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West Antarctic Ice Sheet release new iceberg

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At the LRC, the core sections were scanned with a Geotek multisensor logger that measures porosity, magnetic susceptibility, and P-wave velocity. The core sections were then split, digitally imaged, photographed, and described. Sampling and analyses follow core curation specifications and protocols that were in place before drilling.

Preliminary laboratory analyses are being conducted on core catcher samples that were sub-sampled on board and immediately sent to investigators. For the Great Salt Lake samples, pollen and ostracode analyses are being conducted at the University of Arizona; diatom analyses are being conducted at the University of Utah; and carbon, magnetic, and X-ray diffraction mineralogical analyses are being conducted at the USGS in Denver. For the Bear Lake samples, pollen, ostracode, and amino acid analyses are being conducted at University of Northern Arizona; diatom analyses are being conducted at the University of Utah; and carbon, magnetic, X-ray diffraction mineralogical analyses and inorganic geochemical analyses are being conducted at the USGS in Denver and Menlo Park. Results of these analyses, together with the Geotek logs, digital images, and visual core descriptions for each 1.5-m core section, will form the "Initial Core Descriptions" that will be available in digital form at the World Data Center-A for Paleoclimatology (http://www.ngdc.noaa.gov/wdc/wdca/wdca_paleo.html) and the Index to Marine and Lacustrine Geological Samples Database (http://www.ngdc.noaa.gov/mgg/curator/curator.html), NOAA-NGDC, Boulder, Colorado.

Use of the GLAD800 system is open to any group, with scheduling priority given to projects in the following order: 1) scientific drilling projects supported by ICDP (see http://icdp.gfz-potsdam.de); 2) scientific drilling projects supported by other science agencies (for example, NSF); and 3) other drilling projects. For further information on use of the GLAD800 system, contact Dennis Nielson at DOSECC (see http://www.dosecc.org).

Note: On 8 February 2001, one of the authors of this article, Kerry Kelts, died after a long battle with Hodgkin's disease. Kerry was a professor in the Department of Geology and Geophysics and director of the Limnological Research Center (LRC) at the University of Minnesota; but more important, he was one of the leading driving forces behind global lake drilling. Kerry was on the deck of the Glomar Challenger in December 1978 when the first hydraulic piston core was taken from the ocean (Gulf of California; DSDP Site 480). From that day, it was his dream to have that capability for lakes. Kerry was on the deck of the GLAD800 platform when the first hydraulic piston core was taken from Great Salt Lake on 12 August 2000. The next day, he returned to Minneapolis to begin the treatment from which he never recovered. In his honor, the GLAD800 platform has been named the R/V Kerry Kelts.

Acknowledgments

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West Antarctic Ice Sheet Releases New Iceberg

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In October 2001, *Eos* published an article describing the sudden formation last year of a large fracture across most of the floating tongue of Pine Island Glacier, Antarctica (75°S latitude, 102°W longitude) [*Bindschadler and Rignot*, 2001]. Early last November, the growing fracture completely severed the ice tongue, releasing an iceberg 42 km x 17 km, roughly the size of the Caribbean island of Dominica. What makes this event notable is the insight into the process of iceberg formation made possible by the unprecedented series of image data captured by the Multi-angle Imaging SpectroRadiometer (MISR) instrument in the days just before the calving.

MISR rides aboard NASA's Terra spacecraft and provides continuous imagery of the Earth at multiple viewing angles serving a wide variety of scientific investigations [*Diner et al.*, 1998; http://www-misr.jpl.nasa.gov/mission/minst.html]. Its spatial resolution (275 m) is sufficient for monitoring large crevasses, such as those that precede the formation of large tabular icebergs. Continuous operation provides an advantage over selectively operated, higher-resolution imagers in that data are collected at every opportunity. This continuous mode is extremely valuable for monitoring operations or recording unanticipated events on Earth, such as iceberg calving.

Further increasing the value of the MISR data set is the fact that the 380-km-wide swath of the instrument, combined with the spacecraft's longitudinal convergence away from the Equator, allows for daily coverage of both polar regions. The multiplicity of imaging opportunities is important for areas that are frequently shrouded in persistent cloud cover along the Antarctic coast, such as Pine Island Glacier. Pine Island Glacier discharges ice at a rate greater than any other Antarctic glacier or ice stream. This area of the West Antarctic Ice Sheet is believed to be susceptible to collapse. Through a series of other studies, based primarily on remotely sensed data, Pine Island Glacier is known to be accelerating while the grounded portion is thinning and retreating [*Rignot*, 1998; *Rignot et al.*, in press, 2002]. The sea ice cover in front of the glacier has been decreasing steadily for several decades [*Jacobs and Comiso*, 1997; *Kwok and Comiso*, 2002], and underneath the floating tongue, melting rates are estimated to be as high as 50 m per year [*Rignot*, 1998].

The existence of the crack took the glaciological community by surprise. The initial fracture was almost perfectly straight and extended for 25 km, two-thirds of the distance across the glacier [*Bindschadler and Rignot*, 2001]. Subsequent tracking of the crack with high-resolution imagery clocked its rate of propagation at 15 m per day averaged over a 6-week period. This led to the prediction that the calving might occur on 8 April 2002 (erroneously reported as 8 April 2003), although there was reason to expect the propagation rate might increase as the crack tip entered into the higher stress region at the margin of the glacier.

The new data show that the rift evolved in a very different manner. There is a large coverage

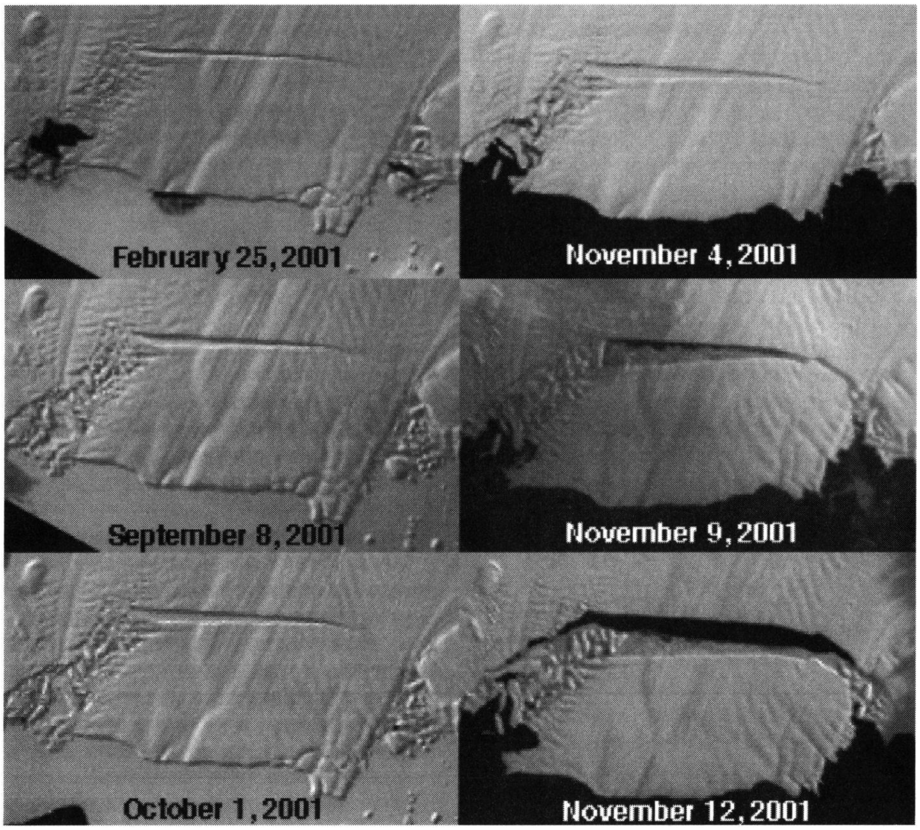

Fig. 1. Lower Pine Island Glacier was imaged by MSIR's vertical-viewing camera on the dates shown. Each frame is 55 km x 33 km (200 pixels x 120 pixels). An animation loop including more images can be viewed at http://www.jpl.nasa.gov/releases/2001/release_ 2001_220.html.

gap between 25 February 2001 and 8 September 2001 during the extended polar night. Before the Sun had set, preventing further optical imaging, the rift appeared much the same as during the previous month. MISR's spatial resolution does not resolve any further growth of the crack at its tip. By the following spring, in September, the crack had lengthened slightly more than 2 km. The next clear image was not collected until nearly a month later on 1 October. By then, the end of the rift had lengthened in a decidedly different direction. Instead of continuing to curve downstream, in accord with the regional stress field, the newest 1-km-long extension of the rift turned upstream, deviating from the previous direction by about 40°.

Examination of a higher spatial resolution Landsat-7 ETM+ image (not shown) revealed that the point of sudden re-orientation of the rift corresponded to a boundary between an avenue of relatively smooth-surfaced glacier and an avenue of glacier containing many smaller crevasses. Tracing these contrasting sections of the glacier upstream, the crevassed avenue is generated at a very crevassed region more than 63 km upstream from the rift. The continued presence of crevasses and crevasse-related features at the rift site indicates that this ice is still substantially disturbed, at least at the surface. This disruption could lead to significant differences between the local stress field at the end of the rift and the regional stress field. We believe this led to the sudden re-orientation of the rift.

The next stage in the rift's evolution involved no discernible lengthening for the next month, confirmed by images on 26 October and 4 November. However, the rift continued to widen during this period. Figure 2 shows measurements of the leading and trailing edges of the rift at a position near the wider northern end. The trailing edge advanced at a steady rate of 2.45 km per year, while the leading edge moved more rapidly at 3.43 km per year. Because the ice downstream of the rift was still attached to the glacier at the south end of the rift, this differential motion corresponds to a rotation of the incipient iceberg at a rate of roughly 3° per year.

Despite this rotation, the fracture failed to lengthen through October until at least 4 November. The next clear view of the glacier on 9 November showed that sometime during the previous 5 days, the fracture had breached the remaining 5 km of the glacier, snapping the iceberg free from the glacier. The orientation of this final portion of the rift parallels the orientation of pure shear expected at the margin. It is likely this last rupture was sudden, similar to the initial fracture in the spring of 2000.

Figure 2 shows how rapidly the gap between the iceberg and the new terminus grew once the iceberg was disconnected. Extrapolating the rapid motion of what had been the leading edge of the rift but is now the trailing edge of the iceberg suggests that the separation of the iceberg occurred closer to the 9 November end of the 5-day interval.

These frequent observations of the final 2 months prior to the release of a large, tabular iceberg emphasize both the episodic nature of the rifting process and the fact that flowing ice contains internal heterogeneities that can confound attempts to treat glacier ice as a continuum [*Hulbe and Whillans*, 1997]. The 17-km along-flow dimension of the iceberg corresponds to 7 years of motion near the terminus. If the glacier were near equilibrium, events of similar magnitudes would be expected at a 7-year periodicity. However, calving has been demonstrated to be exceedingly non-periodic and Pine Island Glacier is not in equilibrium.

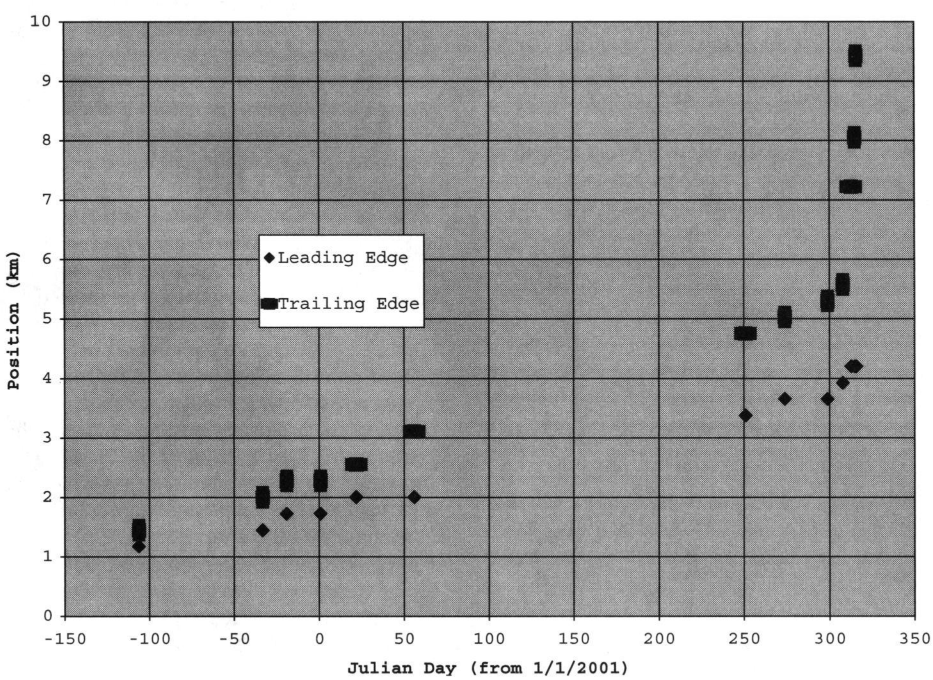

Fig. 2. The positions of the leading and trailing edges of the Pine Island Glacier rift are shown on MISR imagery. Time is represented by Julian Day from 1 January 2001 and position is distance orthogonal to the rift axis from an arbitrary origin.

Both facts make it impossible to predict either the time of release of the next iceberg by the glacier or its magnitude.

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Bush Climate Change Plan Criticized as "Business as Usual"

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The new U.S. climate change strategy, announced by President George W. Bush on 14 February, relies heavily on voluntary greenhouse gas emissions reduction strategies. According to the administration, the strategy begins to address the factors that contribute to climate change "in a serious and sensible way," but critics charge that it will actually result in increased U.S. greenhouse gas emissions.

Bush's strategy, announced during a speech at the National Oceanic and Atmospheric Administration (NOAA) in Silver Spring, Maryland, presents an alternative to the Kyoto Protocol, which includes an initial target of requiring a group of 38 industrialized nations to reduce emissions of 6 major greenhouse gases by a total of 5.2% below 1990 levels by 2012.

Under the Bush plan, the "greenhouse gas intensity" of the United States economy, a formula based on emissions per unit of economic activity, would be reduced by 18% over the next decade.

Critics of the strategy say that reductions in the intensity of greenhouse gas emissions will not result in a lowering of the nation's total output of greenhouse gases. They charge that the 18% intensity reduction represents a continuation of "business as usual," since that figure is the approximate decline that has occurred during the previous decade. The Pew Center on Global Climate Change estimates that the plan would result in U.S. emissions 30% above 1990 levels in 2012.

Methane Recovery, Carbon Sequestration

The Bush strategy includes enhancing voluntary emissions reductions by power plants, proposing several new domestic and international initiatives with other countries on climate science and technology programs, and repackaging some ongoing federal climate change programs and budget proposals, all with the hope of not slowing U.S. economic growth.

The Bush plan also promotes methane recovery and carbon sequestration and would prevent more than 500 million metric tons of greenhouse gases from being emitted into the atmosphere over the course of the decade, according to the White House. If greenhouse gas emissions reduction targets are not reached by 2012, the plan suggests the possibility for further action.

The administration strategy "will set America on a path to slow the growth of our greenhouse gas emissions and, as science justifies, to stop and then reverse the growth of emissions," Bush said in his speech. "If, however, by 2012, our progress is not sufficient and sound science justifies further action, the United States will respond with additional measures that may include broad-based market programs as well as additional incentives and voluntary measures designed to accelerate technology development and deployment."

"Our nation will continue to lead the world in basic climate and science research to address gaps in our knowledge that are important to decision-makers," Bush continued. "When we make decisions, we want to make sure we do so on sound science; not on what sounds good, but what is real."

The plan notes that some specific research priorities for fiscal year 2003 include understanding the North American carbon cycle, developing reliable representation of the global and regional climatic forcing by atmospheric aerosols, investing in computer modeling, and ensuring high-quality, long-term climate data records.

Cutting Emission Intensity versus Cutting Emissions

U.S. energy intensity decreased about 1.6% annually and carbon dioxide emissions per unit of energy consumed dipped about 0.1% per year during the decade of the 1990s, according to a recent report by the Energy Information Administration of the U.S. Department of Energy. These reductions were primarily due to an increase in the non-energy-intensive U.S. economic sectors and to energy efficiency improvements. The annual 1.7% decrease in emission intensity yields about 17% decline over a decade, almost the same as the 18% reduction in the next decade called for in the administration plan.

David Evans, assistant administrator for NOAA's Office of Oceanic and Atmospheric Research, said the 18% figure in the administration plan is probably included more as a consequence of the trajectory of greenhouse gas projections rather than for being selected as a target to reach. "The intent is to use that [figure] as a guide," Evans said, "so that if we seem to be moving way above that line, then probably, as [the president] said, some other kinds of measures would be required."

Thomas Karl, director of NOAA's National Climatic Data Center, added that the plan touches on key areas that scientists are concerned about, by including funding for understanding scientific uncertainties and additional resources for monitoring climate change.

However, the director of the Natural Resources Defense Council's climate center, David Hawkins, said, "The benchmark for global warming policy is whether it cuts global warming pollution. This plan calls for more pollution growth at the same dangerous pace as the past decade." Hawkins said the plan sends a signal to the private sector that the administration is not serious about dealing with climate change.

Warren Washington, a member of the U.S. National Science Board, and a senior scientist in the Climate and Global Dynamics Division at the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, said that while the Kyoto Protocol aims to cut greenhouse gas emissions so that CO_2 concentrations eventually level out at some fixed atmospheric concentration, the Bush plan appears to keep emissions growing on a generally constant, upward slope. "If you ask most scientists involved with climate and with simulations, this [administration plan] is close to business as usual," he said.

Albert Semtner, Jr., professor of oceanography at the Naval Postgraduate School in Monterey, California, and a member of the U.S. National Academy of Science Committee on Global Change Research (CGCR), dismissed the plan as having little substance.

Emission Cap/Trading System Needed

CGCR member John Reilly, associate director for research of the Joint Program on the Science