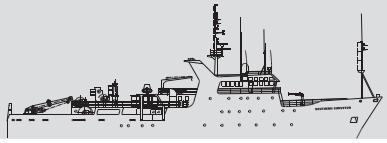


MARINE
NATIONAL FACILITY

2006 program

RV *Southern Surveyor*

voyageplan

SS06/2006

Marine National Facility Research
Charter by Geoscience Australia:

Central North West Shelf Seepage: identifying potential natural hydrocarbon seeps and petroleum prospectivity, Offshore Canning and Roebuck Basins.

Itinerary

Mobilisation: Geraldton Sunday 28 May 2006.
Depart: Geraldton 1200hrs 29 May 2006.
Arrive: Port Hedland 0800hrs Saturday 24 June 2006 and demobilise.

Principal Investigator

Dr John Kennard (Chief Scientist) – Petroleum and Marine Division,
Geoscience Australia. GPO Box 378, Canberra ACT 2601 Australia
Phone: +61 2 6249 9204 **FAX:** +61 2 6249 9915 **Email:** john.kennard@ga.gov.au

CSIRO

Scientific Objectives

- Identify, characterise and sample sites of natural hydrocarbon seepage.
- Improve the understanding of the petroleum prospectivity of the Offshore Canning and Roebuck Basins

Natural hydrocarbon seepage can provide evidence for an active petroleum system within the subsurface. Sites of hydrocarbon seepage can also provide highly diverse ecosystems due to nutrients, biogeochemical cycles and changes in sediment substrate; they may thus be associated with palaeo- or modern reefal buildups.

Voyage Objectives

Areas of potential hydrocarbon seepage have been identified from existing seismic, bathymetry, echo-sounder and synthetic aperture radar (SAR) data (Fig. 1).

Approximately six-eight of these areas will be surveyed and mapped using swath bathymetry, side-scan sonar, 12 & 120 kHz echo-sounder and 3.5 kHz sub-bottom profiles. This acoustic data will provide information on bathymetry, nature of the seafloor, sediment types, sub-seabed stratigraphy and faulting, and evidence for shallow gas. This acoustic data will then be used to select specific sampling sites. These will be chosen to reflect a range of areas of suspected natural hydrocarbon seepage for geochemical and sedimentological sampling.

The areas of potential hydrocarbon seepage reflect a variety of different features, sediment types and water depths, which test a range of potential Palaeozoic and Mesozoic petroleum systems in a variety of geological settings.

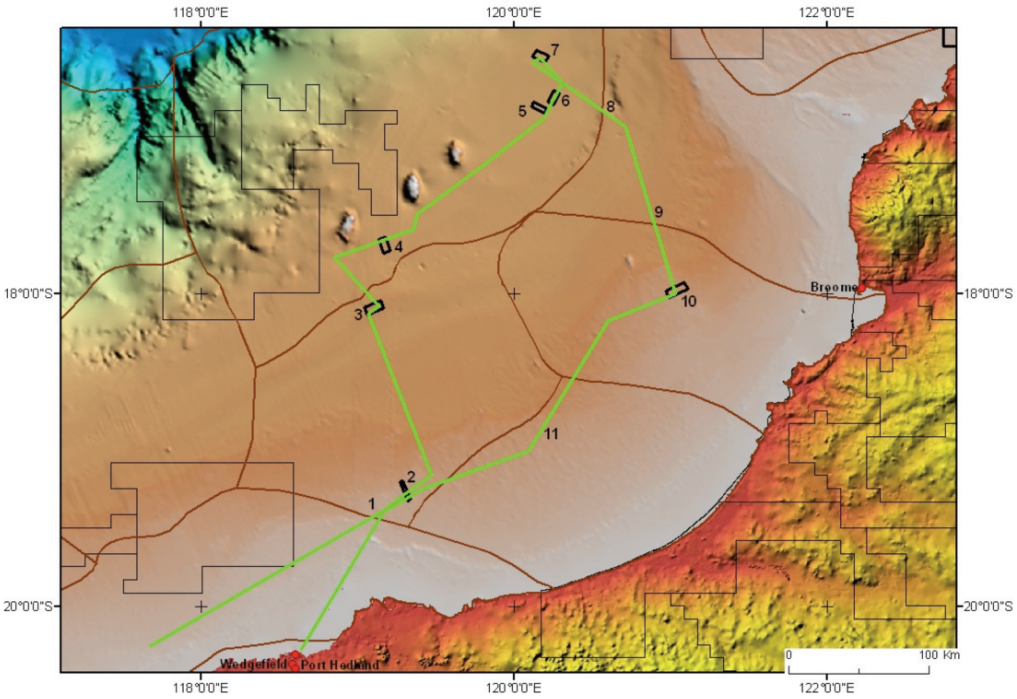
Potential seepage areas to be surveyed:

- Lambert Shelf: SAR anomalies possibly due to tidal flow across bathymetric features. 40-50 m water depth; intraclastic foram sand and gravel.
- Edge of Bedout Sub-basin: SAR anomalies and possible HRDZs, hyperspectral coverage. Edge of Bedout Sub-basin seal failure, Triassic and Jurassic petroleum system. 45-80 m water depth; intraclastic foram sand and gravel.
- Phoenix-1, 2 gas accumulation: Known Triassic gas accumulation; test if any sea floor seepage detectable. Bedout Sub-basin, Triassic system. 140 m water depth; gravely muddy sand [Transect only].
- Bedout High: Multiple possible HRDZs/gas chimneys, SAR anomaly, and multiple earthquake epicentres; hyperspectral coverage. Flank of Bedout High, possible seal failure, Triassic and Jurassic systems. 120-220 m water depth; Pteropod sandy mud to muddy sand.
- South Mermaid Fault Zone (MFZ): 310-330 m water depth; muddy sand.
- North Mermaid Fault Zone (MFZ): 440-470 m water depth; muddy sand.
- Late Miocene buried reef: Rowley Shoals trend, 90 km NE of Mermaid Reef, possible HRDZ/gas chimney. Inner Rowley Sub-basin, Triassic-Jurassic system. 560-620 m water depth; muddy sand.

- Late Miocene inversion faults to seabed in area with SAR anomalies and multiple earthquake epicentres. Oobagooma Sub-basin, Palaeozoic/ Jurassic system. 55-150 m water depth; gravely sand.
- Seabed scarp, Oobagooma High, inboard of MFZ: Fault/erosion scarp, no obvious deep fault, benched erosion terrace. 400-250 m; foram Pteropod sand [Transect only].
- Miocene impact crater: Possible transit site only. 240-300 m water depth; Pteropod (gravely) sand.
- Broome Platform/Oobagooma Sub-basin junction: SAR anomalies and possible wavy pockmarks. Palaeozoic petroleum system. 100 m water depth; oolitic sand.
- Outer Broome Platform: Echo-sounder water column plumes (Franklin 05/2000 Survey) with possible hydrocarbon-related diagenetic zones (HRDZs) and seabed mound; hyperspectral coverage. Offshore Broome Platform, Palaeozoic petroleum system. 60-90 m water depth; peloid foram (gravely) sand.
- Inner Broome Platform: Echo-sounder water column plumes (Franklin 05/2000 Survey) with possible hydrocarbon-related diagenetic zones (HRDZs) and seabed mound; hyperspectral coverage. Offshore Broome Platform, Palaeozoic petroleum system. 60-70 m water depth; peloid foram (gravely) sand.
- Flatspot: Potential high amplitude flatspot within apparent Callovian closure. Offshore Willara Sub-basin, ?Palaeozoic system. 60-90 m water depth; bioclastic ooid sand, gravely sand.

Voyage Track and Time Estimates

Figure 1: Areas of potential hydrocarbon seepage to be investigated during the voyage.



Depart from Geraldton 12:00 29th May, and transit to Area 1 (90 hours).

Area 1: Lambert Shelf SAR 19°22′24″S/119°9′32E

- Survey and sample (5 hours)
- Deploy BRUCE instrumented frame and ADCP (2 hours).

Transit to Area 2 (1 hour).

Area 2: Edge of Bedout Sub-basin

Survey area – approx. corner co-ords: 19°12′22″S/119°16′10″E; 19°11′58″S/119°17′9″E; 19°19′5″S/119°20′3″E; 19°19′32″S/119°19′1″E (wd ~60m).

- Survey (20 hours).
- Sample (36 hours) (?could leave sampling to after Area 11)

Transit to Area 3 (9 hours).

Area 3: Bedout High

Survey area – approx. corner co-ords: 18°5′18″S/119°2′27″E; 18°2′48″S/119°8′31″E; 18°5′37″S/119°9′47″E; 18°8′9″S/119°3′34″E (wd ~125m).

- Survey and sample (61 hours).

Transit and survey to Area 4 (10 hours).

Area 4: Southern Mermaid Fault Zone (MFZ)

Survey area – approx. corner co-ords: 17°39′19″S/119°7′54″E; 17°38′20″S/119°10′35″E; 17°43′33″S/119°12′32″E; 17°44′37″S/119°9′56″E (wd ~320m).

- Survey and sample (46 hours).

Transit and survey to Area 5 (16 hours).

Area 5: SAR MFZ

Survey area – approx. corner co-ords: 16°50′57″S/120°11′36″E; 16°48′17″S/120°6′23″E; 16°43′33″S/120°7′21″E; 16°49′14″S/120°12′32″E (wd ~440m).

- Survey and sample (44 hours).

Transit and survey to Area 6 (2 hours).

Area 6: Northern MFZ

Survey area – approx. corner co-ords: 16°42′2″S/120°15′E; 16°43′12″S/120°17′16″E; 16°47′33″S/120°14′59″E; 16°46′21″S/120°12′44″E (wd ~455m).

- Survey and sample (46 hours).

Transit and survey to Area 7 (5 hours).

Area 7: Miocene buried reef

Survey area – approx. corner co-ords: 16°26′27″S/120°8′18″E; 16°28′52″S/120°13′6″E; 16°31′32″S/120°11′47″E; 16°29′11″S/120°7′1″E (wd ~600m).

- Survey and sample (42 hours).

Transit to intersection of JN88-05 and BR02-009 (16°30′41″S/120°6′44″E) (2 hours).

Area 8: Seabed Scarp and Impact Crater Area

Survey to Seabed Scarp (16°49′49″S/120°34′1″E) and Impact Crater (16°54′35″S/120°40′47″E) (no samples) (6 hours)

Transit to Area 9 (5 hours).

Area 9: Broome/Oobagooma junction
Survey from 17°33'11"S/120°53'50"E to SAR slick (17°36'10"S/120°54'47"E) (1 hour)

Transit to Area 10 (3 hours)

Area 10: Broome Platform
Survey area – approx. corner co-ords: 17°55'35"S/121°5'1"E; 17°58'12"S/121°6'21"E; 18°1'46"S/120°59'9"E; 17°59'12"S/120°57'53"E (wd ~70m).
• Survey and sample (86 hours).

Transit to Area 11 (18°9'56"S/120°36'15"E). (9 hours)

Area 11: Willara Flatspot
• Survey across way point (18°53'2"S/120°10'3"E) (1 hours).

Transit back to Area 1 via Area 2 (7 hours).
Sample at Area 2 if not already done

Area 1: Lambert Shelf SAR
• Retrieve ADCP and BRUCE (2 hours)

Transit to Port Hedland at completion of voyage (8 hours).

Acoustic acquisition – all areas
• EM 300 multi-beam swath • Topas 3.5 kHz sub-bottom profile
• 12 and 120 kHz echo-sounder digital recording • Side-scan sonar • ~6 knots

Acoustic acquisition – all inter-area transits:
• EM 300 multi-beam swath • Topas 3.5 kHz sub-bottom profile
• 12 and 120 kHz echo-sounder digital recording • ~10 knots

Sampling Order
• CTDs & XBTs (1 in each Area at 1st sampling station in each Area; ~6 total)
• Grab samples (1 at each station, 2 or 3 stations in each Area; ~18 total)
• Piston cores (1 at each station, 2 or 3 stations in each Area; ~18 total)
• Gravity cores (1-2 at each station, 2 or 3 stations in each Area; ~18-36 total)
• Vibro-cores only to be used if poor Piston/Gravity core recovery in an Area less than 250 m water depth (1 station in relevant Area; ~2-4 total)
• Dredge only to be used if hard substrate (1 at relevant Station; ~6 total)
• Camera (1 or 2 in each Area, generally first sampling station in that Area; ~6-12 total)
• Benthic sled only to be used if grabs not successful.

Priority for data and sample acquisition

High priority	***Intermediate priority***	***Low priority***
EM300 multi-beam	ADCP	Fluorometer/skimmer
Topas 3.5 kHz sub-bottom profile	Vibro-corer	BRUCE
12 & 120 kHz echo-sounder	Camera	
Side-scan sonar	Benthic sled	
CTD and XBTs		
Sediment grabs		
Piston and gravity cores		
Rock dredge		

RV *Southern Surveyor* Equipment

- EM300 multibeam swath with sound velocity profiler
- Topas 3.5 kHz sub-bottom profiler
- 12 & 120 kHz echo-sounder of water column data to be recorded digitally
- CTD (including Transmissometer)
- Smith-Macintyre grab (2)
- Trawl winch for dredging
- Coring winch (for the gravity core)
- Epibenthic sled and spare nets
- Blast freezer for quick freezing of samples and storage of frozen samples
- Cold room for core storage (cores and grabs) set at 4°C
- Constant Temperature Lab (CTL)
- Camera station for video (operations room or if elsewhere with GPS feed)

Special requirements

- Space for PCs used for sub-bottom profile data processing in addition to TOPAS
- Space for Swath processing
- Space in operations room for Side-scan Sonar and Fluorometer acquisition PCs
- Space in wet laboratory for sedimentology (processing sediments)
- Room for sampling gear on deck (core barrels, liners, spare dredges)
- Room for Thomas (core deployment cradle)
- Room for fluorometer processing and computation
- Room for vibro-corer on deck
- Room for Vibro winch
- Room for video camera winch
- Room for Side-scan winch
- Room for small rock saw in wet laboratory
- Ability to launch work boat with experienced operator for seep sampling (as done for SS06/2005)
- Ability to deploy snorkellers for gas bubble sampling (as done for SS06/2005; Dive Plan approved)
- Use of vessels dynamic positioning equipment will be required

Data sets to be collected from the National Facility's instruments

- Navigation (digital)
- EM 300 Swath-bathymetry (digital)
- TOPAS 3.5 kHz Sub-bottom profiles (digital)
- 12 & 120 kHz Echo-sounder (digital)
- CTD Water temperature and thermo-salinograph
- ADCP on vessel
- All metrological data

User Equipment

GA equipment (transported to the ship)

- BRUCE instrumented frame (LISST laser particle sizer, Seabird CTD, Nortek acoustic current meter plus two OBS sensors)
- ADCP for benthic deployment • Vibro-corer and winch
- Gravity/piston Corer, 8m • THOMAS Core deployment system
- Chain block for mounting on A frame to move 8m core barrels
- Rock dredges • Side-scan Sonar with associated winch, cable and hardware/software
- Deep-water Camera system (using side-scan winch)
- Shallow-water Camera system (using side-scan winch)
- Fluorometer equipment (catamaran, cables, pump, instrument and computer)
- Sampling / storage equipment (bags, buckets ....)
- Microscope • 5mm large plastic sieve (x2)
- Gas catching device as used by AIMS on SS06/2005
- Surface slick sampling devices supplied by Gore, rod and line
- Rock Saw (small one) and room for rock saw in wet laboratory
- Deck plans have been provided for layout of user equipment

Personnel List

John Kennard	GA	Chief Scientist/Shift leader
Andrew Jones	GA	Scientist/Shift Leader
George Bernardel	GA	Scientist/geophysics
Anne Fleming	GA	Scientist/geophysics
Cameron Mitchell	GA	Scientist/swath
Karen Earl	GA	Scientist
Alison Hancock	GA	Scientist/databases
Michele Spinoccia	GA	Swath operator
Jon Stratton	GA	Science technician
Ray DeGraaf	GA	Mechanical technician
Craig Wintle	GA	Mechanical technician, SST
Franz Villagran	GA	Electronic technician
Ian Atkinson	GA	Electronic technician
Stephen Thomas	CMAR National Facility	Voyage Manager, Electronics, SST
Hiski Kippo	CMAR National Facility	Computing, SST

SST – System Support Technician **GA** – Geoscience Australia
CMAR – CSIRO Marine & Atmospheric Research

This voyage plan is in accordance with the directions of the National Facility Steering Committee for the Research Vessel *Southern Surveyor*.

John Kennard
Chief Scientist