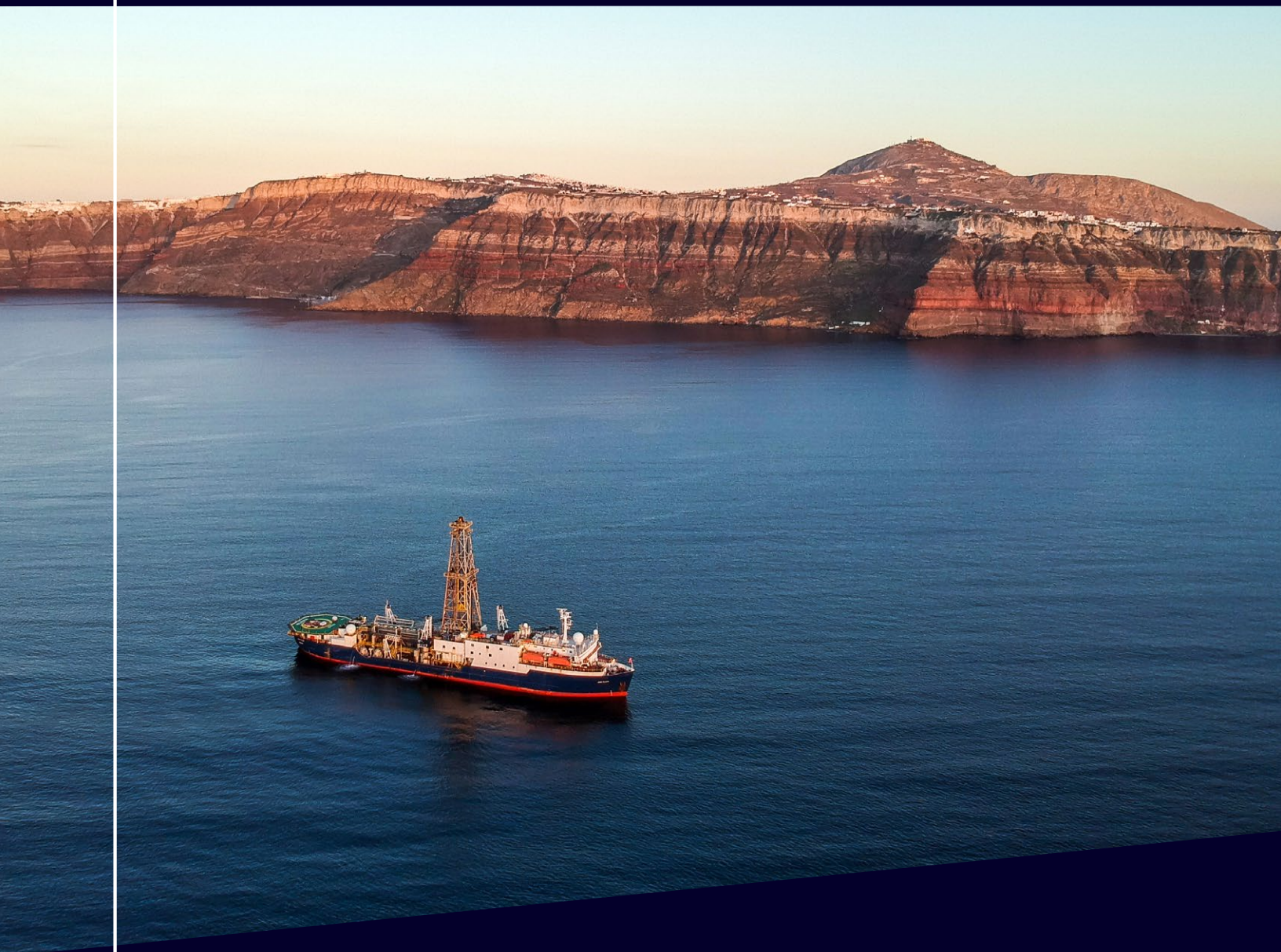


SCIENTIFIC
OCEAN
DRILLING



ANNUAL REPORT

**Australian and New Zealand
IODP Consortium**

2021 & 2022

ANZIC

ANZIC is the Australian & New Zealand International Ocean Discovery Program (IODP) Consortium, part of an international marine research collaboration exploring the Earth under the sea.

Membership in ANZIC enables participation in IODP, which undertakes scientific ocean drilling throughout the world ocean. Ocean drilling addresses scientific problems of global interest by taking continuous cores of rocks and sediments that address four broad themes: deep life, planetary dynamics, climate and geohazards.

Two large coring vessels, *JOIDES Resolution* and *Chikyu*, and alternative mission-specific ship-based coring platforms are used. ANZIC's participation on these, typically, two-month-long expeditions provides international training and research opportunities to the Australian and New Zealand research communities.

ANZIC also provides grants for Australian and New Zealand researchers to study previously collected core samples and data, to rapidly deliver research outputs.

Photo credits:
Front page: Thomas Ronge IODP, JRSO
Above: Sandra Herrmann IODP, JRSO, Sarah Kachovich



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ANZIC Chair's Overview

The last two years have been a challenging time for ANZIC, with major changes in our leadership team and considerable uncertainty around future funding. Despite the challenges, the ANZIC community rallied superbly, and we are now in an excellent position to continue to deliver opportunities for our researchers to participate in IODP.

ANZIC was established to enable Australian and New Zealand researchers access to scientific ocean drilling through the IODP which is a continuation of the world's longest running and most successful international geosciences research collaboration. The IODP operates deep-sea drilling vessels to collect continuous core samples of sediments and rocks from below the sea. This is the ninth year of the current IODP Program that is guided by a decadal science plan (2013-23) – Illuminating Earth's Past, Present and Future.

The community was saddened by the loss of our much loved and respected Director, Prof. Leanne Armand, in early 2022. Leanne had guided ANZIC with great distinction and in doing so had gained the affection and respect of the entire global IODP community.

During 2021 the ANZIC office was operating on bare minimum staffing, but three people in particular stepped up and made an outstanding

contribution to keep our programs on track. I want to pay tribute to Kelly Kenney, Prof. Steve Eggins and Dr. Luke Nothdurft. Kelly, our Program Administrator, operated by herself and mostly online throughout the period. Kelly did a magnificent job in keeping us operational. Steve very generously stepped into the Director's role and was instrumental in maintaining our presence in the key engagements across our operations. Luke, in his role of Chair of the Science Committee, was instrumental in keeping ANZIC operational throughout this challenging time. Due to their efforts, and despite the challenges of COVID-19, we managed to place researchers on several voyages and developed a strategy for our future funding. We owe all three a very big thank you for their efforts over the two years.

On a happier note, we now have a fully staffed headquarters after welcoming Ron, Sarah, and Jenifer to the team.

During 2022 we have bedded down the operation of the Governing Council. It is therefore appropriate to acknowledge Dr. Ian Poiner, the immediate past Chair of ANZIC, and thank him for his outstanding contribution to ANZIC. Among Ian's many important contributions to ANZIC, the work he undertook to place the Governing Council on a robust footing was very important to ANZIC's future.



In further positive developments, we were successful in our bid for a Linkage, Infrastructure, Equipment and Facilities (LIEF) grant which will enable ANZIC to operate effectively until the end of 2024. Again, a very big thank you to those who led that bid. In the meantime, we will continue our attempts to transition our funding to the National Collaborative Research Infrastructure Strategy (NCRIS). The change in federal government has delayed the development of a new Research Infrastructure Investment Plan but we are optimistic of being able to convince government of the value of IODP membership as an essential resource for the marine geoscience community. In addition, we are exploring ways to bring ANZIC, IODP and ICDP together into a coherent approach to scientific drilling. Finally, ANZIC has agreed to collaborate with AuScope Ltd to establish an arrangement for management of the reporting and accountability framework that is required should we be successful in obtaining NCRIS funding.

Looking to the future, ocean discovery programs are evolving. The DV *JOIDES Resolution*, the flagship of IODP, is aging. Planning is underway to determine how IODP will be delivered

in future. Europe and Japan are examining collaboration around Mission Specific Platforms and ANZIC has been approached about possible membership. Consequently, we are conducting a strategic planning process to examine the needs of our consortium for access to seagoing platforms in future. The outcome of the review will be determined by our excellent research agenda and may involve negotiating access to a range of delivery platforms.

At the time of writing, I am both excited by and optimistic for ANZIC's future. We face considerable challenges, but we have the people in place and a motivated community that will ensure we succeed in keeping open the opportunity for our researchers to conduct their research in that most challenging, but vitally important, frontier of geoscience seabed research.

Dr. Chris Pigram AM FTSE
Chair, ANZIC Governing Council

ANZIC Director's Report

In writing this Director's report covering 2021 and 2022, I am conscious that I am representing the efforts of others prior to me taking on the role in mid-2022.

Like the rest of the world, ANZIC continued to face challenging times through 2021 and 2022. Drilling expeditions were cancelled, postponed and re-adjusted, and many of the direct interactions that our science so benefits from were curtailed. Despite this, the global community behind IODP rallied and found solutions that ensured the sampling and science continued.

As if the turmoil induced by the pandemic wasn't enough, the ANZIC Office – and our community – is dealing with deep sadness at the loss of ANZIC's much-loved and highly-respected Director, Prof. Leanne Armand. Much has been written of Leanne's contributions to IODP and to marine science more broadly, but needless to say, Leanne is missed immensely.

Despite the challenges, ANZIC benefitted greatly from the contributions made by Kelly Kenney, our Program Administrator, and Prof. Stephen Eggins, who selflessly stepped in as Interim Director during Leanne's illness. The foresight of Leanne and the Governing Council in establishing the new role of Program Manager has also made a huge difference to ANZIC's ability to keep on top of recent challenges. By all accounts – and now from my own experience – ANZIC is definitely better for the contributions made by Dr. Sarah Kachovich, who commenced in the role in October 2021.

Special thanks are also due to Dr. Luke Nothdurft, Chair of our Science Committee, who ensured the science kept going; Prof. Mike Coffin for stepping in on the *JOIDES Resolution* Facility Board; and Assoc. Prof. Helen Bostock with her help on social media to keep the ANZIC community connected.

After two years of fabulous work as our Communications Officer, Larisa Medenis left us and we welcomed Jen Waters. Jen brought a step change in our communications efforts, including interviews of upcoming expeditioners.

Near the end of the reporting period, ANZIC received the good news of a further two years of funding – to the tune of about \$4.3 million – from the Australian Research Council. Combined with funding from New Zealand's Ministry of Business, Innovation and Employment, this secures ANZIC's access to international scientific drilling infrastructure through to the end of IODP in its current form (September 2024).

Our consortium partners continue to provide strong support for and engagement with ANZIC. This was demonstrated by the ANZIC Marine Geoscience Masterclass that made its much-anticipated post-COVID return in December 2022. Sixteen students from across Australia and New Zealand converged on Sydney and the NSW South Coast for a week of lectures, practicals and fieldwork. The success of the Masterclass, expertly led by Prof. Simon George and his team from Macquarie and Sydney Universities, is made abundantly clear by student testimonials and the level of interest in future Masterclasses (page 50).



When IODP Expeditions resumed, we were thrilled to place an expeditioner on board four expeditions, along with an additional shore-based participant on Expedition 398. You can read about their experiences, and the science, on pages 28-41.

During the reporting period, we enabled even more great science with grants totalling over \$270,000 in the ANZIC IODP Legacy Analytical Funding (AIAF) scheme. This significant investment aids researchers in studying the vast library of core samples and data amassed during the long history of scientific ocean drilling.

In 2021, AuScope agreed to provide funds from their Opportunity Fund to cover the involvement of four Australians in the project Sensitivity of the West Antarctic Ice Sheet to 2 degrees Celsius of warming (SWAIS2C). These funds allow us to pilot involvement in a drilling initiative that aims to combine the efforts of IODP and the International Continental Scientific Drilling Program. The first SWAIS2C hole is due to be drilled during the 2023/2024 Antarctic summer season.

Sarah and I have continued representation on key national bodies such as the National Marine Science Committee, and Science and Technology Australia (STA), including their influential Science

Meets Parliament event. Our opportunities through STA increased considerably when Sarah was announced as an STA Superstar of STEM. This prestigious award is testament to Sarah's passion for science communication and mentoring of women in STEM.

Internationally, the *2050 Science Framework: Exploring Earth by Scientific Ocean Drilling* is now embedded as a guide to future international scientific ocean drilling. It is pleasing that many outcomes of ANZIC's 2019 Ocean Planet Workshop and the efforts of our eight-strong ANZIC writing team are evident in this comprehensive document. Plans for expanded Mission Specific Platform operations continue to be developed by the European Consortium for Ocean Research Drilling (ECORD) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

As we reflect on 2021 and 2022, it is exciting to look to the future as we gather input at our Future Drilling to Explore Earth's Past (2023 Future DEEP) Workshop as a basis for strategic planning around ANZIC's continued involvement in some of the longest running international scientific collaborations.

A handwritten signature in black ink, appearing to read 'Dr. Ron Hackney'. The signature is fluid and cursive, with a large initial 'R'.

Dr. Ron Hackney
ANZIC Director

GeoDiscoveryNZ Report

This was a challenging two years. Shaped by the COVID-19 pandemic and its ongoing complexities of participation in IODP Expeditions, post-cruise workshops, and face-to-face meetings, we were able to nonetheless re-establish the next phase of ANZIC, created a new Charter, and formalised our Aotearoa New Zealand partnership under GeoDiscoveryNZ. We progressed publishing the results of previous expeditions to our region and advanced new scientific drilling proposals. Over the last two years our continuing international partnerships have combined the efforts of scientists worldwide to address critical global challenges facing humanity including climate change, improving coastal resilience, mitigating geohazards, and restoring ocean health.

Dr. Bella Duncan (Victoria University of Wellington) was selected for the August - September 2022 Arctic Ocean Paleooceanography IODP Expedition 377. However, this project has been affected by delays for several years and the expedition was at first postponed then later sadly cancelled due to ongoing safety concerns. More positively, Dr. Jenni Hopkins (Victoria University of Wellington) has been chosen as a shore-based scientist on IODP Expedition 398 (Hellenic Arc Volcanic Field), scheduled to take place from December 2022 to February 2023 and Dr. Georgia Grant (GNS Science) has been selected to sail on Expedition 400 NW Greenland Glaciated Margin, scheduled for August - October 2023.

The establishment of GeoDiscoveryNZ Legacy Analytical Funding (AILAF) has encouraged projects designed to exploit the wealth of data and data products generated through over fifty

years of ocean and continental drilling. We are looking forward to developing the AILAF concept to also host virtual discovery expeditions to draw upon any surprising and unexpected correlations across the historic investment in vast drilling datasets and sample collections.

A major milestone for progressing two Pre-Proposals was achieved during the May - June 2021 R/V *Tangaroa* voyage TAN2104 with the collection of new geophysical data offshore the Hikurangi margin and within Havre Trough. These data are being used to identify potential sites for drilling and will underpin the submission of two full-drilling proposals in 2023. The voyage was led by Dr. Dan Bassett and Dr. Cornel de Ronde (both GNS Science). In addition, we have been successful in securing European funding for EUROFLEETS+ ship days in April 2023 to acquire further multichannel seismic data in support of Hikurangi margin proposals.

Despite COVID-19 many have acknowledged the need to share results from earlier expeditions to our region. Early in 2021 Dr. Laura Wallace (GNS Science), and co-leaders held a series of webinars with Expeditions 372 and 375 Science Party members. These were very well attended despite the challenge of time zones and helped to motivate progress with post expedition publications. In August 2022, Dr. Joe Prebble (GNS Science) and Dr. Christina Riesselman (University of Otago) coordinated a workshop *Southern Ocean super-transects: connecting recent IODP drilling*. This session included updates on recent Southern Ocean/Antarctica IODP drilling and compilation of sediment recovered from each



site. The aim is for connections to be explored in more detail during COVID-delayed expedition post-cruise meetings scheduled for 2023.

Over the next decade, GeoDiscoveryNZ is mindful of the need to grow Early Career capability and launch the next generation of mission-led scientific drilling expeditions and projects. To accelerate this Dr. Georgia Grant organised 65 participants for a day long on-site and virtual workshop in June 2021. The main goals of the workshop were to ensure a wide scope of geosciences talent is represented in IODP and ICDP proposals, and to support opportunities for Early Career Researchers for future proposals by facilitating idea generation and collaborations (see more on page 62).

With the world slowly waking back up we have been able to support participation in several overseas initiatives. Dr. Cécile Massiot (GNS Science) attended a downhole logging and activities planning workshop in Potsdam Germany (June 2022) and contributed to designing the ICDP Connections Among Life, Geo-Dynamics and Eruptions in a Rifting Arc (CALDERA) project she is leading. Josie Frazer (University of Otago) attended the ECORD-hosted Summer School at MARUM, Germany. We have

been able to support the next generation of high achieving undergraduate students to attend the December 2022 ANZIC Masterclass in Sydney; Jamie Baldwin (University of Otago), Nisha Muniandy (Victoria University of Wellington) and Sarah Codyre (University of Otago). Dr. Laura Wallace (GNS Science) was an invited speaker at ECORD MagellanPlus Lisbon Workshop (July 2022) on Mission Specific Platform approaches to assessing natural hazards that impact society.

GeoDiscoveryNZ was present at the Geosciences Society of New Zealand annual conference in December 2022, held at Massey University, Palmerston North. Our booth featured the launch of the new GeoDiscoveryNZ web pages and introduced our new logo/tohu, incorporating the different elements of our identity; Niho Taniwha, representing landscape, rivers, lakes, mountains, and the seafloor, together with the Pūhoro used to communicate movement, genealogy, and navigation.

I congratulate Prof. Rob McKay (Victoria University of Wellington) on his selection to the *JOIDES Resolution* Facility Board in 2022. Finally, in all we have achieved, I would like to acknowledge the support and help from Marianna Terezow, the GeoDiscoveryNZ Committee, and the New Zealand Earth science community.

A handwritten signature in dark ink, reading "S. Henrys". The signature is fluid and cursive, with a large initial "S" and a stylized "H".

Dr. Stuart Henrys
New Zealand Lead Representative and
GeoDiscoveryNZ Chair

ANZIC Interim Director's Report

The nine months that I spent supporting ANZIC went quickly and while this was a challenging and difficult period it was also enormously rewarding.

A **challenge** because ANZIC is faced with sustaining its funding through to and beyond the end of the current IODP phase, while also positioning itself for success in the face of uncertainty about platform availability and operational changes to support the next phase of scientific ocean drilling from 2025.

Difficult because I, along with many others, are still coming to terms with the loss of Leanne.

But also **rewarding** because I have come to better appreciate the value of ANZIC and talents of our community, especially the early-mid career researchers who make up the ANZIC Science Committee and whose enthusiasm and abilities are quite the tonic for anyone feeling jaded. ANZIC is equally blessed with a Governing Council from whose collective and complementary expertise we benefit and are able to learn so much.

Finally, I would like to express my great hope for ANZIC and the future of scientific drilling which promises to be an enabling infrastructure to underpin geoscience research well into the future. Best wishes to everyone in our ANZIC community and all who sail under our flag!

Steve and the office team
preparing to ship off
Leanne's samples.



A handwritten signature in black ink, reading "Steve Eggins".

Prof. Steve Eggins
ANZIC Interim Director
(August 2021 - May 2022)



The ANZIC office team at the end of 2022: Dr. Sarah Kachovich, Kelly Kenney, Dr. Ron Hackney, and Jen Waters.

“Scientific ocean drilling has fundamentally shaped our understanding of Earth’s evolution over the past 200 million years. It provides access to a geological archive of deep time archives that hold clues about Earth’s past climates and life at the depths of the ocean.”

“Australia/New Zealand have a vast marine jurisdiction. Therefore, membership in International Scientific Ocean Drilling is in the national interest and will allow contributions to a multidisciplinary, international research endeavour that aims to test scientific paradigms and hypotheses that inform topics of particular relevance to society: including ground truthing future climate change, probing deep Earth, assessing earthquake and tsunami hazards, diagnosing ocean health and exploring life on Earth and its origins.”

- Dr. Derya Güler, Australian National University

Remembering Leanne

Obituary for Prof. Leanne Armand 1968-2022

We are deeply saddened by the passing of Prof. Leanne Armand, the Director of the Australian and New Zealand IODP Consortium (ANZIC), on January 4th after a valiant battle with a highly aggressive cancer.

Leanne was a major force in IODP from 2017 to 2021, both as ANZIC Program Scientist, and later as ANZIC Director, and through her engagement and questioning on committees including the *JOIDES Resolution* Facility Board. Her contributions to scientific ocean drilling were profound, as she ably guided the ANZIC Program Member Office through a critical period of setting a post-2024 vision for scientific ocean drilling.

Leanne was a micropaleontologist. She undertook her PhD on marine diatoms from the Southern Ocean at the Australian National University (ANU) and Bordeaux University. Her PhD, awarded in 1998, focused on using fossilised diatom species assemblages to determine past changes in sea-surface temperature and sea-ice extent in the Southern Ocean – the topic she then devoted the rest of her career to, contributing significantly to our understanding of the paleoceanography of the Southern Ocean.

After finishing her PhD, Leanne worked at the University of Tasmania. She returned to France in 2007 as the first Australian recipient of a

European Union Incoming Marie Curie Fellowship, studying at the Centre d'Océanographie de Marseille, before moving back to Australia in 2009, where she joined the Department of Biology at Macquarie University in Sydney. She rose to the level of Deputy Director of the MQ Marine Research Centre at Macquarie, where she remained until assuming the first of her ANZIC roles in 2017.

Over her career Leanne participated and led a number of international research voyages to the Southern Ocean and Antarctica, published over 100 papers, supervised a large number of students, and mentored many more early/mid/late career researchers (especially women in marine science). She was the driving force in the creation of the Collaborative Australian Postgraduate Sea Training Alliance Network (CAPSTAN), serving as its first Director.

In 2007, she was awarded the Australian Academy of Science's prestigious Dorothy Hill Medal. She received a U.S. Antarctic Service Medal in 2014 for the Sabrina Coast Mission on the RVIB *Palmer*, and was the first Chief Scientist to conduct an Antarctic expedition on Australia's then-new research ship, RV *Investigator*, in 2017.

In 2020, Leanne was promoted to Professor of Marine Micropalaeontology at ANU.



Leanne's service as leader of the ANZIC Program Member Office was marked by a keen scientific and managerial eye and her tireless support for diversity within IODP. Her expertise, energy, personal warmth, and enthusiasm were infectious. She is greatly missed.

Carl Brenner
(Director, US Science Support Program)

Prof. Clive Neal
(University of Notre Dame)

Assoc. Prof. Helen Bostock
(University of Queensland)

Prof. Mike Coffin
(Director, Institute for Marine and Antarctic Studies)
& **Prof. Henk Brinkhuis** (IODP Forum Chair).



Right: ANZIC friends and family gather to remember Leanne on her bench in Canberra.

Sharing Wisdom

Moments of insights and inspiration from final correspondences between Prof. Leanne Armand and the ANZIC Program Manager

It is with heavy hearts that we bid farewell to a remarkable individual, the late Professor Leanne Armand, whose indomitable spirit and unwavering support touched the lives of many. Leanne's journey, though marred by an aggressive illness, exemplifies resilience, leadership, and a profound commitment to building legacies for those who follow in her footsteps.

Leanne's impact on my professional journey was immeasurable. Despite the constraints of her illness preventing a direct transfer of knowledge, she extended a helping hand through heartfelt emails, guiding me as I embarked on this new role. Her words echoed with wisdom and encouragement, serving as a beacon through the challenges that lay ahead. I wanted to share some of her inspirational words with the ANZIC community, which continue to drive me daily in this role.

"You have some challenges ahead with all of these things [the transition between end of the IODP program and helping secure funding], but you are coming to work with an excellent team, a fun team, and one that looks to build individuals' capabilities and their future prospects. I believe you will flourish and be starting a very significant new chapter in your life, and I am happy that I will be someone that will be helping you to move ahead."

Leanne's vision extended beyond her immediate circumstances. In her final correspondence, she expressed disappointment at not being able to personally welcome and properly mentor me into the role. However, her joy was evident as she shared the success of her plan to build a legacy and opportunities through ANZIC. Her words resonated with a sense of responsibility and foresight.

"There are so few organisations that have an opportunity to be scientists and learn higher-level scientific management at the same time. I bumbled along at the beginning of my term as the ANZIC Program Scientist but had a clear vision of where we needed to go and knew enough through my ANZIC interactions to establish myself in the role."

Leanne's advice served not only as professional counsel but as a testament to her leadership philosophy. "Build a team you want to work with, and let them do their jobs with as much support you can muster through the system," she advised. Her emphasis on drawing the line on past jobs and allowing oneself to develop and be challenged in a new role underscored her belief in continuous growth.

"I believe in you and know you have the passion and desire to see ANZIC continue in one form or another - you are a team and thus legacy builder, that makes you special and, if you want it, makes



you a strong woman leader in our Australian Marine Geoscience space."

In honouring Leanne Armand's memory, let us carry forward her legacy of passion, resilience, and commitment to fostering the growth of those who follow. As we navigate our career journeys, may we draw inspiration from her words and strive to be, like Leanne, strong leaders and builders of legacies.

Leanne's impact lives on, not only in the accomplishments of ANZIC but in the hearts and aspirations of those fortunate enough to have been touched by her wisdom and generosity. May she rest in peace, knowing that her legacy lives on in the success and endeavours of those she inspired.

Dr. Sarah Kachovich
ANZIC Program Manager

Leanne Armand Travel Award

Inaugural recipient, Vikki Lowe, discovers new species.

University of Queensland PhD candidate Vikki Lowe has been named as the first recipient of the Leanne Armand Travel Award, established by the Australasian Quaternary Association (AQUA).

Vikki's thesis is focused on reconstructing paleoceanography of the Southern Ocean using radiolaria. Her research project is providing the first radiolarian records from the South Pacific sector of the Southern Ocean over the last glacial cycle to enhance our understanding of the changes in temperature and sea ice concentrations in this critical region.

Established in memory of the late Prof. Leanne Armand (1968-2022) – former ANZIC Director and Professor of Micropaleontology at ANU – the award will enable Vikki to travel to GNS Science in New Zealand to work with radiolarian expert Dr. Giuseppe Cortese, take high quality images and write a taxonomy paper.

Leanne was a world-leading expert on marine diatoms, which she used to reconstruct the waxing and waning of sea ice in the Southern Ocean. Vikki credits meeting Leanne with inspiring her current path.

"I met Leanne in 2012 when I began my Marine Science undergrad at Macquarie University," she recalls.

"She gave a lecture about her work in Antarctica in one of my first-year subjects, and I thought: 'I don't know what she does, but whatever it is, I want to do that!'. So, I knocked on her door and asked if I could work with her on whatever project she had available. Since then, I have been very single minded in where my career will head."

Vikki's research is progressing well. She has recently discovered a new species of radiolarian in Southwest Pacific cores near the Polar Front, covering the last glacial cycle, choosing to name this new species in Leanne's honour.

"It is exciting to be able to describe a new species, and dedicate its naming to Leanne, who left such a strong legacy in the paleoceanography and micropaleontology fields," she says.



For
Leanne Armand



Vikki Lowe, inaugural recipient of the Leanne Armand Travel Award.



"I feel so privileged to have had Leanne's guidance, and that she was the example I looked towards as I learned what being a scientist was about. Now, I hope this small gesture of naming a species after her will in some way pay tribute to the amazing scientist and person that she was."

The AQUA Leanne Armand Travel Award provides AU\$3,000 to one Australia-based postgraduate or early to mid-career researcher annually, with preference given to applicants seeking to learn microfossil identification or advanced techniques from an expert.

AQUA is seeking ongoing donations to sustain the fund, and options are also available for international transfers. Please contact AQUA or the ANZIC Office for details on how you can help continue Leanne's legacy of training the next generation of scientists.

Learn more about the Leanne Armand Travel Award on our website: iodp.org.au.

"I feel very honoured to have been selected for the Travel Award. And, yes, I will be naming the new radiolarian species after Leanne."

Donations are needed
to sustain the
*Leanne Armand
Travel Fund*

See aqua.org.au for details.

GeoDiscoveryNZ



GeoDiscoveryNZ

Ocean and Land Scientific Drilling and Discovery

In November 2022, GNS Science successfully concluded negotiations on the GeoDiscoveryNZ Agreement with key New Zealand member parties, including NIWA, Te Herenga Waka - Victoria University of Wellington, University of Otago and the University of Auckland. This milestone agreement formalises GeoDiscoveryNZ as a consortium of Crown Research Institutes and Universities dedicated to coordinating global Earth and ocean science research.

The consortium focuses on facilitating geoscience discovery and research relevant to Zealandia, the Southern Ocean, and Antarctica. Using large-scale scientific drilling platforms, samples of sediments and rocks are recovered from below the seafloor, underneath ice and on land, while monitoring subsurface environments.

A key objective for GeoDiscoveryNZ is developing and leading science proposals for drilling expeditions in the Southwest Pacific and the Southern Ocean. The consortium also enables participation in the International Ocean Discovery Program (IODP) with Australia (ANZIC) and the International Continental Scientific Drilling Program (ICDP).

The organisation actively promotes inclusivity, striving to increase Māori and Pacifica participation. GeoDiscoveryNZ also aims to compile and publicise scientific drilling capability and knowledge, engage a broader community of Earth scientists and stakeholders for collaborative international research, and enhance science diplomacy.

An important aspect of this new phase for GeoDiscoveryNZ is the unveiling of a new logo/tohu. This symbolises the agreement among participating New Zealand institutions involved in scientific drilling and heralds an exciting era of scientific discovery in Aotearoa New Zealand. Collaborating with GNS Science Senior Māori Relationship Advisor, Jesse Pickery, and an iwi graphics designer, the team crafted a design incorporating traditional Māori Niho Taniwha and Pūhoro patterns, symbolising landscape, rivers, lakes, mountains, and seafloor, as well as movement, genealogy, and navigation.

GeoDiscoveryNZ Committee:

- GNS Science: Dr. Stuart Henrys (Chair) and alternate Prof. Gary Wilson
- NIWA: Dr. Joshu Mountjoy and alternate Dr. Philip Barnes
- University of Auckland: Dr. Lorna Strachan and alternate Prof. Paul Augustinus
- Te Herenga Waka Victoria University of Wellington: Dr. Robert McKay and alternate Dr. Jenni Hopkins
- University of Otago: Dr. Christina Riesselman and alternate Dr. Christian Ohneiser
- GeoDiscoveryNZ Office Coordinator: Marianna Terezow.

Australian IODP Funding & ICDP Pilot Funding

ANZIC is thrilled to announce that operational funding for Australia until the end of 2024 has been successfully secured. This is a significant achievement following the approval of our ARC LIEF bid on November 16, 2022. This substantial grant, amounting to nearly \$4.4 million over two years, represents the largest single LIEF grant in this round. Spearheaded by Professors Steve Eggins and Eelco Rohling from the ANU Research School of Earth Sciences, the successful bid is a testament to the collaborative efforts of many individuals.

We extend our gratitude to Prof. Richard Arculus for his dedicated contributions over the past five years (2016) under the former ARC LIEF grant. The success of this funding confirmation builds upon Prof. Leanne Armand's vision for sustained Australian and New Zealand involvement in scientific ocean drilling. It lays a robust foundation for transitioning to funding under the National Collaborative Research Infrastructure Strategy (NCRIS), a goal she ardently pursued during her tenure as ANZIC Director. Notably, the LIEF proposal reviews highlighted a commendable enhancement in gender balance among our LIEF Chief Investigators (now at 43 percent women) and the active participation of early-career researchers – advancements that align with Leanne's vision.

Securing funding for 2023-24 empowers ANZIC to advance diverse planned initiatives, expanding marine geoscience research capability in our

region and fostering participation in offshore and onshore science across all career stages.

In addition to the ARC funding success, Australia has secured \$240,000 in AuScope Pilot Project funding for Land-to-sea Geoscience through the SWAIS2C Project, investigating the Sensitivity of the West Antarctic Ice Sheet to 2 degrees Celsius. This project serves as a pilot for Australian participation in an International Continental Scientific Drilling Program (ICDP) project, testing the feasibility and value of ICDP membership for the Australian geoscience research community. The project co-invests in the initial stage of an ICDP program scheduled for 2021-24 in Antarctica, including a one-month onshore analysis of retrieved core materials in New Zealand. ANZIC will oversee all aspects of the Australian project's management and integration into the SWAIS2C ICDP program. This comprehensive funding and project support underscore ANZIC's commitment to advancing marine and continental geoscience research in the region.

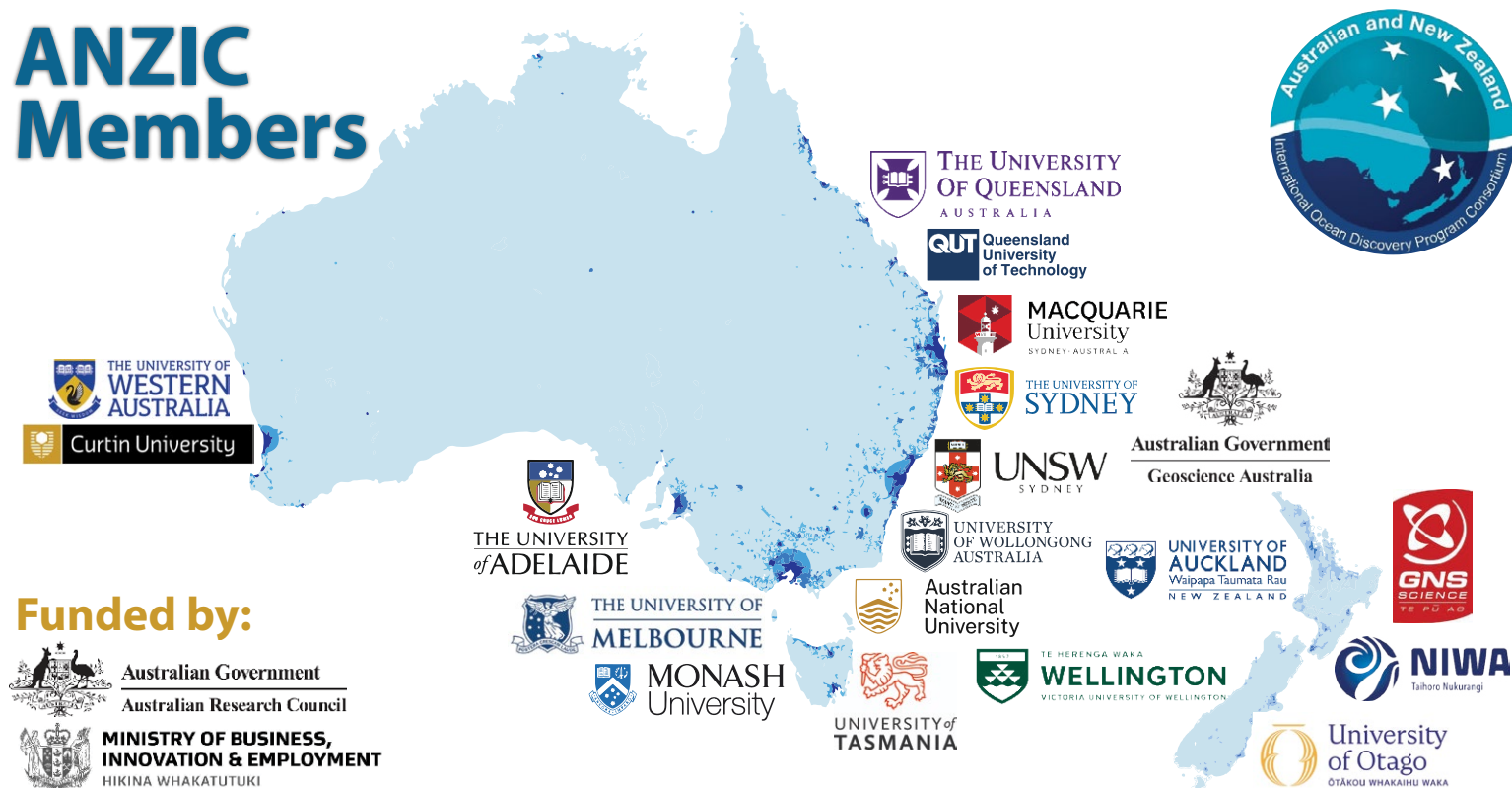


ANZIC Membership

ANZIC is a strategic collaboration between 19 of Australia's and New Zealand's leading universities and scientific organisations.

Our thriving and passionate community is highly engaged, working in unison to advance marine geoscience in our region and beyond.

ANZIC Members



Funded by:



Member Benefits

Through ANZIC, scientists at member institutions can:



Apply to sail on IODP expeditions

Expeditioners are supported with travel funds, berth cost, and up to \$40,000 for post-cruise analytical work.

During 2021-2022, five ANZIC-sponsored expeditioners participated in four Expeditions, from the Southern Ocean to the Arctic Circle (see pages 28-41).



Access funding to support the study of previously collected ocean drilling samples and data

These legacy samples are used to answer scientific questions in a wide variety of fields.

In 2021-2022, over \$270,000 was granted to 15 projects across Australia and New Zealand (see pages 44-45).



Participate in specialist training opportunities

A range of specialist international courses ensure researchers (especially those early in their careers) have the skills necessary to participate in IODP.

In 2021-22, 16 students participated in ANZIC's own Masterclass and we supported a further seven students to attend IODP Summer Schools internationally (see pages 46-57).



Submit proposals to drill new sites

ANZIC supports researchers to develop and submit IODP proposals (see pages 42-43).

Serve on international panels and boards

See pages 26 and 27.



Access education materials

To inspire the next generation of researchers!

ANZIC

Governing Council

Our Governing Council is the steering committee for the consortium. It is responsible for broad ANZIC policy, effective governance and high-level decision making.

We are grateful to all members of the 2021 and 2022 Councils.

2021 Council



Dr. Ian Poiner
Chair



Prof. Leanne Armand
Program Director



Dr. Ben Clennell
CSIRO



Prof. Chris Elders
Curtin University



Prof. Simon George
Macquarie University



Dr. Andrew Heap
Geoscience Australia



Dr. Stuart Henrys
GNS Science



Prof. Dorrit Jacob
Australian National
University/Host



Prof. Eelco Rohling
Australian National
University



Assoc. Prof.
Robert McKay
Victoria University
of Wellington



Dr. Luke Nothdurft
ANZIC Science
Committee Chair



Prof. Chris Turney
University of New
South Wales



Prof. Jody Webster
University of Sydney



Dr. Chris Yeats
Independent
Member

Observers:

Assoc. Prof. Helen Bostock, Prof. Mike Coffin, Prof. David Cohen, Prof. John Foden, Assoc. Prof. Stephen Gallagher, Dr. Richard Jones, Assoc. Prof. Helen McGregor, Dr. Joshu Mountjoy, Dr. Mick O'Leary, Dr. Christina Riesselman, Dr. Craig Sloss, Dr. Lorna Strachan.

2022 Council



Dr. Chris Pigram
Chair



Prof. Steve Eiggins
Interim Director



Dr. Ron Hackney
Director



Dr. David Robinson
Geoscience Australia



Dr Linda Armbricht
ANZIC Science
Committee Chair



Dr. Joanna Parr
CSIRO



Dr. Stuart Henrys
GNS Science



Prof. Dorrit Jacob
Australian National
University/Host



Dr. Jo Whittaker
University of Tasmania



Prof. Eelco Rohling
Australian National
University



Prof. Kliti Grice
Curtin University



Assoc. Prof. Robert
McKay
Victoria University of
Wellington



Dr. Tim Rawling
AuScope/
Independent Member



Roger Fairclough
Neo Leaf Global/
Independent Member

Observers:

Dr. Christina Riesselman, Prof. Ian Suthers, Prof. Jody Webster, Prof. Simon George, Assoc. Prof. Helen Bostock, Dr. Lorna Strachan, Dr. Craig Sloss, Dr. Joshu Mountjoy, Assoc. Prof. Helen McGregor, Assoc. Prof. Stephen Gallagher, Prof. John Foden, Dr. Richard Jones, Dr. Mick O'Leary.

ANZIC Science Committee

Our Science Committee has oversight of the scientific program of ANZIC, including the development of science proposals, setting criteria, assessing and ranking applications for expeditions, post-expedition support, legacy projects, workshops, and other activities related to the science program.

We are grateful to all members of the 2021 and 2022 Committees.

2021 Committee



Dr. Luke Nothdurft
Chair/Queensland
Univ. of Technology



Dr. Joanna Parr
CSIRO



Prof. Leanne Armand
Program Director



Prof. Simon Holford
University of Adelaide



Dr. Christina Riesselman
University of Otago



Dr. Maria Seaton
University of Sydney



Dr. Jo Whittaker
University of Tasmania



Dr. Stefan Loehr
Macquarie University



Dr. Linda Ambrecht
University of Adelaide



Dr. Agathe Lisé-
Pronovost
University of Melbourne



Dr. Lloyd White
University of
Wollongong

2022 Committee



Dr. Linda Ambrecht
Chair/University of
Tasmania



Dr. Christina
Riesselman
University of Otago



Dr. Maria Seaton
University of Sydney



Dr. Agathe Lisé-
Pronovost
University of Melbourne



Dr. Lloyd White
University of
Wollongong



Dr. Luke Nothdurft
Queensland University
of Technology



Dr. Derya Güler
University of
Queensland



Dr. Lorna Strachan
University of
Auckland



Dr. Luc Doucet
Curtin University



Prof. Carmen Gaina
Queensland University
of Technology



Dr. Martin Jutzeler
University of Tasmania



Dr. Lucy McGee
University of Adelaide



Dr. Georgia Grant
GNS Science



Assoc. Prof. Marco
Coolen
Curtin University



Dr. Sara Moron
Polanco
University of Sydney



Dr. Sarah
Kachovich
Program Manager

“Being part of the ANZIC science committee has really broadened my own research. It's given me inspiration to apply my skillset to data and sample sets from past expeditions. I feel a part of a national group, helping to promote science that answers big picture questions.”

– Dr. Lucy McGee, University of Adelaide

ANZIC Representation at IODP

IODP evaluates proposals for scientific drilling expeditions based on impact, logistical feasibility, and cost through a system of Facility Boards and Advisory Panels whose membership is drawn from the international scientific community.

Drilling proposals are first evaluated by the Science Evaluation Panel, which is responsible for evaluating the scientific objectives and technical approach of submitted proposals at all stages, and for forwarding ready-to-drill and top-priority proposals to the appropriate Facility Board. The Environmental Protection and Safety Panel provides critical support to the review process.

ANZIC has participation rights on these IODP panels, with ANZIC representatives listed below.

The IODP Forum is typically held once a year to exchange ideas and views on the scientific progress of IODP and ANZIC representatives attended the 2021 and 2022 IODP Forums.

2021 representatives

Committee or Panel	Member	Institution
Science Evaluation Panel (SEP)	Science Reps: Dr. Mark Kendrick Dr. Fabio Caratori Tontini (alternate) Dr. Hugo Olorook (alternate from May) Site Reps: Dr. Jess Hillman Dr. Wanda Stratford (alternate)	University of Queensland GNS Science Curtin University GNS Science GNS Science
Environmental Protection and Safety Panel	Dr. Ingo Pecher Prof. Myra Keep (alternate)	University of Auckland University of Western Australia
JR Facility Board	Prof. Mike Coffin	University of Tasmania
ECORD Facility Board	Prof. Leanne Armand Prof. Mike Coffin (alternate)	ANZIC/Australian National University University of Tasmania
Curatorial Advisory Board	Prof. Chris Hollis (Chair)	GNS Science/ Victoria University of Wellington

2021 IODP Forum attendees

April Forum	Prof. Leanne Armand Dr. Luke Nothdurft Dr. Stuart Henrys	ANZIC/Australian National University Queensland University of Technology GNS Science
October Forum	Dr. Sarah Kachovich Prof. Steve Eggins Dr. Luke Nothdurft Dr. Stuart Henrys	ANZIC/Australian National University ANZIC/Australian National University Queensland University of Technology GNS Science



Photo credit: Thomas Ronge, JRSO IODP

2022 representatives

Committee or Panel	Member	Institution
Science Evaluation Panel (SEP)	Science Reps: Dr. Mark Kendrick Dr. Hugo Olorook (alternate) Site Reps: Dr. Jess Hillman Dr. Wanda Stratford (alternate)	University of Queensland Curtin University GNS Science GNS Science
Environmental Protection and Safety Panel	Prof. Simon Holford Prof. Myra Keep (alternate)	University of Adelaide University of Western Australia
JR Facility Board	Prof. Mike Coffin Dr. Sarah Kachovich (observer)	University of Tasmania ANZIC/Australian National University
ECORD Facility Board	Dr. Ron Hackney (Liaison) Dr. Sarah Kachovich (alternate)	ANZIC/Australian National University
Curatorial Advisory Board	Prof. Chris Hollis (Chair)	GNS Science/ Victoria University of Wellington

2022 IODP Forum attendees

April Forum	Dr. Sarah Kachovich Dr. Stuart Henrys	ANZIC/Australian National University GNS Science
September Forum	Dr. Ron Hackney Dr. Sarah Kachovich Dr. Stuart Henrys	ANZIC/Australian National University ANZIC/Australian National University GNS Science

IODP EXPEDITIONS

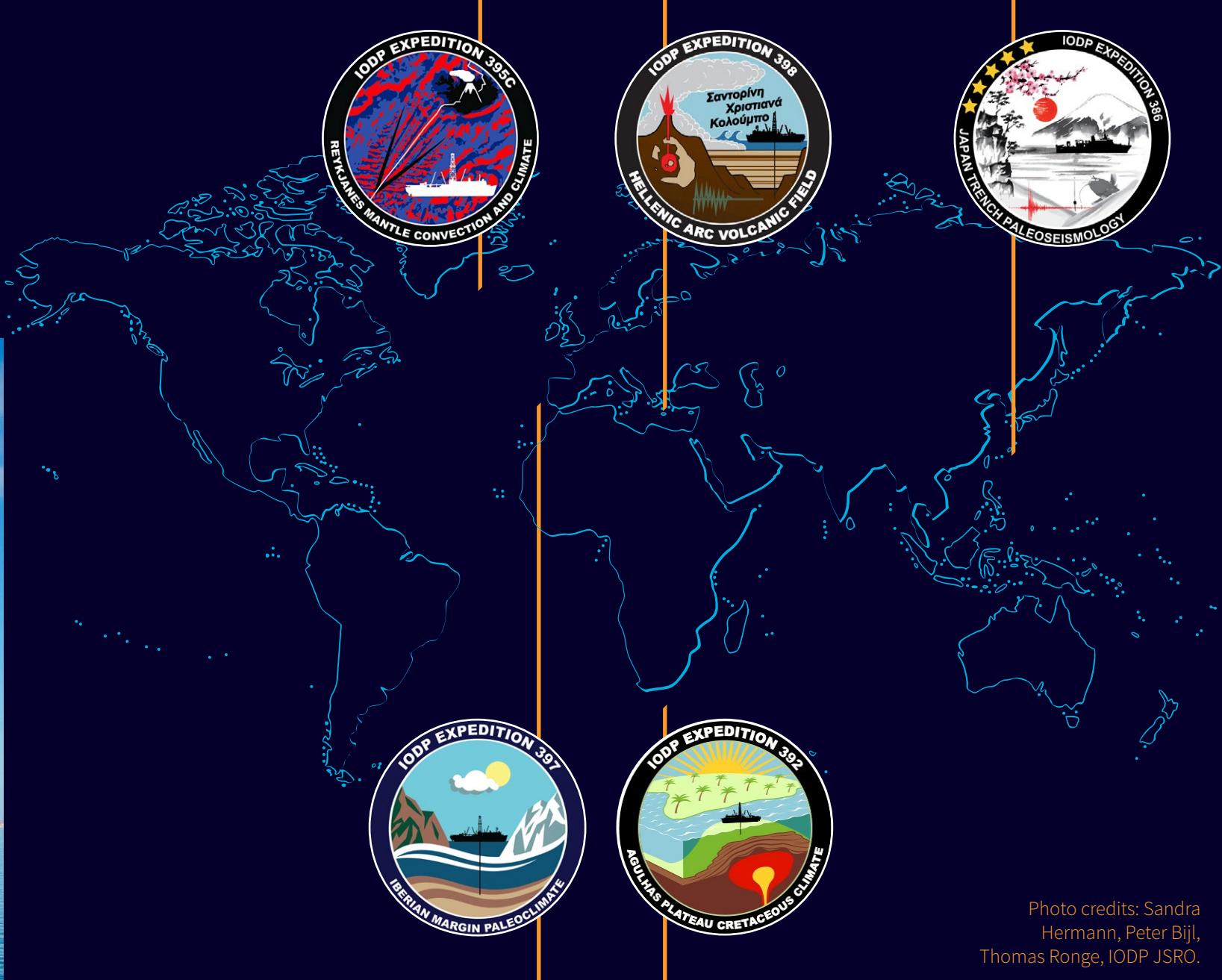


Photo credits: Sandra Hermann, Peter Bijl, Thomas Ronge, IODP JSRO.



Navigating Challenges

Expeditions amid a pandemic

2021 and 2022 presented significant challenges for the IODP due to the COVID-19 pandemic. Travel restrictions impacted all staff, scientists and crew, necessitating adaptations to IODP Expedition plans and operations. Despite these hurdles, IODP maintained its commitment to scientific exploration through innovative approaches and collaborative efforts. ANZIC acknowledges the steadfast dedication of IODP Science Operators, emphasising the importance of collaboration and flexibility in overcoming adversity and sustaining oceanographic research efforts.

Adapting Expedition Plans

In response to the pandemic, the JRSO implemented COVID Mitigation Protocols Established for Safe JR Operations (COPE). These protocols, developed in 2020, provided guidelines for safe expedition operations, including testing, quarantine measures, and revised operational plans as needed.

Several expeditions encountered delays and modifications due to COVID-related challenges:

- Expedition 395P (Complete South Atlantic Transect Reentry Installations) was postponed to Expedition 395E due to COVID cases onboard.
- Expedition 395 (Reykjanes Mantle Convection and Climate) faced postponement, leading to a revised focus on prioritised coring and logging operations, particularly targeting crustal objectives without a science party onboard.

- Expeditions 390C and 395E utilised downtime to install re-entry systems at five of the six South Atlantic Transect primary sites, optimising operational efficiency during disruptions.

Impacts on Shore Activities

The transition to online platforms for editorial meetings ensured continuity in project coordination despite physical limitations. Challenges in sample collection prompted the Expedition 383 and 378 sampling parties to be conducted by JRSO staff, with samples mailed to scientists unable to attend.

Dr. Laura Wallace, Dr. Claire Shepherd, Dr. Martin Crundwell (all GNS Science), Dr. Phil Barnes, Dr. Joshu Mountjoy (both NIWA) and Dr. Ingo Pecher (University of Auckland) held a series of webinars with all the Expedition 372 and 375 science party members, where participants gave a series of talks on their research on the 372/375 data and cores. This was very well attended and spurred lots of interesting discussion and re-engagement of the science party. It also helped to progress post-expedition publications.

Dr. Linda Armbricht (University of Tasmania) was the first ANZIC expeditioner to physically attend a post cruise meeting after the COVID-19 lockdowns. Linda presented her sedaDNA and diatom results from IODP Expedition 382 at Bergen, Norway, between August 23 and 28, 2022.



JOIDES Resolution stuck with dozens of ships at Panama Port, as COVID-19 began to spread globally. Photo credit: C. Glenn Macion (Steward, Entier)



Expedition 398 scientists during the first abandon ship safety drill of the expedition. Photo credit: Erick Bravo, IODP JRSO

At the Gulf Coast Repository, significant sample processing occurred, with a total of 16,121 sample requests processed and additional sample parties conducted for Expeditions 378 and 383 in 2021. In 2022, continued efforts saw 18,204 samples taken from legacy core collections, with additional sampling during Expedition 392 and core description activities for Expedition 395, further enhancing scientific understanding across various domains.

Scientific Milestones

Despite challenges, IODP achieved significant scientific milestones:

- In 2021, more than 5,000 core sections were processed through shipboard laboratories by shipboard technical staff, with over 21,000 samples taken.
- In 2022, over 4,200 core sections were processed during expeditions, accompanied by the collection of more than 30,000 samples.

ANZIC Expeditioners

ANZIC played a vital role in IODP expeditions, despite pandemic-related constraints due to national lockdowns and isolation:

- Four ANZIC Expeditioners and one shore-based Science Party member contributed to various IODP Expeditions:
 - *JOIDES Resolution* Expedition 392 Agulhas Plateau Cretaceous Climate
 - Mission Specific Platform Expedition 386 Japan Trench Paleoseismology
 - *JOIDES Resolution* Expedition 397 Iberian Margin Paleoclimate
 - *JOIDES Resolution* Expedition 398 Hellenic Arc Volcanic Field.
- ANZIC gained an expeditioner from ECORD on the postponed IODP Expedition 395 Reykjanes Mantle Convection and Climate, which sailed twice, once in 2021 without a science party, and again in 2023. This expedition represents an expedition that gained extra core and science. Katharina's IODP Expedition 395 (Reykjanes Mantle Convection and Climate) report will appear in our 2023 annual report.

IODP Expedition 392

Agulhas Plateau

Cretaceous Climate

Dr. Derya Gürer
Australian National University

IODP Expedition 392 marked a historic moment as the first ANZIC expeditioner set sail after the challenging COVID-19 lockdowns. This expedition aimed to drill into the Agulhas Plateau, an elevated region at the southern tip of South Africa, and the Transkei Basin in the Southwest Indian Ocean. The significance of this venture lies in unravelling the mysteries of the Late Cretaceous, a time when Earth experienced a super greenhouse episode and significant climate changes. The recovered basement rocks and sedimentary sequences promise to provide valuable insights into the Agulhas Plateau's nature, origin, and paleoceanographic history.

Designated as a sedimentologist on Expedition 392, my role involved working in a team of 6 Core Describers, with three people on day and three on night shifts. I was a part of the night shift team.

The challenges of working the night shift were amplified by the additional hurdle of adhering to COVID protocols. Having spent three years in isolation to the world and to my collaborations, stepping onto a ship with over 100 unfamiliar faces was both exciting and challenging. The expedition's duration was extended due to a two-week isolation period before sailing, and then two-week isolation and mask-wearing on the ship, limiting the bonding time among the science party

- we only had six weeks bonding time, where a normal expedition would have the port calls and a full 8 weeks on the ship to connect and fully collaborate. Despite these challenges, the joy of knowing we were COVID-free after the isolation period was a significant achievement, making Expedition 392 the first IODP Expedition with a full science party to complete with no onboard COVID incidents.

One of the highlights of this expedition, in terms of the rocks, was encountering unique green sediments. These zeolitic deposits, potentially influenced by hydrothermal activity around volcanic regions on the plateau, presented a stunning array of colours and patterns akin to rock art. Initially we thought they were quite boring, but the green stuff became a focal point of intrigue and discovery as its origins unfolded. Another highlight was to see the K/Pg boundary on the core table. It came up during my shift.

Looking ahead, my focus post-expedition is on delving deeper into the green sediments. I am keen to understand the Agulhas Plateau's emplacement and its paleo-latitude, leveraging paleomagnetic reconstruction techniques on the basement. Additionally, my work will extend to studying calcite veins within the basement, employing uranium/lead geochronology to unravel the timeline of



A core from the expedition containing the Cretaceous/Paleogene (K/Pg) boundary. Photo credit: Etienne Claassen, IODP JRSO



Interesting variations permeate the green sediment layers of this core. Photo credit: Debadrita Jana & IODP

seafloor alteration following the large igneous province emplacement. Questions surrounding the duration of heat transfer and the potential existence of different generations of veining will be explored. The marine carbonate nature of these veins also opens up the opportunity to analyse strontium isotopes, providing insights into paleo-seawater composition.

International Ocean Discovery Program Expedition 392 not only marked a milestone for ANZIC post-COVID but also provided a unique opportunity to explore the geological and climatic history of the Agulhas Plateau. The challenges faced during the expedition, from the isolation period to the rigorous COVID protocols, only added to the significance of the achievements made. As I continue my research on the expedition's findings, the green sediments and calcite veins hold the promise of uncovering new dimensions of Earth's history and contributing to our understanding of past climate dynamics and tectonics.

Dr. Derya Gürer on board Expedition 392.



IODP Expedition 397

Iberian Margin Paleoclimate

Unlocking six million years of detailed climate records

Prof. Jimin Yu

Australian National University

Deep sea sediments hold the secrets of Earth's past changing climate and help scientists understand what the future may hold. Because they trap ancient air, ice cores from polar regions have become the benchmark in measuring past changes in atmospheric greenhouse gas contents. But what we can learn from them is limited, with the oldest ice cores currently cataloguing only the last one million years or so.

That's set to change thanks to IODP Expedition 397 which extended previous sub-seafloor drilling records to enable resolution of climate events on timescales of up to six million years.

"Previously drilled fast-accumulation sediments from the Iberian Margin only date back around 1.45 million years, so we didn't have the high-resolution data to reconstruct detailed past climate changes over a longer period of time," explained ANZIC expeditioner, Prof. Jimin Yu, part of the expedition's sedimentology team.

Jimin's career has been focused on using sediments to reconstruct paleoclimate, very relevant expertise for the Iberian expedition's scientific objectives.

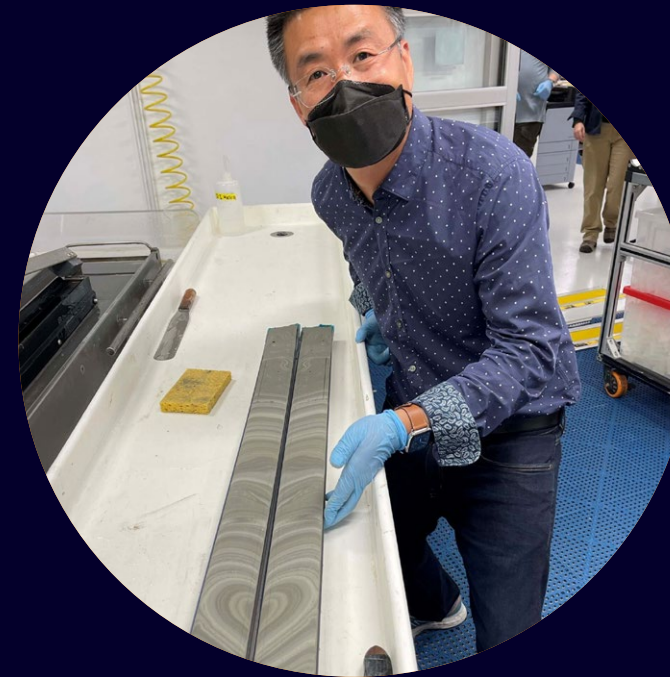
"I use microfossil shells called foraminiferal tests, and measure the chemical composition of

foraminifera based on proxies such as magnesium to calcium ratio, boron to calcium ratio, and boron isotopes," said Jimin.

"From these we can reconstruct sea water chemistry and conditions such as temperature, pH and pCO₂ – all important variables in understanding past climate. By reconstructing ocean acidity in the past, we can better understand variations in the carbon cycle and the ocean's effects on atmospheric CO₂ and climate through time. Advancing our paleoclimate knowledge is thus crucial to better understanding past, current, and future carbon cycle."

The Iberian Margin, off the coast of Portugal, is uniquely positioned to unlock detailed histories of past carbon cycles. Sediments are deposited at nearly ten times the rate of other deep-sea locations, so climate changes can be detected with much greater time resolution. An Iberian Margin sediment archive also contains signals of marine, atmospheric, and terrestrial changes in a single core, enabling investigation of the relative timing of various changes within the ocean-climate system to reconstruct high-resolution climate signals over millennia.

The Iberian Margin holds the secret to high-resolution climate change data, and Expedition



"One of the greatest values of participating in the expedition is that we obtained exceptionally high quality sediments which open a new window for detailed reconstructions of the past climate."

– Prof. Jimin Yu

397's fresh drilling revealed surprises; one of the first cores to come up – the Twitter-famous 'heart core' (above) – revealed incredibly rare soft sediment deformation and complex stratigraphy.

Jimin has worked extensively with Iberian Margin sediments, including in his recent Australian Research Council Discovery Project: *Deep Atlantic's role in millennial atmospheric carbon dioxide changes*. The research aims to substantially improve our understanding of the mechanisms governing the global carbon cycle by generating the first high-resolution deep Atlantic carbon ion and nutrient records over the last 150,000 years.

"The Discovery Project supports us to work on sediments from the Iberian Margin from the last glacial and interglacial cycle. We already have gained great data from cores and our results are currently under review. With continued funding, my students and I will be able to put the sediments from Expedition 397 to use for further breakthroughs," he said.

Expedition 397 sailed from Lisbon, Portugal on *JOIDES Resolution* in October, 2022 and collected cores from four primary drill sites across a varied water depth transect of up to 4.7 km, including

going deeper into a previous hole (U1385 from Expedition 339).

Jimin says the cores will prove a valuable reference for the Southern Ocean. "The Southern Ocean is a critical region for climate change and the carbon cycle, including atmospheric CO₂ variations, but at high latitudes – such as the Antarctic Zone – it can be very difficult to find foraminifera shells."

"We work around this by looking at physical and chemical condition changes in downstream sites and use combined proxies to infer what happened in the Southern Ocean. So Iberian Margin sediments are invaluable in helping us understand Southern Ocean processes and their role in controlling past carbon cycle and climate change over a longer timescale."

Expedition 397 was Jimin's maiden IODP expedition, and he was excited by the extraordinary learning experience.

"The *JOIDES Resolution* is like a floating university. As one of eight scientists in the sedimentology team and one of 26 international scientists on board, it's great to collaborate with them during the expedition and beyond."

IODP Expedition 386

Japan Trench Paleoseismology

Drilling deeper into Earth's seismic history

Prof. Myra Keep

University of Western Australia

When it comes to characterising Earth's complex and multiscale seismic behaviour and its impacts, short historical records – and even shorter instrumental records – don't offer the long-range perspective needed to understand the drivers behind recurring large-magnitude earthquakes.

“At the moment in Australia we're working on around a 50-year record. There's so much we still don't understand about how earthquake systems work,” explained Prof. Myra Keep, whose research focuses on structural geology and tectonics.

Myra boarded the JAMSTEC-operated scientific drilling vessel *Chikyu* for the Personal Sampling Party (PSP) linked to Expedition 386 for which she was team leader for hydroacoustics.

“We're looking for evidence of previous mega earthquakes – the huge magnitude nines – in the sediment cores and in the hydroacoustic data images and bathymetry. We've got some very fine control on where we are in terms of depth and what's under the surface, and it's going to tell us a lot more about how these systems work,” she said.

Expedition 386 aimed to fill the gap in long-term records of giant earthquakes by examining prehistoric events to construct a long-term history, delivering crucial observational data to reduce epistemic uncertainties in seismic hazard assessment in the region and beyond. According

to Myra, the Japan Trench is an ideal location for this work.

“It's on a plate boundary in a highly seismically active zone, and the density of population in this region means earthquakes can have an even more devastating impact,” she explained.

“The Japan Trench is among the world's deepest hadal trenches and is part of a complex plate boundary system where two subduction zones meet. If we can establish how frequently these earthquakes are happening and where the sediments are coming from, we can tell which sections of the plate boundary are failing, and that will give us much higher resolution data.”

It was an unusual expedition, and not just because it was the first Mission Specific Platform collaboration between ECORD and JAMSTEC. Myra was due to sail onboard the JAMSTEC-operated RV *Kaimei* in early 2020, but COVID-19 hit and the expedition was delayed. It eventually went ahead in April 2021, with only a small Japanese skeleton crew onboard to collect the samples while the rest of the Science Party waited for news online.

Despite these hurdles, the mission achieved its objective of sampling 15 sites across the Japan Trench, using giant piston coring to recover 831 metres of continuous upper Pleistocene to Holocene stratigraphic successions. It also



“Participating in Expedition 386 is one of the highlights of my entire career. To be part of a truly collaborative project, all focussed on the same scientific goals, was a truly transformative experience. I am very much looking forward to the collaborations ahead with my amazing new colleagues as we digest all of our data.”

– Prof. Myra Keep

delivered two new depth records in scientific ocean drilling and coring: the deepest water site ever drilled and cored at the water depth of 8023 metres, and the deepest sub-sea level sample, recovered from 8060.74 metres below sea level.

“The capacity to take such deep samples opens up possibilities for our comprehension of the planet that have never existed before, and that's very exciting to be part of.”

The Onshore Science Party from February to March 2022 also charted new territory as the first to take place entirely online. “The cores were transported to *Chikyu* in port, and a small crew of Japanese scientists were onboard splitting and logging all the core while the rest of us were online across different time zones. There were daily midnight meetings with everyone trying to look at the samples on the screen; it was tough.”

Myra was delighted that the PSP later took place onboard *Chikyu* in Shimizu Port, where scientists took 18,300 samples from the cores. She said nothing replaces the opportunity to examine the sediments in real life.

“You can make all sorts of interpretations on screen

or from remotely sensed data, but there's no substitute for getting your hands on the rock: seeing it, feeling it, and then trying to put it together in context,” she said.

What scientists hope to discover through Expedition 386 has direct relevance for offshore paleoseismology in Australia, and to Professor Keep's own research into tectonics, fault reactivation and neotectonics along Australia's North West Shelf.

“I've spent the last two decades looking at remotely-imaged hydroacoustic and seismic data and documenting landslides in the region. Despite Australia supposedly not being particularly seismically active, we've found a lot of unexpected activity,” she said.

“We have evidence of earthquakes young and old, and without those obvious plate tectonic drivers it's difficult to explain them and understand how frequently they occur and where the stress is coming from. By looking at these sediments from an area where we know earthquakes are controlling them, we can compare this to our own data and see if there are any common characteristics.”

IODP Expedition 398

Hellenic Arc Volcanic Field

Acacia Clark
University of Tasmania

Prior to sailing, Acacia shared her thoughts about the expedition and her research.

Tell us a little about your career and your research.

I'm about 18 months into my PhD, where I'm investigating explosive silicic eruptions. I've divided my PhD into two parts; the first is focused on Mount Tarawera in New Zealand's North Island, looking at the Kaharoa eruption in 1315 which fluctuated in intensity over time in unusually unsteady behaviour that isn't well understood. I'm looking at what influenced that unsteadiness. It was quite a hazardous eruption; if something similar happened again, it would be devastating for New Zealand and probably also for Australia.

The second part is focused on the Hellenic arc in the Mediterranean, and that's where the expedition comes in. These silicic eruptions also can occur underwater, but we don't know much about silicic submarine eruptions – they're hard to get to so we don't have much data. On Expedition 398, we'll be able to drill into the sediments that are surrounding these underwater volcanoes to gain high-resolution data and help us understand how these submarine eruptions can be quite different to those on land.

What is your specific role on the expedition?

My role is as a core describer, looking in detail at the cores once they come onboard and describing and logging what I see. This includes looking at the different materials that the core is made up

of, such as volcanic ash, pebble-sized volcanic products known as lapilli, or marine sediments. I was lucky enough to sail as a core describer on an expedition earlier this year on RV Investigator where we drilled for sediments containing volcanic tephra, so I have some experience going in.

What are the key questions the expedition seeks to answer through the sediments you'll be examining?

Volcanic eruptions, particularly highly explosive ones, are very hazardous and life threatening. They produce huge ash plumes, very hot ground-hugging ash and rock flows, and even earthquakes and tsunamis. To understand how these hazards are linked to volcanic activity, we have to look at what's driving that volcanism and how these volcanoes interact with their surroundings. During the expedition, we're going to explore the links between the crustal tectonics, volcanic activity and magma genesis, the dynamics and impacts of explosive submarine volcanic and caldera forming activity, and how calderas collapse during explosive eruptions and recover to enter new magmatic cycles. We'll also be touching on how the marine ecosystem reacts to volcanic eruptions, because that hasn't really been explored in detail.

Why is the Hellenic volcanic arc system an ideal location to seek those answers?

It's ideal because it consists of three large volcanic centres – Christiana, Santorini, and Colombo – along with several submarine volcanoes. Volcanoes in this region have erupted quite

explosively in the past, and there are deposits on land that have been extensively studied but the majority of the erupted deposits lie on the sea floor within rift basins and the Santorini caldera itself. These deposits are hundreds of meters thick so hold a really great record of volcanic history. By drilling to sample these deposits we'll be able to fill gaps in the onshore records, but we'll also access much older deposits. This will give us an extensive record that goes much further back than what we've already learned from the land deposits.

What's the significance of filling that gap in our knowledge, including in our region?

It's important to understand submarine volcanic activity because it can generate tsunamis and also earthquakes – which can trigger a tsunami separately. These can have huge impacts. Anyone who lives near the ocean probably wants to know how or when that might occur, including here in Australia. The Kermadec arc, which contains several active volcanoes, extends from the top of the North Island of New Zealand to Tonga;

there was a massive eruption earlier this year that produced a devastating tsunami for Tonga.

As a PhD student early in your research career, what does the opportunity to be part of an IODP expedition mean to you?

It's a pretty amazing opportunity; I feel very lucky. Who wouldn't want to go on a ship and experience cutting edge research as it's happening? I'll also meet and work with some of the best scientists in the world. As a young scientist, I'm looking forward to learning from everyone on board and collaborating with them, and making great connections that will continue into the future.

How are you feeling about life at sea for the next two months?

I have some idea of what to expect from my previous voyage, and what excited me most was bringing up the core and opening it to see what was inside. It's a strange feeling to be looking at sediments that have been sitting on the ocean floor for years and years, and we're the first people to look at them. You don't know what you'll find and there's a story in every core. I have to admit I'm also really looking forward to the food; I'm not a great cook but I love eating, so it's just luxury having people cook for you every day!

Diversity of cores from Expedition 398.
Photo credit: Thomas Ronge & IODP

IODP Expedition 398

Support & contributions as a shore-based expeditioner

Prof. Axel Schmitt
Curtin University

When the *JOIDES Resolution* unmoored from Tarragona, Spain, on December 19 2022, Expedition 398 (Hellenic Arc Volcanic Field) began in earnest after several days of port preparations. With 28 members of the shipboard science party boarded, the vessel started its five-day transit towards the Aegean Sea, where drilling commenced on December 21. A total of 7345 m was drilled with ~46% core recovery from 12 sites and 28 holes over the following weeks.

These weeks between late December and early February coincided with my relocation from Heidelberg University, Germany, to Curtin University. Nonetheless, I frequently caught up with the expedition's progress as a shore-based member of the science party.

The Hellenic Arc formed by lithospheric plate subduction of Africa underneath Europe, and within this convergence zone, slow subduction of a very old and cold oceanic plate coincides with thinning of the Aegean continental crust, creating horsts and grabens. The Christiana-Santorini-Kolumbo (CSK) volcanic field is the source of a major eruption about 3600 years ago, which drastically reshaped the island of Santorini and impacted Late Bronze Age societies in the eastern Mediterranean. CSK volcanic islands and seamounts are located

within a graben structure, which, as Expedition 398 confirmed with resounding success, is filled with a remarkably complete volcano-tectonic record dating back to the Pliocene inception of arc volcanism.

Geochronology is an important component of reconstructing this uniquely detailed Pliocene–Quaternary marine sediment record, with intercalated volcanoclastic deposits as high-resolution time markers.

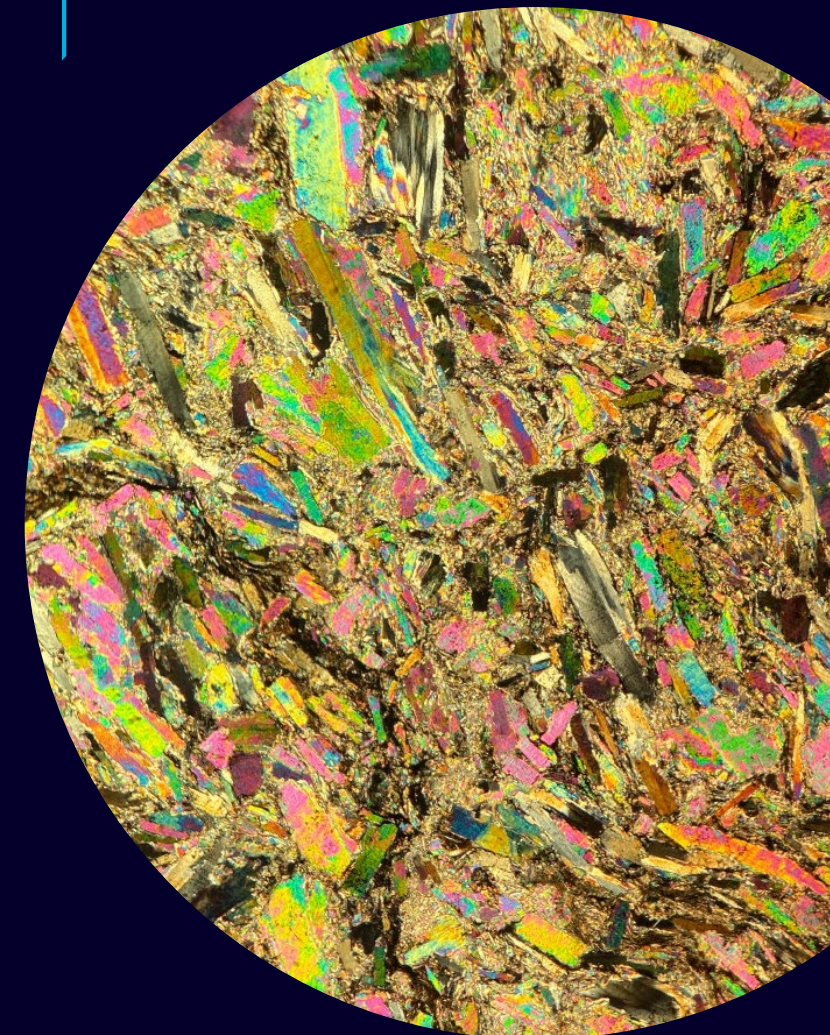
Teaming up with shipboard scientist Sarah Beeth from Oregon State University, evolved tephra were selected for post-cruise research, as they have the highest potential to be dated at high precision using $^{40}\text{Ar}/^{39}\text{Ar}$ and U–Pb zircon geochronology at OSU and Curtin University, respectively. This combination of dating the same tephra by two methods has multiple advantages: while ^{40}Ar produced by decay of ^{40}K is typically retained only after magma cooling during the eruption, the presence of additional atoms of ^{40}Ar in the sample can lead to an overestimation of the eruption age. This is often the case for young samples with low K-abundance, where radioactive accumulation of ^{40}Ar is comparatively slow. Conversely, the decay of U in the accessory mineral zircon will accumulate Pb once a crystal formed in the



Prof. Schmitt with ANZIC Director, Ron Hackney and Program Manager, Sarah Kachovich and his new instrument at the John de Laeter Centre, Curtin University.

magma, often well before the eruption. While the U–Pb zircon method thus only yields a maximum age for tephra deposition, it is nonetheless powerful in unmasking when and how eruptible magma bodies were assembled prior to eruption. In combination, both chronometers can be stringently checked for consistency, as the $^{40}\text{Ar}/^{39}\text{Ar}$ age can never be older than the U–Pb zircon age, thus enhancing confidence in the ages. Moreover, material is efficiently used, as $^{40}\text{Ar}/^{39}\text{Ar}$ primarily targets large crystals ($>200\text{ }\mu\text{m}$), whereas zircon is recovered from the $<200\text{ }\mu\text{m}$ size fraction.

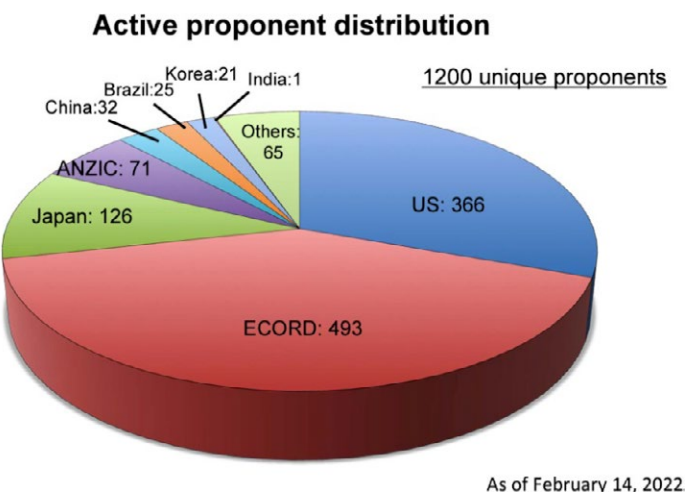
With support from ANZIC Post Cruise Analytical Funding (PCAF), samples of 20 tephra horizons were selected during the Sampling Party in Bremen on 24–30 July 2023 and are currently being processed. Initial age results are expected by the time of the second postcruise meeting that will be held from 20–25 April 2024 on Santorini.



IODP Drilling Proposals

Researchers at institutes in Australia and New Zealand have been at the forefront of leading and contributing to IODP drilling proposals, showcasing their expertise and commitment to advancing scientific understanding of the Earth's processes and history. Through collaborative efforts, these researchers have proposed ambitious drilling projects aimed at unravelling many geological mysteries and hazards, studying climate change, and exploring marine biodiversity.

Their contributions not only demonstrate the importance of international cooperation in scientific endeavours but also highlight the significant role that researchers from these regions play in shaping global marine research initiatives.



Proposal ID	Proposal name	Australian & New Zealand PIs
1002	Totten Glacier Climate Vulnerability	Dr. Taryn Noble (UTAS), Dr. Philip O'Brien (MQ), Prof. Eelco Rohling (ANU), Prof. Andrew Roberts (ANU), Dr. Bradley Opdyke (ANU) and Dr. Linda Armbricht (U Adelaide)
999	New Caledonia Ophiolite L2S	Dr. Rupert Sutherland (VUW) and Dr. Vasileios Chatzaras (Usyd)
998	Antarctic Cryosphere Origins	Prof. Rob McKay (VUW), Dr. Rupert Sutherland (VUW), Dr. Tim Naish (VUW), Dr. Richard Levy (GNS Science) and Dr. Huw Horgan (VUW)
993	Havre Trough Backarc Formation	Dr. Richard Wysoczanski (NIWA), Dr. Sally Watson (NIWA), Dr. Pilar Villamor (GNS Science), Dr. Christian Timm (GNS Science), Dr. Cécile Massiot (GNS Science), Dr. Martin Jutzler (UTAS), Dr. Monica Handler (VUW), Nicholas Dyriw (QUT), Dr. Cornel de Ronde (GNS Science), Dr. Rebecca Carey (UTAS), Dr. Fabio Caratori Tontini (GNS Science), Dr. Dan Bassett (GNS Science) and Prof. Richard Arculus (ANU)
990	Hyuga-Nada Observatory	Dr. Laura Wallace (GNS Science)
983	Kerguelen Plateau Climate Chronicles	Dr. Joanne Whittaker (UTAS), Prof. Mike Coffin (UTAS) and Dr. April Abbott (MQ)

967	Ontong Java Nui LP	Dr. Christina Timm (GNS Science) and Prof. Mike Coffin (UTAS)
961	Gulf of Mexico Glacier-Methane Link	Dr. Jess Hillman (GNS Science)
959	Hikurangi Megathrust Along-Strike Variability	Dr. Laura Wallace (GNS Science), Dr. Stuart Henrys (GNS Science), Dr. Gareth Crutchley (GNS Science), Dr. Dan Bassett (GNS Science), Dr. Philip Barnes (NIWA) and Dr. Daniel Barker (GNS Science)
955	Axial Seamount Observatory	Dr. Cornel de Ronde (GNS Science)
953	Australian-Antarctic Rift-Drift	Dr. Nicky Wright (USyd), Dr. Joanne Whittaker (UTAS), Dr. Isabel Sauermilch (UTAS), Dr. Steven Phipps (UTAS), Dr. Jacqueline Halpin (UTAS) and Prof. Alan Aitken (UWA)
931	East Antarctic Ice Sheet Evolution	Dr. Tim Naish (VUW), Prof. Rob McKay (VUW), Dr. Richard Levy (GNS Science), Prof. Leanne Armand (ANU) and Prof. Alan Aitken (UWA)
926	Great Australian Bight Reflux Brines	Dr. Gene Tyson (UQ), Dr. Gordon Southam (UQ), Dr. Talitha Santini (UQ), Dr. Maija Raudsepp (UQ), Prof. Simon George (MQ), Prof. Stephen Gallagher (U Melb) and Dr. Paul Evans (UQ)
924	Chatham Rise Geologic CO2 Release	Dr. Ingo Pecher (U Auckland), Dr. Helen Neil (NIWA) and Dr. Bryan Davy (GNS Science)
918	Southern Ocean Climate Evolution	Dr. Tim Naish (VUW), Prof. Rob McKay (VUW), Dr. Richard Levy (GNS Science), Dr. Giuseppe Cortese (GNS Science)
871	Lord Howe Rise Continental Ribbon	Dr. Ron Hackney (GA), Dr. Clinton Foster (GA), Prof. Scott Bryan (QUT), Dr. Talitha Santini (UQ), Prof. Dietmar Müller (USyd), Dr. Nick Mortimer (GNS Science), Dr. Sean Johnson (UTAS), Prof. Kliti Grice (CU), Assoc. Prof. Marco Coolen (CU) and Prof. Richard Arculus (ANU)
848	Weddell Sea History	Assoc. Prof. Nicholas Golledge (VUW)
835	Japan Trench Tsunamigenesis	Prof. Virginia Toy (U Otago)
830	Scott Plateau Microbial Interaction	Dr. Bradley Opdyke (ANU), Prof. Stephen Gallagher (U Melb) and Dr. Alexandra Abrajevitch (ANU)
813	Antarctic Cenozoic Paleoclimate	Dr. Philip O'Brien (MQ)
781B	Hikurangi: Riser	Dr. Laura Wallace (GNS Science), Dr. Stuart Henrys (GNS Science) and Dr. Philip Barnes (NIWA)
781	Hikurangi Subduction Margin	Dr. Laura Wallace (GNS Science), Prof. John Townend (VUW), Dr. Rupert Sutherland (VUW), Rick Sibson (U Otago), Dr. Ingo Pecher (GNS Science), Dr. Joshu Mountjoy (NIWA), Dr. Stuart Henrys (GNS Science), Dr. Susan Ellis (GNS Science), Dr. Philip Barnes (NIWA), Dr. Daniel Barker (GNS Science) and Dr. Stephen Bannister (GNS Science)
716 (Exp 389)	Hawaiian Drowned Reefs	Prof. Jody Webster (USyd) and Prof. John Pandolfi (UQ)
698	Izu-Bonin-Mariana Arc Middle Crust	Prof. Richard Arculus (ANU)

ANZIC IODP Legacy Analytical Funding (AILAF)

Every year ANZIC provides legacy grants to scientists in a range of fields for analytical research using the vast library of cores, samples and data already collected by scientific ocean drilling. Our grants continue to facilitate the rapid production of high-quality research outputs and publications.



Photo credit: Sarah Kachovich & IODP

In 2021/2022 several rounds of funding were offered, resulting in 18 applications for a total of \$329,073 requested funding. Applications were received from 15 Australian and 3 New Zealand teams, representing 14 of our consortium member institutions. A third of these were led by women. Ultimately, 15 applications were funded, to the value of \$271,546.

Successful funding recipients and projects

Dr. Hugo Olierook, Curtin University. Did the Caribbean large igneous province cause the Turonian global oceanic anoxic event?

Assoc. Prof. Mark Kendrick, University of Queensland. Evaluation of seafloor-carbonation feedback in atmospheric CO₂.

Prof. Jody Webster, University of Sydney. How high and how fast: new constraints on sea-level change and reef development during Marine Isotope Stage 3 (60-30 ka) from Great Barrier Reef and the North West Shelf.

Dr. Hamed Gamal El Dien, Curtin University. Tracking the recycled carbonates into the deep mantle using Zn isotopes.

Dr. William Defliese, University of Queensland. The halogen composition of subducting oceanic sediments.

Dr. Luc Doucet, Curtin University. Oceanic zircons and their apatite inclusions hold clues to Earth's mantle evolution.

Dr. Derya Gürer, Queensland University of Technology. Tracking Tonga-Kermadec subduction initiation in mixed volcanoclastic-calcereous turbidites with U-Pb zircon geochronology and trace element geochemistry.

Assoc. Prof. Teresa Ubide, University of Queensland. Tracking the growth and evolution of the ocean crust using cryptic crystal archives.

Dr. Lucy McGee, University of Adelaide. Metal isotopes applied to the start of subduction: testing the fluid transfer of copper from slab to surface.

Assoc. Prof. Nathan Daczko, Macquarie University. Mafic melt flux through oceanic rocks.

Dr. Linda Armbricht, University of Tasmania. Improving species identification from short sedimentary ancient DNA (sedaDNA) sequences: an addition to the sedaDNA assembly toolbox.

Assoc. Prof. Milo Barham, Curtin University. Provenance ice-breaker: getting to know Antarctica's cryptic geological history through detrital feldspar Pb-isotopes.

Prof. Claudine Stirling, University of Otago. Interrogating the efficiency of the Southern Ocean's 'biological pump' through abrupt climate reorganisations.

Dr. Georgia Grant, GNS Science. Glacial-interglacial latitudinal temperature gradients in the Southwest Pacific during the mid-Pliocene: an assessment of climate model predictions.

Dr. Jenni Hopkins, Victoria University of Wellington. Hunting for hidden ash: cryptotephra in IODP cores.

Dr. Agnes Reyes, GNS Science. Cycling of high-temperature fluids venting at Brothers Volcano revealed by microscopic studies of mineralogy, corrosion products and fluids trapped in crystals.

Dr. Christina Riesselman, University of Otago. Calibrating the connection: Using the Southern Ocean's most highly-resolved Quaternary sediment record to illuminate the relationship between primary production and Antarctic climate.

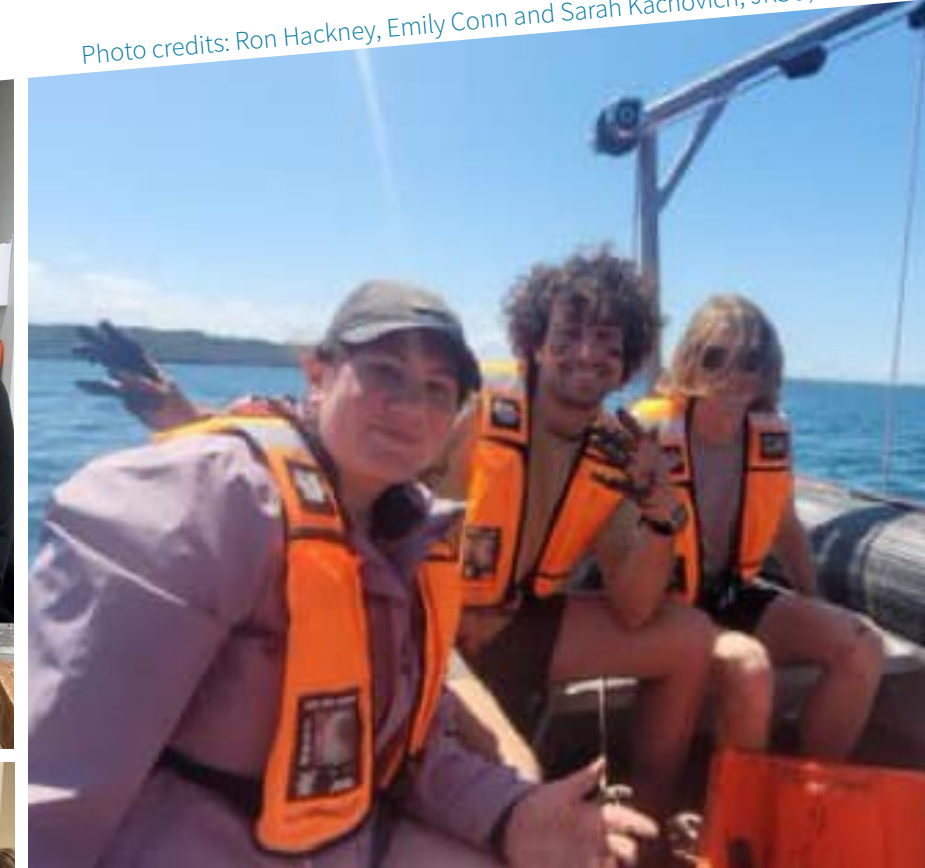
Assoc. Prof. Christopher Moy, University of Otago. Reconstructing millennial-scale coupled atmosphere-ice sheet dynamics in the south Pacific during the Pleistocene.



IODP TRAINING

Every year ANZIC gives students and ECRs at Australian and New Zealand member institutions access to specialist training opportunities, ensuring that researchers have the skills necessary to participate in scientific drilling now and into the future.

Photo credits: Ron Hackney, Emily Conn and Sarah Kachovich, JRSO, IODP



ANZIC Masterclass

Convenor's report

Hosted by:



The ANZIC Masterclass was held from 4-12 December, 2022, in Sydney and nearby NSW, based around the Sydney Institute of Marine Science (SIMS) and including marine and geological fieldwork. The students stayed at Glenferrie Lodge in Kirribilli whilst in Sydney, and at Kioloa Beach Holiday Park when on geological fieldwork. Eleven women and five men participated, representing thirteen Australian and three New Zealand universities. It was hoped that there would be a small contingent of students from ECORD, but that did not eventuate. This was the second time this Masterclass was run in Sydney. Following the initial delivery in 2019, there were cancelled attempts in 2020 and 2021 due to COVID.

The activities nearly all worked as planned, unlike in 2019 when we were significantly impacted by bushfires. The students had a day at Sydney University, with mainly lab-based activities, followed by two days at SIMS during which they undertook marine fieldwork in small boats on Sydney Harbour, and used the SIMS labs for examining collected marine sediment samples. One snag was a non-operational CTD (conductivity, temperature and depth device) which was overcome by borrowing a different one at the last minute.

There was a morning of lecture-style presentations

at SIMS from a variety of IODP-related scientists that showed the breadth of marine geoscience. There was also a successful evening kayak trip for two hours on Middle Harbour, which included a scenic beach stop for refreshments. Three minibuses were used to transport the students and teaching staff to the south coast of NSW for the geological fieldwork over four days, and then a visit to the Geological Survey of New South Wales core store at Londonderry in western Sydney on the last day of the Masterclass. The students experienced a wide variety of beautifully preserved Permian sediments and depositional environments, including the Permo-Triassic Boundary at Coalcliff which was a highlight. They had practise logging cores at Londonderry, and recent sediments at SIMS. The Masterclass finished with lab tours at Macquarie University.

Only two cases of COVID-19 were detected amongst the students, which led to those students missing the last day of the program, and a prolonged quarantine before flights home. Fortunately, additional mask wearing stopped the masterclass being a super-spreader event.

There was a wide range of expertise and geological skill level in the students, including from those who had only completed 1-2 units of geology to those who were already well embarked on the next phases of their learning



(entering Honours, PhD). Greater focus on second year level (where the Masterclass might help direct future career preferences) might be useful in the future. Despite this large diversity in incoming experience, all the students found the 2022 Masterclass useful and enjoyable.

Hon. Prof. Simon George,
Macquarie University
ANZIC Masterclass convenor

ANZIC is grateful to the long list of people who made the Masterclass happen:

- Prof. Simon George, Macquarie University
- Prof. Jody Webster, University of Sydney
- Rebekah Bradshaw, University of Sydney
- Assoc. Prof. Maria Seton, University of Sydney
- Nick Harris, Macquarie University
- Fernando Sobral, University of NSW
- Dr. Tim Austin, University of NSW
- Dr. Justine Channing, Macquarie University
- Andrew Niccum, SIMS

- Dr. Joanna Parr, CSIRO
- Prof. Nathan Daczko, Macquarie University
- Dr. Rebecca Parker, University of NSW
- Dr. Adriana Dutkiewicz, University of Sydney
- Prof. Dietmar Müller, University of Sydney
- Prof. Zanna Chase, University of Tasmania/IMAS
- Dr. Stefan Löhr, Macquarie University
- Dr. Inna Kampoli, Macquarie University
- Lauren Gorojovsky, Macquarie University
- Sean Murray, Macquarie University
- and the ANZIC office team for logistics and support.



ANZIC Masterclass

Student's report

For undergraduates with a particular interest in marine geoscience, exposure to scientific field techniques and meeting like-minded undergraduates can be sparse in initial years of study. This is why the 2022 ANZIC Marine Geoscience Masterclass was such a wonderful opportunity.

Hosted by geoscientists from Macquarie University, undergraduates from Australia and New Zealand experienced nine days jam-packed with field trips, field data collection, lab sessions, tours, seminars, and everything in between. We truly got exposure to everything within the realm of marine geoscience and its applications.

Our first official day kicked off with ANZIC Director, Dr. Ron Hackney, introducing us to the IODP, its history, and how ANZIC fits into its story. He also brought core replicas from previous IODP voyages, including a 1997 core marking the K/Pg boundary, collected north of the Chicxulub Crater! Prof. Jody Webster took us through fossil coral cores collected on the *JOIDES Resolution*, and Dr. Maria Seton guided us through constructing our own ship-time drilling plan with GPlates.

The next two days were hosted at the Sydney Institute of Marine Sciences (SIMS). The group had a blast travelling by water taxi. Students experienced valuable boat time as they collected sediment, plankton, and CTD water readings in

Sydney Harbour. We analysed these samples under microscopes, along with logging harbour sediment cores collected in 2019. Lab time was followed with presentations from prominent Australian marine researchers, and was capped off with kayaking around the foreshore.

After many enjoyable days in Sydney, it was time to leave the luxurious lifestyle in Kirribilli and hit the road. Four days were spent on the South Coast of NSW, introducing students to stratigraphy of the Sydney Basin. Day trips saw students slip, slop and slap, scramble on seaside cliffs, and sidestep swells, all in the name of science! We were taught to identify fossils, bioturbation, and sedimentary structures, to reconstruct the paleoenvironment these beds were deposited, and connect these to modern day analogues. Students worked their way through lithostratigraphy in chronological order, visiting the Wasp Head Formation, Snapper Point Formation, Wandrewandian Siltstone, and other Shoalhaven Group formations.

The final field day saw students visiting a Permian/Triassic (un)conformity under the Sea Cliff Bridge, Clifton. These towering sedimentary cliffs gave us a larger perspective of lithologies previously visited, as well as the chance to see the Permian Illawarra Coal Measures and their boundary with overlying Triassic sedimentary sequences.



Photo credits: Kelly Kenney, Simon George, Stefan L  hr

The diversity and comradery between students provided a supportive and holistic learning atmosphere; exposure to different facets of marine geoscience challenged all students, regardless of experience. It also fostered opportunities for students to share their knowledge and to learn from each other. Emily and Issi did not hesitate to share anecdotes from their shared adventure aboard the *RV Investigator* in 2022.

Emily loved being in an environment filled with people passionate about the sea and rocks. She particularly enjoyed mock-planning a drilling expedition, and deploying instruments from the boats in the harbour, as she hopes to lead an expedition in the future. Emily's main aspiration is to study submarine volcanoes for her Honours, which can be done through marine sediment cores made of tephra. Therefore, the field days were an incredibly valuable review and development of her sedimentary skills.

Issi most enjoyed the field days, absorbing information from George, Stefan, Inna Kampoli

and Lauren Gorojovsky on the local geology. Being born in Sydney, but now a Hobart-based geologist, Issi had never previously been exposed in depth to the Sydney Basin stratigraphy and palaeohistory. His richest learning experience in the field was learning to visualise and interpret paleo-sedimentary depositional environments through field observations. He thinks this skill will not only serve him well in his upcoming honours project, but is also a valuable skill for future geological studies. He is also excited to bore his non-geology friends in Sydney with all he's learned, as he walks the infamous, heavily trafficked, Bondi to Bronte walk in the morning.

Issi and Emily had a wonderful time at the 2022 ANZIC Masterclass and, along with their undergraduate student cohort, would like to thank ANZIC, Macquarie University, University of Sydney, SIMS, and all the wonderful organisers for this incredible opportunity!

Emily Conn, University of Queensland
& Issi Port, University of Tasmania

IODP Summer Schools

ANZIC works closely with IODP offices around the world to ensure international training opportunities are available to Australian and New Zealand students and ECRs. We fund the participation and travel of students selected to attend.

We have seen an increasingly high level of interest from students and ECRs in our member institutions in applying for these amazing and unique training opportunities. The experience of participants is overwhelmingly positive, as is clear from the following reports.

Downhole logging for IODP science, 2021

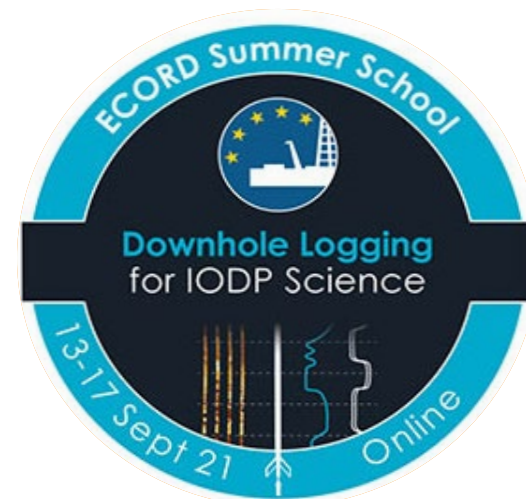
The 2021 ECORD Summer School was hosted on-line by the University of Leicester (UK) from September 13-17. Twenty eight HDR students and early-career researchers from around the world participated and were provided an overview of IODP drilling operations and introduced to geophysical logging techniques.

Dr. William Defliese from the University of Queensland represented ANZIC, and reported that he thoroughly enjoyed the course.

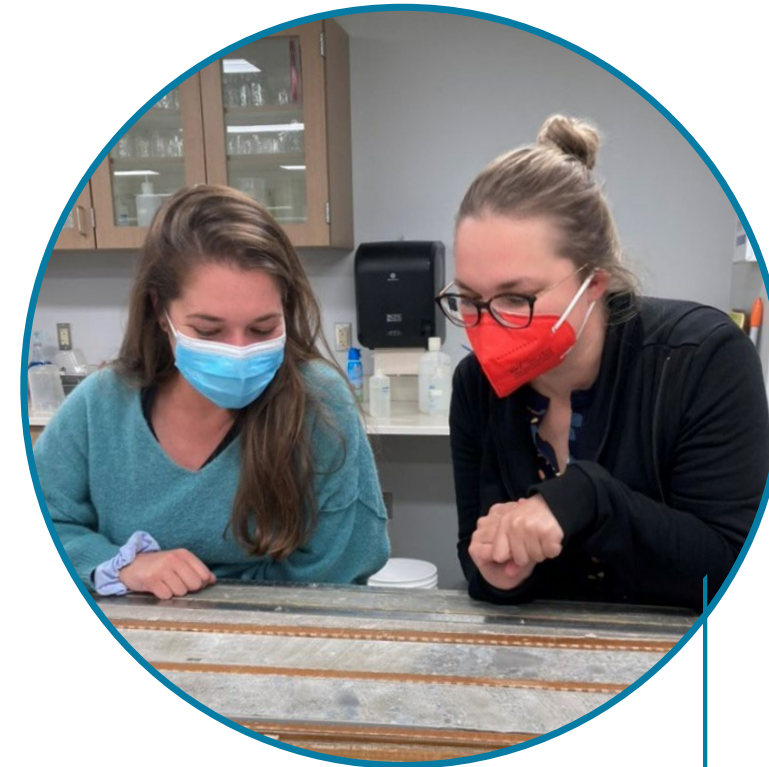
"The petrophysics section was especially interesting, as it touched on a number of topics that are useful in scientific and exploration geology that aren't often covered in the classroom. I'll be incorporating a number of these concepts into my own research and teaching."

"I'd recommend it to anyone interested in downhole logging in the future!"

"The only downside was the time zone, which was particularly challenging from Australia!"



GLacial sediment School (GLASS)



"The best part of this experience was connecting with scientists, professionals and peers from all over the world."

From May 23 to 27, 2022, the Glacial Sediment Core School (GLASS) took place at the Oregon State University Marine and Geology Repository. This week-long event was designed to offer an in-depth exploration of polar paleoclimate research using sediment cores.

The main objective of the program was to equip young scientists with the skills to interpret the stratigraphy of polar marine sediment cores within the broader context of ice dynamics, climate patterns, and source-to-sink processes. Emphasis was placed on enhancing comprehension of past and future ice sheet behaviour in Greenland and Antarctica.

The school adopted a hands-on approach, incorporating diverse laboratory activities and encouraging group collaboration. This method

ensured participants gained a comprehensive understanding of polar marine sediment cores. Importantly, this initiative plays a pivotal role in advancing research on both historical and prospective ice sheets, contributing significantly to the broader scientific community's comprehension of climate change impacts.

Layla Creac'h, a University of Tasmania PhD student, received support from the Scientific Committee on Antarctic Research (SCAR) to participate in the GLASS program. Dr. Katharina Hochmuth from the University of Tasmania played a key role in coordinating the program, contributing her expertise while concurrently involved in the Sampling Party for IODP Expedition 395C Reykjanes Mantle Convection and Climate at Texas A&M University.

ECORD Summer School Downhole Logging, 2022

ANZIC sponsored three students to participate:
Emily Conn, Imogen McDermott & Zhongxuan Li

I was super excited when I got the email that I had been accepted into the ECORD Petrophysics Downhole Logging Summer School. A fantastic opportunity for an undergraduate about to step into the post-university world. And that excitement was warranted. Whilst the time zone switch was very difficult (classes running 11pm to 3am) the content was worth it.

There were overall four days of lectures and exercises presented by experienced researchers about everything from the history and future of IODP, to specific voyages, the process of an expedition as well as the essential mathematics and the inevitable Excel calculations. Not only were the lecturers incredibly knowledgeable, but the other attendees really made it a welcoming and interesting learning experience.

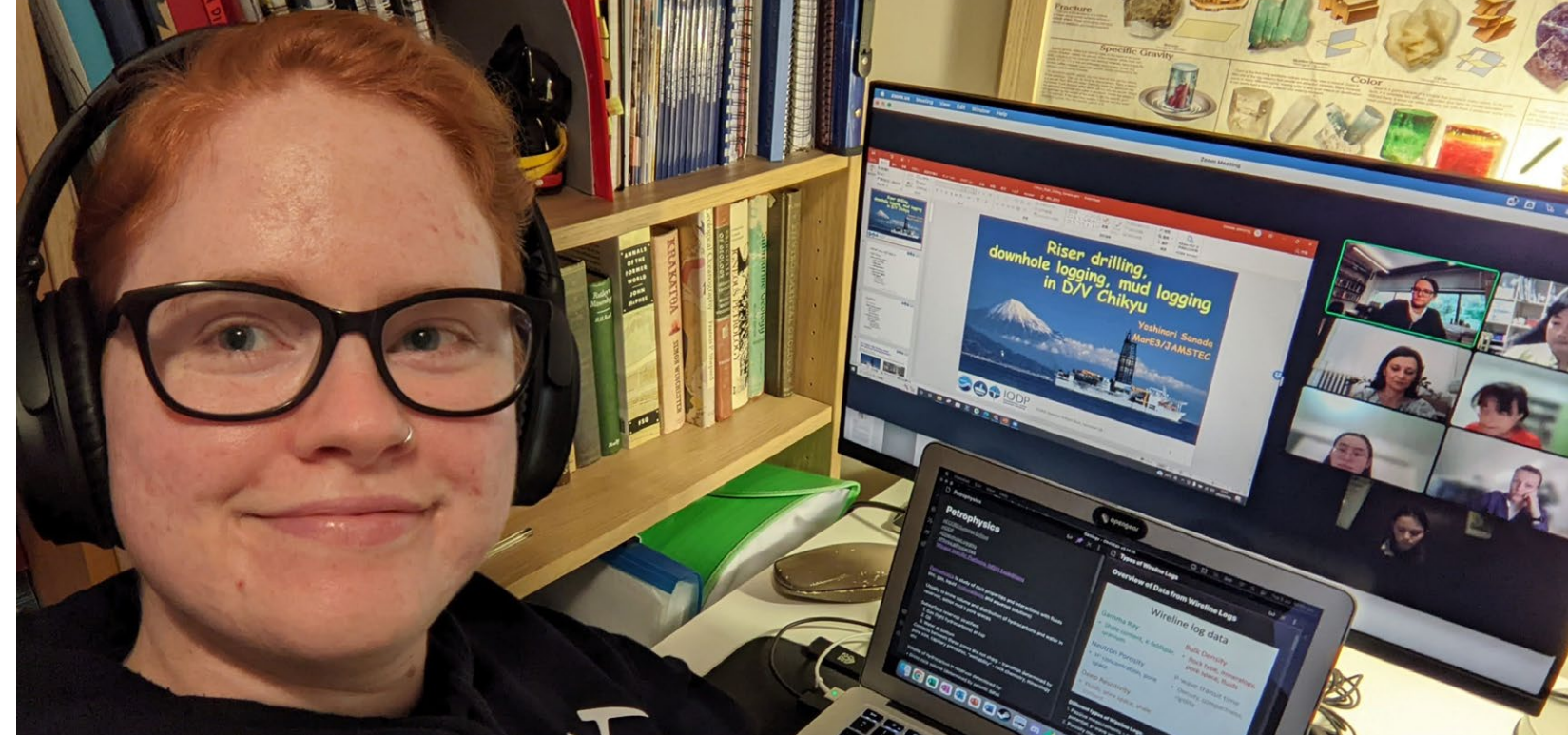
Personally my favourite bit was the Zoom tour of the *JOIDES resolution* whilst it was out on a voyage as well as a particularly fascinating discussion on methane hydrates, a topic I had only briefly touched on before.

If you ever get a chance, it seems like a great way to learn about an invaluable component in ocean drilling and a chance to meet some great people (even if it is only over Zoom).

The five-day virtual ECORD summer school: Downhole Logging for IODP Science brought me so much new knowledge of petrophysics and made me more confident in explaining the logging data from IODP. Scientists from IODP Mission Specific Platform Expeditions, RV *Chikyu*, and United States National Science Foundation took us through IODP history, the operation of different IODP platforms and also the ways to access IODP resources (e.g. logging datasets). We had intensive courses and exercises on petrophysics from Dr. Peter Fitch to learn the basic principles of commonly-used logging methods. Dr. Erwan Le Ber and Dr. Angela Slagle taught us how to integrate logging data with core and seismic results. We also learnt how to identify gas hydrate from logging results from Dr. Marisa Rydzy. On the last day, we gave a presentation on Expedition 364 summarising the logging procedure and results in the real expedition.

I want to thank ECORD for organising this summer school. I also want to thank my supervisor Prof. Simon George and ANZIC IODP for supporting my participation. I strongly recommend students and ECRs join the summer school. A very valuable experience.

Imogen McDermott
Australian National University



The virtual ECORD Summer School: Downhole Logging in 2022 was such a worthwhile experience!

I was captivated by the breadth of knowledge we were learning: the school's focus was on petrophysics and downhole logging, but as part of this, we learned about IODP, its organisational structure, the specifications of the JR and Chikyu, Missions Specific Platforms, and even had a live cross to the JR while it was out at sea!

We also learned skills within petrophysics and logging that not only serve as useful background in geophysics, but that we can actively apply to science at sea and interpreting findings from previous cruises. From the school's practical lessons, I learned the types of rock physical properties, how to calculate parameters like porosity, how to read well logs, and data acquisition with downhole tools deployed through IODP drill holes. We also learned the

types of questions scientists use these tools to answer, and received fantastic guest lectures on specific marine geological phenomena, such as gas hydrates.

The best part of this experience was connecting with scientists, professionals, and peers virtually from all over the world. It was wonderful hearing their experiences of working with IODP at sea, and this motivated me to further pursue my own scientific interests. A few times, we were put into groups to present on the past days' content – working with international peers was fantastic for networking, and made the school feel more collaborative and engaging.

Thank you to the ECORD organisers for creating such a useful and unique program, especially when hosting virtually presents its own challenges, and to ANZIC for their continued support of students and ECRs.

Emily Conn
University of Queensland

ECORD Summer School

Sea Level, Climate Variability & Coral Reefs, 2022

ANZIC sponsored two students to participate:
Victor Piedrahita & Josie Frazer

As well as being hotspots for biodiversity and tourism, coral reefs have an important role as paleoclimate archives and are critical to our understanding of the past. Like tree rings, many corals exhibit annual banding in their calcareous skeletons that can provide high resolution year to year climate records. The use of corals in Paleoclimatology was the focus of this ECORD Summer School, held in September 2022.

Twenty nine postgraduate students from eleven countries attended. Everyone had the chance to present on their own research. The days consisted of both lectures and practical exercises.

Top scientists from around the world brought us up to date with the latest research. Topics covered included the evolution of corals, coral biology and taxonomy, conditions needed for reef growth, the pressures on corals in the modern ocean, and of course the use of corals in climate reconstruction. There are two general methods of using corals in this way. The first is using macroscale reef cores such as the cores collected by IODP during their Great Barrier Reef expedition. Changes in the species present and preservation of corals in these cores were used to interpret large scale changes in sea level and changes in reef growth over thousand-year periods. The second method uses changes in the physical and chemical properties of annual bands in the corals to interpret changes in the environment.

Some corals live for hundreds of years providing a record of the recent environment, while fossilised corals allow for a high-resolution record of the past environment.

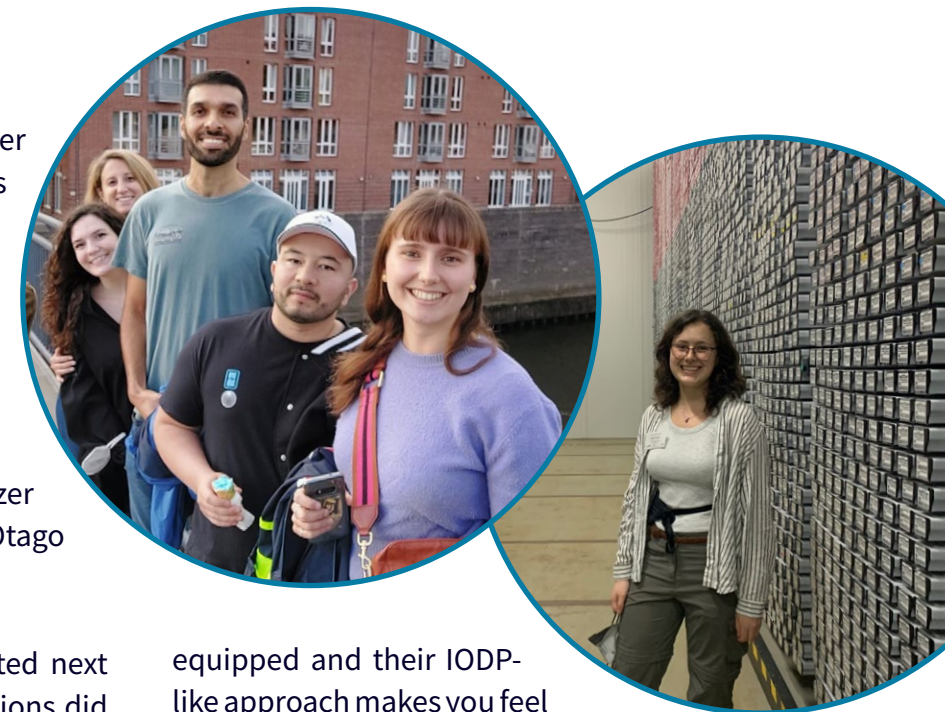
The MARUM Centre is the home of the Bremen Core Repository. Here more than 162 km of cores from the Atlantic and Arctic Oceans as well as the Mediterranean, Black, and Baltic seas are kept at 4°C. During the practical exercises cores from the collection were brought out for students to practise core description techniques in a simulated IODP shipboard workflow. Seeing and working with these cores was very special.

As well as the presentations about corals, we learnt about IODP and how it functions and participated in a valuable session on writing expedition proposals where we got to put what we had learnt into practice. Other highlights included the tour of Bremen and getting to know the other students. They were incredibly friendly and a lot of fun and I look forward to seeing them in the future.

I am grateful to ANZIC and GeoDiscoveryNZ for the financial support to attend. I would also like to thank the organisers of the school; Prof. Dierk Hebbeln, Dr. Ursula Röhl, and Dr. Thomas Felis as well as the technical staff at MARUM and the lecturers for their hard work to bring such a special and invaluable event together.

I came away with a far greater understanding of the potential corals have in helping us to understand the past and better predict the future. Learning from so many perspectives has helped me develop a much more holistic perspective of not only the topic but of IODP.

Josie Frazer
University of Otago



For years, my workplace has been located next to the ANZIC office but COVID-19 restrictions did not allow me to understand properly how IODP works. When I realised about this summer school, I saw a great opportunity to get involved.

My interest is in Palaeocene-Eocene climates, so I applied with some doubts, and I kept asking myself if I should spend precious time on something not exclusively related to my thesis. Now, I look back and am glad I was completely wrong! I learnt that IODP summer schools do not focus only on a scientific topic but also help you understand the importance of IODP in climate science, and train you in multiple skills needed for researchers of our community. You learn how to request samples from IODP repositories, realise your possible role in an expedition, and even carry out exercises that show what it is like to work on a vessel. I could say the courses are almost mandatory for any paleoclimatologist because the skills you develop there cannot be learned in any other place.

I have to say that attending the summer school was such a great experience at a professional level. I got to know MARUM and the very large IODP core repository there. It is amazing to see how geological history is stored in a place where everyone is welcome to make new scientific contributions. Facilities at MARUM are very well

equipped and their IODP-like approach makes you feel you are going into an expedition soon. Summer school practices were carried out at MARUM labs, which gave me the chance to interact with IODP technical staff, and understand the impressive number of things needed to get a core that any PhD student like me can study. Due to geographical and COVID-19 restrictions, PhD students in Australia did not have the opportunity to visit places like MARUM abroad, so attending this summer school was very useful to see how European institutes work.

Visiting MARUM was not only important at a professional level but also at a personal level. I got a bunch of new friends who also work on paleoclimates and gave me advice to attend conferences in Europe, something we may miss in Australia because of our location.

For academic and personal reasons, I highly recommend all people in our community attend IODP courses, workshops, summer schools or any activity carried out by this program. It does not matter whether you are a senior scientist or a 1st-year PhD student, you will always find something you do not know, and you will always have something interesting to say.

Victor A. Piedrahita
Australian National University

ANZIC ACTIVITIES



OUTREACH
EDUCATION
ENGAGEMENT
COLLABORATION

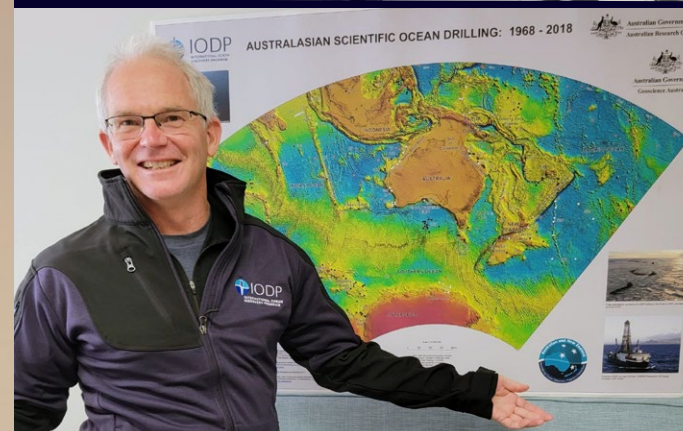


Photo credits: Kelly Kenney and Sarah Kachovich



ANZIC Forum 2022

The ANZIC Forum played a pivotal role in shaping Australia's and New Zealand's contributions to the International Ocean Discovery Program, providing a crucial platform for exchanging information and ideas. Held in a hybrid format over two days in April, the forum aimed to recognise excellence, disseminate knowledge, foster communication, share technical expertise, and cultivate future opportunities in scientific ocean drilling.

With a total attendance of 89 individuals, including 32 at the Shine Dome in Canberra, 15 at the Curtin University regional hub, 10 at the Adelaide University regional hub, and 32 participating virtually, the event actively engaged researchers, students, communicators, collaborators, policymakers, and funders passionate about marine sciences. Upholding

a commitment to inclusivity, ANZIC ensured a safe, productive, and welcoming environment for all participants. The forum was hosted at the Australia Academy of Science's 'Shine Dome' in Canberra, while regional hubs at Curtin University and Adelaide University, led by Dr. Luc Doucet and Dr. Lucy McGee respectively, enhanced accessibility following nation-wide lockdowns.

This event marked a significant milestone in the community's journey out of the COVID lockdown period, facilitating discussions on major changes within the ANZIC Office and laying out plans for the future. Key highlights included reflections on past successes, an overview of the new Strategic Framework, insights from IODP and ANZIC speakers, exploration of future opportunities, and collaborative priority setting within the ANZIC community.

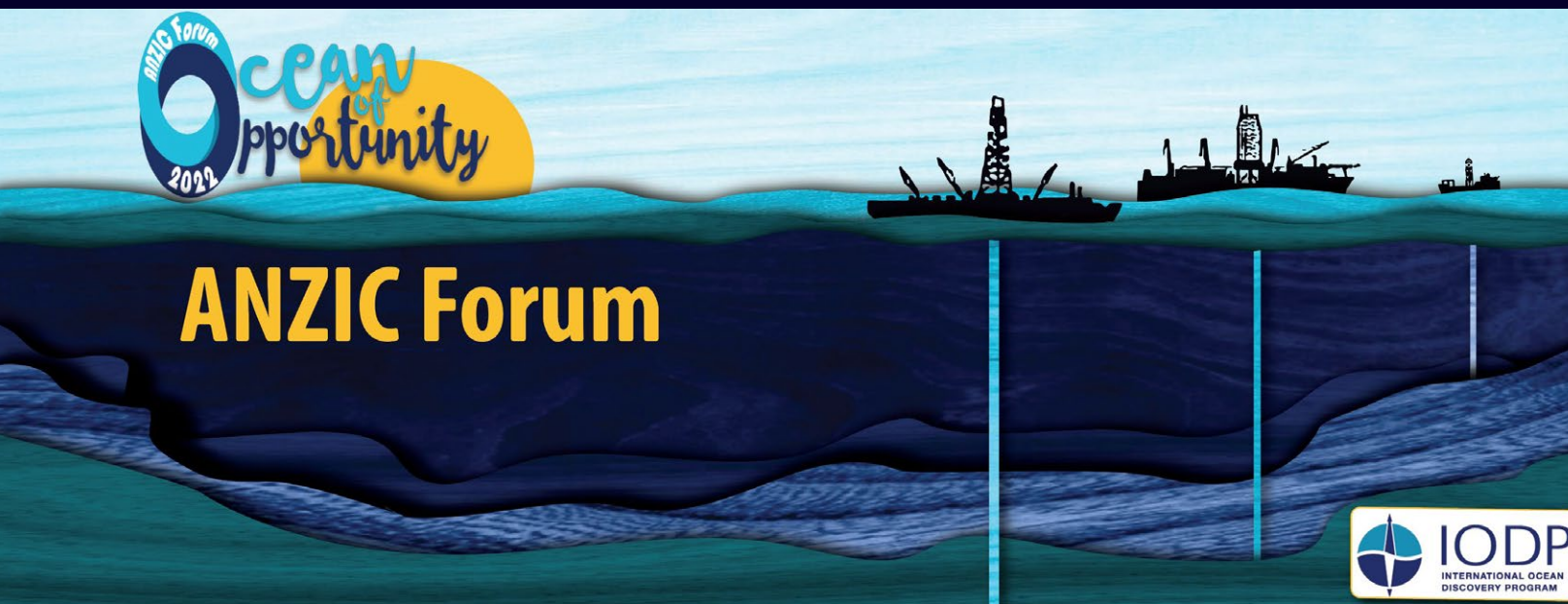
ANZIC priorities as identified at the Forum

Governing Council

1. Enable ANZIC Science Committee activities through budget management
2. Develop ANZIC's Strategic Vision post-IODP
3. Translate ANZIC-IODP science to ANZIC funders and policymakers
4. Strengthen science diplomacy in challenging political contexts

Science Committee

1. Maintain a high-level of support for ANZIC driven science
 1. IODP/ICDP Expeditioners
 2. Legacy and post-cruise grants for analytical work
 3. Training ANZIC scientists in IODP science
 4. Identifying and minimising barriers for ANZIC scientists and educators
2. Support more IODP/ICDP proposals
 1. Encourage more ANZIC proponents on IODP and ICDP proposals
 2. Drive more IODP expeditions to ANZIC and Southern Ocean waters
 3. Provide proposal writing workshops
3. Translate ANZIC-IODP science to other researchers and the general public
 1. ANZIC Strategic Communications Plan
 2. Improve engagement with First Nations and Māori peoples
 3. Engage IODP and ICDP with more geodynamic, ocean, climate and cryosphere modellers
 4. Facilitate international IODP collaboration opportunities and trainings
4. Strengthen collaborations between Australia and New Zealand
 1. Improve access to site survey facilities
 2. Increase collaboration, coordination and opportunities of the two ANZIC nations



Dr. Linda Armbricht chaired the ANZIC Forum at the Shine Dome in Canberra (left) while Dr. Luc Doucet hosted at Curtin University (right).



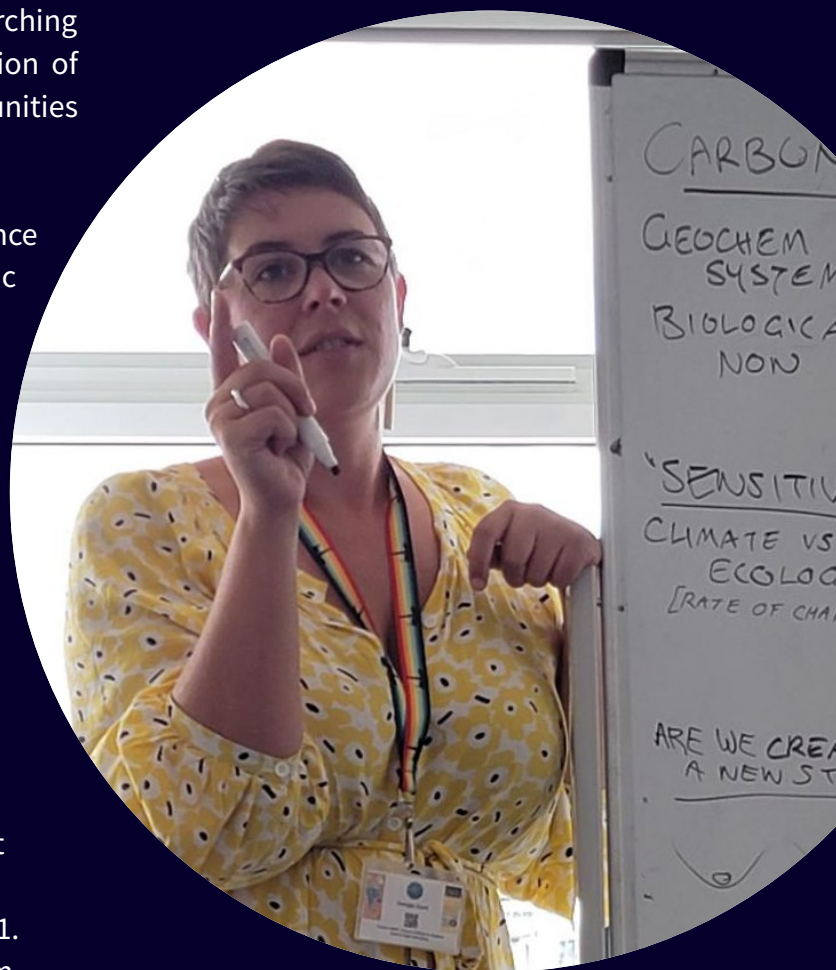
IODP/ICDP Planning Workshop

In June 2021, New Zealand played host to an IODP/ICDP Workshop, which was orchestrated by GNS Science and facilitated by Dr. Georgia Grant. The event saw the convergence of 65 participants hailing from various Australian and New Zealand institutes, convened to deliberate upon the endeavours of the IODP and ICDP. The workshop was driven by the overarching goal of ensuring a comprehensive representation of geosciences in proposals and fostering opportunities for Early Career Researchers (ECRs).

The workshop underscored the critical significance of collaboration, inclusivity, and strategic planning in advancing scientific drilling initiatives in the Southwest Pacific region.

Key recommendations from the workshop:

- GeoDiscoveryNZ, serving as the umbrella for IODP and ICDP initiatives, was urged to establish a more structured governance framework, ensure financial sustainability, and extend robust support to its members for their active participation in IODP and ICDP activities.
- A workshop aimed at forging a Special Interest Group under the Geoscience Society NZ was sanctioned for the Geoscience Conference 2021. The envisioned SIG was perceived as a platform to host annual gatherings and advocate for inclusive participation of ECRs across New Zealand institutions.



On alert during a protected mammal watch.
Photo credit: Sarah Kachovich, IODP JRSO

- The fostering of ongoing collaborations within ANZIC was underscored to optimise the utilisation of research vessels and equipment for site survey data acquisition, bolster the development of IODP and ICDP proposals, and leverage funding for the analysis of legacy data.
- Acknowledgment was made regarding the limited engagement with New Zealand and Australian indigenous communities within these programs, stressing the necessity for broader representation, including increased involvement of indigenous students, and extending outreach to encompass a wider Oceania perspective, encompassing Pacific neighbours.

Recommendations for future action also encompassed endeavours aimed at fostering better integration and communication among NZ institutions, promoting collaboration with Australia, leveraging available funding for legacy material, optimising the utilisation of research vessels, and exploring avenues to encourage ICDP proposals in Australia and New Zealand.

The workshop delved into various topics:

- Introductory insights from representatives of IODP, ANZIC and ICDP, were followed by presentations by nine of the ten New Zealand proponents currently engaged in invited workshops, pre-proposals and an accepted ICDP proposal. The afternoon session featured discussions on novel (and existing) proposal ideas, culminating with an overview of the Otago Repository of Core Analysis.
- Deliberations ensued on the status of IODP/ANZIC and ICDP, elucidating prevailing constraints on new expedition proposals, ongoing efforts in the development of successor organisations, and impediments to ECR participation.
- Discussions on site survey and proposal development highlighted funding impediments, strategies for leveraging legacy data, and technical nuances in proposal crafting.
- The discourse extended to matters concerning participation and governance, elucidating avenues for involvement in IODP/ICDP governance structures, workshops, mentorship programs, and training courses.

Office Activities

The ANZIC Office has been actively engaged in diverse outreach initiatives, showcasing the organisation's commitment to advancing scientific education and collaboration. Our external profile was also given a significant boost by the announcement of Dr Sarah Kachovich as one of the latest cohort of Science & Technology Australia's Superstars of STEM. During the year she also served on STA's Board of Directors as representative for Geography/Geology.

Our main activities are highlighted here.

ANZIC video

We were excited to launch a promotional video in May 2021, showcasing the role of ANZIC within the IODP community. Take a look via iodp.org.au.



ANZIC acknowledges the ECORD for compiling the original version and the *JOIDES Resolution* Science Operator for the B-roll footage of the *JOIDES Resolution* and science.

An ANZIC Charter

The [ANZIC Charter](#) was created to set out a shared vision among our members as to ANZIC's role and processes. It covers the powers, responsibilities and procedures of our Governing Council, the establishment of the Science Committee's terms of reference, articulates the Strategy Committee's statement of purpose, and process for appointing

Governing Council/Science Committee members and an independent chairperson.

It was prepared by a consortium of co-investment partners, and represents a collaboration among Australian and New Zealand institutions and affiliated groups designed to ensure that it reflects a diverse and representative range of views on the corporate governance practices to be followed.

Our Charter was formally adopted on 26 July 2021, and was revised on 11 July 2022.

ANZIC's growing visibility

Over 2021 and 2022, ANZIC's communications reached a growing audience. Our social media presence and influence increased, helping to make ANZIC more accessible, discoverable and inclusive. Our reach on Twitter, in particular, grew spectacularly: our followers swelled from 402 to 3417 in just 12 months.

The audience for our monthly ANZIC Bulletin, via the MailChimp platform, is strong (505 subscribers as of October 2022) and we enjoy high engagement and open rates (48% of subscribers 'often' open our communications).



Chikyu IODP Board Meeting, 2022.

Distinguished Speaker Series

The ANZIC Distinguished Speakers Program serves as a platform to disseminate groundbreaking scientific insights in marine geoscience to the IODP and wider marine geosciences community in Australia and New Zealand. An exemplary session unfolded in June 2021, at the Australian National University (ANU), featuring Kim Picard, an eminent speaker from the AusSeabed project (view the recording on the [ANZIC YouTube channel](#)) The program underscores the significance of fostering collaboration and sharing cutting-edge discoveries, facilitating a dynamic exchange of knowledge within the region.

UN Decade of Ocean Science

The United Nations Decade of Ocean Science for Sustainable Development, spanning from 2021 to 2030, is a global initiative aimed at addressing the critical challenges facing the world's oceans

and promoting sustainable practices. IODP is a key contributor to the UN Ocean Decade which has been officially endorsed as a Decade Action. This recognition allows IODP to actively contribute to the objectives of the UN Ocean Decade.

A notable IODP initiative that aligns with the UN Ocean Decade is the Ocean Shot concept. Serving as an innovative marketing device, Ocean Shot facilitates the submission of proposals, encouraging collaborative efforts to address pressing ocean issues. Various international groups have outlined the nature of their submissions, reflecting a shared commitment to advancing ocean science during this crucial decade.

The combined efforts of the UN Ocean Decade and IODP underscore a commitment to address the challenges facing our oceans and contribute to a more sustainable future.



Sarah Kachovich, Helen Bostock and Emily Conn at the Dorothy Hill Symposium.

World Oceans Day: Portraits of Australians who shaped Marine Sciences

On June 8, 2022, ANZIC helped celebrate [World Oceans Day](#) through an exploration journey led by artists Dr. Sarah Kachovich, Megan Cope, and Jiani Sheng. In collaboration with the National Portrait Gallery Exhibitions Curator, Penny Grist, the artists delved into the stories of three influential Australian marine scientists — Prof. Leanne Armand, Prof. Emma Johnston, and Mibu Fischer — expressed through black and white linocut portraits (see one result on page 15!).

The event also featured a live connection to the *JOIDES Resolution*, which was engaged in marine research in the Atlantic Ocean. The use of portraiture by the Women in Earth and Environmental Sciences in Australasia (WOMEESA) network was highlighted, emphasising its role in promoting awareness of trailblazers in the field and advocating for issues such as gender equality.

Dorothy Hill Symposium for Women in Earth & Environmental Sciences

The Dorothy Hill Symposium for Women in Earth and Environmental Sciences was held at the University of Queensland from 7-9 November 2022. Over the three days, attendees were encouraged to network, participate in tough but much needed discussions, and listen to some inspiring women who are creating a much-demanded change for equity and diversity in our field.

ANZIC Program Manager, Dr. Sarah Kachovich, took out the People's Choice Award for her poster titled: *A small leak can sink a great ship: bolstering women's leadership pipeline of the scientific ocean drilling programs*. This study was dedicated to all the women (with a special tribute to Prof. Leanne Armand), and those identifying as women, in their pioneering and ongoing efforts to push for systemic change for gender equity and inclusion in

the scientific ocean drilling programs. This study will aid ANZIC's strategic decisions going forward to become a more inclusive program. The ANZIC Science Committee and Program Manager plan to finalise and publish the study so that full statistics of the current IODP phase can be included.

Science Meets Parliament

In both 2021 and 2022, ANZIC actively participated in Australia's Science Meets Parliament events. Despite the challenges posed by COVID restrictions, representatives, including Assoc. Prof. Helen Bostock, Dr. Luke Nothdurft, Dr. Sarah Kachovich, and Prof. Carmen Gaina, engaged in meaningful discussions with STEM experts, policymakers, and federal parliamentarians. The 2021 event was hosted online, whereas the 2022 event was hybrid.



Teaching for the future

Sarah conducted an engaging workshop titled *The Future of Teaching* at the Australian Science Teachers Association's annual conference (CONASTA 69) in September 2022. The workshop catered to Australian science educators nationwide, emphasising marine geoscience and the insights gleaned from scientific ocean drilling. Participants were introduced to cutting-edge scientific developments, senior curriculum-aligned resources, and the collaborative efforts of IODP. A live ship-to-shore video call with IODP Expedition 397T allowed educators to virtually explore the *JOIDES Resolution* and discover ways to connect their students with IODP science and scientists.

National Science Week

We were excited to be part of the national launch of Science Week in August 2022 at Parliament House in Canberra. Sarah attended, taking the opportunity to strengthen connections and celebrate the vital role of science in Australia.

This year's theme was *Glass*: More than meets the eye. We celebrated with a social media campaign highlighting various ways that glass presents in IODP cores, from diatoms, marine tephra and cryptotephra to volcanic glass, tektites and

silicoflagellate. Check out the campaign on our Twitter and Facebook feeds.

The ANZIC office also hosted a group of highly engaged students from Marist Catholic College North Shore at ANU Research School of Earth Sciences this Science Week as part of the school's Canberra STEM Initiative tour. Sarah explained ANZIC's and IODP's mission to the group and guided them through an interactive workshop on the day the dinosaurs died, and there were plenty of insightful questions. Definitely some keen future geologists in the room!

Geoscience Society of New Zealand Conference, 2022

At the Geoscience Society of New Zealand Conference in Palmerston North from November 29 to December 1, GNS Science representatives, including Dr. Stuart Henrys, Dr. Cécile Massiot, Dr. Cornel de Ronde, and Dr. Jenny Black, showcased the benefits of GeoDiscoveryNZ membership.

Stuart presented a poster on the strategic vision of GeoDiscoveryNZ and ANZIC. Despite an early departure due to COVID-19, the team effectively managed a sponsor booth, promoting GeoDiscoveryNZ membership and networking with attendees on ongoing research, such as the CALDERA ICDP project and a VR experience of Brothers Volcano. Additionally, a workshop was held to establish a Special Interest Group within the Geoscience Society of New Zealand, aiming to integrate New Zealand researchers into the 2050 IODP Science Framework, particularly emphasising ECR participation and indigenous knowledge engagement.



Representatives of the *Chikyu* IODP Board (CIB) celebrating collaboration in Kobe, Japan, 2022.

The conference, reinstated after its cancellation the previous year due to COVID-19, provided a valuable networking opportunity for the community.

Get into Earth and Marine Sciences

In July 2022, ANU Research School of Earth Sciences (RSES) welcomed Year 9 and 10 students from across Canberra as part of the Get into Earth and Marine Sciences ([GEMS](#)) program for an action-packed day of workshops showcasing the diversity of research in Earth and marine sciences.

ANZIC visitors

The ANZIC Office at ANU hosted several visitors, mainly during 2022 including Dr. Carmine Wainman (Geoscience Australia), Dr. Tim Rawling (AuScope), and Phil Boxall (Australian Antarctic Division). Prof. John Dodson (Institute

of Earth Environment, China) also visited to talk about an ongoing ICDP project in the Weihe Basin. Dr. Marguerite Godard (Université de Montpellier) stopped by to give a status update on the Land-to-Sea New Caledonia Drilling Project, and Dr. Peter Bijl (University of Utrecht) reported on progress around proposed drilling in the Southern Ocean.

Quarterly meetings of the ANZIC Governing Council and ANZIC Science Committee were also held onsite.



ANZIC Publications

Publication Highlight

A publication highlight in 2022 was the comprehensive review paper *Scientific Ocean Drilling in the Australasian Region: A Review* authored by Prof. Neville Exon and Prof. Richard Arculus. This paper, published in the Australian Journal of Earth Sciences, underscores IODP as a prolific 50-year endeavour that has provided generations of public-domain geoscience knowledge on an unprecedented scale. This monumental initiative, primarily involving continuous coring throughout the world ocean, frequently delving to depths exceeding 1000 meters below the seabed, has elucidated the intricacies of continental margins, plateaus, ridges, and the deep ocean, seamlessly contextualising them within the plate-tectonic framework.

Integral to this narrative are the invaluable contributions of Australian and New Zealand scientists who played pivotal roles in conceiving and formulating international proposals. These collaborative efforts facilitated the exchange of ideas and fostered enduring scientific partnerships among diverse international teams aboard research vessels. These partnerships transcend traditional disciplinary boundaries.

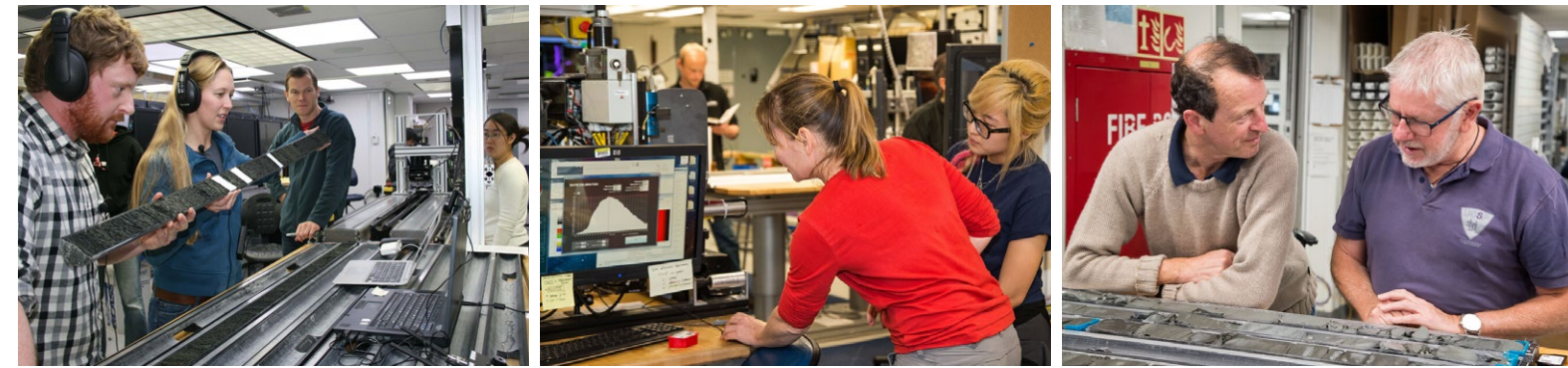
The Exon and Arculus review demonstrates outcomes that extend beyond the immediate Australasian region, addressing global questions encompassing plate tectonics, subduction zones, island arcs, spreading centres, polymetallic ore

deposits, ocean basins, ridges, and subseafloor microbiology. Groundbreaking revelations have reshaped our understanding of geological history over the last 150 million years.

Noteworthy among these outcomes is the transformation of the globe from a generally warm state during the Gondwana era to a cooling phase after Antarctica's isolation around 33 million years ago. The development of the Antarctic Circumpolar Current, severing warm-water connections, triggered a profound reorganisation of ocean currents that dramatically influenced climate dynamics.

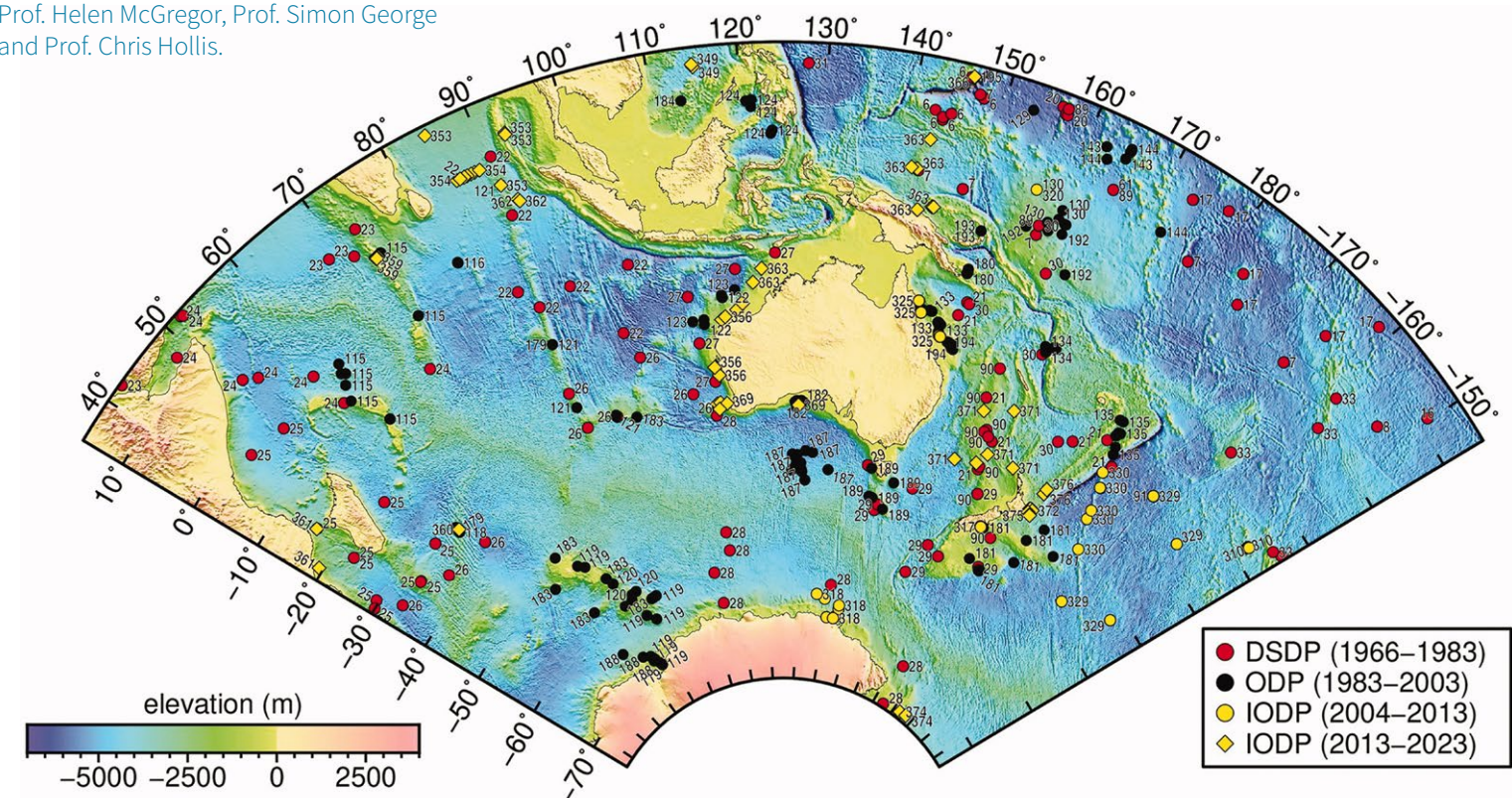
Key points of this paper encapsulate the lithospheric plate dynamics in the Australasian region, the historical isolation of Antarctica, the evolution of mantle plumes (hotspots), and the exploration of feeder zones of hydrothermal systems along with their unique biological ecosystems.

The conclusion is that expeditions in our region have catapulted our understanding of geological and climatic history, the nature of basement rocks, and the processes driving biostratigraphic and oceanographic change. The collective impact of these endeavours represents a monumental leap forward in our comprehension of Earth's intricate processes and histories.



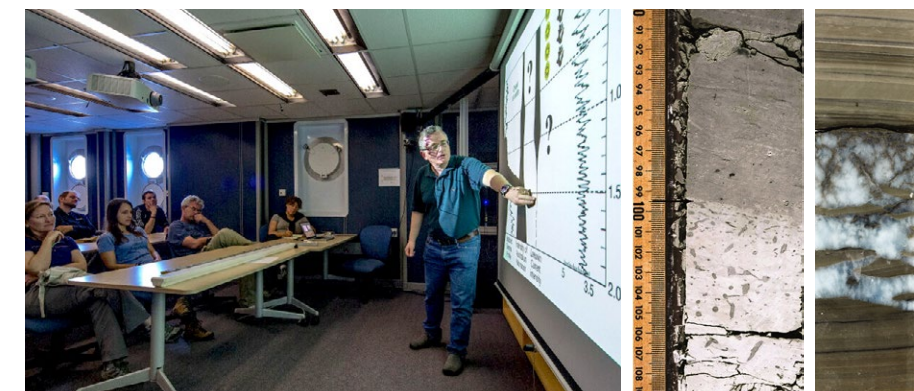
Photos of ANZIC Expeditioners in the region:
Dr. Christina Riesselman, Prof. Rob McKay,
Prof. Helen McGregor, Prof. Simon George
and Prof. Chris Hollis.

Photo credits: Catherine Stickley, Bill
Crawford, Tim Fulton & IODP JRSO



Scientific ocean drilling
sites in the Australasian
Region.

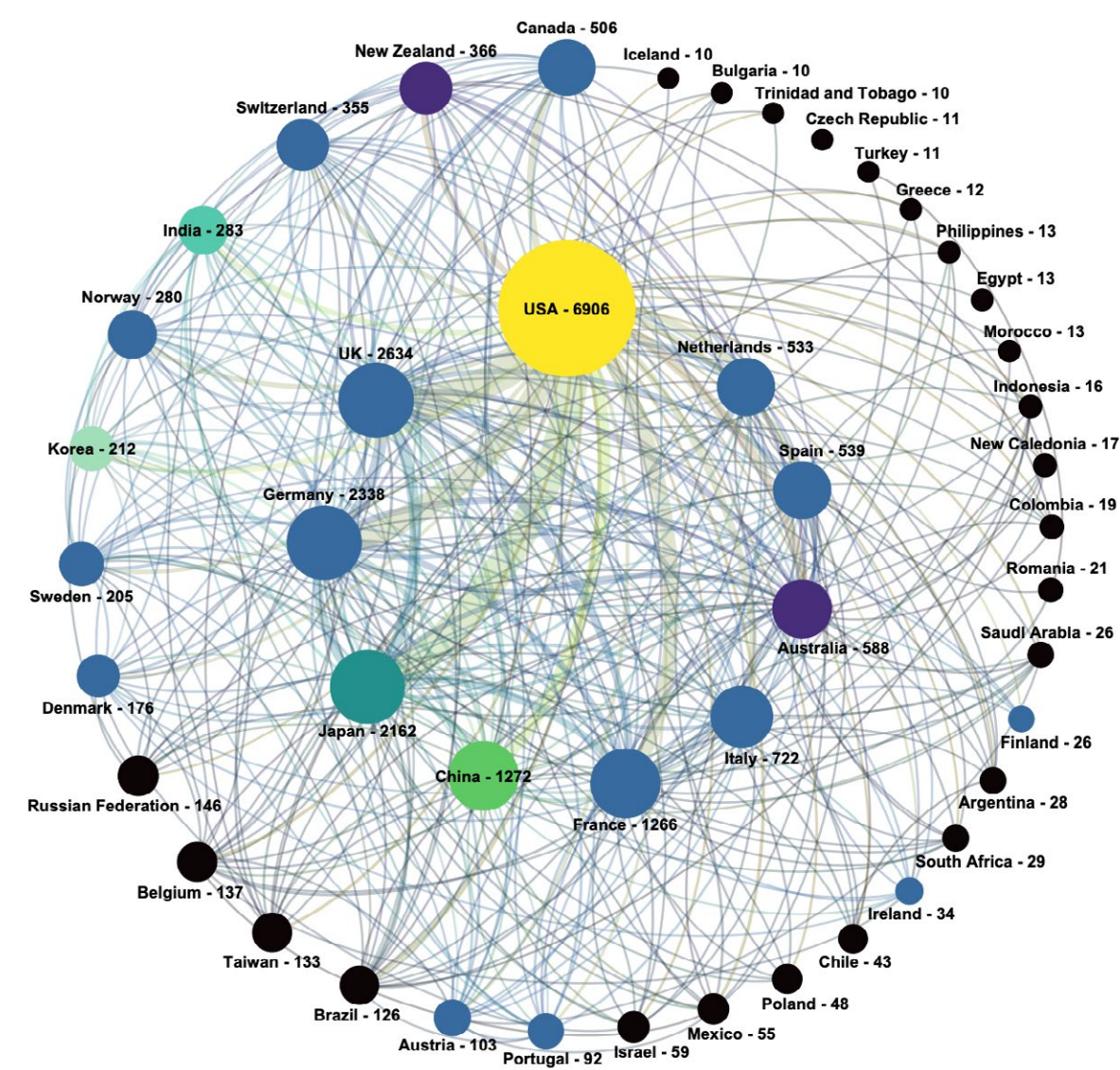
Assoc. Prof. Stephen
Gallagher briefs the
Exp 356 science party
and cores from the
expedition.



Publication Networks

Since the inception of scientific ocean drilling in 1968, ANZIC scientists have contributed over 4,879 publications, representing 11.8% of the publications globally. The 2021 and 2022 records of ANZIC contributions are extracted from the Scientific Ocean Drilling Bibliographic Database, compiled annually by the JOIDES Resolution Science Operator (JRSO).

ANZIC Publication co-author networks *



* Co-author networks for all authors of program-related peer-reviewed journal articles (2003–2022).
Records in the Scientific Ocean Drilling Bibliographic Database as of June 2022 by affiliation country of all authors.
By JRSO Publications Office: 2022 Scientific Ocean Drilling Bibliographic Database 4 and Publication Impact Report.

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.

Date of publication	Scientific ocean drilling journal articles in top three science journals*			Scientific ocean drilling journal articles in next top twenty Earth science journals†			All peer-reviewed scientific ocean drilling journal articles	
	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	0	0	329	33	1,995
1988–2003	18	1	183	49	12	1,300	222	4,069
2004–2007	3	1	75	18	10	572	108	1,581
2008–2013	8	5	111	47	26	978	141	2,172
2014–2015	9	1	33	26	14	376	70	842
2016–2022‡	14	9	101	153	66	1,538	367	2,180
Total	54	20	679	293	128	5,093	941	12,839

Notes: This table was prepared in September 2023 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 categorised 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 2016–2022 = IODP ANZIC Phase 3 (direct). * = Top three science journals (based on Clarivate Analytics journal impact factor) = Nature, Science, and Nature Geoscience. † = Next top twenty Earth science journals (determined by journal impact factor of journals in ISI Web of Knowledge categories related to Earth science) = Nature Communications; Earth-Science Reviews; Proceedings of the National Academy of Sciences of the United States of America; Earth and Planetary Science Letters; Geology; Geophysical Research Letters; Geochimica et Cosmochimica Acta; Geological Society of America Bulletin; Scientific Reports; Climate of the Past; Marine and Petroleum Geology; Tectonics; Quaternary Science Reviews; Journal of Geophysical Research (Solid Earth, Oceans); Chemical Geology; Global and Planetary Change; Journal of Petrology; Paleoclimatology and Paleogeography (including Paleoclimatology because journal name changed in 2018); Geochemistry, Geophysics, Geosystems; and Contributions to Mineralogy and Petrology. 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 2022 only reflect citations that were added to the database by June 2023 and may not represent a complete total of 2022 publications.

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 an author representing Australia	Publications with an author representing New Zealand	Total publications with an author representing Australia and/or New Zealand	Total scientific ocean drilling publications	Percentage of publications with an author representing Australia and/or New Zealand
1968–1987	223	181	290	9,100	3.2
1988–2003	2,194	150	2,311	13,925	16.6
2004–2007	330	87	385	3,886	9.9
2008–2013	395	241	598	5,694	10.5
2014–2015	240	112	310	2,234	13.9
2016–2022†	674	369	985	6,551	15.0
Total	4,056	1,140	4,879	41,390	11.8

Notes: This table was prepared in September 2023 by IODP Publication Services based on data in the Scientific Ocean Drilling Bibliographic Database, a subset of GeoRef hosted by the American Geosciences Institute. 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 categorised 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 2016–2022 = 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 2022 only reflect citations that were added to the database by June 2023 and may not represent a complete total of 2022 publications.

2021-2022 Publications

ANZIC member researchers in the program once again generated significant published works arising from IODP science, with a total of 133 publications for Australia and New Zealand authors in 2021 and 2022, where 48 were ANZIC first authored papers. Overall, there were 1151 publications in IODP science from global scientists in 2021 and 2022. The following alphabetical list includes records from the Scientific Ocean Drilling Bibliographic Database, with ANZIC researchers highlighted in bold. <http://iodp.americangeosciences.org/vufind>

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