Voyage Summary

ss2011_v02

GEOTRACES GP13

MARINE NATIONAL FACILITY

CSIRO

Voyage Summary Pro-forma for MNF Voyages

Voyage Summaries are the formal report of the voyage published on the Marine National Facility website.

Voyage Summaries are a summary record of:

- scientific operations and investigations conducted;
- the location and type of data and samples acquired;
- disposition of and curation arrangements for data and samples;
- the research training supported;
- the research personnel involved.

Voyage Summaries also provide a mechanism to inform:

- the Australian and global research community of research activities undertaken;
- society of the implications of the science that arises from each research voyage.

The Curation Report is part to the Voyage Summary and is a report of the disposition of voyage data and samples. Voyage data-sets and samples contribute to national and international collections and research programs. Their use by the scientific community may continue indefinitely. In all cases voyage data and samples are a valuable public resource. A variety of arrangements exist for the curation of data and samples that arise from a research voyage. In order that the existence and location of the data and samples are visible to the national and international research community, robust metadata on their content and eventual disposition is required. The Marine National Facility curates this metadata and makes directly available a number of the data-sets collected.

The Science Report is attached to the Voyage Summary as Appendix 1 and is a high level summary focused on the science arising from the voyage that is published in the Marine National Facility's Annual Report to the Minister. While several years may be required to complete the investigations of samples and data gathered during a voyage, Chief Scientists are asked to report the present direction of their research and to identify in general terms their post-voyage understanding of its potential benefit to Australia and contribution to the national and international scientific community's understanding of our planet, the oceans and the marine environment.

SHIP

Name: *SOUTHERN SURVEYOR* **Call Sign:** VLHJ

Type of ship: DEEP-SEA RESEARCH VESSEL

VOYAGE NO. ss2011_v02

VOYAGE NAME **GEOTRACES GP13:**
A collaborative international study of the marine biogeochemical cycles of trace elements and their isotopes along a zonal section of the Pacific Ocean east of Australia

VOYAGE PERIOD start 13/05/2011 to 05/06/2011 end
(set sail) **day/ month/ year** **day/ month/ year** **(return to port)**

PORT OF DEPARTURE **Brisbane, Australia**

PORT OF RETURN **Auckland, New Zealand**

RESPONSIBLE LABORATORY

Name Antarctic Climate and Ecosystems Cooperative Research Centre (ACE CRC)

Address University of Tasmania, Private Bag 80, Hobart, TAS 7001

Country Australia

CHIEF SCIENTIST(S)

Dr Andrew R Bowie (ACE CRC, University of Tasmania)

OBJECTIVES AND BRIEF NARRATIVE OF VOYAGE

Scientific Objectives
The ocean plays a vital role in Earth's climate through control of atmospheric carbon dioxide concentrations. One important component of this system is the iron cycle, in which iron-rich soil dust is transported from land through atmosphere to ocean. Iron is a key micronutrient for marine plankton productivity, the scarcity of which limits essential biogeochemical processes and thus ocean fertility. This project will undertake an integrated oceanographic transect and dust monitoring program for iron, other trace elements, and their isotopes (TEIs) along the western end of the GP13 zonal section (~30°S) east of Australia.

Our innovative measurement and analysis strategy will identify processes and quantify fluxes that control the distributions of key TEIs in the southwestern Pacific Ocean, and establish the sensitivity of these distributions to changing environmental conditions. We will use a series of novel techniques to fingerprint the sources, sinks and internal cycling of TEIs, focussing on the atmospheric delivery of iron-dust to the remote ocean. This project will provide maximum scientific reward for evaluating future global change, and has strong international collaborative activity under the auspices of the international GEOTRACES (www.geotraces.org) program.

Outcomes of this project will be an improved ability to predict climate-driven changes in the supply and biogeochemistry of trace elements in ocean waters around Australia. Our research will quantify the importance of atmospheric dust for marine ecosystem health, help inform Government policy on ocean iron fertilisation as a carbon sequestration strategy, and provide a broad basis for evaluating future climatic changes in coupled atmospheric - ocean processes.

Voyage Objectives

This voyage will undertake a zonal transect along ~30°S east of Australia out into the South Pacific (GEOTRACES GP13 line). Three types of stations will be used to achieve our aims: (i) normal stations (every 1° of longitude), (ii) super stations (every 5°), and (iii) mega stations (every 10°) (see Voyage Track). The type of sampling and order of deployments at normal, super and mega stations are outlined below and in the Voyage Plan.

Specific aims of the project are:

(1) Undertake an integrated zonal oceanographic transect east of Australia studying the marine biogeochemical cycles of TEIs, as part of Australasia's contribution to the international GEOTRACES program;

(2) For the first time, establish the full water column, basin-scale distribution of TEIs (which a specific focus on iron, aluminium, manganese, copper, zinc, cobalt, cadmium), and investigate the role of micronutrient TEIs in the oceans surrounding Australia, and their relationship to environmental and ecosystem conditions;

(3) Determine the sources, sinks and fluxes of iron and other TEIs (focussing on atmospheric dust delivery and biomass burning), as well as their transport, solubility and chemical form in the ocean. This includes the use of quasi-conservative elemental tracers of inputs, dissolution and redox cycling;

(4) Collect subsamples for subsequent analysis of other GEOTRACES 'key parameters' (such as stable, radioactive and radiogenic isotopes; as listed in Table 2 of the GEOTRACES Science Plan) by international colleagues who are not able to participate in the field program.

Voyage activities:

The following activities will be conducted on-board the RV *Southern Surveyor* to meet our scientific objectives:

1- CTD profile down to 1500 m at normal stations and full water column at super/mega stations to characterise physical oceanography (temperature, salinity, dissolved O_2, optical transmissivity and in situ fluorescence). In addition, water will be sampled for macro-nutrient analysis (MNF hydrochemistry), particulate organic carbon (POC) and nitrogen (PON), and phytoplankton characterisation. Phytoplankton characterisation includes floristic information measured back in the laboratory using microscopy, high-performance liquid chromatography and flow cytometry. Samples will be fixed or stored in liquid N_2 until analysis.

2- Trace metal sampling down to 1500 m at normal stations and full water columns at super/mega stations using a specialised General Oceanics trace metal rosette (TMR) equipped with 12 x 10 L Niskin-X bottles. The water collected will be manipulated under laminar flow in a clean container van set up on-board. Water collected will be used to measure the following parameters:

- Dissolved trace elements (Fe, Al, Cd, Zn, Co, Mn, Pb, etc, using FIA and ICP-MS techniques).
- Iron chemical speciation using an electrochemical approach
- Iron bioavailability
- Large sample volumes (1-2 L) for iron, zinc, cadmium and copper isotopes (for MC-ICP-MS analysis)
- Large sample volumes (5-10 L) for radiogenic isotopes of Pa, Th, Nd (ICP-MS analysis)
- Nutrients at the nanomolar levels (segmented flow colorimetric analysis with a liquid waveguide capillary cell)

3- Deployment of in situ McLane pumps (at 4 depths) at super/mega stations to measure parameters that require the filtration of large volumes (up to 100 L). The filters collected will be used to measure particulate materials – including trace metals, carbon, biogenic silicic acid and DNA.

4- Dust collection using a high-volume sampler set up on the monkey island. Filters will be analysed by ICP-MS to assess metal solubility and fluxes associated with dust deposition.

The procedure associated with the deployments of the trace metal clean rosette and in situ pumps are outlined in Appendixes 1 and 2 of the Voyage Plan). All procedures will be discussed at toolboxes with personnel at sea prior to deployment. Most shipboard participants have experience in deploying such equipment. For more details about the measurements associated with this oceanographic voyage please refer to the original proposal.

All these operations are required for the success of this project. The most critical one is sampling trace metal clean water using the trace metal rosette (TMR). The use of the McLane pumps will allow the measurement of the in-situ stochiometric ratios of particles (including phytoplankton) and are thus important to understand the dynamics of this marine system. Both the trace metal rosette and in situ pumps deployments have been successfully undertaken during SSv01/2010. Deployment of the standard CTD is essential to characterise the physical oceanography of the region and place our GEOTRACES measurements in a hydrographic context. Finally, the sampling of atmospheric dust should also be regarded as a priority as it has been demonstrated that dust supply is important in that region and it could induce phytoplankton blooms; yet little is known on the trace elements that can potentially be released and the subsequent biological effect associated with the dust deposition in the South Pacific.

The trace metal rosette will be deployed off the stern using the towed body winch fitted with 6 km of 6 mm Dynex rope and using a specialised trace metal block suspended on the trawl deck ‘A’-frame. The McLane pumps will be deployed off the stern using the net drum winch fitted with 4 km of 9 mm (7 mm wire with 1 mm thick PVC coating) sheathed mooring wire and through a block on the trawl deck ‘A’-frame. Each will used independent winches and lines to rapidly switch between deployments.

Results

Deployment of all equipment required for the GEOTRACES GP13 voyage was successful. The trace metal rosette (TMR), the McLane pumps, CTD and aerosol sampler all performed well. Three types of stations were used to achieve our aims: (i) 29 normal stations (every 1^{o} of longitude), (ii) 3 super stations (every 5^{o}), and (iii) 4 mega stations (every 10^{o}). Deployments at normal stations were typically down to 1500 m, with deployments at super- and mega- stations to the full water column. We also collected samples and data from the TMR and CTD down to 6000 m at station 31 (32.5^{o}S, 177^{o}W) to characterise for the first time trace elements and isotopes in the deep waters passing through the Kermadec Trench.

Over 3000 dissolved water samples were collected from the TMR, over 400 particulate filter samples from the McLane pumps, over 2000 water samples from the CTD, and 9 filter samples from the aerosol sampler. Samples will be analysed in the 6-18 month period following the voyage in the laboratories of the respective Principal Investigator for the following parameters:

- Dissolved trace elements (Fe, Al, Cd, Zn, Co, Mn, Pb, Ba, etc, using FIA and ICP-MS techniques).
- Abundance and isotopic composition of trace elements in suspended marine particles
- Particulate organic carbon (POC) and nitrogen (PON)
- Iron and copper chemical speciation using an electrochemical approach
- Iron bioavailability
- Large sample volumes (1-2 L) for iron, zinc, cadmium and copper isotopes
- Large sample volumes (5-10 L) for radiogenic isotopes of Pa, Th, Nd
- Trace elements in atmospheric dusts collected on filters from an aerosol sampler
- Trace elements in collected rain samples
- Nutrients at the nanomolar levels
- Phytoplankton characterisation using microscopy, high-performance liquid chromatography and flow cytommetry
- Photosynthetic health
- Genomics and metagenomics
- Nitrogen fixation genes

A number of analyses were carried out on-board including dissolved Fe by flow injection analyses, iron chemical speciation by competitive ligand equilibration – cathodic stripping voltammetry, phytoplankton photophysiology and hydrography (major nutrients, salinity, oxygen) by standard techniques. Shipboard data indicate that the TMR was non-contaminating for dissolved Fe, one of the most contamination-prone elements. At station #3, a typical micronutrient-type and oceanographically-consistent profile for dissolved Fe was observed (Figure 1). We were unable to carry-out all our planned analytical tasks on board due to contaminated Milli-Q pure water supply (flow injection analyser), and unstable power supply and ship's vibrations (cathodic stripping voltammeter) in the ANU 20' clean container. These samples will now be analysed in the home laboratories after the voyage. Surface subsamples for nanonutrients were collected from the TMR at all stations, and were analysed on the next leg of the GP13 section by New Zealand colleagues. Unfortunately, preliminary data indicate low level contamination for nanonutrients collected from the TMR. The PIs are investigating the source of this problem. Ocean colour satellite data (8 day MODIS image, 4 km resolution) and aerosol dust data and forecasts (NAAPS, hysplit forward trajectories) was relayed to the ship by colleagues at University of Technology Sydney (Dr Mark Baird) and Griffith University (Prof. Grant McTainsh and the Australian dustwatch network), respectively, in order to help with sampling strategies during the voyage.

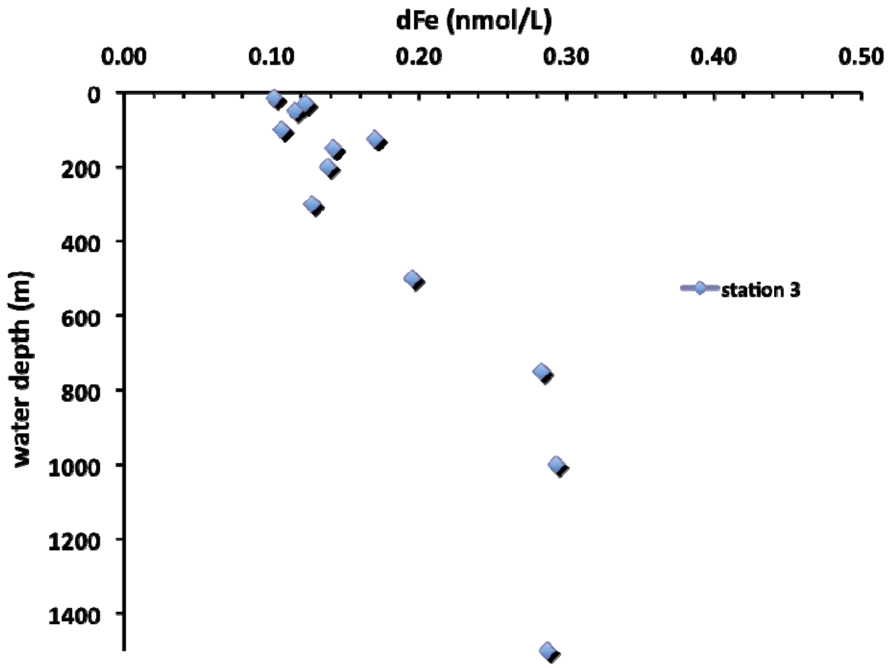

Figure 1. Dissolved iron (dFe) distribution in the upper 1500 m of the water column at mega-station #3 (30^{o}S, 155^{o}E).

Two stations were not carried out due to inclement weather (stations 09, and 25 CTD only deployed). Two deployments (station 03 cast 2, and station 04 cast 1) of the TMR were unsuccessful due to a software problem. This was resolved by reverting to an earlier version of the software, which was successfully tested at station 04 cast 2. An intermittent problem was identified with the one of the McLane pumps. This was believed to be due to a faulty communications cable between the electronics housing and the pump head, and the Chief Scientist is in consultation with the pump manufacturer to resolve this problem.

Operations were carried out in an efficient manner, which resulted in many deployments taking less time than that allocated. This allowed us to add an extra 2 normal stations at the end of the Australian leg of the GP13 section and finish our science at 32.5^{o}S 170^{o}W.

This project is the first time that data on the distribution of many trace elements and their isotopes (TEIs) along the GP13 section in the Tasman Sea and southwest Pacific has been collected, and the 8 deep water deployments (including a 6000 m deployment of the TMR in the Kermadec Trench at 32.5^{o}S 177^{o}W) represent some of the few deep profiles that presently exist in any ocean worldwide. Preliminary results from shipboard analysis of dissolved Fe indicate that the western end of the transect had extremely low concentrations of dissolved Fe, despite the proximity of sampling to the continental shelf and possible dust deposition sources. Upper mixed layer nutrient concentrations were below micromolar detection limits at all stations along section GP13, with typical increases below the mixed layer. These preliminary hydrography results demonstrate low NOx concentrations in the top 100 m. Based on the maximum quantum yield (Fv/Fm), phytoplankton east of 170°E were nutrient limited. Complementary studies on the voyage will indicate the degree of iron and nitrogen co-limitation in these waters. The photosynthetic competency along the GP13 section is shown in Figure 2. In addition, new EM300 swath bathymetric data was collected along the ocean section from 153°30'E to 170°W along 30°S (diverting to 32.5°S at 177°E), an area of significant topography including ocean ridges and trenches, submerged reefs and seamounts. This data is archived and can be processed and quality controlled after the voyage.

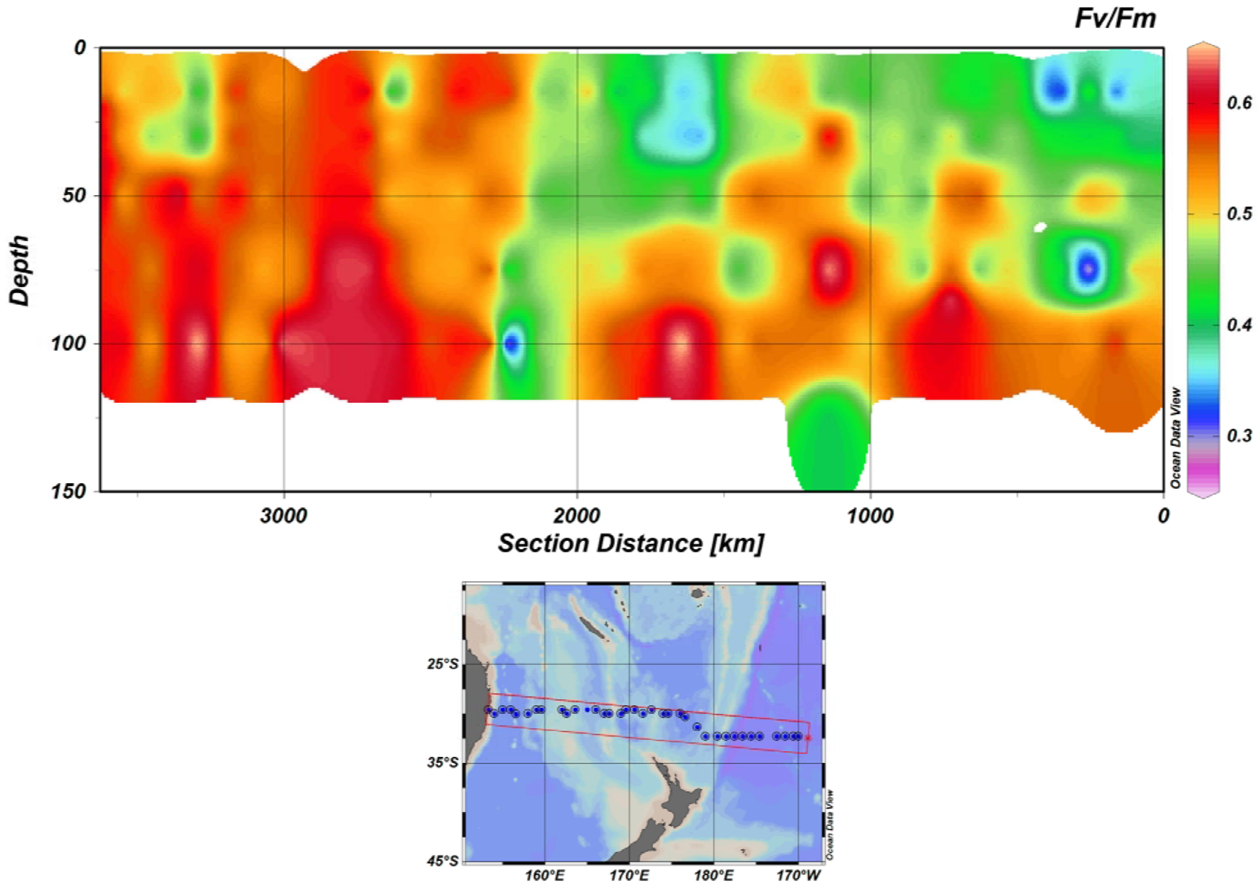

Figure 2. Average Fv/Fm in the upper 150 m along the GP13 section (~30°S) in the Tasman Sea and southwest Pacific Ocean.

In summary, voyage ss2011_v02 successfully achieved the following objectives:
(1) We carried out an integrated zonal oceanographic transect east of Australia studying the marine biogeochemical cycles of TEIs, as part of Australasia's contribution to the international GEOTRACES program;
(2) Samples were collected to establish the full water column, basin-scale distribution of trace elements and isotopes along GP13 for the first time;
(3) Data from subsequent laboratory analyses will determine the sources, sinks and fluxes of TEIs (focussing on atmospheric dust delivery), as well as their transport, solubility and chemical form in the ocean;
(4) A number of subsamples were collected for later analysis of other GEOTRACES (such as stable, radioactive and radiogenic isotopes) and bioGEOTRACES (marine microbial biogeography and biogeochemistry; i.e., 'omics') key parameters by international colleagues who are not able to participate in the field program.

Voyage Narrative

Voyage ss2011_v02 departed Brisbane at 16:40 on Friday 13 May, 2011. The RV *Southern Surveyor* headed out into the Tasman Sea in calm conditions, with dolphins swimming ahead of the bow and into a wonderful sunset. The scientific party, which included participants from 7 different nations, quickly became accustomed to life at sea, and prepared instruments and equipment for the test stations and toolboxes scheduled for early the following morning.

The voyage plan consisted of ‘normal’ station spaced every degree 1^{o} of longitude and ‘super’ or ‘mega’ stations at every 5^{o} of longitude. Normal stations included deployment of the trace metal rosette (TMR) and CTD with sampling to 1500 m, and large volume in situ pumps were also deployed at the ‘super’ or ‘mega’ stations, which sampled the full water column.

After a 6 hour passage to open water, we woke up to the sight of Gold Coast skyscraper hotels and the headland of Byron Bay along the coastline. Toolboxes were held on the bridge for deployments of the TMR off the stern and the CTD off port midships. Several scientists took ginger and sea-sickness tablets to overcome the effects of an increasing sea-swell. After successful deployments, we headed for an evening normal station #1 at 30^{o}S 153^{o}30’E, with scientists settling into the 12-hour working shifts. Trace metal analysis systems were tested in the ANU 20’ container on the forecastle deck.

The first ‘mega-station’ soon arrived at 30^{o}S 155^{o}E, where all equipment was deployed to the full ocean depth of 4700 m: CTD, TMR twice, and McLane large-volume in situ pumps twice (after toolbox and test dip). A number of biological parameters were sampled at this station off both the TMR and CTD. The deep cast of the TMR was not successful, with the Niskin bottles returning to the surface empty. Since we were already behind schedule, the winds were increasing and we needed time to diagnose the problem, we decided to continue slowly to the next station. At station 4, and another failed deployment of the TMR, we diagnosed the problem to be related to the ‘Rosesoft’ software used to program the TMR, and reverted to an earlier version of the firmware that had been used successfully on ss2010_v01. No more problems with the TMR software were encountered for the rest of the GP13 cruise.

Our normal stations continued to proceed well, with typically 1 hour for the CTD and 2 hours for the TMR deployments. At station #7, we encountered Elisabeth Reef nearby which rose to 200 m below the surface of the ocean, which was now a deep blue colour. We experienced mostly clear sunny days with 15-20 knot winds, which allowed for smooth operations. A number of albatross were sighted following the ship. On the evening of 19 May, clocks were advanced 1 hour. The super-station at 30^{o}S 160^{o}E proceeded well, except for the failure of one of the McLane pumps. The long duration of the station meant that both teams of scientists had to work longer shifts than normal and rest up between operations where possible. We deployed the Benthos deep-sea ‘pinger’ on the TMR for the first time at this station, which allowed us to target the bottom depth of 1667 m.

Station #9 was cancelled due to bad weather and increasing sea-swell. The next 3 normal stations were carried out efficiently, with all equipment (TMR and CTD) working well. We also continued to collect aerosol dust samples on the ship’s monkey island when the winds were favourable (sector and strength). We arrived at the 30^{o}S 165^{o}E mega-station on Friday 19th May. This station was a re-occupation of the PINTS (ss2010_v01) process station P1. A full suite of parameters were collected, together with samples for an international GEOTRACES intercalibration exercise. This station also coincided with Pier’s birthday, and the stewards baked a cake for the occasion as a reward for staying up all night!

The next 5^{o} of longitude were covered in just under 2 days, and we were soon approaching our next super-station (#18) at 170^{o}E. A group photo of the scientific team was taken on the aft deck in sunny conditions prior to the station, which was carried out smoothly over the next 11 hours. Efficient sampling operations and smooth seas allowed us to catch up on time lost at the beginning of the voyage and after the next 4 normal stations, we were back on schedule. Colleagues at Griffith University informed us that conditions over the continent were suitable for large-scale dust entrainment, and therefore we continued to monitor our aerosol sampling equipment carefully as we passed just south of Norfolk Island, where ship’s time advanced 1 hour to NZST.

We passed the half-way mark (‘hump day’) of the voyage as we approached mega-station #23 again, which again meant another long working day for the scientific party. All equipment performed well. Weather conditions were dominated by northerly winds, bringing relatively humid air (~85% humidity) southwards, 25 knots of winds and a fairly confused, choppy sea. After station #24 (30^{o}S 176^{o}E), the cruise track diverted in a south-easterly direction toward the 32^{o}30’S line of latitude. The TMR at station #25 was aborted due to rapidly worsening weather conditions, and difficulty in spooling the Dynex rope through the General Oceanics block on the stern ‘A’-frame. After a weather delay of 10.5 hours, the next few normal stations proceeded well as we crossed the South Fiji Basin. Here, the topography of the surrounding seafloor was very interesting, with a number of seamounts and ridges observed as we approached the boundary between the Indo-Australian and the Pacific plates. This region was mapped using the EM300 swath bathymetric data system on board the ship. Rain sampling was also carried out in this region from the ship’s monkey island.

Super-station #28 took place on the international date-line, where east meets west and tomorrow became yesterday! However, the ship remained on NZST time for the rest of the voyage, to aid logging of activities. We marked the occasion with a lunchtime photo on the bow of the ship, and continued to proceed with deployment of our TMR, CTD and McLane pumps. One of the McLane pumps failed on both deployments at this station, and at this station we were able to diagnose that this was due to a faulty communications cable between the electronics housing and the pump head. Unfortunately, we did not have a spare cable on-board, but informed our NZ colleagues to arrange for a new one for their leg of the GP13 section, which followed ours.

We were about 6 hours ahead of schedule as we approached normal station #31, which was situated over the Kermadec Trench, where the ocean depths reached 8850 m. Both the CTD and TMR were deployed to 6000 m depth at station #31, their maximum rated deployment depths. We believe that the TMR operation was the deepest TMR deployed ever throughout the world’s oceans. Our last mega-station (#33) was located at 32^{o}30’S 175^{o}W. The seas were exceptionally calm here. Scientific equipment again worked well, except one of the McLane pumps. The ship’s crew demonstrated a number of safety equipment at this station, including distress beacons (or ‘flares’), rocket line-throwing equipment and emergency position indicating radio beacons (EPIRBs).

Our goal of the Australian leg of GP13 was to complete our final station at the 170^{o}W line of longitude, which intersected the CLIVAR P15S line, and was a region of important scientific value due to the mixing of a number of water masses from the Pacific and Antarctic Oceans. The Captain and Chief Scientist therefore decided to steam directly to station #38 at 170^{o}W, with the plan to pick up the intermediate normal stations on the return leg to Auckland. We successfully deployed the CTD and TMR to 4000 m at station #38, and took extra samples including radionuclides, and those for NZ and international GEOTRACES intercalibration exercises. The second leg of GP13 on the New Zealand RV *Tangaroa* will start at 32^{o}30’S 170^{o}W. Normal stations #37 to #35 were carried out efficiently and we were also able to deploy the TMR (no CTD) at station #34, before diverting to a south-westerly course for the transit to New Zealand. A fair north-easterly wind pushed RV *Southern Surveyor* into port, and voyage ss2011_v02 arrived in Auckland at 08:00 on Sunday 5 June, 2011.

The success of the Australian leg of GEOTRACES GP13 was due to the very efficient and professional execution of station activities, good teamwork by scientists, ship’s crew and officers, and effective communications between all parties. A blog of the cruise is posted at http://www.obs-vlfr.fr/GEOTRACES/index.php/outreach/cruise-blogs/gp13-blog, as part of GEOTRACES Outreach activities. A scientist from a developing nation (Dr Thato Mtshali from CSIR, South Africa) was a member of the scientific contingent as part of the GEOTRACES Education and Training activities.

Summary

Voyage ss2011_v02 was a huge success. Over 5000 samples were collected over the 23 days of shiptime, many of them for parameters that have not been measured in this region of the ocean before, and never in the deep-sea (>1000 m) waters that we sampled. These samples will be analysed in the laboratories of the

Principal Investigators in the 6-18 month period following the voyage. Good sea conditions, and efficient operations by both the scientific party and crew allowed us to deploy all scientific equipment and instruments, and achieve our overall scientific objectives. The multidisciplinary background and experience of the PIs benefitted the collaborations at sea, and made for an enjoyable and productive atmosphere during the voyage.

PROJECT (IF APPLICABLE)

Project name	***GEOTRACES: An International Study of the Marine Biogeochemical Cycles of Trace Elements and Their Isotopes (www.geotraces.org)***
Coordinating body	***GEOTRACES International Project Office, 14, av. Edouard Belin, 31400 Toulouse cédex 9, France***

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MARSDEN SQUARES

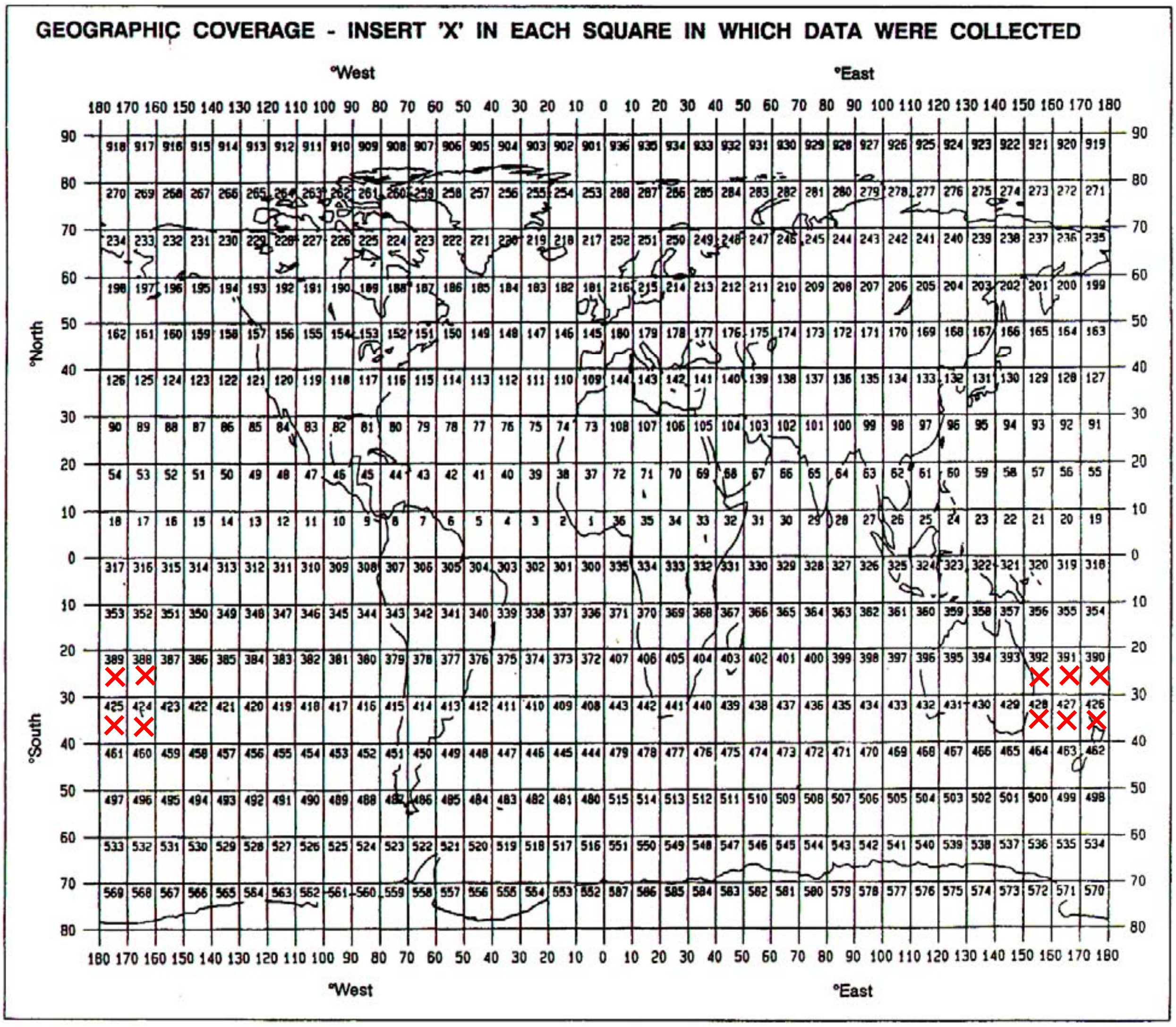

Figure 3. Geographic coverage

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

Item No	PI	APPROXIMATE POSITION						DATA TYPE	DESCRIPTION
	See page above.	LATITUDE			LONGITUDE			enter code(s) from list on last page.	
		deg	min	N/S	deg	min	E/W		
None									
								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN					
Item No.	PI see page above	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on last page	DESCRIPTION
1	MNF	76	^{o}C	H10	**Temperature**, measurement at the top and bottom of each CTD
2	MNF	114	N/A	H10	**Salinity**, used to calibrate the sensor of the seabird 911, 2-3 samples per cast (depending on depth of CTD)
3	MNF	114	µmol/L	H21	**Dissolved oxygen**, used to calibrate the sensor of the seabird 911, 2-3 samples per cast (depending on depth of CTD)
4	MNF	760	µmol/L	H22 H75 H26	**Major nutrients** (NOx, Si and PO4) taken at each CTD deployment.
5	MNF	190	µmol/L	H22 H75 H26	**Nanonutrients** (NOx, Si and PO4) taken at each TMR deployment. These need further analysis by flow injection and will complement analysis that were below detection limit from the MNF Hydrochemists
6	A	540	nmol/L	H30	**Dissolved and total dissolvable iron** from the TMR. These samples will be analysed in the lab using flow injection technique.
7	A	540	nmol/L	H30	**Total dissolved trace metals** (Cu, Mn, Fe) from the TMR. Sample will be analysed using isotope dilution ICP-MS.
8	D	168	nmol/L	H30	**Total dissolved trace metals** (Cu, Zn, Cd, Pb) from the TMR. Sample will be analysed using ICP-MS.
9	E	168	nmol/L	H30	**Fe chemical speciation** from the TMR. Sample will be analysed using electrochemical techniques.
10	D	168	nmol/L	H30	**Cu chemical speciation** from the TMR. Sample will be analysed using electrochemical techniques.
11	D	150	nmol/L	H30	**Dissolved trace metal stable (Fe, Zn and Cu) isotopic signature** from the TMR. Sample will require further analysis using MC-ICP-MS technique.
12	B	150	nmol/L	H30	**Dissolved trace metal stable (Cd) isotopic signature** from the TMR. Sample will require further analysis using MC-ICP-MS technique.
13	B	48	nmol/L	H30	**Dissolved trace metals** for **GEOTRACES and AUS-NZ intercalibration** exercises from the TMR. Analysis using various techniques.
14	E	100	µmol/L	H90	**Suwannee River fulvic acid (SRFA)-like** compounds from the TMR.
15	E	228	µg/L	B02	**Pigments** and **Chl a** from the CTD. Analysis by HPLC technique back in the laboratory. These will be use to infer the biomass and the composition of the phytoplankton community.
16	E	228	cell/mL	B07	**Picoplankton** and **bacterial abundance** from the CTD using flow cytometry.
17	E	228	Relative units	B90	**Photosynthetic health (Fv/Fm)** of the phytoplankton community from the CTD. These samples are used to infer nutrient limitation. These samples were analysed on-board using the Water-PAM.
18	B	112	N/A	B90	**Nifh** from the CTD. A gene that controls the expression of nitrogenase, the primary enzyme used during nitrogen fixation.
19	I	112	nmol/L	H90	**Dissolved barium** from the CTD. These samples will require further analysis using ICP-MS.
20	A	21	µmol/L	B71	**Particulate organic carbon and nitrogen** from 3 depths on the CTD used to complement McLane pump samples. Samples collected for land-based mass spectrometry analysis.

21	H	70	cell/mL	B90	**Flow cytometry** (glutaraldehyde preserved samples) (bioGEOTRACES).
22	H	70	N/A	B90	**Single cell genomics** (glycerol preserved samples) (bioGEOTRACES).
23	H	70	N/A	B90	**qPCR and Metagenomics** (bioGEOTRACES).
24	G	114	nmol/L	H32	**Dissolved radiogenic (Pa, Th, Nd) isotopes** from the CTD. These samples will require further analysis using ICP-MS.
25	A	28	nmol/L	H30	**Particulate trace metals** from the McLane pumps. These samples were collected on QMA filters and will require further analysis using ICP-MS.
26	A	28	µmol/L	B71	**Particulate organic carbon and nitrogen** from the McLane pumps. These samples were collected on QMA filters and will require further analysis using mass spectrometry techniques.
27	A	28	µmol/L	H30	**Particulate iron mineralogy** from the McLane pumps. These samples were collected on QMA filters and will require further analysis using X-ray synchrotron techniques. Collected for Dr Thato Mtshali (CSIR, South Africa)
28	E	28	N/A	B90	**Metagenomics and ferredoxin/flavodxin index** from the McLane pumps. These samples were collected on QMA filters.
29	D	28	µmol/L	H32	**Particulate trace metal stable isotopes** from the McLane pumps. These samples were collected on polycarbonate filters and will require further analysis using MC-ICP-MS.
30	G	28	µmol/L	H32	**Particulate trace metal radiogenic (Pa, Th) isotopes** from the McLane pumps. These samples were collected on polycarbonate filters and will require further analysis using MC-ICP-MS.
31	C	9	nmol/L	M70	**Atmospheric dust** collection. These samples will require further analysis for trace metals using ICP-MS. Collected by Dr Ed Butler for analysis by lab A and Dr Alex Baker (UEA, UK)
32	A	2	nmol/L	M71	**Rain** collection. These samples will require further analysis for black carbon and trace metals using ICP-MS. Collected by Dr Laurie Burn-Nunes (Curtin Uni.)
					Please continue on separate sheet if necessary

CURATION REPORT

Item No.	DESCRIPTION
1	The organisational unit is the Marine National Facility. Data will also be made available (after the 2-year delay) on the GEOTRACES Data Assembly Centre (GDAC) database.
2	The organisational unit is the Marine National Facility. Data will also be made available (after the 2-year delay) on the GEOTRACES Data Assembly Centre (GDAC) database.
3	The organisational unit is the Marine National Facility. Data will also be made available (after the 2-year delay) on the GEOTRACES Data Assembly Centre (GDAC) database.
4	The organisational unit is the Marine National Facility. Data will also be made available (after the 2-year delay) on the GEOTRACES Data Assembly Centre (GDAC) database.
5	The organisational unit is the Plymouth Marine Laboratory (United Kingdom). Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
6	The organisational unit is the Antarctic Climate & Ecosystems CRC. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
7	The organisational unit is the Antarctic Climate & Ecosystems CRC. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
8	The organisational unit is the Australian National University. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
9	The organisational unit is the University of Technology Sydney. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
10	The organisational unit is the Australian National University. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
11	The organisational unit is the Australian National University. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 3 years is expected to analyse the samples and publish the results.
12	The organisational unit is the National Institute for Water and Atmospheric Research (New Zealand). Data will be made available on the national MarLIN and international GDAC database. A timeframe of 3 years is expected to analyse the samples and publish the results.
13	The organisational unit is the National Institute for Water and Atmospheric Research (New Zealand). Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
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18	The organisational unit is the National Institute for Water and Atmospheric Research (New Zealand). Data will be made available on the national MarLIN database. A timeframe of 2 years is expected to analyse the samples and publish the results.
19	The organisational unit is the Vrije Universiteit Brussel (Belgium). Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
20	The organisational unit is the Antarctic Climate & Ecosystems CRC. Data will be made available on

	the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
21	The organisational unit is the Massachusetts Institute of Technology (USA). Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
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32	The organisational unit is the Antarctic Climate & Ecosystems CRC. Data will be made available on the national MarLIN and international GDAC database. A timeframe of 2 years is expected to analyse the samples and publish the results.
	Please continue on separate sheet if necessary

TRACK CHART

✔

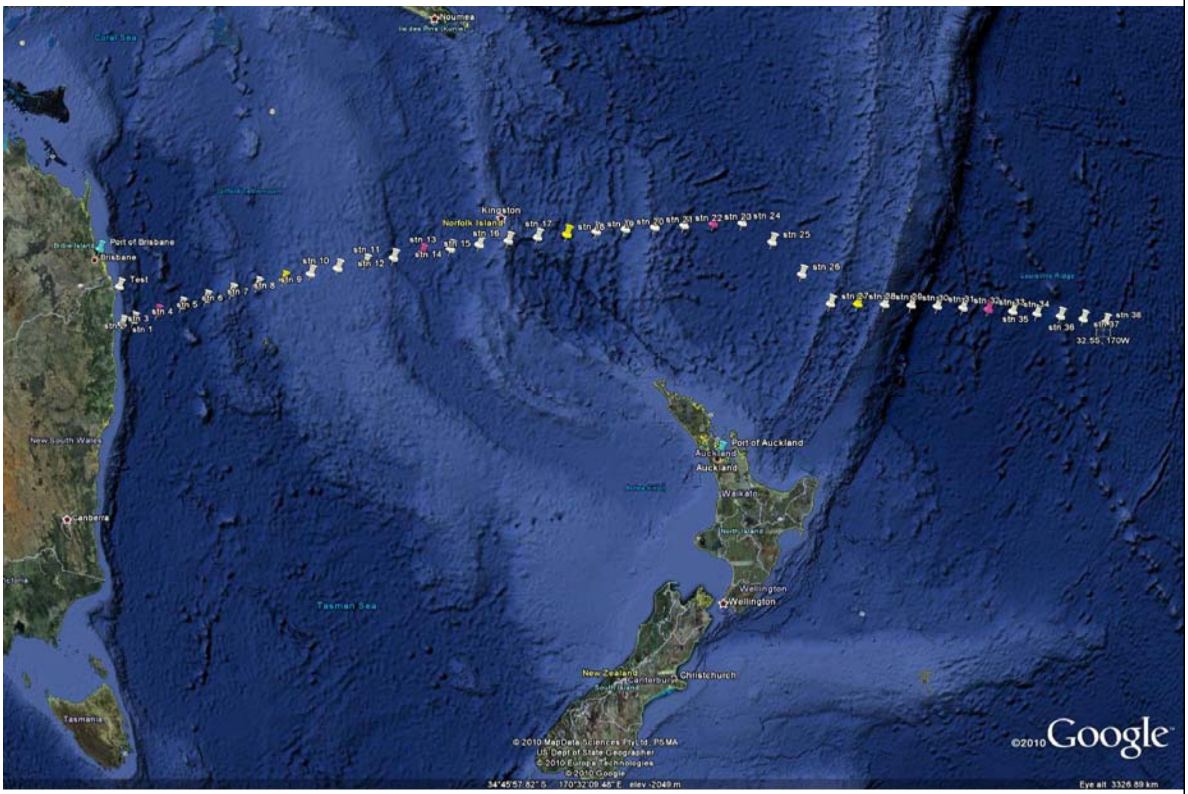

Figure 4. Station locations along the Australian leg of the GEOTRACES GP13 cruise track (voyage ss2011_v02) overlain on Google Earth bathymetry of the study region. Normal stations (1o longitude spacing) are shown in white, super stations (every 5o) in yellow and mega stations (every 10o) in pink. Start (Brisbane, 13 May 2011) and finish (Auckland, 05 June 2011) ports are shown as blue markers. Stations 9 and 25 were cancelled due to bad weather.

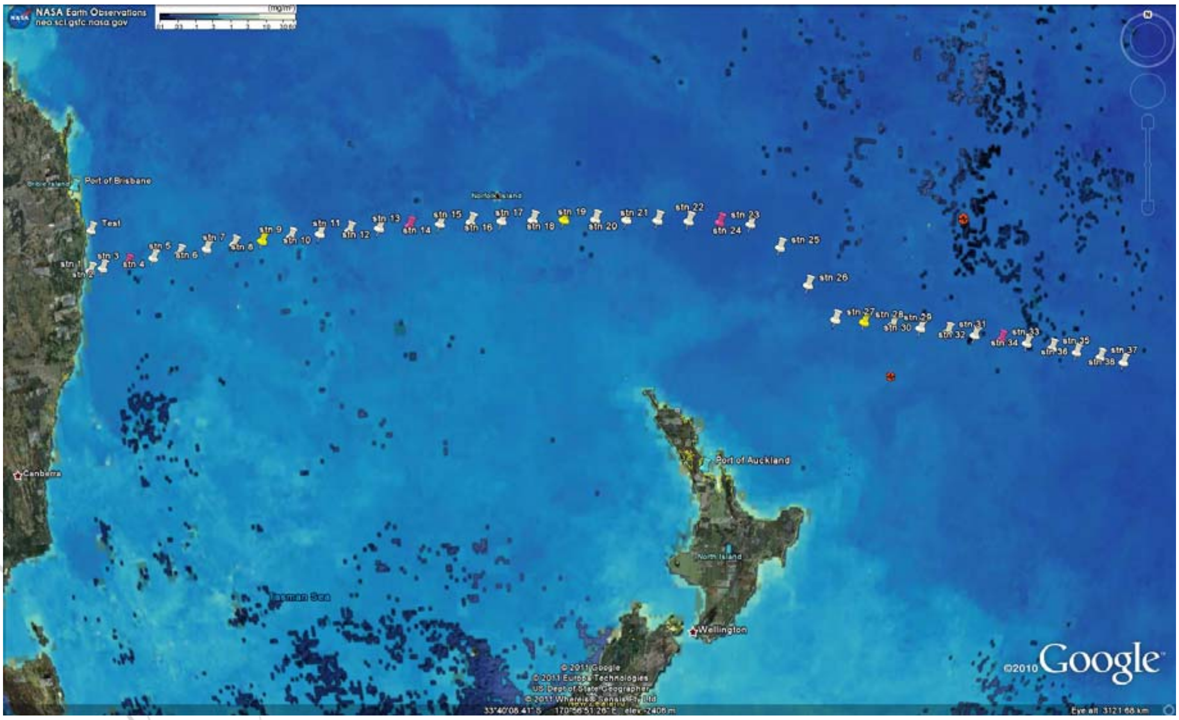

Figure 5. Station locations along the Australian leg of the GEOTRACES GP13 cruise track (voyage ss2011_v02) overlain on May 2011 composite Chlorophyll Concentration (1 month - Aqua/MODIS).

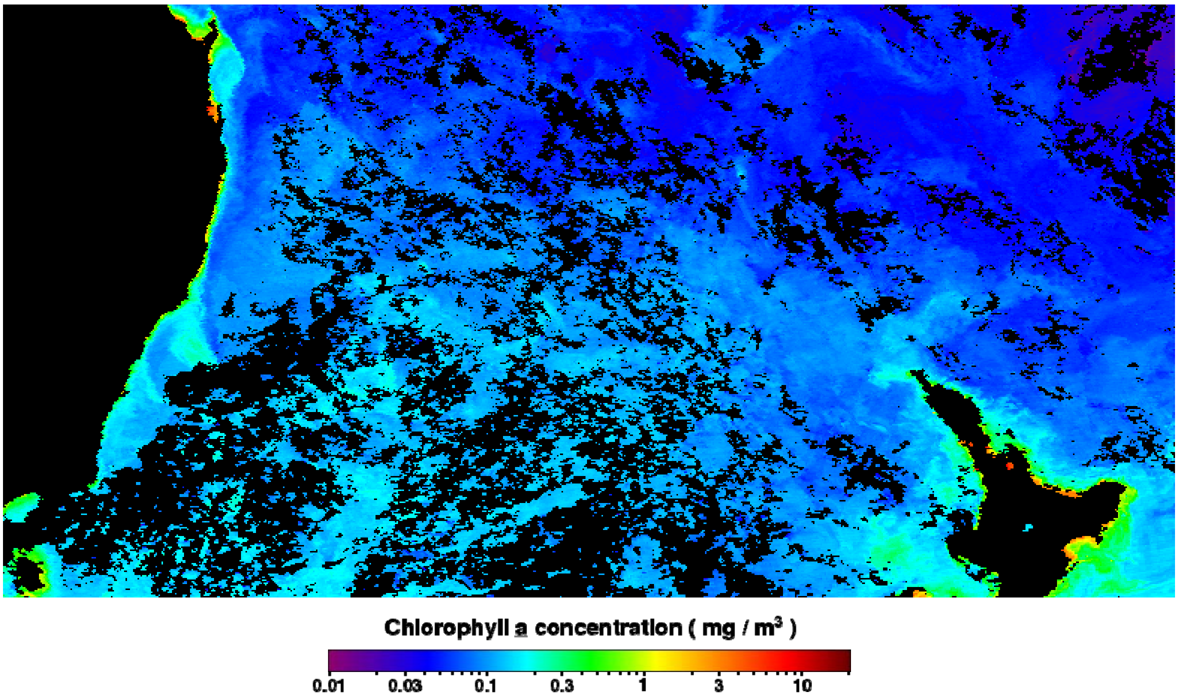

Figure 6. 8 day MODIS image of Tasman Sea (4 km resolution) taken on 30 May 2011 with colour bar of chlorophyll a concentration along the bottom (courtesy of Dr Mark Baird, UTS).

GENERAL OCEAN AREA(S)

Tasman Sea
Southwest Pacific Ocean

SPECIFIC AREAS

Voyage ss2011_v02 undertook a zonal ocean section along the 30°S line of latitude (from 153°30'E to 176°E) and then diverting to 32°30'S and continuing eastwards (from 179°E to 170°W) (Figure 4). This constituted the GEOTRACES GP13 line, with stations re-occupying the CLIVAR P06 line. A full station and event log can be found in Appendix 2.

PERSONNEL LIST

Scientific Participants

Name	Affiliation	Role
Andrew Bowie	ACE CRC	Chief Scientist, Chemical oceanographer (trace metal rosette chief)
Christel Hassler	UTS	Alternative Chief Scientist, Biological oceanographer (CTD chief)
Pier van der Merwe	ACE CRC	Marine chemist (McLane pumps chief)
Delphine Lannuzel	UTAS	Sea-ice marine chemist
Claire Thompson	ANU	Chemical oceanographer
Louiza Norman	UTS	Marine biologist
Laurie Burn-Nunes	Curtin Uni.	Trace chemist
Taryn Noble	UTAS	Marine paleoceanographer
Fabien Queroue	UTAS	Marine chemist
Thato Mtshali	CSIR, Stellenbosh (South Africa)	Marine chemist
Ed Butler	UTAS	Chemical oceanographer
Pamela Brodie	CSIRO MNF	Voyage Manager, Computing Support
Karl Forcey	CSIRO MNF	Electronics Support, DVM
Sue Reynolds	CSIRO MNF	Hydrochemist
Peter Hughes	CSIRO MNF	Hydrochemist

Marine Crew

Name	Role
John Barr	Master
Mike Tuck	Chief Mate
Tom Watson	Second Mate/Cadet
Upendra Kapugeekiyena	Chief Engineer
Mike Yorke-Barber	First Engineer
Graham Perkins	Second Engineer
Robert Dittko	Chief Cook
Cassandra Rowse	Chief Steward
Brooke Seal	Second Steward
John Howard	Boatswain/CIR
Graham McDougal	Integrated Rating
Nathan Arahunga	Integrated Rating
Ellen Smith	Integrated Rating
Gareth Gunn	Integrated Rating

THANK YOU FOR YOUR COOPERATION

ACKNOWLEDGEMENTS

We acknowledge the captain, officers and crew of the RV *Southern Surveyor* for excellent and professional work at sea, and for helping to create a friendly atmosphere on board the vessel. This project benefitted from the generous loan of major scientific equipment from ANU, ACE CRC, NIWA, UTAS and CSIRO. Dedicated and efficient collaboration by the sea-going scientific team and Marine National Facility participants, and other land-based Principal Investigators, was instrumental to the success of this voyage. Taryn Noble is thanked for writing the cruise blog (posted at: http://www.obs-vlfr.fr/GEOTRACES/index.php/outreach/cruise-blogs/gp13-blog), Laurie Burn-Nunes for preparing the Event Log, Claire Thompson for collating the Metadata, Christel Hassler for preparing the CTD Log, Mark Baird for provision of MODIS satellite images, and Craig Strong and Grant McTainsh for sending HYSPLIT and NAAPDS aerosol data to the ship.

The GEOTRACES GP13 project is supported by the Australian Research Council (refs.: DP1092892 and DP110100108), the University of Tasmania Institutional Research Grants Scheme (ref: L0018934) and Rising Stars (ref: B0019024) schemes, the Australian Government Cooperative Research Centres Programme through the Antarctic Climate and Ecosystems CRC (ACE CRC), Scientific Committee for Oceanic Research (SCOR) (sponsorship of participation of Dr Thato Mtshali), the National institute for Water and Atmospheric Research (NIWA) (loan of equipment), and CSIRO Marine National Facility (shiptime and logistics).

Chief Scientist

Andrew Bowie

Dr Andrew Bowie, 11 July 2011

APPENDICES

Appendix 1 - Science Report
Appendix 2 – Event Log
Appendix 3 – Metadata Report

3.1 CTD metadata
3.2 TMR metadata
3.3 McLane pump metadata
3.4 Dust sampler metadata
3.5 Rain collection metadata

Appendix 1 - Science Report

Voyage SSv02/1011

Title - GEOTRACES GP13: A collaborative international study of the marine biogeochemical cycles of trace elements and their isotopes along a zonal section of the Pacific Ocean east of Australia.

Chief Scientist: Dr Andrew R Bowie (Antarctic Climate & Ecosystems CRC, University of Tasmania, Australia)

Itinerary
Departed: Brisbane, Australia, 16:00, Friday 13 May 2011
Arrived: Auckland, New Zealand, 08:00, Sunday 05 June 2011

Contribution to Australia's national benefit:
This research facilitated Australian leadership in the new international GEOTRACES program (www.geotraces.org), studying a wide range of chemical, physical and biological processes involved in the cycling and supply of trace elements and their isotopes (TEIs) in the ocean, and their sensitivity to changing environmental and climatic conditions. This work directly addressed internationally recognised issues in climate change and identified National Research Priorities under the theme 'Environmentally Sustainable Australia'; especially in regards to goals: (PG7) "Responding to climate change and variability", and (PG5) "Sustainable use of Australia's biodiversity". Our studies have provided vital information on the prevalence and flux of key TEIs for ocean-atmosphere biogeochemical and climate models. This will enable prediction of the role of ocean biology in past (glacial) and future regulation of atmospheric CO_2, and help inform policy on ocean fertilisation. We have developed innovative technologies and expertise for the broader advantages of research partners, fostered Australian research competitiveness, and improved its oceanographic science and technology capabilities through participation in leading-edge, global marine biogeochemical research.

As a result of this voyage:

1. We have a better understanding of the marine biogeochemistry of key TEIs in the ocean, thus facilitating their explicit inclusion in numerical models of ocean marine ecosystems, and allowing a prediction of the role of biology in regulation of carbon transfer to the deep sea.

2. Preliminary results from shipboard analysis indicate that the western end of the GP13 transect had extremely low dissolved Fe concentrations (an element vital for marine biological growth), despite proximity to continental sources. Post-cruise laboratory analysis will indentify the degree of iron and nitrogen co-limitation in these waters.

3. We have mapped, for the first time, the three-dimensional distribution of TEIs in the southwest Pacific Ocean, and conducted experiments to understand their sources, sinks and internal cycling.

4. We have commenced a program of high-profile international research under the GEOTRACES program. Our initiatives are prompted by the increasing recognition that TEIs are playing a crucial role as regulators and recorders of important biogeochemical and physical processes that control the structure and productivity of marine ecosystems, the dispersion of contaminants in the marine environment, the level of greenhouse gases in the atmosphere, and global climate.

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 2

GEOTRACES GP13 (ss2011_v02) Event Log

					Start		Finish		Duration	Start		Start		Start			
				Deployment depth	Local		Local			UTC		Lat	Long	Lat	Long	Bottom depth	Comments
Event#	Stn #	Cast #	Operation	(m)	Date	Time	Date	Time	(h)	Date	Time	Deg	Deg	Dec	Dec	(m)	
1			Depart Brisbane		13-May-11	16:30				13-May-11	06:30	27o30'	153o06'				
2	Test		Trace metal rosette	60	14-May-11	08:53	14-May-11	09:05	00:12	13-May-11	22:53	28°27.3'S	153°45.7'E			80	
3	Test		CTD	70	14-May-11	12:40	14-May-11	12:54	00:14	14-May-11	02:40	28°55.4'S	153°43.1'E			80	
4	1		Trace metal rosette	80	14-May-11	20:11	14-May-11	20:21	00:10	14-May-11	10:11	29°59.9'S	153°30.0'E			89	
5	1		CTD	89	14-May-11	20:52	14-May-11	21:13	00:21	14-May-11	10:52	29°59.9'S	153°30.0'E			89	
6	2		CTD	1500	15-May-11	10:58	15-May-11	12:04	01:06	15-May-11	00:58	30°00.0S	154°00.2E			3500	
7	2		Trace metal rosette	2000	15-May-11	12:20	15-May-11	14:09	01:49	15-May-11	02:20	30°00.0S	154°00.2E			3500	
8	Test		McLane pumps	100	15-May-11	23:02	15-May-11	23:40	00:38	15-May-11	03:02	30°00.0'S	155°00.0'E			4663	
9	3	1	Trace metal rosette shallow	1500	16-May-11	01:00	16-May-11	02:11	01:11	15-May-11	15:00	29°59.9'S	155°00.1'E			4663	
10	3		CTD	4500	16-May-11	02:45	16-May-11	05:55	03:10	15-May-11	16:45	29°59.9'S	155°00.1'E			4663	
11	3	1	McLane pumps QMA	1114	16-May-11	10:00	16-May-11	13:00	03:00	16-May-11	00:00	29°59.9'S	155°00.1'E			4663	
12	3	2	McLane pumps PC	1100	16-May-11	17:47	16-May-11	18:27	00:40	16-May-11	07:47	30°00.0'S	155°00.2'E			4663	
13	3	2	Trace metal rosette deep	4500	16-May-11	19:15	16-May-11	22:25	03:10	16-May-11	09:15	30°00.0'S	155°00.2'E			4663	Did not fire
14	4		CTD	1500	17-May-11	03:24	17-May-11	04:35	01:11	16-May-11	17:24	30°00.1'S	155°57.7'E			4700	
15	4		Trace metal rosette	1600	17-May-11	04:58	17-May-11	06:06	01:08	16-May-11	18:58	30°00.1'S	155°57.7'E			4700	Did not fire
16	4		Trace metal rosette	160	17-May-11	06:42	17-May-11	07:08	00:26	16-May-11	20:42	30°00.1'S	155°57.7'E				Rosette test dip to 160m
17	5		CTD	1500	17-May-11	12:36	17-May-11	13:41	01:05	17-May-11	02:36	30°00.0S	156°56.0'E			4848	
18	5		Trace metal rosette	1700	17-May-11	14:14	17-May-11	15:31	01:17	17-May-11	04:14	30°00.0S	156°56.0'E			4848	
19	6		CTD	1500	17-May-11	21:10	17-May-11	22:15	01:05	17-May-11	11:10	30°00.0'S	158°00.0'E			2038	
20	6		Trace metal rosette	1700	17-May-11	22:30	17-May-11	23:42	01:12	17-May-11	12:30	30°00.0'S	158°00.0'E			2038	
21	7		CTD	1500	18-May-11	05:10	18-May-11	05:42	00:32	17-May-11	19:10	30°00.0'S	159°0'E			1760	
22	7		Trace metal rosette	1650	18-May-11	06:58	18-May-11	08:35	01:37	17-May-11	20:58	30°00.0'S	159°0'E			1760	
23	8		Trace metal rosette	1660	18-May-11	14:46	18-May-11	16:00	01:14	18-May-11	04:46	30°00.0'S	159°56.7'E			1671	
24	8		CTD	1671	18-May-11	16:20	18-May-11	17:53	01:33	18-May-11	08:20	30°00.0'S	159°56.7'E			1671	
25	8	1	McLane pumps QMA	1100	18-May-11	19:31	18-May-11	22:55	03:24	18-May-11	09:31	30°00.0'S	159°56.7'E			1671	
26	8	2	McLane pumps PC	1150	18-May-11	23:59	19-May-11	03:55	03:56	18-May-11	13:59	30°00.5'S	160°00.0'E			1671	
27	9		CTD		19-May-11	09:00	19-May-11	10:30	23:00	18-May-11	23:00	30°00.0'S	161°00.0'E				CTD cancelled due to bad weather
28	9		Trace metal rosette		19-May-11	10:30	19-May-11	12:30	00:30	19-May-11	00:30	30°00.0'S	161°00.0'E				TMR cancelled due to bad weather
29	10		CTD	1160	19-May-11	16:40	19-May-11	17:36	00:56	19-May-11	06:40	30°00.0'S	162°00.0'E			1160	
30	10		Trace metal rosette	1120	19-May-11	17:55	19-May-11	18:47	00:52	19-May-11	07:55	30°00.0'S	162°00.0'E			1160	
31	11		CTD	1216	20-May-11	02:10	20-May-11	03:18	01:08	19-May-11	15:10	30°00.0'S	162°59.9'E			1216	Time change +1h (to +11 h ahead of UTC)
32	11		Trace metal rosette	1200	20-May-11	03:33	20-May-11	05:15	01:42	19-May-11	16:33	30°00.0'S	162°59.9'E			1216	
33	12		CTD	1666	20-May-11	11:17	20-May-11	12:24	01:07	20-May-11	00:17	30°00.0'S	163°49.5'E			2212	
34	12		Trace metal rosette	1650	20-May-11	12:35	20-May-11	13:47	01:12	20-May-11	01:35	30°00.0'S	163°49.5'E			2212	
35	13	1	Trace metal rosette shallow	1150	20-May-11	19:46	20-May-11	20:45	00:59	20-May-11	08:40	30°00.0'S	164°53.1'E			3385	
36	13		CTD	3385	20-May-11	20:57	20-May-11	23:20	02:23	20-May-11	09:57	30°00.0'S	164°53.1'E			3385	
37	13	1	McLane pumps QMA	1075	20-May-11	23:39	21-May-11	02:10	02:31	20-May-11	12:39	29°59.9'S	165°00.3'E			3385	
38	13	2	McLane pumps PC	1075	21-May-11	03:10	21-May-11	05:55	02:45	20-May-11	16:10	29°59.9'S	165°00.3'E			3385	
39	13	2	Trace metal rosette deep	3430	21-May-11	06:30	21-May-11	09:10	02:40	20-May-11	19:30	29°59.9'S	165°00.3'E			3385	
40	14		Trace metal rosette shallow	1700	21-May-11	18:13	21-May-11	19:30	01:17	21-May-11	07:00	30°00.0'S	166°00.0'E			2382	
41	14		CTD	1500	21-May-11	19:47	21-May-11	20:54	01:07	21-May-11	08:47	30°00.0'S	166°00.0'E			2382	
42	15		CTD	1500	22-May-11	02:18	22-May-11	03:30	01:12	21-May-11	15:00	30°00.0'S	166°58.0'E			2838	
43	15		Trace metal rosette	1650	22-May-11	04:30	22-May-11	05:13	00:43	21-May-11	17:30	30°00.0'S	166°58.0'E			2838	
44	16		CTD	1500	22-May-11	11:22	22-May-11	12:12	00:50	22-May-11	00:22	30°00.0'S	168°00.0'E			976	
45	16		Trace metal rosette	940	22-May-11	13:06	22-May-11	13:48	00:42	22-May-11	02:06	30°00.0'S	168°00.0'E			976	
46	17		CTD	1500	22-May-11	19:43	22-May-11	20:45	01:02	22-May-11	08:43	30°00.0'S	168°54.9'E			3128	
47	17		Trace metal rosette	1650	22-May-11	20:52	22-May-11	22:00	01:08	22-May-11	09:52	30°00.0'S	168°54.9'E			3128	
48	18	1	Trace metal rosette shallow	1100	23-May-11	05:06	23-May-11	05:58	00:52	22-May-11	18:06	30°00.0'S	170°00.0'E			3038	
49	18		CTD	3040	23-May-11	06:15	23-May-11	08:28	02:13	22-May-11	19:15	30°00.0'S	170°00.0'E			3038	
50	18	1	McLane Pumps QMA	1125	23-May-11	09:35	23-May-11	12:02	02:27	22-May-11	22:35	30°00.0'S	170°00.0'E			3038	
51	18	2	Trace metal rosette deep	3070	23-May-11	12:35	23-May-11	14:52	02:17	23-May-11	01:35	30°00.0'S	170°00.0'E			3038	

				Deployment depth	Local		Local			UTC		Lat	Long	Lat	Long	Bottom depth	Comments
Event#	Stn #	Cast #	Operation	(m)	Date	Time	Date	Time	(h)	Date	Time	Deg	Deg	Dec	Dec	(m)	
52	18	2	McLane Pumps PC	1150	23-May-11	15:17	23-May-11	17:58	02:41	23-May-11	04:17	30°00.0'S	170°00.0'E			3038	
53	19		CTD	1500	23-May-11	23:52	24-May-11	01:01	01:09	23-May-11	11:23	30°00.0'S	170°52.6'E			2203	Time change +1h (to +12h ahead of UTC)
54	19		Trace metal rosette	1650	24-May-11	01:13	24-May-11	02:28	01:15	23-May-11	13:13	29°59.8'S	170°59.8'E			2203	
55	20		CTD	1500	24-May-11	08:25	24-May-11	09:36	01:11	23-May-11	20:25	30°00.0'S	171°57.5'E			2770	
56	20		Trace metal rosette	1750	24-May-11	09:46	24-May-11	11:25	01:39	23-May-11	23:00	30°00.0'S	171°57.5'E			2770	
57	21		CTD	1500	24-May-11	18:00	24-May-11	18:57	00:57	23-May-11	06:00	30°00.0'S	173°00.0'E			1550	
58	21		Trace metal rosette	1560	24-May-11	19:05	24-May-11	20:17	01:12	23-May-11	07:05	30°00.0'S	173°00.0'E			1550	
59	22		CTD	1500	25-May-11	02:06	25-May-11	03:17	01:11	24-May-11	14:06	30°00.0'S	174°00.0'E			3267	
60	22		Trace metal rosette	1700	25-May-11	03:25	25-May-11	04:45	01:20	24-May-11	16:45	30°00.0'S	174°00.0'E			3267	
61	23	1	Trace metal rosette shallow	1200	25-May-11	11:10	25-May-11	12:20	01:10	24-May-11	23:10	30°00.0'S	174°43.6'E			4092	
62	23		CTD	4092	25-May-11	12:20	25-May-11	15:20	03:00	25-May-11	00:20	30°00.0'S	174°43.6'E			4092	
63	23	1	McLane Pumps QMA	1175	25-May-11	15:20	25-May-11	18:07	02:47	25-May-11	03:20	30°00.0'S	174°43.6'E			4092	
64	23	2	McLane Pumps PC	1175	25-May-11	18:48	25-May-11	21:00	02:12	25-May-11	06:48	30°00.0'S	174°43.6'E			4092	
65	23	2	Trace metal rosette deep	4150	25-May-11	21:35	26-May-11	00:34	03:59	25-May-11	09:35	30°00.0'S	174°43.6'E			4092	
66	24		CTD	1500	26-May-11	06:42	26-May-11	07:49	01:07	25-May-11	18:42	30°00.0'S	175°56.8'E			4261	
67	24		Trace metal rosette	1700	26-May-11	08:06	26-May-11	09:50	01:44	25-May-11	20:06	30°00.0'S	175°56.8'E			4261	
68	25		CTD	1500	26-May-11	16:30	26-May-11	17:47	01:17	26-May-11	04:30	30°36.0'S	177°00.0'E			4294	
69	25		Trace metal rosette	1600	26-May-11	18:18	26-May-11	19:03	00:45	26-May-11	06:18	30°36.0'S	177°00.0'E			4294	TMR aborted due to bad weather
70	26		CTD	1500	27-May-11	09:34	27-May-11	10:55	01:21	26-May-11	21:34	31°36.0'S	178°00.0'E			3805	
71	26		Trace metal rosette	2200	27-May-11	11:15	27-May-11	13:03	01:48	26-May-11	23:15	31°36.0'S	178°00.0'E			3805	
72	27		CTD	1500	27-May-11	20:44	27-May-11	21:46	01:02	27-May-11	08:44	32°25.25'S	178°54.7'E			2242	
73	27		Trace metal rosette	1800	27-May-11	22:00	27-May-11	23:06	01:06	27-May-11	10:00	32°25.25'S	178°54.7'E			2242	
74	28	1	Trace metal rosette shallow	1500	28-May-11	04:19	28-May-11	05:24	01:05	27-May-11	16:19	32°30.0'S	180°00.0'E			2835	
75	28		CTD	2835	28-May-11	05:40	28-May-11	07:45	02:05	27-May-11	17:40	32°30.0'S	180°00.0'E			2835	
76	28	1	McLane Pumps QMA	1200	28-May-11	09:10	28-May-11	11:40	02:30	27-May-11	21:10	32°30.0'S	180°00.0'E			2766	
77	28	2	Trace metal rosette deep	2980	28-May-11	12:00	28-May-11	14:02	02:02	28-May-11	00:00	32°30.0'S	180°00.0'E			2810	
78	28	2	McLane Pumps PC	1200	28-May-11	14:38	28-May-11	17:25	02:47	28-May-11	02:38	32°30.0'S	180°00.0'E			2800	
79	29		CTD	1420	28-May-11	22:36	28-May-11	23:40	01:04	28-May-11	10:36	32°30.0'S	179°18.2'W			1420	
80	29		Trace metal rosette	1350	28-May-11	23:56	29-May-11	00:50	00:54	28-May-11	11:56	32°30.0'S	179°18.2'W			1420	
81	30		CTD	1500	29-May-11	06:12	29-May-11	07:19	01:07	28-May-11	18:12	32°30.0'S	178°12.0'W			5870	
82	30		Trace metal rosette	1650	29-May-11	08:00	29-May-11	09:12	01:12	28-May-11	20:00	32°30.0'S	178°12.0'W			5870	
83	31		CTD	6000	29-May-11	14:35	29-May-11	18:24	03:49	29-May-11	02:35	32°30.0'S	177°01.2'W			6228	
84	31		Trace metal rosette	6050	29-May-11	18:34	29-May-11	22:45	04:11	29-May-11	06:34	32°30.0'S	177°01.2'W			6228	
85	32		CTD	1500	30-May-11	03:33	30-May-11	05:13	01:40	29-May-11	15:33	32°30.0'S	176°05.2'W			5580	
86	32		Trace metal rosette	1700	30-May-11	05:36	30-May-11	06:50	01:14	29-May-11	17:36	32°30.0'S	176°05.2'W			5580	
87	33	1	Trace metal rosette	1100	30-May-11	12:16	30-May-11	13:12	00:56	30-May-11	00:16	32°30.0'S	175°00.0'W			5596	
88	33		CTD	5500	30-May-11	13:20	30-May-11	16:58	03:38	30-May-11	01:20	32°30.0'S	175°00.0'W			5596	
89	33	1	McLane pumps	1200	30-May-11	17:20	30-May-11	20:10	02:50	30-May-11	05:20	32°30.0'S	175°00.0'W			5596	
90	33	2	McLane pumps	1200	30-May-11	20:55	30-May-11	23:25	02:30	30-May-11	08:55	32°30.0'S	175°00.0'W			5596	
91	33	2	Trace metal rosette	5700	31-May-11	00:00	31-May-11	03:43	03:43	30-May-11	12:00	32°30.0'S	175°00.0'W			5596	
92	38		CTD	4000	01-Jun-11	05:07	01-Jun-11	07:45	02:38	31-May-11	17:07	32°30.0'S	170°00.0'W			5499	
93	38		Trace metal rosette	4300	01-Jun-11	08:00	01-Jun-11	10:55	02:55	31-May-11	20:00	32°30.0'S	170°00.0'W			5499	
94	37		CTD	1500	01-Jun-11	15:55	01-Jun-11	16:55	01:00	01-Jun-11	3:55	32°30.0'S	171°00.0'W			6575	
95	37		Trace metal rosette	1750	01-Jun-11	17:03	01-Jun-11	18:30	01:27	01-Jun-11	5:03	32°30.0'S	171°00.0'W			6575	
96	36		CTD	1500	01-Jun-11	23:30	02-Jun-11	00:42	01:12	01-Jun-11	11:30	32°30.0'S	172°00.0'W			4850	
97	36		Trace metal rosette	1650	02-Jun-11	00:48	02-Jun-11	01:52	01:04	01-Jun-11	12:48	32°30.0'S	172°00.0'W			4850	
98	35		CTD	1500	02-Jun-11	07:17	02-Jun-11	08:24	01:07	01-Jun-11	19:17	32°30.0'S	173°00.0'W			5903	
99	35		Trace metal rosette	1750	02-Jun-11	08:30	02-Jun-11	09:34	01:04	01-Jun-11	20:30	32°30.0'S	173°00.0'W			5903	
100	34		Trace metal rosette	1650	02-Jun-11	14:36	02-Jun-11	15:36	01:00	02-Jun-11	02:36	32°30.0'S	174°00.0'W			5637	

Appendix 3.1

Recap sample collected for CTD

							Parameters									
Lat (S)	Long (E)	Time out UTC	date (UTC)	GP13 Stn #	CTD #		Pigments	Flow cyto UTS	Fv/Fm	Nih	Ba	POC, PON	Flow cyto MIT	Glyc MIT	qPCR MIT	series nuclides
						Lab:		UTS					MIT	MIT	MIT	UTas
29 59.926	153 30.216	11:10	14-May	1	2		x	x	x	x			x	x	x	
30 00.129	154 00.263	02:05	14-May	2	3		x	x	x	x			x	x	x	
29 59.683	155 01.588	19:54	15-May	**3**	**5**		x	x	x		x	x				x
29 59.811	156 00.089	18:36	16-May	4	6		x	x	x	x			x	x	x	
30 00.069	156 59.503	03:44	17-May	5	7		x	x	x	x						
29 59.953	158 00.028	11:08	17-May	6	8		x	x	x	x						
29 59.997	159 00.356	20:23	17-May	7	9		x	x	x	x			x	x	x	
29 59.984	159 59.943	07:50	18-May	**8**	**10**		x	x	x		x	x				x
29 59.776	162 00.068	07:34	19-May	10	11		x	x	x	x						
30 00.064	162 59.821	16:18	19-May	11	12		x	x	x	x			x	x	x	
29 59.970	163 59.833	01:27	20-May	12	13		x	x	x	x						
29 59.985	165 00.044	12:19	20-May	**13**	**14**		x	x	x		x	x				x
29 59.859	166 00.300	09:54	21-May	14	16		x	x	x	x						
30 00.047	167 00.017	16:30	21-May	15	17		x	x	x	x			x	x	x	
30 00.040	167 59.963	01:17	22-May	16	18		x	x	x							
30 00.015	169 00.007	09:44	22-May	17	19		x	x	x	x						
29 59.979	169 59.977	20:31	22-May	**18**	**20**		x	x	x	x	x	x				x
29 59.877	170 59.827	13:03	23-May	19	21		x	x	x	x			x	x	x	
30 00.009	171 59.990	21:38	23-May	20	22		x	x	x	x						
29 59.978	172 59.918	06:58	24-May	21	23		x	x	x	x						
30 00.190	174 00.094	15:18	24-May	22	24		x	x	x	x			x	x	x	
30 00.044	174 59.957	03:12	25-May	**23**	**25**		x	x	x		x	x				x
30 00.030	176 00.011	19:50	25-May	24	26		x	x	x	x			x	x	x	
30 35.845	176 59.874	05:46	26-May	25	28		x	x	x							
31 35.573	178 00.527	22:52	26-May	26	29		x	x	x	x			x	x	x	
32 29.933	179 00.079	09:44	27-May	27	30		x	x	x	x						
32 30.086	179 59.945 **W**	19:45	27-May	**28**	**31**		x	x	x	x	x	x				x
32 30.007	178 59.960 **W**	11:41	27-May	29	32		x	x	x	x			x	x	x	
32 29.989	177 59.912 **W**	19:22	28-May	30	33		x	x	x							
32 30.010	176 59.965 **W**	06:26	29-May	31	34		x	x	x	x						x
32 29.993	175 59.875 **W**	17:15	29-May	32	35		x	x	x	x			x	x	x	
32 29.974	174 59.974 **W**	04:59	30-May	**33**	**36**		x	x	x		x	x				x
32 29.978	170 00.016 **W**	19:48	31-May	38	37		x	x	x	x	x		x	x	x	x
32 30.028	170 59.995 **W**	04:57	1-Jun	37	38		x	x	x	x						
32 30.004	171 59.927 **W**	12:41	1-Jun	36	39		x	x	x	x			x	x	x	
32 29.926	172 59.946 **W**	20:22	1-Jun	35	40		x	x	x	x						
					Storage		-196 C	-196	N/A (dark, esky)	-80 C	4 C	60 C (oven)	-80 C	-80 C	-80 C	acidified

Mega Stn

Super Stn

Usual depths for each parameters (see specific metadata sheet for details)

Pigments	15/30/50/75/100/DCM if any	
Fv/Fm	as pigments	
Flow cyto UTS	as pigments	
Nih	1530.50/75 (15 and 30 m in duplicates)	
Ba	all water column	sampled only at super and mega stn
POC, PON	15/50/100	sampled only at super and mega stn
Flow cyto MIT	15/30/50/75/100 dulicate	NB: CTD 32, 35 and 37 additional depths to 1500 m
GLYC MIT	15/30/50/75/100 duplicate	NB: CTD 32, 35 and 37 additional depths to 1500 m
qPCR MIT	15/30/50/75/100 triplicate	NB: CTD 32, 35 and 37 additional depths to 1500 m
U-series nuclides	50/200/500/750/1000/1250/1500/1750/2000/2500/3000/4000	

NB: position and time considered is CTD out data

Appendix 3.2
Trace metal rosette metadata

						Parameters														
Lat (S)	Long (E)	End time U	Date (UTC)	GP13 Stn #		Nanonutrie	Trace Meta	Trace Meta	Trace Meta	Fe isotope	Zn isotope	Cu isotope	Cu speciati	Cd isotope	Fe ligands	Fe bioavail	SRFA-like	Fe ligands	GEOTRACES	
					Lab:	NIWA	ACE CRC	ACE CRC	ANU	ANU	ANU	ANU	ANU	U. Otago	UTS	UTS	UTS	UTS	ACE CRC	NIWA
30S	153o30'	10:29	14-May	1			x		x											
30S	154o00'	03:30	14-May	2		x	x		x											
30S	155oE	16:11	14-May	3		x	x	x	x	x	x	x	x	x	x	x	x	x		
30S	156oE	20:46	16-May	4		x	x		x											
30S	157E	05:30	17-May	5		x	x		x											
30S	158E	13:20	17-May	6		x	x		x											
30S	159oE	22:20	18-May	7		x	x		x											
30S	160E	05:25	18-May	8		x	x	x	x						x	x	x	x		
30S	162E	08:50	19-May	10		x	x		x											
30S	163E	17:25	19-May	11		x	x		x											
30S	164E	02:45	20-May	12		x	x		x											
30S	165E	09:19	20-May	13		x	x	x	x	x	x	x	x	x	x	x	x		x	
30S	165E	20:57	20-May	13			x	x	x	x	x	x	x	x		x	x	x	x	
30S	166E	08:30	21-May	14		x	x		x											
30S	167E	17:31	21-May	15		x	x		x											
30S	168E	02:55	22-May	16		x	x		x											
30S	169oE	10:25	22-May	17		x	x		x											
30S	170E	18:00	22-May	18		x	x	x	x						x	x	x	x		
30S	170E	02:00	23-May	18			x	x	x						x		x	x		
30S	171E	13:55	23-May	19		x	x		x											
30S	172E	23:40	23-May	20		x	x		x											
30S	173E	04:43	24-May	21		x	x		x											
30S	174E	16:50	24-May	22		x	x		x											
30S	175E	00:00	24-May	23		x	x	x	x	x	x	x		x	x	x	x	x		
30S	175E	11:15	25-May	23			x	x	x	x	x	x		x	x		x	x		
30S	176E	~ 21:50	25-May	24		x	x		x											
30 36S	177E	00:00	26-May	25																
31 36S	178E	01:05	26-May	26		x	x		x											
32.5S	179E	10:35	27-May	27		x	x		x											
32.5S	180E	00:00	27-May	28		x	x	x	x	x			x		x	x	x	x		
32.5S	180E	00:00	27-May	28			x	x	x	x			x		x		x	x		
32.5S	179W	12:22	28-May	29		x	x		x											
32.5S	178W	00:00	28-May	30		x	x		x											
32.5S	177W	08:55	29-May	31		x	x	x	x				x							
32.5S	176W	18:48	29-May	32		x	x		x											
32.5S	175W	00:49	29-May	33		x	x	x	x	x	x	x	x	x	x	x	x	x		
32.5S	175W	11:15	30-May	33			x	x	x	x	x	x	x	x	x	x	x	x		
32.5S	170W	22:30	1-Jun	38		x	x	x	x							x	x	x	x	x
32.5S	171W	05:46	1-Jun	37		x	x		x											
32.5S	172W	13:50	1-Jun	36		x	x		x											
32.5S	173W	21:10	1-Jun	35		x	x		x											
32.5S	174W	03:13	2-Jun	34		x	x		x											
					Sampling protocol:	Unfiltered	Filtered	Unfiltered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered	Filtered
					Storage	Frozen	Acidified	Acidified	Acidified	Acidified	Acidified	Acidified	Frozen		Frozen	Frozen	Frozen	Frozen	Acidified	

Mega Stn
Super Stn

Usual depths for each parameter (see specific metadata sheet for details)

Nanonutrients	NIWA	all stns	min. top 5 depths
Trace Metals	ACE CRC	all stns	all depths
Trace Metals	ACE CRC	stn 3,8,13,:	all depths
Trace Metals	ANU	all stns	all depths
Fe isotopes	ANU	stn 3,13,23	all depths
Zn isotopes	ANU	stn 3,13,23	all depths
Cu isotopes	ANU	stn 3,13,23	all depths
Cu speciation	ANU	stn 3,13,28	all depths
Cd isotopes	U. Otago	stn 3,13,23	15/30/50/75/100/150/300/500/750/1000/1250/1500/2000/3000/4000/5000
Fe ligands	UTS	stn 3,8,13,:	15/30/50/75/100/125/150/300/750/1500/3000/5000/bottom
Fe bioavailability	UTS	stn 3,8,13,:	15/30/50/75/100/125/150/300/750
SRFA-like	UTS	stn 3,8,13,:	15/30/50/75/100/125/150/300/750/1500/3000/5000/bottom
Fe ligands	UTS	stn 3,8,13,:	15/30/50/75/100/125/150/300/750/1500/3000/5000/bottom
GEOTRACES	ACE CRC	stn 13,38	all depths
	NIWA	stn 38	all depths

Appendix 3.3
McLane pump metadata

Lat (S)	Long (E)	End time (UTC)	Date (UTC)	GP13 Stn #	Cast	Filter	Parameters Trace metals/POC-PON ACE CRC	Trace metal isotopes ANU	Fv/Fm UTS	Fe mineralogy CSIR/Princeton	Metagenomics, ferredoxin/flavodxin index UTS	TMs, Pa, Th isotopes ANU/Utas
30 S 155E	155E	02:00	16/05/11	3	1	QMA	x	x	x		x	
30 S 155E	155E	07:30	16/05/11	3	2	PC						x
30 S 160E	160E	12:00	18/05/11	8	1	QMA	x	x	x		x	
30 S 160E	160E	17:15	18/05/11	8	2	PC						x
30 S 165E	165E	14:30	20/05/11	13	1	QMA	x	x	x	x	x	
30 S 165E	165E	18:20	21/05/11	13	2	PC						x
30 S 170E	170E	23:50	22/05/11	18	1	QMA	x	x	x	x	x	
30 S 170E	170E	05:20	23/05/11	18	2	PC						x
30 S 175E	175E	05:30	25/05/11	23	1	QMA	x	x	x	x	x	
30 S 175E	175E	08:30	25/05/11	23	2	PC						x
32.5S 180I	180E	23:00	27/05/11	28	1	QMA	x	x	x	x	x	
32.5S 180I	180E	04:30	28/05/11	28	2	PC						x
32.5S 175\	175W	07:40	30/05/11	33	1	QMA	x	x	x	x	x	
32.5S 175\	175W	10:50	30/05/11	33	2	PC						x

4 pumps usually operated on each cast.
Filters:

QMA quartz microfibre
PC polycarbonate

Appendix 3.4
Dust sampler metadata (Lear-Siegler Hi-Vol sampler)

START (Filter Loaded)				END (Filter Removed)				Sample Hours	Filter #	Notes
Lat (S)	Long (E/W)	Time (UTC)	Date (UTC)	Lat (S)	Long (E/W)	Time (UTC)	Date (UTC)			
-28.8631	153.7307	01:45	14/05/2011	-30.0000	156.7697	01:08	17/05/2011	25.2	SS-GP13_01	
-30.0000	156.8878	01:45	17/05/2011	-30.0000	160.6549	21:50	18/05/2011	23	SS-GP13_02	Max of 23 h had been reached by 08:00 UTC on 18 May 2011, but night-time and other activities prevented removal until time shown
-30.0000	163.6468	22:03	19/05/2011	-30.0004	169.9996	22:59	22/05/2011	60.7	SS-GP13_03	3-day filter, under prevailing easterlies
-30.0015	170.0002	23:39	22/05/2011	-30.0068	172.2045	00:55	24/05/2011	23	SS-GP13_04	Max of 23 h
-30.3457	176.5648	01:30	26/05/2011	-32.4974	179.9984	01:22	28/05/2011	14.3	SS-GP13_05	
-32.5005	-179.9988	02:20	28/05/2011	-32.5003	-170.0020	20:43	31/05/2011	23	SS-GP13_06	Max of 23 h
-32.5017	-170.0041	21:18	31/05/2011	-35.1679	177.9148	19:36	3/06/2011	4.4	SS-GP13_07	Filter halted because nearing end of voyage, and wind remaining in unfavourable sampling quarter
-35.2135	177.7741	20:16	3/06/2011	-36.6259	174.9417	19:16	4/06/2011	--	SS-GP13_08	Exposure Blank (23 h exposure)
		20:15	4/06/2011			20:15	5/06/2011	--	SS-GP13_09	Cassette Blank

Appendix 3.5

Rain collection metadata

Lat (S)	Long (E)	End time (U	UTC date	Parameter Black carbon Curtin U.	 Fe bioavailability UTS	 Fe ACE CRC
31°35.719'S	178°00.435'E	22:36	26/05/2011	x	x	x
31°48.989'S	178°14.401'E	03:10	27/05/2011	x		x
				~400 - 600 mL	~100 mL	~60 mL