

A proposal for a science topic for IPY
IPY Theme *Understanding Change at the Poles*

POLAR REGIONS, CLIMATE CHANGE AND GLOBAL CATASTROPHES

MAJOR THEMES

We have no modern analogues for many of the environments that once dominated the high latitudes, such as the times when dinosaurs roamed through polar forests. What were environments like at the ends of the Earth at such times? To know how the polar climate system operated and interacted with the global system in the past we must piece together the evidence we can glean from the rocks and use climate models to quantify the interactions between the poles and the rest of the globe.

We are fascinated by extreme and unique events in Earth history. The catastrophic extinction of biotas at the end of the Cretaceous may have been due to extra terrestrial impacts, along with rapid climate change. This dramatic event has been studied in detail in many mid or low latitude regions but we know far less about what happened in the polar regions. Were events at the poles damped or heightened by their high latitude position? Are the polar regions especially susceptible to future catastrophes?

We do not know why the poles became glaciated. The reasons for major glaciations are not well known, yet these events represent fundamental shifts in our planet's environment. Possibilities include changes in the orbit of the Earth around the sun, the opening and closing of ocean gateways, uplift of the mountains at the high latitudes and declining concentrations of atmospheric carbon dioxide. However, we know little about how these combined forcing mechanisms effected polar and global climate, or whether or not any of them were truly responsible for the initiation of Antarctic glaciation 33 million years ago and Northern Hemisphere glaciation 2.7 million years ago.

OBJECTIVES

- To compile a major database, linked with Geographical Information Systems (GIS), of all published geological information about palaeoclimates and environments at the poles over the past 100 million years. This will include a range of data on fossil animals and plants, geochemistry, sedimentology, and any other data source for palaeoenvironments. Both marine and terrestrial environments will be included. Strengths and gaps in the database will be identified.
- To collect more data from the field for specific intervals of time, especially catastrophic events such as times of dramatic climate change or mass extinctions. The Cretaceous/Tertiary boundary and its associated events will be a prime target in both polar regions (Seymour Island, Greenland). These field events will include both geologists who have local knowledge but will also involve new experts that can be drawn into polar science for the first time and add new dimensions to the expertise applied to polar science.

- To use the newly collected polar data and information held within the global geological database to produce boundary conditions for climate modelling studies. The models will help us understand the dynamics of past polar climates and the forcing and feedback mechanisms associated with initiation of polar glaciation as well as providing a global environmental context to the new data collected from Antarctica and Greenland.

OUTCOMES

- An innovative and interactive database of geological information, of immense value for all geoscientists, for polar researchers that require an ancient evolutionary context in which to place their modern observations, and for climate and ecosystem modellers. Critical gaps that will be identified will be useful pointers for targeted funding for future research.
- New data and observations about specific catastrophic events in the polar regions and how they relate to global activities. This will be linked to data from lower latitude regions to build a truly global picture.
- New predictions of past climate change in high latitudes. New understanding of the climate mechanisms that operated in the polar regions, especially in the greenhouse world, and how our present climate system may respond to future climate change.

PUBLIC UNDERSTANDING OF SCIENCE

This work is extremely attractive to the media, especially the K/T catastrophe and will receive excellent media coverage. Interaction with schools would be very popular. It is envisaged that School teachers would be involved with field work. Interactive software would be produced as a teaching tool illustrating the evidence for past environments and climate model output. An interactive web site will be set up where scientists and interested members of the public can search the database and run simplified climate model experiments.

Participants & Potentially Interested Groups

- Jane Francis, University of Leeds and members of the Centre for Polar Science and the White Rose Palaeobiology Group (Universities of Leeds and Sheffield) (both Arctic and Antarctic).
- Alan Haywood and members of the British Antarctic Survey's palaeoenvironments group.
- Paul Valdes and members of the Bristol University BRIDGE Group.
- Sergio Marensi and colleagues at the Instituto Antartida Argentino.
- Geoscientists with interests in the K/T boundary, the Eocene/Oligocene boundary, Antarctic Peninsula environments during the Neocene and in the evolution of the Transantarctic Mountains.
- Geoscientists who work on Greenland, Russian Arctic (Open University and colleagues), Canadian Arctic (GSCanada) and Svalbard (CASP, SPRI, other nations).