

IceSked

Issue 26: June 2016

Newsletter of the Antarctic Research Centre
Victoria University of Wellington

A Word From the Director

There is something for everyone in this newsletter. We report on some exciting fieldwork conducted by our staff and students this summer in New Zealand and Antarctica, as well as profile some outreach and communication activities.

Tim Naish

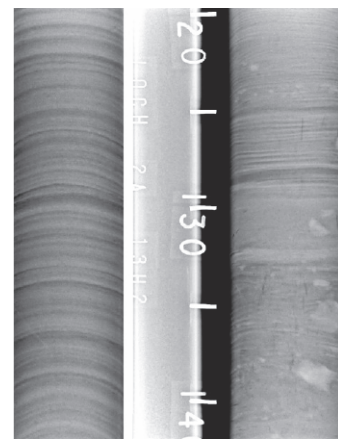
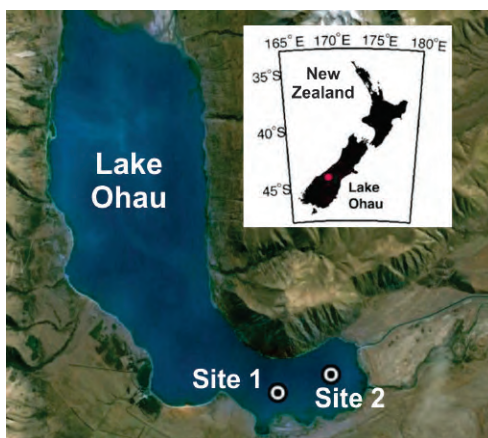
Drilling a 17,000 Year Paleoclimate Record from Lake Ohau, southern New Zealand

Our knowledge of the potential impact of future climate change is limited by the relatively short-duration of instrumental records. For that reason, high-resolution climate records that span millennia are essential to place current climatic changes into a longer perspective. Records from the Southern Hemisphere are particularly scarce. Lake Ohau, South Island formed around 17,000 years ago as glaciers retreated at the end of the last ice age, leaving behind a deep basin. Sediment has been accumulating layer-by-layer over the millennia, creating a geological record up to 80 metres thick. For the past six years a team of researchers led by VUW and GNS Science have been working towards coring this sediment. And finally we have done it! The LOCH (Lake Ohau Climate History) drilling project was completed in February-March this year at two sites in the south eastern arm of the lake using a purpose-built barge operated by Webster Drilling and Exploration Ltd. The size and weight of the barge and its support vessel (from University of Otago Department of Marine Sciences) caused us a few problems as Ohau lived up to its name (=‘place of wind’ in Te Reo) and our original anchors began dragging on the bottom. With new anchors in place the movement stopped and coring was able to begin. We used a hydraulic piston corer, similar to the system used by the Ocean Drilling Program, and successfully double-

cored two sites for a grand total of ~230 metres of core. As the cores came ashore we were able to x-ray them to get a sense of what we had recovered. We were delighted to find layer after layer of mm-thick mud laminations going all the way to the bottom of the hole. The layers become thinner and more distinct with depth, indicating significant environmental change around the lake and most likely in the nature of the lake itself. The very oldest lake sediments contain a feature common in Antarctic marine sediments – namely ‘drop stones’ caused by iceberg rafting of gravel sized material from the head of the lake. Today the glaciers in the river valleys feeding Lake Ohau are many kilometres from the river mouth, but at the time of the drop stones the glaciers must have terminated in the lake itself, as the Tasman Glacier does in Lake Pukaki today. We are in the process of CT (3D x-ray) scanning all of the core, measuring its magnetic and physical properties and carrying out preliminary pollen analysis. New information gleaned from this unique record will help reconstruct patterns of environmental change, including temperature and precipitation changes on inter-annual to millennial timescales. These observations will then be integrated with global and regional climate models to help investigate the causes of climate variability in the Southern Hemisphere mid-latitudes.

Gavin Dunbar

Location of LOCH project core sites; LOCH project drill rig and barge (on right) and the support vessel ‘Beryl Brewin’ with tender on left; x-ray images of the sediment cores (left: near the surface, right: just above the ice age gravels) showing the annual layers and drop stones



A Science Story: Antarctic Bound VUWAE 60 - K001C, K001D, K040

Ice and Fire: Searching for clues of past ice sheet change on the flanks of Mt Discovery volcano

It's long been known that marine sediments bearing fossil scallops, barnacles and marine microfossils occur in glacial moraines sitting up to 150 metres above present day sea level on the flanks of the McMurdo volcanoes. Pioneering work by early VUWAE expeditioners Vella and Eggers first described and mapped the distribution of these deposits, which became known as the Taylor and Scallop Hill formations. Reinvigorated by the discovery of a new location on the northern flank of Mt Discovery, during a reconnaissance two years ago by GNS scientist, Richard Levy and our own Nick Golledge, we returned with a small team including myself, Richard, ARC Centre Manager Michelle Dow, and our Masters student Libby Galbraith.

We described two new stratigraphic sections: one on Mt Discovery and the other on Brown Peninsula at roughly similar elevations of



Tim Naish (far left) and Richard Levy (far right) talk to Ministers Bridges and English, Brown Peninsula, Antarctica

150 metres above present day sea level. Preliminary results show that the fossiliferous glaciomarine deposits are laterally continuous and record past advance and retreat of the ice sheet in McMurdo Sound. Key questions that Libby's project will focus on are: How old are these deposits – Last glacial maximum (20,000 years), last interglacial (125,000 years) or Pliocene (3 million years); how warm was the climate/ocean; how did they get to the elevation they are today? The research will provide important constraints for regional computer simulations to help us understand how the ice sheet responded to past warmer than present climates that may relevant to future change.

It was great to also find the geological sections described in the original papers that had not been visited for decades. We even found an old food box in Alan Eggers 1970s camp not far from what is now Lake Eggers, however we were not tempted by the Skippy peanut butter or Cadburys chocolate. For Michelle it was her first trip to Antarctica to see how the operation works at the coal face. We were also visited by the Deputy Prime Minister, Hon Bill English and Associate Minister for Climate Change, Hon Simon Bridges, who while impressed by what we could tell from a pile of "fossiliferous rubble", could see the value in supporting geological drilling!

Tim Naish

Mawson Glacier: How much, how fast and why did it melt?

In January, myself, Andrew Mackintosh, Shaun Eaves, and prospective PhD student Ross Whitmore headed to Mawson Glacier. Mawson Glacier, over 200 km from Scott Base, may hold insight into the potential rates and magnitudes of ice loss in Antarctica and, ultimately, how such glaciers can respond to a changing climate. The aim of our expedition was simple – to collect rocks that were deposited by the glacier as it thinned since the last ice age (~20,000

years ago). We explored a series of nunataks – essentially, mountains surrounded by glacier ice – by foot and helicopter, collecting cobbles at various elevations above the glacier margin. Field work during January was enjoyably mild (-3 to +5 °C), which was warm enough to form large melt ponds on the glacier and cause the snow around our camp to thaw. Next we will dissolve the ~300 kg of rock samples and measure their geochemical signal to estimate the past thinning history of Mawson Glacier.

Richard Jones



Left to right: Richard Jones, Andrew Mackintosh, Shaun Eaves and Ross Whitmore, Mawson Glacier, Antarctica

Imaging the West Antarctic Ice Sheet grounding line

The Siple Coast of the West Antarctic Ice Sheet (WAIS) has preoccupied the glaciological community since the potential for rapid, marine ice-sheet retreat was first postulated in the late 1960s and early '70s. Central to the current understanding of this instability hypothesis is the relationship between ice flow across the ice-sheet-ice-shelf transition (the grounding zone), oceanic forcing, and ice thickness. At present the Siple Coast ice streams drain approximately one third of the WAIS. Kamb Ice Stream stands

out amongst its neighbours as its flow ceased approximately 160 years ago making it a poster child for natural variability in ice flow.

The five member team on Kamb Ice Stream was one of the furthest-afield deployments supported by Antarctica New Zealand in recent years at a distance of approximately 900 km from Scott Base. The team, led by myself and supported by Darcy Mandeno, Becky Goodsell, and students Sam Taylor-Offord (VUW) and Matt Vaughan (University of Otago) deployed for six weeks. During this time, we performed geophysical experiments to image the ice sheet and the underlying sediments using active-source seismic and radar methods. Targets included sedimentation at the grounding zone, subglacial drainage at the ice stream margin, and site surveying for the upcoming NZARI hot water drilling programme. The team also used seismic surveying to image deeper sedimentary structures beneath the stagnant Ross Ice Shelf downstream of the Kamb Ice Stream. These data will serve as site survey for a potential drilling target for an archive of climate and ice sheet history.

Huw Horgan



Left to right: Sam Taylor-Offord, Matt Vaughan, Becky Goodsell, Huw Horgan and Darcy Mandeno, Scott Base, Antarctica

The S.T. Lee Young Scientist Exchange

On a cold Alaska morning late in March 2016, I boarded a plane to make the long trip from Fairbanks, Alaska to South Island, New Zealand. Through the S.T. Lee Travel Award, I was able to spend an amazing three full weeks split between doing field work on South Island, meeting researchers at the Antarctic Research Centre, and figuring out how to get scientific grade data while flying a small hobby-level drone.

My research focus is on finding better ways to incorporate drones into science, and better ways to handle, process, and manage the data they produce. This award was a brilliant opportunity for me to try those processes in the field while working with researchers Brian Anderson and Huw Horgan to collect drone imagery over different geological sites in New Zealand. I spent my first week meeting Brian and his team, and doing test flights with my drone, collecting and processing the imagery. My second week was at the ARC talking to researchers, learning about what they do, and having some very fun conversations about how we could incorporate drones into that work. I was also able to give a presentation on some of the work that we are doing in Alaska – for which there was a lot of enthusiasm and helpful feedback. For my third week I hit the road with Huw and his graduate student, Lauren Vargo. We placed seismometers on Tasman Glacier, flying from site to site in

a helicopter. In between our helicopter flights, I conducted flights of my own with my drone, collecting as much imagery as I could of the enormous glacier.

The entire trip was an incredible whirlwind. I learned a lot – both about scientific needs in New Zealand, and about the strengths and limitations of my own research. I also very much enjoyed getting to brainstorm with Brian about possible new uses for drones in science. I could not be more grateful to Dr Lee for having given me the opportunity to meet with the researchers at the ARC. It was a wonderfully motivating experience to get to work with such a talented and dynamic group and I would love to visit again someday.

Sean Barberie

Sean Barberie flying the drone at Castle Hill, South Island



Visiting Researcher Updates New Zealand Glacier Inventory

From February until May 2016, I visited the ARC and was hosted by Andrew Mackintosh. Normally based in Germany at the Technical University of Munich, my research in New Zealand focused on a new project to update the New Zealand Glacier Inventory (NZGI). The existing inventory is based on manually-mapped glacier outlines obtained from aerial photographs mainly from 1978. The new NZGI will be based on satellite images mapped (semi-) automatically and will include both clean-ice and debris-covered ice from the most recent imagery. To familiarize myself with New Zealand glaciers, I was involved in two field trips to Tasman and Brewster glaciers and also in a student excursion to Franz Josef and Fox glaciers. A very special event for me was a flight in a small plane over the South Island glaciers as part of the NIWA led mapping of end of summer snow lines.

Initial results were obtained using Landsat-8 satellite imagery from mid-February 2016. Clean-ice regions were detected using an established method that takes a ratio of energy at different wavelengths. These results are combined with information from a digital elevation model, which provides the extent of debris-covered ice. Glacier outlines were then generated automatically, and validation showed the results were promising. To refine the technique, a second satellite platform is being tested. This satellite provides higher spatial-resolution data for the same time period, however a methodology for this platform has not yet been established so its use will need some refinement. Discussions with Andrew, Brian Anderson, and Andrew Lorrey (NIWA) have been very helpful for determining the correct detection parameters suitable for obtaining true glacier outlines. I hope to come back to New Zealand next year to continue more of this work.

Sabine Baumann



Sabine Baumann on the debris covered ice of Tasman Glacier, South Island

OTHER ACTIVITIES

Climate Change in the Pacific

Professor Guilford opened a three-day conference at Victoria University from 15-17 February focusing on the threat of climate change in the Pacific, stressing his heartfelt concern over the issue.

Professor Guilford said the science behind climate change is "crystal clear" and can't be ignored.

Victoria's own Climate Change Research Institute is working to provide a better link between science and policy, while the Antarctic Research Centre is looking at the Antarctic climate and its influence on the global climate system. The conference brought together top scientists, environmentalists, policy makers,

community leaders and NGO representatives, from at least 17 Pacific nations. Speakers included Republic of Kiribati President Anote Tong, international experts, James Renwick (SGEES) and the ARC's Tim Naish.

President Anote Tong described how some of the nation's islands may disappear within two or three decades due to rising sea levels, while James described how changes in rainfall, tropical cyclones and temperature extremes, are having devastating effects on food security and communities, and Tim spoke on the effects of sea-level rise.



An Audience with the Governor-General

On the 16 February, the ARC was honoured to be involved with a visit from the Governor-General, Sir Jerry Mateparae. His Victoria University visit involved a cinematic performance in commemoration of the First World War, before a round table discussion led by ARC Director, Tim Naish, and including Nancy Bertler, Andrew Mackintosh and James Renwick (SGEES) focusing on insights into the impact of CO₂ levels and climate change on the state of Antarctica's ice sheets and their potential contribution to rising sea levels. His tour ended with an interactive demonstration on 4D led by the School of Engineering.

Andrew Mackintosh, Tim Naish, and Nancy Bertler along with Pro Vice-Chancellor Mike Wilson being introduced to the Governor-General, Sir Jerry Mateparae

Italy and New Zealand in Antarctica

The Antarctic Research Centre and the Embassy of Italy held a series of short presentations "Italy and New Zealand in Antarctica. Latest achievements and challenges in a common endeavour" on 25 February, to celebrate the long history of collaboration between Italy and New Zealand in Antarctica.

The event was the first formal celebration of this relationship, and was attended by a wide range of interested public, Victoria faculty, government officials, and a number of dignitaries including the Italian Ambassador His Excellency Carmelo Barbarello. The talks were from three Italians who had just arrived in New Zealand from Antarctic fieldwork, and five New Zealanders, of which three were also in Antarctica this season, as well as a panel discussion moderated by our Director, Tim Naish.

"Antarctica has significant scientific value and is very unique, but it is also a challenging environment to work in. The collaboration with Italy lets us carry out more scientific research because we can work together to share resources and expertise," said Tim.



Left to right: Dr Steve Parker (NIWA), Dr Neil Gilbert (Constantia Consulting), Dr Riccardo Bono (Unita' tecnica Antartide), Associate Professor Laura Crispini (Università di Genova), Ambassador Barbarello, Pro Vice-Chancellor Professor Mike Wilson, Professor Tim Naish, Associate Professor Paola Rivarolo (Università di Genova), Professor Peter Barrett, Dr Richard Levy (GNS Science), Professor Gary Wilson (New Zealand Antarctic Research Institute)

