



Members:

















































Chairman's Overview

With about 60% of Australia's and 95% of New Zealand's territory offshore, our two nation's vast oceans are central to the heritage, heart and economic future of our countries. For example, by 2025, Australia's marine industries will contribute around A\$100 billion each year to our economy, with our oceans and coasts providing a further A\$25 billion worth of ecosystem services, such as carbon dioxide absorption, nutrient cycling and coastal protection. The value of our marine estates to all Australians and New Zealanders is matched only by the enormous economic and environmental wealth that these assets afford us. As such, our countries share common marine research needs that recognise the value of international collaborative ocean science to both nations and the International Ocean Drilling Program (IODP) is a wonderful example.

Scientific ocean drilling through the IODP is a continuation of the world's longest running and most successful international geosciences research collaboration. The Program will celebrate 50 years of operations in 2018. The IODP operates deep-sea drilling vessels to collect continuous core samples of sediments and rocks from below the sea floor for dedicated research purposes. This is the fifth year of the current IODP Program that is guided by a decadal science plan (2013-23) – Illuminating Earth's Past, Present and Future.

ANZIC is one of IODP's 23 International partners and is a 0.5 associate member of the US/European Consortium via a MOU with the United States National Science Foundation. Australia and New Zealand's participation in IODP through ANZIC continues to grow in strength and significance. IODP has conducted significant research in the Australasian region from proposals often initiated, proposed and lead by ANZIC members. Other internationally located expeditions have enabled ANZIC members to contribute to significant breakthroughs in understanding global climatic events and be exposed to the new technology surrounding drill technology and deep sea biosphere recovery.

This year has been another very successful year for ANZIC. In 2017, sixteen ANZIC scientists took part in six JOIDES Resolution expeditions in our region, and we held a very successful IODP Regional Planning Workshop in Sydney and a Marine Geoscience Masterclass in New Zealand that continues to inspire the next generation of marine geoscientists. There were three port calls by the JOIDES Resolution in Australia that provided wonderful opportunities to communicate the value and contribution of IODP to Southern Hemisphere marine science, to fellow marine scientists and the community generally. Australian and New Zealand scientists through ANZIC continue to be important contributors to IODP. ANZIC authors are represented in 21% of all IODP publications over the almost 50-year life of the Program for a very small contribution to operational costs. Currently ANZIC contributes 1% to IODP's \$US180 million annual international operational budget. ANZIC success is a tribute to the commitment of our 20 member universities and research organisations and their international counterparts with excellent leadership and support from the Governing Council and Program Office team. I look forward to working with the Governing Council and the Program Office team to ensure the continued success of



ANZIC-IODP.

In September 2017 we farewelled Professor Exon after ten years as the IODP Program Scientist. Under his leadership and hard work the ANZIC contribution to IODP has been exceptional. Furthermore, Professor Exon has played an outstanding role for many years as a scientist and science leader in Australia. Congratulations on his appointment as an ANU Emeritus Professor and in that role I am confident he will continue to contribute to the success of ANZIC. Exploring the Earth under the Sea: Australian and New Zealand achievements in the first phase of IODP Scientific Ocean Drilling, 2008-2013 was published in November 2017. A book that Neville not only edited but also made significant contributions to and it is an enduring legacy of his contribution.

With Neville's departure we welcomed the appointment of Associate Professor Leanne Armand as the new Program Scientist. An international expert in Southern Ocean diatom taxonomy with a strong interest in the distribution of individual species related to the physical oceanic environment, and the subsequent preservation of this environmental relationship in the fossil record. Leanne is a very successful sea going scientist who is well known to IODP having been the ANZIC representative on the ECORD Facility Board and the ANZIC Science Committee for several years. Leanne has an excellent understanding of the governance of the program and is held in high standing by the international IODP community.

Looking to the future 2018 will be a special year for ANZIC, with four JOIDES Resolution expeditions in our region, all of high scientific and societal interest, and with very strong ANZIC involvement including a number of co-chief scientists. A key focus of Governing Council will be to work with our member universities and research organisations and the broader Australian and New Zealand earth science communities to develop the next generation of ANZIC IODP proposals to ensure ANZIC continues beyond 2020. ANZIC is an essential part of Australia's and New Zealand's research portfolios as IODP attracts the best and brightest talent and the collaboration of Australia and New Zealand in ANZIC demonstrates we can be successful in bringing this talent to Australasia. I look forward to working with the Governing Council and the Program Office team to ensure the continued success of ANZIC-IODP.

Dr Ian Poiner
ANZIC Governing Council Chair

Program Scientist's Summary

Ocean Drilling in General

Ocean drilling addresses scientific problems of global interest. It explores how the Earth has worked in the past, how it is working now, and how it may work in the future – a big and ongoing task! International Ocean Discovery Program (IODP) platforms take continuous cores of sediments and rocks from all the world's oceans, at times reaching several kilometres below the sea bed. Two large coring vessels, the JOIDES Resolution and the Chikyu, and mission specific alternative platforms, are used to 'ground truth' scientific theories based largely on remote sensing geophysical techniques.

The IODP is the successor to earlier ocean drilling programs – the Deep Sea Drilling Project (DSDP), the Ocean Drilling Program (ODP), and the Integrated Ocean Drilling Program (IODP). The present phase of IODP has similar general aims but some changes in detail as compared to the first phase of IODP

The many ocean drilling expeditions in our region since 1968 have provided new scientific knowledge of global significance. Hundreds of scientists participate each year, tackling 'big science' questions in fields ranging from climate change to the deep biosphere and plate tectonics. Each expedition in our region not only brings high-technology drilling vessels here, but also about 30 outstanding scientists to work with our participants on issues of great scientific interest.

Australia and New Zealand consortium

Australia and New Zealand are members of IODP, in our own Australia and New Zealand IODP Consortium (ANZIC). Our scientists work with research teams from around the world, and post-cruise research cooperation often extends far beyond IODP. Our geoscientists and microbiologists are making important scientific contributions, and coring expeditions in our region and elsewhere have improved and will keep improving our understanding of global scientific questions.

In 2017, the ANZIC consortium consisted of 16 universities, four government agencies, and one marine geoscience peak body. Australia is the major ANZIC financial contributor but benefits are shared between our two countries. ANZIC funding of about \$A3.2 million for 2017 came from an ARC/LIEF grant of \$A2 million, contributions from Australian partners of \$A875,000, and contributions from New Zealand partners of \$A415,000. In 2017, we had 16 shipboard places on *JOIDES Resolution*, 14 scientists plus two outreach and education officers, plus a variety of other benefits. Our normal *JOIDES Resolution* scientific quota was greatly increased by having three co-chief scientists, four scientists as 'national observers', and two additional scientists paid for by Australia under special arrangements.

Membership of IODP helps us maintain our quality in marine research, and our region's geography, climate, oceanography and plate tectonics make its study vital in addressing various global science problems. The Australasian region has seen

a great deal of scientific ocean drilling since its inception, including 12 expeditions from 2009 to 2017. Four more regional expeditions will occur in 2018. This is a huge credit to our scientists, who have played leading roles in building successful proposals. One reward is that, from 2010 to 2018, we will have had nine ANZIC scientists in the key role of Co-chief Scientist on seven of the expeditions. These scientists not only helped design the expeditions but play a key role in shipboard decision making, and in post-cruise scientific decisions. Post-doctoral and doctoral students have opportunities to train in areas of geoscience and microbiology that could not be studied in any other way.

Our membership of the Japanese consortium was diverted this year as no *Chikyu* IODP expeditions were scheduled. Thus an extra \$US300,000 for additional shipboard positions to increase our presence on regionally scheduled expeditions as provided to the US National Science Foundation.

The very important Australian National Research Infrastructure Roadmap was published in May 2017 (https://www.education. gov.au/2016-national-research-infrastructure-roadmap).We have long argued that a better solution for Australian IODP research would put it in a special Australian research grouping. funded for participation in major long-term multinational research using foreign owned infrastructure; such programs are now funded in a rather ad hoc manner. Our Roadmap submissions drew attention to this possibility. Our submissions are available with all others at https:// submissions.education.gov.au/Forms/ National-Research-Infrastructure-Capability-Issues-Paper-Submissions. As a result of our submissions, the Roadmap document included a text box about IODP, as an example of an excellent international research program from which Australia gains a great deal scientifically in a very cost-effective manner. The National Marine Science Committee submission on marine science, as a whole, gave favourable mention to IODP, and ANZIC has now become a member of that committee.

Following on from the Roadmap, ANZIC Chairman Ian Poiner was asked by the Department of Education and Training to take the lead in a submission of scenarios for funding involving scientific marine, ice and land drilling. The marine (IODP) drilling submission, prepared by Ian and the ANZIC Office, argued that funding for IODP drilling, after our last presently funded year of 2020, should double our working presence in IODP.

In September, Leanne Armand was appointed the new ANZIC Program Scientist and worked alongside Neville Exon prior to his retirement at the end of the same month. Leanne has come from Macquarie University and has been the ANZIC representative on the ECORD Facility Board and the ANZIC Science Committee for several years, thus bringing an excellent understanding of the governance of the program and her highly appreciated standing in the international IODP community.

An upgrade to the ANZIC Office was instigated during the change-over of Program Scientists with a move to attractive and much larger offices and workspaces within the Research School of Earth Sciences at ANU. The ANZIC Office is now a suitable space for small meetings, for visiting scientists and for the ANZIC Office Team.



Scientific Activities

Expeditions

ANZIC has active members on all IODP committees. In 2017 fourteen scientists and two Education and Outreach Officers took part in five *JOIDES Resolution* expeditions.

- Expedition 367, South China Sea Rifted Margin A
- Expedition 368, South China Sea Rifted Margin B
- Expedition 369, Australian Cretaceous Climate and tectonics (Naturaliste Plateau)
- Expedition 371, Tasman Frontier Subduction and Climate (Lord Howe Rise)
- Expedition 372, Gas Hydrates and Hikurangi Subduction Margin LWD

In addition there was one very successful European IODP expedition late in the year, with an ANZIC scientist to take part in the post-cruise science party early in 2018:

Expedition 381, Corinth Active Rift Development



Mission specific platforms in 2017 Fugro Synergy Exp 381 Corinth Rift funded by ECORD (Photo credit J. Everest, ECORD/IODP)

The three regional expeditions were of exceptional significance:

 Expedition 369 addressed the nature of middle and late cretaceous sedimentation in and near the Australo-Antarctic Rift off southwest and southern Australia, when numerous global anoxic events led to the deposition of black shales (potentially of interest to petroleum explorers source rocks).



Exp 369 Hobart (Photo credit: William Crawford, IODP JRS)

- Expedition 371 addressed the unusual history of the Lord Howe Rise and adjacent regions from about 55 million years ago, when the global tectonic pattern changed, and the Pacific 'Rim of Fire' initially compressed this part of the sunken continent of Zealandia from the east, lifting part of it above sea level. The expedition received extensive media coverage.
- Expedition 372 addressed the slow-slip Hikurangi subduction zone, east of New Zealand's North Island, from the point of view of its role as an earthquake zone, and also its unusual large accumulations of gas hydrates.



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Other Activities

A very successful Australasian IODP Regional Planning Workshop was held at Sydney University in June, 2017. This major workshop chaired by Rob McKay, Chair of the Scientific Committee, covered all the Australian and New Zealand region and was modelled on the earlier, equally successful, Indian Ocean and Southwest Pacific Ocean workshops. The workshop covered all platform possibilities, but our main aim was to start the process of writing good proposals to attract JOIDES Resolution back into our region around 2022.

A very successful Marine Geoscience Masterclass was held in New Zealand for outstanding undergraduate students from all our university partners, and this involved extensive land and marine fieldwork. Feedback from both students and leaders was very positive. The aim of the Masterclasses is to demonstrate that geology and IODP science can provide exciting futures for undergraduate students, many of whom have not yet decided on their long term careers.

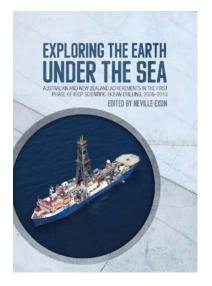


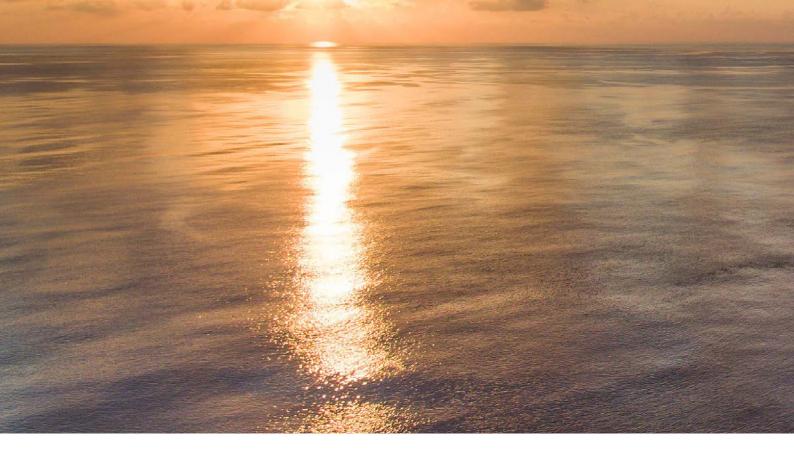
Marine Geoscience Masterclass

This year, JOIDES Resolution made three port calls in Australia (Townsville, Hobart and Fremantle), and New Zealand port calls started in Lyttelton in January 2018. The IODP Office helped ensure the Australian port calls were the focus for press releases and there was unprecedented international coverage

of Expedition 371. There were also highly successful tours of interested groups on the ship. The Australian groups included scientists from universities, CSIRO and the Australian Institute of Marine Sciences, and science teachers and students from high schools.

A book, edited and largely written by Neville Exon, Exploring the Earth under the Sea: Australian and New Zealand achievements in the [rst phase of IODP Scientific Ocean Drilling, 2008-2013 http://dx.doi.org/10.22459/EEUS.10.2017 was published in November. The book is available both digitally free of charge and on paper from ANU Press. www.ress.anu.edu.au. It covers the activities of Australia and New Zealand in the first phase of the IODP, is designed for a scientifically literate layperson, and is written to be inherently interesting. It includes, for example, the impressions of a number of young scientists on their first drilling expeditions. It was launched at the National Library in December, with an introduction by Stephen Buckman of the Australian Research Council, and a lecture on IODP and the book by Neville.





The Future of IODP

A ten-year phase of ocean drilling, under the name International Ocean Discovery Program, commenced in late 2013, and funding is agreed in principle for the *JOIDES Resolution* and the European alternative platforms until late 2023, subject to reviews. Long-term Japanese funding for the deep-drilling vessel *Chikyu* is still under consideration, but occasional IODP expeditions are going ahead on the Japanese margin. Australia is funded through until the end of 2020, and New Zealand expects to remain in ANZIC at least that long.

The themes of the new Science Plan – Illuminating Earth's Past, Present and Future - are:

- Climate and Ocean Change: Reading the Past, Informing the Future
- Biosphere Frontiers: Deep Life and Environmental Forcing of Evolution
- Earth Connections: Deep Processes and their Impact on Earth's Surface Environment
- Earth in Motion: Processes and Hazards on Human Time Scales

The years 2017 and 2018 are very special for ANZIC, with seven *JOIDES Resolution* expeditions in our region, all of high scientific and societal interest, and with very strong ANZIC involvement including a number of co-chief scientists. In 2018 those expeditions will be:

- Expedition 374: Ross Sea West Antarctic Ice Shelf
- Expedition 375: Hikurangi Subduction Margin
- Expedition 376: Brothers Arc Flux (north of New Zealand)



Welcome:

Associate Professor Leanne Armand as the new ANZIC Program Scientist 2018



Acknowledgments

Final word of thanks

I retired as the ANZIC Program Scientist, at the end of September, 2017. On this occasion, I would like to say that this 10 year role provided me with great interest, and I am proud of what I and my colleagues have managed to do in that time. In particular, the two regional IODP workshops – Indian Ocean in 2011, Southwest Pacific Ocean in 2012 – have generated much interest and many successful regional drilling proposals.

The Australasian IODP workshop in 2017 certainly also generated much interest and is sure to generate many proposals. I edited and shepherded to publication the book *Exploring the Earth under the Sea,* covering the first phase of IODP from 2008 to 2013, which contains articles by many of our scientists. It was published by ANU Press in 2017.

Professor Neville Exon - ANZIC Program Scientist





The New Zealand members of ANZIC recognise participation in IODP in collaboration with Australia and other international partners is the only way we will uncover the rich and vast climatic, biological, chemical, and geological history buried beneath the ocean floor of Zealandia and the Southern Ocean.

The international geoscience community also acknowledges that Zealandia and the Ross Sea are particularly well positioned to answer global science questions related to climate change and the processes that cause earthquakes and rock mineralisation. Over the last six years a team of New Zealand scientists and their international partners have promoted and matured proposals that have culminated in scheduling six IODP expeditions that are taking place between July 2107 and December 2018. Expeditions 371 (Tasman Frontier Subduction Initiation and Paleogene Climate) and 372 (Creeping Gas Hydrate Slides and Hikurangi LWD) have been completed. The remaining four expeditions will take place in 2018.

In total 13 New Zealand scientists and four outreach officers will take part in these expeditions. Five of the six expeditions are led by New Zealanders providing an unprecedented opportunity to showcase the relevance of geoscience to the wider New Zealand public. In September 2017 Chris Hollis and Stuart Henrys were interviewed by Kim Hill on the popular Radio NZ Saturday Morning show, at the start of the Expedition 371. We provided a briefing paper on IODP to the incoming Minister of Science, Hon. Megan Woods, in November. IODP was showcased at the annual GNS Science Client Function in December. Richard Arculus gave a short presentation on the benefits arising from New Zealand's membership of IODP to a wide range of GNS clients, collaborators, and stakeholders. The function included a live ship video link to the co-chief scientist, Phil Barnes, on the JOIDES Resolution (Expedition 372) and several IODP themed displays were exhibited at the function venue.

The New Zealand geoscience community have been successful in recent years in gaining contestable science funding, through Ministry of Business, Innovation and Employment, Endeavour and Marsden Funding, to undertake studies complementary to IODP drilling. We have also successfully partnered with the international community to bring ships, seafloor drilling rigs, remotely operated underwater vehicles, and autonomous underwater vehicles to our waters. These assets are vital to enhance drilling results and build the case for future proposals. A GNS Science-led research programme on the Hikurangi Subduction Margin has undertaken extensive outreach and community engagement to help local communities learn about the importance and relevance of the research and to address concerns about the environmental impacts of scientific drilling and seismic surveys.

The lack of long-term ANZIC membership funding remains a considerable risk for New Zealand's ongoing participation in IODP. The expeditions of 2018 and a fresh suite of ministers in government, provide a crucial opportunity to secure long-term commitment from the New Zealand government to enable New Zealand scientists and students to continue to participate in the world's largest geoscience programme.



Dr Stuart Henrys GNS Science



ANZIC IODP Organisation

The organisational involvement of Australians and New Zealanders in IODP falls into a number of categories: IODP panels, ANZIC committees, conferences and workshops.

Australian and New Zealand partners in IODP in 2017

The Consortium joined the new phase of IODP in September 2013. Australia was funded for 2016 to 2020 under a new ARC/LIEF grant, and New Zealand partners were self-funded, with GNS Science contributing a major proportion of their membership.

Australian IODP partners:

- Australian Research Council
- CSIRO
- · Geoscience Australia
- Australian National University
- Curtin University of Technology
- James Cook University
- Macquarie University
- Monash University
- MARGO (Marine Geoscience Office)
- Queensland University of Technology
- University of Adelaide
- · University of Melbourne
- University of New South Wales
- University of Queensland
- University of Sydney
- University of Tasmania
- · University of Western Australia
- University of Wollongong



































New Zealand IODP partners:

- GNS Science
- NIWA (National Institute of Water and Atmospheric Research)
- University of Auckland
- University of Otago
- · Victoria University of Wellington











ANZIC members of IODP Committees

ANZIC has participation rights on most IODP Scientific Advisory Structure panels, with ANZIC representatives listed in Table 1.

Table 1: ANZIC Members of IODP Committees in 2017

Committee or Panel	Member	Organisation	
JOIDES Resolution Facility Board	Mike Coffin; alternate Gary Wilson Special scientific adviser Andrew Roberts	University of Tasmania University of Otago Australian National University	
Chikyu IODP Facility Board	Andrew Heap; alternate Greg Yaxley	Geoscience Australia ANU	
ECORD Facility Board	Leanne Armand; alternate Craig Sloss Special scientific adviser Stephen Gallagher	Macquarie University Queensland University of Technology University of Melbourne	
Science Evaluation Panel	Timothy Naish; alternate Zanna Chase and and Rob McKay Ben Clennell; alternate Andrew Gorman	Victoria University Wellington University of Tasmania Victoria University Wellington CSIRO University of Otago	
Environmental Protection and Safety Panel	David Campin; alternate Suzanne Hurter	Queensland Government University of Queensland	
IODP Forum	Neville Exon alternate Richard Arculus	ANZIC Office, ANU ANU	

ANZIC Governing Council

The Governing Council (GC) is a steering committee for the Australia-NZ IODP Consortium, and looks after broad policy. Its 2016 membership is listed below. Professor Stephen Eggins, the Director of the Research School of Earth Sciences at ANU is responsible for ANZIC office.

In March, three major ANZIC meetings were held consecutively to get people together early at the present phase of ANZIC funding. Professor Stephen Eggins hosted two meetings at ANU: a Science Committee meeting and a stakeholders meeting. Andrew Heap hosted a GC meeting at Geoscience Australia on the next day. In September, Associate Professor Oliver Nebel hosted a GC meeting at Monash University Melbourne, and in November Professor Stephen Eggins hosted another meeting at ANU. Two intervening meetings were convened by telephone, and other business was carried out by email.

Table 2: Members of the ANZIC Governing Council in 2017

Person	Position	Institutions	Expertise	
Ian Poiner	Chair	Independent scientist	Marine scientist	
Richard Arculus	Lead Chief Investigator of the ARC/LIEF grant	ANU, Canberra	Igneous petrologist. ODP shipboard scientist. IODP co-chief scientist	
Leanne Armand	Program Scientist	ANZIC office, ANU, Canberra	Micropaleontologist and paleoceanog- rapher	
Ben Clennell	CSIRO representative	CSIRO Petroleum Exploration and Production	Petroleum geologist. ODP shipboard scientist. SEP panel member	
David Cohen	University of NSW, Sydney	University of NSW, Sydney	Igneous petrologist and geochemist, mineral exploration	
Mike Coffin	Australian university representative	University of Tasmania	Marine geophysicist	
Stephen Eggins	ANU representative	ANU, Canberra	Geochemist	
Chris Elders	Australian university representative	Curtin University of Technology, Perth	Petroleum geologist, seismic interpreter, margin evolution	
Neville Exon	ANZIC Program Scientist Jan-Sept	ANU, Canberra	Marine geologist and geophysicist. ODP co-chief scientist	
Simon George	Australian university representative (Sept-Dec 2016)	Macquarie University, Sydney	Organic geochemist, IODP Shipboard scientist	
Andrew Heap	GA representative	Geoscience Australia, Canberra	Marine geologist and sea bed mapping	
Stuart Henrys	Chair, NZ IODP	GNS Science, Wellington	Marine geophysicist	
Helen McGregor	Australian university representative	University of Wollongong	Climate modelling	
Robert McKay	ANZIC Science Committee Chair	Victoria University Wellington	Sedimentologist, Antarctic glacial history	
Joshu Mountjoy	NZ representative	NIWA, (National Institute of Atmospheric Research), Wellington	Marine Geologist, active tectonics, gas hydates	
Oliver Nebel	Australian university representative	Monash University, Melbourne	Igneous petrologist and geochemist	
Chris Yeats	Independent expert adviser	NSW Geological Survey Executive Director	Hydrothermal systems. ODP and IODP shipboard scientist	
Stephen Buckman	ARC observer	Australian Research Council, Canberra	Atomic physicist	



ANZIC Science Committee

The Science Committee encourages and assists the development of science proposals, organises topical workshops, assesses cruise applicants, applicants for IODP panel membership, and applications for special analytical funding, and helps get quality speakers to visit Australian and New Zealand research centres. The committee's revised membership in 2017 is listed below.

In 2017, there were a total of five expedition calls for participation, and we received responses for all these expeditions, with a total of 29 applications received from ANZIC scientists. Applications were more numerous for the one expedition located in Australian and New Zealand waters, with 14 ANZIC applications received for Expedition 376 to investigate the Brothers Arc hydrothermal complex. This was a record number of applications received by the ANZIC office for a single IODP expedition. For all expeditions, those applicants



JOIDES Resolution Hobart Portcall team - Brad Clement (IODP/TAMU), Richard Arculus (ANZIC Lead CI), Neville Exon (Outgoing Program Scientist), Trevor Falloon (UTas), Leanne Armand (Incoming Program Scientist) and Ian Poiner (ANZIC Governing Council Chair)

deemed suitable were ranked, and our rankings were sent on to the relevant expeditionary planners. In general, our top-ranked applicant was to scheduled to participate for each expedition.

A significant activity endorsed by the Science Committee in 2017 was the running of a workshop held at Sydney University, Australia in June. The workshop was attended by 97 scientists from 12 countries, with the aim to investigate future drilling opportunities in the eastern Indian Ocean, southwestern Pacific Ocean, and the Indian and Pacific sectors of the Southern Ocean. A total of 23 proposal ideas were discussed, with 12 of these deemed mature enough for active proposal development or awaiting scheduled site survey cruises. Of the remaining 11 proposals, fundamental hypotheses that are testable by drilling in our region were discussed, but either site surveys are required or hypotheses need further development. Refinements are anticipated based upon regional IODP drilling in 2017/2018, analysis of recently collected site survey data, and the development of future site survey proposals. We hope and expect that this workshop will lead to a new phase of scientific ocean drilling in the Australasian region in the early 2020s

Governing Council also authorized Science Committee grants for work on material and data from ocean drilling material, which were made from the funds provided by our partners, but excluding ARC/ LIEF funds. A small sub-committee dealt with requests for general post-cruise scientific funding (maximum grant of \$40,000 per person). Three shipboard participants were awarded a total of \$94,922.



Table 3: Members of ANZIC Science Committee in 2017

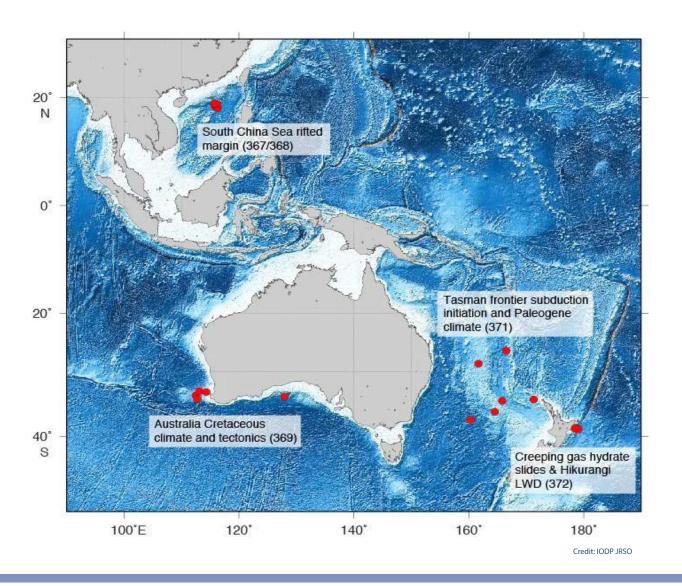
People	Institutions	Expertise		
Robert McKay, Chair	Victoria University, Wellington	Sedimentologist		
Leanne Armand	Macquarie University	Micropaleontologist (Diatoms), Southern Ocean geoscience		
Irina Borissova	Geoscience Australia	Marine geophysicist and basin studies		
Ben Clennell	CSIRO	Petroleum geologist		
Mike Coffin	University of Tasmania	Marine geophysicist, large igneous provinces		
Chris Elders	Curtin University	Seismic interpretation of continental margins, petroleum geologist		
Neville Exon	Australian National University	Marine geologist and geophysicist		
Kliti Grice	Curtin University	Organic geochemist		
John Moreau	University of Melbourne	Microbiologist		
Nick Mortimer	GNS Science, Dunedin	Tectonics, petrologist, SW Pacific, Zealandia and Antarctic regional geologist		
Oliver Nebel	Monash University, Melbourne	High temperature geochemist		
Joanna Parr	CSIRO	Submarine ore geologist		
Gordon Southam	University of Queensland, Brisbane	Microbiologist		
Virginia Toy	University of Otago	Structural geologist		
Jody Webster	University of Sydney	Carbonate sedimentologist		
Greg Yaxley	Australian National University	Igneous petrologist		

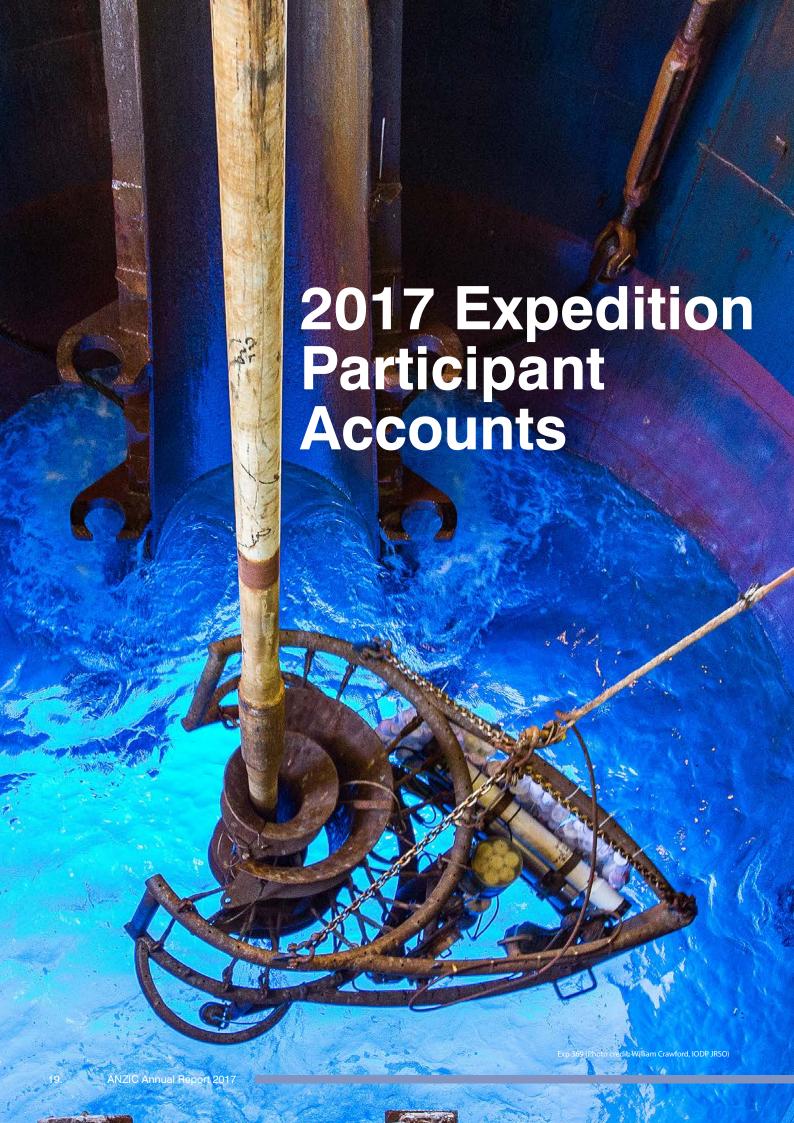


Table 4: Participants in IODP Expeditions in 2017

Expidition	Date	Participants
367: South China Sea Rifted Margin A	February 7– April 9, 2017	- Isabel Sauermilch (UTas) sedimentologist
368: South China Sea Rifted Margin B	April 9 – June 9, 2017	- Kelsie Dadd (USyd) sedimentologist
371: Tasman Frontier Subduction Initiation and Paleogene Climate	July 27– September 26, 2017	 Rupert Sutherland (VUW) Co-chief Scientist Wanda Stratford (GNS) physical properties Kristina Pascher (GNS) radiolarians Hugh - Morgans (GNS) forams/observer Gayane Asatryan (UQ) radiolarians/observer Debra Beamish (QEd) Education and Outreach
369: Australian Cretaceous Climate and Tectonics.	September 26– November 26, 2017	 Lloyd White (UoW) petrophysics, downhole measurements, and physical properties Alessandro Maritati (UTas) sedimentologist Carmine Wainman (Adel) sedimentologist/observer
372: Creeping Gas Hydrate Slides and Hikurangi Subduction Zone LWD	November 26, 2017– January 4, 2018	 Phil Barnes (NIWA) Co-chief Scientist - regional geology Ingo Pecher (Auckland) Co-chief Scientist-gas hydrates Ben Clennell (CSIRO) petrophysics Joshu Mountjoy (NIWA) sedimentologist/observer Erin Todd (Otago) Education and Outreach







Expedition 367 South China Sea Rifted Margin A

7 February - 9 April 2017, RV JOIDES Resolution

Isabel Sauermilch: Physical Properties, University of Tasmania /IMAS

Two expeditions - 66 onboard scientists - one project. During IODP expeditions 367 & 368, JOIDES Resolution took its journey to the northern South China Sea with the target to unravel the mechanisms occurring during lithospheric extension and continental breakup. Magma-poor rifted continental margins remain less well understood. Only one, the North Atlantic Iberia-Newfoundland margin, has been investigated during several ocean drilling expeditions. Since then, the discovery of extreme continental crust thinning and mantle exhumation has been a key to explain the formation of many other magma-poor rift systems, including the South China Sea margin. Our IODP expeditions tested this existing margin model - for the first time - by drilling down to the crustal basement at numerous different locations, close to and within the interpreted Continent-Ocean-Transition

Outcomes of both expeditions will provide crucial information, in order to understand the formation of magma-poor rifted margins. A high-impact paper is submitted based on the results from in total seven drill sites (Larsen et al., Nature Geoscience https://doi.org/10.1038/s41561-018-0198-1). Numerous research plans and collaborations between onboard and onshore scientists will focus on a wide range of interesting topics in tectonics, climate and oceanography.



I personally sailed as a petrophysicist on Expedition 367. Participating in an IODP expedition is one of the most exciting experiences of my early scientific career. During my studies at University of Bremen (Germany), I was informed about IODP expeditions and shown pictures of drilling operations, cores and sampling parties. I could not even imagine in a dream that I would get this unique opportunity to sail aboard the JR myself one day. Months of excitement between receiving the confirmation letter and arriving in Hong Kong are nothing compared to the experiences I gained throughout the two-months long stay on the ship. On the morning of the 8th February, the bus filled with scientists who would spend a long time together at sea, is about to leave the hotel. It felt like a very long drive through Hong Kong's ocean of skyscrapers, until we finally could have a first glimpse at the JR and its tall derrick lying at the port. Adam Klaus, our IODP staff scientist, waited in front of the ship's gangway to welcome us. After spending some time, trying to find the right cabin (and back!), we gathered together in the conference room for presentations on ship safety, information technology, overviews of science, drilling operations, core flow and work in the laboratories. After some days in port, the voyage started with a short transit to the first drill site U1499.

Obviously, the first "Core on deck!" is a very exciting moment. Besides many other reasons, being part of the petrophysics team is especially exciting, because we are the first ones to see and work on the cores - after the drilling team and technical staff. Physical properties (p-wave velocity, density, magnetic susceptibility, natural gamma radiation, thermal conductivity) are measured on whole-round cores before they get split in archive

and working halves. Afterwards, the cores continue their journey to be analysed by the other working groups. Velocity and point magnetic susceptibility measurements are implemented once again on a split half and samples are taken for moisture and density analysis. After finishing operation at both drill sites, downhole logging was implemented with the Triple Combination and Formation Micro Scanner sonic, as well as the Versatile Seismic Imager for site U1500.

Expedition 367 has been unique with regard to exceptional drilling operations and breaking records. Both drill sites are in water depths of more than 3770 m. About 150 m of basement rocks has been recovered in a single hole, additionally to the overlying 1380 m thick sediment column. The overall recovery rate in the hard rock section was 76.7%, which is remarkable! For such a drilling operation in a single hole, an installation of an 842 m long casing was needed under the guidance of superintendent Steve Midgley; the longest single casing string ever in the history of DSDP, ODP and IODP. A combination of two free-fall funnels on top of each other was installed, in order to reenter the hole with such a heavy casing. It was the first time that such an installation was realised. Site U1500 with 1529 m was the 7th deepest hole during the past 33 years of ODP/IODP, and the 12th deepest single expedition hole including DSDP expeditions. It was very fascinating to follow the drilling operations and to learn about the engineering possibilities and achievements. Other mentionable highlights are 'Hole U1500' cake and Sunday's BBQ, for sure.

Another uniqueness of this expedition was to organise site summary meetings not only for 33 onboard scientists, but also for 33 additional scientists from expedition 368 who were connected to the ship via zoom, joined for discussions and stayed updated. A one-day crossover at the end of our expedition with all 368 scientists was very exciting as well as challenging. It was crucial to share important key information about recent recoveries, methodology and to discuss the following drilling plans. Nevertheless, it was very great to meet and quickly get to know the 'second' half of the science team before they were sailing off to new adventures.

After two months, I think, the best part of participating in this expedition was to interact with so many different wonderful people, who come from many different countries and scientific backgrounds. It is great to work all together on the same scientific goal and everyone contributing their own knowledge and point of view. But not only did I learn so much scientifically; it was also great to live together and get to know some incredibly lovely people. This voyage broadened my horizons in many different directions. After the expedition, I continue collaborating with onboard as well as onshore scientists and look very much forward to learn about the scientific achievements of each 367 and 368 scientist in the future.



Expedition 368 South China Sea Rifted Margin B

9 April - 11 June, 2017, RV JOIDES Resolution

Kelsie Dadd: Sedimentologist, University of Sydney

Expedition 368 (and 367) saw a return to the South China Sea's northern rifted margin originally investigated in EXP 349 and OPD Leg 184. Our main objective was to determine the nature of the basement within critical crustal units across the continent ocean transition (COT). We drilled into oceanic crust at Site U1502 and continental crust at Sites U1501, U1504 and U1505 confirming the placement of the COT and that this margin differs from other magma-poor rifted margins as there was no subcontinental lithospheric mantle exhumed during plate rupture as is the case for other non-volcanic or magma-poor rifted margins. Some of the most important achievements were to recover a relatively continuous sequence of the pre-rift, synrift and post-rift sediments since the Eocene and to determine that there was no time-lag between (final) plate rupture and asthenospheric upwelling supporting the generation of igneous material with a basaltic, MORB-type composition.

We set sail from Hong Kong on the morning of April 14 for the South China Sea (SCS) after a five-day port call. This port call was a little busier than some as it included a science crossover meeting as Expeditions 367 and 368 were run as a single science program. EXP 367/368 were a Complementary Project Proposal (CPP) with funding from the Chinese government. This gave me a chance to sail again with Chinese colleagues from EXP 349 and to practice my very poor Chinese. I was in the core description team as a sedimentologist and working the noon to midnight shift. My main scientific goal was to sample volcanic ash layers to add to the database that I developed on EXP 349. I use the ash to develop a tephrostratigraphy and to look at the evolution of the nearby volcanic arc over time. Unfortunately, the northern SCS sediments have few ash layers and we interested only two discrete layers during the expedition. However, combining these with samples from EXP 367 and ashrich sediment areas will allow the research to go ahead.



As with most IODP expeditions, we made so many fantastic discoveries ranging from major findings on the geologic, climatic and tectonic evolution of the SCS, to seeing a microfossil or structure for the first time and realising its significance. On a regional scale, the SCS basin includes major seismic stratigraphic unconformities and the excellent recovery of pre-rift, syn-rift and post-rift sediments has allowed new time-depth constraints to be placed on some of these. We were able integrate new microfossil ages, changes in the depositional

environment, petrophysics and borehole logging data with the existing seismic reflection data. Among these seismic unconformities, the T60 unconformity is the most prominent and important for understanding the regional geological evolution of the SCS, is easily recognised basin-wide, and is present at Sites U1501, U1502 and U1505.



Other geological highlights for me were the sequence of altered basaltic rocks at Site U1502. These were highly altered basaltic breccia, brecciated basalt, pillow basalt and sheet basalt. The breccia clasts of basalt are in a matrix of carbonate, epidote, chlorite, iron (hydr)oxide, quartz, zeolite minerals and clay minerals. Sulfide mineralisation was widespread and dominated by pyrite, with minor sphalerite, chalcopyrite, and covellite. The alteration was so intense that it took us a while to recognise not only structures such as pillows and flow boundaries, but initially that this was basalt! Did we drill into an extinct Cyprus-style mineralisation system buried in the SCS? Another highlight was the mylonitic epidote-chlorite to calc-silicate schists containing granofels clasts at Site U1504. Handheld pXRF analyses showed an average mafic igneous composition for both the schist and the clasts. At present, the metamorphic evolution of this unit and its connection with the opening of the South China Sea is unknown but hopefully all will be revealed during post-cruise research.

On the smaller scale we found abyssal agglutinated benthic foraminifera in a sandy interval at Site U1502. The agglutinated benthic foraminifer assemblage indicates an abyssal paleoenvironment and provides a possible age of late Eocene for this interval. At Site U1504, larger benthic foraminifers belonging to Nummulites and other genera indicate an Eocene or slightly younger age and a warm shallow marine environment. The palaeoenvironmental and age data that these assemblages provide is integral to our understanding of the sequence at these sites.

Drilling was successful at all but one site. At Site U1503, we successfully installed a reentry system and casing, but we were unable to deepen the hole below the casing because of repeated breakdowns of the low clutch diaphragm in the drawworks and concerns that we did not have enough spares to last the remainder of the expedition. Without the drawworks low clutch, we could not drill deeper than 3400 m (water depth plus penetration depth). Because Site U1503 had a planned depth of 5695 m (water depth plus penetration depth), we had to abandon the hole and restrict future sites to those where the total drill string length was less than 3400 m. Despite these constraints, we went on two drill two further very successful

IODP Expedition 369: Australian Cretaceous Climates and Tectonics 26 September – 26 November 2017, RV *JOIDES Resolution*

Lloyd White: Physical Properties and Downhole Measurements, University of Wollongong

IODP Expedition 369 set sail from Hobart and docked in Fremantle, targeting sites in the Great Australian Bight and Mentelle Basin (adjacent to Naturaliste Plateau) off southern and south-western Australia. The aims of the expedition were to: (1) obtain samples deposited at high latitude during the Cretaceous to better understand the rise and collapse of the Cretaceous hot-house; (2) recover records of past oceanic anoxic events during major carbon cycle perturbations, and (3) better understand the paleoceanographic, depositional and volcanic history associated with the break-up of India, Australia and Antarctica. The successful expedition collected five cores in water depths between 690 – 3,900 m, penetrating over 500 m of section at each site.



Gale force winds and high seas in the Southern Ocean were waiting for us as soon as we left the shelter of Tasmania and passed Bruny Island. However, the weather had calmed by the time we reached our first site in the Bight and, by this time, most people were starting to turn up for meals once more. We obtained excellent recovery at this first site - breaking an IODP record for what can be achieved with a rotary core barrel - recovering nearly 700 m of black claystone. We guickly got used to the routine of logging and working out how to use the amazing array of analytical equipment on-board. However, before long we were tripping pipe and moving westward once more, again in the teeth of a second gale. During the transit we wrote up the reports for this first site - a requirement of IODP expeditions is you are not allowed to leave the vessel until site report chapters are written, so it was good to get this sorted as we knew future writing time would be limited because the next sites were all very close to one another.

Each of the sites in the Mentelle Basin region yielded something new or special. We successfully obtained several copies of the globally occurring Oceanic Anoxic Event 2 (~94 Ma) and a

section through the Cretaceous-Paleocene boundary, as well as a number of other important climatic markers. In addition we sampled the basaltic rocks associated with the break-up of India and Australia and cored through what is likely a slump/detachment zone.



This was my first time sailing with IODP and I must thank ANZIC and IODP for giving me the opportunity to be involved. ANZIC and the ARC's support meant that we had three early career scientists involved with the expedition (Carmine Wainman – Adelaide, Alessandro Maritati – Tasmania, and myself). A major benefit from IODP expeditions is the chance to work with people who cover the diversity of what is 'Earth Science', so the cruise gave each of us the opportunity to collaborate and develop new projects with geoscientists from around the world.



My role during the expedition was as a physical properties and downhole logging specialist. However, it was not until the very last site that I was actually involved in any downhole logging – this was purely driven by the timing of the other logging runs, which always occurred off my shift – I really owe my counterpart and the logging engineering for doing most of this work. Though I missed out on most of the logging runs, there was always work to be done. As the structural geologist, I worked with the hard-rock geologist on identifying samples from the basalt cores that are to be used for dating and analysis. In particular, I was asked to piece together the 'hard rock' core before it was cut (this turned out to be my favorite job). I also enjoyed working with the Education and Outreach Officers who did a fantastic job figuring out new and exciting ways to share what we were doing with people all over the globe.

Expedition 371: Tasman Frontier Subduction Initiation and Paleogene Climate

27 July - 26 September 2017, RV JOIDES Resolution

Rupert Sutherland: Co-chief Scientist, Victoria University Wellington

Our primary goal was to understand Tonga-Kermadec subduction initiation through recovery of Paleogene sediment records in the Tasman Sea. Secondary goals involved understanding regional oceanography and climate since the Paleogene. We recovered 2506 m of cored sediment and volcanic rock in 36.4 days of drilling at six sites during a total expedition length of 58 days. Wireline logs were collected at Sites U1507 and U1508.

Shipboard observations made using cores and logs represent a substantial gain in fundamental knowledge about northern Zealandia, because only Deep Sea Drilling Project Sites 206, 207, and 208 had previously penetrated beneath upper Eocene strata within the region. Since previous drilling in 1971, a substantial body of seismic reflection data has been collected that provided a firm basis for selecting informative sites. We made important new discoveries. Fossils recovered show that most of northern Zealandia, an area about the same size as India, was radically affected by formation of the Pacific Ring of Fire, about 40 to 50 million years ago. Our preliminary observations suggest that regions now under more than 1 km of water became land or shallow seas, and other regions that are now under 3 km of water may have been much shallower, or even land. Changes in geography were massive, and may help explain how the unique plants and animals of the southwest Pacific dispersed and evolved.



The scientific benefits of basic exploration are much broader than just understanding a fundamental question of how plate tectonics works. The fossil and geochemical records will provide new clues into why climate was so warm in the southwest Pacific during the Paleogene, and how the Neogene climate system has changed. In particular, the relative roles of paleoceanography and plate tectonics are now much clearer than they were. The region represents several million square kilometres of lower bathyal sedimentary environments that are now distal to land, with almost every type of bathyal sedimentary environment represented. The lithostratigraphy, physical properties measurements, and chemistry observations will provide

fundamental advances into how these deep-water sediments are deposited and become diagenetically altered. Most importantly, as far as I am concerned, we have more than doubled the basic knowledge about half of one of Earth's continents. The materials collected will lead to many diverse

publications, and like DSDP Leg 21, our samples will probably still provide a basis for research in 50 years from now.

There was a buzz of excitement aboard the ship throughout the voyage. We were explorers, and we were acutely aware of how the world was watching with interest as we sampled the hidden continent of Zealandia. Several hundred mainstream media stories ran during the week that we left Townsville. There continues to be global interest.



We had many challenges during our voyage. A medical emergency resulted in evacuation of one scientist, and the captain also chose to leave (unexplained) in Auckland. Unusually poor weather cost us about two weeks of standby time and meant that we could not run wireline logs everywhere that we wanted to. The logging tools became stuck and we were forced to cut off logging cable at our Reinga Basin site, leaving insufficient cable for deep-water sites anyway. It turns out that hyperthermal events result in clay-rich strata that are hard to recover, so key records that climate scientists were hoping to study were missing. Despite all that, there was a sense of teamwork and exploration that kept spirits up during the long and arduous adventure.

We were very fortunate to have high ANZIC participation during our voyage. The co-chief position, two formal observers (with full scientific involvement as paleontologists), and one education and outreach position were filled by ANZIC, in addition to our formally-allotted science position. A total of 32 scientists from 12 countries participated in the voyage. We had a wonderfully balanced team in terms of gender, age, interests, and nationality. It was hard work, but a pleasure and privilege to participate in. I would recommend such an expedition to any young scientist or prospective co-chief.



Expedition 372: Creeping Gas Hydrate Slides and Hikurangi LWD 26 November, 2017 - 4 January, 2018, RV *JOIDES Resolution*

Co-Chief Scientists Phillip Barnes, NIWA and Ingo Pecher, University of Auckland

OVERVIEW: Expedition 372 combined two research topics, slow slip events (SSEs) on subduction faults (IODP Proposal 781A-Full) and actively deforming gas hydrate—bearing landslides (Proposal 841-APL). Our study area on the Hikurangi margin east of New Zealand, offshore of the township of Gisborne, provided unique locations for addressing both research topics. The subduction margin is characterized by the shallowest slow slip events (SSEs) on Earth. They repeat on 1-2 year timeframes, and extend close to the Hikurangi Trough (the subduction trench). Expedition 372 was one of two that will address the objectives of Proposal 781A to study the mechanisms of slow slip fault processes. On Expedition 372, our aim was to acquire



logging-while-drilling (LWD) data using Schlumberger drilling tools from two sites (U1518, U1519) on the margin above the slow slipping fault, at which coring and borehole observatory installations were planned for Expedition 375 (May 8th – May 5th, 2018). A third site (U1520) was drilled in the trench in front of the accretionary wedge, where rocks entering the subduction fault zone could be logged, and later cored on Exp. 375. We met our objectives at the two sites on the margin, reaching 600 mbsf and 650 mbsf. We achieved drilling to 750 mbsf in the trench, where our target depth had been 1200 m. Overall, the drilling produced excellent to good quality petrophysical data, which successfully supported the operations planning of Expedition 375.

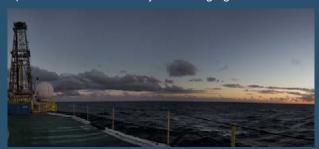
Our study of the Tuaheni Landslide Complex (TLC) was aimed at understanding the mechanisms that lead to inferred creeping movement of the landslide, including the possible role that gas hydrates may play in this process. Expedition 372 comprised a coring and logging program to test various landslide hypotheses. Due to weather-related downtime, our program needed to be reduced and we focused on a set of experiments at a site in the creeping part of the landslide, where we conducted a successful LWD and coring program to about 200 mbsf depth. The drilling at two holes produced excellent LWD logs and almost complete core recovery, through the landslides and gas hydrate stability zone. This was followed by deployment of the temperature-dual-pressure (T2P) probe at a third site, with at least one successful pressure measurement recorded at a critical depth below the landslide. The wealth of data collected from the TLC, and our planned post-expedition research should enable us to test all the major hypothesis we proposed for creeping landslide

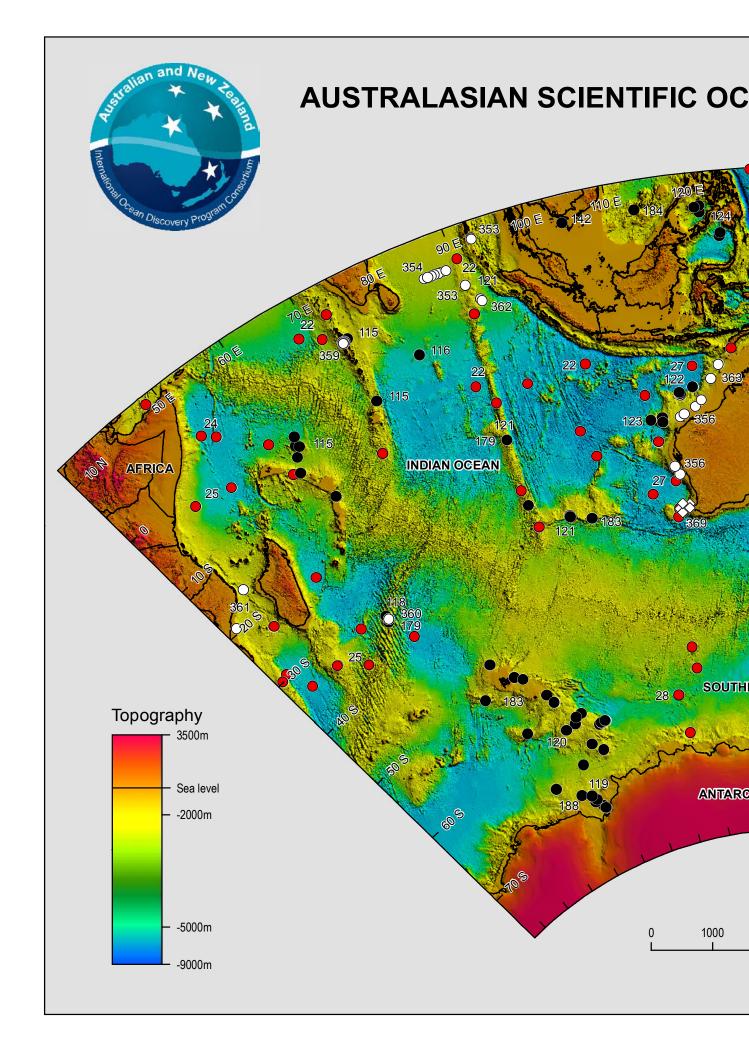
Phil Barnes was involved in the development of Proposal 781A commencing in 2010, in activities associated with pre-expedition site approvals by the EPSP, and various Co-Chief Scientist activities in the leadup to the expedition. Phil led the collection of some of the site survey data and was responsible for the pre-expedition interpretations of the seismic reflection profiles and multibeam bathymetric data sets that supported the Hikurangi Margin drilling sites. Consequently, for me, it was particularly exciting to

see the LWD data unfold in both real time and in the processed and interpreted logs, and how these aligned with the pre-drilling seismic refection data interpretations.

Although I have led and participated in many national and international marine geological and geophysical surveys over 30 years at NIWA and the former New Zealand Department of Scientific and Industrial Research, Expedition 372 was my first ever experience on a drilling ship, and my first exposure to drilling operations, LWD tools, and logging data! Needless to say, this expedition was a personal challenge, but one on which I learnt a great deal, and made many new friends and personal research collaborators. We two Co-Chief Scientists were fortunate to have Leah LeVay as our IODP Expedition Project Manager/IODP Staff Scientist. She constantly guided us through the various onboard Co-Chief activities, prompted us for the numerous presentations required from us, and the numerous reporting activities. I was also very grateful for the fantastic science party we had, and in particular, a number of senior science party members whom had sailed on JR previously, some in Co-Chief Scientist roles. In particular, the team/discipline leadership contributions from Ann Cook, Brandon Dugan, Marta Torres, and Greg Moore were outstanding. The advice and Co-Chief mentoring provided by these, and others with previous JR experience were gratefully received. At the time of writing this, I'm getting ready to sail on Expedition 375 in the role of core-log-seismic integration, during which we will see the coring and borehole observatories installed. The two expeditions combined will certainly make a personal career highlight for me.

Ingo Pecher led the development of the Ancillary Project Letter for the TLC studies. Like Phil, I had never sailed on the JOIDES Resolution or any other drilling vessel before. I was on the seismic shooting vessels however, for walkaway VSPs during ODP Legs 164 and 204, admiring the stable JR from a distance. I have analysed seismic data to study gas hydrates since my PhD in the 1990s; it was a unique experience to finally have the sediments that we were "seeing" in the seismic data come on board – including gas hydrates! I am very impressed by all the science that can be done with LWD and am hooked now - I had been warned before the voyage that this would happen. Like Phil, I am very grateful to the many people on board and onshore who made this happen. Leah LeVay's fantastic role in managing us scientists cannot be underestimated. Her upbeat approach in guiding us through the many tasks as co-chiefs is greatly appreciated. I am also very grateful for the great science party and the fantastic help we got from individual team leaders such as Ann Cook, Brandon Dugan, Greg Moore, and Marta Torres – their previous experience on the JR, including as co-chiefs, was invaluable. The JR's scientific support team was extremely helpful and knowledgeable. I much appreciated their "can-do" attitude. I also would like to point out that the TLC studies would not have been possible without the tremendous work by a number of scientists, in particular Joshu Mountjoy (part of the shipboard team) and Gareth Crutchley (shore-based). We also acknowledge both IODP's and ANZIC's efforts in handling the many organisational aspects of this expedition. Drilling during Expedition 372 was a great personal experience for me and certainly a career highlight.





EAN DRILLING: 1968 - 2018 130 匡 PACIFIC OCEAN **AUSTRALIA** ERN OCEAN AOIT Drill sites O IODP completed sites IODP planned sites ODP DSDP 2000 3000 $4000\,\mathrm{km}$

Workshops, Conferences and other Outreach activities

Science meets Parliament in Canberra, March

This year's Science meets Parliament, organised by Science & Technology Australia, was the 18th annual meeting of scientists and Federal parliamentarians. 200 scientists attended two days of events to learn about the importance of science to Parliament and to public policy. This culminated with delegates holding meetings with Members of Parliament and Senators to discuss Australian and international science. ANZIC was represented by Dr David Heslop from ANU and Professor Jonathan Aitchison from the University of Queensland, both found it stimulating. This note is based on a report by David Heslop.

The event was opened at Old Parliament House by Australia's Chief Scientist, Dr Alan Finkel, who discussed the values that scientists and politicians share, and how important it is to understand this link when communicating scientific outcomes to parliamentarians. Panel discussions then provided delegates with expert insights into science reporting in the media, how to turn research into news, and how science can inform and shape policy. The final activity of the day focused on ways to engage effectively with politicians. There was a gala dinner at Parliament House attended by all delegates and many Members of Parliament and Senators.



Australian of the Year, Professor Emeritus Alan Mackay-Sim, opened day two. He spoke about the underlying curiosity that motivates scientists and the increasing importance of public-private partnerships. Other discussions involved Senator Kim Carr (Shadow Minister for Innovation, Industry, Science and Research) who encouraged scientists to think how they could help politicians in a changing cultural landscape. Senator Arthur Sinodinos, Minister for Industry, Innovation and Science, announced the Australian National Science Statement 2017 at a National Press Club lunch. He presented his vision for Australian Science with a strong emphasis on the importance of women in STEM research. Delegates then returned to Parliament House to sit in on Question Time.

The highlight of the second day was group meetings with parliamentarians, which provided our two representatives with the opportunity to discuss and celebrate the achievements of the IODP and ANZIC. Jonathan Aitchison had a fruitful meeting with Liberal Party MP, Craig Kelly, and discussed with him the India-Asia collision and associated earthquakes, including the related IODP Expedition 362, researching the Sumatra Seismogenic Zone. David Heslop spoke about ANZIC's work in palaeoclimate reconstruction with Pauline Hanson's One Nation Party staffers working with Senator Brian Burston. The activities closed with drinks shared with the Parliamentary Friends of Science, providing a further opportunity to discuss the IODP and ANZIC with Members of Parliament.

Geoscience Australian Open Day in Canberra, August

Catherine Beasley and Neville Exon went to Geoscience Australia for much of Sunday 20 August for their open day (at the end of Science Week). A large crowd was drawn to a live video streaming session with the *JOIDES Resolution*, at the time drilling on the Lord Howe Rise for Expedition 371. Deb Beamish, Expedition and Outreach Officer for the expedition, did a great job addressing the many questions from the audience about ocean drilling and life on board. Ron Hackney and Andrew Heap of Geoscience Australia, and Nobu Eguchi from JAMSTEC, all spoke briefly about the importance of Australia-Japan cooperation in IODP.

There was considerable interest in the ANZIC/IODP exhibition, staffed by Catherine, Neville, Ron, Andrew, Nobu, and Toshimune Nakamura, also from JAMSTEC. The display included a detailed model of *Chikyu* and had a particular focus on the two excellent ceramic models of actual IODP cores. These core replicas beautifully illustrate two key points in geological history - the Cretaceous-Tertiary boundary, and the Paleocene-Eocene boundary – both associated with global extinctions of fauna and flora. The Cretaceous-Tertiary boundary meteorite impact, in the region of present-day Mexico, caused massive tsunamis and wildfires plus a long global winter, and marked (among many other things) the end of the Age of Dinosaurs and the dawn of the Age of Mammals. This topic fascinates children and many adults.

Australasian IODP Regional Planning Workshop, June

With JOIDES Resolution leaving the Pacific in 2019, it was timely to start building new IODP proposals or reinvigorate old ones, to ensure that there are numerous proposals approved to drill in the globally important Australasian region, when the vessel is likely to next return to this region in the early 2020s.

The approach of broad regional IODP workshops worked exceedingly well for the Indian Ocean in 2011 (Scientific Drilling No. 14, 60-63), and the Southwest Pacific Ocean in 2012 (Scientific Drilling, No.17, 45-50). The regional focus of these workshops got together many key players from all IODP fields, and led to a number of excellent multidisciplinary proposals being submitted, which could be drilled as a group, thus making logistical sense. The results exceeded our expectations, with many expeditions already completed in the Indian Ocean, and a major series of expeditions scheduled in the Southwest Pacific Ocean.

The Australasian IODP workshop, at Sydney University in June 2017, was similarly designed, but the intention was to cover all possible platforms and not just the *JOIDES Resolution*. European-funded alternative platforms are very suitable, for example, for work in shallow-water reefal areas and on the Antarctic continental shelf. We have high hopes that IODP Proposal 871, for the use of the *Chikyu* to drill deep into the Cretaceous on the Lord Howe Rise, will come to fruition this decade. Our aim was to develop community-based scientific priorities and new IODP proposals.

We knew that the workshop would catalyse excellent new proposals to address global geoscience questions collaboratively, including those questions of the current IODP Science Plan. Because of the already strong demonstration of diverse interests in IODP exploration in the region, the workshop had a very strong basis. It was designed to identify synergies, improve integration, discuss additional opportunities and establish the robust international

alliances that are essential for strong research proposals. Indeed, this workshop is triggering work on many exciting new proposals. Initial outcomes are set out below.

The workshop was introduced with a plenary session of invited speakers outlining the broad IODP Science plans and capabilities, as well as more detailed keynote presentations reviewing each of the four themes in the 2013-2023 IODP Science Plan in the regional context. This was followed by overview talks of relevant regional research, including recent and upcoming expeditions in the region. The second day consisted of breakout sessions with 10-minute presentations from the workshop participants who had submitted abstracts outlining potential ideas for future drilling.

The approach of the workshop was to combine local expertise with international experts, as well as to encourage early career researchers to become actively involved in developing proposals. A total of 97 participants represented 12 different countries, namely Australia, New Zealand, New Caledonia, Japan, India, Germany, United Kingdom, France, Denmark, Sweden, USA, and Canada.

About two dozen proposal ideas were discussed, with 12 of them deemed to be mature enough for active proposal development to begin, with an aim of submission of pre-proposals in late 2017 or 2018 (Figure 2 below). These are proposals with either sufficient existing site survey data or site survey cruises planned. As regards the remaining proposals, key regions were identified where key hypotheses are testable by drilling. However, these require either site survey proposals to be developed, or further scientific development of the hypotheses. These refinements are anticipated to be made through integration of upcoming IODP drilling in the region during 2017 and 2018, or through analysis of recently collected (or soon to be collected) site survey data.

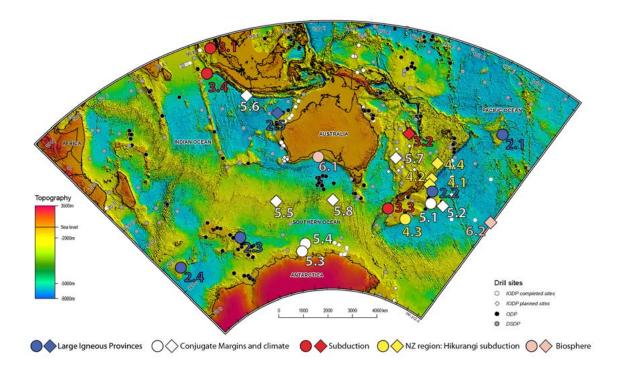
Three pre-proposals were accepted for further development by SEP in January 2018:

- Proposal 924, Lowell Stott and others: Chatham Rise Geologic CO2 release (JOIDES Resolution)
- Proposal 926, Ulrich Wortmann and others:
 Great Australian Bight Reflux Brines (JOIDES Resolution)
- Proposal 931, Amelia Shevenell and others:
 East Antarctic Ice Sheet Evolution (mission specific platform)

The full Workshop Report is available on various IODP web sites, including the ANZIC website (http://iodp.org.au/wp-content/uploads/Workshop-report_FINAL.pdf). A draft summary report was submitted to Scientific Drilling in December 2017, and was accepted in January 2018.

Figure 2 (below): Location map of potential proposals discussed in the workshop, with color-coded dots denoting the main theme for each proposal. Small colored circles indicate previous (and planned) drilling by the Deep Sea Drilling Project (DSDP), Ocean Drilling Program (ODP), and IODP. Larger circles and diamonds are projects discussed in the meeting and are colored by theme, and numbered according to sections discussed in text. Large circles indicate proposals that appear mature enough to develop pre-proposals. Large diamonds require site survey proposals to be developed, or are awaiting the results of upcoming drilling in the region (e.g., Hikurangi Subduction zone and Lord Howe Rise regions) and may require a focus workshop to further refine hypotheses.

Figure 2



Visits of *JOIDES Resolution* to Australian ports (ship tours and media publicity), July, September and November

This year, JOIDES Resolution made three port calls in Australia (Townsville, Hobart and Fremantle) with more to come in New Zealand in 2018. The IODP Office helped ensure the Australian port calls were the focus for press releases and there was unprecedented international coverage of Expedition 371. There were also highly successful tours of interested groups on the ship. The Australian groups included scientists from universities, CSIRO and the Australian Institute of Marine Sciences, and science teachers and students from high schools. We had excellent support from JOIDES Resolution shipboard and managerial staff.

Townsville

Expedition 371 (Tasman Frontier Subduction Initiation and Paleogene Climate) sailed from Townsville on 30th July and berthed in Hobart on 26th September. The co-chief scientists were Rupert Sutherland from Victoria University, Wellington, and Jerry Dickens from Rice University in Texas. The other ANZIC scientific participants were Wanda Stratford, Kristina Pascher and Hugh Morgans from GNS Science, and Gayane Asatryan from the University of Queensland. In addition Debra Beamish, from Corinda State High School in Brisbane, sailed in an education and outreach role involving video sessions from the ship among other things.

The expedition was designed to reveal how a region hundreds of kilometres east of Australia, centred on the Lord Howe Rise, had behaved in the past 53 million years. The submerged continent of Zealandia, including the Lord Howe Rise, was largely part of Australia until 75 million years ago, when it started to break away and move to the northeast. That movement halted 53 million years ago, when subduction began in the east in a new plate tectonic configuration, and compression caused some uplift in parts of Zealandia. This is a key area to study the changes in global climate and oceanography, after Antarctica froze over and the world began to cool, with many fluctuations over time. As Australia moved north and the Tasman Sea developed, global circulation patterns changed and water depths over Zealandia fluctuated.

A VIP and media tour of the ship, plus two scientific tours, was hosted in Townsville on 28th July. Neville Exon attended and was happy with the very worthwhile set of activities. Alistair Bone of James Cook University's media group put out a local press release, which ensured very good media attendance, including press interviews with the co-chief scientists. Journalists attended from Seven TV News, ABC TV News, Nine TV News, WIN TV News, the Townsville Bulletin, and from JCU publicity. A national media release was put out by William Wright of ANU's media group. We know of 150 news items reaching almost 2 million people, and doubtless there were many more. This coverage was almost unprecedented for IODP expeditions and some interviews followed the ship's departure, including at least one by video-link with the ship.

The tours for about 35 people, organised by marine geologist James Daniell from James Cook University, included scientists and students from JCU and the Australian Institute of Marine Sciences. JCU is no longer a member of ANZIC so their support for the visit was greatly appreciated. The visits from high level policy makers at JCU sparked their interest, and ANZIC greatly hopes that JCU will re-enter ANZIC in due course.

Hobart

Expedition 371 berthed in Hobart on 26th September, and JOIDES Resolution sailed on Expedition 369 on 1st October. Leanne Armand, Catherine Beasley and Neville Exon attended from the ANZIC Office, and Neville had been heavily involved in planning the visit as regards media coverage and ship tours. Scientists

from both expeditions attended an excellent reception at the Tug Bar near the ship on the arrival evening, kindly hosted by the Tasmanian Polar Network.

Andrew Rhodes of the University of Tasmania's media unit put out a release focussing on Zealandia, which ensured that all significant media outlets visited the ship on the morning of 27th September, including representatives of the three TV stations. Interviews were arranged with co-chief scientist Rupert Sutherland, and Brad Clement, Director of Science Services for *JOIDES Resolution*. Again interest focussed on the sunken continent of Zealandia, and again the result was excellent worldwide media coverage.

Ten ship's tours involving about 150 people were organised for 27th September: Attendees included VIPs and scientists from CSIRO and the University of Tasmania, students from the University of Tasmania, and science educators from Tasmanian high schools. Wonderful support was proved by various people, with special mention due to Martin Jutzeler, who led four tours of university students. Other tour guides included Trevor Falloon, Richard Arculus and Deb Beamish. That evening, ANZIC and CSIRO hosted a well-attended public symposium. Excellent talks from the two co-chief scientists were followed by refreshments and discussion.

The next morning there were two tours of a total of 35 science students and three teachers from Rose Bay High School, which generated great interest from the teachers and held the students' interest. All-in-all, the port call was very successful in spreading the story arising from the *JOIDES Resolution* expedition and IODP far and wide, and in allowing many scientists, science educators and students an insight into the remarkable vessel and its activities.

Fremantle

Expedition 369 (Australian Cretaceous Climate and Tectonics), focussing on the Great Australian Bight and the Naturaliste Plateau and Mentelle Basin off southwestern Australia, sailed from Hobart on 1st October and berthed in Fremantle on 26th November. The co-chief scientists were Richard Hobbs from Durham University and Brian Huber from the Smithsonian Institution. The ANZIC scientific participants were Lloyd White from the University of Wollongong, Alessandro Maritati from the University of Tasmania, and Carmine Wainman from the University of Adelaide.

The expedition addressed the nature of Middle and Late Cretaceous sedimentation in and near the Australo-Antarctic Rift off southwest and southern Australia, when numerous global anoxic events led to the deposition of Cretaceous black shales (potential petroleum source rocks for the explorers) laid down in globally hothouse conditions. The strata drilled at five sites provide a nearly continuous record of how the geography, volcanism, oceans and climate of the southern margin of Australia changed over the last 140 million years. A number of black shale sequences were cored, and the results should help address the controversy about the origin of the anoxic events. What were the relative roles of productivity and ocean circulation in the perturbations in the carbon cycle that caused oxygen depletion in large areas of the world's oceans? What role did local factors such as extensive volcanic activity and restrictions in circulation play?

Unfortunately this expedition led to little media interest in Perth, despite a good press release and invitations to tour from CSIRO media, However, the 18 ship tours on 27th and 28th November were a great success, with about 140 attending, including scientists from CSIRO, Curtin University and University of Western Australia, petroleum exploration industry scientists and engineers, numerous science teachers, and science students including two groups of high school students from Mazenod College. The tours were initially organised by Neville Exon from Canberra and overseen by Leanne Armand in Fremantle. They were led by Ema Frery (CSIRO), Stephen Gallagher (University of Melbourne), Kelsie Dadd (University of Sydney), Katie Halder (Canning College), Suzy Urbaniak (Kent Street Senior High School), Lloyd White (University of Wollongong), and Leanne Armand.

Education & Outreach Report

IODP Expedition 371: Tasman Sea Frontier

Debra Beamish E & O officer

On July 30th, 7am Australian time, the *Joides Resolution* pulled away from the Port of Townsville. This was the start of an extraordinary adventure, with an amazing team of research scientists from 12 different countries. The scientists shared a common aim, and that was to embark on an expedition to drill into the submerged lost continent of Zealandia. As the ship pulled away, there was not only an air of excitement and anticipation, but also just a hint of nerves. After years of planning, no one knew what the next 2 months would hold. The adventure of a life time has begun for these researchers.

The first two days were packed with meetings, discussions and collaborative learning with the group of brilliant minds from around the world. This was a rare unique opportunity for these researchers to work together and piece the Zealandia puzzle together. On August 3rd, the first cores came on the deck, and the excitement began.....

The *JR* is an exceptional workplace, with a totally unique atmosphere. What is the "magic" ingredient and why so different to the other places I have worked. Everyone had a very unique collegial bond, where they appreciated the very rare opportunity of a group of international researchers working together 24/7 on a common project. This opportunity had presented them with a totally new challenge, to discover and understand how the continent Zealandia had formed. Plate tectonics went through a major upheaval 50 Million years ago, and the Pacific Rim subduction zone began to form. This was a very significant geological event and totally changed how the earth was evolving.

As one of the research scientists passed the E&O office, she commented "You really do, have the best job on the ship." I contemplated that idea for a moment and decided... "She's right." Every day I learnt something new, everyday something exciting happened, and every day I appreciated the amazing journey I was on!!



The videographer Adam Kurtz and myself, on our very first day at sea, began the day with a 7:00 am meeting in the chief scientist's office. Expedition 371, had attracted a very big media following. We discussed the protocol for media link-ups, and what interviews the scientists would be doing while we were away at sea. The project objectives of EXP 371, was to drill on the submerged continent of Zealandia and in doing so, reassess the plate tectonic history of the Tasman Sea. The geological phenomena of the "submerged continent of Zealandia" had hit the headlines.

In our first week, we helped organise media interviews for the co-chief scientists. I never dreamt, that I would be chatting with the BBC one-day, organising Houston and Spanish radio links the next, and helping to run a podcast interview for the Canadian science show, Den of Lore, the following day.

We were busy, and everyday just flashed by with incredible speed. My job was made easier, due to the very professional team of people I was working with. The scientists were willing to drop what they were doing and chat to groups of primary/ secondary/ tertiary students from around the world. Dr Steve Pekar, from Queens NYC, had primary school children totally captivated, with the awe of geologists as time travelers..... (move over Dr Who).

Micropaleontologist May Huang shared her passion for ostracods, with thousands of school children from around the world. US sedimentologists Joyeeta Bhatttacharya and Michelle Drake educated our future scientists by sharing with them the passion of their careers. The sediments have a story to tell of how life and climate have changed throughout geological time. I had the leading scientific experts on the ship, who were ready 24/7 to talk to the world about what they were finding on Expedition 371.

The senior lab officer, Bill Mills, stepped in to talk about the equipment that had been specifically designed for the ship. It was a privilege to hear Bill talk to a captive audience at the Geoscience(Australia) open day. Driller Glen Barrett, while we were in transit, came down from the driller's 'dog house' to answer questions from the Geoscience group. As well as an expert technical team, the very professional group of geologists never hesitated to explain new concepts of biostratigraphy, sedimentology in the NZ paleogene, or the paleoclimate of an Oligocene foraminifera.

We had a steady flow of 'Ship to Shore' link-ups, with various schools/ colleges/ tertiary institutes and community groups, from around the world. The Geological Society of Cornwall, Geoscience Australia, Children's newspaper, press4kids from New York, Colleges and schools in LA, Brooklyn Public library NY, schools in Germany, Switzerland, Chile, Brazil, New Zealand and Australia. My day could start with chatting to people from the media in Spain, and finish with a link to the Brooklyn Public library in New York City.

I would encourage any Earth Science/ Science teacher to apply for the Education and Outreach position on the *Joides Resolution*, every day is truly an amazing journey!





ANZIC scientists have contributed appreciably to the understanding of the Earth's geology, climatic evolution and geohazards over the decades and more recently has been making contributions related to the biosphere frontier theme.

Since the inception of the ocean drilling program in 1968, through to our current program in 2017, ANZIC scientists have contributed over 4,000 publications, representing 11.5% of the near 35,000 publications globally produced as a direct result of ocean drilling programs (Table 5). Our publication successes are founded on the ANZIC community's genuine engagement facilitated by participation in Expedition on-board or shore-based scientific parties supported by ANZIC or through the unique ANZIC Legacy analytical grant support program.

To gain a better insight to the inputs of ANZIC scientists to the current program, Table 5 has been organised to indicate the breakdown of peer-reviewed publications related to all phases of the ocean drilling program indicative of years ANZIC have been direct (affiliated members) and indirect (non-funded periods). In the current phase of direct funding (2016-2017), ANZIC members have contributed a noteworthy 14.1% of the global output attributed to IODP research, with Australian and

New Zealander researchers having been involved in 11.8% and 3.8%, respectively, of this total output. Compared to other periods of the program, the current phase's results, taken in to consideration with the many expeditions in our region and increased number of scientists on board, would suggest that we will reach or break our previous contribution to the program set in the first 1988-2003 (18.7%) funded Australian Ocean Drilling Program period (Table 5) by 2020.

To temper this bigger picture success, Table 6 reveals that at the time of data collection for the 2016-2017 period (publication by June 2018), top-tier journal publications from ANZIC scientists were modest at 20% (4 papers) from a total of the 20 published globally. We expect impact at the higher level to change over the next few years with many ANZIC co-chiefs leading publication efforts of global significance and impact. Alternatively, Table 6 also reveals that of all scientific journal publications only taken into account, ANZIC members have produced 7.6% of the global IODP output, with Australian and New Zealand scientists contributing 10%, each respectively, of the top three tier publications, and 5.5% and 2.5% of the top twenty Earth Science journals.

The IODP Publication Services compiled the 2017 publication citation list found after Table 6. This information is based on data in the Scientific Ocean Drilling Bibliographic Database, a subset of GeoRef hosted by the American Geosciences Institute, and indicates 79 works were published in 2017 by ANZIC members (highlighted in bold).

Table 5: Scientific ocean drilling publications* including authors representing Australia or New Zealand, compared to all scientific ocean drilling publications produced internationally

Date of publication	Publications with authors representing Australia	Publications with authors representing New Zealand	Total publications with authors representing Australia and/or New Zealand	Total scientific ocean drilling publications	Percentage of publications with authors representing Australia and/or New Zealand
1968–1987	223	181	290	9,063	3.8
1988-2003	2,188	150	2,305	13,702	16.8
2004-2007	328	83	379	3,722	10.2
2008-2013	379	236	577	5,210	11.1
2014-2015	221	221 101 282		1,895	14.9
2016-2017	166	42	198	1,405	14.1
Total	3,505	793	4,031	34,997	11.5

Notes: This table was prepared in September 2018 by International Ocean Discovery Program (IODP) Publication Services based on data in the Scientific Ocean Drilling Bibliographic Database, a subset of GeoRef hosted by the American Geosciences Institute (http://iodp.americangeosciences.org/vufind). The criteria for the country-specific queries were the date ranges listed and institutional affiliation containing the words "Australia" or "New Zealand." Date ranges are categorized based on funding periods: 1968–1987 = Pre-Australian membership (indirect), 1988–2003 = Australian Ocean Drilling Program (ODP) membership; 2004–2007 = ODP/Integrated Ocean Drilling Program Phase 1 (indirect), 2008–2013 = Integrated Ocean Drilling Program ANZIC Phase 1, 2014–2015 = IODP ANZIC Phase 2 (direct), and 2016–2017 = IODP ANZIC Phase 3 (direct). * = Totals include peer-reviewed articles in science journals; published conference proceedings and abstracts; books and chapters in books; theses; and Deep Sea Drilling Program, ODP, Integrated Ocean Drilling Program, and IODP publications. † = Statistics for 2017 only reflect citations that were added to the database by June 2018 and may not represent a complete total of 2017 publications.

Table 6. Peer-reviewed scientific ocean drilling articles including authors representing Australia or New Zealand and published in top-tier journals, compared to all peer-reviewed scientific ocean drilling articles.

tion	articles in top three science		Scientific ocean drilling journal articles in top twenty Earth science journals [†]			All peer-reviewed scientific ocean drilling journal articles		
Date of Publication	Articles with an author representing Australia	Articles with an author representing New Zealand	All articles	Articles with an author representing Australia	Articles with an author representing New Zealand	All articles	Articles with an author representing Australia and/or New Zealand	All articles
1968–1987	2	3	176	1	0	359	33	1,988
1988-2003	18	1	180	47	12	1,334	220	4,036
2004-2007	2	1	68	20	7	584	104	1,531
2008-2013	8	5	106	43	25	987	138	2,078
2014-2015	8	1	30	19	11	356	61	763
2016-2017 [‡]	2	2	20	17	8	309	46	600
Total	40	13	580	147	63	3,929	602	10,996

Notes: This table was prepared in September 2018 by IODP Publication Services based on data in the Scientific Ocean Drilling Bibliographic Database, a subset of GeoRef hosted by the American Geosciences Institute (http://iodp. americangeosciences.org/vufind). Date ranges are categorized based on funding periods: 1968-1987 = Pre-Australian membership (indirect), 1988-2003 = Australian Ocean Drilling Program (ODP) membership; 2004-2007 = ODP/Integrated Ocean Drilling Program Phase 1 (indirect), 2008–2013 = Integrated Ocean Drilling Program ANZIC Phase 1, 2014-2015 = IODP ANZIC Phase 2 (direct), 2016-2017 = IODP ANZIC Phase 3 (direct). * = Top three science journals (based on Thompson/Reuters impact factor) = Nature, Science, and Nature Geoscience. † = Top twenty Earth science journals (determined by impact factor of journals in ISI Web of Knowledge categories related to Earth science) = Proceedings of the National Academy of Sciences of the United States of America; Earth-Science Reviews; Geology; Geochimica et Cosmochimica Acta; Earth and Planetary Science Letters; Geophysical Research Letters; Quaternary Science Reviews; Journal of Petrology; Geological Society of America Bulletin; Global and Planetary Change; Contributions to Mineralogy and Petrology; Chemical Geology; Journal of Geophysical Research; Marine and Petroleum Geology; AAPG Bulletin; Climate of the Past; Geochemistry, Geophysics, Geosystems; Organic Geochemistry; Paleoceanography and Paleoclimatology; and Tectonophysics. Criteria for country-specific queries were the journal International Standard Serial Number (ISSN), the date ranges listed, and institutional affiliation containing the words "Australia" or "New Zealand," with conference proceedings and abstracts; theses; books; and DSDP, ODP, and IODP publications filtered out. ‡ = Statistics for 2017 only reflect citations that were added to the database by June 2018 and may not represent a complete total of 2017 publications.

2017 Publications Authored by ANZIC Members

The following alphabetical list includes records from the Scientific Ocean Drilling Bibliographic Database (http://iodp. americangeosciences.org/vufind/) that were published in 2017, with ANZIC members highlighted in bold type.

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T: +61 2 6125 7999 E: iodp.administrator@anu.edu.au W: iodp.org.au Jaeger 4 Building, Australian National University, 142 Mills Rd, Acton ACT 2601, AUSTRALIA