IceSked

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A Word From the Director

With the most important global climate change negotiations to date happening in Paris this month the timing could not be better for newly published, highly relevant research from ARC staff and students. These studies highlight the importance of limiting global warming to less than 2°C above pre-industrial levels if major loss of the Antarctic ice sheet is to be prevented. *Tim Naish*

A Third Prestigious Rutherford Fellow in the ARC

Nick Golledge, a Senior Research Fellow in the ARC has been awarded a Rutherford Discovery Fellowship of $800,000 over five years to continue his leading-edge research in aspects of global climate stability. Nick joins the ranks with fellow ARC colleagues, Nancy Bertler and Rob McKay who were awarded their Rutherford Discovery Fellowships in 2011 and 2013, respectively.

Nick received one of twelve fellowships which are designed to support and foster the development of future leaders in the New Zealand science and innovation system by encouraging their career development and enabling them to establish a solid track record for future research. He plans to use his fellowship to further understanding of how the Antarctic ice sheet, the largest ice sheet on Earth, will respond to a warming world and the contribution it is likely to make to future sea-level rise.

"With around 10 percent of the world's population currently living less than 10 metres above sea level," says Nick, "the societal impact of the potential collapse of the Antarctic ice sheet would be significant."

Nick says he is delighted to be awarded a Rutherford Discovery Fellowship and excited about the new research possibilities that it will facilitate.

"Particular benefits of receiving the Fellowship are the international collaborations that I hope to develop and the two new PhD students that the funding will support."

Nick started his career as a geologist with the British Geological Survey (BGS), based in Edinburgh, Scotland. During his 12 years with the BGS he mapped and interpreted the geological deposits of past ice sheets, but it was during his PhD research (undertaken part-time while at the BGS) that he began to appreciate the strength of computer modelling as an additional tool in the reconstruction of past ice sheets and the climates that gave rise to them. Since moving to New Zealand in 2009, Nick has focussed on the Antarctic ice sheet, using computer models to simulate ice growth and decay during periods of the past that otherwise can only be inferred from sparse geological records. This research is now looking to the future, attempting to predict the ice sheet changes that might occur as the climate warms.

Nick Golledge

Ocean Researcher Recognised by a Royal Society of New Zealand Honour

The scientific contribution of the ARC's Lionel Carter has been recognised with the presentation of the 2015 Hutton Medal. Awarded annually by the Royal Society of New Zealand, the medal recognises outstanding research in earth, plant and animal sciences.

Lionel investigates geological and oceanic processes, which includes deciphering marine geological records to assess changes in ocean environments. His work has demonstrated the roles of plate tectonics, ocean currents, sea levels and climate change in shaping New Zealand's submarine continental landmass.

Of particular note, Lionel identified the mechanisms whereby sediment from New Zealand rivers is discharged into the ocean and transported up to 4,500 kilometres, to be dragged into converging tectonic plates and ultimately recycled to the surface via volcanic activity. He has contributed to identifying indicators in sediment to measure environmental change, as well as scientific models to predict environmental responses to climate warming. Recent work includes participation in ANDRILL: A drilling programme in Antarctica to identify the effect of a changing Ross Ice Shelf on ocean circulation and water mass.

His research has had direct commercial application through a range of marine engineering projects such as the International Cable Protection Committee to better protect the global fibre-optic cable network from marine hazards. The network is responsible for around 95 per cent of all international internet and communications traffic.

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Ocean Researcher Recognised by a Royal Society of New Zealand Honour continued

"I am deeply honoured to receive the Hutton Medal for 2015," says Lionel. "But it is an honour to be shared. Research into environmental change is a team effort involving experts in geology, oceanography, climatology and computer modelling, to name but a few".

"I have been fortunate to have been part of such teams, the latest being the highly talented group from the Antarctic Research Centre of Victoria University."

The Hutton Medal adds to Lionel's other honours, including being made a Fellow of the Royal Society of New Zealand in 2003 and receiving the Marsden Medal for outstanding service to Science in 2012.

Lionel Carter (left) receiving his medal from RSNZ Vice President Barry Scott
Photo credit: Royal Society of New Zealand

A Science Story: Direct Evidence of Ice Sheet Instability in the Recent Geological Past

Sea-level rise in the next century will become increasingly dominated by glacier and ice sheet contributions, and threshold behaviour could bring unwelcome surprises. Of particular concern is the 'marine ice sheet instability', where initial retreat of an ice margin into a deepening valley leads to progressive, unstable ice loss. Two recent ARC publications have highlighted the role that this instability mechanism played in the retreat of the Antarctic ice sheet in the Ross Sea region following the last ice age (~20,000 years ago). Both of these studies imply that once triggered, marine ice sheet retreat could be rapid and persist for centuries in the absence of further forcing.

Richard Jones (a current ARC Postdoctoral Fellow) led a study published in *Nature Communications*, with his PhD supervisors Andrew Mackintosh, Kevin Norton (SGEES) and Nick Golledge. Using results from the newly developed Beryllium-10 dating facility at VUW, Richard showed that Mackay Glacier, an outlet of the East Antarctic Ice Sheet, underwent rapid thinning around 7,000 years ago, in a climate similar to present. This is the first study to unambiguously link geological evidence of rapid ice surface lowering to the marine ice sheet instability. It also shows that glacier thinning events, similar to those observed by satellites in rapidly changing parts of Antarctica today, may continue unabated for centuries.

Glacial erratic deposited by a once thicker McKay Glacier is dated using cosmogenic isotopes to work out the history of thinning

Working on ANDRILL site survey cores collected beneath the Ross Ice Sheet, in the vicinity of the proposed Coulman High drilling project, the ARC's Rob McKay, Nick Golledge, Tim Naish, Gavin Dunbar, and MSc graduate Sanne Maas led a paper in *Geology* that showed this process of marine ice sheet instability was widespread during the deglaciation in the central regions of the Ross Sea. They obtained an age for the retreat of the ice sheet in central Ross Sea more than a thousand years earlier than previous studies from coastal sites in the Western Ross Sea. Supporting ice sheet model output indicates that substantial ice loss could have occurred in the central Ross Sea prior to the Holocene and may have contributed to rapid global sea-level rise (e.g. Meltwater Pulses) of up to 4 m per century.

Of concern is a growing realisation that the marine ice sheet instability may cause significant ongoing loss of Antarctic ice sheet mass for millennia to come even if climate stabilises. Studies using ice sheet model simulations for future carbon dioxide emission pathways, including one led by Nick Golledge published in *Nature* last month, predict an on-going commitment to many metres of global sea-level rise if Earth's climate warms more than 2°C above pre-industrial levels – the United Nations "safe" climate limit. Together, these two geological studies provide the first evidence that this process has actually occurred in the past.

Andrew Mackintosh and Rob McKay

Jones, R.S., Mackintosh, A.N., Norton, K.P., Golledge, N.R., Fogwill, C.J., Kubik, P.W., Christl, M., Greenwood, S.L., (2015). Rapid Holocene thinning of an East Antarctic outlet glacier driven by marine ice sheet instability. *Nature Communications* 6:8910 doi: 10.1038/ncomms9910

McKay, R., Golledge, N.R., Maas, S., Naish, T.R., Levy, R., Dunbar, G., Kuhn, G., (2015). Antarctic marine ice-sheet retreat in the Ross Sea during the early Holocene. *Geology* doi:10.1130/G37315.1

Mountain Glacier Research

In October, funding through the S.T. Lee Young Researcher Travel Award allowed me to visit the Antarctic Research Centre for two weeks. Affiliated with the University of Alaska Fairbanks, I model the current and future evolution of selected Alaska glaciers, using a model suite originally developed by the ARC's Brian Anderson. The visit was very useful, allowing me to discuss the model and my modifications directly with the developer of the code. Collaboration with Brian further allowed me to initiate some of the upcoming programing efforts and to discuss the future of the model in general.

My visit confirmed that although our field areas differ in many aspects, there is significant overlap between the glacier research at the ARC and my work. In addition to the glacier modelling, we discussed various other methods and results of our work. Among the highlights was Brian's introduction to his group's unmanned aerial vehicle setup for glacier surveying, his presentation of their efforts for deriving transient snow line elevations through airborne campaigns, and the discussion of a regional mass balance study led by Andrew Mackintosh, which sheds new light on the atypical recent advances of some New Zealand mountain glaciers.

Overall, I benefited greatly from the immersion in the group and am very grateful for having received the S.T. Lee Travel Award. In addition to the scientific enrichment, I was delighted to escape the long Fairbanks winter for a few weeks. *Christian Kienholtz*

Christian Kienholz at Cape Reinga, New Zealand

The Southern Ocean and the Future of Antarctica

Steve Rintoul presenting his lecture in the Hunter Council Chambers, VUW

The 13th annual S.T. Lee Lecture in Antarctic Studies "The Southern Ocean, climate change and the future of the Antarctic ice sheet: A soft underbelly in East Antarctica?" was presented by Dr Steve Rintoul to a full house on 15 September.

Steve was an outstanding speaker, who had an arduous week, involving three presentations, media interviews, a round table meeting discussing the latest science around sea-level rise at the NZ Parliamentary Commission for the Environment, meetings with GNS Science, NIWA and VUW scientists, multiple social events and a field trip in the rain to the Wairarapa.

Steve is a Fellow at the CSIRO Oceans & Atmosphere Flagship and the Antarctic Climate and Ecosystems Cooperative Research Centre in Hobart. His research is focused on the role of the ocean in the climate system. He has a particular fascination for the Southern Ocean, where his work has led to a deeper appreciation of the influence of the region on global climate, biogeochemical cycles and biological productivity. He has led 12 expeditions to Antarctica and coordinated the major international Southern Ocean climate research programs conducted over the past 25 years. Steve was a Coordinating Lead Author for the 5th Assessment of the Intergovernmental Panel on Climate Change. His scientific achievements have been recognised by many national and international awards, including the Georg Wüst Prize, the Martha T. Muse Prize, the Australian Antarctic Medal, and election as a Fellow of the Australian Academy of Science.

Steve gave a repeat of his S.T. Lee Lecture at the University of Otago on the 16th, hosted by Gary Wilson. Otago have strong research interests in his specialist area and ARC have a close collaboration with many of their researchers. Overall it was a highly successful week and significantly raised the profile of the role of Antarctica in climate change research and the importance of the UN Paris climate change negotiations.

You can view Steve's lecture at:
http://www.victoria.ac.nz/antarctic/about/events/s-t-lee-lecture/s.t.-lee-lecture-2015

And his media interviews:

RNZ Nine to Noon -
http://www.radionz.co.nz/national/programmes/ninetonoon/audio/201770834/east-antarctica-ice-sheet-melting-faster

RNZ Our Changing World -
http://www.radionz.co.nz/national/programmes/ourchangingworld/audio/201770705/east-antarctica-not-a-'sleeping-giant'

NZ Herald -
http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11315512

OTHER ACTIVITIES

More Celebrations for the ARC

Congratulations to Nancy Bertler and Rob McKay who are amongst the successful PI's recently awarded a Marsden Fund in the 2015 awards. Their project "Predicting a sea change: Antarctic ice-ocean interactions in a warming world" involves the integration of high-resolution marine and ice core records and numerical modelling to better understand ice-ocean interactions in the Ross Sea. ARC colleagues Lionel Carter and Nick Golledge are also associated with the project, which will receive $810K over three years.

ARC staff have been PI's on 11 Marsden projects since 2001, seven Fast Starts and four standard grants.

VUWAE 9 Reunion Hosted at the ARC

On 4 November five members of VUWAE 9 met here at the ARC to celebrate 50 years since their expedition. They were geologists Warwick Prebble (Leader) and Jim Cole, physicists Robin Bell and Ray Hoare, and biologist Alan Baker. Geologists Tony Ewart (Queensland) and Don Palmer (Ohio) sent their best wishes. The remaining members could not be located or were known to have passed away.

ARC Director Tim Naish welcomed VUWAE members and spoke about current Antarctic research. VUWAE 9 members each gave a brief outline of their 1964-65 work – geologists on Black Island, Brown Peninsula, the Koettlitz ice free region and Taylor Valley; physicists and biologist on Brown Peninsula; lakes Vanda, Miers and Taylor; and the Wright and Miers valleys. Four ARC scientists (Peter Barrett, Andrew Mackintosh, Nancy Bertler, Rob McKay) outlined past and current projects.

(left to right) Robin Bell, Warwick Prebble, Alan Baker, Jim Cole and Ray Hoare

VUWAE 9 memories:

Potato Cakes - These were the ultimate nutritional blizzard food. Take equal parts of self-raising flour and potato powder. Add powdered milk, egg, salt, pepper and mix with snow until of a good consistency. Deep fry in New Zealand butter over a kerosene primus to taste. Serve with a sauce of powdered meat and tomato soup. *Robin Bell*

How Not to Store your Boots - I can remember my first night at Scott Base. The base was full so I and several others slept in the hangar, which had an iron-grating floor. After the long flight and the excitement of arrival, I was keen to get into my sleeping bag, and duly took my boots off and put them on the floor forgetting the soles were wet. Next morning, to my embarrassment, I had to use my hammer to detach my boots from the floor! *Jim Cole*

We warmly encourage any other VUWAE parties considering a reunion or small gathering to contact us and use our facilities to reunite and reminisce, but also to find out what is happening at the ARC today, as part of your legacy.

Rachael Rhodes in Cambridge

Where are they Now?

After completing my PhD with the ARC at Victoria University in 2011, I moved to the USA for a 4-year postdoctoral position at Oregon State University, working with Ed Brook. My research involved an exciting new analytical advance in ice core science: Using a laser spectrometer to measure trace gases continuously. Highlights were having a paper on the WAIS Divide methane record published in *Science* and fieldwork in NE Greenland and Taylor Glacier, Antarctica.

This May I moved back to the UK and worked in Robert Mulvaney's lab at the British Antarctic Survey. We analysed shallow cores from West Antarctica to constrain accumulation rates for the iSTAR project.

Recently, I started a Marie Curie Individual Fellowship working with Eric Wolff at the Department of Earth Sciences, University of Cambridge. My aim is to reconstruct changes in Arctic sea ice across abrupt climate events using a combination of Greenland ice core chemistry and an atmospheric chemistry transport model. Modelling is a new, tricky challenge for me. I'm excited by all the questions I plan on answering…if I can ever get the thing to run… *Rachael Rhodes*

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