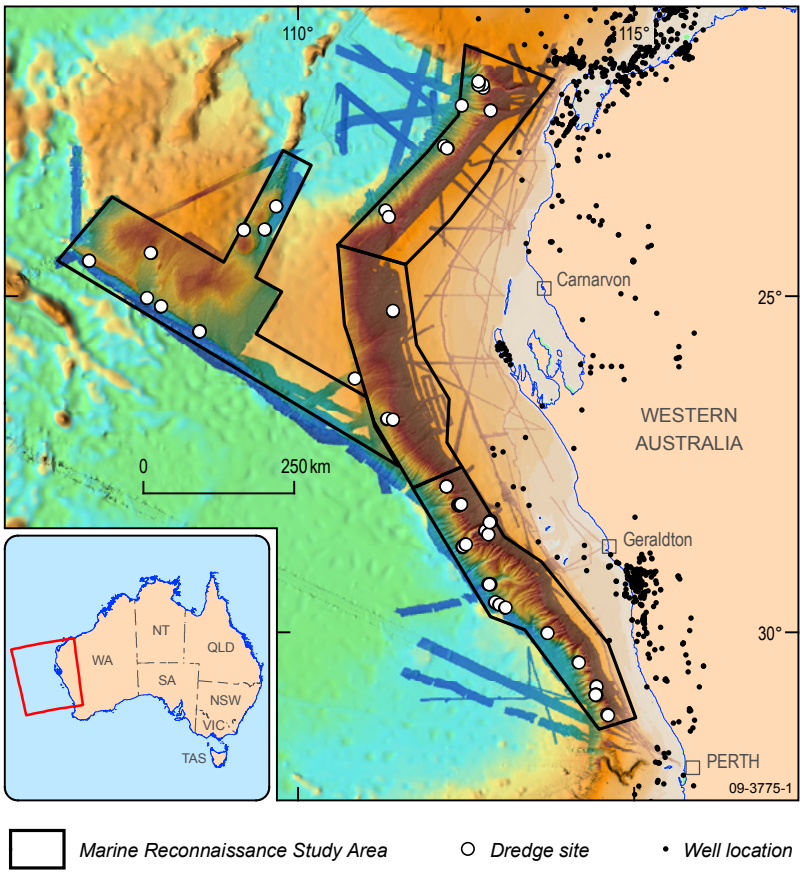

Figure 3. Swath bathymetry collected during the Southwest Margin marine reconnaissance survey onboard RV *Sonne* showing dredge sample locations.

The objectives of the survey included:

- Determining the age, lithology and geochemical character of rocks from the main sediment depocentres and underlying basement.
- Determining the nature of the crust underlying depocentres by modelling calibrated geopotential data.
- Characterising the physical properties of the seabed associated with the basin areas.
- Characterising the abiotic and biotic relationships on a variety of ecologically significant geomorphic features (such as canyons, ridges, and plateaus).

Multibeam sonar was used to map more than 200 000 square kilometres of seabed – an area almost the size of Victoria – increasing the mapped area of Australia's EEZ by 12 per cent (table 1). More than 18 000 kilometres of magnetic, gravity and sub-bottom profiler (SBP) data were collected. In addition, samples were collected from 62 sites using a variety of equipment to gather information on the geology, geomorphology, sedimentology, ecology and oceanography of the region.

Analysis of the available seismic data from the frontier basins has shown that thick successions of sedimentary rocks

are exposed in the steep walls of several large submarine canyons. These were targeted by the dredging program. Sedimentary rocks sampled at different stratigraphic levels in these canyons will provide crucial information on the basin stratigraphy. Moreover, sampling and imaging of the sedimentary successions in the Exmouth and Zeewyck sub-basins suggest that the outboard parts of these basins extend up to 60 kilometres seaward off the currently published basin boundaries. Analysis of samples from these areas will assist in developing an understanding of the basin history and assessing its potential petroleum prospectivity. These data will be used to underpin any future petroleum acreage release areas.

Over 40 new submarine canyons and previously unknown volcanic pinnacles were discovered during the survey. These discoveries revealed the spatial structure of the seabed environments to be far more complex than previously thought. Studies are currently underway to characterise the seabed environments for the purposes of defining Australia's little-known deep-sea biodiversity.

"These discoveries revealed the spatial structure of the seabed environments to be far more complex than previously thought."

Work programs onboard the RV *Sonne* involved collaboration between Geoscience Australia and the Geological Survey of Western Australia (GSWA). Four geologists from the GSWA took part in the survey and provided expert knowledge about Western Australian geology. The survey also provided a unique opportunity for 18 university students from 10 countries (Australia, Belgium, Canada, China, France, Indonesia, Iran, Malaysia, Singapore and the United States) to complete crucial training in marine science and fieldwork as part of the University of the Sea program. The students supported scientific staff in all onboard research activities.

Table 1. Data and samples collected during the survey.

Data type	Total recovery
Geophysical	
Square kilometres of swath data	200 000
Kilometres of magnetic, gravity, and SBP data	18 000
Physical	
Rock dredges	53
Surface grabs (with black & white camera tows)	28
Camera tows (colour with stills)	17
Boxcores	8
Benthic sleds	4
Conductivity, turbidity and depth casts	8

For more information

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