Australia's Marine National Facility

VOYAGE SUMMARY ss2012_v06

ECOSAT (Eastern COral SeA Tectonics)

Voyage period:
26/10/2012 to 20/11/2012

Port of departure:
Cairns, Australia

Port of return:
Brisbane, Australia

Responsible laboratory:
University of Sydney
School of Geosciences

Madsen Building F09,
University of Sydney, Sydney
NSW, Australia

Chief Scientist
Maria Seton, EarthByte Group,
School of Geosciences

CSIRO

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Scientific Objectives

Tectonic framework for the easternmost Coral Sea and northern extent of the Lord Howe hotspot.

The main scientific objectives of this voyage are to investigate:

- The nature of the crust (continental/volcanic/oceanic) underlying the main ridge and plateau features in the eastern Coral Sea including Louisiade Plateau, Rennell Island, East Rennell Island Ridge, South Rennell Fracture Zone/Trough, Loyalty and Fairway Ridges and West Torres Plateau by directly sampling and comparing basement from each sampled feature.
- The age and structure of the Santa Cruz/Torres and d'Entrecasteaux Basins through magnetic profiling and explore whether they share a spatial and temporal relationship. We will also explore whether the basins formed in a back-arc setting related to Cretaceous or Eocene subduction or whether they preserve a piece of oceanic crust from the Panthalassic Ocean.
- The extension of the Lord Howe hotspot trail into the eastern Coral Sea, north of the Bellona Plateau by directly sampling extinct volcanic edifices and exploring whether the West Torres Plateau is capped by volcanics and thereby related to the Lord Howe hotspot.

Voyage Objectives

The main voyage objectives are to:

- Acquire magnetic anomaly data over the Santa Cruz/Torres and d'Entrecasteaux Basins using a magnetometer. We plan to collect three magnetic profiles across the North d'Entrecasteaux Basin, to complement existing magnetic anomaly data and three magnetic anomaly profiles crossing the poorly sampled Santa Cruz/Torres Basin. The tracks are designed to trend perpendicular to the inferred spreading fabric of these basins (NW-SE) and to fill data gaps.
- Sample the basement at a total of 10 sites including Louisiade Plateau, Rennell Island, East Rennell Island Ridge, South Rennell Fracture Zone/Trough, Loyalty and Fairway Ridges and West Torres Plateau via dredging. Over four days of multibeam (swath) and single beam sonar profiles will be collected to assist with the selection of sampling sites. Between three and six hours (depth dependent) per dredge site has been allocated for dredging activities

Results

Scientific Objectives

- Mixed success – We had an ambitious plan to dredge the major ridge and plateau features in the eastern Coral Sea. We successfully obtained volcanic rocks from several locations along the East Rennell Island Ridge, a spur of the West Torres Plateau and the Loyalty Ridge. We obtained samples of volcanic sandstone and greywacke from the Fairway Ridge indicative of continental basement from the Lord Howe Rise. In addition, a new sample site at the Le Noroit seamounts successfully obtained rocks indicating continental basement from the New Caledonia Trough. We were unsuccessful at obtaining basement from the Louisiade Plateau where we instead recovered young mudstone probably representing sediment drape over the plateau. We were also unsuccessful at recovering basement from the Rennell Island Ridge but did recover large amounts of benthic limestone and sandstone, which may be quite old. We were denied permission to conduct scientific research in the territorial waters of Vanuatu so were unable to dredge the main part of the West Torres Plateau. An unexpected outcome of the voyage was that we uncovered extensive shallow water carbonates at depths of up to 2500 m, suggesting that the entire area has undergone widespread, anomalous flooding. The precise nature of this subsidence event will require further dating and palaeo-environmental analysis.
- Successful – We obtained 3 full profiles and 4 partial profiles in the Santa Cruz/Torres Basin that fill in a major magnetic anomaly data gap. Unfortunately, we had to modify our magnetic profile plan due to our inability to conduct scientific research in Vanuatu territorial waters. Initial interpretation of the magnetic anomaly data indicate an Oligocene/Miocene age for the basin, consistent with recently dated volcanics along the South Rennell Trough. We obtained four full profiles across the d'Entrecasteaux Basin. Initial interpretation of the magnetic anomalies is difficult but the difference in character of the magnetic anomalies patterns between the Santa Cruz and d'Entrecasteaux Basins indicates that they did not form as one basin but rather had distinct seafloor spreading histories. This helps to constrain the tectonic evolution of the area and the nature of the plate boundaries through time.
- Successful – but pending post-voyage analysis. We obtained basaltic samples from the southernmost part of the South Rennell Trough, the Bellona Plateau and the westernmost spur of the West Torres Plateau. These samples will require further analysis to confirm whether the volcanism is attributed to the Lord Howe hotspot. The identification of olivine-rich

basalt from the West Torres Plateau is consistent with a hotspot/Large Igneous Province related feature.

- An additional and unexpected scientific objective was met when we transited over an area close by a purported island that appeared in scientific datasets and Google Earth but absent from the hydrographic charts used by the master on board the ship. We found that the hydrographic charts accurately measure the water depth in the region and that the global bathymetry datasets used by the scientific community are incorrect in the area by over 2000 m in places. Our result has led to the update of several fundamental scientific datasets such as global bathymetry and coastlines owe hotspot.

Results

Voyage Objectives

- We collected three full and four partial magnetic anomaly profiles across the Santa Cruz/Torres Basin and filled in a known magnetic anomaly data gap. Four full profiles across the d'Entrecasteaux Basin were collected, which will also fill in data gaps. The magnetometers worked well for the entirety of the voyage.
- We conservatively planned for a total of 10 dredges during our voyage but due to good weather and crew and time saved due to our inability to enter Vanuatu waters, we were able to exceed the amount of dredges planned by 8. The major rock types found include limestone, basalt, volcanic breccia, volcanic sandstone and Mn crusts. Minor rock types include andesite, quartzofeldspathic sandstone, mudstone, phosphorite, granite and quartzite.

Voyage Narrative

Depart Cairns October 24, 2012

Transit to survey area.

The installation of the gravimeter is complete before departure and data are being recorded. The collection of swath bathymetry data and monitoring of the Topas system start soon after departure from Cairns. These are the only activities occurring as we are traversing an extensive reef area and will only deploy the magnetometer once the water depths are consistently greater than 250 m. The magnetometer is deployed around 1200 on 27/10/12. The data from the magnetometer appear spiky, however as we are able to filter out the spurious data, we will leave the magnetometer in and test the secondary magnetometer after the first dredge. No leak warnings are given. On the 28/10/12, we are informed that there is a problem with the ship's gyro, leading to random and sudden changes in the ship's course. These changes are affecting the magnetic and gravity data collection but we will be able to filter out these effects. The quality of the swath and Topas are good as we are in shallow water. Weather conditions are calm seas.

Louisiade Trough Magnetic Profiles, October 28 to October 31,2012

We are collecting four short profiles across the Louisiade Trough (not part of the original voyage plan) during our transit to dredge site 1. The magnetic anomaly profiles will assist in dating of basin opening and the bathymetry and gravity profiles will help to understand the relationship between the Louisiade Plateau and Mellish Rise. The quality of swath bathymetry data is moderate/poor as we are in water depths of greater than 4000 m, beyond the normal capability of the system. The Topas system is interfering with the swath system and is not performing well in deep and topographically steep areas so it is no longer monitored. The ship slowed at 1100 on 30/10/12 in order to reset the gyro and navigation. The magnetometer is brought in to 75 m and is taken back out at around 1115. Weather conditions are calm seas.

Dredge Site 1, October 31,2012

The ship is directed towards the southern edge of the Louisiade Plateau along an existing swath bathymetry profile where steep slopes are known to exist. We conduct an extensive swath bathymetry survey of the site starting at 0445 in order to find a site suitable to dredging. We find several interesting features including a crater-like structure that may be volcanic, numerous lava-like flows and several gullies. As the aim of the Louisiade Plateau dredge is to target Louisiade Plateau basement, we decide on a dredge location along a steep slope along one of the gullies. The magnetometer is brought in at 1300 and dredging commenced at 1330 on 31/10/12. The dredge yielded a soft, brown-coloured mudstone but no basement and is therefore unsuccessful. After completion of dredge 1, the reserve magnetometer is deployed which seems to work much better (i.e. no spikes in the data).

Dredge Site 2, October 31 to November 1, 2012

At 2130, during the transit between dredge site 1 and 2, a major water leak in the gym is discovered. The electronics for the swath system are located in the directly below the leak requiring that the swath system be switched off while repairs were undertaken. The swath system is switched off for around 15 and a half hours. In addition, as the electricity to the entire deck had to be switched off, the gravimeter had to be turned off following the rough seas procedure. The gravimeter is then switched to UPS and levelled successfully. The procedure took 35 minutes. The gravity data are being monitored more closely but no problems have been detected.

The second dredge site along the western side of the Rennell Island Ridge is reached before the swath bathymetry

system is operational. It is decided that we would dredge at this location based on the echo-sounder data and existing data, which indicated steep slopes. The magnetometer is brought in and dredging began at 0800. Dredging is successful as we obtained a benthic, chalky limestone. Although these rocks do not indicate basement, they will potentially provide constraints on the age and subsidence of the Rennell Ridge cap. At 1300, the engineers gave the OK to switch on the swath system so we decided to perform swath mapping of our site to provide context to the rocks that were just dredged. Although the reserve magnetometer appeared to be working well, we decided to deploy the original magnetometer, which had undergone some maintenance (fixing of a few loose connections) as a test to see if data quality is improved. The quality of data from the original magnetometer remains poor so we will switch to the reserve magnetometer at the next dredge site for the rest of the voyage. Seas are calm.

Dredge Site 3, November 1 to November 2, 2012

At around 0930, the magnetometer is brought in and dredging starts within site of Rennell Island at dredge location 3. The dredge is a success yielding good quality and quantity of varitextured basalts, which will provide information on the age and composition of the north part of the Rennell Ridge. The carbonate rocks will give extra age info and subsidence history. After dredging is complete, the reserve magnetometer is deployed. At 14:00, the gravimeter is switched off again in order to transfer its power supply to permanent UPS. The rough seas procedure is followed, the gravimeter levelled and the data appeared normal. The procedure took 15 minutes. Seas are calm.

Santa Cruz Basin Magnetic Profiles, November 2 to November 6, 2012

The next 4 days are spent collecting swath, gravity and magnetic anomaly data over the Santa Cruz Basin. We lost the swath and the echo sounder at depths of greater than 5500 m, beyond the normal capability of the system. An inspection of the magnetic anomaly data showed decreasing amplitude of the anomalies as we approach the San Crisobel Trench so we decide to cut the magnetic profile lines short and instead conduct a zig-zag pattern to capture a few more magnetic anomaly tracks where data before joining up with the next line. As we have been denied permission to conduct scientific research in the territorial waters of Vanuatu, we have shortened our magnetic profile lines in the southeastern part of the Santa Cruz Basin. The seas are the roughest to date with up to 22 kn winds.

Dredge Site 4 and 5, November 6, 2012

The original voyage plan included two dredge locations on the West Torres Plateau, within the territorial waters of Vanuatu. As we have been denied entry, we decided to target the westernmost spur of the West Torres Plateau, on the border between the Solomon Islands and Vanuatu. This has saved us significant time. A detailed swath survey is conducted starting at 2330 and dredging commenced at 0430. Dredge 4 recovered basalt (possibly olivine-rich) with a very thick (9cm) manganese crust. Although there is a short distance to the next dredge location, the magnetometer is deployed because we found the magnetic readings useful for identifying volcanic features. Dredge 5 is chosen to be along the eastern ridge of the South Rennell Trough after a detailed swath survey is conducted. Dredging commenced at 20:00. At this site we recover a nearly full dredge bag. However, instead of the expected lava, the only rock type (bar one piece of pumice) is Mn-encrusted cream coloured limestone. Although these rocks are interesting from a carbonate sedimentology point of view, it is less useful for understanding the nature of the underlying basement. The magnetometer is deployed at 2300.

Dredge Site 6, November 7, 2012

Dredge site 6 is chosen along the eastern ridge of the South Rennell Trough, south of dredge site 5. The swath survey commences at 0730 and reveals no especially steep (i.e. dredgable) slopes. It is decided that we will target probable erosion canyons that trend NW-SE in the hope that debris filling the canyon will be sampled. The magnetometer is pulled in at 1300 with dredging commencing at 1445. Although less than 1 kg of rock is recovered from this site, the dredge is successful as the small piece of basalt is analysable and datable. Its presence suggests the M-Ridge is underlain by basalt. The magnetometer is deployed at 1645.

Magnetic profiles d'Entrecasteaux Basin, November 8 to November 9, 2012

Magnetic profiles are being collected parallel to the inferred spreading direction in the d'Entrecasteaux basin. During the weekly inspection of the gravimeter shock absorbers, it is noticed that one of the shock absorbers is flat.

As a temporary measure and until we await instructions via email, we implement a system of taking readings every 2 hours and pumping the shock absorber as necessary. The gravimeter is turned off on the 09/11/2012 at 1430 in order to replace the flat shock absorber with a piece of foam. The rough seas procedure is followed. Upon restarting at 1500, the gravimeter took 10 minutes to level, longer than previous instances but the data appears reasonable.

Dredge Site 7, November 9, 2012

The location for dredge site 7 is chosen after a detailed swath survey along the eastern ridge of the South Rennell Trough. The swath system had a difficult time mapping the peaks with the system crashing at positive slope changes. We survey two parallel lines from ridge crest down into east edge of Rennell Trough and select a dredge target about halfway down into trough. The sea bottom on this feature is cut by

two faults (so hard rock) but the faults themselves are too small to target. Dredging commenced at 2130 while surrounded by three fishing boats with long wires. The dredge became stuck and the dredge assembly is missing when retrieved, broken off at the thin cable. The dredge is unsuccessful. The magnetometer is deployed at 0115.

Magnetic profiles d'Entrecasteaux Basin, November 10, 2012

A continuation of magnetic anomaly profiles parallel to the inferred spreading direction is being collected in the d'Entrecasteaux Basin. The new dredge and wire have been attached. Due to the SE trade winds, the ship is pitching quite a bit. Seas are moderate.

Dredge Site 8, 9 and 10, November 11 to November 12, 2012

We reach the Loyalty Islands dredge site at 1930 and bring in the magnetometer. Existing high-resolution bathymetry of the area, showed a NNE-trending ridge on the E side of a major seamount. One of several steep, W-facing scarps is chosen just below the ridge crest (wind from ESE, top appeared to be sharp, not flat and therefore coral-free). Dredging commences at 2030. The dredge is successful as we recover an altered olivine basalt with amygdules of calcite and likely an intraplate alkali basalt similar to those on the Loyalty Islands. Dredge 9 starts at 0000 along a 'V' shaped valley with a SE face rising to a steep spur, as identified in the existing swath. The dredge is back on deck at 345 but is unsuccessful as we only recover pumice, coral and ooze. We move a short distance to dredge site 10 where we target an east-facing, possibly fault-controlled, terrace riser believed to be lava flows or sedimentary rocks underlying the younger volcanoes. Dredge 10 starts at 0745, is complete by 1100 but is unsuccessful as we only recover pumice, coral and ooze, similar to dredge 9. The magnetometer is deployed at 1110. The seas are very calm for the entire dredging operation.

Dredge Site 11, November 13, 2012

The transit between the Loyalty Islands and a dredge location along the South Rennell Trough pass an area known as the La Noroit seamounts, within the northernmost part of the New Caledonia Trough. As we are ahead of schedule, we decide to target one of these seamounts/ridge features for dredging, navigatating to one of the gravity anomalies highs (and former dredge site). Due to 20 kn easterly winds, we are unable to dredge the cleanest scarp on the massif (near SE corner) and instead target a ESE striking slope near the NE corner. Dredge site 11 dredging operations commence at 1030. Although only a trivial quantity of useable rock is recovered, the presence of quartzite and granite in the manganese nodules is highly significant and indicates the presence of continental rather than oceanic crust beneath this north end of the New Caledonia Trough. The magnetometer is deployed at 1430.

Dredge Site 12, 13 and 14, November 14, 2012

Reached dredge site 12, which is a site in the southernmost part of the South Rennell Trough. A prominent scarp at moderate depths is selected for dredging. The magnetometer is retrieved at 1015 and dredging commences at 1040. The dredge is unsuccessful with no rock recovery, possibly due to not reaching bottom because of strong bottom currents. Following failure of dredge 12, a different slope aspect is chosen for dredge 13 on the south side of the massif. The dredge is deployed at 1430 and back on deck at 1700. At dredge 13, we recover probable limestone. The lack of other rocks means it is of limited use for the objectives of the voyage, which is to identify the basement of the South Rennell Trough. We transit back to an area that we had previously swathed and found an impressive, dredgeable scarp along the eastern flank of the southern part of the South Rennell Trough. Dredge 14 is in the water at 2115 and on deck by 00:30. The dredge is highly successful yielding approximately 400 kg of rock and comprising jointed basalts and volcaniclastic sedimentary rocks mainly sandstone. The magnetometer is deployed at 0105.

Dredge Site 15, November 15, 2012

The next dredge site is chosen to target the southernmost portion of the South Rennell Trough. It is decided to dredge the steep lip of the smooth area - on the NE side because of wind direction. Magnetometer retrieval initiates at 1345 and dredge 15 is deployed at 1500. The dredge recovers both shallow and deep-water limestone with some lava fragments possibly related to the northernmost volcano in Lord Howe seamount chain. The magnetometer is deployed at 1815.

Dredge Site 16, November 16, 2012

Dredge site 16 is chosen on the NW side of Chesterfield Plateau. Magnetometer retrieval initiates at 0845. Dredge 16 deploys at 0855. No rocks are found in dredge bag, which is partially torn at the bottom but a mix of thinly Mn coated lava with some limestones and pumice are recovered from the pipe dredges. The lava fragments are the first recovered fragments from the Chesterfield or Bellona Plateaus, major outpourings of the Lord Howe seamount chain. The magnetometer is deployed at 1130. The transit to dredge sites 17 and 18 pass close by a purported island that appeared in scientific datasets and Google Earth but is absent from the hydrographic charts used by the master on board the ship. We change course slightly to pass over the bathymetric high shown on the hydrographic charts. We find that the hydrographic charts accurately measure the water depth in the region and that the global bathymetry datasets used by the scientific community are incorrect in the area by over 2000 m in places. This transit and discovery is not part of the original voyage plan.

Dredges Site 17 and 18, November 17, 2012

The Fairway Ridge is covered with existing high-resolution swath data and several seismic lines. Dredging commences at 0600 under difficult conditions due to a strong northerly current. The dredge gets stuck and comes back on deck destroyed with a torn open back. The pipe dredges contain ooze, hard young reef limestones and associated individual skeletal debris, yellow sandstone and micritic limestone and a few small angular chips of hard, dark sandstone. We reach dredge site 18 along the northern Fairway Ridge at 1300. The shear-pin went thereby releasing the rocks in dredge bag. Fortunately, half a pipe dredge of ooze, red-brown recrystallised lavas (quite distinctive) and some small pieces of coralline limestone and Mn crusts is recovered. After dredge 18, we start our transit back to Brisbane.

Transit back to Brisbane November 17 to November 20, 2012

The magnetometer is switched off on 19/11/2012 at 1315 for testing of both magnetometers. As we have completed the science program, we decide against redeploying the magnetometer.

Arrive Brisbane, November 20, 2012

Arrival in Brisbane is followed by a media event planned by CSIRO that is attended by the scientific party.

Summary

The majority of the objectives of the voyage were completed successfully. The basement rocks recovered from Le Noroit Seamounts and Fairway Ridge are the first continental rocks recovered from the New Caledonia Trough and Lord Howe Rise, respectively, and will allow us to better constrain the geological history of eastern Australia, Zealandia and New Caledonia.

The volcanic rocks collected from the West Torres Plateau, Rennell Island Ridge and South Rennell Trough coupled with magnetic anomaly data from the Santa Cruz Basin will allow us to determine the timing of widespread Cenozoic extension in the eastern Coral Sea and better constrain the location and type of plate boundaries operating in the area.

The extensive shallow water carbonates that we uncovered at anomalous depths indicates that a massive drowning occurred in the area pointing to perhaps a significant dynamic topography signal in the SW Pacific.

Our results from the Bellona Plateau, southernmost South Rennell Trough and West Torres Plateau have potentially uncovered the oldest rocks associated with the Lord Howe hotspot, thereby allowing us to constrain plate motion paths of the Australian plate.

The voyage received significant media coverage (most read story of 2012 in the Sydney Morning Herald) related to the “undiscovery” of Sandy Island during a transit between the Chesterfield Islands and Nereus Reef. This result, which appears minor at the time, has led to the updating of several fundamental datasets used by the scientific community (e.g. topography and coastlines). It was also extremely successful at capturing the public’s attention about the value of marine scientific research.

Principal Investigators

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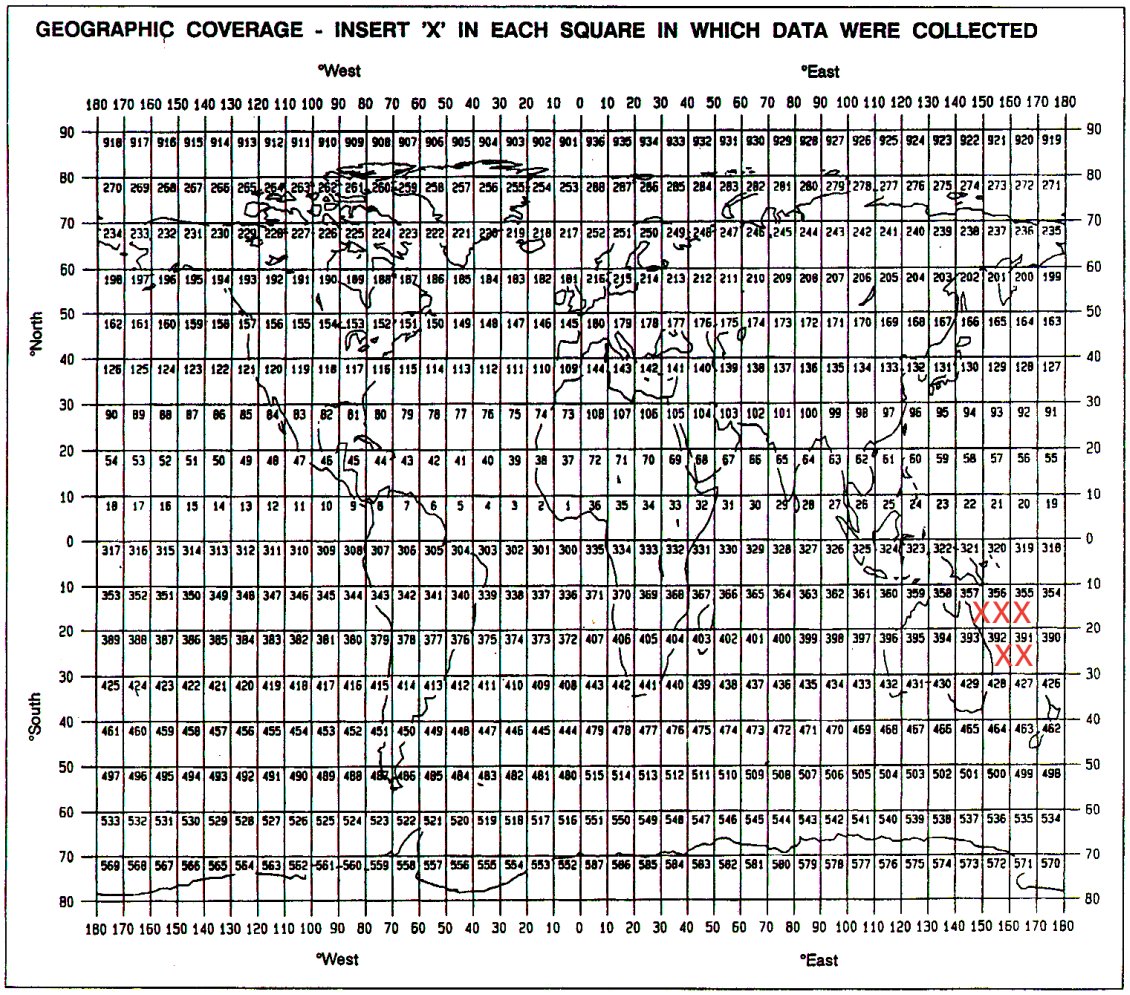
D. Sebastien Meffre, School of Earth Science, University of Tasmania TAS 7005 Sebastian.Meffre@utas.edu.au

E. Steve Micklethwaite, CET (M006), University of Western Australia, 35 Stirling Highway, Crawley, WA 6009. steven.micklethwaite@uwa.edu.au

Marsden Squares

A red "x" indicates where data was collected.



SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

ITEM NO.	PI	NO	UNITS	DATA TYPE	DESCRIPTION
1	A/B	6800	km	G27	Measurement of the Earth's magnetic field recorded in mGals using a sea-based gravimeter. Continuous recording for the entire voyage, except for three instances when the power to the gravimeter had to be disrupted for up to half an hour. Data recorded for analysis of density and crustal variations in the area.
2	A/B	6200	km	G28	Total magnetic intensity of the Earth's magnetic field recorded in nanoTesla using towed magnetometer. Continuous recording for the entire voyage, with the following exceptions (a) dredge sites, (b) transits between proximal drede sites, and (c) beginning and end of voyage. Data recorded for analysis of magnetic polarity reversals within ocean crust, interpretation of the age distribution of oceanic crust within the study area and the analysis of crustal types.
3	A/C/D/E	18	dredges	G01	Rock samples from dredges. Useful rock samples for the purpose of conducting detailed lab-based analysis were recovered from 14 sites. This will include studies of whole-rock composition, mineralogy and age-dating for volcanic and metamorphic rocks and age-dating and analysis of depositional environments and water depths for limestones and sedimentary rock samples.
4	A/E	13,600	km	G74	Multibeam bathymetry acquired using ship-installed system. Continuous recording for the entire voyage, except for a period of 15.5 hours when the system was forcibly switched off. Data recorded for identification of dredge sites and study of seafloor geomorphology

CURATION REPORT

ITEM NO.	DESCRIPTION
1	The digital gravity data will be stored at the School of Geosciences, University of Sydney. It will also be added to the database at Geoscience Australia, and added to the international NGDC repository.
2	The digital magnetic anomaly data will be stored at the School of Geosciences, University of Sydney. It will also be added to the database at Geoscience Australia, and added to the international NGDC repository.
3	Rock samples will be split between the University of Sydney, GNS Science, University of Tasmania, University of Western Australia and Geoscience Australia. Geoscience Australia will receive a type example from each dredge site. The rocks will be added to the PETLAB database hosted at GNS Science.
4	The digital swath data will be stored at the School of Geosciences, University of Sydney. It will also be added to the database at Geoscience Australia, Canberra and eventually provided to GEBCO and the NGDC repository for updating global bathymetry datasets.

Personnel list

Scientific Participants

Maria Seton	University of Sydney	Chief Scientist
Simon Williams	University of Sydney	Geophysicist
Nick Mortimer	GNS Science	Geologist
Sebastein Meffre	University of Tasmania	Geologist
Steve Micklethwaite	University of Western Australia	Geologist
Sabin Zahirovic	University of Sydney	Student
Maral Hosseinpour	University of Sydney	Student
Yongliang Bai	University of Sydney	Student
Jarrod Moore	University of Sydney	Student
Louise Nott	University of Sydney	Student
Daniela Wolf	University of Hamburg	Student
Don McKenzie	CMAR	MNF Voyage Manager
Peter Dunn	CMAR	MNF Electronics Support
Rick Smith	CMAR	MNF Swath Mapping Support
Hiski Kippo	CMAR	MNF Computing Support

Marine Crew

Name	Role
John Barr	Master
Mick Tuck	Chief Mate
Naomi Peterson	Second Mate
Nick Fleming	Chief Engineer
Rob Cave	First Engineer
Graeme Perkins	Second Engineer
Charmayne Aylett	Chief Steward
Steven Leslie	Chief Cook
Oliver Herlihy	Second Cook
Tony Hearne	CIR
Matt Streat	IR
Peter Taylor	IR
Ron Johnson	IR
Michael Chalk	IR

Acknowledgements

We would like to thank Geoscience Australia, who provided funding to cover the costs associated with the voyage.

Maria Seton
Chief Scientist

Voyage Track

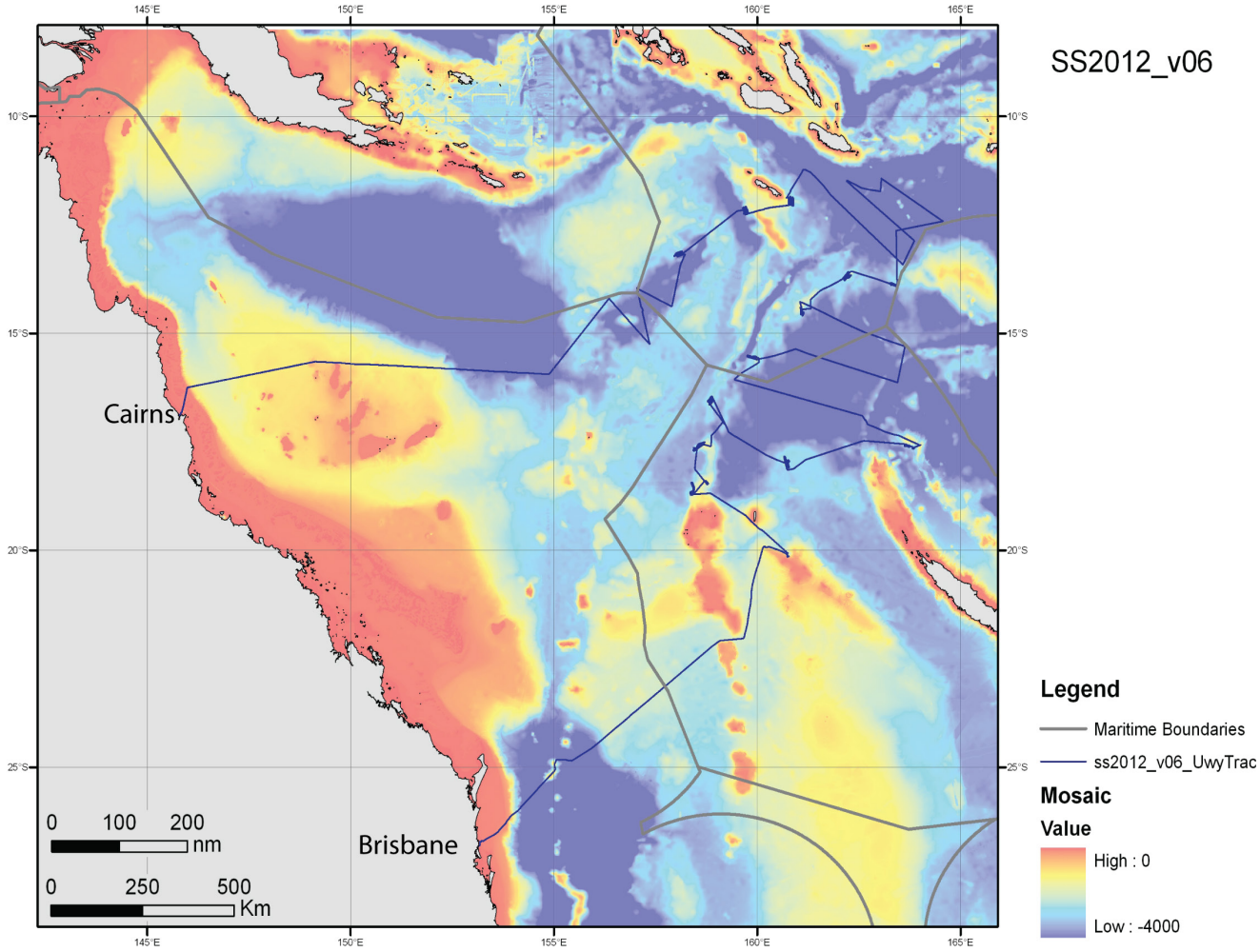


Figure 1: Bathymetry map of the Coral Sea with the ship track of ss2012_v06 in blue and maritime boundaries marked as grey polygons. The voyage started in Cairns and ended in Brisbane.

General Ocean Area(s)

Coral Sea, Pacific Ocean

Specific Area

Most activity was conducted in the eastern Coral Sea, including Louisiade Plateau and Trough, Rennell Island Ridge, Santa Cruz Basin, South Rennell Trough, d'Entrecasteaux Basin and Loyalty Ridge. Further south, areas included the Bellona Plateau near Bampton Reef and the Fairway Ridge near Nereus Reef.

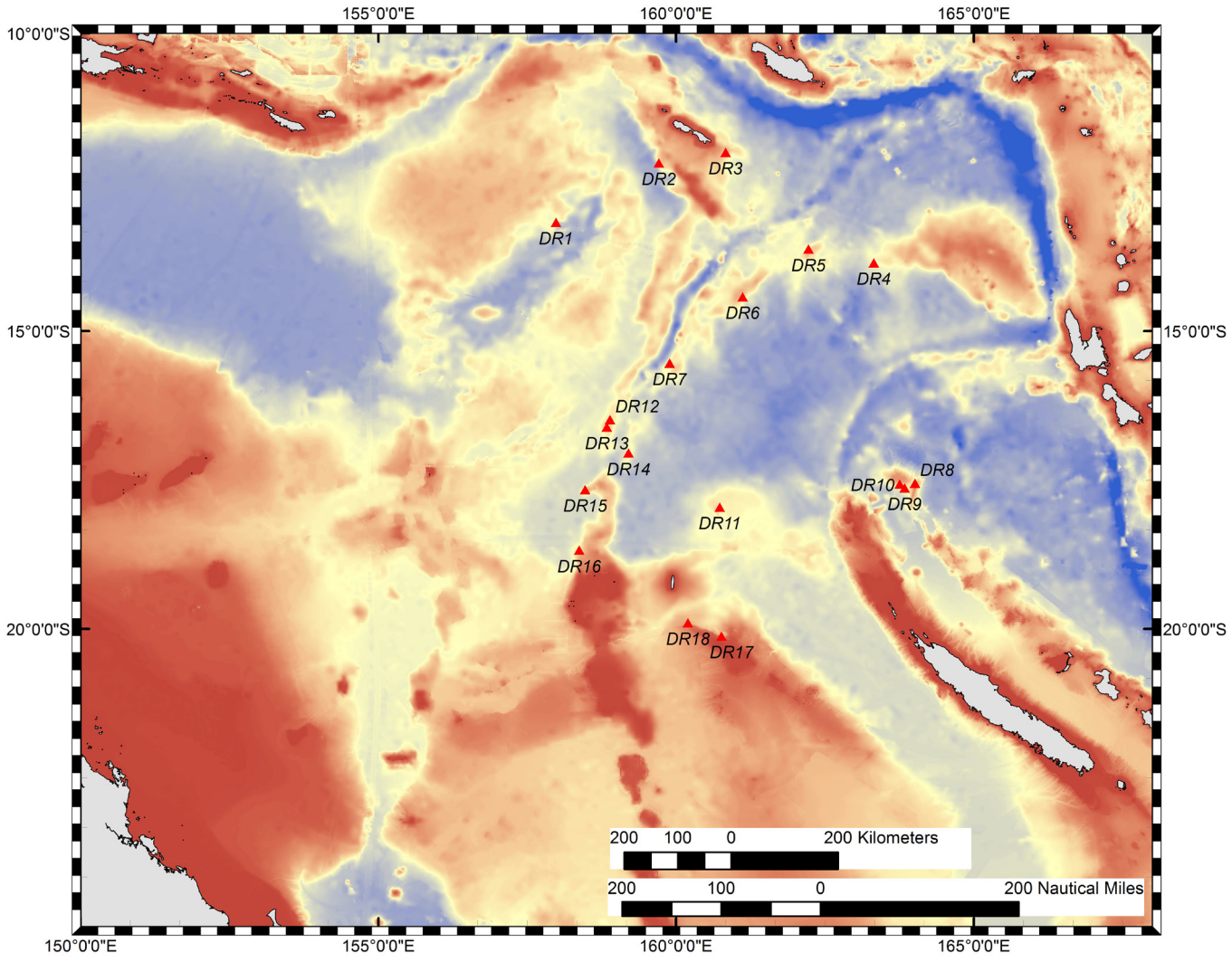


Figure 2: Bathymetry of the Coral Sea with dredge locations marked as red triangles.

CSR/ROSCOP PARAMETER CODES

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
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