IceSked

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Newsletter of the Antarctic Research Centre
Victoria University of Wellington

A Word From the Director

As we hunker down for winter which means more focus on research and teaching for most of us, we reflect in this newsletter on exciting activities and successes of the last summer's field season in Antarctica and acknowledge the success of the film *Thin Ice: The Inside Story on Climate Change* produced in collaboration with the University of Oxford. *Tim Naish*

A Global Launch for a Global Issue

On Earth Day (22 April), the film *Thin Ice: The Inside Story of Climate Science* was launched globally in at least 120 countries and on all seven continents, with over 200 organised screenings and 19,000 online views.

This initiative between Victoria University of Wellington, the University of Oxford and DOX Productions, London, was over six years in the making, and takes a fresh look at the changes taking place in the Earth's atmosphere, oceans and ice sheets. The 73-minute-long documentary gives the public a rare opportunity to see climate scientists at work, talking about what they do, and their hopes and fears.

The Thin Ice project was conceived over a cup of coffee at a climate change conference in March 2006, when the Antarctic Research Centre's Peter Barrett, suggested to fellow geologist Dr Simon Lamb, then at Oxford University, that he make a film about climate science and scientists with his friend David Sington from DOX Productions. Support from Oxford came through Philip England, then Head of Earth Sciences, with co-production and website development in New Zealand from Catherine Fitzgerald (Blueskin Films) and James Franklin (Pixeco), respectively. Using the website as a platform for the global launch was the work of ARC student, Heidi Roop, and Rhian Salmon (Climate Change Research Institute).

The resulting film takes viewers on Simon's personal journey of discovery as he meets and interviews 40 scientists working at the front line of climate research in the Arctic, Antarctic, Southern Ocean, New Zealand, Europe and the United States. Simon says "I was motivated to make the film by a determination that people should hear from climate researchers themselves". Perhaps the most significant achievements is reflected in a blog post by Chicago physicist Ray Pierrehumbert's post last month, where he says "One of the many things I like about this film is that it puts a human face on climate science". One of the 44 comments following says "It's like having a chat with a knowledgeable mate down at the pub".

A number of the scientists who feature in the film joined the packed Soundings Theatre at Te Papa for the Wellington Earth Day screening and a lively panel discussion chaired by columnist, commentator and broadcaster Finlay Macdonald. Finlay talked not only with Simon Lamb on the film, but also covered the science as well as the international and social implications with Victoria University panellists Dr Nancy Bertler, Dr Adrian Macey, and Associate Professor Marc Wilson.

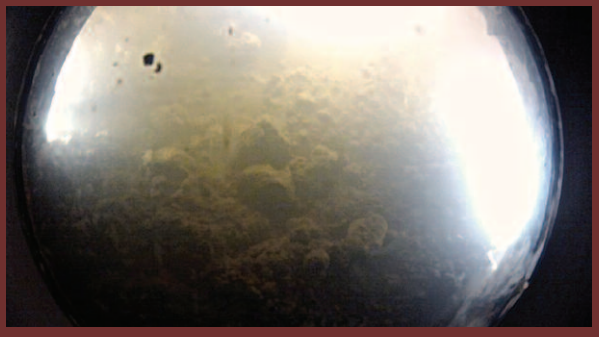
A feature of the project is the Thin Ice website (www.thiniceclimate.org), which hosts the trailer, and close on 40 video clips taken from the 120 hours of interviews. These expand on key aspects of the film, for those with deeper interests and educators. The website also includes biographies of the scientists and film makers. The website shop has options for purchasing a copy of the film for private and public screenings. There is also a version with subtitles in five different languages including Mandarin, English, Spanish, French, and German. For more information see the website or e-mail ThinIceClimate@vuw.ac.nz

A Science Story - Subglacial Lakes and the WISSARD Project

The last decade has seen an increasing awareness of subglacial lakes and their important role in the hydrologic system beneath ice sheets. Airborne radar and remote sensing methods have now located many hundreds of lakes beneath the Antarctic ice sheets. The significance of subglacial lakes is twofold; i) they potentially harbour long-isolated biology adapted to the extreme sub ice-sheet environment, and ii) the distribution of water beneath ice sheets influences the flow of the overriding ice. Some subglacial lakes, such as Subglacial Lake Vostok are large and well known, but smaller lakes now appear ubiquitous and linkages between these lakes have been well demonstrated. A subset of these lakes, termed active lakes, have been observed to fill and drain quickly and are considered especially significant as they have the potential to rapidly introduce water to the ice sheet's bed leading to accelerating ice flow.

In paired papers in *Earth and Planetary Science Letters* (Horgan et al., 2012 and Christianson et al., 2012) ARC researcher Huw Horgan and colleagues have provided the first comprehensive geophysical survey of an active subglacial lake in the Antarctic. During the 2010/2011 and 2011/2012 field seasons Huw and colleagues from the US and Italy deployed the first stage of the National Science Foundation sponsored Whillans Ice Stream Subglacial Access Research Drilling (WISSARD) Project. In their subsequent publications the team use seismic and radar techniques to demonstrate that Subglacial Lake Whillans, which lies beneath one of the major ice streams feeding the Ross Ice Shelf, is a perennially shallow feature. Although the ice surface overlying the lake had previously been seen to rise and fall by approximately five metres, no water depths greater than eight metres were imaged. Additional analysis of remotely sensed laser altimetry and GPS data by the authors showed that at low stands the lake is poorly connected with some portions rising and lowering before others. The impact of this lake on the overlying ice motion is unlikely to be significant unless the lake is able to drain extremely rapidly.

In early 2013 Subglacial Lake Whillans became the first active subglacial lake beneath the Antarctic ice sheet to be directly accessed. The WISSARD Project used newly developed clean access hot water drilling to make a 20 cm diameter hole through the approximately 800 m thick ice allowing water and sediment sampling from this unique environment. Results from this recent work are ongoing, but promise to be exciting with preliminary biological analysis indicating traces of life beneath the ice sheet. The WISSARD project continues. This coming season WISSARD will target the downstream end of the drainage of Subglacial Lake Whillans, where it crosses the ice sheet – ice shelf grounding line and enters the ocean cavity beneath the Ross Ice Shelf. The grounding line is a critical zone for ice sheet stability and direct sampling there will doubtlessly lead to exciting scientific discovery.



The sediment-water interface at the bottom of Subglacial Lake Whillans imaged by a borehole camera (Photo: Alberto Behar, NASA)

Horgan, H.J., Anandakrishnan, S., Jacobel, R.W., Christianson, K., Alley, R.B., Heeszel, D.S., Picotti, S., Walter, J.I., (2012). Subglacial Lake Whillans — Seismic observations of a shallow active reservoir beneath a West Antarctic ice stream. *Earth and Planetary Science Letters* 331–332: 201-209.

Christianson, K., Jacobel, R.W., Horgan, H.J., Anandakrishnan,. S., Alley, R.B., (2012). Subglacial Lake Whillans — Ice-penetrating radar and GPS observations of a shallow active reservoir beneath a West Antarctic ice stream. *Earth and Planetary Science Letters* 331–332: 237-245.

Richard Jones after a long day walking in miserable weather with a pack full of rocks! (Photo: Chris Fogwill)

Antarctica's Glaciers: When and Why did they Melt?

Throughout January, I hammered and sawed rocks, traversed glacier ice and trekked around mountains, often with over 20 kg of samples on my back. As many previous Antarcticans can relate to, I experienced temperatures cold enough to freeze breath to scruffy facial hair, had to dig myself out of my tent on occasional mornings, suffered without a shower or (ever-essential) social media and had to get used to a bucket for a toilet for three weeks – but why? It was all in the name of science, but I cannot ignore that it was a fun and exciting time too.

Accompanied by Kevin Norton (SGEES) and Chris Fogwill (The University of New South Wales), my business in Antarctica was to investigate how much the Mackay Glacier had melted since the peak of the last ice age (about 20,000 years ago), but also to understand what caused it (rising sea level, or a warming atmosphere or oceans). To do this, I collected rocks on the flanks of the glacier and will next estimate when they were left behind and uncovered by the ice (using a technique called cosmogenic exposure dating). Three camps and 28 days of exploring by foot produced a total of nearly 400 kg of rock collected. I was pleased, despite running out of whisky, tea and coffee before the end.

My PhD research has a year and a half remaining, in which time I will be processing samples in the lab, running glacier computer models and compiling analysed results into a thesis. The fresh air of Antarctica was great while it lasted.

Richard Jones

Piecing Together the Puzzle: What did Antarctica look like Thousands and Millions of Years Ago?

Jacob Anderson (University of Canterbury) and Nick Gollege looking at one of the glacial erratics (Photo: Dougal Townsend)

In October 2012 PhD student Bella Duncan and I went south with members of GNS Science, Otago University, and University of Southampton (UK) to spend a month carrying out geological fieldwork on and around Mt. Discovery, in southern McMurdo Sound, Antarctica. The project was multi-faceted, with some team members investigating the Last Glacial Maximum (LGM; about 18,000 years ago), while others focused on collecting and describing glacial erratics of Eocene age (about 56-34 million years ago). Both teams were attempting to learn something new about the Antarctic continent during these periods of the past, when climates were considerably different from present. By collecting and interpreting microfossils from the Eocene strata, we can make inferences about the climatic conditions at southern high latitudes at a time before the growth of the ice sheet we see today. But mapping the distribution of these (and other) glacial erratics allows us to reconstruct the pattern of ice-flow during the last major expansion of the present ice sheet (the LGM), which we can then link to environmental conditions that prevailed at the time. In this way we can begin to see how Antarctica has adapted to changes in atmospheric and oceanic conditions through geological time, helping us to make better predictions for the future. It all sounds quite simple in theory, but getting this information proved more challenging than any of us had expected - throughout the month that we spent on the ice we were continually battered by gale-force katabatic winds, which frequently turned already difficult working conditions into a dangerous white-out. Two of our tents were destroyed, our field gear was continually buried in snow-drifts metres deep, and sometimes we couldn't leave camp for days on end. But despite all this we still had a successful season, collecting over 450 kg of rock samples and hundreds of pages of field notes. Now the real work begins, analysing and interpreting the data, and piecing together the puzzle of what Antarctica looked like thousands and millions of years ago.

Nick Golledge

The night shift team in the drilling tent

A Technological Breakthrough in Ice Coring

The highlight of the recent 2012/2013 field season in Antarctica has been the success of ice core drilling operations in the Ross Sea at Roosevelt Island, led by Nancy Bertler. The Roosevelt Island Climate Evolution (RICE) Project is a New Zealand led, nine nation collaboration with partners from Australia, Denmark, Germany, Italy, the People's Republic of China, Sweden, the United States of America, and the United Kingdom. The project aims to determine when and how quickly the world's largest ice shelf, the Ross Ice Shelf, could collapse allowing West Antarctic ice to accelerate into the ocean and exacerbate sea level rise.

During the field season, Nancy and two of her PhD students, Daniel Emanuelsson and Peter Neff, ARC's Science Drilling Office duo, Alex Pyne and Darcy Mandeno, and international collaborators spent almost four months at Roosevelt Island, recovering the RICE ice core. The camp, 760 km south east of Scott Base, was supplied with 30 tonnes of drill system, fuel, drill fluid, scientific equipment and camping gear. Poor weather conditions at the site caused some flights to be delayed by more than three weeks but nonetheless, the camp and drilling operations were set-up and after drilling 20 hrs a day, 6 days a week, for 27 days, the team completed the drilling ahead of schedule reaching bedrock at 763 m depth on the 20 December 2012. This very successful outcome continues to confirm that the Danish Hans-Tausen drill design, from which the Victoria University ice core drill is based, is not only a very good intermediate drill design but also that the new design components, including the hydraulic drill mast designed by Darcy, have proven their value.

A particular achievement is the high core quality, even through the brittle ice zone, where high pressure in the gas bubbles and thermal shock usually lead to heavily fractured ice. In addition, the team was able to retrieve small quantities of the underlying sediment, which could provide clues about the last time Roosevelt Island was under water.

In the field, the ice cores were stored 4 m underground in an actively cooled storage cave, keeping the ice well below minus 22°C, despite a particularly warm summer, causing at times positive surface temperatures. The cores were then transported in insulated boxes by DC-3 aircrafts, flying at 10,000 ft to keep the ice cold during the 2.5 hour long flight back to Scott Base. The ice was shipped back to New Zealand in March. Since mid-May and until mid-August, the international RICE community are in Wellington to process the ice at GNS Science's New Zealand Ice Core Research Laboratory, concluding with a RICE workshop on the emerging data.

OTHER ACTIVITIES

The Antarctic Research Centre Endowed Development Fund: Supporting the Next Generation of Antarctic Scientists

In 2004 the Antarctic Research Centre launched an Endowed Development Fund Appeal to provide funds for students to undertake research in Antarctica. The fund has now reached $500,000 with fifty-four grants having been awarded so far. Annually we disburse small grants up to $4000 to 8-10 postgraduate students, which makes an enormous difference and enables some amazing opportunities to be taken up, that would not have otherwise been possible. Examples include; participation in international summer schools in glaciology, modelling and paleoclimatology, the opportunity to work with collaborators in world-class analytical facilities, and the ability to travel to international meetings such as the American Geophysical Union meeting and to present their scientific discoveries on the world stage. These opportunities have led to both, our students finding great positions and postdoctoral fellowships overseas, and a number of international students coming to the ARC to undertake postgraduate study. We very much value your support in helping us achieve this important milestone. Planning is currently underway on how we take the Endowed Development Fund to the next level to enable us to continue to support the next generation of Antarctic scientists.

For further information on how you can provide philanthropic support to the Antarctic Research Centre, please contact our Director, Professor Tim Naish, Email: timothy.naish@vuw.ac.nz, or Anita McKegg, Development Manager, Ph: 0800 VIC GIFT (0800 842 4438), Email: anita.mckegg@vuw.ac.nz. All donations are made through the Victoria University Foundation, a registered charity, and are therefore eligible for a charitable gift taxation rebate.

Message from a Recipient

In 2007, during my PhD I received support from the ARC Endowed Development Fund to work with Professor Doug MacAyeal (University of Chicago), a pioneer in numerical ice sheet modelling, to develop an understanding of the physics that drive ice sheet simulations. This experience made me realise the need for geological records to provide input (boundary conditions) for such models, as well as being able to evaluate model performance with geological-based paleoclimate reconstructions. Reflecting on my experience at the University of Chicago years later, being immersed in a truly world-class research group in a field that was outside of my research speciality, provided me with a confidence to integrate model and geological data and interact with researchers from a wide range of disciplines.

Following this visit to Professor MacAyeal's lab, I was afforded an opportunity to work with other world-leading scientists from New Zealand, the United States, Italy and Germany, as part of the ANDRILL Program, where I became an integral part of the sedimentology team, and as part of my PhD led several interdisciplinary studies on the climate and ice sheet record in the ANDRILL drill core record. Following my PhD, I have worked on other international initiatives, most notably the Integrated Ocean Drilling Program Expedition 318 to Wilkes Land in Antarctica. *Rob McKay*

Message from a Donor

The main reasons I was keen, and honoured, to make a donation to the Antarctic Research Centre were to acknowledge their enviable record in Antarctic research for nearly 50 years and to support their ongoing research programme and graduate student involvement by also contributing funds to the ARC Endowed Development Fund that provides ongoing support to young Antarctic scientists.

ARC's leading edge research is recognised worldwide and their activities make a significant contribution to our understanding of the Antarctic, climate history and climate change and modelling.

Knowing how tough funding gets, it was great to have the opportunity to provide the support and it has been a pleasure to give something back, and make a contribution, to the department that had confidence in and supported me in my graduate student days. *Alan Eggers*

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