

**MARINE**  
**NATIONAL FACILITY**

# 2010

*RV Southern Surveyor*  
program



**voyagesummaryss2010\_T02**

## **SS2010\_T02**

### Deep-water benthic biodiversity of the GAB Marine Park

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#### **Voyage period**

Start: 10/08/2010

End: 20/08/2010

Port of departure: Fremantle, Australia

Port of return: Hobart, Australia

#### **Responsible laboratory**

SARDI Aquatic Sciences, West Beach, Adelaide, Australia

#### **Chief Scientist(s)**

David Currie, SARDI Aquatic Sciences

## Scientific Objectives

The Benthic Protection Zone (BPZ) of the Great Australian Bight Marine Park (GABMP) is presently one of fourteen temperate Commonwealth Marine Protected Areas (MPAs) in Australia. These MPAs form part of an integrated strategy for marine conservation and management through the National Representative System of Marine Protected Areas. At present, no data are available on the benthic biodiversity of the continental slope of the BPZ, or the environmental factors that affect their patterns of distribution and abundance. The primary research aim of this transit voyage is to assess the regional significance and diversity of the deep-water faunal communities of the BPZ.

### Three other piggy-back objectives on the voyage are to:

- Investigate water mass structure and interactions along the southern margin of Australia, and particularly the chemical properties and isotopic signatures of the westward flowing Flinders Current.
- Characterise and map previously unsurveyed sections of Australia's upper-slope seabed to support bio-regional planning and management.
- Deploy autonomous profiling floats to characterise the changing state of the upper ocean and patterns of ocean climate variability.

## Voyage Objectives

- 1) Collect quantitative samples of benthos (both infauna and epifauna) from six depth-stratified sampling stations on the continental slope of the BPZ.
- 2) Collect profiled water samples and hydrographic data from six sampling sites along the voyage path, close to the shelf edge-slope.
- 3) Collect swath bathymetry from previously unmapped sections of the upper-slope and mid-slope seabed between Fremantle and Hobart.
- 4) Deploy Argo floats at four locations between Kangaroo Island and Tasmania.

## Results

- 1) Collect quantitative samples of benthos (both infauna and epifauna) from six depth-stratified sampling stations on the continental slope of the BPZ.

Samples of sediment and infauna were collected from three depth-stratified stations (500 m, 1000 m and 2000 m) inside the BPZ using a 0.1 m<sup>2</sup> Smith-McIntyre grab. Quantitative samples of epifauna were also collected from the same three locations using a beam-trawl (4m x 1m, with 1cm mesh). Due to poor weather conditions sampling for infauna and epifauna was not undertaken at three other proposed sampling stations inside the BPZ (200 m, 1500 m and 4000 m).

- 2) Collect profiled water samples and hydrographic data from six sampling sites along the voyage path, close to the shelf edge-slope.

The CTD-rosette sampler was successfully deployed down to approximately 1000 m depth at five sampling sites on the upper-slope between Cape Leeuwin in Western Australia and Port Davey in Tasmania. Due to the very rough sea conditions experienced during the transit, all but two of these water sampling sites had to be established opportunistically at new locations when the weather conditions eased. Despite these revisions in location, it is expected that these data will enable all survey objectives for the hydrochemistry component to be met.

- 3) Collect swath bathymetry from previously unmapped sections of the upper-slope and mid-slope seabed between Fremantle and Hobart.

High resolution swath bathymetry was collected continuously by the EM300 multi-beam mapper over most of the 2100 Nm voyage between Fremantle and Hobart. Unfortunately the prevailing wind and sea-state, particularly at the start of the voyage, often made it unsafe to follow the optimum swath line. Despite this, large areas of the upper-slope were mapped for the first time during this transit, and will undoubtedly make a significant contribution to the national habitat mapping project. A highlight of the seabed mapping component was the discovery inside the BPZ of a cone shaped volcanic mound rising almost 200 m above the seafloor at a depth of 2000 m (Figure 1). Previous work by Geoscience Australia mapping volcanic features on seismic data in the region suggests that it is likely to be an igneous build-up formed during the Middle Eocene.

- 4) Deploy Argo floats at four locations between Kangaroo Island and Tasmania.

All four Argo floats were successfully deployed during the later part of the voyage. One of the instruments initially failed to “chirp” when the magnetic switch to initialise the satellite link was triggered, but this problem was quickly rectified and the float released at a revised location.

## **Voyage Narrative**

### **Tuesday 10th August**

The science party met the RV *Southern Surveyor* at Berth "E" Victoria Quay, Fremantle, and began mobilisation at 0800 hrs. At 0900 hrs the vessel Master convened a meeting to discuss the science plan and establish the cabin and watch allocations. After lunch, all new crew were provided with a familiarisation tour and introduced to the onboard safety regulations and muster stations. The induction to the vessel was completed in the early afternoon with an emergency training muster. At 1700 hrs the vessel departed Fremantle Harbour, and began the transit south towards Cape Leeuwin in light seas (20 knot NE wind and 2 m swell).

### **Wednesday 11th August**

Strengthening northerly winds (40 knots) and following seas saw us proceed rapidly down the SW coast of Western Australia, and at 1200 hrs we had rounded Cape Leeuwin. Unfortunately, these weather conditions were less than useful for our passage east, with short, heavy, northerly swells causing the ship to roll heavily at times. When we arrived at our first scheduled sampling station (CTD\_001), winds were gusting up to 45 knots and ship was rolling heavily. Following discussions with the Master, sampling at this location was deemed too dangerous, and was abandoned. The vessel proceeded to the next water sampling site (CTD\_002) along our planned swath survey route.

### **Thursday 12th August**

Gale-force winds (>40 knots) generated by a slow-moving low-pressure cell continued throughout the early hours of the morning and made for a rough sea, with short 3 m NNE swell. At 0800 hrs the vessel was nearing the second planned water sampling site (CTD\_002), so a meeting was convened by the Master to discuss our sampling options. It was agreed during the meeting that the prevailing weather conditions were simply too dangerous for deploying the CTD. Water sampling at this site was therefore cancelled, and the ship directed along the swath track to the next planned water sampling site (CTD\_003, approximately 160 Nm to the east). As the winds began to ease during the morning (20 knots WNW) an opportunistic sampling site (CTD\_002.5) was established on the 1000 m depth contour, and a successful CTD cast undertaken at 1340 hrs. At 1430 hrs the vessel returned to the swath transit line, and the remainder of the day was spent mapping the seabed topography of the upper slope.

### **Friday 13th August**

At 0300 hrs a toolbox meeting was held on the bridge to assess the weather conditions for water sampling at site CTD\_003 (approximately 10 Nm away). Winds at this time were relatively light (20 knots W), but the short 5m SW swell was moving the ship considerably. At 0400 hrs the vessel was on station at CTD\_003, and the ship turned into the wind to test its stability. A CTD cast to 1000 m was successfully completed at 0450 hrs. The vessel then proceeded to the next sampling station (CTD\_004) at 0500 hrs, along a revised route 10 Nm south of Pollock Reef in the Recherche Archipelago. This new path was necessary due to the rough following sea. By the late evening the ship was rolling moderately in very rough seas and 45 knot SW winds, and it was clear well in advance of our arrival at station CTD\_004 (2330 hrs), that water sampling at this site would not be possible. A decision was therefore made to continue on our swath path towards our first benthic sampling site in the BPZ.

### **Saturday 14th August**

Heavy seas prevailed all day (40-50 knot SW winds and swells to 9m) on our passage towards the BPZ. All sea-doors on the vessel were shut. Due to the poor weather conditions, and the likelihood that it would continue during our sampling window in the BPZ, a toolbox meeting was convened at 1630 hrs to review and prioritise sampling. To accommodate time lost to bad weather, and to reduce the risks to crew safety during trawl and grab deployments, a decision was made to cut the proposed sampling program in the BPZ in half (from 6 to 3 sites). At 2240 hrs the vessel arrived on station at BPZ\_500, and the ship was turned into the weather to wait for the sea conditions to ease.

### **Sunday 15th August**

Grab sampling in the BPZ commenced at first light (0530 hrs) in rough but moderating conditions (30 knot WSW winds), with an 8 kg sample of fine sediment being successfully collected at station BPZ\_500. This operation was immediately followed by our first beam-trawl shot. The trawl gear being payed-away at 0800 hrs and safely returned to the deck at 1915 hrs. The catch from this trawl shot included a large number of different fish (e.g. Ling *Genypterus* spp., Cucumberfish *Paraulopus* spp. and Whiptails *Coelorinchus* spp.) and invertebrate species (e.g. Urchins *Goniocidaris* spp. and Holothurians *Paracaudina* spp.), which were eagerly processed by the science party en route to the next sampling station (BPZ\_1000). The vessel arrived at station BPZ\_1000 at 1140 hrs and proceeded to deploy the CTD to a depth of 980 m. This operation went smoothly, and the CTD frame was successfully brought back onboard at 1235 hrs. A Smith-McIntyre grab was then undertaken, and a 9 kg sample of mud collected at 1345 hrs. The final operation at BPZ\_1000 was successfully completed at 1530 hrs, when the beam-trawl was brought back onboard after a 30 minute tow. This trawl shot contained almost 20 kg of fish and invertebrates, many of which were not represented in the previous shot. The vessel proceeded south at 1600 hrs toward our last benthic sampling station (BPZ\_2000), and arrived on site at 2300 hrs. The Smith-McIntyre grab was immediately deployed on arrival at station BPZ\_2000, but this failed to collect more than 1kg of sediment. A second grab sample was therefore undertaken, and a 3 kg sample of mud successfully brought onboard just after midnight.

### **Monday 16th August**

At 0200 hrs we began to pay-away the wire for our final beam-trawl tow at station BPZ\_2000. This gear took more than 1 hour to reach the seafloor, and was eventually brought onboard again at 0440 hrs, after a 30 minute tow on the seafloor. The total catch weight from this site was disappointing (~1 kg), as it was much smaller than that taken at the other two sampling depths (500 m and 1000 m). Despite this, the biota collected from BPZ\_2000 was diverse, and contained several crustacean and anemone species not recorded at the shallower sites. At 0500 hrs the vessel recommenced its transit to Hobart, leaving the Marine Park at 0600 hrs with a slight beam sea and moderate SW swell.

### **Tuesday 17th August**

Some of the best weather conditions of the transit were experienced on Tuesday morning (20 knot NE winds and 4m SSW swell), so some of the science party took the opportunity to dismantle and pack the benthic sampling gear on deck. With a less lively ship motion, it was also seen as an opportune time to curate the last of the faunal samples, and commence cleaning the wet labs. During the afternoon, a science meeting was convened to discuss options for opportunistic water sampling between the BPZ and Hobart, and to confirm the locations for four Argo float deployments.

### **Wednesday 18th August**

At 0100 hrs the vessel was on station (39° 24.8 S, 138° 23.0E) 200 Nm south of Kangaroo Island, for the first of four Argo float deployments. A second Argo float was deployed at 0700 hrs (39° 57.1 S, 139° 19.1E) approximately 180 Nm south of Cape Jaffa. The weather deteriorated over the rest of the day, with gale force NE winds (35-40 knots) and a rough following sea causing the ship to roll moderately, but heavily at times. These conditions made it difficult to undertake any work in the laboratories, so most members of the science party used the time to catch up on some sleep.

### **Thursday 19th August**

At 0100 hrs the ship was on station (41° 49.1 S, 142° 35.2E) 100 Nm south-west of King Island, for the third Argo float deployment. The last Argo float was released at 1300 hrs (43° 04.0 S, 144° 53.7E) 30 Nm south-west of Point Hibbs. During this deployment the vessel was turned and held into the weather, so that an opportunistic water sample (CTD\_005.5) could also be taken at the same location. At 1500 hrs the CTD was back onboard after a 1000 m cast. The vessel then continued onto the last scheduled water sampling site (CTD\_006). The vessel arrived on station, 20 Nm west of Port Davey at 1735 hrs, and successfully recovered the final 1000 m CTD cast at 1830 hrs. After securing the CTD frame, the vessel began the last section of the transit round SW Cape and on to Hobart.

### **Friday 20th August**

The vessel docked at the CSIRO wharf in Hobart at 1100 hrs, and demobilisation was completed at 1600 hrs.

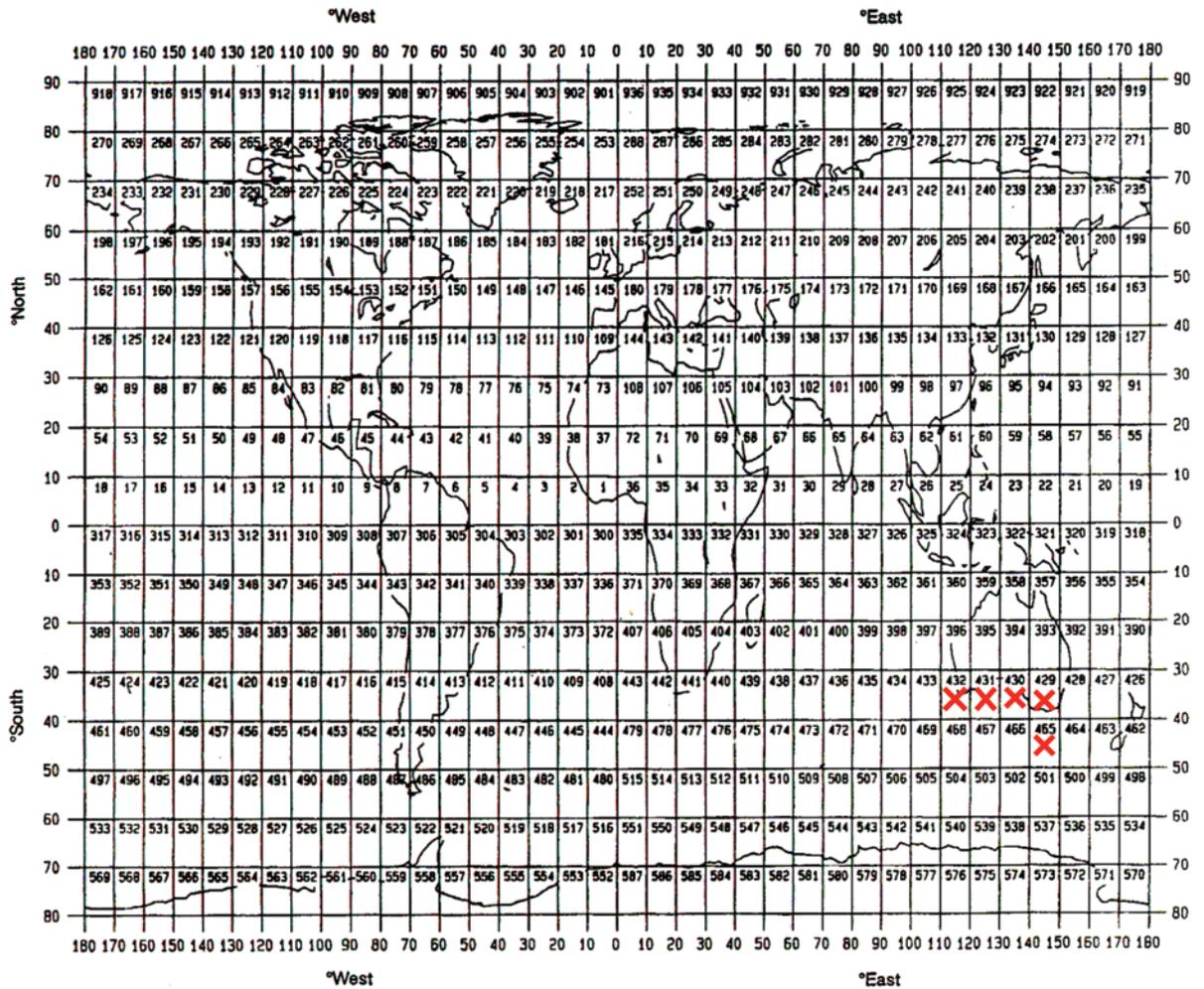
## **Summary**

Weather conditions in the Great Australian Bight during winter are notoriously challenging, and we were fully aware of the adverse impact that poor weather conditions might have on the success of this voyage. To meet these potential challenges, a flexible sampling plan was proposed that prioritised sampling and could be revised on a daily or hourly basis as necessary. In the end, this flexible plan was essential, as weather conditions during the transit were generally poor and often atrocious (e.g. swell heights of 9m and winds of 50 knots). These conditions meant that almost half of the proposed benthic sampling in the BPZ could not be conducted safely. It also meant that not all of the planned water sampling or seabed mapping could be completed successfully. Despite our inability to achieve all of our voyage objectives, we still see this voyage as a success. As a result of the voyage we now have a novel insight into the deepwater benthic biodiversity of the GABMP. We also have regionally important oceanographic samples that will, when analysed, provide improved understanding of water mass interactions along Australia's southern margin. The Argo floats deployments are already assisting in measuring and reporting the changing state of the upper ocean, while the swath data is uncovering many new topographic features on the upper slope. Most notably, the swath data from this voyage has confirmed the existence of a volcanic pinnacle inside the GABMP, which will undoubtedly stimulate interest in the evolution and biology of this remarkable feature.

## **PRINCIPAL INVESTIGATORS**

- A. David Currie, SARDI Aquatic Sciences, Adelaide
- B. Rudy Kloser, CSIRO Marine and Atmospheric Research, Hobart
- C. Laura Richardson, Australian National University, Canberra
- D. Bob Weldon, CSIRO Marine and Atmospheric Research, Hobart

**GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED**



**MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS**

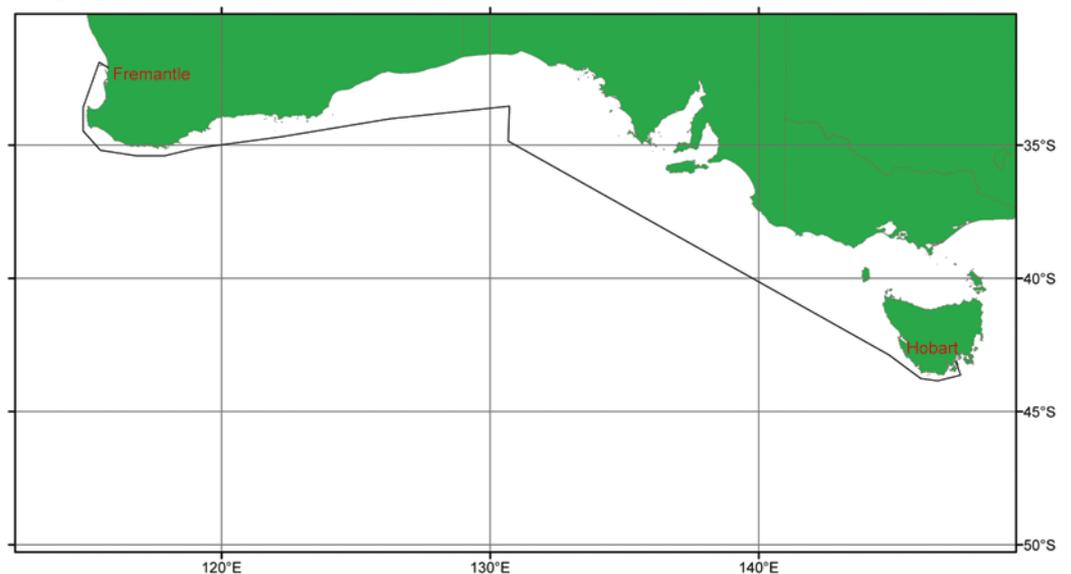
Item No	PI See page above	APPROXIMATE POSITION						DATA TYPE	Description
		LATITUDE			LONGITUDE				
		deg	min	N/S	deg	min	E/W		
1	D	39	24	S	138	23	E	D06	Argo Float – free drifting, profiling to 1000m. Deployed 18 August UTC.
2	D	40	01	S	139	26	E	D06	Argo Float – free drifting, profiling to 1000m. Deployed 18 August UTC.
3	D	41	48	S	142	35	E	D06	Argo Float – free drifting, profiling to 1000m. Deployed 19 August UTC.
4	D	43	04	S	144	53	E	D06	Argo Float – free drifting, profiling to 1000m. Deployed 19 August UTC.

**SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN**

Item No.	PI see page above	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION
1	A	3	stations	G02	Smith-McIntyre grab (0.1m <sup>2</sup> ). Sediment sub-samples taken for onshore geological analysis. Fauna preserved for onshore identification, enumeration and biomass.
2	A	3	stations	G01	Beam trawl (4m x 1m, with 1cm mesh). Fauna retained for onshore identification, enumeration and biomass.
3	B	2	launches	H13	Expendable Bathythermographs (XBT) for calibrating acoustic return speed for sounders.
4	B	10	days	G74	Continuous mapping of seafloor topography and structure using EM300 multi-beam sounder.
5	C	5	stations	H10	All CTD casts to 1000m depth. Sensors mounted for conductivity, temperature, oxygen, PAR, and fluorescence. Water samples taken from Niskin bottles at 12 depths for analysis of salinity, nutrients, and isotopic signature.

CURATION REPORT	
Item No.	Description
1	Samples to be processed by SARDI Aquatic Sciences. Data and biological reference material to be lodged at the South Australian Museum.
2	Samples to be processed by SARDI Aquatic Sciences. Data and biological reference material to be lodged at the South Australian Museum.
3	Data to be processed by CSIRO Marine and Atmospheric Research and archived on the MarLIN Database.
4	Data to be processed by CSIRO Marine and Atmospheric Research and archived on the MarLIN Database.
5	Seawater isotopes to be analysed at ANU. All other data to be processed by CSIRO Marine and Atmospheric Research and archived on the MarLIN Database.

### Voyage track



GENERAL OCEAN AREA: Southern Ocean

SPECIFIC AREAS: Great Australian Bight

## PERSONNEL LIST

### Scientific Participants

Name	Affiliation	Role
David Currie	SARDI	Chief scientist
Saras Kumar	DENR	Invertebrate taxonomist
Rod Simpson	UNE	Invertebrate taxonomist
Laura Richardson	ANU	Oceanographer, student
Anna Hill	UTAS	Swath mapping, student
Jessica Nilsson	UTAS	Fisheries biologist, student
Pamela Brodie	CSIRO MNF	Voyage manager / computing support
Karl Forcey	CSIRO MNF	Electronics support
Bernadette Heaney	CSIRO MNF	Swath mapping
Sue Reynolds	CSIRO MNF	Hydrochemistry

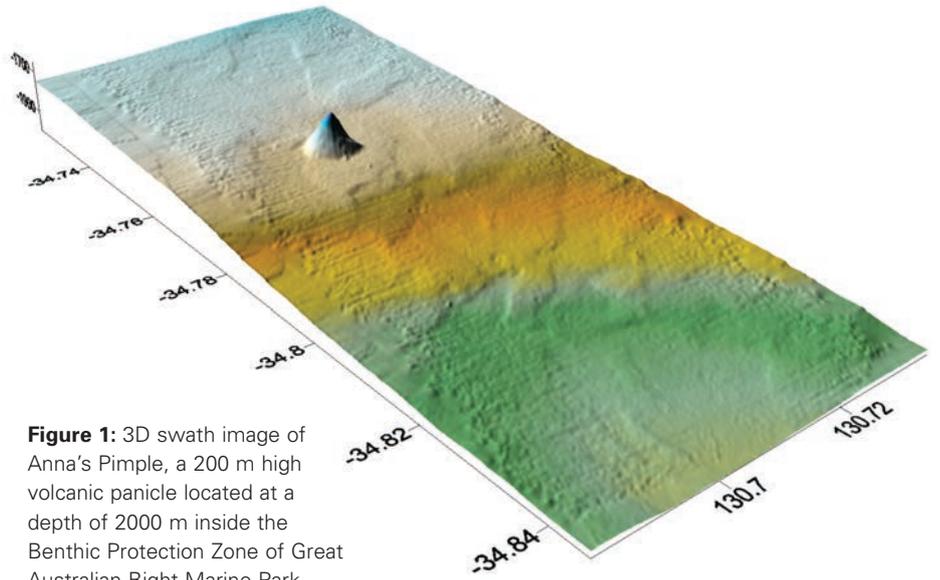
### Marine Crew

Name	Role
Les Morrow	Master
John Boyes	Chief Mate
Alex Cherchukan	Second Mate
James Hickie	Chief Engineer
Nick Fleming	First Engineer
Graeme Perkins	Second Engineer
Tony Hearne	Bosun
Nathan Arahanga	IR
John Allwood	IR
Jonathan Lumb	IR
Daniel Nicholson	IR
Scott Nichols	Chief Cook
Lynette McLaren	Second Cook
Charmayne Aylett	Chief Steward

### Acknowledgements

This research could not have been undertaken safely and efficiently without the assistance of a highly skilled group of mariners. In particular, we would like to thank the captain and crew of the RV *Southern Surveyor* for their professional and enthusiastic support throughout the voyage. We would also like to thank the MNF staff for their outstanding efforts in keeping the instrumentation and data streams running. Thanks are also due to the many support staff at CSIRO and SARDI who helped develop and mobilise the sampling equipment. Finally, thanks to the MNF and DSEWPC for providing financial and logistical support for this research.

**David Currie**  
*Chief Scientist*



**Figure 1:** 3D swath image of Anna's Pimple, a 200 m high volcanic pinnacle located at a depth of 2000 m inside the Benthic Protection Zone of Great Australian Bight Marine Park.

## CSR/ROSCOP PARAMETER CODES

M01 Upper air observations  
M02 Incident radiation  
M05 Occasional standard measurements  
M06t Routine standard measurements  
M71 Atmospheric chemistry  
M90 Other meteorological measurements

### PHYSICAL OCEANOGRAPHY

H71 Surface measurements underway (T,S)  
H13 Bathythermograph  
H09 Water bottle stations  
H10 CTD stations  
H11 Subsurface measurements underway (T,S)  
H72 Thermistor chain  
H16 Transparency (eg transmissometer)  
H17 Optics (eg underwater light levels)  
H73 Geochemical tracers (eg freons)  
D01 Current meters  
D71 Current profiler (eg ADCP)  
D03 Currents measured from ship drift  
D04 GEK  
D05 Surface drifters/drifted buoys  
D06 Neutrally buoyant floats  
D09 Sea level (incl. Bottom pressure & inverted echosounder)  
D72 Instrumented wave measurements  
D90 Other physical oceanographic measurements

### CHEMICAL OCEANOGRAPHY

B01 Primary productivity  
B02 Phytoplankton pigments (eg chlorophyll, fluorescence)  
B71 Particulate organic matter (inc POC, PON)  
B06 Dissolved organic matter (inc DOC)  
B72 Biochemical measurements (eg lipids, amino acids)  
B73 Sediment traps  
B08 Phytoplankton  
B09 Zooplankton  
B03 Seston  
B10 Neuston  
B11 Nekton  
B13 Eggs & larvae  
B07 Pelagic bacteria/micro-organisms  
B16 Benthic bacteria/micro-organisms  
B17 Phytobenthos  
B18 Zoobenthos  
B25 Birds  
B26 Mammals & reptiles  
B14 Pelagic fish  
B19 Demersal fish  
B20 Molluscs  
B21 Crustaceans

B28 Acoustic reflection on marine organisms  
B37 Taggings  
B64 Gear research  
B65 Exploratory fishing  
B90 Other biological/fisheries measurements  
H21 Oxygen  
H74 Carbon dioxide  
H33 Other dissolved gases  
H22 Phosphate  
H23 Total - P  
H24 Nitrate  
H25 Nitrite  
H75 Total - N  
H76 Ammonia  
H26 Silicate  
H27 Alkalinity  
H28 PH  
H30 Trace elements  
H31 Radioactivity  
H32 Isotopes  
H90 Other chemical oceanographic measurements

### MARINE CONTAMINANTS/POLLUTION

P01 Suspended matter  
P02 Trace metals  
P03 Petroleum residues  
P04 Chlorinated hydrocarbons  
P05 Other dissolved substances  
P12 Bottom deposits  
P13 Contaminants in organisms  
P90 Other contaminant measurements

### MARINE GEOLOGY/GEOPHYSICS

G01 Dredge  
G02 Grab  
G03 Core - rock  
G04 Core - soft bottom  
G08 Bottom photography  
G71 In-situ seafloor measurement/sampling  
G72 Geophysical measurements made at depth  
G73 Single-beam echosounding  
G74 Multi-beam echosounding  
G24 Long/short range side scan sonar  
G75 Single channel seismic reflection  
G76 Multichannel seismic reflection  
G26 Seismic refraction  
G27 Gravity measurements  
G28 Magnetic measurements  
G90 Other geological/geophysical measurements