

ANNUAL REPORT ON GEOTRACES ACTIVITIES IN AUSTRALIA
MAY 2014 – JUNE 2015

Meetings

- GEOTRACES presentations and co-authorships by Australian scientists at the following meetings: AGU Fall Meeting (San Francisco, USA, Dec 2014), ACCOMC-CGASM annual meeting (Aspendale, Victoria, Nov 2014), 3rd International Symposium on the Effects of Climate Change on the World's Oceans (Santos City, Brazil, Mar 2015), APICS (Melbourne, Australia), May 2015.
- Informal meeting on Aus-NZ GP13 data during *RV Investigator* trials voyage.

New funding

- Australian Research Council Discovery grant for project “Hot iron: Are submarine volcanoes important for Southern Ocean iron supply?”. Operating funding to support the trace metal biogeochemistry on the 2-month research expedition (January-March 2016) on *RV Investigator* to study hydrothermalism and biospheric impacts around Heard/McDonald Islands in the Southern Ocean (“HEOBI” cruise).
- Australian Antarctic Science grant for project “Submarine Volcanism and Hydrothermalism around Heard and McDonald Islands”. Funding to support logistics, geochemistry and geophysics on HEOBI voyage.
- Awarding of shiptime to support “K-axis” voyage in the Indian sector of the Southern Ocean south of Kerguelen plateau in January-March 2016 on *RSV Aurora Australis*. The project “Assessment of habitats, productivity and food webs on the Kerguelen Axis in the Indian Sector of the Southern Ocean” will examine principal drivers of ecosystem structure and processes and includes a trace element biogeochemistry component.
- Awarding of shiptime to support “SOTS-Eddies-CAPRICORN” voyage in the Southern Ocean in March-April 2016 on *RV Investigator*. The voyage combines three projects, including the “Integrated Marine Observing System Southern Ocean Time Series automated moorings for climate and carbon cycle studies southwest of Tasmania” and “Linking eddy physics and biogeochemistry in the Antarctic Circumpolar Current south of Tasmania”, both of which will include a trace element biogeochemistry component.
- Awarding of in-kind logistical support for fieldwork on the Antarctic sea-ice in spring 2015, for the project “Impact of changes in sea ice extent on primary productivity in the Southern Ocean: links between the iron and carbon cycles in fast ice and the marginal ice zone”.

New results

- Results from the French-led GEOTRACES Process Study KEOPS-2 (GIpr01), a natural iron fertilisation experiment around the Kerguelen Islands in the Southern Ocean published in a special issue of Biogeosciences (http://www.biogeosciences-discuss.net/special_issue133.html)
- Results from the GEOTRACES Process Study SIPEX-2 (GIpr02), a multidisciplinary biogeochemistry expedition examining the role of Antarctic sea ice as a natural ocean fertilizer during the spring in the sea ice zone near east Antarctica, are currently being published in a special issue of Deep-Sea Research II.
- Submission of results for the GEOTRACES intercalibration exercises for marine particulate trace elements (led by Phoebe Lam).

New projects (two examples)

- PROJECT 1: Tasman Sea biological response to dust storm events during the austral spring of 2009 (Gabric et al., 2015). We investigated various field, model and satellite data on atmospheric dust loading and chlorophyll levels in the Tasman Sea to explore the connection between the spring dust storm season of 2009, and the ecosystem response of the Tasman Sea. We used a high resolution dust transport model to simulate dust deposition to the ocean surface, which indicates significant, albeit episodic deposition which was enhanced by widespread precipitation, especially during the late September ('Red Dawn') and mid-October events. These events promoted large scale phytoplankton blooms in the Tasman, with chlorophyll-a values well above their springtime climatological averages. These results are noteworthy as this is the first report of a significant biological response to dust-derived nutrient addition in the Tasman Sea, with previous studies finding no response.
- PROJECT 2: Trace metal aerosol sampling to investigate inputs to Australian and Antarctic waters. A series of trace metal clean aerosol samplers have been established at various land based sites across Australia and also on the new Australian research vessel Investigator since 2013. This includes locations at: (1) Gunn Point Tropical Atmospheric Research Station (Northern Territory) to investigate the solubility of biomass burning derived aerosol iron to tropical waters as part of the 'Savannah Early-Late Dry Season Fire Experiment'. (2) Cape Grim Baseline Air Pollution Station (Tasmania) to investigate soluble iron inputs to the Southern Ocean using sector control to sample only 'baseline air'. (3) Gingin Gravity Discovery Centre (Western Australia) to investigate dust delivery into the southeast Indian Ocean from the dry arid regions of WA. (4) Onboard the *RV Investigator* in waters south of Tasmania, Australia to investigate dust delivery to the open Southern Ocean.

Cruises

- No GEOTRACES cruises took place in the reporting period.
- Four expeditions outlined above are planned for the next 12 months, including 3 to be proposed as GEOTRACES Process Studies. GEOTRACES researchers in Australia are heavily committed to these process studies in the Southern Ocean. This, combined with a current shortage of 'GEOTRACES researchers' nationally, limits our ability to lead GEOTRACES full sections at this time.

Other activities

- The commissioning of the new Australian oceanographic research vessel Investigator has been completed. The ship has improved facilities to undertake GEOTRACES science. A dedicated "Trace metals and micronutrients" trials voyage took place in April 2015, where new a clean container, a trace metal clean rosette (TMR), 6 in situ pumps (ISP), an aerosol sampling system, and a clean underway sampling system were tested.

New publications (involving Australian GEOTRACES researchers)

- Gabric AJ, Cropp R, McTainsh G, Butler H, Johnston B, O'Loingsigh T, Dien Van Tran, 2015. Tasman Sea biological response to dust storm events during the austral spring of 2009. *Marine and Freshwater Research*, in press.
- Chase Z., McManus J, Mix A.C., Muratli J., 2014. Southern-ocean and glaciogenic nutrients control diatom export production on the Chile margin. *Quaternary Science Reviews* 99, 135-145

- Norman L et al., 2015. The role of bacterial and algal exopolymeric substances in iron chemistry. *Marine Chemistry* 173, 148-161
- Sedwick PN, Sohst BM, Ussher SJ, Bowie AR, 2015. A zonal picture of the water column distribution of dissolved iron (II) during the US GEOTRACES North Atlantic transect cruise (GEOTRACES GA03). *Deep Sea Research Part II: Topical Studies in Oceanography* 116, 166-175
- Qu erou  F et al., 2015. High variability in dissolved iron concentrations in the vicinity of the Kerguelen Islands (Southern Ocean). *Biogeosciences* 12 (12), 3869-3883
- Planchon F et al., 2015. Carbon export in the naturally iron-fertilized Kerguelen area of the Southern Ocean based on the ²³⁴Th approach. *Biogeosciences* 12 (12), 3831-3848
- Winton VHL et al., 2015. Fractional iron solubility of atmospheric iron inputs to the Southern Ocean. *Marine Chemistry*, in press
- Schallenberg C et al., 2015. Dissolved iron and iron (II) distributions beneath the pack ice in the East Antarctic (120  E) during the winter/spring transition. *Deep Sea Research Part II: Topical Studies in Oceanography*, in press
- van Der Merwe, 2015. Sourcing the iron in the naturally fertilised bloom around the Kerguelen Plateau: particulate trace metal dynamics. *Biogeosciences* 12 (3), 739-755
- Bowie AR et al., 2015. Iron budgets for three distinct biogeochemical sites around the Kerguelen archipelago (Southern Ocean) during the natural fertilisation experiment KEOPS-2. *Biogeosciences Discussions* 11 (12), 17861-17923
- Lannuzel D et al., 2015. Iron biogeochemistry in Antarctic pack ice during SIPEX-2. *Deep Sea Research Part II: Topical Studies in Oceanography*, in press
- Ratnarajah L, Bowie AR, Lannuzel D, Meiners KM, Nicol S, 2015. The Biogeochemical Role of Baleen Whales and Krill in Southern Ocean Nutrient Cycling. *PloS one* 9 (12), e114067
- Worsfold PJ, Lohan MC, Ussher SJ, Bowie AR, 2015. Determination of dissolved iron in seawater: A historical review. *Marine Chemistry* 166, 25-35
- BP von der Heyden BP et al., 2015. Ubiquitous presence of Fe (II) in aquatic colloids and its association with organic carbon. *Environmental Science & Technology Letters* 1 (10), 387-392
- Lannuzel D, van der Merwe PC, Townsend AT, Bowie AR, 2015. Size fractionation of iron, manganese and aluminium in Antarctic fast ice reveals a lithogenic origin and low iron solubility. *Marine Chemistry* 161, 47-56
- Boyd PW et al., 2015. Why are biotic iron pools uniform across high-and low-iron pelagic ecosystems? *Global Biogeochemical Cycles*, in press
- Ellwood M et al., 2015. Volatile Selenium Fluxes from Selenium-contaminated Sediments in an Australian Coastal Lake *Environmental Chemistry*, in press
- Ellwood MJ et al., 2015. Iron stable isotopes track pelagic iron cycling during a subtropical phytoplankton bloom. *Proceedings of the National Academy of Sciences* 112 (1), E15-E20
- Maher W, Ellwood M, Raber G, Foster S, 2015. Measurement of arsenic species in environmental, biological fluids and food samples by HPLC-ICPMS and HPLC-HG-AFS, *Journal of Analytical Atomic Spectrometry*, in press
- Thompson CM, Ellwood MJ, 2014. Dissolved copper isotope biogeochemistry in the Tasman Sea, SW Pacific Ocean. *Marine Chemistry* 165, 1-9
- Thompson CM, Ellwood MJ, Sander SG, 2014. Dissolved copper speciation in the Tasman Sea, SW Pacific Ocean. *Marine Chemistry* 164, 84-94

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