RV *Investigator* Voyage Plan

Voyage #:	**IN2016_V04**		
Voyage title:	Influence of temperature and nutrient supply on the biogeochemical function and diversity of ocean microbes		
Mobilisation:	0800 Sydney, Tuesday, 30 August 2016		
Depart:	1400 Sydney, Wednesday, 31 August 2016		
Return:	1600 Brisbane, Thursday, 22 September 2016		
Demobilisation:	0800 Brisbane, Friday, 23 September 2016		
Voyage Manager:	Hugh Barker	**Contact details:**	Hugh.barker@csiro.au
Chief Scientist:	Martina Doblin		
Affiliation:	University of Technology Sydney	**Contact details:**	Martina.Doblin@uts.edu.au
Australian Principal Investigators: (investigators on board have initials listed)	Mark Brown (MB) – Deputy Chief UTS: Justin Seymour; Peter Ralph; David Suggett (DS); Shauna Murray, Penny Ajani MacU: Martin Ostrowski (MO), Leanne Armand, April Abbott (AA) CSIRO: Richard Matear UNSW: Iain Suthers (IS) UTas: Gustaaf Hallegraeff UTAS: Andrew Bowie (Supplementary project: Natural iron fertilisation of oceans around Australia: Linking terrestrial dust and bushfires to marine biogeochemistry)		

Scientific objectives

Our goal is to resolve how changes in seawater temperature and nutrient concentrations, linked to shifting oceanographic circulation in eastern Australia, influences the diversity of microbial communities and the key biogeochemical transformations (C, N, P, Si, Fe and S) they mediate. The broader ecosystem implications for zooplankton, larval fish and marine megafauna will also be addressed.

Our findings will be used to improve current biogeochemical and ecosystem models to increase their accuracy in forecasting changes in ocean productivity and biogeochemical fluxes in eastern Australia.

Our specific aims are to:

Aim	Scientific objective	Required vessel activity	Investigators
1	Characterise the diversity and function of microbial communities in the relatively warm EAC, against the relatively cool water of the Tasman Sea and adjacent shelf waters	CTD-rosette water collection and associated physicochemical measurements, followed in close succession by vertical net hauls to collect microplankton (20 µm, 70 µm), at *multiple stations* in the EAC and adjacent water masses. 1-3 day drift in the EAC involving CTD-rosette sampling in the EAC, where the vessel is required to remain in the water mass in the vicinity of a standard SVP Lagrangian drifter (as per IN2015_v03). Water will also be sampled from the underway system to achieve high resolution measurements of phytoplankton biomass and photosynthetic function (chlorophyll-a fluorescence, carbon fixation) along the voyage track. Tows by the Triaxus with CTD sensor, ecotriplet, PAR and LOPC.	All
2	Conduct perturbation experiments to experimentally test the role of temperature and nutrients (particularly N and Fe) in microbially mediated biogeochemical transformations	Trace metal-clean water collection (using the TMR or underway supply as contingency) in the EAC and adjacent water masses, followed by deckboard incubations with added nutrients at different temperatures.	All

Aim	Scientific objective	Required vessel activity	Investigators
		At each process station, in situ Mclane pump deployments at multiple depths will be made to collect high volume particulate samples for capturing environmental DNA.	
3	Assess the links between microbial biomass, size structure and carbon production with higher trophic levels (zooplankton, micronekton and cetaceans-seabirds) in a frontal eddy(ies) relative to adjacent shelf and EAC waters	Water collection and associated physicochemical measurements with standard CTD-rosette *during the day*, followed in close succession by vertical net hauls to collect microplankton (20, 200, 500 µm). Continuous daylight observations from the Monkey Island for cetaceans and seabirds, and their behaviour (feeding or migrating). This activity will be coupled with, EZ+LOPC tows (and a simultaneous surface neuston) with a bongo net as back-up *at night*, and continuously recording EK60 bioacoustic measurements and ADCP.	All
4	Sample sediments to examine water-sediment geochemical processes and historical record of plankton.	This will involve deployment of the multi-corer to sample sediment cores off Eden/Narooma, and Port Hacking National Reference Station.	AA, MD
5	To sample aerosols to study natural iron fertilisation of oceans around Australia: linking terrestrial dust and bushfires to marine biogeochemistry (Supplementary Project)	We will sample and conduct experiments on atmospheric particles containing terrestrial dust, bushfire smoke and anthropogenic emissions that are transported from Australia to its surrounding oceans. We will install an atmospheric sampling system connected to the ship's forward air intake line for the clean collection of particles in the aerosol lab. Trace metal clean water will also be collected from the underway supply line and/or the trace metal	PhD student

Aim	Scientific objective	Required vessel activity	Investigators
		rosette (TMR) in order to undertake preliminary leaching and dissolution experiments on the collected particles, and to correlate the atmospheric flux of trace elements with the surface in-water concentrations. We will also opportunistically collect event-based clean rainwater samples using either a polyethylene funnel and collection bottle (when conditions allow) or a Dual Chimney Precipitation Sampler (currently on order), to quantify the trace metal deposition in the 'bulk' and 'precipitate-only' fractions.	

Voyage objectives

The above Table 1 indicates the required vessel operations to achieve our scientific objectives.

Previous sampling opportunities have not allowed us to revisit water masses (Aim 1) or conduct replicate experiments in the same water mass (Aim 2). Our objectives are therefore to more comprehensively sample the distribution and diversity of microbes across multiple oceanographic features. This includes cross-shelf transects, but also includes cross-eddy transects by extending shelf transects offshore (Aim 3).

To achieve Aim 3, we will require real-time satellite information to identify our target area, as well as access to the IMOS ocean colour, SST, SSH data archive while on board. We will also conduct in situ 'mapping' of the target frontal eddy area using the Triaxus towed underwater body before we determine the exact location of transects and daytime CTD stations. Aim 3 activities will also involve bioacoustic monitoring in the western Tasman Front off Port Stephens, and within and outside of a frontal eddy. This will involve recording data from the EK60 of all 5 frequencies (if possible), which need to be appropriately coordinated with both ADCP. We suggest the two instruments should be programmed to ping and listen together, and to ignore any EK60 deeper than 750 to 1,000 m (to be confirmed with MNF and CSIRO bioacoustics group).

Aims 1 and 2 relate to our original application for ship time and are hence the top priority. The Aim 3 activities occur mostly at night, which can be integrated into the day-time focussed sampling of Aims 1 and 2. Our intent is therefore to address these aims in waters north of Bass Strait (depending on the oceanographic features present).

Activities to address Aim 4 have the lowest priority and are left to later in the voyage, but PIs have indicated that sediment cores from Port Hacking (NSW) will have strong scientific value for examining sediment fluxes and looking at the historic presence of microbial taxa.

Aerosol sampling, aim 5, supplementary project

We will install an atmospheric sampling system for the clean collection of particles in the ship's aerosol lab. This system consists of vacuum pumps (Thomas Sheboygan 2107CD18), flow meters (DiTGM ML-2500) and filtration systems (Savillex PFA). The manifold is connected to air intake lines fed from the sampling nozzle located ~10 m above sea level on the foremast at the bow of the vessel. Samples will be collected on filters housed in 47 mm filtration holders located within a laminar flow hood (AirClean Systems) to avoid contamination. The system is controlled by automated sector control switch (pump controller) to ensure the system only samples 'clean' air from the forward sector (nominally between 270^{o} port and 90^{o} starboard), avoiding air impacted by the ship's exhaust. The system is capable of running up to 4 flow lines in parallel, to enable replicate sampling or to sample for different parameters using different filters on different lines. A newer more sophisticated version of this aerosol sampling system (including PM1, PM2.5, and TSP size selective inlets) is being developed at CSIRO and should be ready for installation on RV Investigator in the latter part of 2016.

Samples will be collected on a range of different filter types (polycarbonate, Whatman-41, cellulose, Teflon) suitable for different analytical needs. Filters will be changed approximately daily, depending on the aerosol loading, flow rates and amount of time the air inlet is in a suitable 'clean' air sector and sampling takes place. The sector sampling switch records the date/times and waypoints when the wind is 'in sector'. A range of procedural and field exposure blanks will be collected at sea, as well as preliminary leaching and dissolution experiments. Sampled filters will be stored frozen and returned to the shore-based laboratory for further experiments and analyses.

We will also opportunistically collect event-based clean rainwater samples using either a polyethylene funnel and collection bottle (when conditions allow) or a Dual Chimney Precipitation Sampler (N-Con Systems model 00-127; currently on order), to quantify the trace metal deposition in the 'bulk' and 'precipitate-only' fractions. Samples will be collected on upper and forward decks, probably on 05 level near the hand rail immediate in front of the bridge and when heading into the wind. Power for the automated rain sampler can be supplied from the Bridge Equipment Room.

The project also requests access to the RV Investigator trace metal clean underway supply system (preferably the outlet in the clean wet lab which has been designed for clean filtration and sampling in the laminar flow hood) and/or clean water from the trace metal rosette (TMR). This will enable us to correlate the atmospheric flux of trace elements with the surface in-water concentrations. Surface seawater will also be used for leaching and dissolution experiments on the collected atmospheric particles.

Operational Risk Management

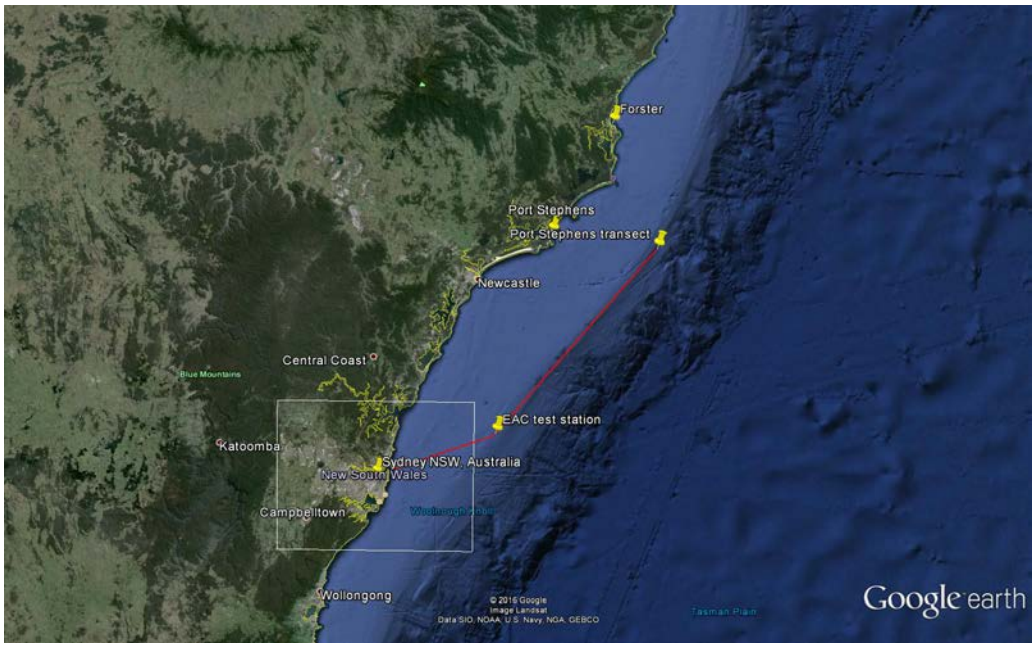
The planned operations with the EZ and the Triaxus have been identified as potentially high risk work, due to the fact that they share the same termination. They therefore trigger MNF procedures for potentially high risk operations. As the EZ and Triaxus will be used extensively to address Aim 3, we will note their hours of deployment (up to a maximum of 50 hours) and work conservatively to plan for periodic re-termination. We also note that re-termination will take 1 person ~8 h at a minimum. Furthermore, the bongo net and neuston net provide back-up for the EZ net, and also provide options as the Triaxus and EZ net share the same winch and termination. We note that swap-overs take ~2 h under normal sea conditions.

The planned use of radioactive and stable isotope tracers (13C/14C for primary production; tritiated leucine and thymidine for bacterial production, 15N for uptake of different N sources including N2) also trigger MNF procedures for potentially high risk operations, due to the risk of contamination. We will consult with the CSIRO Radiation Safety and Assurance Manager and outline our risk management strategy and protocols in our applications to use radioisotopes and stable isotopes on board.

Overall activity plan including details for first 24 hours of voyage

We plan to steam out of Sydney Harbour heads in the afternoon of 30 August 2016 in a north-easterly direction towards Port Stephens. Before departure, we will do CTD familiarisation (stage 1 training) with water samplers in the CTD room. We will then undertake our first CTD station (bottle test to 1,000 m, then trial cast for hydrochemistry training in the EAC) and toolbox for the drop camera (deployed alongside regular CTD), Triaxus and bongo net deployments. We will then steam further north to Port Stephens, where we will deploy the Triaxus, following a westward transect across the shelf into near-shore waters, monitoring the vertical structure of the water to identify the presence of eddies. Bongo nets (with 0.5 mm mesh) will be deployed during the night at offshore and coastal sites.

The aerosol sampling system will be started soon after leaving port in Sydney, and will run continuously until arrival in Brisbane. In addition, we will sample rain opportunistically if conditions are suitable. The trace metal clean underway supply will be started in open waters.



The general rhythm of our sampling will involve CTD stations during the day, swapping over to Triaxus-EZ net and Bongo net deployments at night.

There will be two types of CTD casts – normal (with regular CTD-rosette) and "process study" (with TM-rosette, TMR). Normal CTD casts will go to 1000 m (depth permitting) and sample bottles (requiring dissolved nutrient analyses) will be fired at ~1000, 500, 250, 100, 75, C-max, 30, 15 m and the surface (i.e. 9-depth CTD). TMR casts will go to 250 m and sample bottles will be fired at up to three depths: below the C-max, at the C-max and at the surface, maximising water volume for TM-clean incubations. It is likely that at process stations, at least two regular CTD-rosette deployments and one TMR deployment will be required, meaning that samplers will drain the CTD as swiftly as possible. CTD casts will be undertaken during transects to characterise the microbial diversity across oceanographic features, and TMR casts will be undertaken at process stations by trained personnel.

At each process station, it is necessary to capture information about light attenuation in the upper ocean, and will require the ship to position itself so that deployment occurs on the sunlit side (i.e. out of the ship's shadow). Finally, for each process station, we will deploy Mclane is situ pumps (ISPs) (at multiple depths simultaneously) to do high volume sampling for environmental DNA.

Please note: The times below are local; and conservatively assume 10 knot transit speeds (rather than 11 knots).

Date	**Day**	**Activity**
Tues 30 Aug	mobilisation	Mobilisation and dock-side CTD training
Wed 31 Aug	1	14:00 Transit ~3 h to NE of Sydney 18:00 CTD bottle test to 1000 m then first test cast in EAC and CTD training, along with drop camera tool box and deployment; 22:00 Continue north to off Port Stephens (7 h more steaming); 22:00 TMR test deployment; Tool-box for Bongo and neuston tows Tool box for Triaxus deployment (and EZ net) Triaxus tow during night across frontal edge to shelf and back; (depending on weather, possible Bongo and neuston tows)
Thurs 1 Sept	2	06:00 Process station #1 EAC with deployments in the following order: Regular CTD (1.5 h) Regular CTD (1.5 h) Regular CTD (1.5 h) TMR (1.5 h) 12:00 Triaxus transect across frontal (cyclonic) eddy for 6 h 20:00 Complement previous Triaxus transect with bongo and neuston net tows on shelf and offshore, to 04:00, the steam to start of CTD (Swap Triaxus to EZ on towed body winch tomorrow)
Fri 2 Sept	3	06:00 Frontal (cyclonic) eddy CTD transect (6 stations, 10 nm apart or as otherwise determined on board); 18:00 EZ-LOPC sampling at night to 04:00, shelf and eddy
Sat 3 Sept	4	06:00 Process station #2 Eddy Regular CTD (1.5h) Regular CTD (1.5h)

Date	Day	Activity
		Regular CTD (1.5 h) (note no TMR needed) Toolbox for ISP (Mclane pump) deployment Mclane pump deployment (depending on eddy dynamics) 11:00 CTD transect 18:00 EZ-LOPC sampling at night, shelf and eddy
Sun 4 Sept	5	04:00 Steam back south to ~ Sydney (10 h) 14:00 CTD transect across warm core eddy; 22:00 EZ-LOPC sampling at night along frontal boundary and in the western Tasman Front area
Mon 5 Sept	6	06:00 Process station #3 EAC/warm core eddy; (further south than previous); 12:00 steam to site of EAC drift study
Tues 6 Sept	7	Continue EAC drift study, with CTD near Lagrangian drifter
Wed 7 Sept	8	06:00 Process station #4 EAC/warm core eddy Regular CTD (1.5 h) Regular CTD (1.5 h) TMR (1.5 h) Continue EAC drift study
Thurs 8 Sept	9	Port Hacking NRS water and sediment sampling Tool box for multicorer Sediment coring Steam to Eden (~200 nm; 20 h to Eden from Sydney) towing Triaxus
Fri 9 Sept	10	Transit to Eden Triaxus at night with bongo net tow before and after
Sat 10 Sept	11	06:00 Process station #5 Coastal (Eden); Survey for potential multicorer sites off Eden / Narooma (sediment type dependent) Coring
Sun 11 Sept	12	06:00 Coastal to offshore transect off Eden; Transect with 5 CTD stations from coast to offshore Transit to Narooma overnight towing Triaxus (~5-8 h) - Will require consultation regarding fishing gear
Mon 12 Sept	13	06:00 Process station #6 Coastal (Narooma/ Montague Island);
Tues 13 Sept	14	06:00 Coastal to offshore transect off Narooma; Transect with 5 CTD stations from coast to offshore Transit to Jervis Bay overnight towing Triaxus (~7-10 h)

Date	Day	Activity
Wed 14 Sept	15	06:00 Process station #7 Coastal (Jervis Bay)
Thurs 15 Sept	16	06:00 Coastal to offshore transect off Jervis Bay; Transect with 5 CTD stations from coast to offshore Transit to Port Hacking overnight towing Triaxus (~6-9 h)
Fri 16 Sept	17	06:00 Targeted CTD sampling of different water masses available in the western Tasman Front (wTF). Process station #8 Tasman Sea Triaxus while steaming to Port Stephens/Forster
Sat 17 Sept	18	Transit to Port Stephens/Forster 18:00 EZ net tows off Port Stephens or Forster (depending on OceanCurrent, targeting similar water mass to 2nd, 3rd Sept. Coring at shallow sediment location.
Sun 18 Sept	19	06:00 Process station #9 Eddy; Following water collection, transit to deep sediment location and core. EZ-LOPC sampling at night along frontal boundary and in the western Tasman Front area
Mon 19 Sept	20	Steam from Forster to Coffs (~10 h), pausing to make bongo net tows during evening (6 h) Note that we want to sample Coffs Harbour moorings (CH070): 153.2985, -30.2833 (CH100) : 153.3967, -30.2678 And under the Coffs Harbour radar: North of Coffs - Red Rock (RRK): 153.2312, -29.9839, South of Coffs - North Nambucca (NNB): 153.0111, -30.624
Tues 20 Sept	21	06:00 Coastal to offshore transect off Coffs Harbour; Transect with 3-5 CTD stations from coast to offshore EAC Steam to Byron Bay (~10 h)
Wed 21 Sept	22	06:00 Coastal to offshore transect off Byron Bay; Transect with 3-5 CTD stations from coast to offshore EAC 18:00-23:00 plankton net tows with CTD 23:00 Steam from Byron Bay to Moreton Bay (13 h steam).
Thur 22 Sept	23	12:00 Meet Pilot in Moreton Bay Pilot to Port of Brisbane
Fri 23 Sept	demobilisation	

Voyage track example

As with all voyages, our sampling program will depend on the oceanographic features (i.e., presence of eddies, southward extent of EAC), the ability to adaptively sample based on real-time oceanographic information (i.e. satellite data) as well as the weather. The draft voyage track (Fig. 1) shows the expected oceanographic targets (rather than the specific latitude and longitude) over the first half of the voyage.

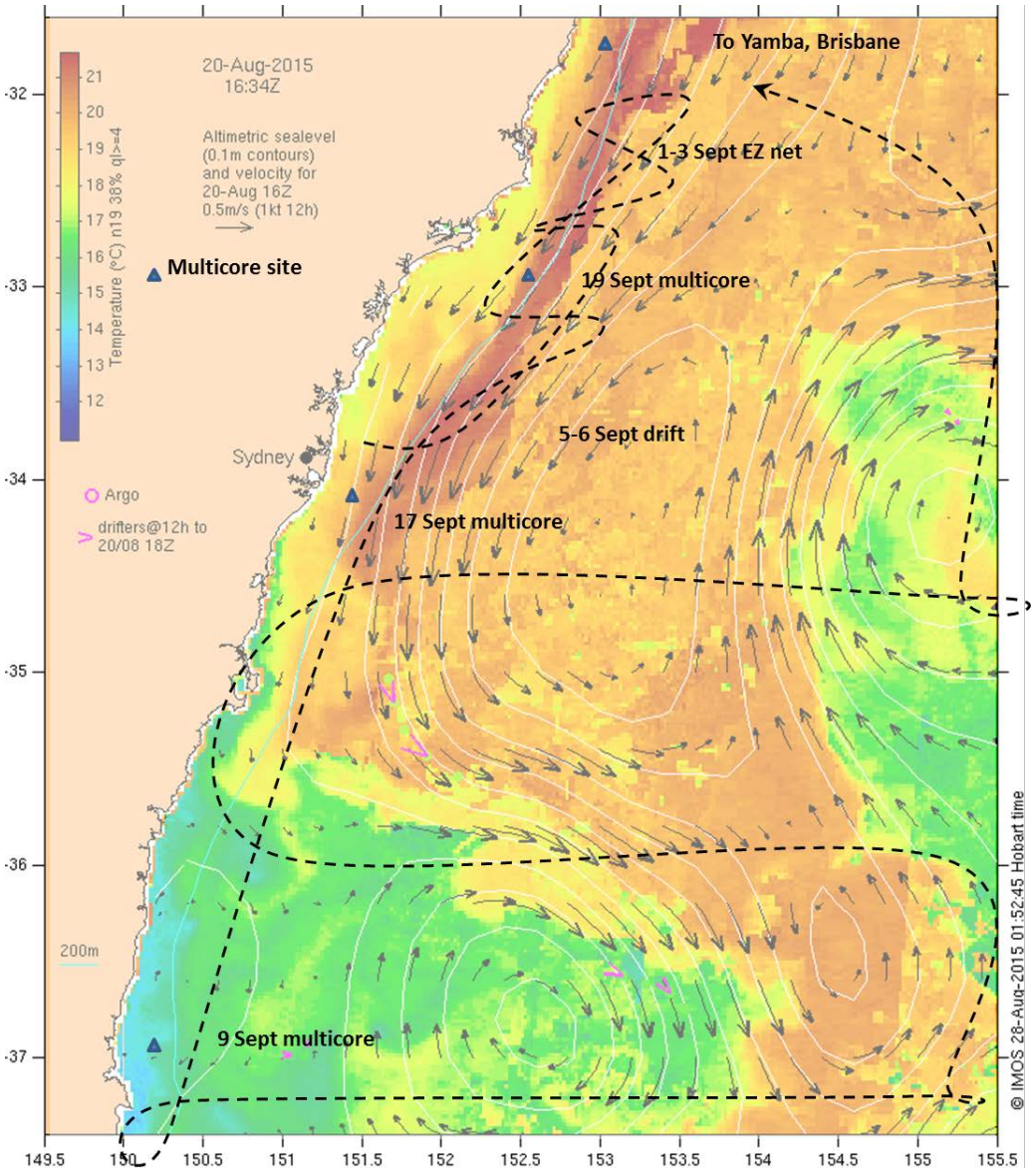


Fig. 1 Voyage track 29 Aug-5 Sept.

An overview of the voyage track is shown below in Figure 2.

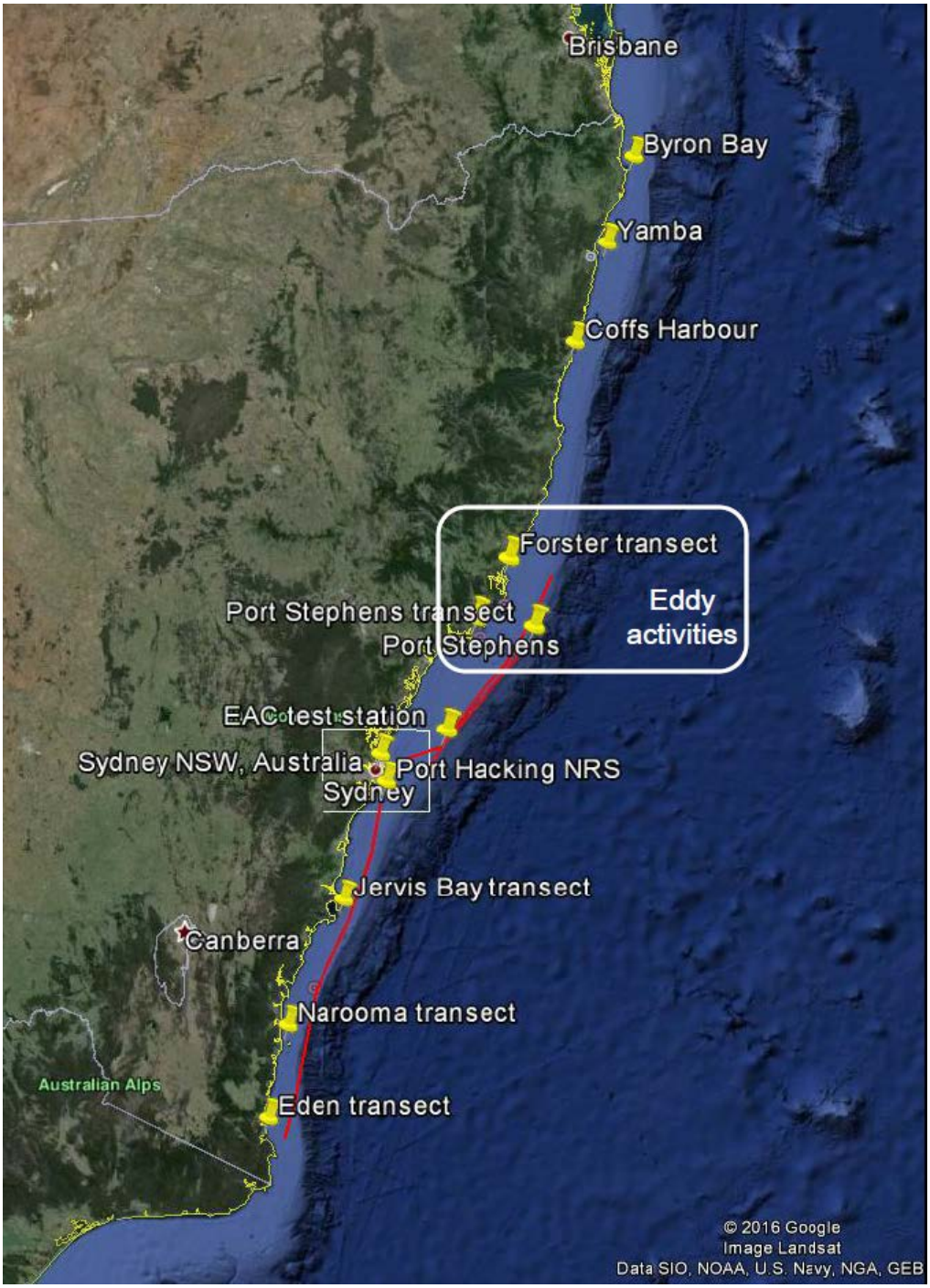


Figure 2. View of overall voyage track showing Sydney as the start port and Brisbane as the end port.

Sediment coring sites

The principal investigator leading this objective, April Abbott, will be on board and has indicated that a paired set of shallow/deep sites is her requirement to achieve her scientific objective.

Her goal is to quantify the magnitude and isotopic signature of the diffusive flux of neodymium (Nd) from the sediments off eastern Australia. To accomplish this, pore fluid from multi-cores will be extracted on board via centrifugation. The cores should be maintained in the core tubes and at ambient bottom water temperatures until processed, and must be extruded in anoxic conditions to prevent the loss of neodymium from the fluid state. Anoxic conditions are achieved in an inflatable glove bag using compressed nitrogen. The isotopic signature of this diffusive flux of neodymium has only been directly measured in the North Pacific with expansion of this data set critical to interpretations of neodymium isotopes in the context of past ocean circulation. The pore fluid measurements provide the isotopic signature and magnitude of the flux and the remaining sediments provide mechanistic information on the biogeochemical constraints of the release of Nd from the particles during early diagenesis. Comparison of the pore fluid isotopic signature to the bottom water (<1 m above sediment surface) is crucial to the evaluation of the validity of the neodymium record interpreted in past ocean circulation reconstructions fed into climate models to predict future changes. Specifically, if the bottom water signature does not match pore fluid, the record is not robust. Data from the North Pacific has suggested this flux is most important in oxic waters below the surface mixed layer and away from reactive terrestrial materials while water-column only observations have suggested the flux is most important on the continental shelf. Thus the coupling of deep sites (>1000 m) with shelf sites (<300 m) allows for direct comparisons of the diagenetic processes off the east coast of Australia to those observed in the North Pacific and observation of changes along the path of the EAC.

Priority	Location	Lat	Long	Additional information
1 (trial deployment)	Port Hacking (PH100)	-34.1163	151.2190	Microbial ecologist collaborators (e.g. Prof Gustaaf Hallegraeff) prioritise this site for the record of phytoplankton through time, not for geochemical measurements.
1	North of Eden inshore (shallow)	-35.889348	150.268347	For geochemical analysis. Sediment type clay to coarse silt.
1	North of Eden offshore	-35.811042	150.704936	For geochemical analysis. slope; 40-50 km off shore (between 1000-2000 m water depth)
2	Forster offshore (deep)	-38.184949	152.956958	Between 1000-2000 m water depth)
2	Forster inshore (shallow)	-32.125264	152.583314	150 m water depth

Waypoints and stations

No.	Name	Lat	Lon	Course	Dist (NM)	TDist (NM)
1	Garden Island	33°51.919'S	151°13.366'E	25.2	0.6	0
6	Sydney PBG	33°51.378'S	151°21.371'E	78.8	57.8	8.2
7	CTD Bottle Test in the EAC	33°40.000'S	152°30.000'E	13.1	58.3	66
8	Port Stephens	32°42.000'S	152°46.000'E	179.2	56.1	124.3
9	Drift Study	33°40.000'S	152°47.000'E	252.2	81	180.4
10	Port Hacking	34°04.780'S	151°14.310'E	190.2	59.1	261.4
11		35°02.624'S	151°01.740'E	198.3	118.1	320.4
12		36°55.137'S	150°15.881'E	235.2	13.3	438.5
13	Eden Start	37°04.447'S	149°59.178'E	88.9	228.5	451.8
14	Eden Finish	37°00.000'S	155°00.000'E	278.8	215.8	680.4
15		36°25.681'S	150°23.572'E	323.1	8.5	896.2
16	Montague Start	36°17.589'S	150°16.055'E	89.9	125	904.6
17	Montague Finish	36°17.445'S	152°55.249'E	298.9	118.2	1029.7
18	Sediment sampling site inshore	35.889348 S	150.268347E	18.3	12.3	1147.9
19	Sediment sampling site offshore	35.811042 S	150.704936 E			
20	Jervis Start	35°07.022'S	150°50.725'E	115.1	61.6	1160.2
21	Jervis Finish	35°33.526'S	151°59.900'E	6.2	170.9	1221.8
22	Port Stephens Sta	32°42.514'S	152°22.218'E	113	45.7	1392.7
23	Port Stephens Fin	33°01.428'S	153°14.900'E	329.7	59.5	1438.4
24	Forster Start	32°07.709'S	152°37.890'E	98.5	63.4	1497.9
24	Forster Finish	32°17.296'S	153°53.445'E	343.6	121.5	1561.3
25	Coffs Start	30°19.397'S	153°12.947'E	99.5	27.3	1682.8
26	Coffs Finish	30°24.080'S	153°45.253'E	348.1	30.6	1710.1
27		29°54.426'S	153°38.040'E	339.8	28.5	1740.7
28	Yamba	29°26.098'S	153°26.089'E	98.5	34	1769.2
29	Yamba Finish	29°31.337'S	154°05.982'E	342.3	55	1803.2
30	Byron Bay Start	28°37.930'S	153°46.610'E	89.8	46.8	1858.2
31	Byron Bay Finish	28°37.731'S	154°41.498'E	323.4	85.2	1905
32		27°29.130'S	153°44.125'E	346.1	35.6	1990.2
33		26°54.196'S	153°34.440'E	298	22.8	2025.8
34	Brisbane PBG	26°42.887'S	153°10.711'E	181.4	5.6	2048.7

Time estimates

The following time estimates are based on a steaming speed of 11 knots.

Date	Time	Activity
30 Aug	5 h	Steam from Sydney to EAC
30 Aug	5 h	Steam from EAC to Port Stephens
2 Sept	6 h	Steam from Port Stephens to Forster
3 Sept	7 h	Steam from eddy to Sydney region (EAC)
7 Sept	18 h	Steam from Port Hacking to Eden
10 Sept	11 h	Steam from Eden to Montague Is
12 Sept	7 h	Steam from Montague Is to Jervis Bay
14 Sept	6 h	Steam from Jervis Bay to Port Hacking
15 Sept	10 h	Steam from Port Hacking to Port Stephens
15/16 Sept	6 h	Steam from Port Stephens to Forster
18 Sept	6 h	Steam from Forster to Coffs Harbour
19 Sept	14 h	Steam from Coffs Harbour to Byron Bay
21 Sept	14 h	Steam from Byron Bay to pilot pickup port of Brisbane

Piggy-back projects

Not applicable

Investigator equipment (MNF)

Oceanographic data collection

- Triaxus with CTD, Ecotriplet, PAR and LOPC
- ADCP and Bioacoustics EK60 to 1500 m (Matt optimised set up)
- ADCP 75kHz (less interference with EK60)
- Access to data from underway systems (Thermosalinograph, Atmospheric Underway Sensors, Biological Oceanography Underway Sensors)

Water sampling

- TMR clean rosette (noting CTD is not available)
- TM2 clean van (white) for TMR bottle processing and preparing ISP filter heads (i.e. load filters)
- TMR storage van (10') used for programming and preparing the TMR and ISPs. Also includes UTas gear:
    - Orange trolley (for ISPs)
    - Black plastic pallet (for TMR)
    - 100kg epoxy coated weight (for ISPs)
    - Black container ramp (for ISPs)
    - Power/lighting in TMR van
    - 2 x plastic fish-hooks (for TMR)
    - Spare yellow extra weights (for TMR)

- Mclane pumps (ISPs)
- Access to the trace metal clean underway supply system (in laminar flow hood outlet in clean wet lab) and/or to water from the TMR

Plankton sampling

- EZ net with 5 nets
- LOPC
- Bongo nets (2 x 500 µm)
- Neuston net (Mark Lewis)

Biogeochemical rate measurements

- Radiation van (container lab) is requested for primary production and bacterial production measurements using 14C/13C and tritiated leucine/thymidine (radioisotopes), as well as nitrogen fixation and dissolved N measurements using 15N (stable isotope)
- Deck board incubators with flow through water systems

Sediment sampling

- Multi-corer and core tubes
  Cores will be frozen in tubes and then extruded so that coring tubes used at our first station Port Hacking) can be re-used for other sites.
- Mounting ability to maintain cores upright until processed
- Sub-bottom Profiler

Labs

- -80 freezers, blast freezer and controlled temperature lab
- Access to GP dirty wet lab (for plankton sorting and fixing; storage of liquid N2 shippers and processing of sediment cores)
- Access to GP clean wet lab (for RNA/DNA filtration, access to TM clean water from underway system
- Access to clean dry lab
- Access to underway lab (for fluorometers and other underway equipment)
- Hydrochemistry support to analyse regular CTD as well as experimental samples for dissolved nutrients
- Access to Milli-q system (in GP dry lab (clean), and in GP wet lab)
- Access to aerosol sampling lab
- Preservation Lab

Aerosol sampling

- Air Sampling Pump Controller -- Sector control switch used to switch vacuum pumps on/off and enable sampling of air only when the ship is in a ‘clean’ sector (i.e., prevents contamination of samples by sampling air impacted by the ship’s exhaust); requires Ethernet data feed of ship’s met data
- Advanced aerosol sampling system -- Under-development. To be requested after September 2016. Consists of three single 47mm filter holders with size selective inlets (PM1, PM2.5, TSP), flow control and volume recording system, pumps and housing.

User Equipment

UTS (MD, JS, PR, DS)

- UTS Micro-CSI laboratory van including Influx flow cytometer and high throughput imager
- Laboratory based peristaltic and vacuum pumps
- Multispectral Fast repetition rate fluorometers (Chelsea Fast-Ocean, Soliense); one to be maintained on the bench with discrete samples and the other to sip continuously from the underway surface supply; One other to be located in the Istotope container lab, with a fourth held spare
- Toughbook laptop to program TMR and Maclane pumps (ISPs)
- Gas chromatograph (GC) (UTS) + required gas tanks for helium, hydrogen and air (E size tanks) [located in air chemistry lab]
- Liquid nitrogen dry shippers (15-30L) to be stored in GP dirty wet, clean wet lab and dry lab required for GC operation and cryopreservation
- Spectrophotometer (UTS)
- Sulphur chemoluminescence device
- filtration manifolds for filtering seawater
- Aquarium heaters and pumps to recirculate water (to be used in deckboard incubators)

UNSW (IS, MB)

- Dissecting microscope and HD camera system for zooplankton and larval fish
- 10 NOAA SVP Drifters (as per IN2015-V03, to be delivered to Hobart in August 2016)
- Drop Camera
- LOPC – to be mounted on EZ net.

UTAS (AB, MP)

- Aerosol sampling system (UTAS/CSIRO), includes pumps, flow meters, tubing and filtration holders
- Laminar flow hood (UTAS), for clean sampling and sample handling
- Sampling bottles (UTAS), to collect seawater from ship's trace metal clean underway supply and/or TMR
- Precipitation (Rain) Sampler (UTAS)
- Equipment to help with TMR and ISP deployments: Orange trolley (for ISPs), Black plastic pallet (for TMR), 100kg epoxy coated weight (for ISPs), Black container ramp (for ISPs), Power/lighting in TMR van, 2 x plastic fish-hooks (for TMR), Spare yellow extra weights (for TMR)

MacU (AA)

- Core extrusion table (dirty wet lab)
- two glove bag set ups (clean wet lab)
- Centrifuge (85 mL samples at 12000 rpm; clean wet lab)
- Table to hold centrifuge (clean wet lab)
- Battery packs and filters needed for the Maclane pumps (ISPs)

Special Requests

- We would like to have a daily voyage planning meeting
- LOPC integration with EZ net
- TM wet clean lab van (white) and rosette that requires power, comms on main deck
- TM storage van (10')
- Micro-CSI laboratory on deck 02 requires power, freshwater connection
- Optics cage needs to be deployed out of vessel shadow
- Gases (air, helium, hydrogen – E size tanks (3.5 m^2) will be required for running the gas chromatograph in atmospheric lab
- We wish to store liquid nitrogen dry shippers (15 to 30L) in the dirty wet, clean wet and clean dry lab on the main deck. The dry shippers will not have more than 15L of liquid in them at any time.
- The deckboard incubators with flow through seawater are requested for running incubation experiments
- The isotope van will be required for performing bacterial production measurements with tritiated leucine/thymidine, and phytoplankton production with 13C/15N. 14C incubations will take place inside the van.
- Neuston net boom deployed for duration of voyage
- Means of deploying a hand net for phytoplankton (20 µm)
- We will need operational assistance with the sediment multi-corer
- In addition to regular CTD casts, we would like to have additional seawater samples from experiments analysed for dissolved nutrients
- ASP - please provide a record of incineration events for atmospheric team. It would be good to have advance notice of these if possible
- ASP – please consult with voyage manager and science team about effluent releases
- Morgane Perron requires access to the rain radar or a call from the bridge when rain is expected.

Permits

- Permit from AFMA for plankton was requested by I. Suthers on 17 May 2016.
- Permit for use of radioactivity has been granted to M. Doblin (expires 24 March 2018).

Sampling teams

Regular CTD	**TMR/ISPs**	**Nets**	**Multicorer**	**Isotope lab**	**Underway sampling**	**MicroCSI**
MNF operations room: Martina Doblin Rosette sampling: - Mark Brown - Justin Ashworth - Kirianne Goosen - Elisabeth Desacheux - Martin Ostrowski - Allison McInnes - Amaranth Focardi - Malwenn Lassudrie-Duchesne Filtration coordinator :Mark Brown	Martin Ostrowski Leonardo Laiolo Dave Suggett	Iain Suthers + team Malwenn Lassudrie-Duchesne	April Abbott Joey Crosswell Rebecca Darcy	Marco Alvarez Dave Hughes Bonnie Laverock Marco Gardinia Martina Doblin	Dave Suggett Joey Crosswell	Kun Xiao Allison McInnes

Personnel List

(Shift A 2 pm-2am; Shift B 2am-2pm); monkey island obs will be in daylight hours 6am-6 pm.

1.	Hugh Barker	Voyage Manager	CSIRO MNF
2.	Brett Muir	SIT Support	CSIRO MNF
3.	Nicole Morgan	SIT Support	CSIRO MNF
4.	Amy Nau	GSM Support	CSIRO MNF
5.	Dave Watts	GSM Support	CSIRO MNF
6.	Christine Rees	Hydrochemistry	CSIRO MNF
7.	Stephen Tibbens	Hydrochemistry	CSIRO MNF
8.	Pamela Brodie	DAP Support	CSIRO MNF
9.	Karl Malakoff	DAP Support	CSIRO MNF
10.	Mark Lewis	Mechanical Support	CSIRO MNF
11.	Jason Fazey	Mechanical Support	CSIRO MNF
12.	Martina Doblin	Chief Scientist	UTS
13.	Allison McInnes	Post-doc	UTS
14.	Leonardo Laiolo	PhD student	UTS
15.	Marco Alvarez	PhD student	UTS
16.	Kun Xiao	Flow cytometry operator	UTS
17.	Mark Brown	Alternate Chief Scientist	UNSW
18.	Kirianne Goosen	PhD student	UTas
19.	Elisabeth Desacheux	Post-doc	UTS
20.	Marco Gardinia	PhD student	UTS
21.	Martin Ostrowski	Principal Investigator	MacU
22.	Amaranth Focardi	PhD student	MacU
23.	Rebecca Darcy	MRes student	MacU
24.	Joey Crosswell	Post-doc	UTS
25.	Justin Ashworth	Research fellow	UTS
26.	David Suggett	Principal Investigator	UTS
27.	David Hughes	PhD student	UTS
28.	April Abbott	Research scientist	MacU
29.	Iain Suthers	Zooplankton team leader	SIMS-UNSW
30.	Zoe White	MSc – OPC and Triaxus	SIMS-UNSW
31.	Gary Truong	PhD– cetaceans and seabirds-1	SIMS-UNSW
32.	Chris Stanley	MSc - larval fish, lobster	Macquarie Uni
33.	Ricardo Alvarez Pacheco	PhD– cetaceans and seabirds-2	Southern Cross University
34.	Luvia Garcia	Student	New Zealand
35.	Malwenn Lassudrie-Duchesne	Visiting Fellow UTS	UTS
36.	Deepa Varkey	Postdoc	UTS
37.	Morgane Perron	PhD student	UTas
38.	Bonnie Laverock	Postdoc	UTS
39.	Matt Holland	prospective PhD student	UNSW

Signature

Your name	Martina Doblin
Title	Chief Scientist
Signature	
Date:	15 Aug 2016