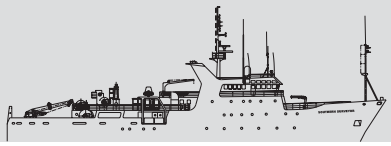


MARINE
NATIONAL FACILITY

2005 program

RV *Southern Surveyor*

voyageplan

SS06/2005

Biogeochemical processes, effects and signatures of hydrocarbon and ground-water seepage within a tropical, carbonate-rich system: Australia's Timor Sea.

Itinerary

– Begin loading AIMS equipment, Sunday, 29 May 2005 as other operations permit.
– Depart Darwin 1000hrs, Tuesday, 31 May 2005
– Steam to Karmt & Sahul Shoals region for research work
– Arrive Darwin 1000hrs, Thursday 23 June 2005 and unload vessel

Principal Investigators

• Gregg J. Brunskill, Chief Scientist **Email:** g.Brunskill@aims.gov.au
• Kathyrn A. Burns • David McKinnon
Australian Institute of Marine Science, Townsville, Queensland

• Bradley Opdyke, Australian National University, Canberra
• Geoff O'Brien, Adelaide University, Adelaide

CSIRO

Scientific Objectives

1. Determine the ecological importance of submarine seeps in the Timor Sea (all).
2. Estimate the flux of greenhouse gases from the seafloor to the atmosphere (Brunskill, Burns).
3. Determine variations in century and millennial scale burial rate of carbon, metals, and other signals of climate change and ENSO events (Brunskill, Opdyke).
4. Test hypotheses about interactions of seep oil and methane with biota, and how this effects biodiversity in this region (Burns)
5. Test geological predictions of the locations of submarine vents (O'Brien).
6. Map and discover trends in locations of submarine seeps on the seafloor (O'Brien).
7. Determine the variations and controls on primary production and respiration of water column plankton (McKinnon).
8. Determine the reasons for the low abundance of coral on the shoal mound tops, and determine the rate of growth and age of coral and limestone on the mound tops.

Voyage Objectives

1. Discover seeps of methane, oil, and brines on the seafloor, using wheelhouse sounder showing bubble plumes, seismic transects, swath mapping, surface and near bottom water sampling, and sediment coring tools. Gas chromatographic measurements of methane in water will be done in the ship laboratory.

2. Obtain sediment cores from soft and hard bottom seafloor, and subsample the cores carefully for hydrocarbon and inorganic chemical measurements, and preserve samples for analyses in our home laboratories.

3. Obtain samples of relict and living biota from the seafloor in association with submarine seeps, using sled dredges, rock dredges, Smith-MacIntyre Grab, and near-bottom water samples.

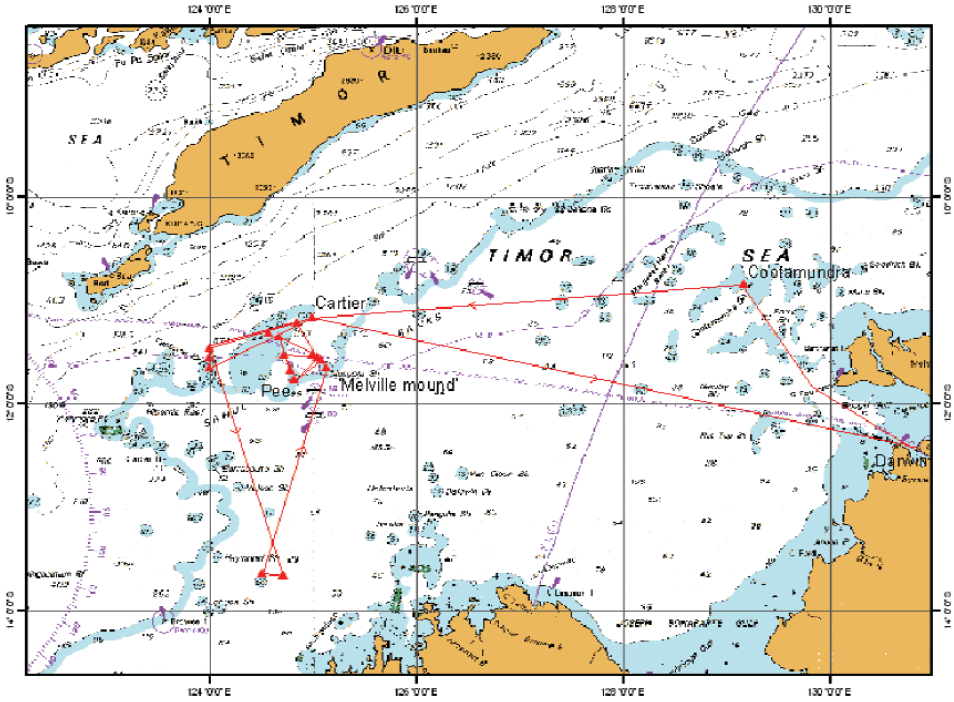
4. Use the swath mapping and seismic tools on the ship to locate best sites for biological and chemical sampling of the water column and seafloor.

5. Measure the daily consumption and production of oxygen in the water column to estimate primary production and respiration. Also to sample the zooplankton, which consume the products of primary production.

6. Obtain drill cores of living and dead corals from the tops of shoal mounds, to measure the history of hydrocarbon abundance, and the age of the mound tops.

Voyage Track

RV Southern Surveyor 31 May - 23 June 2005



Time Estimates

31 May, depart Darwin

1 June, transit to Cartier Trough, assemble first trap mooring

[Cootamundra Shoals coral coring on the way out, or on return?

10° 50' S., 129° 10' E., 20 m depth on Mound top.]

2-3 June, 11° 09' S. and 125° 00' E. at 500 m depth contour, Cartier Trough

CTD and Niskin water sampling at sediment trap site

Methane profiles

Pu flocc samples of surface water, ship's pump.

Productivity and respiration sampling and measurements

Plankton sampling

Smith-MacIntyre Grab benthic sampling

Deploy sediment traps

Acoustic Doppler Current Profiling transects

Swath and seismic mapping in this region, night

Benthic camera work

Assemble second sediment trap mooring.

3-4 June, Move to 11° 26.8'S. and 124° 00 E. on 500 m depth contour

CTD and Niskin water sampling at sediment trap site
Methane profiles
Pu flocc samples of surface water from ship's pump
Productivity and respiration sampling and measurements
Plankton sampling
Smith-MacIntyre Grab benthic sampling
Kasten Core
Deploy sediment traps
Acoustic Doppler Current Profiling transects
Swath and seismic mapping in this region, night
Benthic camera work

4-5 June, transit to Cornea Site, approximately 70 miles south of Pee Shoals

13° 38.64' S., 124° 43.05' E.
13° 38.95998' S., 124° 43.30998' E.
13° 38.95998' S., 124° 42.99' E.
13° 37.57002' S., 124° 30.88998' E.
13° 38.62998' S., 124° 43.06002' E.

Detail maps supplied from Geoscience Australia (.pdf files),
Irena to have these files ready for ship Master use.

5-8 June, or longer if the vent is full bore bubbling…

Low slack tides at 1550-1840 over 5-10 June at Heyward Shoal [See appendix 1 for LT times, submarine seeps are likely to flow fast at lowest tide = least water pressure]
Watch depth sounder (100-200 kHz) for bubble plumes at low tide
Swath and seismic map the region, find a pattern for domes/mounds
ADCP map the convection cell created by the vent?
Deploy inverted funnel bubble trap to collect surface gas for GC analysis
CTD and Niskin water sampling
Methane and radium profiles, big Niskin Cage
Pu flocc sample, 1000 litres of surface water?
Productivity and respiration sampling and measurements
Plankton sampling
Deploy KAB small traps for particle collection
Smith-MacIntyre Grab samples, benthic sampling
Explore "pockmark" seafloor to west of Cornea Site
Kasten cores, soft sediment in deeper water to west?

9 June, transit to southern rim of Cartier Trough, Mangola Shoals area, the Melville Mound at 11° 38' S., 125° 08' E.

9-14 June, Kasten Core at 11° 34.06' S., 125° 5.12' E. at 306 m

Explore Melville Mound with swath mapper, seismic profiling
Coordinates: 11° 38' S., 125° 08' E., 300-250 m, mound 50 m high
And 200-300 m in diameter, surrounded by a moat.
ROVs and benthic camera, explore mound and Mangola Shoal
CTD profile
Productivity & Respiration
Zooplankton sampling
Benthic sampling
Drill Core Melville Mound (hard bottom at 250 m)
Big Niskin Cage sampling of near-Mound water, after coring.
Scuba Coral Coring if appropriate site found
Scuba Coral Coring on top of Pee Shoal, 11° 45' S., 124° 49.5' E.
Kasten Core at 11° 32.44' S., 125° 2.76' E. at 356 m
Pu sample of surface water, 1000 litres at this coring site?
If there is time, explore by swath & seismic sounding the deep mounds in Cartier Trough at 11° 39.5' S., 124° 47' E. at 89 m top in >400 m depth; 11° 31' S., 124° 43.5' E. at 91 m top in >350 m water depth.

15-17 June, Explore flat top and deep crevasse in Sahul Shoals, WNW of Pee Shoals.

Swath & seismic map area around 11° 20.36' S, 124° 40.52 E. at 25-30m water depth, on top of the Sahul Shoal.
CTD & Niskin Sampling
ROV & benthic camera survey
Production & respiration measurements
Zooplankton
Benthic sampling
Kasten Core at 11° 30.59' S., 125° 0.19' E. at 410 m
Coral cores from large bommies, if they can be found
Swath map and seismic sounding around 11° 18.13' S., 124° 34.85' E. at 250 m water depth, the bottom of the crevasse, hard bottom.
CTD & Niskin sampling
ROV and benthic camera survey
Production & Respiration measurements
Zooplankton
Benthic sampling
Big Niskin cage sampling after coring.
Kasten Core at 11° 12.06' S., 124° 51.0' E. at 404 m

18-20 June, Recover Sediment Traps

Trap: 11° 26.8'S. and 124° 00 E. on 500 m depth contour, W. of Sahul Shoals
Repeat CTD, Production & Respiration, Zooplankton if desired.

[Options for kasten cores due south of this location:
11° 32' S. and 124° 00' E. at 400 m depth.
11° 38' S. and 124° 00' E. at 300 m depth.]

Trap: 11° 09' S. and 125° 00' E. at 500 m depth contour, Cartier Trough
Repeat CTD, Production & Respiration, Zooplankton if desired.

21-22 June, steam for Cootamundra Shoals & Darwin

Coral Coring at Cootamundra Shoals,
10° 50' S., 129° 10' E., 20 m depth on Mound top.
This shoal is about 3 hours out of Darwin.

23 June, arrive Darwin

Unload ship
Transfer gear to Perkins
Ship samples to AIMS
Drink some beer
Return home.

Appendix 1: Heywood Shoal Low tides:

[The best time to see submarine seepage will be during low low tides]

Date	Time
5 June,	1514
6 June,	1634
7 June,	1707, lowest tide
8 June,	1738, lowest tide
9 June,	1809
10 June,	1838

Southern Surveyor Equipment

- CTD system and 20 X 10L Niskin bottles
- CSIRO Transmissometer, Oxygen and PAR sensors on CTD
- ADCP current profiling & data recovery/graphics
- The new Swathmapper, computers & software for processing to view
- 3.5 khz sub-bottom profiler, digital output to save on CD
- 120 kHz depth sounder and recording to CD system, 200 kHz Bridge sounder
- Underway salinity, temperature, fluorometry (chlorophyll)
- Compressor for SCUBA tank filling • Freezers, fridges in labs
- Distilled or MilliQ lab water supply • Rock dredges

Special Requirements

1. Constant Temperature lab set around 20-22 deg C
   (to be advised onboard by Dave McKinnon)
2. Workboat with experienced coxswain for diving and surface water gas sampling
3. Special "hydrocarbon clean" areas and arrangements (details to be advised onboard):
   Please advise Marine Crew to ask Voyage Manager before using any hydrocarbon based products when mobilisation begins in Darwin, until further advice is provided by scientists during voyage briefing.
4. Ship positioning for camera and small ROV work (to be discussed onboard at briefing)

User Equipment

- 4 AIMS large sediment trap arrays with their moorings and floats, acoustic releases
- 8 railway wheels, chain, anchors for two large sediment trap moorings
- 2 small KAB sediment trap arrays, with mooring wires & anchor
- Towed cameras, small ROV system, drop cameras (Max Rees, Peter Speare)
- Sled dredges, large & small (Carsten Wolff)
- Kasten corer and accessories (Brunskill)
- Core tube racks, sampling deck table, extrusion gear, core catcher caddy
- Smith-Mac Grab sampler, weighted to 300 kg, cocking frame & jack
- 5 X 30 L Niskin bottles & CTD in custom cage for near bottom water sampling (Brunskill)
- GC-FID for methane determinations, with nitrogen, air and hydrogen gases (Burns)
- UVF detector for hydrocarbon estimation (Burns)
- Incubation boxes and micro oxygen titration gear for respiration studies (McKinnon)
- Plankton sampling nets (McKinnon)
- Radium photon counters, 200 and 1000 liter deck containers for radium samples (Pfitzner)
- Bubble collector, gas sampling gear
- Sediment Pore water extraction apparatus
- Vacuum filtration boxes, lab table centrifuge
- SCUBA tanks, diving equipment (Zagorskis, McLean)
- Coral coring apparatus, hand-operated, pneumatic drive (Zagorskis, McLean)
- Shipping containers for coral bommies & cores

Personnel List

Gregg Brunskill	AIMS	Chief Scientist, Sediment traps, coring, bubble collector
Kathy Burns	AIMS	Hydrocarbons & methane measurements in water & sediment
Irena Zagorskis	AIMS	Water sample processing, trap & core sediment processing, data recording
John Pfitzner	AIMS	Radiochemistry sampling & shipboard measurements, sediment core processing
Cary McLean	AIMS	Moorings of traps, ROV and drop camera work, assist in coring
Max Rees	AIMS	ROV, submarine cameras, benthic biota sampling
Ken Wasmund	Uni of Gold Coast	benthic biota & microbial sampling & sample processing
Dave McKinnon	AIMS	oxygen consumption & production, zooplankton sampling, chlorophyll calibration
Luiz Felipe Mendes de Gusmao	AIMS	Zooplankton
Geoff O'Brien	Uni of Adelaide	swath mapping & seismic signals of seeps
Bradley Opdyke	ANU	Holocene climate change signals from sediment cores
Stephen Thomas	CMR	Voyage Manager & Electronics, System Support Technician
Bernadette Heaney	CMR	Computing, System Support Technician
David Terhell	CMR	Hydrochemistry, System Support Technician
Andrea Cortese	GA	Swath processing

Note: System Support Technicians are nominated as per AMSA requirements for additional berths on vessel.

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

Gregg J. Brunskill
Chief Scientist