

## INTERNATIONAL POLAR YEAR – PROJECT PROPOSAL

**WEST ANTARCTIC ICE SHEET – GLACIAL / INTER-GLACIAL STABILITY (WAIS – GIGS)**

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*Given the present predictions of sea level rise (9 - 88 cm by 2100), the number of people suffering from coastal flooding each year will rise from 10 million today, to ~200 million by 2080. Even a partial collapse of the West Antarctic Ice Sheet (WAIS), which is not included in these predictions, would, however, substantially add to sea level rise and dramatically multiply the population at risk. The West Antarctic Ice Sheet is considered to have the potential to retreat or even collapse over century timescales and is known to be thinning over a wide area. Newly developed techniques of seismic investigation and developing drilling technologies mean that we can now propose an IPY drilling campaign that will substantially increase our ability to predict the future of WAIS by improving our understanding of its response to former climate change.*

Currently, our best efforts to understand and predict the future of the WAIS and its contribution to sea level rise rely on numerical modelling, and would be greatly improved by understanding its response to climate change over the last few glacial cycles. Several studies have proposed the collapse of WAIS during at least once interglacial periods in the last 600 ka<sup>1,2</sup>, although this has been widely disputed (e.g.<sup>3</sup>). The history of WAIS over this period has particular significance as some of these interglacial periods were warmer than the present and perhaps similar to conditions we expect to result from anthropogenic greenhouse warming.

We propose to use rapid drilling technology to drill through 3-4 km of ice at 2 key sites in WAIS, allowing the recovery of sediment samples from the beneath the ice sheet. Analysis of the microfossils, <sup>10</sup>Be isotopes, and optical-/thermo-luminescence dating of these samples will indicate the age of the present ice sheet, and when this area was last open to marine conditions. The work is similar to analyses performed on sediments from the Siple Coast, which indicated open-ocean conditions during a recent interglacial period<sup>1</sup>. However, that site is close to the margin of WAIS and so is not diagnostic of major collapse; we will choose sites that can provide a confident diagnosis of conditions across the ice sheet. The first drill-hole, in the Amundsen Sea Sector, will help us determine whether the rapid changes in this area<sup>4</sup> could be precursors to collapse. The second site, will be chosen as to indicate the likelihood of complete collapse of the ice sheet.

Several drilling technologies are available and a detailed project proposal would need to determine which would be most efficient. For the present, we favour an upgrade of the BAS hot-water drill which can be transported by Twin Otter aircraft and will be used to drill through 2.5 km of ice in 2004/05. We estimate that each hole would require a fuel cache of ~100 drums of fuel, and a team of ~10 scientists to retrieve subglacial sediments, 2 or 3 holes could be drilled in a single season. Dating of the sediment samples will involve collaborating laboratories in several nations. To increase the probability of recovering sub-glacial sediments, we will conduct site surveys using seismic techniques we have perfected over the last decade<sup>5,6</sup>. These techniques can determine the subglacial bed-type, and will allow us to determine the optimum drill site - an area underlain by soft, or poorly lithified sediment – as well as provide a local and regional context to the deposition, including lateral continuity and homogeneity.

This ambitious activity requires major logistic resources and international cooperation. The reward for success will be widely understood, but its importance in global change science will be lasting. The project is unlikely to be undertaken without the momentum generated by selection as an IPY project.

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