

IceSked

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Newsletter of the Antarctic Research Centre
Victoria University of Wellington

A Word From the Director

Time flies when you're having fun! It's hard to believe that it's almost five-years since I took over the reins from Peter Barrett as Director of the Antarctic Research Centre. We seem to be on track given that Peter feels it's now safe to retire at the end of the year. It remains a privilege to work each day with such a committed and talented team of staff and students. This year, we popped the champagne corks and celebrated Nick Golledge's Marsden Fast-Start success, Lionel Carter's Marsden Medal, two PhD and six MSc completions, and we prepare for a celebration of Peter's retirement.

Tim Naish

Lionel Carter Awarded 2012 Marsden Medal



Lionel Carter receiving his Marsden Medal from Hon. Steven Joyce, Minister of Science and Innovation

Congratulations to Lionel Carter, this year's recipient of the New Zealand Association of Scientists (NZAS) highest honour, the Marsden Medal. As stated on the NZAS website, "The Marsden Medal is awarded for a lifetime of outstanding service to the cause or profession of science... in the widest connotation of the phrase." The citation summarising

Lionel's contribution recognises an outstanding 40 year research career as a practicing geoscientist making significant contributions to marine geology, palaeoceanography, and applied marine geology. Put quite simply our present knowledge of the undersea extent of the New Zealand continent and its interaction with water masses that originate in the Antarctic and tropical Pacific would not exist without Lionel's research career...which has transformed our knowledge of the interaction between climate, topography and ocean circulation with important implications for understanding the processes that have formed NZ's undersea exclusive economic zone.

After completing a PhD at the University of British Columbia, Canada, he joined the New Zealand Oceanographic Institute in 1973 (now NIWA) where he spent the next 32 years as Project Director, Project Leader and Principal Scientist and participated on 35 oceanographic research voyages, 26 as voyage/science leader. He has been an invited scientist on five international voyages including Leg 181 of the Ocean Drilling Program. He has published over 130 refereed papers in international scientific journals, which have been cited more than 2000 times. Much of the research is applied to industry especially regarding the protection of the global subsea

fibre-optic cable network that underpins international communications and the internet. During his career he has been a passionate educator and public communicator disseminating scientific results via the media, talks to the public and policymakers on the oceans and the impacts of climate change as well as popular articles. In 2003 he was made a Fellow of the Royal Society of New Zealand.

Since 2005, when Lionel became Professor of Marine Geology at Victoria University, he has relished teaching in both the undergraduate and graduate programmes. He has supervised more than 24 postgraduate students, receiving in 2011 the Postgraduate Students Association Award for "Most Popular Supervisor" – an impressive feat given that most of his career was spent at a Government research institute.

Although contemplating retirement, or at the very least more time with his wife Susan and widely dispersed family, Lionel remains dedicated to the cause. With colleagues and students he continues to publish insightful research on New Zealand's climate and oceans in a warmer world, and is a passionate advocate for New Zealand's world class climate and marine research community.



A Science Story – Modelling the Antarctic Ice Sheet at the Last Glacial Maximum

The Antarctic ice sheet is the largest ice mass on Earth and its complete melting would raise global sea level by ~58 metres. Many questions remain unanswered concerning how this immense feature will respond to future warming. Over the last few years, thanks to a substantial donation by Alan Eggers, the Antarctic Research Centre has developed significant expertise in glaciology and modelling. As part of this effort, Nick Golledge led a paper in the prestigious journal *Proceedings of the National Academy of Sciences* on ice sheet modelling of the Antarctic ice sheet at the Last Glacial Maximum (LGM), the peak in the last 'ice age' around 20,000 years ago. This modelling study is one of the first to be constrained by geological evidence from this period, and parallel computing allowed this model to be applied at a higher spatial resolution (5 km) than many previous efforts. The reward has been an improved understanding of how ice sheets respond to climate forcing.

In the absence of a comprehensive understanding of ice sheet processes and due to the short period (~decades) of observations by satellites, geological records of past ice sheet behaviour provide important clues into the nature of ice sheet response. The period between the LGM and today is especially meaningful, because 'footprints' left behind by the Antarctic ice sheet are recorded as geological evidence in the ice-free regions in Antarctica. Together with ice core records from the Antarctic interior, these constraints document the changes that occurred in the Antarctic ice sheet during the last period of major climate warming. Ice sheet models can 'add value' to this geological data by providing a continental-scale interpretative framework for answering questions about how the ice sheet responds to climate forcing.

The model used by Nick, known as the Parallel Ice Sheet Model (PISM), was developed at the University of Alaska, Fairbanks. Nick, with support from the 2010 S.T. Lee Travel Award to Fairbanks, is now an experienced user of this model. Kevin Buckley from Victoria University's School of Computer Science and Engineering, helped to develop the computing infrastructure to run the model on supercomputing facilities. Together, with Dr Chris Fogwill, a glacial geologist from the University of New South Wales and myself, Nick was able to simulate the ice sheet during the LGM in a manner that was consistent with geological evidence.

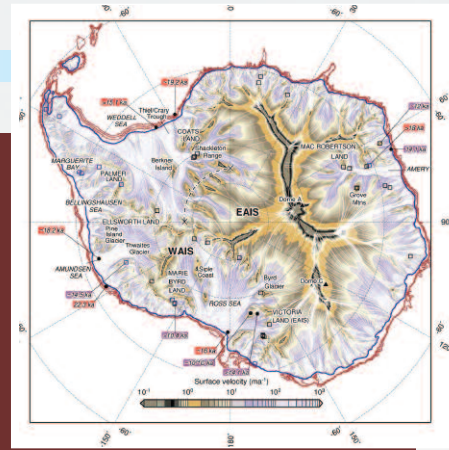
A good fit between model and data provided an opportunity for further experimentation, and in particular, a chance to better understand how the ice sheet responded to climate forcing. In the second part of the paper, Nick and the team showed the modelled ice sheet was sensitive to small changes in ocean

temperature and sea level rise around its margin, and this led to far-reaching changes in the ice sheet interior. In other words, the results revealed that changing ocean conditions don't just affect the ice sheet margins, but a close connection in the model exists between the Southern Ocean and the ice sheet interior, through narrow corridors of fast moving ice, known as ice streams. This finding is important because melting of the polar ice sheets has been one of the key uncertainties in predicting future sea level rise, and these results imply a rapid response from the ice sheet as the ocean around Antarctica warms.

This paper represents an important step, but there is still much to learn about the Antarctic ice sheet and its response to climate forcing. Present-generation ice sheet models for the most part do not solve for the full stress field within ice sheets, and many aspects of ice sheet models (e.g. climate forcing or boundary conditions) are inadequately represented or poorly known. The Antarctic Research Centre now includes scientists working on the development and application of models, and also in the collection of the glaciological data required to test them. I am hopeful that we will continue, as Nick has done in this study, to move forward and ultimately develop a more complete picture of the nature and rate of future ice sheet response.

Andrew Mackintosh

Golledge, N.R., Fogwill, C.J., Mackintosh, A.M., Buckley, K.M., 2012. Dynamics of the Last Glacial Maximum Antarctic ice-sheet and its response to ocean forcing. *Proceedings of the National Academy of Sciences of the United States of America* 109(40): 16052-16056, doi: 10.1073/pnas.1205385109.



Modelled surface velocity of the Antarctic ice sheet at the LGM. The modelled ice sheet includes vast areas of relatively slow flow, as well as narrow corridors of faster flow known as ice streams. In this study, ice streams served as conduits for propagating a signal of sea level rise or oceanic warming into the interior of the ice sheet



*The Aurora above Alice's hostel in Fairbanks
(Photo by fellow guest, Eiichi Matsuyama)*

S.T. Lee Young Researcher Travel Award

Two researchers from the Antarctic Research Centre headed to Alaska this year supported by the S.T. Lee Young Researcher Travel Award. Andrew Mackintosh visited during June/July, where he met with glaciologists at the University of Alaska, Fairbanks (UAF), presented at the International Glaciological Society Conference 'Glaciers and Ice Sheets in a Warming World', and attended field trips to Denali National Park and Valdez. Highlights included visiting the 50 km-long surge-type glaciers descending off Mt McKinley, the Gulkana Glacier which is a long-term mass balance monitoring site, and the Columbia Glacier, a massive, fast flowing and rapidly retreating tidewater glacier in Prince William Sound. Our other recipient, Alice Doughty, recently headed to Fairbanks in November, greeted by temperatures of minus 32°C, less than 6 hrs of sunlight, and bright green night skies from the Aurora. Alice was working on glacier models and alpine glaciers with the Glaciers Group at UAF including Prof. Regine Hock and the 2011 recipient Marijke Habermann.



Sanne Maas proudly displaying one of her sediment cores from Coulman High

Deciphering the Deglacial History of the Ross Ice Shelf

After moving from Holland and commencing my studies at Victoria University, I was inspired to conduct research in Antarctica. During my MSc research, I was fortunate enough to have this opportunity, undertaking fieldwork in Antarctica, where I collected marine sediment cores at Coulman High, Ross Ice Shelf. My recently completed MSc project was part of the larger ANDRILL efforts in the Ross Sea region. This study provides an additional reconstruction of the glacial and depositional history of the Ross Ice Shelf since the last ice age. Foraminifera collected from the sediment were radiocarbon dated, providing the southernmost foraminifera date for the retreat

of grounded ice in the western Ross Sea since the Last Glacial Maximum. These dates indicate that there were open water conditions at Coulman High around 8,850 (± 55) years before present.

With support from both the ARC Endowed Development Fund and the University, I am now working on publishing work from my thesis. In the future, I hope to be involved in more Antarctic research, until then, I am enjoying my newly found post-masters free time and look forward to graduating this December.

Sanne Maas

“Dust in the Wind...Nothing Lasts Forever but the Earth and Sky” (Kansas, 1977)

In late 2010, I spent a month on a skidoo negotiating sastrugi, breathing through a “gimp” mask and developing throttle-thumb while traversing a ~1,500 km sampling grid on sea ice in western McMurdo Sound. Sea ice works as a natural sediment trap, capturing windblown material in snowdrifts during winter months, rafting sediment out to sea and eventually depositing it in the ocean during summer melt. With support from the ANDRILL Programme, a 2011 GSNZ Hastie Award and 2012 Dominion Post Scholarship, my MSc research focusses on the contribution this aeolian sediment makes to the Ross Sea marine environment. Dust is thought to be an important component of the geological record in the region and a natural fertiliser for plankton blooms that occur there. The goal of my research is to measure, for the first time over a broad area, how much dust actually enters the ocean via sea ice.

This year I’ve analysed the mass, grain size and composition of my samples to improve our understanding of aeolian transport pathways, processes and distribution for the area. Initial results show a complex distribution, with plumes of coarser material close to land and the amount and size of dust decreasing away from source regions. I’m also using a 2D dust transport model to simulate sediment accumulation on sea ice under local wind conditions and to evaluate sediment fluxes during episodic storms as opposed to normalised conditions.

Jane Chewings



Jane Chewings on the look-out while traversing the sea-ice



Prof. Qin Dahe presenting the 10th S.T. Lee Lecture in Victoria’s Council Chambers

S.T. Lee Lecture Celebrates 10 Years

This year marked the 10th year of the S.T. Lee Lecture Series in Antarctic Studies established by Singapore philanthropist Lee Seng Tee. Therefore it was only fitting that a Chinese glaciologist and climatologist, Prof. Qin Dahe, from the China Meteorology Administration, and State Key Laboratory of Cryospheric Sciences, Chinese Academy of Sciences presented “Linking Cryospheric Science in China and Antarctica” on 27 September. Peter Barrett opened the event by giving a brief history of the Lecture and its previous presenters, before Vice-Chancellor Prof. Pat Walsh’s introduction. Prof. Qin reviewed the progress of the current 5th Assessment of the Intergovernmental Panel on Climate Change (IPCC) of which he is a member,

and outlined changes to the global cryosphere. He also highlighted cryospheric science in Asia particularly the research on mapping permafrost and how this affected the construction of the Tibet highway and railway. Prof. Qin ended his presentation with an entertaining summary of his scientific expedition to Antarctica, where in December 1989 he became the first Chinese person to reach the South Pole on foot. He was part of a party of six scientists from China, Japan, France, United States, United Kingdom, and the former Soviet Union, who traversed the entire Antarctic continent, collecting and analyzing samples along the way, with the use of sled dogs between 27 July 1989 and 3 March 1990.

OTHER ACTIVITIES

Victoria's Talent Showcased at NZ IceFest

Victoria University in conjunction with the Antarctic Research Centre was a proud sponsor of and contributor to the inaugural New Zealand IceFest, a month-long festival, held in Christchurch from 14 September-14 October, celebrating the best of the Antarctic. The event hosted various talks, artists, debates and kids activities all of which Victoria staff and students actively took part in.

The festival opened with the "100 Years Dinner" that included a drop of MacKinlay's Replica Edition of Shackleton's Whisky, recently found preserved in the ice. Victoria's talent was on display the following weekend beginning with the premier performance of *These Rough Notes* named for some of the last words written in Scott's diary on his fateful journey to the South Pole. Poems written by Prof. Bill Manhire were set to music by Assoc. Prof. Norman Meehan, sung by Hannah Griffin and accompanied by musicians from the NZ School of Music. The weekend also featured the highly attended debate "What does Climate Change Mean for Us?" where experts, including VUW's Prof. Tim Naish (ARC), Prof. Dave Frame (Climate Change Research Institute), and Dr Adrian Macey (School of Government), discussed the scientific, economic and political implications of climate change for New Zealand. Other events included informal "Science Cafés" where the public had the opportunity to talk with leading Antarctic researchers including Tim and Prof. Peter Barrett, and conversations with experts across various Antarctic themes including Victoria's Dean of Science, Prof. David Bibby on the challenges of energy use in the Antarctic, and Bill on his Antarctic poetry. Also running throughout the festival were science activities with the ARC and GNS Science partnering up on *Flakes, Blobs, and Bubbles*. A concept created by ARC's Dr Dan Zwartz and developed by Dan and PhD student Heidi Roop, kids of all ages learnt about the process of glacier and ice sheet formation. They were then tasked with drawing their version of snowflakes, firn and ice (with air bubbles) which were scanned and collated into an ice core mosaic on display during the festival. This activity has also gone global, being selected as the flagship educational activity for the Association of Polar Early Career Scientists Fall 2012 International Polar Week (see <http://icecoreart.weebly.com/>).

A. Tim Naish presenting the science during the climate change debate

B. Heidi Roop and Michelle Dow (ARC Centre Manager) show off the 'Knowledge Cube' panels they helped create. The panels highlight the collaborative research undertaken by GNS Science and the ARC

C. Kids creating snowflakes for 'Flakes, Blobs and Bubbles'

D. 'These Rough Notes' concert by NZ School of Music



Richard "Dick" Barwick (1929-2012)

Dick was a young lecturer at Victoria University when he was seconded as biologist to the official summer support party of the 1956-58 Commonwealth Trans-Antarctic Expedition. There he met the two geology students of the first VUW Antarctic Expedition (VUWAE 1), Peter Webb and Barrie McKelvey, helping facilitate their explorations. Dick then joined them and the late physicist and expedition leader Colin Bull, for VUWAE 2 and its exploration of the Wright and Victoria Dry Valleys, vividly described 50 years later in Colin's book *Innocents in the Dry Valleys*. Dick's early memories were of "free-wheeling yet self-disciplined roaming and exploring around the outskirts of Christchurch."

He was a keen outdoorsman, skilled in art and photography, and established a career in biology with an MSc (Hons) at Victoria on the ecology of scincid lizards. In 1960 Dick took up a lectureship in zoology at what was to become the Australian National University, Canberra. Dick pioneered animal satellite tracking and monitoring in Australia, and in the mid-1980s, began a long collaboration with Ken Campbell on the evolutionary anatomy and ecology of ~400-million year old Devonian lungfishes, attracting widespread international recognition. For more on Dick's life and career see www.anu.edu.au/emeritus/ohp/interviews/dick_barwick.html

