MARINE
NATIONAL FACILITY

annual report

2011-2012

RV *Southern Surveyor*

CSIRO

Australia has the third largest marine estate of any nation, more than twice the size of the Australian continent. Recognising that blue water marine research is beyond the means of individual Australian research organisations, the Marine National Facility (MNF) was established by the Australian Government in 1980. The MNF operates Australia's only dedicated blue water research vessel that carries out research in the national interest from the tropics to the Southern Ocean.

The Marine National Facility provides researchers from organisations across Australia and their international collaborators with a world class blue water research platform. Through strategic long term investment the facility has developed a body of expertise and an equipment portfolio to support blue water research.

The facility is owned and operated by CSIRO on behalf of the Australian government. It is overseen by an independent Steering Committee that reports to the Minister for Innovation, Industry, Science and Research.

Proposals for research on the vessel are evaluated by an independent Science Advisory Committee and peer reviewed by Australian and international scientists for science quality, the ability of researchers to reach the stated objectives and how the work contributes to national benefit.

Our marine estate is extensive and largely unexplored. Australia's surrounding oceans and seas are a source of food, minerals, energy and a major driver of our climate. Ocean based industries contribute more than 10% of the nation's Gross Domestic Product – yet their potential has barely been tapped.

Marine geological events can result in tsunamis that can threaten our coastal communities and shipping.

Regions that have a high environmental value such as the Great Barrier Reef support communities through the generation of tourist income. Conservation plays a critical role in protecting biodiversity and fishing stocks.

Research improves our understanding of the marine environment and our ability to manage it more effectively.

Australia's investment in marine science is an investment in our future.

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Cover photo courtesty of Richard Arculus.

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Chairman's ADDRESS

The Marine National Facility has been in a major transition period.

A new research vessel, the *Investigator*, is currently being built and work is underway to transition operations from the *Southern Surveyor* to *Investigator*. On arrival in Hobart, the new research vessel will have remaining equipment installed, systems will be tested and staff will undergo familiarisation training. The vessel will then commence a series of commissioning voyages to fully test the capability of the vessel and that all systems are working to expectations. During this period some opportunity science will be carried out, but will not be prolonged.

Our work for the period focused on three major areas – maintaining the operational efficiency of the *Southern Surveyor*, supporting the building of the new vessel, *Investigator*, and updating policies, procedures, websites and computer systems in preparation for the commencement of operations of *Investigator*.

Building a new research vessel and all that is associated with it is a once in a lifetime opportunity for most people.

The process has involved many people from across the Australian marine research community, and international and local collaborators, contractors, and marine equipment suppliers.

The breadth of involvement and support has been impressive and reinforces the importance of the Marine National Facility as an integral part of marine research in Australia and its role in supporting international collaborations.

In January 2012 we were fortunate to have the Prime Minister visit the CSIRO Marine and Atmospheric Research laboratories in Hobart and tour the *Southern Surveyor*.

The Marine National Facility is a significant investment for the Australian Government, particularly with the building of *Investigator*, so it was a terrific opportunity to showcase our current vessel and the work we do.

In May 2011, a call for Expressions of interest for sea time on *Investigator* for the 2013-14 and the 2014-15 periods was carried out. The process was quite different to the normal application process as 2013-14 was the commissioning year for *Investigator*, and the call for 2014-15 was to gauge the interest in the first full year of science operations.

The commissioning year science operations were opportunistic with caveats that this period was to test the vessel and its equipment and voyage participants would need to accommodate these needs.

Over 35 *Expressions of interest* were received for 1155 days of sea time. Given we currently aim for approximately 180 days per year for *Southern Surveyor* and our target for *Investigator* was 300 days per year, this was an excellent result demonstrating the high level of demand for the new vessel's capabilities.

Transitioning our policies, procedures and our support systems to *Investigator* has been a large task.

The *Investigator* will be a much larger vessel with increased endurance, more berths, and increased range that enables it to operate down to the ice edge. It is also better equipped with state of the art equipment and greater flexibility for a wide range of scientific operations.

Some of the changes that impact on voyage operations include:

- Moving to multi-year applications from single year applications
- Operating down to the ice edge and remote regions of the Pacific, Southern and Indian oceans.
- Having the potential for more than one project team on the vessel due to the increased number of berths (i.e. 40 scientific berths with *Investigator* verses 15 scientific berths with *Southern Surveyor*)
- Being able to stay at sea for longer (i.e. 60 days with *Investigator* verses 26 days with *Southern Surveyor*

To reflect the new operating environment, the application system for sea time was redesigned for the 2014 - 15 application period which opened in early July 2012.

While people have been very busy with preparing for *Investigator*, science operations have continued as per normal with the *Southern Surveyor*.

Deploying and retrieving moorings was a major component of the work carried out by *Southern Surveyor* in 2011-2012.

Three voyages deployed moorings that were part of the Integrated

Marine Observing System. These moorings are very large being up to five kilometers tall stretching up from the seafloor. Some are connected to a buoy on the surface while others sit well below the surface so as not to interfere with shipping.

The moorings have instruments scattered along their length which collect data and samples. Some information may be transmitted back by satellite while the remainder is collected when the mooring is retrieved. While a vessel like *Southern Surveyor* can take measurements while in an area, the moorings sample and collect data over a long period. A mooring may be operating for two years before a return voyage collects it and its valuable data and samples.

There were three moorings deployed in the Southern Ocean and five along a transect eastward from Brisbane to monitor the East Australian Current. This current stretches from the Coral Sea along the east coast towards Tasmania, and has a significant impact on our climate and fisheries. Understanding this current is important for the management of marine resources, and how changes in the current might impact on our climate.

Off the Western Australian coast, work has been underway to better understand the recruitment of the Western Rock Lobster. The Western Rock Lobster is the largest fishery in Australia and very important to the Western Australian economy. Understanding recruitment where small early stage lobsters which have been swept out to sea are returned to the coastal areas to grow into adults is very important for the effective management of the fishery.

Studying the geology of the ocean floor has also been the focus of four voyages.

Off the Western Australian coast, hydrocarbon seepage was studied which has implications for petroleum exploration, geological storage of carbon dioxide, biological communities that live near seepage areas, and contribution of methane to the atmosphere with its consequences on climate.

The study of the northern Lau Backarc Basin provided the opportunity to better understand the interaction between the Australian and Pacific tectonic plates. Understanding this region is important as there is evidence of current magmatic and tectonic activity which has implications for earthquakes and tsunamis. These active regions also are a source of important minerals that are drawn from below the surface and form the basis of future deposits that have potential commercial application.

A voyage over the Perth Abyssal Plain, one of the least studied ocean basins around Australia, yielded a better understanding of its formation in the past.

A transit voyage between Australia and Fiji also provided the opportunity to map the sea floor to provide a better understanding of the seabed geomorphology, sediment distribution and sub-seafloor characteristics of the southern Queensland continental shelf.

Students are an important part of the MNF program. Voyages provide an excellent training opportunity for future marine scientists who may be involved in research, management, planning or one of many other vocations associated with the marine community.

On two of the voyages, the search for marine debris continued. The proliferation of plastics in our oceans is a reminder of how this vast resource can be polluted by human activities.

The composition of the MNF Steering Committee changed.

Tim Moltmann finished his term at the end of November 2011. Tim was originally an ex officio appointment for CSIRO on the committee, and after his secondment to the University of Tasmania in 2009, he became a member of the Steering Committee. I would like to thank Tim for his contribution, especially his policy work for the *Investigator*.

To broaden representation and policy input, the Chair of the Oceans Policy Science Advisory Group (OPSAG) was appointed as an ex officio member to the Steering Committee. The position was filled by John Gunn, the current Chair of OPSAG and also the Chief Executive Officer for the Australian Institute of Marine Science (AIMS).

To improve communication to stakeholders of committee decisions, a Communiqué is now being sent out after each Steering Committee meeting commencing with the meeting in April 2012.

Professor Craig Johnson took a sabbatical in France for twelve months and will return in early 2013. During this time I will be acting as Chairman for the Marine National Facility Steering Committee and Steering Committee representative on the Scientific Advisory Committee.

Professor Richard Arculus
Acting Chairman, Steering Committee
Marine National Facility

INVESTIGATOR

Construction begins

The Future Research Vessel Project to build the *Investigator* was launched in August 2009. Following a rigorous procurement process undertaken by the CSIRO, Teekay Holdings Australia Pty Ltd was awarded the contract in January 2011 to design, build and commission the new vessel.

On 31 January 2012 the Strike Steel Ceremony in Singapore at the Sembawang Shipyard commemorated the start of construction.

Once construction commenced it proceeded quickly. The vessel was constructed in blocks, which were transported to a berth and welded together.

CSIRO's CEO Dr Megan Clark talks with Mr PK Ong Managing Director of Sembawang Shipyard at the Keel Laying Ceremony in May 2012

The team at the Strike Steel Ceremony

FRV blog keeps the public informed

A Communication Officer, Sarah Schofield, was appointed to support the Future Research Vessel Project and the Marine National Facility. One of her early tasks was to establish the *Investigator@* CSIRO blog in February 2012.

This provides a running commentary on the activities of the Future Research Vessel Project and information about Marine National Facility voyages.

The blog has been very popular and an easy way for people interested in the research vessel to follow the construction process. For most of us this is a once in a life time journey!

An international effort

The building of components for the vessel has been an international effort.

The electric propulsion motor ready for shipment from Spain to Singapore and some of the team involved.

Investigator Lego®

A limited number of Lego ® ***Investigators*** have been built and used as prizes and giveaways

Prime Minister visits the *Southern Surveyor*

The Prime Minister, the Hon Julia Gillard visited the CSIRO Marine and Atmospheric Research laboratories in Hobart, toured the Marine National Facility research vessel, *Southern Surveyor* and was briefed on progress with the new vessel, *Investigator* on 16 January 2012.

Governance and management

Steering Committee

Chairman
Professor Craig Johnson*
Professor Richard Arculus*

Members
Professor Richard Arculus
Mr Greg Paten
Mr Graham Peachey
Mr John Gunn (ex-officio)**
Mr Tim Moltmann***
Ms Toni Moate (ex-officio)

* In 2012 Professor Craig Johnson left for sabbatical in France and during this period Professor Richard Arculus acted as Chairman.

** John Gunn, Chair of OPSAG attended his first Steering Committee meeting in April 2012.

*** Mr Tim Moltmann finished up his term with the Steering Committee at the November 2011 meeting. The MNF would like to thank Mr Moltmann for his valuable contribution to the Steering Committee, particularly his policy work for the *Investigator*.

Scientific Advisory Committee

Chairman
Professor Roger Bradbury

Members
Professor Craig Johnson (ex-officio) #
Professor Richard Arculus (ex-officio) ##
Professor Iain Suthers
Dr Bernadette Sloyan
Dr Diana Greenslade
Dr Miles Furnas (Alternate for Dr Kathryn Burns) #
Dr Kathryn Burns ##
Dr Peter Harris #
Dr Andrew Heap (Alternate for Dr Peter Harris) ##

2011
2012

Ship Management Team

Director
Mr Ron Plaschke

Personal Assistant
Ms Linda Gaskell

Ship Manager
Mr Stephen McCullum

Operations Manager
Mr Don McKenzie

Operations Officer
Ms Lisa Woodward

Operations Officer
Mr Aaron Shorthouse (June 2012 -)

Executive Officer
Mr Leigh Walters

Staff changes

Director appointed

Mr Ron Plaschke was appointed Director, Marine National Facility on 1 July 2011 after previously acting in the role.

New Operations Officer

Aaron Shorthouse was appointed as an Operations Officer in June 2012 to assist in the transition process to *Investigator* and the additional workload once *Investigator* commences operations.

John Gunn, Greg Paten, Toni Moate, Graham Peachey, Richard Arculus, Ron Plaschke

The Minister for Innovation, industry, Science and Research the Senator The Hon Kim Carr reappointed all members of the Steering Committee whose terms were due for renewal. To strengthen the Steering Committee, the Senator supported the recommendation by the Chairman of the Steering Committee and appointed the Chair of the Oceans Policy Science Advisory Group (OPSAG) as an ex-officio member.

Meeting Australia's National Research Priorities

Australia's marine research needs are defined by the National Research Priorities. The Australian Government sets these priorities to address the challenges facing the nation.

The four National Research Priorities are:

- An environmentally sustainable Australia
- Promoting and maintaining good health
- Frontier technologies for building and transforming Australian industries
- Safeguarding Australia

Each priority area has a suite of associated goals. Nine goals across the priority areas, appropriate to the Marine National Facility, have been selected and are considered when assessing the national benefit of applications to use the Facility.

An environmentally sustainable Australia

Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies

Goal 2
Transforming existing industries

New technologies for resource-based industries to deliver substantial increases in national wealth while minimising environmental impacts on land and sea.

Goal 4
Reducing and capturing emissions in transport and energy generation

Alternative transport technologies and clean combustion and efficient new power generation systems and capture and sequestration of carbon dioxide.

Goal 5
Sustainable use of Australia's biodiversity

Managing and protecting Australia's terrestrial and marine biodiversity both for its own value and to develop long term use of ecosystem goods and services ranging from fisheries to ecotourism.

Goal 6
Developing deep earth resources

Smart high-technology exploration methodologies, including imaging and mapping the deep earth and ocean floors, and novel efficient ways of commodity extraction and processing (examples include minerals, oil and gas) while minimising negative ecological and social impacts.

Goal 7
Responding to climate change and variability

Increasing our understanding of the impact of climate change and variability at the regional level across Australia and addressing the consequences of these factors on the environment and on communities.

Frontier technologies for building and transforming Australian industries

Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research

Goal 4
Smart information use

Improved data management for existing and new business applications and creative applications for digital technologies (examples include e-finance, interactive systems, multi-platform media, creative industries, digital media creative design, content generation and imaging).

Safeguarding Australia

Safeguarding Australia from terrorism, crime, invasive diseases and pests, strengthening our understanding of Australia's place in the region and the world, and securing our infrastructure, particularly with respect to our digital systems

Goal 1
Critical infrastructure

Protecting Australia's critical infrastructure including our financial, energy, communications, and transport systems.

Goal 3
Protecting Australia from invasive diseases and pests

Counteract the impact of invasive species through the application of new technologies and by integrating approaches across agencies and jurisdictions.

Goal 5
Transformational defence technologies

Transform military operations for the defence of Australia by providing superior technologies, better information and improved ways of operation.

Summary of voyages and national priorities 2011 – 2012

The Marine National Facility carried out two types of voyages in this period.

Research voyages

A research voyage is a program of scientific work approved by the Marine National Facility through an independent international peer reviewed process. A call for applications for sea time is made annually and Australian scientists can apply with their international collaborators. Research voyages are funded by the Marine National Facility.

Transit voyages

A transit voyage is a connecting voyage between two Research Voyages or a Research Voyage and a Research Charter Voyage. To make best use of the facility these voyages are used for opportunistic science and training of students and young scientists through the Next Wave program. The call for transit voyage applications is made annually after announcing the research voyage schedule which details any transits that are required.

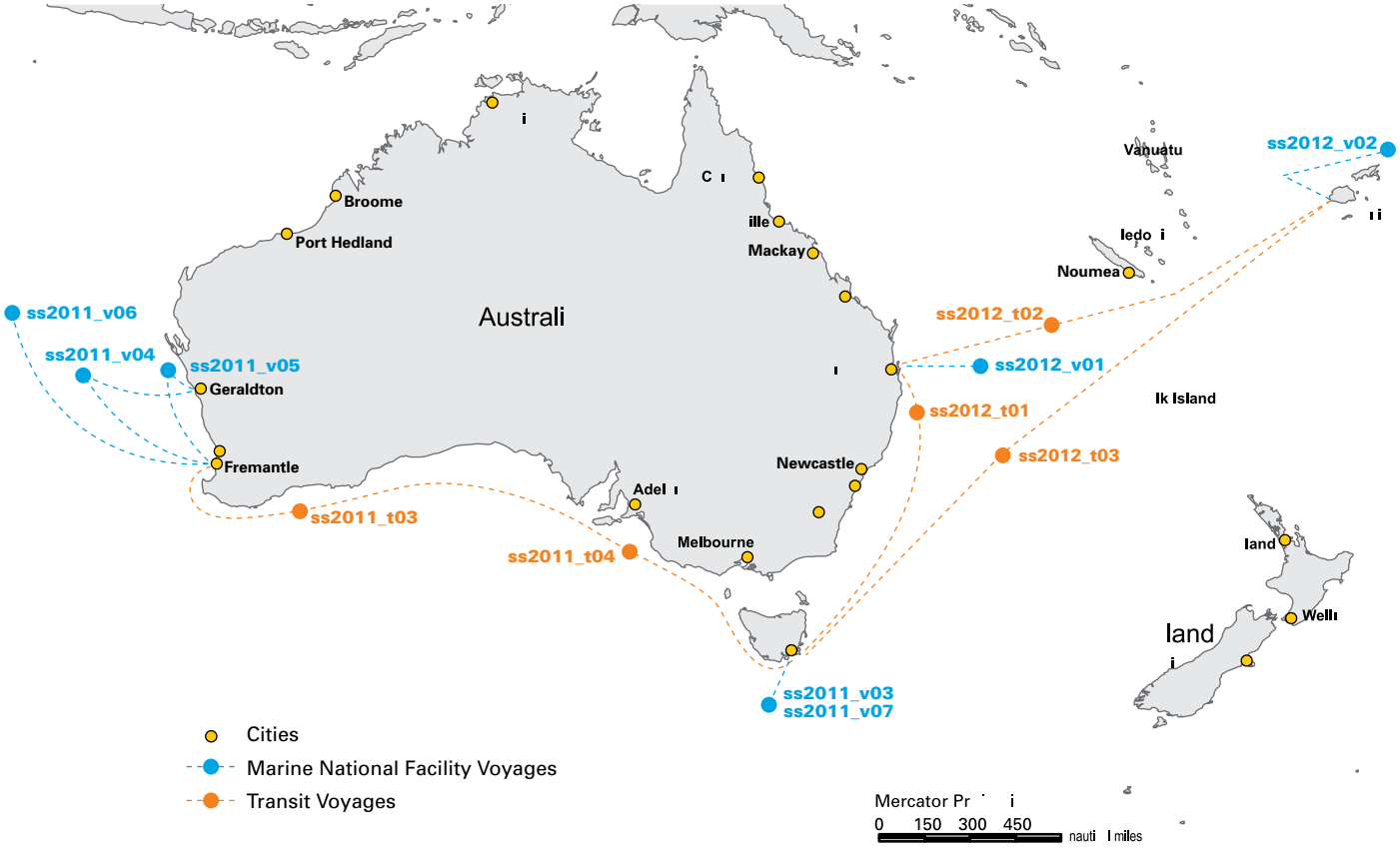
Research voyages

			NATIONAL RESEARCH PRIORITIES								
			Environmentally Sustainable Australia					Frontier Technologies	Safeguarding Australia		
Voyage	Voyage title	Lead Organisation	2	4	5	6	7	4	1	3	5
ss201_v03	Integrated Marine Observing System observations for climate and carbon cycle studies, southwest of Tasmania	ACE-CRC					■				
ss2011_v04	Biological oceanography of the Western Rock Lobster – winter/spring dynamics	University of Western Australia			■						
ss2011_v05	The influence of natural hydrocarbon migration and seepage on the geological and biological systems of the offshore northern Perth Basin	Geoscience Australia		■	■	■	■				
ss2011_v06	The Perth Abyssal Plain: Understanding Eastern Gondwana break-up	University of Sydney				■					
ss2011_v07	Integrated Marine Observing System observations for climate and carbon cycle studies, southwest of Tasmania	ACE-CRC					■				
ss2012_v01	Sustained monitoring of the East Australian Current: Mass, heat and freshwater transports	CSIRO Marine and Atmospheric Research					■				
ss2012_v02	The northern Lau Backarc Basin: Magmatism, tectonics and hydrothermal activity	Australian National University				■			■		

Transit voyages

			NATIONAL RESEARCH PRIORITIES								
			Environmentally Sustainable Australia					Frontier Technologies	Safeguarding Australia		
Voyage	Voyage title	Lead Organisation	2	4	5	6	7	4	1	3	5
ss2011_t03 *Next Wave*	The distribution of pelagic and benthic fauna along Australia's southern seaboard	University of Western Sydney			■						
ss2011_t04 *Next Wave*	2,000 years of oceanic history offshore southern Australia	Australian National University					■				
ss2012_t01	XBT fall-rate experiments using XBT/CTD inter-comparisons	CSIRO Marine and Atmospheric Research					■				
ss2012_t02	Great Barrier Reef phase shift: Gardner Bank to Gardner Reef	James Cook University			■	■	■				
ss2012_t03	Sources, distribution and fate of floating marine plastics	University of Western Australia			■					■	

Map of voyages 2011 – 2012



Research voyages

Research voyage ss2011_v03

Integrated Marine Observing System observations for climate and carbon cycle studies, southwest of Tasmania

Prof Tom Trull, Antarctic Climate and Ecosystems Cooperative Research Centre (Chief Scientist)

Two Integrated Marine Observing System moorings were deployed and one mooring recovered south-west of Hobart. These moorings improve scientists understanding of climate and carbon sequestration processes in the Southern Ocean and informs debate about the urgency of efforts to mitigate emissions that contribute to climate change.

The moorings are part of the Integrated Marine Observing System (IMOS) with data being provided via the Integrated Marine Observing System internet portal (http://portal.aodn.org.au/aodn/) to Australian and international researchers.

Importance

The information collected improves our understanding of how the oceans process carbon.

The Southern Ocean is important to global and regional climate and carbon cycling, because of its highly energetic interactions with the atmosphere, its deep mixing, and its role in connecting all the basins in the global ocean.

The development and deployment of instrumentation to observe air-sea exchanges in these waters is essential to enable informed assessment of possible changes in climate and climate variability, and in uptake of atmospheric carbon dioxide by the Southern Ocean. The physical and meteorological observations will allow testing of the parameters of air-sea interactions to better define what needs to be considered in climate models.

The information also assists in determining the accuracy and ability of climate models to adapt to different climatic scenarios.

The carbon, oxygen, and biogeochemical observations will help to determine the factors that contribute to the ability of the Southern Ocean to absorb significant amounts of anthropogenic or man-made carbon dioxide. This informs debate about the urgency of efforts to mitigate emissions.

This voyage marks the start of the first twelve month operational deployment of the Pulse mooring.

Moorings are complex to deploy

The deployment and retrieval of moorings is a complex undertaking made even more difficult by the rough sea conditions that can be experienced in the Southern Ocean.

The two moorings that were deployed 580 km southwest of Tasmania were called Pulse-8 and SAZ47-14. They are part of the Southern Ocean Time Series facility, which is a facility in Australia's Integrated Marine Observing System, and also part of the OceanSITES (www.oceansites.org/) international network of open ocean observatories.

The instruments on the moorings record information over a long period of time, something a ship cannot do.

The SAZ47 mooring has been deployed approximately annually since 1997.

An iRobot glider from the Australian National Facility for Ocean Gliders (ANFOG) was also deployed to obtain temperature, salinity, oxygen, phytoplankton fluorescence and particle backscatter measurements along a duck diving trajectory from the moorings site back to Tasmania while the *Southern Surveyor* returned to Hobart.

Addressing National Research Priorities

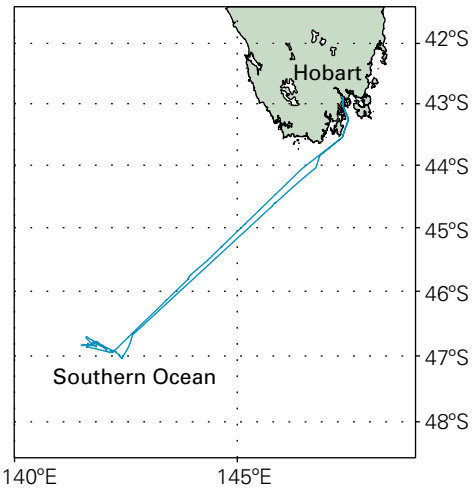
An environmentally sustainable Australia

- Goal 7: Responding to climate change and variability

Itinerary

Departed Hobart 1 August 2011
Arrived Hobart 7 August 2011

> Voyage track



> Deployment team. Left to right: Eric Schulz, David Cherry, John Howard, Mark Rosenberg, Peter Jansen, Tom Trull and Stephen Bray (Not shown: Bruce Barker, Rex Keen, Rod Langham, Nathan Arahanga). Credit: Bruce Barker

SAZ47-14

The SAZ47-14 mooring has funnel-shaped sediment traps which collect samples that allow scientists to determine how much particulate carbon and other materials are taken into the oceans interior. Clusters of deep sea floats are required to keep the mooring upright. The floats consist of heavy glass spheres which can withstand immense pressure and are protected by yellow plastic casings which can be shackled together.

Ocean sediment samples are taken at depths of 1,000 m, 2,000 m and 3,500 m.

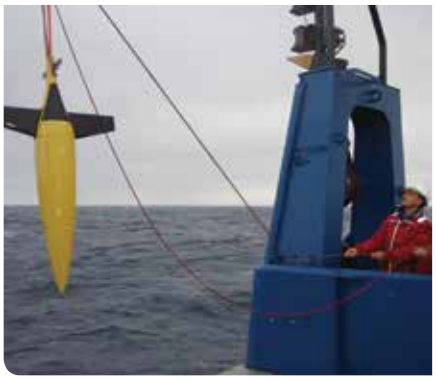
The mooring is approximately 3,745 m tall from the anchor weight that sits on the bottom to the sub-surface floats which are 855 m below the surface.

SAZ mooring deep sea floats packs prepared for deployment.
Credit: Rex Keen

Carbon sequestration

In the ocean carbon sequestration, through biological processes, results in the capture and long term storage of carbon dioxide. Organisms use carbon as they grow and their remains sink to the bottom on death adding to the ocean sediments.

This process plays an important role in the global carbon cycle.



Deployment of the ANFOG glider.
Credit: Rex Keen

Research voyage ss2011_v04

Biological oceanography of the Western Rock Lobster – winter/spring dynamics

Prof Anya Waite, University of Western Australia (Chief Scientist)

The Western Rock Lobster is the largest fishery in Australia.

Managers have recently warned that the fishery may be suffering low recruitment, with small numbers of juveniles returning to the coast to grow into adults.

Investigating the cause

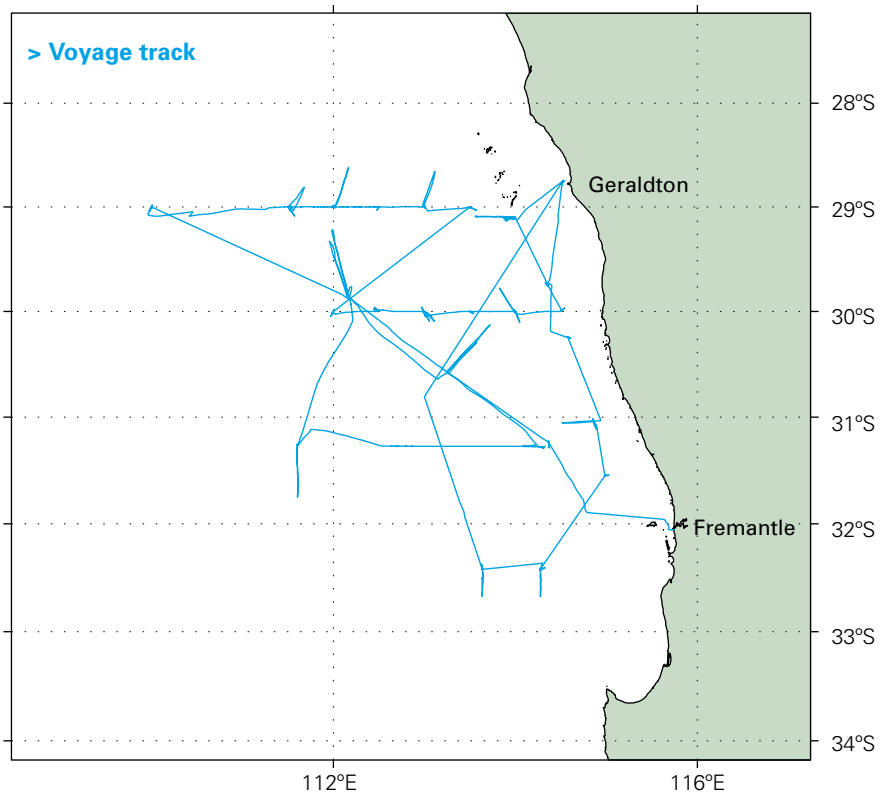
Our work investigates the environmental factors that may be responsible for low recruitment. We studied the 9 – 11 month larval stage (the phyllosoma), which are carried offshore and mixed in large rotating water masses called eddies (~200 km diameter). We collected phyllosoma in the open ocean and studied their feeding behaviour in shipboard experimental tanks. We identified a favourite food for the larvae, and are determining how their diet supports their health and nutrition.

Our work will contribute to a more evidence-based, better managed fishery by identifying key planktonic systems known to support the nutrition of larval lobsters, as well as oceanographic mechanisms transporting them back to shore.

We work closely with both Department of Fisheries and lobster aquaculturalists ensuring rapid transfer of the new knowledge to assist in the management of the fishery.

As a result of this voyage:

1. We have a better understanding of the nutrition of larval lobsters. They prefer arrow worms to other equally nutritious food, such as krill. Their nutrition may depend on the patchiness of such prey in the open ocean.
2. We found large numbers of larvae (over 1000 collected in 21 days) spread across thousands of square kilometres of open ocean. The large eddies off Western Australia often create strong landward jets, moving the larvae back to shore.
3. Mapped the intensity and location of these jets, which are visible from space via satellites and may be important for understanding success of recruitment in a particular year.
4. We plan to investigate further the movement of the larval lobsters into the offshore eddy field, as well as tracking juveniles as they mature and migrate back across the continental shelf to support a new adult population.



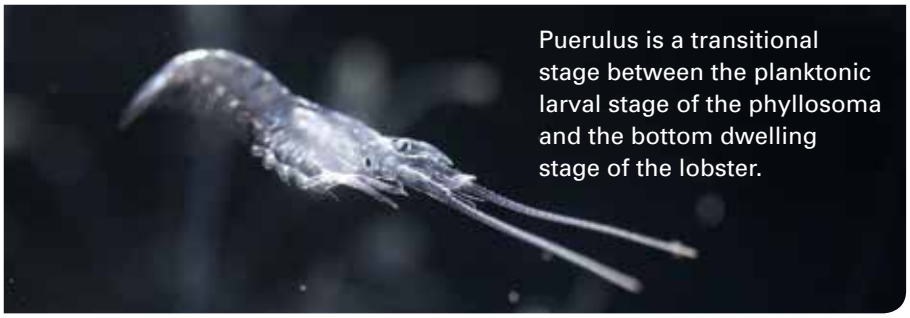
Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 5: Sustainable use of Australia's biodiversity

Itinerary

Departed Fremantle 25 August 2011
Arrived Geraldton 13 September 2011



Puerulus is a transitional stage between the planktonic larval stage of the phyllosoma and the bottom dwelling stage of the lobster.

Phyllosoma is the larval stage of the lobster and forms part of the plankton.

Tanks used to study the feeding behaviour of the phyllosoma.
Credit: Richard O'Rorke

Research voyage ss2011_v05

The influence of natural hydrocarbon migration and seepage on the geological and biological systems of the offshore northern Perth Basin

Dr Andrew Jones, Geoscience Australia (Chief Scientist)

The purpose of the voyage was to study natural hydrocarbon seepage in the offshore northern Perth Basin.

This work will improve our understanding of the development of deep sea oil and gas resources, the leaking and sealing nature of geological structures and potential implications for geological storage of carbon dioxide (CO_2), the impact of seepage on biological communities and how the seepage of methane will contribute to the carbon budget and impact on climate modelling.

Work carried out

In the first leg the marine survey mapped the shape and structure of the seabed and the structure of the sub-surface sediments within 100 metres of the seabed using multibeam bathymetry, sub-bottom profiler and sidescan sonar. Researchers from CSIRO also deployed hydrocarbon sensing equipment capable of detecting oil in seawater.

On the second leg, a remotely operated vehicle supplied by research collaborators from the Royal Netherlands Institute for Sea Research (NOIZ) and the University of Ghent, who were also on the voyage, provided many hours of underwater video footage.

There were also 15 gravity cores and 58 sediment grabs to sample surface and sub-surface sediments.

Contribution to Australia's national benefit

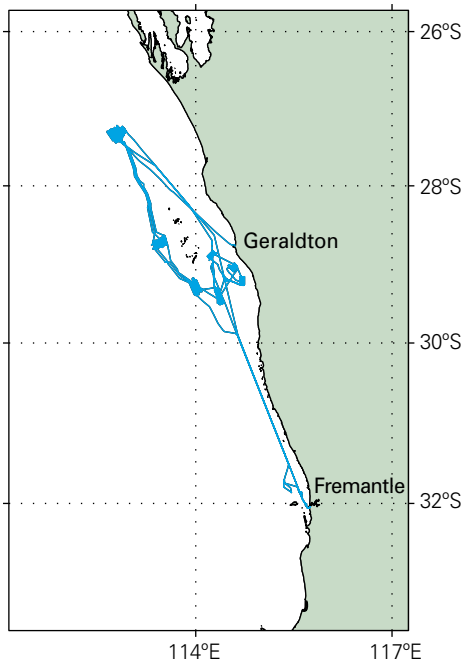
The research outcomes have many potential benefits.

- Mapping and quantifying natural hydrocarbon seepage in the offshore northern Perth Basin may assist in understanding the effectiveness of petroleum systems and integrity of hydrocarbon traps, which could influence the petroleum prospectivity of the region.
- Understanding the sealing or leaking nature of geological structures and faults within the Perth Basin may facilitate more effective selection of potential sites for geological storage of CO_2.
- Potential sites of natural seepage may be found to support biological communities that rely on chemosynthesis of the seeping hydrocarbons as their primary source of energy. Biological data characterising seepage sites could be utilised in considering future Marine Protected Areas (MPAs) for Australia's southwest margin.
- Understanding the input of methane from natural hydrocarbon seepage to the carbon budget will increase the certainty in future climate modelling scenarios.

As a result of the voyage:

1. We have a better understanding of the nature and spatial distribution of potential natural hydrocarbon seepage in the offshore northern Perth Basin, which informs us about the effectiveness of the petroleum systems within this part of the basin, and the influence on benthic habitats along this part of Australia's southwest margin.
2. We have found that natural hydrocarbon seepage, if present at all, is rare in the offshore northern Perth Basin, and that such a low level of seepage is unlikely to have an impact on geological or biological systems or anthropogenic activities in the region.

> Voyage track



3. We have mapped, in the northern part of the survey area, multiple lines of evidence consistent with known natural hydrocarbon seepage, including potential fluid migration pathways through the strata below the seabed, hydro-acoustic flares in the water column, and pockmarks and carbonate blocks on the seabed.
4. We have commenced a program of analysing sediment and biological samples in order to provide further evidence that may support a natural hydrocarbon seepage interpretation for the northern part of the study area, or may reveal low-level seepage not identified during the survey.

Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 4: Reducing and capturing emissions in transport and energy generation
- Goal 5: Sustainable use of Australia's biodiversity
- Goal 6: Developing deep earth resources
- Goal 7: Responding to climate change and variability

Itinerary

Leg 1

Departed Geraldton 21 September 2011
Arrived Fremantle 3 October 2011

Leg 2

Departed Fremantle 4 October 2011
Arrived Fremantle 18 October 2011

The Smith McIntyre Grab is used to collect sediments from the ocean floor. Credit: Geoscience Australia

Deep Underwater Camera used to view hydrocarbon seepage on the back deck prior to deployment. Credit: Geoscience Australia

Hydrocarbon seepage at 545 metres (extracted from video).
Credit: Geoscience Australia

Research voyage ss2011_v06

The Perth Abyssal Plain: Understanding Eastern Gondwana break-up

Dr Simon Williams, University of Sydney (Chief Scientist)

The Perth Abyssal Plain is one of the more poorly understood ocean basins surrounding Australia.

The aim of the voyage was to collect magnetic, bathymetric and dredge data to address knowledge gaps regarding the:

1. Crustal nature of prominent features in the basin.
2. Tectonic mechanism/s responsible for forming the basin and its prominent structures.
3. Timing of the formation of the basin and prominent structures.

Outcomes

The survey achieved its scientific aims including the collection of six magnetic anomaly profiles across the Perth Abyssal Plain, and the collection of swath and dredge data from seven sites on the Batavia Knoll, Gulden Draak Ridge, and Dirck Hartog Ridge. Continental rocks were recovered from the Batavia Knoll and Gulden Draak Ridge demonstrating that these features are micro-continents rifted from India during breakup between Australia and India.

As a result of this voyage:

1. We have found that the Batavia Knoll and the Gulden Draak Ridge are continental in nature, while the Dirck Hartog Ridge is likely a purely oceanic feature.
2. We have a better understanding of the seafloor spreading processes that formed the Perth Abyssal Plain and led to the formation of the Batavia and Gulden Draak micro-continents, as well as the Dirck Hartog Ridge, and the distinctive trough north of the Batavia Knoll.
3. We have mapped both bathymetric and magnetic anomaly signatures across the previously under-surveyed Perth Abyssal Plain, and collected rock samples from 7 locations to understand the crustal nature of the seafloor.
4. We have commenced programs of;
   a. magnetic anomaly processing and interpretation; and
   b. analyses of the rock samples obtained to understand the timing and mechanism of their formation. Together these data will enable us to refine tectonic reconstructions of India-Australia separation, which formed the Perth Abyssal Plain, as well as providing insights into geological events that shaped western Australia over a billion years before Gondwana breakup.

Addressing National Research Priorities

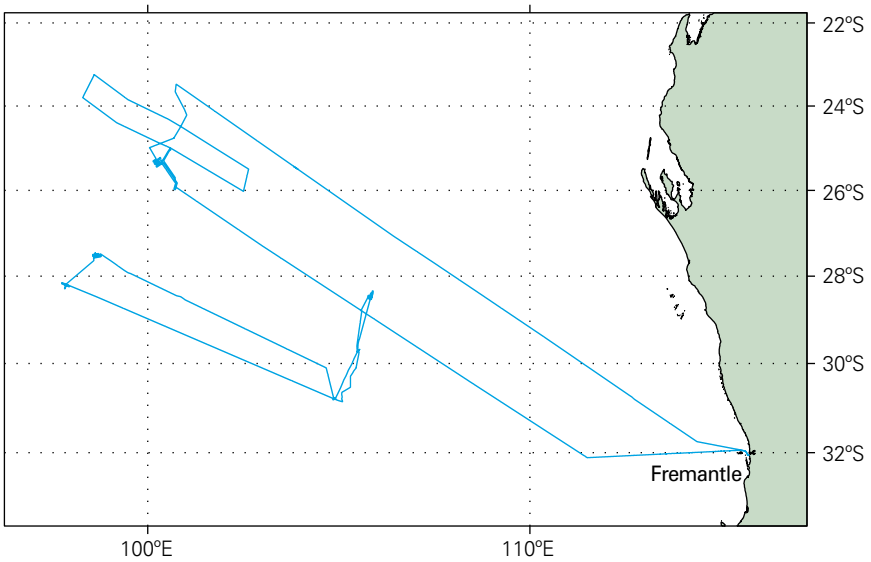
An environmentally sustainable Australia

- Goal 6: Developing deep earth resources

Itinerary

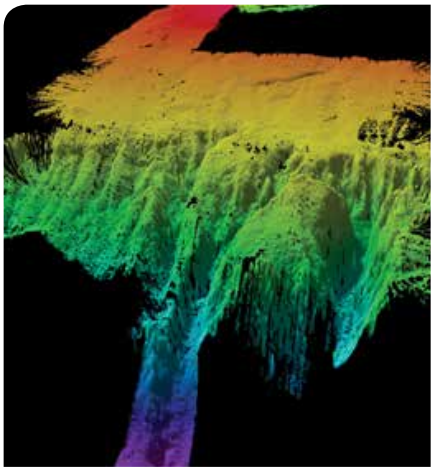
Departed Fremantle 20 October 2011
Arrived Fremantle 9 November 2011

> Voyage track



Rocks dredged from the seafloor.
Credit: Robyn Gardner

Associate Professor Nathan Daczko and Robyn Gardner cataloguing and classifying dredged rocks.
Credit: Jacqui Halpin



Canyons on the western flank of the Batavia Knoll – one of the submarine continental landmasses.
Credit: Tara Martin

Research voyage ss2011_v07

Integrated Marine Observing System observations for climate and carbon cycle studies, southwest of Tasmania

Dr Eric Schulz, Bureau of Meteorology (Chief Scientist)

This voyage marks the second deployment of the Southern Ocean Flux Station (SOFS) mooring and is part of the Integrated Marine Observing System.

The SOFS-2 mooring will be deployed to obtain in-air and in-sea measurements to better understand the exchange of heat, moisture, and gases between the ocean and atmosphere.

The flow of heat and mass is a measure of the ocean atmosphere interaction that controls climate variability and water mass formation on a range of scales.

Carbon dioxide is transported from the surface waters down to the ocean interior in the form of sinking particles. This "biological pump" drives carbon sequestration from the atmosphere, and writes the sedimentary record.

The controls on its intensity are complex and involve processes that vary on daily, weekly, seasonal, and inter annual timescales. Obtaining observations with the necessary frequency is not possible from ships. For this reason the Integrated Marine Observing System Southern Ocean Time Series Facility seeks to obtain this information using automated sensor measurements and sample collections using moorings such as SOFS-2.

The deployment was successful and additional time was spent mapping the ocean floor for future Pulse and SOFS mooring sites.

Addressing National Research Priorities

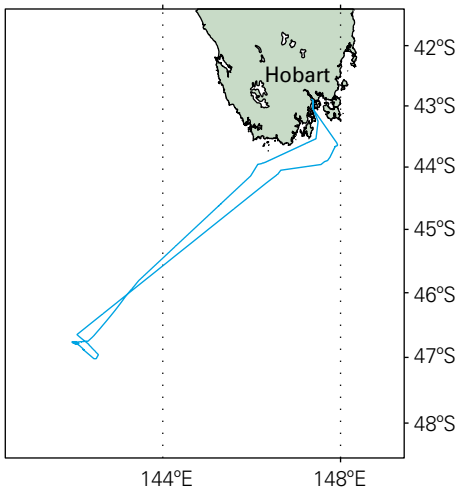
An environmentally sustainable Australia

- Goal 7: Responding to climate change and variability

Itinerary

Departed Hobart 22 November 2011
Arrived Hobart 27 November 2011

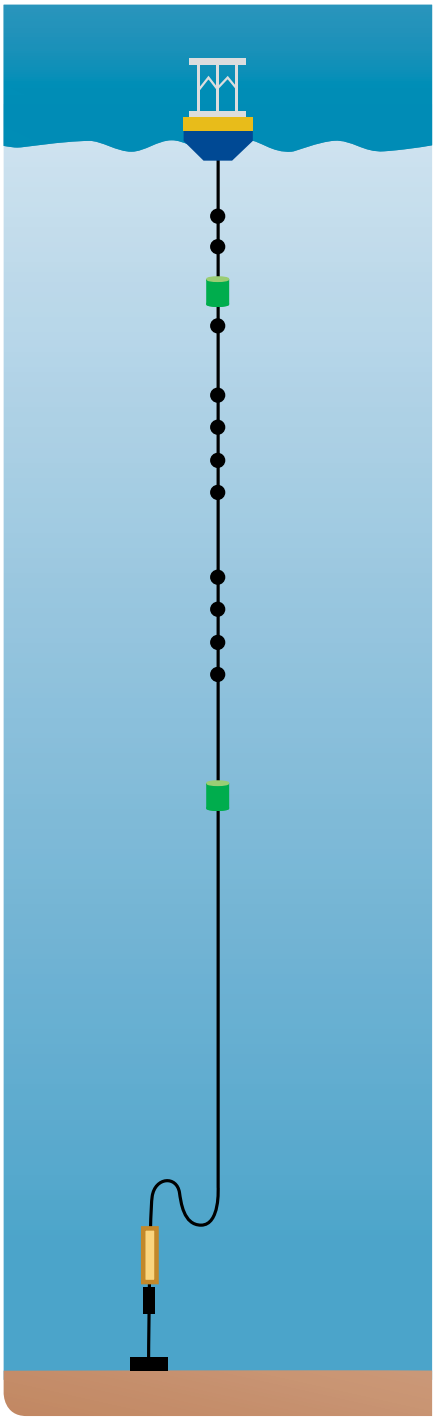
> Voyage track



This voyage is part of a series of voyages to support SOFS (ss2012_v02, ss2011_v01, ss2011_v07, ss2012_v03, ss2013_v06) **and also the other IMOS SOTS moorings at the site** (ss2010_v07, ss2011_v03).

The SOFS-2 surface float being deployed from the *Southern Surveyor*.
Credit: Eric Schulz

The SOFS-2 mooring in position after being deployed. Credit: Eric Schulz



The SOFS-2 mooring stretches from the ocean surface to the seafloor – 4,550 metres. Instruments are located along the length of the mooring

Research voyage ss2012_v01

Sustained monitoring of the East Australian Current: Mass, heat and freshwater transports

Dr Ken Ridgway, CSIRO Marine and Atmospheric Research (Chief Scientist)

The East Australian Current (EAC) stretches from the Corel Sea to east of Tasmania and is about 100 km wide, can reach speeds of seven knots and moves up to 30 million cubic metres per second. The current moves warm water from the Coral Sea down the east coast of Australia.

The aim of the voyage was to deploy an array of five full-depth current meter and property (CTD) moorings extending approximately 240 km from the continental shelf to the abyssal waters off Brisbane to study the EAC. At this location the EAC is approaching its maximum strength and its flow is relatively uniform and coherent. The moorings will measure the current and how it varies over time.

East Australian Current

The EAC is the largest ocean current in the Australian region, influences the environment along the east coast and plays a central role in the global circulation system which impacts on our climate.

The mooring array is part of the Integrated Marine Observing System and will contribute directly to a proposed global network of boundary current arrays.

Deploying the moorings

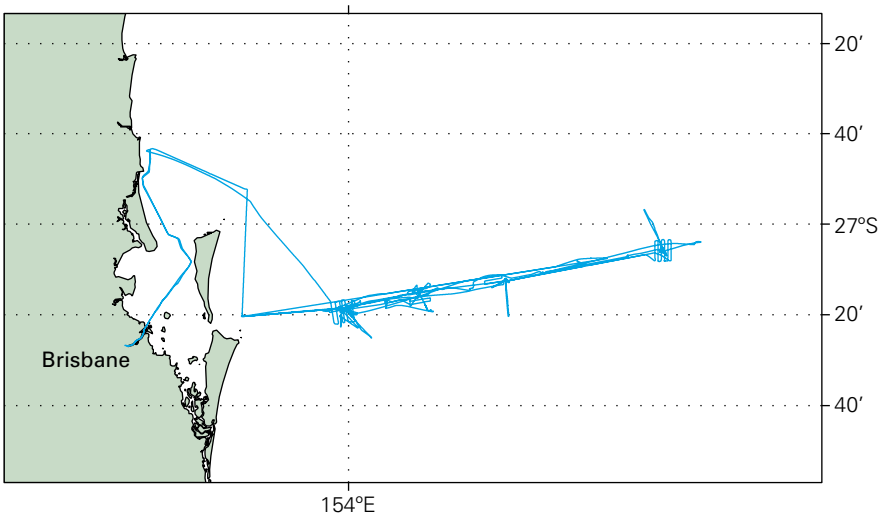
Prior to deploying the moorings the ocean floor at each location was surveyed to determine a flat area of sufficient size. This was particularly important for the two inshore moorings as they were located on the continental shelf and there were a limited number of suitably flat sites.

The moorings will be recovered in 18-24 months at which time the data from the instruments will be collected and analysed.

Benefits of the work include:

1. The provision of data for heat and freshwater budgets around Australia to determine the oceanic influence on climate.
2. Better understanding of observational constraints on operational programs (*BLUElink, ACCESS*).
3. In situ data for coastal studies and coastal ocean state estimate systems.
4. Observations to link biological diversity and productivity to physical and chemical processes.
5. Understanding climate change impacts on marine ecosystems.

> Voyage track



As a result of this voyage:

1. We have a better understanding of the EAC off Brisbane from the CTD, ADCP and LADCP data collected on this voyage. These results will be included in an initial paper. A far more comprehensive understanding will await the retrieval of all moorings.
2. We have found that the observed vertical and horizontal structure of the EAC during April confirms the results obtained from BLUElink ocean models which were used to design the array. The complete results from the voyage will only be obtained after the array is retrieved in two years time.
3. We have mapped the bottom topography at each mooring site at high resolution. This will facilitate future retrievals and deployments of the EAC moorings.
4. We have commenced a program of monitoring the mass, heat and freshwater transport of the EAC. The moorings will be in place for 18-24 months before retrieval and data processing and analysis. Some form of observing array will be maintained at this location in a two year ongoing mode.

Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 7: Responding to climate change and variability

This project also addresses the theme, *Improving the understanding and prediction of ocean currents and the links between large-scale offshore variability and the response of the Australian shelf/slope boundary current system* in the Integrated Marine Observing System (IMOS) Science Plan.

Itinerary

Departed Brisbane 20 April 2012
Arrived Brisbane 29 April 2012

Scientists and mooring team check the equipment prior to loading on the ship. Credit: Sarah Schofield

The team prepares for the deployment of a mooring. Credit: Ken Ridgway

Research voyage ss2012_v02

The northern Lau Backarc Basin: Magmatism, tectonics and hydrothermal activity

Prof Richard Arculus, Australian National University (Chief Scientist)

The voyage to the northern Lau Backarc Basin was to study a region where the relative motion between the Australian and Pacific tectonic plates is particularly complex.

The types of volcanic and mineralising activity occurring in this zone are a modern example of the processes which have combined in the geological past to create some of Australia's greatest mineral wealth.

Work carried out

The areas of interest were surveyed with multibeam sonar swath mapping and dredge sites identified. Dredging recovered a wide range of samples that were analysed back on land both in Australia and overseas.

Water samples and measurements were collected at different depths using a CTD package and these helped identify three major hydrothermal plumes. A hydrothermal plume is generated by heated sub-surface rocks through which circulating water is exchanged, and the resulting heated brine is ejected from the sea floor in the form of plumes of heated water; a rapid drop in temperature as the plume encounters sea water at ambient temperature triggers precipitation of many ore-bearing minerals.

Expanding our knowledge

The voyage improved our understanding of the tectonic processes within the area investigated.

The study also identified the products of seafloor mineralising activity which are potentially of commercial interest.

In addition, important information was gathered for the modelling of ocean circulation from samples collected adjacent to mineralising hot springs and as part of a broad study of movements of water masses in the south-western Pacific.

As a result of this voyage:

1. We have a better understanding of the way the Australian and Pacific tectonic plates interact around the north of the Fijian islands, linking zones of extremely rapid crustal formation and magmatic eruptions with accompanying mineralising hot-spring activity.
2. We have found zones of current magmatic and tectonic activity with implications for earthquake and tsunami activity, and potential precious and base metal-rich hot-spring activity.
3. We have mapped eight zones where new sea floor is being created with accompanying crustal extension and faulting, extending for a distance of ~1000km in an east-west direction north of the Fijian islands.
4. We have commenced a program of analytical geochemistry including trace elements and isotopic characteristics of the dredged natural volcanic glasses and rocks, and water samples obtained over the full range of ocean depths.

Addressing National Research Priorities

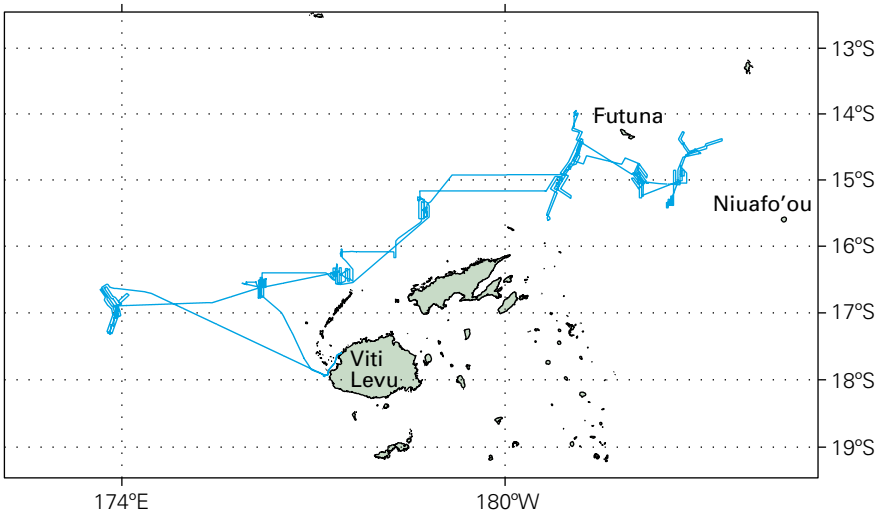
An environmentally sustainable Australia

- Goal 6: Developing deep earth resources

Itinerary

Departed Lautoka, Fiji 12 May 2012
Arrived Lautoka, Fiji 5 June 2012

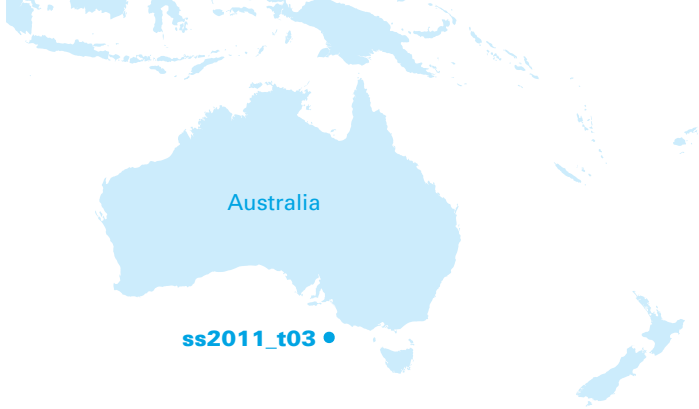
> Voyage track



Scientific staff and marine crew sorting volcanic rocks samples recovered to the aft deck. Credit: Karl Forcey

Wide angled view of the Wet Laboratory with the CTD package in the foreground. Credit: Richard Arculus

Transit voyages



Research voyage ss2011_t03

The distribution of pelagic and benthic fauna along Australia's southern seaboard

Dr Sebastian Holmes, University of Western Sydney (Chief Scientist)

The transit voyage provided the opportunity for students and researchers carry out research.

Student objectives

The students characterised the macro-fauna inhabiting the benthos at a range of depths along Australia's southern coast and investigated the regional surface productivity and studied the distribution of pelagic organisms along the southern shelf of Australia.

The students work program provided them with a taste of what it was like to live and work on an ocean going research vessel and exposed them to some of the different sampling methods and equipment used in oceanographic research.

The work carried out by the students contributed to their PhDs.

Mapping

The voyage also provided the opportunity for research scientists to use vessel transit time to complete mapping of the upper-mid slope seabed for this region with multi-beam mapping and associated ecological interpretation.

The upper-slope and mid-slope seabed 100 m to 1,500 m depth range, are regions important for regional marine planning, biodiversity and conservation assessments and fisheries habitat mapping.

The multi-beam mapping was also part of the student activities.

Marine debris

For another scientist the transit voyage provided the opportunity to further her study of the distribution, abundance and composition of floating marine debris around Australia.

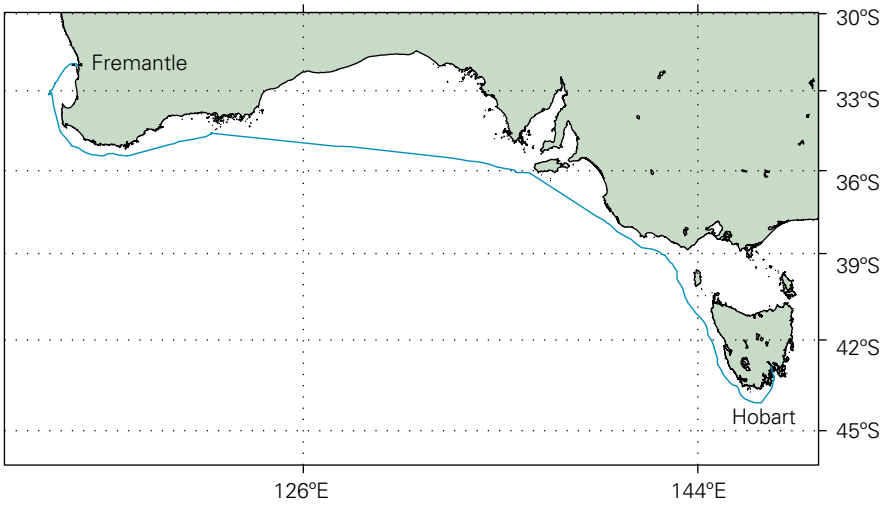
Marine debris is a major hazard to marine life and leads to aesthetic degradation, economic losses and human health hazards. Our understanding though of the distribution and content of marine debris in our oceans has been limited.

Determining the amount, distribution and types of plastics present in Australian waters will allow us to estimate the potential impact of plastic refuse on the Australian marine environment.

As a result of this voyage:

1. We have a better understanding of the distribution of buoyant plastics in Australia's offshore waters, the isotopic signatures (C13/N15) of both surface and sediment POM and the nature of the seafloor (at the 500 m isobath) along Australia's southern seaboard.

> Voyage track



2. We have found that there is a considerable amount of buoyant plastics present in offshore waters and identified some interesting deep water reefs off Esperance.
3. We have mapped the 500 m isobath along the whole continental shelf of the southern seaboard of Australia, from Hobart to Freemantle.
4. We have commenced a program of examining the links between surface productivity and benthic productivity.
5. We have quantified the distribution, amount and types of buoyant plastic debris in Australian waters.

Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 5: Sustainable use of Australia's biodiversity

Itinerary

Departed Hobart 12 August 2011
Arrived Fremantle 23 August 2011

Fishing for plastic with a Neuston net.
Credit: Sebastian Holmes

The blog provides an interesting way of engaging those who were not on the voyage.

Research voyage ss2011_t04

2,000 years of oceanic history offshore southern Australia

Prof Patrick De Deckker, Australian National University (Chief Scientist)

The goal of the voyage was to reconstruct past sea-surface temperatures in the ocean along the southern margin of Australia across a large temperature gradient for comparison with northern hemisphere records spanning the last millennium.

Work carried out

We have obtained a series of short sedimentary archives that predate the instrumental record that will enable us reconstruct past sea-surface temperature records along the southern Australian margin, including the west coast of Tasmania. We sailed through a 10° latitude gradient. This is the first time that sediment/water interface samples have been obtained from this region except for three short cores taken in the Murray Canyons Group area.

Once we have made our measurements on those sedimentary archives, we will be able to contribute to a global network of past temperature records that will help our understanding of climatic signals and help better predict future variability.

Tubes containing sediments and water above them [as seen on left] are examined in the laboratory.
Credit: Ashley Burkett

Outcomes

Our results will eventually be compared with those obtained after our previous transit voyage [ss2011_t01] held in May 2011 and for which we already have determined sedimentation rates and sea-surface temperature changes over the last three centuries. Preliminary results from the Tasman Sea show little temperature changes in waters south of Brisbane, extensive changes in the region south of Sydney, and less pronounced changes offshore northern Tasmania.

As a result of this voyage:

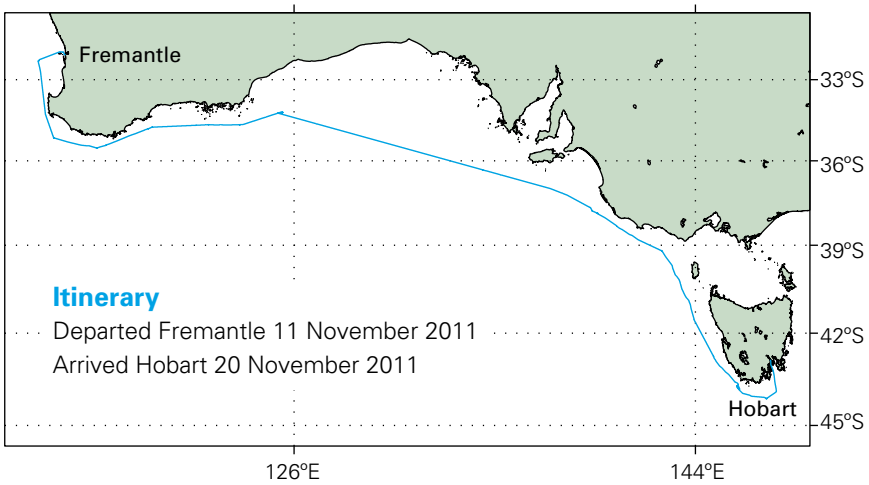
1. We will have a better understanding of past sea-surface temperature changes offshore southern Australia. In parallel, we have obtained benthic samples for examination of the foraminifera assemblages that may inform us on the nature of the nutrients on the sea floor.
2. We have found that the sea floor at numerous locations consists of biogenic sand, suggesting therefore that bottom currents are active otherwise we would have found much finer grained material.
3. We have mapped a canyon/undersea slide along the south western corner of Tasmania.
4. We will be able to establish sedimentation rates on the sea floor at selected sites.
5. We also collected water samples along a deep profile off the west coast of Tasmania that will be dated using radiocarbon in order to understand the age of the different water masses. The data will be used for comparison against ages of deep-sea corals recently collected for an ANU PhD student's thesis.

Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 7: Responding to climate change and variability

> Voyage track



Research voyage ss2012_t01

XBT fall-rate experiments using XBT/CTD inter-comparisons

Rebecca Cowley, CSIRO Marine and Atmospheric Research (Chief Scientist).

The aim of the voyage was to assess the fall-rate and temperature biases of modern expendable bathythermographs (XBTs). The results from the XBTs will be compared to the high accuracy CTD system.

A number of old (1980-2003) XBT probes were also deployed to enable a comparison with modern probes.

The work will help answer the questions:

1. Do modern XBTs have temperature and depth biases?
2. Do older XBTs (circa 1980-2003) show similar temperature and depth biases to those found in previous work?
3. Can we use depth soundings to check depth accuracy, and how do these results compare with the CTD/XBT inter-comparison method?

As a result of this voyage:

1. We have a better understanding of the historical fall rate of Expendable BathyThermographs, which are routinely used for upper-ocean temperature measurements by science agencies (such as CSIRO) and Navies worldwide. The XBT is a simple instrument with a thermistor in the nose that measures temperature as the probe falls through the water, passing the information to the surface via a thin copper wire. Calculation of the depth is based on a fall-rate equation. Variations in manufacture over time have resulted in variations in fall rate in the XBT. The data collected from XBTs since they were first used in 1966 comprises some 18% of available ocean temperature data. Since the historical ocean temperature record is used in modelling for climate prediction and estimates of sea-level rise, errors in the XBT data can have a large impact on these calculations. We will be able to use the results of these XBT/CTD intercomparisons to help pin down estimates of XBT fall rates from 1983-2003 for some Sippican probe types, and hence provide a correction to the historical XBT data set.
2. We have found that the construction of the older XBTs (pre-2003) results in a larger number of failures since the copper wire in these older probes easily tangles during shipping. When an XBT fails due to cracks or kinks in the copper wire, the temperature profile tends warm. This false warming, if not removed from the historical data record, can result in warmer estimates of ocean temperature. More modern probes have a better construction, resulting in less warm failures.
3. We will be testing a method of determining the fall rate of XBTs using the depth sounder and 'hit bottom' signals on the XBT trace. By comparing the depth sounder information with this signal, we can estimate the fall rate. We will also use a well-known method of determining the fall rate of XBTs by using the CTD data and comparing the small changes in temperature with depth between the two instruments. Each method has its' advantages and disadvantages, and by using a combination of both, we will be able to utilise all the results, including from the failed XBTs.

Addressing National Research Priorities

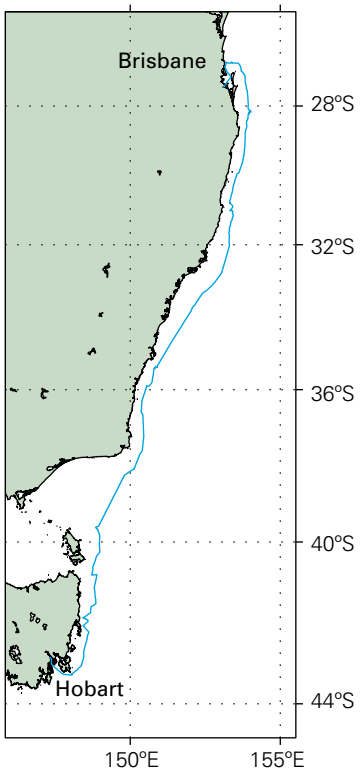
An environmentally sustainable Australia

- Goal 7: Responding to climate change and variability

Itinerary

Departed Hobart 11 April 2012
Arrived Brisbane 18 April 2012

> Voyage track



Research voyage ss2012_t02

Great Barrier Reef phase shift: Gardner Bank to Gardner Reef

Dr Robin Beaman, James Cook University (Chief Scientist)

"On a global scale, coral reefs are experiencing a period of rapid change. The world has effectively lost 19% of the original area of coral reefs since 1950, with the loss predicted of 35% of coral reefs in the next 40 years." (Wilkinson, 2008).

The vulnerability of coral reef habitats to climate change is high as corals are highly sensitive to increasing sea temperature and ocean acidification. The increased frequency of coral bleaching due to further increases in sea surface temperature (SST) will cause a decline in coral cover, increases in algal dominance, and shifts towards species that are more thermally tolerant.

Exceptions to this pattern may occur at the southern limits of the Great Barrier Reef where tropical carbonates transition into temperate carbonates.

The observed shift of average marine climate zones south by >200 km since 1950 could potentially result in the Great Barrier Reef extending south, causing an algal to coral phase shift as coral settlement follows the changing environmental gradient.

Understanding the transition

This project contributes new high-resolution maps, and information about the seabed geomorphology, surficial sediment distribution, and sub-seafloor character of the southern Queensland continental shelf.

The high resolution maps will provide vital baseline data for future environmental surveys that will ground truth the area for associated benthic marine life.

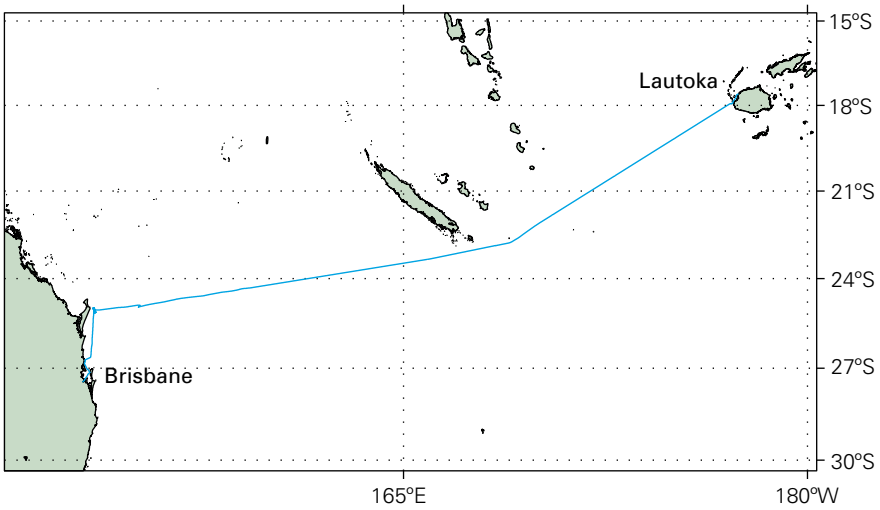
The data collected by this voyage will be used to investigate the extent, structure and morphology of this potentially important site lying within the tropical/ temperate marine climate zone.

Additionally, the continuous multibeam data acquired between Australia and Fiji contributes to understanding the shape and sub-surface nature of the deep seafloor.

As a result of this voyage:

1. We have a better understanding of the geomorphic extent and substrate that comprise the Fraser shelf area. This information will help us to understand the substrate limitations that would largely control any future extension of the southern Great Barrier Reef, such as a phase shift from an algal- to coral-dominated environment.
2. We have found an extensive area of hard substrate on the Fraser shelf, with a seabed surface covered in small pinnacles. We have also found the detailed geomorphology, or shape, of the North Recorder Seamount, in addition to numerous small volcanoes on the seafloor between Australia and Fiji.

> Voyage track



3. We have mapped an extensive area of the Fraser continental shelf comprising the shallow Gardner Bank and surrounding hard substrate seafloor. Additional mapping was conducted over the North Recorder Seamount in the Tasman Basin, and then continuously over mostly unmapped seafloor between Australia and Fiji.

4. We have commenced a program of marine geophysical data analysis that will generate 3D bathymetry and sub-surface models of the Fraser continental shelf in the vicinity of Gardner Bank. The models will be used to fine-tune a detailed sediment facies map for the area, which can be used in future surveys.

Addressing National Research Priorities

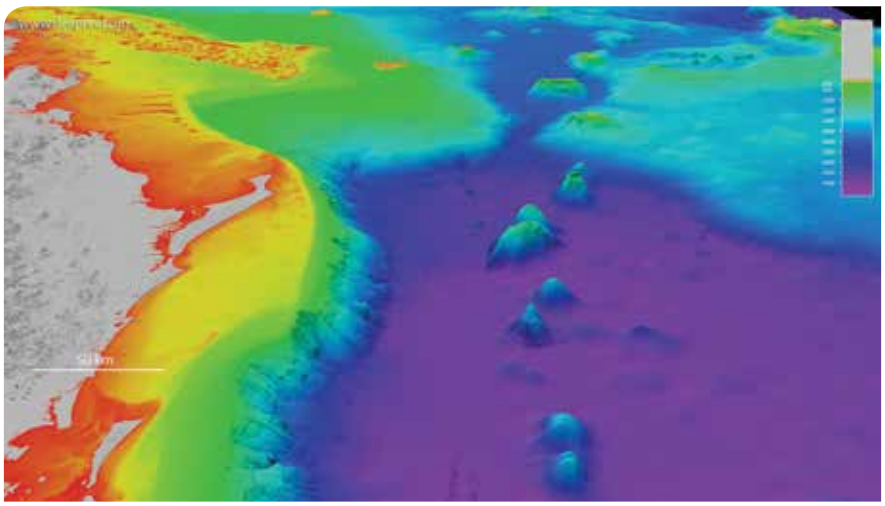
An environmentally sustainable Australia

- Goal 5: Sustainable use of Australia's biodiversity
- Goal 6: Developing deep earth resources
- Goal 7: Responding to climate change and variability

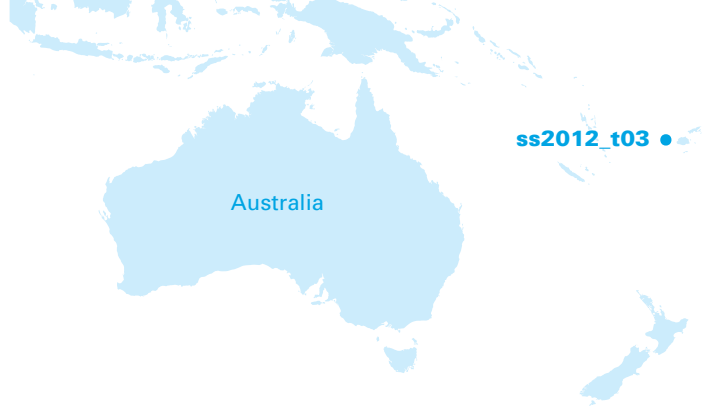
Itinerary

Departed Brisbane 3 May 2012
Arrived Lautoka 10 May 2012

The research team. Credit: Robin Beaman



3D view of the Fraser continental shelf, site of the Gardner Bank shallow-water survey, and the Tasmantid Seamounts extending through the Tasman and Coral Seas. Credit: Robin Beaman



Research voyage ss2012_t03

Sources, distribution and fate of floating marine plastics

Ms Julia Reisser, University of Western Australia & CSIRO Wealth from Oceans Flagship (Chief Scientist)

Floating marine plastics have become a major hazard to marine life and are also leading to aesthetic degradation, economic losses and human health hazards. Due to these issues, monitoring studies are needed to assess the effectiveness of governments' actions in reducing the overall amount of marine plastics in Australia.

Research

For the first time, floating marine plastics were systematically sampled in waters close to the Australian continent. The data will provide information to identify sectors and regions that contribute most significantly to the increase in marine plastic pollution, facilitating the government's ability to address this threat via national and international negotiations.

Better management plans to decrease marine plastics hazards to marine life and humans can be delivered through a better understanding of marine plastics' composition, spatial distribution and origins.

Importance

Marine plastic debris has become a major hazard to marine life through ingestion (causing death and intoxication) and entanglement.

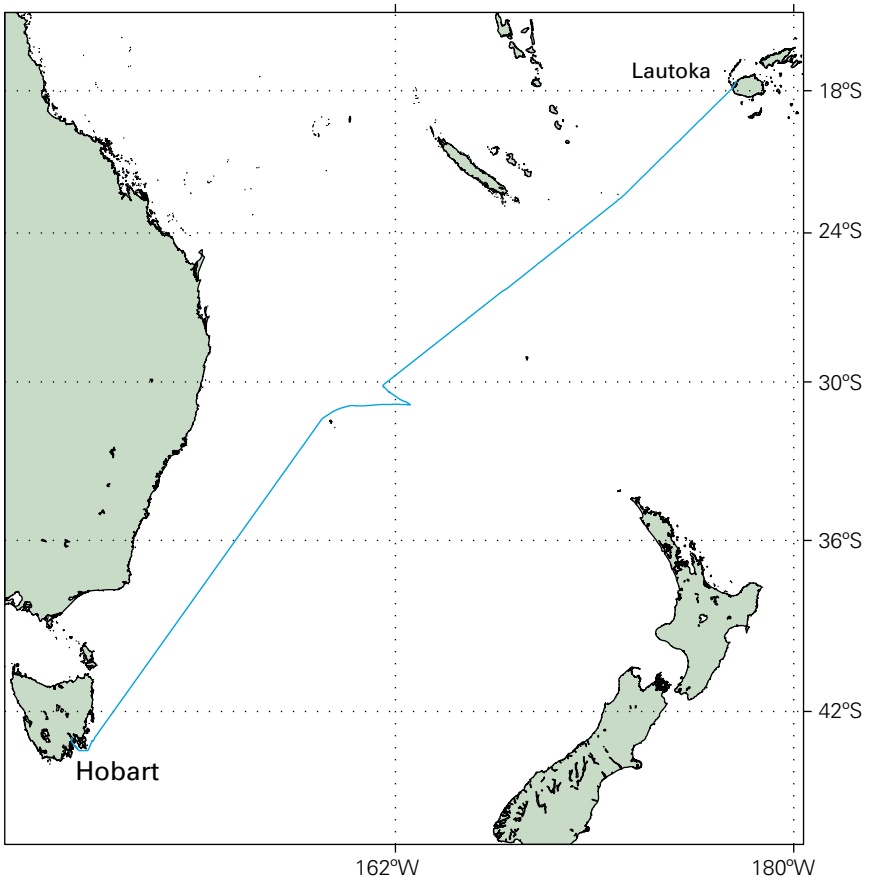
Some plastics are toxic to humans, particularly to infants and children. Marine plastics can contain toxins from the plastic itself (i.e. phthalates) and from additional contaminants absorbed from the surrounding seawater (i.e. PCBs). The plastics pose a toxic threat to the food chain and some seafood might have toxins coming from the plastics.

Floating marine plastics can also carry invasive species from one location to another, as they are a long-lived hard substrate that allows the transfer and movement of marine organisms and eggs.

As a result of this voyage:

1. We have a better understanding of the spatial distribution of floating marine plastic in waters close to the Australian continent. Future analyses will give us; (1) the types of polymer that occur in these waters and (2) the probable origin of these plastics.

> Voyage track



2. We have found that marine plastics in Australia are coming from national and international sources.
3. We have mapped plastic concentration at the oceans' surface in waters close to Australia through the execution of one hundred and twenty nine 15 minute net tows.
4. We have commenced a program of at-sea floating marine plastic monitoring study.

Addressing National Research Priorities

An environmentally sustainable Australia

- Goal 5: Sustainable use of Australia's biodiversity

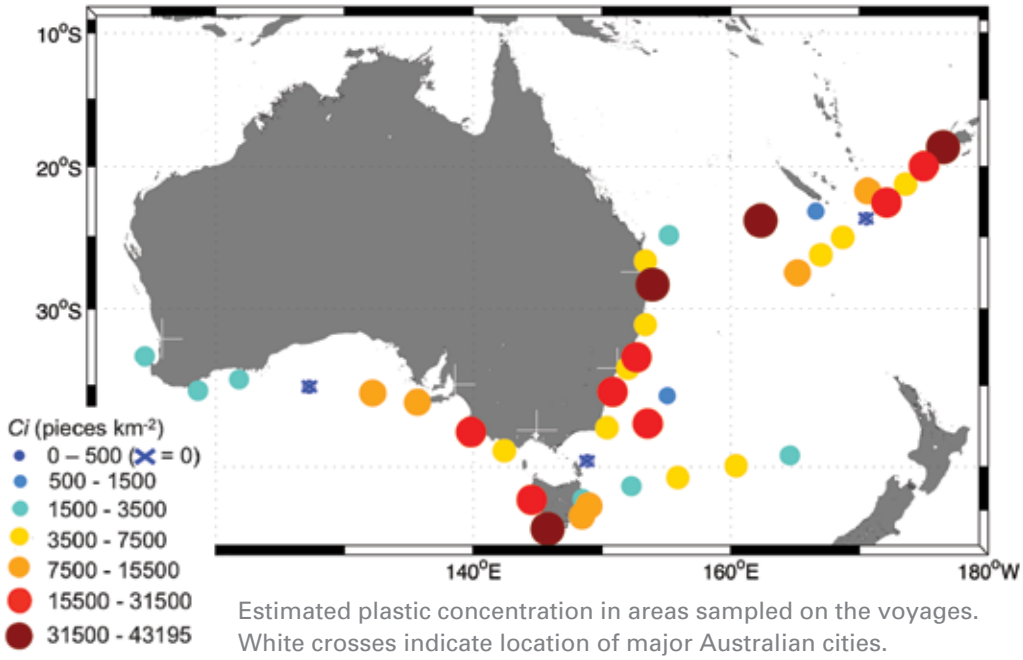
Safeguarding Australia

- Goal 3: Protecting Australia from invasive diseases and pests

Itinerary

Departed Lautoka, Fiji 7 June 2012
Arrived Hobart 18 June 2012

Manta net being towed by *Southern Surveyor* to collect plastics



Estimated plastic concentration in areas sampled on the voyages. White crosses indicate location of major Australian cities.

News

Mawson Century Flotilla

On a sparkling Hobart day, *Southern Surveyor* took part in the Mawson Flotilla Centenary celebrations on the River Derwent in Hobart on 2 December 2011 to mark the historic first voyage for Australian Antarctic researchers.

The event gained national news coverage and excellent support from the local community who watched with interest from the banks of the Derwent River.

Panoramic view of the flotilla and spectator craft on the Derwent River.
Credit: Sam Rosewarne

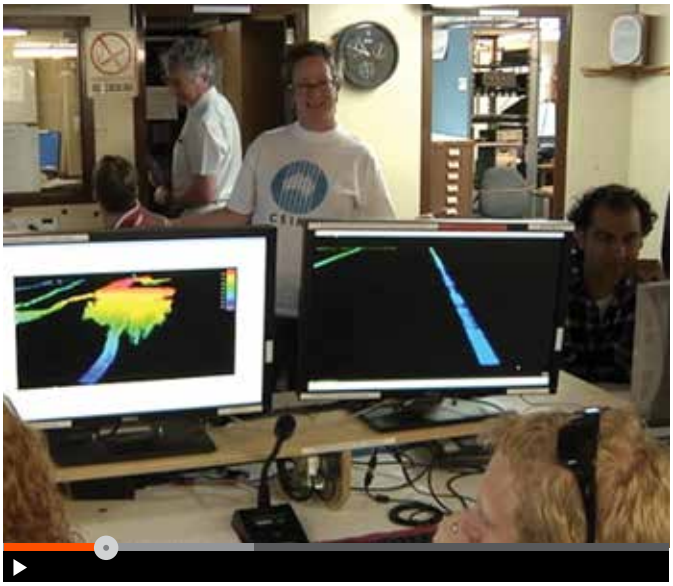
The Southern Surveyor followed by other vessels in the flotilla. Credit: Doug Thost

Australian Museum exhibition

On Monday 28 November 2011 on board the *Southern Surveyor*, three 'stories' were filmed as part of a suite of products being collated for an Australian Museum exhibition on Deep Oceans. The exhibition will start in July 2012 and remain in the museum for a year, it will then be set up at Questacon where it will be on show for 12 months and finally the display will take to the road as a travelling exhibition in rural communities. The exhibition is aimed at 7-12 year olds.

Life onboard *Southern Surveyor* with oceanographer Dr Bronte Tilbrook (www.youtube.com/watch?v=hUl0TA-gCK0)

How the *Southern Surveyor* works with Stephen (Rowdy) McCullum (www.youtube.com/watch?v=hIWu2z_V2Ak)



Science onboard with Susan Wijffels (http://www.youtube.com/watch?v=hUl0TA-gCK0) (http://www.youtube.com/watch?v=LK0tRT5zJQk)

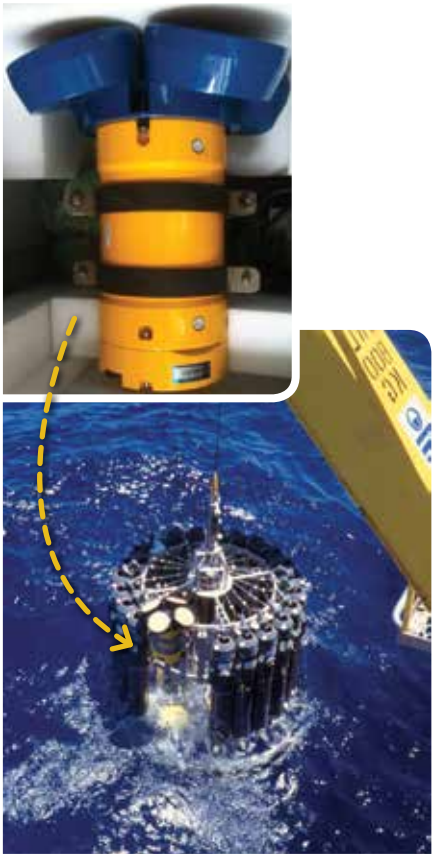
New technology

The Marine National Facility adds new functionality and upgrades technologies on the vessel to ensure that it can meet the needs of the marine research community. Given the *Southern Surveyor* is nearing the end of its operational life with the Marine National Facility the focus has been on equipment that can be transferred to the new vessel *Investigator* in 2013.

LADCP

A new Lowered Acoustic Doppler Current Profiler (LADCP) was purchased to replace a ten year old unit that was no longer functioning. The new unit is easier to use, more robust and the data stream is easier to process.

The LADCP is an acoustic current profiler that can be lowered the full depth of the ocean to study ocean currents and eddies.



LADCP can be attached to a range of devices such as the CTD package

ISUS

The In-Situ Ultra-violet Spectrophotometer (ISUS) analyses nitrate which is an important nutrient for ocean sea life. An ISUS has been purchased and is mounted on the CTD package when required. As it is lowered down into the water it creates a profile of the dissolved nitrate.

ISUS provides a powerful way of investigating changes in nitrate in a vertical water column when used in conjunction with analyses of water samples collected at different depths using Niskin bottles.

RBR Salinometer

A small portable and fast salinometer has been purchased to measure salinity and to complement our existing laboratory salinometer.

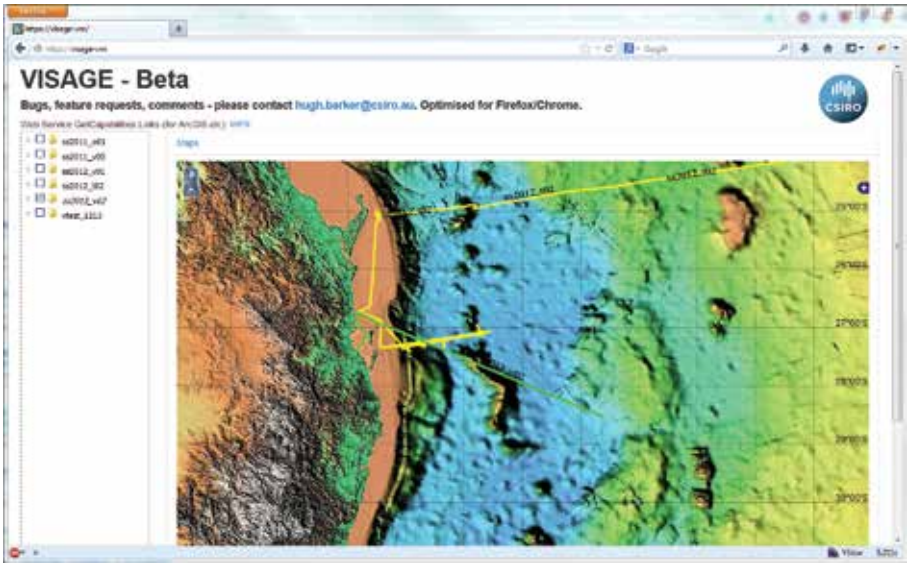
A salinometer measures the salinity of a water sample collected in a Niskin bottle on a CTD package.

Underway fluorometer

The underway fluorometer is a new instrument that measures fluorescence in the water. It can be used to measure chlorophyll fluorescence which is an indicator of phytoplankton biomass.

Data visualisation system

An underway data visualisation system called VISAGE has been developed to provide voyage participants with access to underway data at sea using a web-based front-end to a geospatial database.



Visage allows for historical voyage tracks to be displayed with current information

Maintaining operational efficiency

Maintaining the operational efficiency of *Southern Surveyor* until its replacement arrives has been a priority for the Marine National Facility. This has been achieved through an enhanced maintenance program funded by the Australian Government.

The three year $5.97 million program which included $1.8 million set aside for two dry dockings concluded at the end of the 2011/12 financial year.

The reliability of the *Southern Surveyor* has been maintained throughout the period except for two lost days on a voyage off Fremantle in July 2010 due to a fuel line problem. So the target to maintain the level of reliability at a maximum of 24 hours down-time per calendar month at sea was exceeded on one occasion by one day.

It is also pleasing to note that some improvements have made the vessel a better working and living environment for the crew and science participants, which has been reflected in improved morale on the vessel.

As many of the tasks were preventative, the maintenance program was instrumental in maintaining reliability and minimizing disruption to scientific research operations at sea.

The following is a breakup of enhanced maintenance projects by category carried out during the 2011-12 financial year at a total cost of $886,000.

Of the 64 projects which formed the full scope of the works over the three year period (2009-2012), 56 have been assessed as effectively providing insurance against breakdowns to at least 2014. The remaining eight project areas will require ongoing attention which can be delivered through the vessel's annual repairs and maintenance program.

Maintaining the operational efficiency of the vessel and the safety of all those onboard and in port is a high priority for the Marine National Facility.

Category of works	No of projects
Hull and superstructure	2
Propulsion	1
Auxiliary machinery and services	4
Air conditioning and refrigeration	2
Electrical	5
Safety systems	3
Navigation and bridge	2
Deck machinery and research equipment	1
Accommodation	1

Collaboration

Marine technology is a specialised field and scientific equipment can be expensive. The Marine National Facility works with other organisations such as the Australian Antarctic Division to share technology. This has benefits for all parties as it saves money and better utilises the expertise and equipment that exists in different organisations.

Investigator bristles with new technology

Investigator, which is under construction, is a highly sophisticated floating laboratory, monitoring station and a deployment and sample collection platform. It will also be a floating home for up to 60 crew and scientists.

Scientific equipment for the vessel has been selected and prioritised through a Technical Advisory Committee with representatives from each of the marine scientific communities in Australia.

Investigator will have an expanded range of equipment particularly to carry out geoscience and atmospheric research. The vessel will also have a big advantage over *Southern Surveyor* as most of the equipment will be new and using the latest technology.

Statistics

The following statistics are for the 2011 – 2012 financial year.

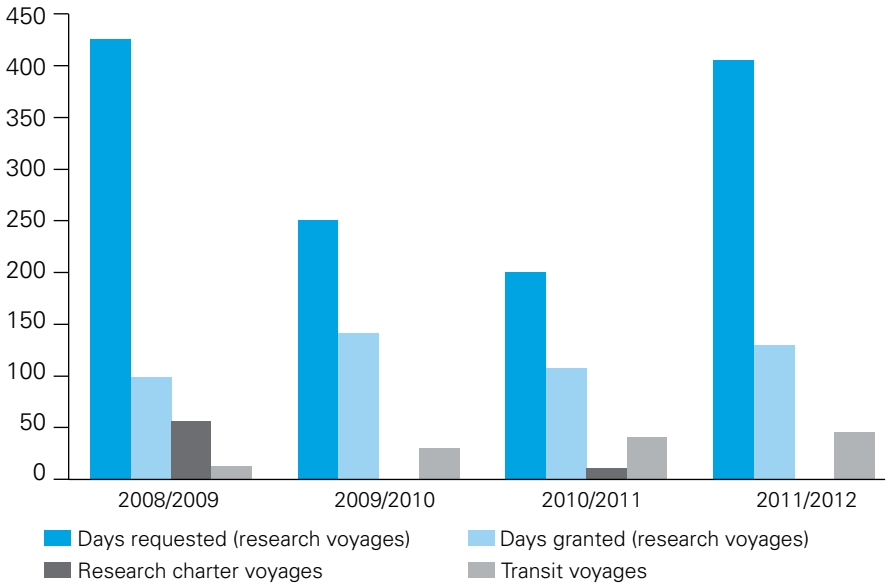
Application for use of the Marine National Facility

The Marine National Facility provided 130 days of ship time grants for research voyages.

Ports Visited

The Marine National Facility's research vessel, *Southern Surveyor*, visited the following ports (home port Hobart not included).

Port	Number of visits
Brisbane	2
Fremantle	3
Geraldton	1
Lautoka	2



Availability of Platform

At sea	Days
Research Voyages	116
Research charter voyages	0
Transit Voyages	46
Sea Trials	2
Days at sea	**164**

In port	
Research Voyages Mob/Demob	14
Unallocated port days	188
Dry dock	0
Days in port	**202**

Note – Ship time grants for research voyages include days at sea and the days in port to load (Mob – mobilisation) and unload (Demob – demobilisation) the vessel.

Operations Room on Southern Surveyor. Credit: Richard Arculus

Voyage participation

The Marine National Facility brings scientists together from a wide variety of research organisations to address Australia's marine research issues.

Investment in the Marine National Facility enables universities, Australian government and State agencies to conduct research that supports the sustainable development of Australia's marine resources.

Scientific personnel from 24 organisations from Australia, Belgium, France, Israel, Netherlands, New Zealand and United States America sailed on the *Southern Surveyor*.

Australian Universities	11
Australian Agencies*	8
International Universities	8
International Agencies	3

*CSIRO divisions are listed below but only counted once in the total number of Australian agencies

On a research voyage, the Chief Scientist is responsible for the scientific program. Other scientists (including international collaborators) and technical staff provide support for the scientific program and research equipment, while students assist and gain valuable experience in research vessel operations. Together, these groups make up the scientific participants on a research voyage. The following charts illustrate the number of scientific participants on research voyages by their affiliation.

The following is a list of the organisations represented on the voyages.

National

Antarctic Climate Ecosystems Cooperative Research Centre

Australian National University

Bureau of Meteorology

CSIRO Land and Water

CSIRO Marine and Atmospheric Research

Department of Fisheries, Western Australia

Geoscience Australia

James Cook University

Macquarie University

Nautilus Minerals

P&O Maritime Services

Royal Australian Navy

University of Wollongong

University of Western Sydney

University of Sydney

University of New South Wales

University of Tasmania

International

Boston University, US

Carnegie Institution Washington, US

Ghent University, Belgium

National Oceanic and Atmospheric Administration, US

Royal Netherlands Institute for Sea Research

University of Auckland, New Zealand

University of Bordeaux, France

University of Israel

Students

Australian National University

Indiana State University, US

Institut de Physique du Globe, Strasbourg, France

James Cook University

Macquarie University

Murdoch University

University of Auckland

University of New South Wales

University of Queensland

University of Strasbourg, France

University of Sydney

University of Western Sydney

Key performance indicators

Incidents are an important indicator of performance but more importantly provide continuous feedback which assists in the management of the vessel.

An incident is any event, which has the potential to impact on our people, neighbours, the environment or to our business.

By looking at the cause of incidents, many of which are minor, managers have the opportunity to make continual improvements.

Incidents reported on the *Southern Surveyor* decreased from 33 in 2010/11 to 25 in 2011/12.

Occupational Health & Safety

In 2011/12 there were no lost time injuries (LTI) and no medical treatment injuries (MTI).

A LTI is a work related injury which results in a person being unfit for work on any shift, watch or work day after the occurrence of the injury or illness, as reported in a medical certificate.

A MTI is an incident that is not severe enough to result in lost work days (i.e. LTI) but severe enough to require medical treatment rather than requiring just simple first aid treatment.

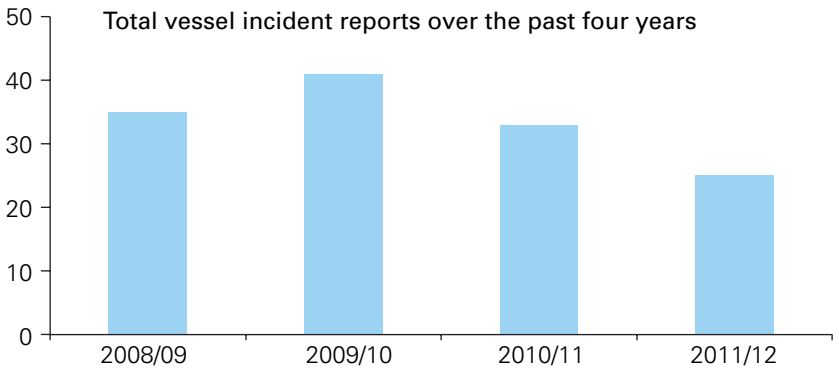
Environmental impact

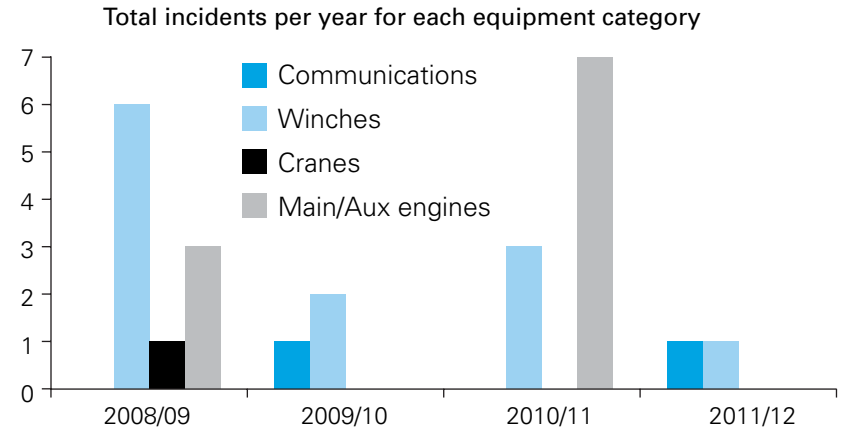
No incidents resulted in hydrocarbons entering the environment.

No incidents resulted in releases of ozone depleting gas emissions.

Repairs and maintenance

Most incidents were relatively minor except for a small fire in the Fish Laboratory which was quickly extinguished. An electrical smell was detected in the laboratory and while crew members were trying to determine the source, a small fire started due to a poor electrical connection in an extension cord. The fire was quickly extinguished and the cause investigated.





User feedback

Continuous improvement is an important part of ship management. The Chief Scientist, Voyage Manager and the Ship's Master each have different perspectives of a voyage due to their job roles. To help identify changes that need to be made after a voyage each of the managers are asked to rate their degree of satisfaction of a range of issues, using the following scale:

5 Excellent
4 Very Good
3 Good
2 Moderate
1 Poor

The following graph provides an overall satisfaction rating by taking an average across all voyages and the responses from the Chief Scientist, Voyage Manager and the Ship's Master.

Financial statement

Financial report for the period ending 30 June 2012

Balance Sheet	2012 $	2011 $
REVENUE		
Research and Services Revenue	-	-
Other External Revenue	92,226	508,212
Appropriation Revenue	13,482,801	12,532,475
TOTAL REVENUE	13,575,027	13,040,687
EXPENSES		
Salaries	2,289,675	2,223,130
Travel	203,198	229,241
Other Operating	7,494,910	8,951,825
Business Unit/Enterprise Costs	2,065,199	1,862,876
TOTAL EXPENSES	12,052,982	13,267,072
OPERATING RESULT	**1,522,045**	**(226,385)**
CAPITAL		
Capital Purchases	252,554	466,379

Please note: With the exception of capital purchases, all other Balance Sheet accounts are maintained at the Organisational level only.

Glossary

ADCP
Acoustic Doppler Current Profiler

ATWS
Australian Tsunami Warning System

BOAGS
Benthic Optical, Acoustic and Grab sampler

BPZ
Benthic Protection Zone

Chief Scientist
The person with the responsibility for the science program on the voyage

CMAR
CSIRO Marine and Atmospheric Research

CO_2
Carbon dioxide

CPR
Continuous Plankton Recorder

CTD
Usually refers to an instrument that measures Conductivity (used to measure the salinity of sea water), Temperature and Depth

EAC
East Australian Current

FRV
Future Research Vessel

GEOTRACES
An international study of marine biogeochemical cycles of trace elements and their isotopes.

IMOS
Integrated Marine Observing System

IPCC
Intergovernmental Panel on Climate Change

LADCP
Lowered Acoustic Doppler Current Profiler. Used to study currents and eddies.

MNF
Marine National Facility – Includes the *Southern Surveyor*, data generated from voyages and the people and equipment to support the vessel

MPA
Marine Protected Area

Next Wave
A program that provides the opportunity for early career researchers and students of marine science to experience the working environment on a blue water research vessel.

NCRIS
National Collaborative Research Infrastructure Strategy

Investigator
New research vessel being built for the Marine National Facility.

OPSAG
Oceans Policy Science Advisory Group

SOFS
Southern Ocean Flux Station

SOTS
Southern Ocean Time Series

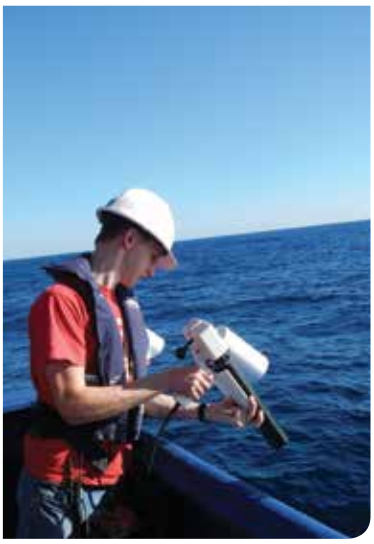
SST
Sea surface temperature

Voyage Manager
The Voyage Manager represents CSIRO's interests as owner of the vessel.

XBT
Expendable Bathythermograph measures temperature as it falls through the water and sends the information back to the ship via a pair of fine copper lines.

The expendable bathythermograph (XBT) is a device for obtaining a record of temperature as a function of depth. They can be deployed from moving ships and from non-research vessels which broadens the situations in which they can be used.

The XBT consists of an expendable probe, a data processing and recording system, and a launcher. When the XBT is launched the wire connecting the two units unwinds as it descends through the water and provides data back to the vessel.



Deploying XBTs on the voyage
Credit:Julia Reisser

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