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## A summary of ANZIC in IODP, 2008–2013

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IODP is the world's largest international scientific geoscience program, with a yearly operational budget of about US\$180 million and 26 participating nations at the end of 2013. IODP deploys two large drilling vessels and other drilling platforms on scientific expeditions. Australian and New Zealand scientists, through ANZIC, have at least one position on each expedition. The coring platforms and core repositories are provided by foreign entities, and we obtain access to them by paying membership contributions. The platforms are in three categories: the workhorse vessel *JOIDES Resolution*, the deep-drilling vessel *Chikyu* and the alternative platforms provided by the European Consortium for Ocean Research Drilling (ECORD).

In 2013, 14 Australian universities and four government research agencies were part of the ANZIC consortium, along with two government agencies and two universities from New Zealand. Our annual funding of about AU\$2.5–3 million came from the Australian Research Council and our Australian and New Zealand members, and US\$1.5–1.8 million of this went toward our IODP memberships.

Through the ANZIC consortium, Australia and New Zealand are important players in the exciting IODP project, with the eager participation of many scientists. With our partners including nearly all the major science

organisations on Earth (those from Brazil and Israel being the latest to join), we have direct access to, and active engagement with, the world's best scientific minds. We estimate that from early 2008 until late 2013, at least 80 Australians and 20 New Zealanders have worked on ocean drilling science, and our scientists' voices are respected in key international decision-making committees. Our member universities and research organisations have worked exceedingly well together, and with their international counterparts. Our contribution to scientific ocean drilling has been substantial, with the involvement of Australians in 9 per cent and New Zealanders in 3 per cent of all refereed publications at the end of 2013 – all for a 1 per cent contribution to the overall US\$180 million annual international operational budget.

Membership of IODP is critical to helping us maintain our leadership in Southern Hemisphere marine research. The Australasian region saw five IODP expeditions in 2009 and 2010 (with an Australian co-chief scientist on one of them), another four occurred in 2015 and 2016, and 10 have been scheduled for 2017 and 2018. We have at least one scientist on all IODP expeditions and, on regional expeditions to which our scientists have provided much input, that number can increase to four or five, often including a co-chief scientist.

The generosity of our major partners means that we get a marvellous return on our very modest investment in the international operational budget, and access to assets worth around US\$1 billion. Note that an average two-month IODP expedition recovers thousands of metres of sediments and rocks that provide a wonderful store of highly varied information for subsequent investigation.

From 2008 to 2013, ANZIC put 34 scientists on 25 IODP expeditions (of a possible 32), and another two were part of a science party but did not go to sea. Of the 35 scientists directly involved, 29 were based in Australia and seven in New Zealand. We also put a New Zealand science communicator aboard one expedition.

The expeditions were split geographically as follows:

- Western Pacific Ocean: 14 (7 in our region; 7 *Chikyu* in northwest Pacific)
- Eastern Pacific Ocean: 6
- Southern Ocean: 1 (in our region)
- Atlantic Ocean: 3

The expeditions could be split roughly as follows:

- Deep Biosphere and Subseafloor Ocean: 2 (1 in our region)
- Environmental Change, Processes and Effects: 9 (4 in our region)
- Solid Earth Cycles and Geodynamics: 14 (1 in our region; 5 *Chikyu* in northwest Pacific)

The expeditions of most immediate scientific interest to us were those in our region:

- Canterbury Basin Sea Level Expedition 317 was drilled by the *JOIDES Resolution* east of New Zealand's South Island, and included the deepest sedimentary hole (2,000 m below the sea floor (mbsf)) ever drilled by the ship without re-entry to the drill hole. It has provided excellent information about global sea-level rise and fall in the last 15 million years.
- Wilkes Land Glacial History Expedition 318 was drilled by the *JOIDES Resolution* north of the Australian Antarctic Territory, and revealed a great deal about the change from a warm Antarctica 33.5 million years ago to its present state, including the dramatic cooling of the ocean. For example, it showed that palm trees grew on the Antarctic margin 55 million years ago.
- Great Barrier Reef Environmental Changes Expedition 325 was drilled by the *Greatship Maya* into ancient reef platforms seaward of the Great Barrier Reef. It has provided material for a unique study of the ancestral reefs at the peak of the last glaciation (then 140 m below the present sea level) and those that formed as sea level rose as the Earth warmed thereafter. It has provided important evidence that sea level rose at highly variable rates.
- The South Pacific Oceanic Gyre Subseafloor Life Expedition 329 was drilled by *JOIDES Resolution* in the south-central Pacific. It was designed to test the depth to which microbes survive and examine their nature in one of the lowest productivity regions on Earth. It showed that microbes were relatively rare here but did exist to considerable depths. The concentration profiles of oxygen and nitrate demonstrate that the rate of microbial respiration is generally extremely low.
- The Louisville Seamount Trail Geodynamics Expedition 330 was drilled by *JOIDES Resolution* and covered a northwest-trending seamount trail east of the Tonga Trench. It was designed to test whether the Louisville hotspot had remained fixed over time, and whether

the nature of volcanic seamounts changes over time. It showed that the hotspot had remained fixed and that there was petrologically homogeneous volcanism through time.

As regards publications, membership strongly affects output, but there is also a time lag of some years. Neither Australia nor New Zealand was a member in the early days of ocean drilling, although Australia was a member of ODP from 1989 to 2003, and Australia and New Zealand joined IODP only in 2008. The number of actual publications from IODP expeditions since then is only a small proportion of what we expect in the longer term. It is worth noting that 11.4 per cent of ocean drilling publications had ANZIC authors from 2003, when IODP started, to 2013. The total number of recorded refereed DSDP–ODP–IODP publications with Australian and/or New Zealand authors up to 2013 is 3,451, or 12 per cent of all publications.

Two major international planning workshops were held during this period – the IODP New Ventures in Exploring Scientific Targets (INVEST) workshop in Bremen, Germany, in 2009, and the Chikyu+10 workshop in Tokyo in 2013 – and ANZIC scientists were heavily involved in both. Two major regional Australian-inspired workshops were also important. The first such workshop was the Indian Ocean IODP Workshop held in Goa, India, in 2011. This workshop brought scientists interested in ocean drilling in this region together to plan IODP proposals that have led to a series of expeditions in the Indian Ocean in 2015 and 2016. The second was the Southwest Pacific Ocean IODP Workshop held in Sydney in 2012. It also led to a number of proposals that have or will come to fruition with Pacific Ocean drilling in 2016, 2017 and 2018.

There have been port calls with associated ship visits and publicity in Townsville, Hobart, Wellington and Auckland by the *JOIDES Resolution*, and in Townsville by the *Greatship Maya*. The Hobart port call was attended by local scientific leaders and the then Minister for Innovation, Industry, Science and Research, the Honourable Kim Carr, and many others. The New Zealand port calls featured extensive visits and excellent media publicity.

Outreach activities remain central to ANZIC's mission; in both 2012 and 2013, we funded 20 university undergraduate students to attend an ANZIC Marine Geoscience Masterclass in Perth, with the aim of inspiring the next generation of scientists to work in this exciting area of research. Their feedback was very positive.

The Allen Consulting Group in Canberra carried out a review of Australia's participation in the Integrated Ocean Drilling Program that was finalised in March 2013 ([iodp.org.au/publications/independent-review-of-australian-participation-in-integrated-ocean-drilling-program/](http://iodp.org.au/publications/independent-review-of-australian-participation-in-integrated-ocean-drilling-program/)). They concluded:

that the benefits to Australia of direct membership of the IODP consortium far exceed the modest costs of participation. Moreover it would be detrimental to Australia's interests not to be a member of the next phase of scientific ocean drilling. Participation in this next phase is well aligned with current government policy as articulated in the 2012 National Science Investment Plan, the aspirations of the Australia in the Asian Century White Paper and Australia's policy of fostering international scientific collaborations (see Chapter 12 for more about this review).

The first 10-year phase of IODP, IODP(1), ended in September 2013, with another 10-year phase of ocean drilling from late 2013 to 2023 under the new name International Ocean Discovery Program (IODP(2)) with the same acronym, IODP. The structure of the new program is much looser than the previous one, with those who provide the vessels – the US, Japan and Europe – having ultimate control of the associated programs. Australian institutions received funding for two years (2014 and 2015) under an ARC/LIEF grant and this was later renewed for 2016 to 2020, and New Zealand remains in ANZIC for that period.

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