MARINE
NATIONAL FACILITY

2012 program

RV Southern Surveyor

CSIRO

voyagesummaryss2012_t02

ss2012_t02

Voyage: Great Barrier Reef phase shift: Gardner Bank to Gardner Reef

Voyage Period

Start: 02/05/2012
End: 10/05/2012
Port of departure Brisbane, Australia
Port of return: Lautoka, Fiji

Responsible laboratory

School of Earth and Environmental Sciences, James Cook University
PO Box 6811, Cairns Queensland 4870
Australia

Chief Scientist

Dr Robin J. Beaman

Scientific Objectives

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). About 46% of coral reefs are regarded as healthy except for currently unpredictable global climate threats, which includes the Great Barrier Reef (GBR). The vulnerability of coral reef habitats to climate change is high as scleractinian corals are highly sensitive to increasing sea temperature and ocean acidification (Marshall and Johnson, 2007). 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 GBR where tropical carbonates transition into temperate carbonates. The observed shift of average marine climate zones south by >200 km since 1950 (Lough, 2008) could potentially result in the GBR extending south, causing an algal to coral phase shift as coral settlement follows the changing environmental gradient.

The shelf adjacent to Fraser Island is located at the transition between tropical carbonates (GBR) to the north and cool-water carbonates to the south (Schröder-Adams et al., 2008), and represents an ideal natural laboratory to investigate this phase shift.

On the outer-shelf, Gardner Bank lies in depths of 20 to 60 m and comprises a hard substrate of red algal nodules and pebble- to cobble-sized rhodoliths (Lund et al., 2000), under the influence of the East Australian Current (Harris et al., 1996). Living platey and small massive corals grow in competition with both red algae and extensive areas of fleshy algae (Davies and Peerdeman, 1998; Marshall et al., 1998). The projected warming trend in SST would anticipate a phase shift from a red algal-dominated substrate to a coral-dominated substrate. A hypothesis is that Gardner Bank would form an antecedent surface for future coral reef development through net coral framework accretion. In effect, Gardner Bank would become Gardner Reef, therefore it is crucial that the extent, structure, and morphology of this potentially important site be investigated.

Voyage Objectives

The key questions are: (1) will the GBR tropical carbonate province extend further south under projected warming trends?; and (2) can relatively shallow, hard substrate geomorphic features within the tropical/temperate transition zone (e.g. Gardner Bank) provide the necessary habitat to support such as shift? We proposed to address these questions using two independent approaches: (1) Field mapping using multibeam and seismic methods; and (2) Oceanographic numerical modelling. The field mapping provides the critical baseline maps to characterise the substrate of Gardner Bank for the potential to provide a suitable habitat for subsequent coral reef growth. The numerical modelling will be conducted by AIMS and CSIRO who are developing a 3D whole-of-GBR hydrodynamic model. The aim of the hydrodynamic model is to provide a capability to support the prediction and analysis of connectivity and exchange of material, including larvae, throughout the GBR. The model will be used to predict the trajectory and spatial distribution of coral larvae in the southern GBR under warming scenarios.

The field mapping utilises the Simrad EM300 multibeam system and Topas sub-bottom profiler on the RV Southern Surveyor to map the extent of Gardner Bank. The high-resolution bathymetry, backscatter, and sub-bottom datasets will then be used to develop seabed character maps and sub-surface information that show the detailed spatial extent and geomorphology of the bank. Post-voyage, the acoustic datasets, in conjunction with existing groundtruth samples, will be used to fine-tune sediment facies boundaries (Lund et al., 2000), which can then be used to highlight areas of potentially enhanced coral settlement and growth. Another field mapping objective is that the sub-bottom profiler and multibeam system be run continuously for the remaining transit leg to Fiji, and pass over the North Recorder Seamount, which lies adjacent to the south-east Queensland margin in the northern Tasman Sea. The transit is an opportunity to acquire new data to help improve our understanding of these important seamount ecosystems. In addition, the Geological Survey of New Caledonia have requested a slight deviation of track between the Kelso and Capel banks, so as to acquire new multibeam data adjacent to the previous Noucaplac-2 survey between these two remote Coral Sea atolls.

Results

Our main field objective was to map Gardner Bank which lies on the outer continental shelf to the east of Fraser Island. After about a 100 nm transit north from Brisbane we commenced surveying over the bank using the Simrad EM300 multibeam swath sonar and Topas sub-bottom profiling system. Initially, we used a line spacing of 250 m, then reduced these to about 190 m line spacing over the shallower parts of the bank. Individual survey lines were conducted using bearings of 150°/330° for along-shelf distances of about 17,500 m, or about the distance travelled in one hour at a survey speed of 9-10 kn. After about 24 hours on site, we achieved nearly 100% multibeam coverage for an area 4,300 x 17,500 m, or 75.25 km2 (Figures 1 and 2).

To fully survey all of Gardner Bank would probably require another 24 hours on site, however, we were able to clearly resolve the landward half of the bank. Survey depths overall ranged from 65.70 to 23.09 m, after reducing for predicted tides at Waddy Point. The area of the survey that comprises the actual Gardner Bank, as marked on the nautical chart AUS816, has depths shallower than 30 m and rises up to 23.09 m.

This broad shallow area has numerous small sharp pinnacles dotted over the surface. Sub-bottom profiles confirm that Gardner Bank is a hard substrate with soft sediments pooling within depressions as parallel to sub-parallel strata.

Underlying Gardner Bank, and extending towards the south-west of the survey area lies a much larger bank in deeper depths of about 42 to 50 m depth. This larger bank area was interesting as it reveals that a much larger proportion of the Fraser shelf area is actually a hard substrate, with mobile softer sediment, such as sand, likely constrained closer to Fraser Island coastline. This large bank area was also covered in small pinnacles, similar to the shallower Gardner Bank, and also showing parallel to sub-parallel sub-surface reflectors in small depressions between the pinnacles.

Both north and south of the Gardner Bank, and either side of the extended deeper bank area, were broad smooth depressions to a lower depth limit of 65.70 m. These depressions also recorded a thin covering of softer sediment lying within the depressions and forming an apron against the hard substrate at the edges of the depressions. No fine-scale pinnacles were observed within these depressions as the seafloor appeared smooth due to sediment infill. These broad depressions seem to drain toward the shelf edge, however, only a more complete survey would confirm this.

A single rock dredge was attempted on a shallow pinnacle feature at 28.5 m in position 25° 04.1'S 153° 31.5'E in order to obtain a groundtruth sample of the surficial substrate. However, on tension the wire cable broke and we lost the rock dredge. Future expeditions will be able to utilise the new and extensive baseline map data collected from this voyage to better plan groundtruth sample locations at this site. So the main field objective was a success, obtaining very high-resolution bathymetry, backscatter and sub-bottom profile data over Gardner Bank.

Another field mapping objective was to continue the EM300 multibeam swath sonar and Topas sub-bottom survey from Gardner Bank to Lautoka, Fiji for about 2,600 km. With survey permit approval from the French and Fijian government agencies responsible, we successfully achieved this objective with continuous multibeam bathymetry data collected from Gardner Bank to the Fijian pilot station off Nadi (Figure 3). However, the Topas sub-bottom profiler was turned off due to poor returns over the hard seafloor terrain over the North Fiji Plate two days out from arrival at Lautoka.

During the transit, an opportunity was planned to acquire multibeam data over the North Recorder Seamount. The seamount, part of the Tasmantid chain of seamounts, rises over 3000 m above the surrounding northern Tasman Basin and had never been mapped previously with modern systems. We discovered a least depth of 703 m over a relatively flat-topped summit about 2 km across, but with very steep sides and canyons draining to the surrounding basin seafloor in over 3900 m depth (Figure 4).

Additionally, another field objective was to acquire multibeam data on behalf of the Geological Survey of New Caledonia while transiting through their waters. In particular, few modern surveys have been conducted between the Kelso and Capel banks, part of the Lord Howe chain of seamounts. We transited between these large Coral Sea atolls and then continued across the Lord Howe Rise, surveying numerous small submarine volcanoes emerging between the thick Lord Howe Rise sediments (Figure 5).

Voyage Narrative

Wed 2nd May 2012

Wind 15 kn from 106°. Sea state 2. Nil swell.

0600 in position 27° 26.8’S 153° 04.6’E berthed at Forgacs Shipyard, Brisbane River

At 1300 we departed Forgacs Shipyard and commenced the pilotage down the Brisbane River and into Moreton Bay. A safety induction was provided for the Science Crew to introduce all emergency gear, exits, and general safety for the vessel. At 1600 an all ship emergency muster was held to familiarise everyone with life raft positions. We started logging EM300 multibeam and Topas sub-bottom profiling data at 1754. Then at 1915 we deployed the magnetometer, streamed off the back of the ship, as we left Moreton Bay for the transit north up to Gardner Bank.

Thu 3rd May 2012

Wind 16 kn from 145°. Sea state 3. Swell from the SE at 2 m.

0600 in position 25° 07.6’S 153° 31.4’E

After an overnight transit along the southern Queensland coast we arrived off Gardner Bank at 0430 and recovered the magnetometer.

At 0509 a conductivity/temperature/depth (CTD) logger was lowered to a depth of about 50 m, to obtain a sound velocity profile over the survey site. The magnetometer was deployed again, then systematic multibeam swath surveying commenced over Gardner Bank at 0554. This surveying continued throughout the day in lines about 10 nm long, progressively revealing the shallow (~24 m) part of the bank. At 1600 a rock dredge was lowered on top of a 28.5 m pinnacle at position 25° 04.1’S 153° 31.5’E. Unfortunately, the wire cable broke under tension and the rock dredge was lost. At 1630, all multibeam, Topas, and magnetometer surveying commenced again over Gardner Bank.

Fri 4th May 2012

Wind 22 kn from 113°. Sea state 4. Swell from the SE at 2 m.

0600 in position 25° 54.0’S 153° 28.7’E

After a full night of surveying over Gardner Bank, we commenced crosslines at 0410 over the bank to prove the tidal reduction for the multibeam data. By 0630 we had completed the survey of Gardner Bank and broke-off towards the east for the start of the transit to Lautoka, Fiji. At 0710 we crossed the Queensland shelf break at about 120 m, which triggered the start of expendable bathythermograph (XBT) drops down the continental slope. By 1230 we had crossed into the Tasman Basin with depths of 4100 m. At 1700 we arrived off the North Recorder Seamount which rises over 3000 m above the surrounding seafloor. We swath surveyed right over the peak then back into the Tasman Basin. The magnetometer was finally recovered at 1740 and instead deployed the Continuous Plankton Recorder (CPR). Just east of the seamount in position 24° 55.0'S 155° 12.5'E at 1816 was the first marine debris trawl, which recovered some plastic pieces.

Sat 5th May 2012

Wind 13 kn from 189°. Sea state 3. Swell from the SE at 2 m.

0600 in position 24° 38.4’S 156° 59.8’E

Overnight surveying across the eastern Tasman Basin, then at 0100 the vessel commenced surveying up the western side of the Lord Howe Rise. At 1330 we entered the French EEZ and notified their authorities of our entry. By 1900, we had entered the saddle between the Kelso and Capel banks, which are part of the Lord Howe Rise Seamount chain. The multibeam bathymetry revealed the rugged flanks of Kelso Bank to the north of our transit path, then by 2200 we had passed back onto the eastern side of the Lord Howe Rise over relatively flat seafloor at a depth of about 2000 m.

Sunday 6th May 2012

Wind 13 kn from 186°. Sea state 3. Swell from the SE at 2 m.

0600 in position 24° 02.3’S 161° 11.6’E

Continued multibeam and sub-bottom profiling overnight of the eastern side of Lord Howe Rise. At 1000, we were surprised to come across 3 to 4 small volcanic cones in position 23° 57.6’S 161° 40.8’E. The largest cone had a height above the surrounding seafloor of 513 m, with a least depth of 541 m. The multibeam obtained very good 3D pictures of their morphology. At 1324, we did a change-out of the CPR silks and then conducted a second marine debris trawl in position 23° 52.2'S 162° 20.3'E. This time collecting some minor plastics, together with many small blue bottle, medusa, larval fish and crustaceans. At 1500 we commenced transiting over the New Caledonia Basin.

Monday 7th May 2012

Wind 14 kn from 186°. Sea state 3. Swell from SE about 2 m.

0600 in position 23° 24.8’S 165° 25.9’E

Overnight we crossed the New Caledonia Basin heading towards the southern tip of New Caledonia. The ship’s progress has us arriving on time in Lautoka, however, with permission we were able to delay arrival by a few hours to allow further marine debris trawls. At 1100 we observed several whale blows at a distance, so we shut down all acoustic equipment until well clear. The whales were small with dark smooth backs, possibly pilot whales or false killer whales. At 1325, we conducted the third marine debris trawl in position 23° 12.8'S 166° 37.1'E, getting large pieces of Sargassum weed but with no plastics found in the samples. Minor pumice pieces were also found in the samples, indicative of the volcanic province we were entering. By 1500 we transited close around the southern end of New Caledonia.

Tuesday 8th May 2012

Wind 12 kn from 208°. Sea state 2. Swell from SE about 1 m.

0600 in position 22° 31.7'S 169° 23.3'E

Overnight sailing through the southern New Caledonia islands that dot the Norfolk Ridge. We passed several islands close enough to observe 3D multibeam images of coral rubble from their steep flanks. At 0300 we started the long seafloor descent into the New Hebrides Trench, one of the deepest trenches in the Southwest Pacific. More evidence of volcanoes were seen in the multibeam data with a volcano seen at position 22° 38.5'S 169° 14.5'E in a depth of 1391 m, then another seen at position 22° 30.6'S 169° 23.2'E in a depth of 1730 m. We lost multibeam bottom detect around 6000 m depth, then at 0710 passed over the deepest part of the New Hebrides Trench at 6800 m, as measured by the Simrad ER60 singlebeam echosounder. The vessel transited onto the North Fiji Plateau with little sediment observed in the Topas system, showing a very rugged seafloor of ridges. At 1320 another marine debris trawl was obtained at position 21° 46.1'S 170° 37.3'E, this time with many small pieces of plastic recovered. The CPR was removed from the water at 1325 after a problem was found with the internal silk rolls.

Wednesday 9th May 2012

Wind 15 kn from 328°. Sea state 2. Swell from SE about 1 m.

0600 in position 20° 21.0'S 173° 03.0'E

Overnight surveying across the North Fiji Plateau in seabed depths of around 3000 m. The Topas sub-bottom profiler was turned off due to poor returns over the hard seafloor terrain. We crossed into the Fiji EEZ around 0550 and continued multibeam surveying over the plateau.

Thursday 10th May 2012

Wind 7kn from 036°. Sea state 2. Nil swell.

0600 in position 17° 56.1'S 177° 10.8'E

Continued overnight multibeam surveying across the North Fiji Plateau, with depths ranging from 3000 to 2000 m. At about 0600 we commenced the ascent up the Fiji continental slope towards the pilot station boarding ground off the western side of Viti Levu. The final XBT drop was made at the 200 m depth contour. At 0800 we started the pilotage into Navulu Passage near Nadi, Viti Levu, and finally shut down the EM300 multibeam system. We arrived at Lautoka wharf 1000 at the end of the transit voyage.

Summary

From an operational standpoint, the ss2012 _ t02 transit voyage from Brisbane to Lautoka was a great success. The transit voyage was completed on time and achieved all the field mapping objectives. We are confident that following our post-voyage analyses of the marine geophysical data, this will help us to achieve the overall scientific objective, which is to investigate the extent, structure and morphology of this potentially important antecedent bank/reef site lying within the tropical/temperate marine climate zone.

We now have a complete 3-dimensional view of the landward side of Gardner Bank and over half of the main Gardner Bank itself. A discovery was the extensive, deeper hard substrate bank lying to landward of Gardner Bank. The surfaces of these hard substrate features are covered in small sharp pinnacles. Broad, smooth depressions lie either side of Gardner Bank and the deeper extensive bank feature. Sub-bottom profiles clearly show where hard and soft sub-surface features develop.

The wealth of EM300 multibeam and Topas sub-bottom profile data now allow us to develop a fine-scale sediment facies map as an important baseline map for future groundtruthing surveys of this tropical/temperate transition zone. For example, it will be important to discover what coral/macroalgae is associated with the shallow (<25 m) Gardner Bank versus the benthos on the deeper (42 to 50 m) extensive bank. Such information will contribute to other studies further south that are also studying modern processes acting on the benthic marine life on the southern Queensland shelf.

We were also able to map for the first time, the North Recorder Seamount, and acquire continuous multibeam swath data during the 2,600 km transit from Gardner Bank to Fiji. Much of this data were collected over unsurveyed seafloor, and therefore provides vital new data for the various national mapping agencies to help to understand the geomorphology and structure of the deep Australian, French, and Fijian seafloor.

Analyses of these datasets will generate significant discoveries as well as stimulate new expeditions to understand the geologic evolution of the Tasman and Coral seas.

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Principal Investigators

A. Robin Beaman	Gardner Banks and transit survey
B. Julia Reisser	Predicting the sources, distribution, and fate of marine debris
C. Clare Murphy	Transect measurements of greenhouse gases in the marine atmosphere
D. Alan Poole	XBT samples
E. Frank Coman	Transect measurements of plankton distribution in surface waters
F. Benjamin Cohen	Magnetic survey of the Fraser continental shelf

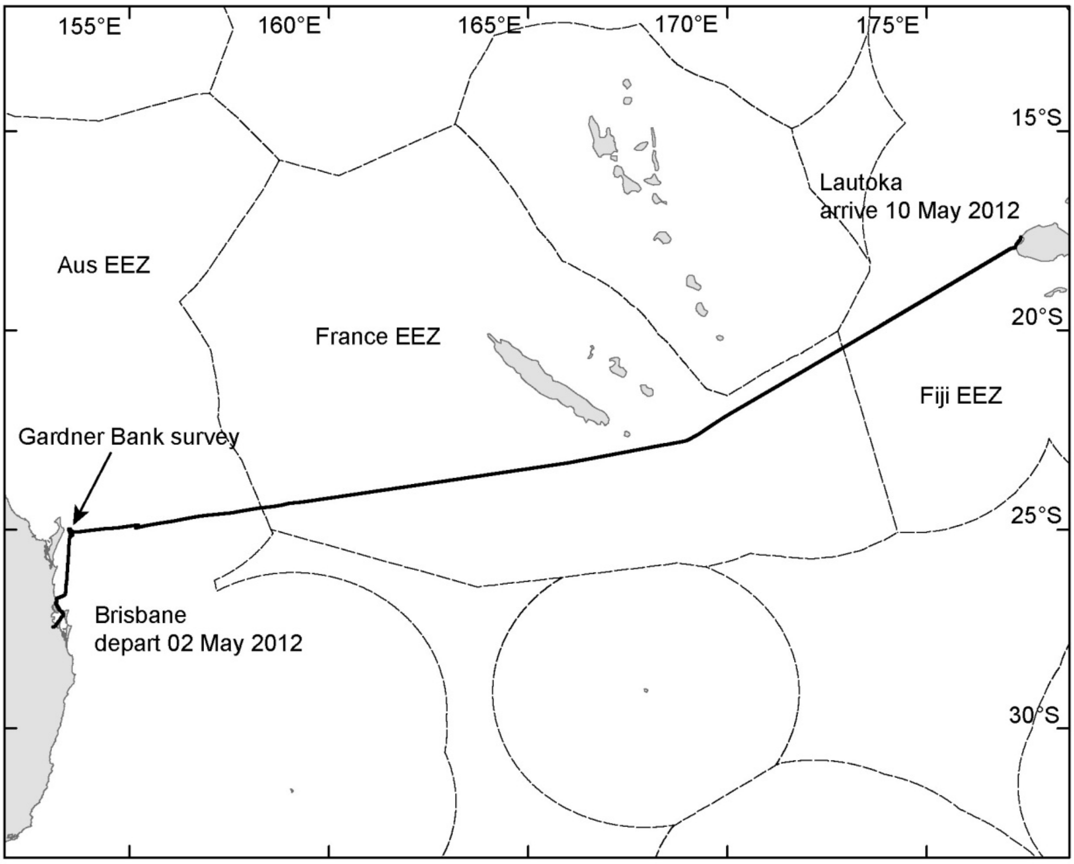
SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Item No.	PI see above	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION
1	A	50	m	H10	CTD taken at Gardner Bank for purposes of sound velocity profile
2	A	3285.04	km	G74	EM300 multibeam data collected during the transit
3	A	2690.43	km	G75	Topas sub-bottom profiler data collected during the transit
4	F	700	km	G28	Towed magnetometer data collected on the shelf and basin
5	E	1193.72	km	B09	Continuous Plankton Recorder data collected during the transit
6	D	100	stations	H13	XBT sensors deployed during the transit
7	C	~3300	km	M71	Continuous CH_4, CO_2, N_2O, del13C , CO, O_3 data
8	B	4	stations	P90	3 x 15 min tows at each station for marine floating debris

CURATION REPORT

Item No.	DESCRIPTION
1	CTD data held by Robin Beaman, School of Earth and Environmental Sciences, James Cook University, email: robin.beaman@jcu.edu.au
2	EM300 multibeam data held by Robin Beaman, School of Earth and Environmental Sciences, James Cook University, email: robin.beaman@jcu.edu.au
3	Topas sub-bottom profiler data held be held by Robin Beaman, School of Earth and Environmental Sciences, James Cook University, email: robin.beaman@jcu.edu.au
4	Towed magnetometer data held by Benjamin Cohen, School of Earth Sciences, University of Queensland, email: b.cohen@uq.edu.au
5	Continuous Plankton Recorder data held by CSIRO Marine and Atmospheric Research CPR group, email: frank.coman@csiro.au
6	XBT data held by CSIRO Marine and Atmospheric Research ARGO/SOOP group, email: alan.poole@csiro.au
7	Marine greenhouse gas data held by Clare Murphy, School of Chemistry, University of Wollongong, email: clarem@uow.edu.au
8	Marine plastic debris data held by Julia Reisser, Environmental Systems Engineering & UWA Oceans Institute, University of Western Australia & CSIRO Marine and Atmospheric Research, email: julia.reisser@csiro.au

TRACK CHART



GENERAL OCEAN AREA(S)

Tasman Sea, Coral Sea, Southwest Pacific Ocean

SPECIFIC AREAS

Gardner Bank is a shallow (approx. 20 to 60 m) bank lying due east of Fraser Island, centred on position 25° 03'S 153° 32'E. This transit voyage conducted a multibeam and sub-bottom profile survey at the site for about 24 hours prior to the transit to Lautoka, Fiji.

PERSONNEL LIST

Scientific Participants

Name	Affiliation	Role
Robin Beaman	JCU	Chief Scientist
Murphy Birnberg	JCU	Scientist
Gustavo Hinestrosa	USydney	Scientist
Adrian Eddy	RAN	Scientist
Benjamin Cohen	UQ	Scientist
Dagmar Kubistin	UWollongong	Scientist
Julia Reisser	CMAR/UWA	Scientist
Don McKenzie	CMAR	MNF Voyage Manager
Lindsay MacDonald	CMAR	MNF Electronics Support
Hugh Barker	CMAR	MNF Computing Support
Tara Martin	CMAR	MNF Swath Technician
Sascha Frydman	CMAR	MNF Swath Technician

Marine Crew

Name	Role
John Barr	Master
Mike Tuck	Chief Mate
Tom Watson	Second Mate
Nick Fleming	Chief Engineer
Gavin Herbert	First Engineer
Graeme Perkins	Second Engineer
Stephen Leslie	Chief Cook
Peter Graham	Second Cook
Emma Carlos	Chief Steward
Tony Hearne	Chief Integrated Rating
Matt Streat	Integrated Rating
Peter Taylor	Integrated Rating
Nathan Arahanga	Integrated Rating
Robert Spaans	Integrated Rating

ACKNOWLEDGEMENTS

We would like to sincerely thank the Master and crew of the RV Southern Surveyor, as well as the Marine National Facility staff, for their outstanding work throughout the voyage. We appreciate their great effort in making this voyage a success.

Dr Robin Beaman, James Cook University

Chief Scientist

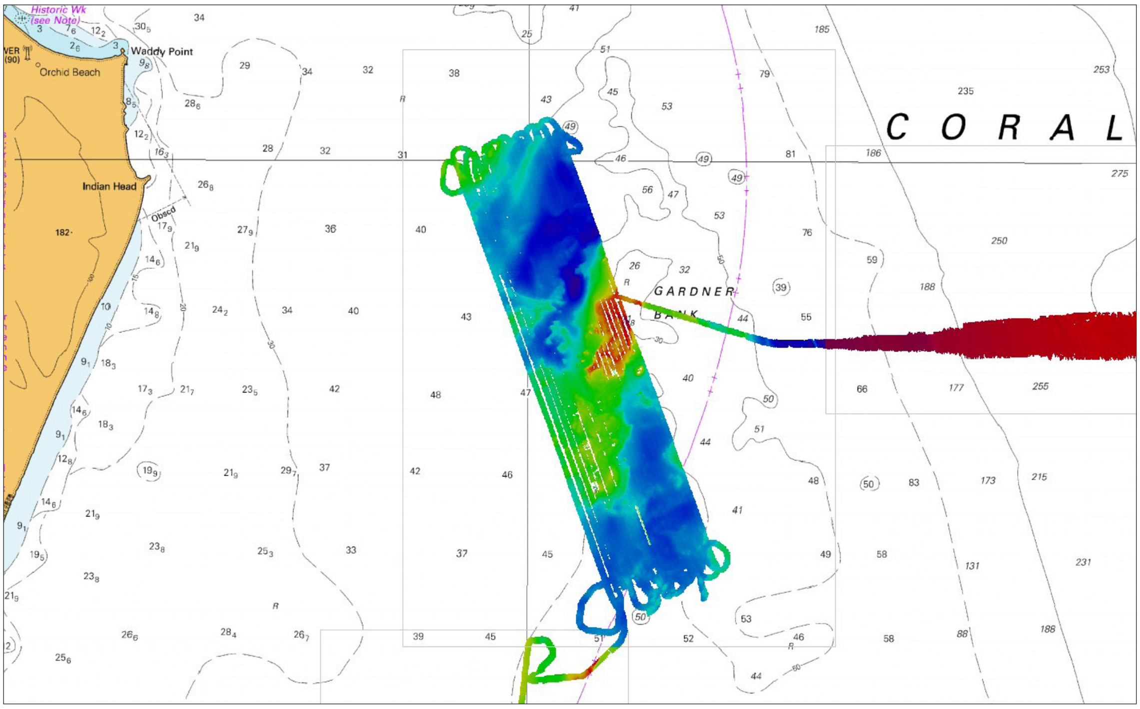


Figure 1. Multibeam bathymetry coverage over Gardner Bank, overlaid on chart AUS816.

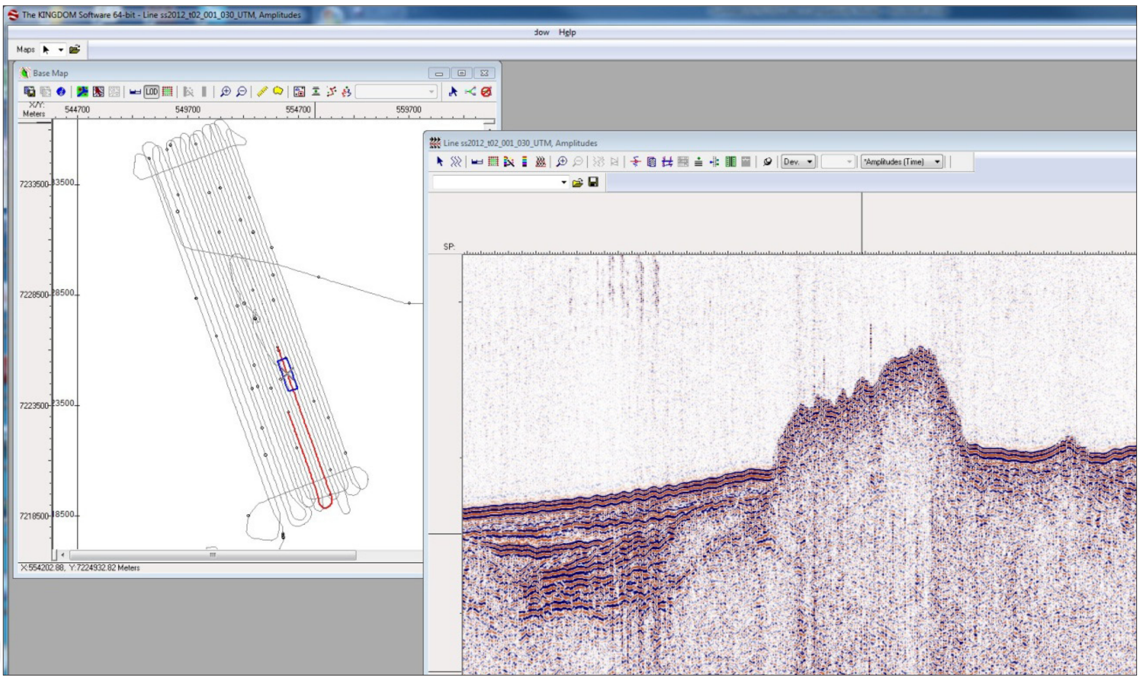


Figure 2. Example of Topas sub-bottom profile data over Gardner Bank, using Kingdom software, with a profile shown over a pinnacle near the centre of the survey area.

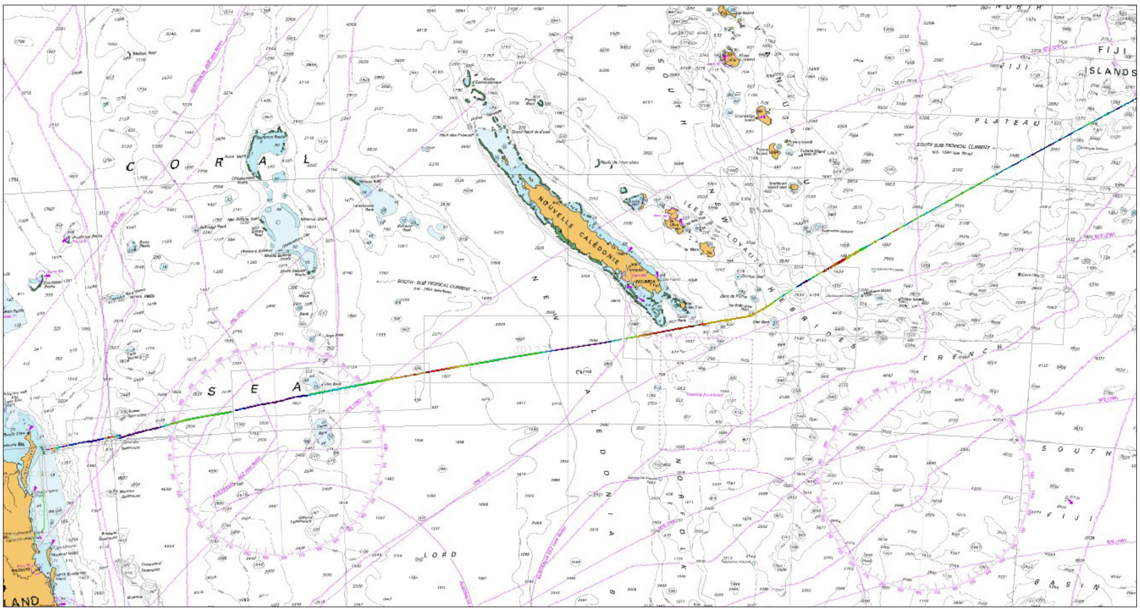


Figure 3. Multibeam coverage from Brisbane to Lautoka, Fiji, overlaid on chart AUS4602.

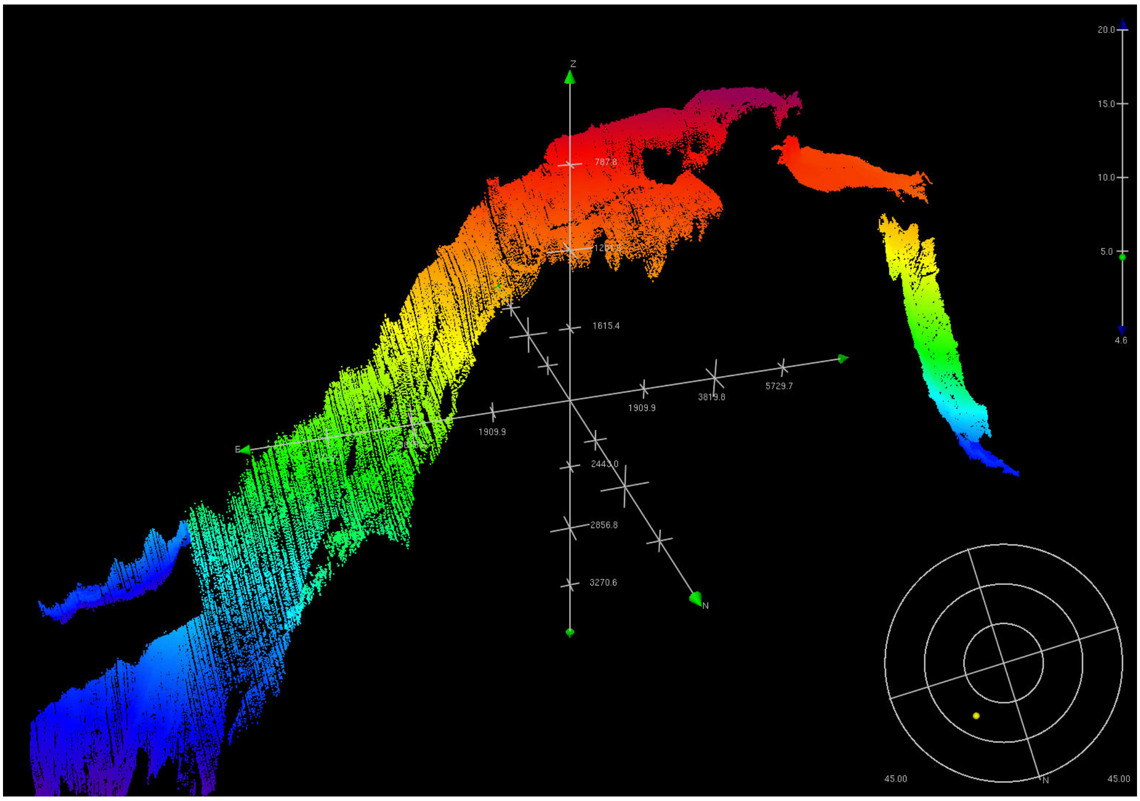


Figure 4. 3D-view of the North Recorder Seamount using the multibeam point cloud bathymetry data.

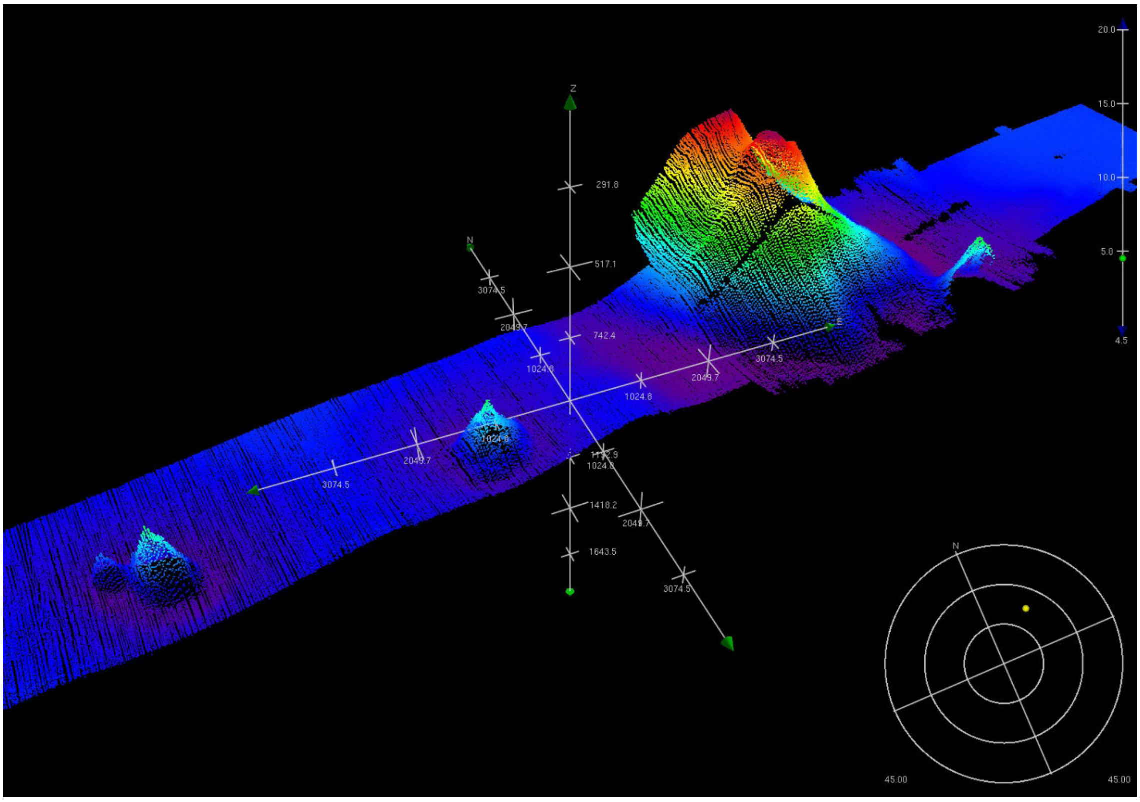


Figure 5. 3D-view of the New Caledonia submarine volcanoes found on the Lord Howe Rise.

APPENDICES

Appendix 1. Magnetic survey of the Fraser continental shelf

Appendix 2. Transect measurements of greenhouse gases in the marine atmosphere

Appendix 3. XBT samples

Appendix 4. Predicting the sources, distribution, and fate of marine debris

Appendix 5. Transect measurements of plankton distribution in surface waters

CSR/ROSCOP Parameter Codes

METEOROLOGY	
M01	Upper air observations
M02	Incident radiation
M05	Occasional standard measurements
M06	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/drifting buoys
D06	Neutrally buoyant floats
D09	Sea level (incl. Bottom pressure & inverted echosounder)
D72	Instrumented wave measurements
D90	Other physical oceanographic measurements

CHEMICAL OCEANOGRAPHY	
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 BIOLOGY/FISHERIES	
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

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

Appendix 1. Magnetic survey of the Fraser continental shelf

Total intensity magnetic field measurements were made using a SeaSPY Overhauser magnetometer, provided by Geoscience Australia, towed 200 m behind the A frame of the RV Southern Surveyor. A total of 700 line-km of magnetic data were collected (Figure 1), incorporating 167 line-km from offshore Caloundra to Gardner Bank, 364 line-km over Gardner Bank (not including turns between lines), and 168 line-km from Gardner Bank to the North Recorder Seamount. The average line spacing over Gardner Bank was 190 m. Data were recorded continuously, with the exceptions outlined in Table 1. Most of the transit between Caloundra and Gardner Bank is magnetically quiet, with the exception of a 400 nT anomaly between 26.1-26.2°S. Gardner Bank is characterised by anomalies with peak-to-trough amplitudes of up to ~400 nT. North Recorder Seamount has a negative anomaly of ~800 nT. No technical problems were experienced during the data collection, and this piggy-back project of ss2012 _ t02 was completed successfully.

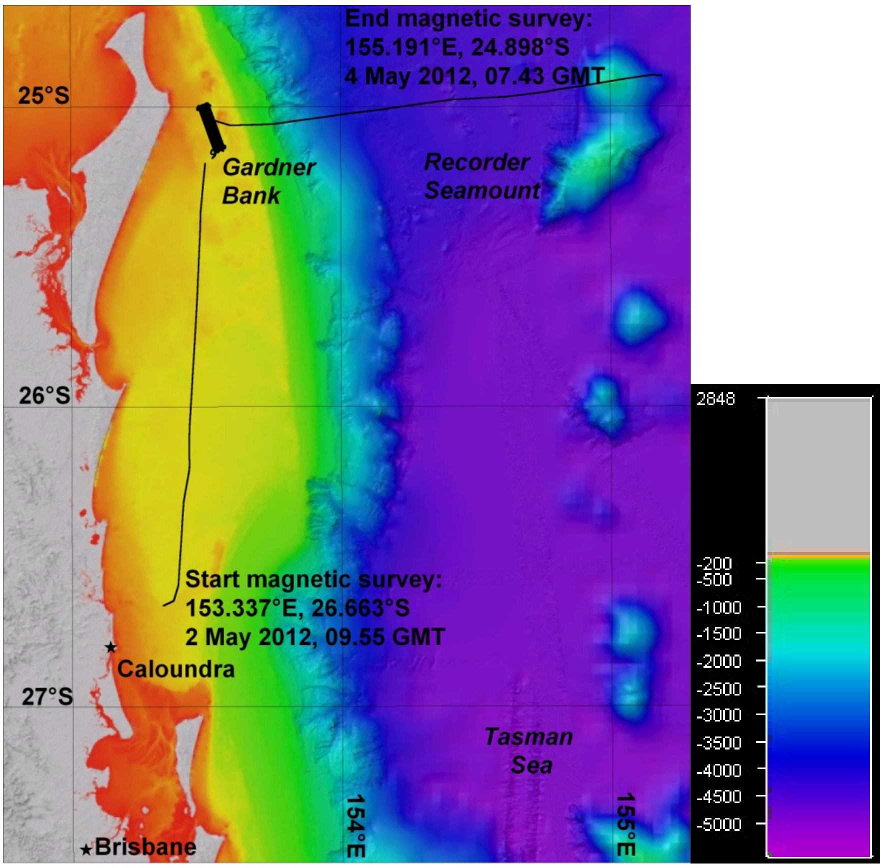


Figure 1. Location map for magnetic survey undertaken in ss2012_t02, with the ship track indicated by the solid black line. Bathymetry is from Beaman (2010), with the depth scale (metres) to the right.

Table 1. Summary of magnetic data collection.

Longitude (°E)	Latitude (°S)	Date and time	Comment
153.33694	26.66306	2 May, 0955	Start survey
153.49757	25.18812	2 May, 1834	Retrieval commenced before CTD cast
153.52381	25.17057	2 May, 1942	Magnetometer redeployment at 200 m complete
153.54010	25.07741	3 May, 0220	Commence shortening cable (to 50 m)
153.52428	25.03780	3 May, 0240	Magnetometer redeployment at 200 m complete
153.53049	25.07246	3 May, 0539	Retrieval commenced before dredge
153.51952	25.01588	3 May, 0712	Magnetometer redeployment at 200 m complete
155.19081	24.89835	4 May, 0743	End magnetic survey

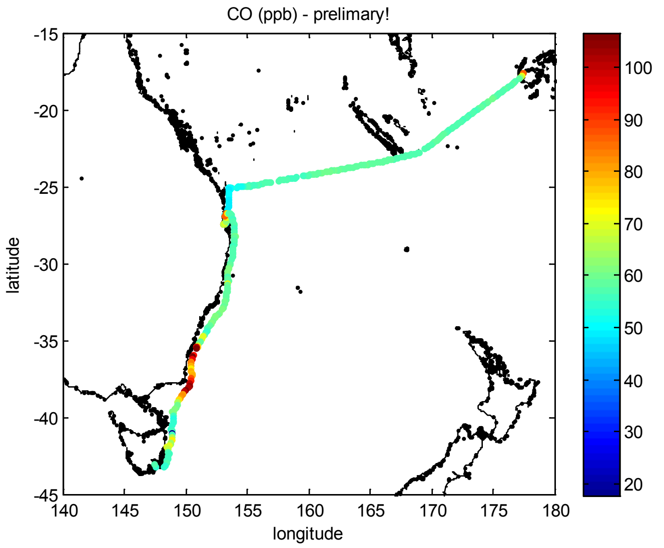
Benjamin Cohen, University of Queensland

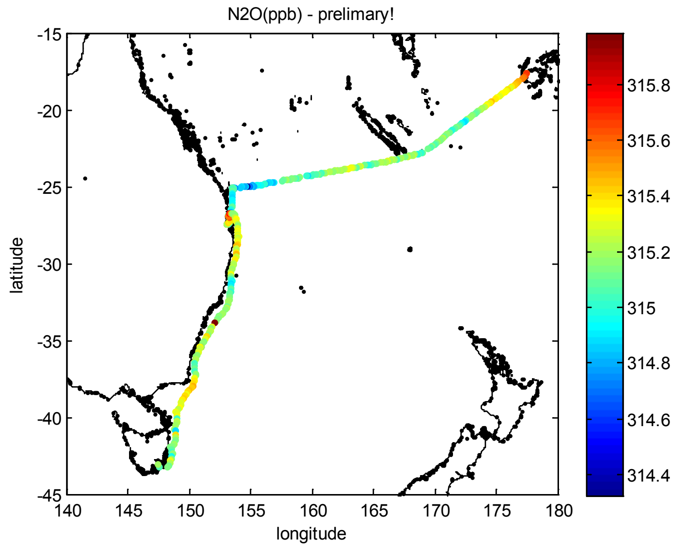
Appendix 2. Transect measurements of greenhouse gases in the marine atmosphere

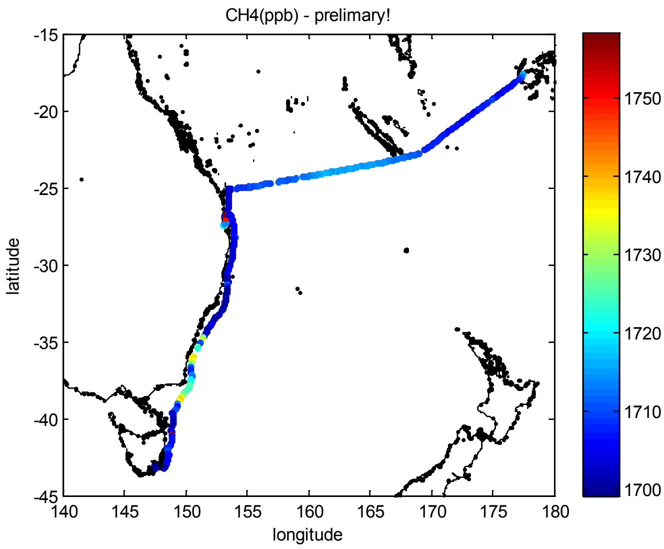
Climate change is one of the most pressing global environmental issues of our time. It is driven by atmospheric change, and in particular by the large growth in greenhouse gases. There have been a great number of measurement campaigns focused on the Northern Hemisphere, however the data coverage in the Australasian region are sparse.

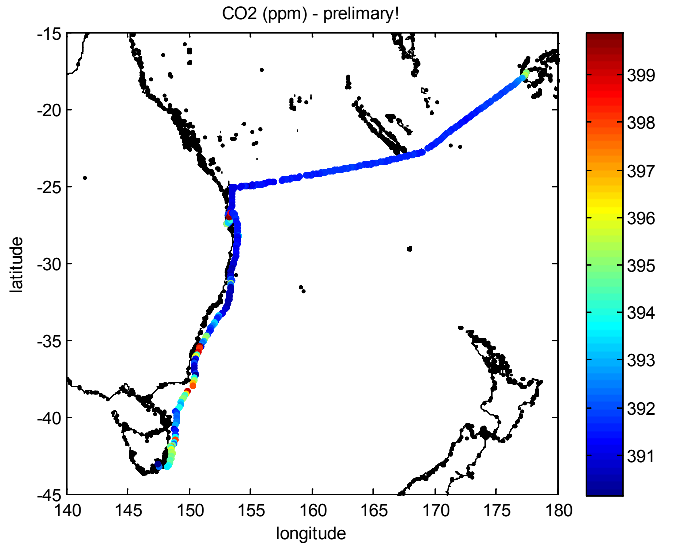
To characterise the sources and sinks of the major greenhouse gases in the Australasian region, continuous in situ measurements of the key greenhouse gases methane, carbon dioxide, nitrous oxide, as well as carbon monoxide and ozone were performed during ss2012 _ t02. The data were collected by using a fully automated Fourier Transform Spectrometer for CH_4, CO_2, N_2O, del13C , CO and a UV absorption instrument for O_3, with a time resolution of 5 min and 1 min, respectively.

The measurements performed on the ss2012 _ t02 transect from Brisbane (27.3°S 153.1°E) to Lautoka (17.6°S 177.5°E) represent marine background conditions over the Pacific ocean. The concentrations will be compared with continental influenced air masses, collected during the first transect from Hobart, ss2012 _ t01 (42.5°S 147.2°E) to Brisbane (27.3°S 153.1°E). The preliminary data results are shown in the figures below. This unique dataset will help constrain current models of the lower atmosphere, and hence improve our understanding of the processes contributing to the growth and variability of greenhouse gases in the atmosphere.

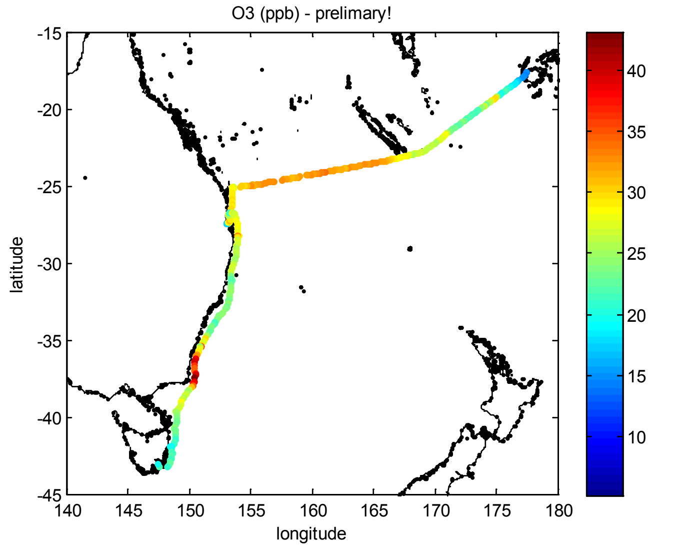








Clare Murphy, University of Wollongong



Appendix 3. XBT samples

The SOOP group at CSIRO have been undertaking regular XBT transects (PX30) between Brisbane and Fiji for more than 25 years. The transects are usually performed from commercial ships but in this instance the RV Southern Surveyor was used.

During the ss2012 _ t02 transit voyage, 100 XBTs were deployed at regular intervals commencing east of Fraser Island and finishing in Navula Passage near Nadi, Fiji (Figure 1). 90 XBTs were successful with only 10 failures of XBT Probes (Figure 2).

A SOOP wireless XBT system was used to perform the XBT drops and no major problems were encountered during the transit voyage. The data are archived at CSIRO and entered into a global data base at JCOMM.

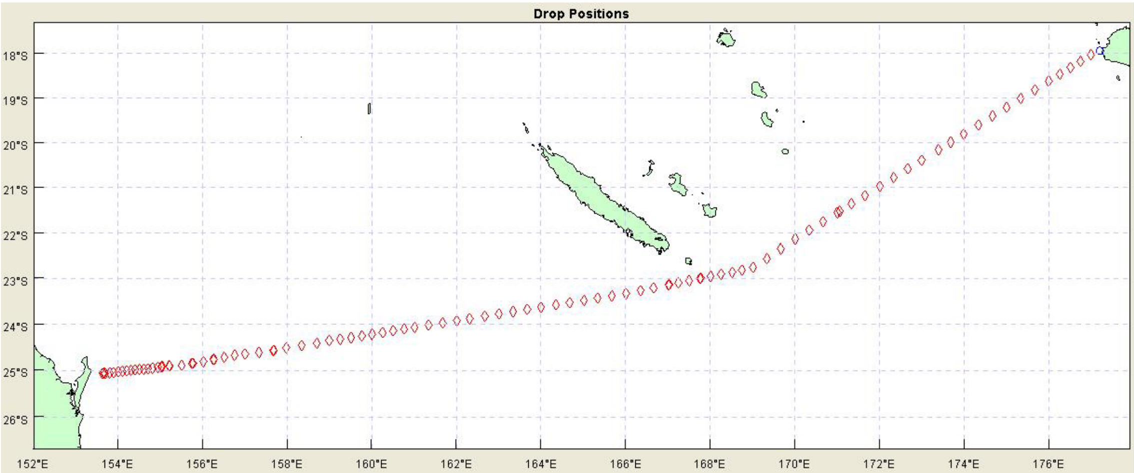


Figure 1. Locations of the XBT drops between Brisbane and Lautoka.

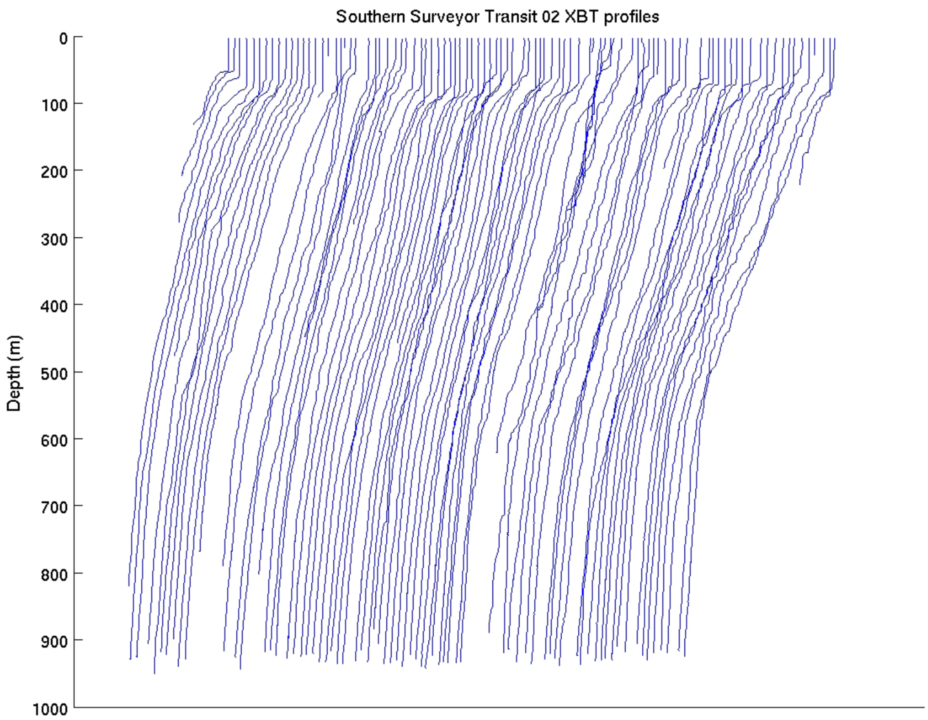


Figure 2. Results of XBT drops.

Alan Poole, SOOP/ARGO Electronics Technician

Appendix 4. Predicting the sources, distribution, and fate of marine debris

The scientific objectives of the ss2012 _ t02 transit voyage were to estimate concentration of floating marine debris using: (1) neuston trawls with a net lined with a 0.33 mm mesh, with three tows of 15 min at each station; (2) visual surveys conducted from dawn to dusk for 1 hour, four times per day.

Four stations were sampled by neuston net (Figure 1 and Table 1). An example of floating marine debris collected by neuston trawl is shown in Figure 2.

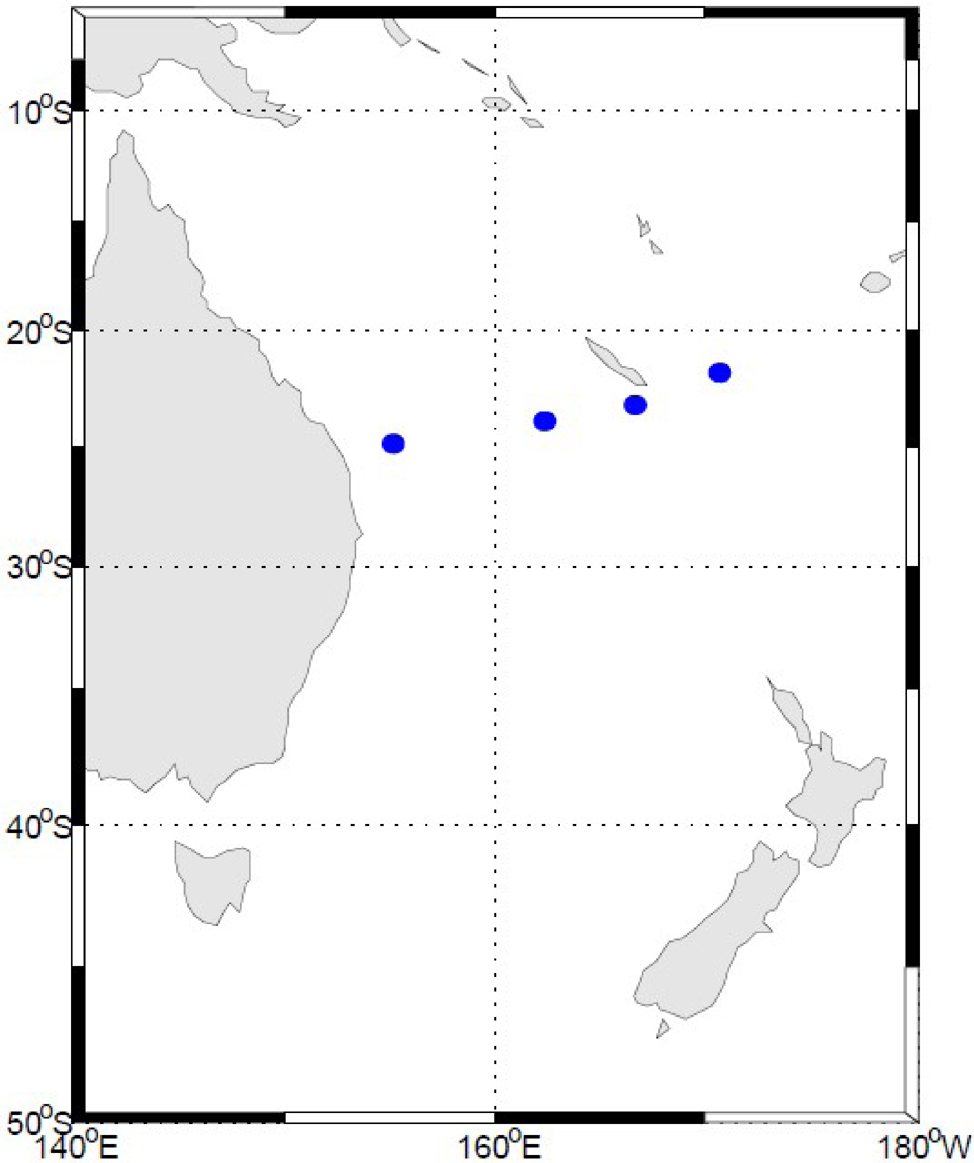


Figure 1. Map of trawl stations conducted during the voyage ss2012_t02.

Table 1. Summary of trawl positions.

Station	Number Tow	Start Lat (°'S)	Start Lon (°'E)	End Lat (°'S)	End Lon (°'E)
1	1	24 55.084	155 12.525	24 55.084	155 12.136
1	2	24 55.610	155 12.136	24 55.610	155 14.495
1	3	24 56.681	155 10.983	24 56.681	155 10.263
2	4	23 52.232	162 20.311	23 52.064	162 21.511
2	5	23 52.064	162 21.511	23 51.935	162 22.343
2	6	23 51.926	162 22.415	23 51.788	162 23.340
3	7	23 12.812	166 37.146	23 12.623	166 38.077
3	8	23 12.617	166 38.111	23 12.449	166 39.027
3	9	23 12.437	166 39.105	23 12.262	166 40.009
4	10	21 46.1535	170 37.369	21 45.700	170 38.162
4	11	21 45.652	170 38.251	21 45.125	170 39.139
4	12	21 45.069	170 39.242	21 44.560	170 40.132

Figure 2. Example of plastic floating marine debris.

Julia Reisser, CSIRO/University of Western Australia

Appendix 5. Transect measurements of plankton distribution in surface waters

The Australian Continuous Plankton Recorder Survey is funded by the Integrated Marine Observing System (IMOS) and is run as a collaboration between CSIRO and the Australian Antarctic Division.

The survey collects phytoplankton and zooplankton samples from around the Australian coastline and the Southern Ocean using a Continuous Plankton Recorder (CPR), a torpedo shaped device approximately 1 m long and weighing 80 kg (Figure 1).

The recorder is towed behind the ship at about 10 metres depth with seawater and plankton entering through a small opening in the nose. Plankton are trapped between two layers of silk and preserved.

Data resulting from this process are used to: (1) develop baselines relating to the biodiversity and distribution of plankton; (2) document changes in response to climate change; (3) provide indices for fisheries management; (4) detect harmful algal blooms; and (5) validate remote sensing and initialise and test ecosystem models.

For the ss2012 _ t02 transit voyage , the CPR was first deployed at about 1740 on Friday 4th May and then recovered at about 1325 on Tuesday 8th May after a problem was found with the internal silk rolls. Figure 2 shows the track coverage of the CPR from first deployment to final recovery.

Figure 1. The Continuous Plankton Recorder used on the RV Southern Surveyor.

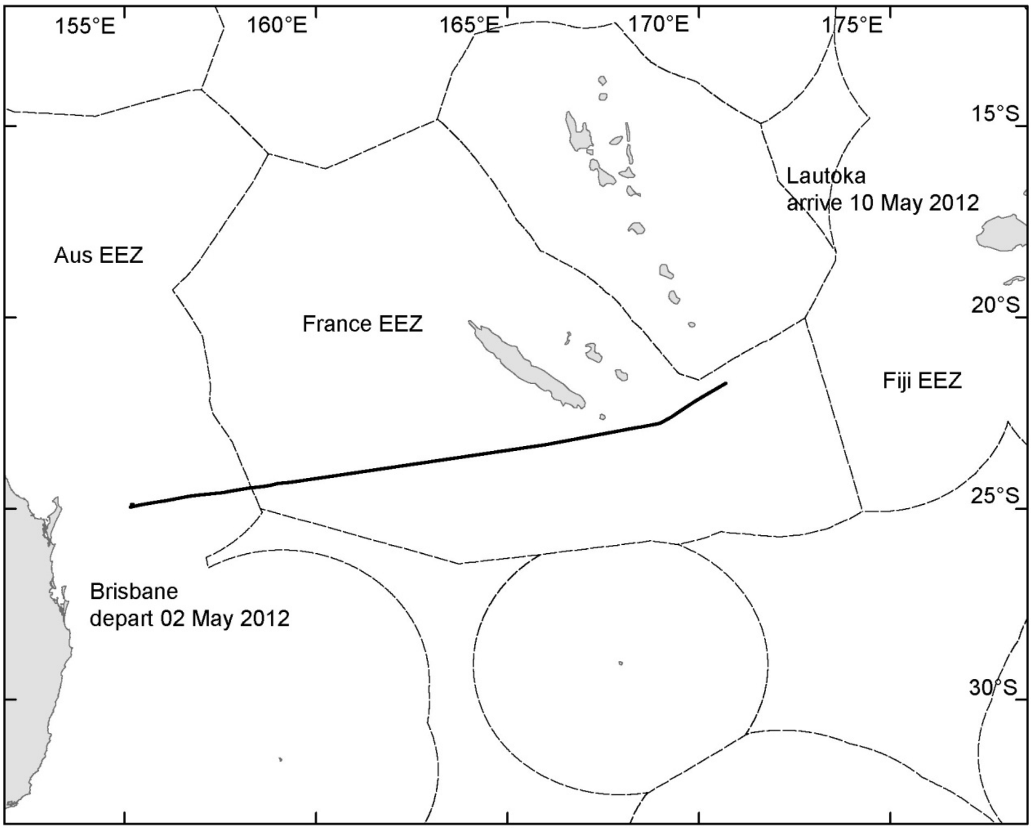


Figure 2. Track showing CPR tow track

Don McKenzie, CSIRO (on behalf of Frank Coman, CSIRO)