Cover Photos

Top Photo

This is the northern edge of iceberg B-15A floating in the Ross Sea, Antarctica. (Photo by Josh Landis)

Bottom Photo

National Science Foundation-funded researcher, Douglas MacAyeal, installs a tower with instruments on iceberg B-15A. These instruments will relay position, temperature, wind speed, pressure, and humidity to a satellite. Scientists are tracking the conditions on and around the iceberg as it makes its way through the waters off Antarctica. (Photo by Josh Landis)

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Foreword

This *Science Planning Summary* publication is for use by U.S. Antarctic Program participants only. Others interested in knowing more about U.S. antarctic activitities are encouraged to view the National Science Foundation's Polar Research web site at http://www.nsf.gov/od/opp. This site includes descriptions of each of the current year's scientific research projects.

This United States Antarctic Program (USAP) *Science Planning Summary* contains a synopsis of the plan for the 2001-2002 season (i.e., from mid-August 2001 to mid-August 2002) for the USAP. This publication is a preseason summary (i.e., prior to the 2001-2002 austral-summer season); it contains the current information available as of mid-to-late September 2001. Some of this information may change throughout the austral-summer and winter-over periods as project planning evolves.

There is a Table of Contents and the following three basic sections in this publication.

1) Front Matter

The Front Matter contains information about the austral-summer and austral-winter dates and populations for the USAP stations. There are also synopses about the research vessel cruises. Also, there are research objectives for the Southern Ocean Global Ocean Ecosystems Dynamics (SO GLOBEC) projects, since there are not individual project write-ups for these projects as detailed information was not available at the time of publication. Information about the following USAP programs/events is also in the Front Matter: Technical Events; Media Visitors; Writers & Artists; Teachers Experiencing Antarctica; Scouting in Antarctica; Environmental, Health, and Safety Initiatives; and the Science Event Numbering System.

2) Individual Research Project Write-Ups

There are 126 research project write-ups in this year's hard-copy *Science Planning Summary*. Please note that several more projects could become active during the 2001-2002 season as time progresses.

Individual research project write-ups are arranged by Antarctic Program:

- Aeronomy & Astrophysics
- Biology & Medicine
- Environmental Monitoring
- Geology & Geophysics
- Glaciology
- Oceans & Climate Systems

Within each Antarctic Program section, the individual write-ups are arranged alphabetically by the first two letters of the Science Event Number (SEN), then numerically by the internal three digits of the SEN. (Note: A description of the SEN system is on page F-38.)

After the research objectives section in each project write-up, there is the NSF Award number. The NSF award numbers can be used to search the NSF Award Abstracts Database on the NSF web site (www.nsf.gov) at http://www.nsf.gov/home/grants/grants_awards.htm. The database provides such information as an abstract describing the project, the award amount, the start date of the award, and the type of award. The site offers searches by date, NSF program, principal investigator's institution, and state, as well as fielded searches.

3) Indexes

There are four indexes at the back of this publication that list the following and the associated page numbers of the project write-ups published in this hard-copy *Science Planning Summary*:

- Index A: Alphabetical List of Deploying Research Team Members
- Index B: Alphabetical List of Principal Investigators' Names
- Index C: Alphabetical List of Principal Investigators' Home Institutions/ Affiliations
- Index D: List of Research Projects by Main Location

Note: Here are explanations of several acronyms used in this book:
TBD = To be determined
NA = Not available
R/V = Research Vessel

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1. No more than two covers per person per station per year.
2. Covers will be processed for personal (that is, noncommercial) use of individuals only.
3. U.S. correspondents use domestic first-class postage for the APO addresses (below) and international first-class or air mail postage for the Palmer Station address.
4. Non-U.S. correspondents use international first-class or airmail postage.

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McMurdo Station, Antarctica
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APO AP 96599-5700

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Amundsen-Scott South Pole Station, Antarctica
PSC 468 Box 400
APO AP 96598-5400

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Palmer Station, Antarctica
c/o AGUNSA
Deposito Franco Antarctica
P.O. Box 60-D
Punta Arenas, Chile

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Philatelic mail is processed and returned to senders as soon as possible, but the processing is in addition to regular duties of station personnel. Some processing is done during the austral winter, when antarctic stations are isolated, resulting in year-long (or longer) delays in mailing covers back to the collectors.

United States Antarctic Program
Science Planning Summary
2001-2002 Field Season

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United States Antarctic Program
Science Planning Summary
2001-2002 Field Season

FRONT MATTER

McMurdo Station

McMurdo Station Austral-Summer and Austral-Winter Dates and Population

McMurdo Station, the largest of the United States Antarctic stations, is the main operational center for the continental United States Antarctic Program.

During the 2001 austral-winter season, 220 science, Aviation Technical Services (ATS), and Raytheon Polar Services Company (RPSC) contractor personnel remained at McMurdo Station to maintain station operations and to conduct winter-over research.

The winter operations tempo changed at WINFLY (Winter Fly In), which began on 20 August 2001 with a series of five flights from Christchurch, New Zealand, to McMurdo Station. During the time period from WINFLY to the Mainbody austral-summer season station opening on 2 October 2001, three research projects began operations. Preparation of the station's facilities to accommodate the planned summer program will begin at the actual Mainbody station opening. Early estimates indicate that McMurdo's population could peak at 1100 during the 2001-2002 austral-summer season. However, the weekly population average is expected to be approximately 1000.

McMurdo Station will close out the 2001-2002 austral-summer season activities on 23 February 2001. After this closing, approximately 260 people will remain at McMurdo Station during the 2002 austral-winter months to maintain station operations, perform construction tasking, and conduct winter-over research.

McMurdo-Based Air Operations

McMurdo-based aircraft (helicopter, Twin Otter fixed-wing aircraft, and LC-130 fixed-wing aircraft) will continue to support USAP researchers and program logistical functions. Again this season, Petroleum Helicopters Inc. (PHI) will provide helicopter support. All four helicopters (two AS-350B2 "A-STAR" and two Bell 212 "Hueys") will operate from McMurdo Station this season. They will support researchers in the Royal Society Range, the McMurdo Dry Valleys, and on Mt. Erebus. Additionally, one helicopter will be based out of the Italian Station at Terra Nova Bay.

LC-130 Hercules fixed-wing aircraft will provide resupply and research support to South Pole Station. They will also support research activities at Siple Dome, the onset of Icestream D, Byrd Surface Camp, and the Trans Antarctic Seismic (TAMSEIS) camp in East Antarctica. Research activities will also be supported by two contract Twin Otter fixed-wing aircraft throughout the USAP area of operations.

Major Field Camps for McMurdo-Based Researchers

The following information describes the USAP-supported Antarctic field camps which will be used by McMurdo-based researchers for various research projects.

Siple Dome Camp

The Siple Dome Field Camp—located at 81º 39' S, 149º 04' W—will support the following three research projects this season: GO-180-0 (Dr. Anandakrishnan), GF-121-0 (Dr. Luyendyk), and Il-171-0 (Dr. Waddington). In addition, the support contractor's camps staff will continue to dismantle and retrograde the infrastructure associated with the PICO drilling project, which was completed two seasons ago.

Once again, the Siple Dome Camp will be used as a staging point for research groups utilizing Twin Otter aircraft to access other field locations in West Antarctica. Five resident support contractor staff members will maintain this camp.

Byrd Surface Camp

The Byrd Surface Camp — located at 80º 05' S, 119º 32' W — will be used as a staging area for the U.S. International Trans-Antarctic Scientific Expedition (ITASE) traverse. The following are ITASE projects: IU-133-O (Dr. Jacobel), IU-153-A (Dr. Mayewski), IU-153-B (Dr. Mayewski), IU-155-O (Dr. Albert), IU-158-O (Dr. Bales), IU-178-O (Dr. Hamilton), IU-185-O (Dr. Meese), IU-193-O (Drs. Steig, White, and Shuman), and IU-311-O (Dr. Arcone).

The support contractor's personnel will open and staff the camp while the traverse equipment is de-winterized and prepared for the traverse. The camp will close after the traverse departs and reopen when the traverse team returns. Three members of the support contractor's staff will accompany the traverse team.

Onset D Camp

The Onset D Camp — located at 80° 45' S 125° 45' W — will support two projects this season: IO-205-O (Dr. Anandakrishnan) and GO-167-O (Dr. Morse). The camp will be winterized and left partially up in preparation for the seismic traverse planned for next year. Five resident support contractor staff will operate this camp.

Tamseis Camp

The Tamseis camp (TAM CAMP) — located at 81° 41' S, 122° 26' E — will support one project this season: GO-089-O (Dr. Weins). The camp will be a logistic hub and refueling point for the extensive Twin Otter operations required to install an array of seismic instruments. There will be three contractor personnel operating this camp.

South Pole Station

South Pole Station Austral-Summer and Austral-Winter Dates and Population

Amundsen-Scott South Pole Station will open for normal 2001-2002 austral-summer activities on 29 October 2001. An operational opening on 22 October 2001 will precede this normal station opening. During the operational opening, the incoming crew and the outbound winter-over crew will perform turnover activities, including completion of the skiway and preparation of the station for summer operations.

The upper population limit for the 2001-2002 austral summer at South Pole has been established at 220 people. This number reflects the increased construction load at the station, as construction of the new South Pole Station enters its fifth season. It will be more important than ever to focus on safety, interpersonal cooperation, and conservation of water and electrical power.

The austral-summer season is scheduled to end on 15 February 2002. Approximately 60 people will remain on station for the 2002 austral-winter season (from February 2002 until November 2002) to maintain station operations, conduct winter-over research, and continue construction work on the new station.

Palmer Station

Palmer Station Austral-Summer and Austral-Winter Dates and Population

Palmer Station will open for the 2001-2002 austral-summer season on 21 September 2001 with the arrival of the R/V *Laurence M. Gould* (cruise LMG01-08). Turnover of many of the 2001 austral-winter station-support staff (20 staff members) to the 2001-2002 austral-summer station-support staff (22 staff members) will occur at this time and continue over the following four weeks.

The transition from the 2001-2002 austral-summer station-support staff to the 2002 austral-winter station-support staff (average of 30 staff members) will be staggered over several R/V *Laurence M. Gould* cruises from early-February 2002 to late April 2002. The main winter project will be a complete remodel of the lab spaces in the Biolab building.

R/V *Laurence M. Gould*

The following information describes the R/V *Laurence M. Gould's* research and logistics operations plan for the 2001-2002 season. The ship's schedule may change throughout the year as various requirements evolve. The current schedule for the R/V *Laurence M. Gould* can be found on the World Wide Web (www.polar.org/science/marine/pdf/lmg/lmgsched.pdf).

The R/V *Laurence M. Gould* begins its fifth year of service to the United States Antarctic Program (USAP) in January 2002. This vessel is on charter to Raytheon Polar Services (the support contractor for the National Science Foundation Office of Polar Programs) from Edison Chouest Offshore in Galliano, Louisiana.

The R/V *Laurence M. Gould* will support 10 cruises in the 2001-2002 season. This vessel supports both full-fledged research cruises and supply runs to Palmer Station and Antarctic Peninsula Field Camps throughout the year. Biology, chemistry, and physical oceanography research projects are all part of this season's operational plan in Antarctica. Ports-of-call will include Punta Arenas and Talcahuano, Chile; Palmer Station, Antarctica; and Copacabana Field Camp on King George Island.

The R/V *Laurence M. Gould* is a 239-foot ice-classed research vessel, which has a maximum berthing for 28 science personnel, including a minimum of four support contractor staff. In addition, two berthing vans are available for Palmer Station science and support personnel berthing during both southbound and northbound transits.

The following are synopses of the 2001-2002 R/V *Laurence M. Gould* cruises:

LMG01-08 (Logistics Cruise)

This cruise, which follows an R/V *Laurence M. Gould* maintenance period, will depart from Punta Arenas, Chile, on 15 September 2001. This 17-day cruise is a Palmer Station staff turnover and resupply. The R/V *Laurence M. Gould* will return to Punta Arenas, Chile, on 02 October 2001.

LMG01-08A (Logistics Cruise)

This cruise, which is the second of two back-to-back resupply and staff turnovers for Palmer Station, will be separated only by a short open period in Punta Arenas, Chile. The R/V *Laurence M. Gould* will depart Chile on 07 October 2001 for 14 days. While this cruise is primarily a logistics cruise for Palmer Station, the Copacabana Field Camp (BO-040-O) on King George Island will be opened for the season as well. The Copa Field Camp is the base of operations for Antarctic Biology and Medicine Program project BO-040-O (Dr. Wayne Trivelpiece), which is a study of the effect of environmental variability on penguins inhabiting the island.

The R/V *Laurence M. Gould* will return to Punta Arenas, Chile, on 21 October 2001.

LMG01-08B (Logistics Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 26 October 2001 for a 10-day, third-consecutive Palmer Station resupply cruise. The ship will make a one-day logistics port call at Palmer Station before departing for Punta Arenas, Chile. It will arrive at Punta Arenas on 05 November 2001.

LMG01-09 (Research Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 02 December 2001 and arrive at Palmer Station on the fourth day of this 26-day research cruise. The remainder of the cruise will be spent in and around the Bransfield Strait and King George Island in support of the following Antarctic Biology & Medicine Program projects:

- Project BO-023-O (PI: Dr. Veit) will be onboard conducting bird surveys in their grid centered around 61 degrees South and 55 degrees West (north of Elephant Island). In addition, the researchers will be conducting plankton net tows and collecting fish-finding sonar data while in the work area. Thirty Conductivity-Temperature-Depth (CTD) profiles will also be collected at various stations in the work area.
- Project BO-281-O (PI: Dr. Scheltema) will also be onboard conducting plankton net tows, dredges, grabs, and Otter Trawls in the Gerlache and Bransfield Straits as far north as King George Island. Plankton net tows will be conducted during the south- and north-bound transits across the Drake Passage. XBT and ADCP water-column profile data will be collected to determine the position of the polar and sub-Antarctic fronts, where the researchers may wish to take additional samples. BO-281-O researchers hope to demonstrate the existence of, and mechanism for, the dispersal of certain plankton species in the Drake Passage between the South American and Antarctic continents.

The R/V *Laurence M. Gould* will make a brief stop at Palmer Station on Christmas Eve, 24 December 2001, before returning to the pier in Punta Arenas, Chile, on 28 December 2001.

LMG02-01 (Research & Logistics Cruise)

The R/V *Laurence M. Gould* will set sail for this 30-day cruise from Punta Arenas, Chile, on 02 January 2002 and will arrive at Palmer Station on 06 January 2002. The vessel will then depart the following day to spend 20 days in support of the following Antarctic Biology & Medicine Program LTER projects for this austral-summer cruise:

- Project BP-013-L/N/P (PI: Dr. Fraser) will focus on seabird communities, emphasizing the sources and quantity of food consumed within the foraging range of the seabirds.
- Project BP-016-L/N/P (PI: Dr. Vernet) will focus on rates of primary production, phytoplankton community structure and light absorption

properties, and their relationship to physical forcing.

- Project BP-021-L/N (PI: Dr. Martinson) will compile, model, and manage data from the LTER field season and research cruises.
- Project BP-028-L/N/P (PI: Drs. Quetin & Ross) will focus on the effects of interannual variation in the extent of pack ice and food resources on the macrozooplankton.
- Project BP-032-L/N/P (PI: Dr. Ray Smith, LTER Project Manager) will focus on processes controlling the space/time variability of phytoplankton biomass and production.
- Project BO-045-N/P (PI: Dr. Ducklow) will focus on the transport and fate of Persistent Organic Pollutants (POPs) in Antarctic Coastal Seas.
- Project BP-046-L/N (PI: Dr. Karl) will focus on the microbiology and carbon-flux component.

A brief stop will be made at Palmer Station on 28 January 2002 before the R/V *Laurence M. Gould* will return to Punta Arenas, Chile, on 01 February 2002.

LMG02-01A (Logistics Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 05 February 2002 on a 10-day Palmer Station resupply cruise. The ship will make a two-day logistics port call at Palmer Station before departing for Punta Arenas, Chile. It will arrive at Punta Arenas on 15 February 2002.

LMG02-01B (Logistics Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 19 February 2002 on a 12-day Palmer Station resupply cruise. A GO-096 mooring will also be recovered in the Palmer Deep for Rob Dunbar. The ship will make a logistics port call at Palmer Station before and after the mooring recovery. The R/V *Laurence M. Gould* will arrive at Punta Arenas, Chile, on 03 March 2002.

LMG02-02 (Research & Logistics Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 08 March 2002 for a 25-day cruise, which is a mooring recovery and redeployment for the United States' Southern Ocean portion of the Global Ocean Ecosystems Dynamics project (SO GLOBEC). A short logistics stop will be made at Palmer Station before continuing on to the work area in Marguerite Bay. This cruise is part of a two-year series of two-ship cruises supporting several Antarctic Ocean & Climate Systems Program and Antarctic Biology & Medicine Program projects. This cruise is made up of the following tentatively scheduled components:

- Project OG-231-O (PI: Drs. Beardsley & Limeburner) will study circulation and water property evolution using moored, drifter, and float measurements of current and temperature.
- Project OG-238-O (PI: Dr. Padman) will study mesoscale circulation, tides, and mixing using shipboard Acoustic Doppler Current Profiler (ADCP) and Conductivity-Temperature-Depth (CTD) for tidal modeling and analysis.
- Project BG-239-O (PI: Drs. Hildebrand, Moore, & McDonald) will study whale population distributions using acoustic moorings and whale sightings.
- International Whaling Commission (PI: Dr. Debra Thiele) will also study whale population distributions via whale sightings and biopsies.

The vessel will make a stop at Palmer Station on 29 March 2002 and will return to Punta Arenas, Chile, on 02 April 2002.

LMG02-03 (Research & Logistics Cruise)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 07 April 2002 for this 43-day cruise. The vessel will stop at Palmer Station for a short logistics visit and then continue on to the U.S. Southern Ocean GLOBEC work area in Marguerite Bay. The U.S. SO GLOBEC project is a series of multi-disciplinary research cruises ending in March 2003. This process cruise is made up of the following tentatively scheduled components:

- Project BG-232-O (PI: Drs. Costa, Burns & Crocker) will study the foraging ecology of crabeater seals by analysis of blood, stomach, and lavage samples.
- Project BG-234-O (PI: Dr. Fraser) will study seabird ecology using seabird observations and diet samples.
- Project BG-235-O (PI: Drs. Fritsen & Griggs) will study sea-ice microbial communities by examining their distribution and in-situ primary production.
- Project BG-236-O (PI: Dr. Daly) will study krill distribution, physiology, and predation; copepod prey abundance (water-column component) using net tows and fish-finding sonar to enhance the krill swarm model.
- Project BG-245-O (PI: Dr. Torres) will study krill physiology and fish ecology using net tows, experiments, scuba diving surveys, and acoustics.
- Project BG-246-O (PI: Dr. Vernet) will study water-column phytoplankton primary productivity using Conductivity-Temperature-

Depth (CTD) water samples.

- Project BG-248-O (PI: Dr. Zhou) will study krill distribution, physiology, predation, and copepod prey abundance (water-column component) using net tows, Acoustic Doppler Current Profiler (ADCP), and fish-finding sonar to enhance the krill swarm model.

The R/V *Laurence M. Gould* will return to Palmer Station on 16 May 2002 and Punta Arenas, Chile, on 20 May 2002.

LMG02-04 (Dry Dock)

The R/V *Laurence M. Gould* will depart Punta Arenas, Chile, on 25 May 2002 for Talcahuano, Chile. The vessel will arrive Talcahuano on 31 May 2002 and enter the graving dock at the ASMAR facility. While there, the R/V *Laurence M. Gould* will undergo a U. S. Coast Guard inspection as well as modifications and upgrades to onboard science instrumentation.

The R/V *Laurence M. Gould* will return to Punta Arenas, Chile, on 20 June 2002.

LMG02-04A (Logistics Cruise)

The R/V *Laurence M. Gould* will depart from Punta Arenas, Chile, on 05 July 2002 to retrieve the Palmer Station hazardous waste and transfer it directly to the R/V *Nathaniel B. Palmer*, which will transport the waste directly to the United States for disposal.

The R/V *Laurence M. Gould* will return to Punta Arenas, Chile, on 22 July 2002.

LMG02-05 (Research & Logistics Cruise)

The R/V *Laurence M. Gould* will depart from Punta Arenas, Chile, on 29 July 2002 for the 52-day U.S. SO GLOBEC's final process cruise. This GLOBEC cruise is part of a multi-disciplinary research project made up of the following tentatively scheduled components:

- Project BG-232-O (PI: Drs. Costa, Burns & Crocker) will study the foraging ecology of crabeater seals by analyzing blood, stomach, and lavage samples.
- Project BG-234-O (PI: Dr. Fraser) will study seabird ecology using seabird observations and diet samples.
- Project BG-235-O (PI: Drs. Fritsen & Griggs) will study sea-ice microbial communities by examining their distribution and in-situ

primary production.

- Project BG-237-O (PI: Dr. Harvey) will study krill age and dietary history using net tows.
- Project OG-241-O (PI: Drs. R. Smith, Martinson, & Perovich) will study sea-ice optics.
- Project BG-244-O (PI: Drs. Ross & Quetin) will study krill and zooplankton and how it relates as a function to sea ice using net tows and scuba diving.

The R/V *Laurence M. Gould* will make a brief logistics stop at Palmer Station on 14 September 2002 before returning to Punta Arenas, Chile, on 19 September 2002.

R/V *Nathaniel B. Palmer*

The following information describes the R/V *Nathaniel B. Palmer's* research and logistics operations plan for the 2001-2002 season. The ship's schedule may change throughout the year as various requirements evolve. The current schedule for the R/V *Nathaniel B. Palmer* can be found on the Web (www.polar.org/science/marine/pdf/nbp/nbpsched.pdf).

During the 2001-2002 season, the R/V *Nathaniel B. Palmer* will support seven cruises. Researchers on the vessel will conduct biological, chemical, physical oceanographic, and marine geology studies in the Weddell Sea; Bransfield Strait and Marguerite Bay areas near the Antarctic Peninsula. Ports-of-call will include Punta Arenas and Talcahuano, Chile; Palmer Station; Cape Shirreff on Livingston Island; and Seymour Island.

The R/V *Nathaniel B. Palmer* is managed for the NSF by Raytheon Polar Services Company on a long-term charter from Edison Chouest Offshore of Galliano, Louisiana. This research vessel, built in 1992, begins its second 10-year charter in April 2002. The R/V *Nathaniel B. Palmer* is ice-classed (ABS-A2) and capable of breaking three feet of level ice at three knots. The vessel can accommodate 39 scientists including seven support contractor staff and normally sails with an operating crew of between 20 and 24. There are more than 4000 square feet of exterior main deck working areas and more than 5500 square feet of laboratory space on the vessel.

The following are synopses of the 2001-2002 R/V *Nathaniel B. Palmer* cruises:

NBP01-05 (Research Cruise)

The R/V *Nathaniel B. Palmer* will set sail for this 42-day cruise from Punta Arenas, Chile, on 07 September 2001. The vessel will support the following Antarctic Biology & Medicine Program LTER projects for this austral-winter cruise:

- Project BP-013-L/N/P (PI: Dr. Fraser) will focus on seabird communities, emphasizing the sources and quantity of food consumed within the foraging range of the seabirds.
- Project BP-016-L/N/P (PI: Dr. Vernet) will focus on rates of primary production, phytoplankton community structure and light absorption properties, and their relationship to physical forcing.
- Project BP-021-L/N (PI: Dr. Martinson) will compile, model, and manage data from the LTER field season and research cruises.
- Project BP-028-L/N/P (PI: Drs. Quetin & Ross) will focus on the effects of interannual variation in the extent of pack ice and food resources on the macrozooplankton.
- Project BP-032-L/N/P (PI: Dr. Ray Smith, LTER Project Manager) will focus on processes controlling the space/time variability of phytoplankton biomass and production.
- Project BO-045-N/P (PI: Dr. Ducklow) will focus on the transport and fate of Persistent Organic Pollutants in Antarctic Coastal Seas.
- Project BP-046-L/N (PI: Dr. Karl) will focus on the microbiology and carbon-flux component.

The R/V *Nathaniel B. Palmer* will return to Punta Arenas, Chile, on 19 October 2001.

NBP01-05A (Seismic Sea Trials)

The R/V *Nathaniel B. Palmer* will leave Punta Arenas, Chile, on 30 October 2001 for a six-day training cruise. Training will include a new ODEC Bathy W system; BOLT and GI seismic air guns; Syntron air gun controller; Oyo-DAS and Lookout Geophysical seismic recording systems; a new multi-channel seismic streamer cable; and the Seabeam 2112 multibeam swath sonar.

The R/V *Nathaniel B. Palmer* will arrive back in Punta Arenas, Chile, on 05 November 2001.

NBP01-06 (Research & Logistics Cruise)

The R/V *Nathaniel B. Palmer* will depart Punta Arenas, Chile, on 09 November 2001 for a 22-day research cruise and Cape Shirreff Field Camp opening. Following the field camp opening, the R/V *Nathaniel B. Palmer* will stop briefly at Palmer Station before beginning operations for the following Marine Geology & Geophysics Program and Ocean & Climate Systems Program projects:

- Project GO-097-O (PI: Dr. Wiens) will retrieve data from four seismic stations at three Chilean military bases on King George Island, Greenwich Island, and the Antarctic Peninsula. The stations are part of a long-term study using broadband seismograph equipment in the Antarctic Peninsula Region and southern Chile. This is the final year of the project and so science operations will include the derigging and transporting of all project-related equipment from the bases.
- Project OO-124-O (PI: Dr. Visbeck) will focus on the recovery and redeployment of two moorings at about 63 degrees South, 41 degrees West and 62 degrees South, 43 degrees West. Conductivity-Temperature-Depth (CTD) sampling will be done at each of the mooring sites and along the transect between sites if possible.

The R/V *Nathaniel B. Palmer* will arrive back in Punta Arenas, Chile, on 01 December 2001.

NBP01-07 (Research Cruise)

The R/V *Nathaniel B. Palmer* will leave Punta Arenas, Chile, on 05 December 2001 for 39-day Antarctic Geology and Geophysics cruise. The cruise will support the following projects:

- Project GO-065-O (PI: Dr. Aronson) will study global climate change and the evolutionary ecology of Antarctic Mollusks in the late Eocene. Work will consist of collecting fossils on Seymour Island and returning them to a base camp for packing and shipping to the United States.
- Project GO-092-O (PIs: Dr. Berger & Dr. Domack) will study the zeroing of light-sensitive luminescence in silt-size feldspar grains from representative glaciomarine depositionial settings in Antarctica, specifically in the Antarctic Peninsula region. These objectives will be met by collecting suspended particulate matter from sediment plumes, core-top sediment samples, and sediment trap materials. Primary work areas will include Brialmont Cove, Andvord Bay, Lallemand Fjord, and Admiralty Bay.

This R/V *Nathaniel B. Palmer* cruise will end in Punta Arenas, Chile, on 13 January 2002.

NBP02-01 (Research Cruise)

The R/V *Nathaniel B. Palmer* will set sail from Punta Arenas, Chile, on 18 January 2002 for a 45-day Antarctic Marine Geology and Geophysics Program project. The vessel will support research operations for the following projects:

- Project GO-083-O (PI: Dr. Anderson) will reconstruct the West Antarctic Ice Sheet configuration during the Last Glacial Maximum, study its retreat history, and examine the interaction of individual paleo-ice streams and the beds on which they rested. These objectives will be met by collecting multi-beam, seismic data, deep-tow side-scan sonar data, piston and kasten cores. Bottom camera, sub-bottom profiler, fish-finding sonar, Conductivity-Temperature-Depth (CTD) data, and grab samples may be collected as well.
- Project GO-154-O (PI: Dr. Bart) will study the frequency of glacial advances during the late Neogene. The objective is to acquire three regional strike-oriented single-channel seismic profiles on the outer continental shelf. Equipment used will include a small airgun array, and the single-channel streamer recording system.

The R/V *Nathaniel B. Palmer* will return to Punta Arenas, Chile, on 04 March 2002.

NBP02-02 (Research Cruise)

The R/V *Nathaniel B. Palmer* will depart Punta Arenas, Chile, on 09 April 2002 for a 42-day cruise supporting the United States' Southern Ocean Global Ocean Ecosystems Dynamics (SO GLOBEC) project. This cruise is part of a two-year series of two-ship cruises supporting several Antarctic Ocean & Climate Systems Program and Antarctic Biology & Medicine Program projects. This survey cruise is made up of the following tentatively scheduled components:

- Project OG-231-O (PI: Drs. Beardsley & Limeburner) will study circulation and water property evolution using moored, drifter, and float measurements of current and temperature.
- Project OG-233-O (PI: Dr. Fanning) will study water-column nutrient analysis using Conductivity-Temperature-Depth (CTD) samples.
- Project OG-238-O (PI: Dr. Padman) will study mesoscale circulation, tides, and mixing using shipboard Acoustic Doppler Current Profiler (ADCP), Conductivity-Temperature-Depth (CTD), and Lowered ADCP for tidal modeling and analysis.
- Project BG-239-O (PI: Drs. Hildebrand, Moore, & McDonald) will study whale population distributions using acoustic moorings and

whale sightings.

- Project OG-240-O (PI: Drs. Hofmann, Klinck, & Locarnini) will study hydrographic modeling, both biological and physical, using shipboard Conductivity-Temperature-Depth (CTD) profiles, ADCP circulation data, bio-optical and krill models.
- Project OG-242-O (PI: Dr. Powell) will study small-scale mixing and krill behavior using microstructure profiling/krill swarm models.
- Project BG-243-O (PI: Dr. Ribic) will study seabird distribution and abundance using strip-transect survey.
- Project BG-246-O (PI: Dr. Vernet) will study water-column phytoplankton primary productivity using Conductivity-Temperature-Depth (CTD) water samples.
- Project BG-247-O (PI: Drs. Ashjian, Davis, Gallager, & Wiebe) will study zooplankton distribution, abundance in the water column, and sea-ice/water-column boundary using ROVs, BIOMAPER towed sensor array, and net tows.

The R/V *Nathaniel B. Palmer* will return to Punta Arenas, Chile, on 21 May 2002.

NBP02-03 (Dry Dock)

The R/V *Nathaniel B. Palmer* will set sail from Punta Arenas, Chile, on 25 May 2002 for a 5-day cruise to Talcahuano, Chile, for the following 48-day dry dock/maintenance period. The following projects are tentatively scheduled:

- SeaBeam 2112 removal
- Simrad multibeam installation
- Seawater system upgrade

The vessel will depart Talcahuano, Chile, on 19 July 2002 and arrive at Punta Arenas, Chile, on 25 July 2002.

NBP02-04 (Research Cruise)

The R/V *Nathaniel B. Palmer* will depart Punta Arenas, Chile, on 31 July 2002 for a 50-day cruise supporting the U.S. SO GLOBEC project. This final survey cruise is part of a multi-disciplinary research project made up of the following tentatively scheduled components:

- Project OG-231-O (PI: Drs. Beardsley & Limeburner) will study circulation and water property evolution using moored, drifter, and float measurements of current and temperature.
- Project OG-233-O (PI: Dr. Fanning) will study water-column nutrient analysis using Conductivity-Temperature-Depth (CTD) samples.
- Project BG-235-O (PI: Drs. Fritsen & Griggs) will study sea-ice microbial communities by examining their distribution and in-situ

primary production.

- Project BG-236-O (PI: Dr. Daly) will study krill distribution, physiology, and predation; copepod prey abundance (water-column component) using net tows; and fish-finding sonar to enhance the krill swarm model.
- Project OG-238-O (PI: Dr. Padman) will study mesoscale circulation, tides, and mixing using shipboard Acoustic Doppler Current Profiler (ADCP) and Conductivity-Temperature-Depth (CTD) for tidal modeling and analysis.
- Project BG-239-O (PI: Drs. Hildebrand, Moore, & McDonald) will study whale population using acoustic mooring and whale observations to determine population distributions.
- Project OG-240-O (PI: Drs. Hofmann, Klinck, & Locarnini) will study hydrographic modeling, both biological and physical, using shipboard Conductivity-Temperature-Depth (CTD) profiles, ADCP circulation data, bio-optical and krill models.
- Project OG-242-O (PI: Dr. Powell) will study small-scale mixing and krill behavior using microstructure profiling/krill swarm models.
- Project BG-243-O (PI: Dr. Ribic) will study seabird distribution and abundance using strip-transect survey.
- Project BG-245-O (PI: Dr. Torres) will study krill physiology and fish ecology using net tows, experiments, scuba diving surveys, and acoustics.
- Project BG-246-O (PI: Dr. Vernet) will study water-column phytoplankton primary productivity using Conductivity-Temperature-Depth (CTD) water samples.
- Project BG-247-O (PI: Drs. Ashjian, Davis, Gallager, & Wiebe) will study zooplankton distribution, abundance in the water column, and sea-ice/water-column boundary using ROVs, BIOMAPER towed sensor array, and net tows.
- Project BG-248-O (PI: Dr. Zhou) will study krill distribution, physiology, and predation; copepod prey abundance (water-column component) using net tows; Acoustic Doppler Current Profiler (ADCP); and fish-finding sonar to enhance the krill swarm model.

The R/V *Nathaniel B. Palmer* will return to Punta Arenas, Chile, on 19 September 2002.

Southern Ocean
Global Ocean Ecosystems Dynamics
(SO GLOBEC)
Research Objectives

The goal of the U.S. Global Ocean Ecosystems Dynamics (U.S. GLOBEC) program is to understand and ultimately predict how populations of marine animal species respond to natural and anthropogenic changes in climate. Research in the Southern Ocean indicates a strong coupling between climatic processes—via the annual formation and destruction of sea ice—and ecosystem dynamics. As participants in the Southern Ocean GLOBEC program (SO GLOBEC), we will investigate the dynamic relationship between physical processes and ecosystem responses by identifying critical parameters that affect the distribution, abundance, and population dynamics of target species. Overall, we hope to elucidate shelf-circulation processes and their effect on sea-ice formation and antarctic krill (*Euphausia superba*) distribution, and to examine the factors that govern how krill survive and become available to higher trophic levels (including penguins, seals, and whales). To accomplish this we use moored-instrument investigations; broad physical, biological, and chemical oceanographic surveys; process-oriented investigations; and modeling studies focused on austral-winter processes in the western Antarctic Peninsula region.

We have chosen Marguerite Bay in the central western Antarctic Peninsula continental shelf, which is characterized by unusually high krill production. We hypothesize that these high production levels result from a unique combination of factors, both physical and biological, that enhance krill growth, reproduction, recruitment, and survivorship throughout the year.

Water masses on the continental shelf off Marguerite Bay consist of inflowing Upper Circumpolar Deep Water, which is relatively warm, salty, oxygen-poor, and nutrient-rich. In winter, atmospheric processes cool and freshen this water and recharge it with oxygen to produce Antarctic Surface Water. This austral-winter environment also provides particularly favorable conditions for larval and adult krill survival, including

- a shelf circulation that keeps the krill population in a favorable environment for extended periods;

- a persistent winter ice cover that provides dependable food and protection for larval krill to grow and survive over the winter; and
- on-shelf intrusions of Upper Circumpolar Deep Water, supplying heat, salt, and nutrients that affect ice properties and enhance biological production.

Making use of the U.S. Antarctic Program's two research ships — the icebreaking research ship *Nathaniel B. Palmer* and the ice-strengthened research ship *Laurence M. Gould* — we will continue our two-year field study in mid-March 2002 (the late austral fall). Working in the Antarctic Peninsula region until mid-August 2002, we will conduct five cruises aboard the two ships in and around Marguerite Bay. The results of the integrated SO GLOBEC program will improve our power to predict living marine resources, especially with respect to local and global climatic shifts.

Southern Ocean GLOBEC: Circulation and water property evolution.
Robert Beardsley and Richard Limeburner, Woods Hole Oceanographic Institution.

As part of the Southern Ocean GLOBEC program, we will develop and deploy on the continental shelf off Marguerite Bay a series of moorings, which will include current meters, sensors to measure salinity, temperature and zooplankton concentration, upward-looking acoustic sounders to track ice motion, and acoustic Doppler current profilers. Our proposed mooring design will quantify and characterize the inflowing and outflowing water masses, and provide the physical component for the integrated modeling effort. Instrumented drifters will supplement the mooring data. These data should quantify the spatial and temporal variability of the (presumed) clockwise flow of water masses through the bay, and define the tidal and transient flows driven by storms and southward meanders of the Antarctic Circumpolar Current.

Southern Ocean GLOBEC: Mesoscale circulation, tides and mixing.
Lawrence Padman, Earth and Space Research.

Our project has three major components:

- to collect, analyze, and archive Acoustic Doppler Current Profiler (ADCP) and Conductivity-Temperature-Depth (CTD) data in order to be able to characterize mesoscale circulation features and the regional

hydrography;
- to develop an accurate model of tidal currents in Marguerite Bay; and
- to provide a data set of small-scale processes (such as shear instabilities, tidal stirring, mesoscale eddies, and double diffusion) that are required to establish effective parameters for the vertical movement of heat, salt, and nutrients. The results of our project will provide a unified data base, linking water-column and sea-ice processes with the biology of krill and its predators.

Southern Ocean GLOBEC: Water column microstructure.
Thomas Powell, University of California, Berkeley.

Our objective is to make a quantitative assessment of the small-scale temperature and salinity structure of the oceanic surface layer to study the effect of stratification and turbulence on the biochemical and biological processes under the winter sea ice. These modification processes work through mixing associated with shear instabilities of the internal wave field, double diffusion of salt and heat, and mixing driven by surface stress and convection. We will use two microstructure profilers capable of resolving the small but crucial vertical variations that drive these processes.

Southern Ocean GLOBEC: Hydrography and biological and physical modeling. *Eileen Hofmann, John Klinck, and Ricardo Locarnini, Old Dominion University.*

We have two objectives: to characterize the regional hydrography, and to develop a hierarchy of models to organize and integrate physical and biological observations. We will define the water masses in the Marguerite Bay region with repeated regional surveys for temperature, salinity, nutrients, and oxygen and will supplement these with data from both a moored current-meter and temperature array and, also, from acoustic surveys of the upper-ocean current structure. Modeling will provide a mechanism to link water-column and sea-ice processes with the biology of krill and its predators. To synthesize physical and biological models over the continental shelf, we will use three types of models to order the various observations: time-dependent biological models, depth-time models of physical and biological characteristics, and three-dimensional and time-dependent models.

Southern Ocean GLOBEC: Sea ice physics.

Douglas Martinson, Lamont-Doherty Earth Observatory; Raymond Smith, University of California, Santa Barbara; Donald Perovich, U.S. Army's Cold Regions Research and Engineering Laboratory.

The optical properties of snow and sea ice evolve through the winter and vary greatly, both spectrally and spatially. These properties, important elements of the physical environment, strongly influence the distribution of, and the resources available to, antarctic krill. The intensity and distribution of incident radiant energy within the snow, ice, and water column—and the linked physical, optical, chemical, and biological processes that modulate its distribution—are known but poorly quantified. These properties also influence snow and ice algae, water-column productivity and visibility, for both predator and prey; they are also essential in satellite observations as proxy indicators of geophysical sea-ice parameters. To create improved quantitative models with which to follow the temporal and spatial evolution of this snow and ice marine ecosystem, we will deploy an array of instrumented ice beacons, augmented by periodic, ship-based and satellite observations, along with theoretical studies.

Southern Ocean GLOBEC: Dissolved nutrient measurements.

Kent Fanning, University of South Florida.

Our project focuses on providing high quality measurements of water-column silica, phosphate, nitrite, ammonia, and nitrate concentrations. These measurements will be examined in conjunction with the marine biological and physical oceanography components.

Southern Ocean GLOBEC: Primary production in the water column.

Maria Vernet, Scripps Institution of Oceanography, University of California, San Diego.

Focusing on primary production in the water-column, we will use direct experimental estimates, modeling results from a fast-repetition-rate fluorometer, and modeling of primary production from optical as well as biophysical models. This research will be coordinated with components focused on sea-ice production and sea-ice habitats.

Southern Ocean GLOBEC: Sea-ice microbial communities.
Christian Fritsen, Desert Research Institute; University of Nevada.

Focusing on the distribution and activities of sea-ice microbial communities, we will use an integrated combination of sampling (vertical profiles, horizontal surveys, and under-ice surveys) and observational protocols. Experiments will be designed to estimate microbial activity within the sea ice and at the ice/seawater interface. We will coordinate our research with components studying the water-column productivity and the sea-ice habitat.

Southern Ocean GLOBEC: Water column krill distribution and abundance in winter.
Meng Zhou, University of Minnesota.

We will use acoustic techniques to acquire data on the distribution of juvenile and adult krill and mesozooplankton prey. We will also study krill shrinkage and mortality rates, and krill aggregation behavior. The results will be analyzed in coordination with components involved in physical and biological models.

Southern Ocean GLOBEC: Zooplankton distribution and abundance.
Peter Wiebe, Carin Ashjian, Cabell Davis, and Scott Gallager; Woods Hole Oceanographic Institution.

This project will focus on juvenile and adult krill and mesozooplankton prey-distribution and abundance, using a sophisticated instrument package. Known as BIOMAPPER II, the instruments in the package include an acoustic backscatter sonar system, a video plankton recorder, and an environmental sensor system. Additionally, a remotely-operative vehicle will be used to map the distribution and behavior of krill under ice.

Southern Ocean GLOBEC: Winter ecology of larval krill.
Robin Ross and Langdon Quetin, University of California, Santa Barbara.

Focusing on the under-ice distribution and abundance of larval and juvenile krill, we will assess the physiological condition of krill associated with areas of sea ice providing food of differing quality and quantity. In an effort to understand the overall age-specific dynamics of krill in winter, we will coordinate with krill study components focusing on adults in the water column.

Southern Ocean GLOBEC: Krill physiology, distribution, predation and fish ecology.

Kendra Daly, University of South Florida.

This project will focus on krill physiology, using measures of respiration, excretion, and proximate analysis. Feeding experiments will be conducted using various measurement techniques. Under-ice surveys and sample collection will provide information on krill abundance and distribution. Additionally, the distribution and abundance of fishes and squid — krill predators — will be investigated using acoustic and net-tow methods.

Southern Ocean GLOBEC: Biochemical determination of age and dietary history in the krill.

H. Rodger Harvey, Center for Environmental Sciences, University of Maryland.

To determine the population/age structure of krill in field populations (over seasonal and interannual time scales), and to establish markers for dietary history, we will apply new biochemical approaches based on lipids that are specific to different food resources. This research will be coordinated with components studying krill feeding and growth.

Southern Ocean GLOBEC: Seabird distribution and abundance in winter.

Christine Ribic, University of Wisconsin; William Fraser, Montana State University.

Our project focuses on large-scale distribution, abundance, and habitats of seabirds, as well as on seabird diet-composition and small-scale foraging behavior. To accomplish this, we will use strip-transect surveys and examine large-scale data with spatial analysis software and models. Additionally, satellite transmitters will be used to correlate foraging behavior with diet studies.

Southern Ocean GLOBEC: Foraging ecology of crabeater seals.

Daniel Costa and Daniel Crocker, University of California, Santa Cruz; Jennifer Burns, University of Alaska, Anchorage.

Using a combination of satellite-linked tracking, specialized diver-recorders, and stable isotopic tracers, we will focus on the distribution and foraging behavior of adult female crabeater seals. These data will be coordinated with other study components focused on prey (krill) distribution and the physical environment. The results will be analyzed using an optimality model.

Southern Ocean GLOBEC: Mysticete whale acoustic census in the GLOBEC west antarctic project area.

John Hildebrand, Scripps Institution of Oceanography, University of California, San Diego.

We will determine minimum population estimates, distribution, and seasonality for mysticete whales, especially blue whales, by using passive acoustic recorders deployed on the seafloor for one to two years. The deployment of a large aperture, autonomous, hydrophone array in the antarctic will use passive acoustics as a tool to detect and count mysticete whales.

Southern Ocean GLOBEC: Modeling the effects of eddies and mean flows on Southern Ocean biology.

Glen Flierl, Massachusetts Institute of Technology.

Our objective is to understand the interactions of biological and physical dynamics by modeling the spatial distribution of krill, which form dense aggregations (or patches) on the small scale. The spatial distribution of these patches apparently depends on

- the advance and retreat of sea ice;
- the three-dimensional movement of water masses from small-scale turbulence to the dynamics of the Antarctic Circumpolar Current; and
- the pressure of the food supply and predation.

Earlier studies indicate that physical processes dominate on the larger scale, while biological processes dominate on the smaller scale. However, the relative importance of the two as a function of scale has not been investigated systemically. To accurately represent patchiness in a circum-antarctic model, we will study a detailed model that can resolve the scale of krill patches and help us to analyze and understand the field observations. These results will allow us to improve the parameters of krill distributions in meso-scale and basin-scale models of the Southern Ocean.

Technical Events

Every field season, the United States Antarctic Program sponsors a variety of technical events that are not scientific research projects in their own right, but support one or more science projects with field support, data collection and archiving, or technical services. The technical events for the 2001-2002 research season are as follows:

TO-150-M
Ice Core Drilling Services (ICDS)
Shot Hole System in Support of Sridhar Anandakrishnan's Seismic Survey

Dr. Charles Bentley
University of Wisconsin Madison
Department of Geology and Geophysics
1215 W. Dayton Street
Madison, WI 53706
Phone: (608) 262-0693
E-Mail: bentley@geology.wisc.edu

This project will be working from mid-November 2001 to late December 2001 at Williams Field to test a new drilling system which will be used in the future for drilling shotholes at the head of Icestream D for Dr. Sridhar Anandakrishnan's Seismic Survey project (SEN IO-205-O).

TO-150-S
Ice Core Drilling Services (ICDS)
Sesimometer Emplacement—Quiet Earth Sector Seismological Observatory (QESSO)

Dr. Charles Bentley
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Madison, WI 53706
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This project will work from mid-November 2001 to early February 2002 to conduct dry drilling (with an electro-mechanical coring drill) of three to four holes (approximately 300-meters deep) in a site located 8 km from the South Pole (in the Quiet Earth Sector). Once the drilling has been completed, the work area will be leveled to avoid drifting. These holes will be used by the U. S. Geological Survey for seismometer emplacement during the next field season

This project will also do one drill test of one hole near an existing seismic vault located close to the South Pole Station and will put a borehole seismometer in this hole in order to test the borehole seismometer.

TO-296-O
Automatic Geophysical Observatory (AGO) Servicing Program

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Science Support / AGO
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There are six AGO stations distributed over the Antarctic Plateau. Each station is a general research station that can support a wide variety of experiments. Each station is intended to run for 12 months without human intervention and will supply electrical power (up to 50 watts in the winter and 180 watts in the summer) and heat to the experiments. The current experiments are a suite of six different experiments which are examining the interaction of the solar wind with the Earth's magnetosphere. Three of the stations also have a Seismometer.

From early November 2001 through mid-January 2002, the project team members will travel via Twin Otter aircraft to each of the six Automatic Geophysical Observatory (AGO) stations distributed over the Antarctic Plateau. The team members will set up tent camps in order to service and upgrade each site. Team members will retrieve AGO data, ensure that all existing experiments are functional, and prepare each station to run for the next year. This year, the team will install a new photometer at all six AGO stations.

Once the servicing is complete, LC-130 aircraft will arrive with fuel for the stations. The team members will refuel the AGOs, then return via LC-130 aircraft to McMurdo Station, where they will perform post-season work during mid-to-late January 2002 to repair equipment, refill propane cylinders for the next season, and prepare vessel retrograde. AGO data will be sent to Augsburg College, where it will be processed and distributed to participating investigators.

TO-308-O
McMurdo Ground Station

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NASA's McMurdo Ground Station (MGS) will be tracking a variety of in orbit scientific (TRACE, FAST, WIRE, SWAS, etc.) and mapping (Radarsat, Landsat-7, QuikSCAT, ERS, etc.) satellites, as well as supplying launch and early orbit support for new satellites using the 10 meter antenna located above McMurdo Station next to building 71. MGS will also be supplying real time data (downlink) and commanding (uplink) support to a variety of projects via NASA's dedicated 128 Kbit data line (voice support is through a dedicated 16 Kbit voice loop with Goddard Space Flight Center). Some recorded data (Radarsat and ERS SAR data as well as Taurus START 2 treaty compliance data) will be shipped back to the U.S. for processing. If requested, MGS will uplink data through the MTRS-1 ground station located on Black Island, or MTRS-2 ground station located on Crater Hill through TDRSS (Telemetry and Data Relay Satellite System) to the NASA facility at White Sands, New Mexico.

Project team members at McMurdo Station will provide ground station maintenance and operation.

TO-312-O
TeraScan : Arctic and Antarctic Research Center (AARC) at Scripps Institution of Oceanography

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The TeraScan project collects data from polar orbiting satellites, archives the data, and provides the data to the scientific community and for flight forecasting support.

The NSF/OPP support contractor personnel will continue to collect NOAA and Defense Meteorological Satellite Program (DMSP) data from the TeraScan ground stations at McMurdo Station, Palmer Station, and on the R/V *Nathaniel B. Palmer*. They will deliver the data at regular intervals to the Arctic and Antarctic Research Center (AARC). Personnel at AARC will archive and deliver the data to the scientific community upon request.

The NSF/OPP support contractor personnel will also provide year-round routine maintenance on all of the USAP TeraScan ground stations.

TO-396-O
Installation, Operation, and Maintenance of a Comprehensive Test Ban Treaty (CTBT) Class Infrasound Array in Windless Bight, Antarctica

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In late November 2001, two project team members will travel via tracked vehicle to Windless Bight, where they will establish a field camp to service and repair the infrasound system. During this time, one team member will remain at McMurdo Station to update system computers and service the radio relay system at the MTRS2 site. In early December 2001, the Windless Bight team will return via tracked vehicle to McMurdo Station and all team members will return to the home institution.

One team member will return to McMurdo Station and in early January 2002 will escort two Comprehensive Test Ban Treaty (CTBT) diplomats during their inspection of data transmission equipment and procedures. The goal of this diplomatic visit is to certify the McMurdo Station CTBT site as an approved reporting station in the world-wide CTBT sensor network.

Data from the Windless Bight infrasound system will be forwarded to the CTBT office in Vienna, as well as to the home institution, where it will be made available for research into the natural infrasonic background.

TO-513-O
National Science Foundation (NSF) Polar Programs
Ultraviolet Spectroradiometer Network

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The NSF Ultraviolet (UV) Monitoring Network was first established in 1987 by the office of Polar Programs in response to the serious ozone depletion reported in Antarctica. BSI installed, operates, and maintains this network. This network is the first automated, high-resolution UV scanning spectroradiometer network installed in the world. It currently is providing data to the researchers studying the effects of ozone depletion on terrestrial and marine biological systems. The system is used to develop and verify models of atmospheric light transmission and the impact of ozone depletion.

The annual BSI site visits are planned as follows: South Pole Station from early January 2002 to late January 2002, McMurdo Station from late January 2002 to early February 2002, Palmer Station for one week in February or March 2002. The project member plans to test, maintain, upgrade engineering, and calibrate the high-resolution UV spectroradiometer at the Atmospheric Research Observatory (ARO) at the South Pole Station, at the Arrival Heights Facility at McMurdo Station, and at the T-5 building at Palmer Station. The support contractor's science technicians will assist year-round in the maintenance of the UV monitor and the transmission of data.

Media Visitors to U.S. Antarctic Research Stations

Each year, the National Science Foundation (NSF) selects a very limited number of journalists to visit the U.S. Antarctic Program's research stations to report on the scientific work being conducted in Antarctica. The media visits to the research sites—which could not take place without NSF's assistance because of the lack of commercial transport to and within the continent—serve to inform U.S. taxpayers about the publicly supported program.

Public affairs officers from NSF's Office of Legislative and Public Affairs (OLPA) assist reporters during their stay in Antarctica. Many reporters maintain their interest in the U.S. Antarctic Program for years after they visit the southernmost continent.

An Antarctic "group media tour" of previous years has been replaced by individual visits, for which there are many more requests than can be met. Reporters apply with a concise letter that proposes a reporting plan, based on ideas often developed in conjunction with OLPA's public affairs officers. Reporters may join a research cruise, for example, or spend an extended time at a field camp. They may focus on research in a particular discipline, pursue a broader interest in the science program as a whole, or concentrate on a unique project taking place in a particular season. For most reporters, the individual scientists and life at the remote stations are a compelling part of the scientific story to be told.

The program is open only to media professionals; and representatives from a variety of media, including print, radio, television, film, and online journalism, may be selected in a given year. These reporters reach diverse audiences that include everyone from children to semi-technical readers to the general public. U.S. media receive preference in selection as do proposals that reflect some background knowledge of the U.S. Antarctic Program.

Reporters interested in covering the science program are usually rated more highly than those who wish to focus on operations or on Antarctica in general. Freelance writers must provide evidence in the form of a letter on the target market's letterhead that their work will be published or aired as a result of the trip. Space is particularly limited each year for television and film outlets.

Reporters' requests are competitively evaluated each year by a committee drawn from OLPA and the Office of Polar Programs, and final selections are made from highly rated proposals for travel during the upcoming Antarctic summer (usually between November and February).

For more information on NSF's Antarctic media visits, contact:

Peter West
Public Affairs Officer
Office of Legislative and Public Affairs
National Science Foundation
4201 Wilson Blvd., Rm. 1245
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A production team from CNN was selected to visit Antarctica during the 2001-2002 research season.

Antarctic Artists & Writers Program

The Antarctic Artists & Writers Program, National Science Foundation, provides an opportunity for the humanities (e.g., painting, photography, writing, history, and other liberal arts) to be part of the U.S. Antarctic Program. Artists and writers work at U.S. stations and camps, often with science groups but sometimes on their own, to create works that portray the region or activities there.

The program helps to record America's antarctic heritage and responds to White House direction that the U.S. Antarctic Program "support the range of U.S. antarctic interests." Application procedure, selection criteria, and a list of past participants are at http://www.nsf.gov/od/opp/aawr.htm.

Selection compares to the way NSF selects science projects: a peer-review panel meets at NSF annually to evaluate the applications, and its advice heavily influences NSF's decisions. Those selected receive field support (including air travel from the United States), but no direct award of NSF funds. The program is mainly for U.S. citizens; applicants from other Antarctic Treaty nations can be considered if their works will reach a significant U.S. audience.

The following are Artist & Writer participants during the 2001-2002 season:

Live @ the Exploratorium: Origins

Mary K. Miller
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Objective: The hands-on San Francisco museum Exploratorium, with funds from NSF's Educational, Secondary, and Informal Science Education Program (ESI-9980619), is developing educational webcasts, web-based resources, and museum activities (collectively called Live @ the Exploratorium: Origins) or six research sites, of which one is the U.S. Antarctic Program.

Field season: A four-person team will work out of McMurdo Station in November 2001 - January 2002, visiting research groups and others to develop material and doing some real-time broadcasts to the Exploratorium.

Solo acoustic guitar CD about Antarctica

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http://www.henrykaiser.net

Objective: Mr. Kaiser will compose, improvise, and record an instrumental, solo acoustic guitar CD about Antarctica – its landscape, weather, natural features, exploration, and science. The CD will be produced entirely on site in Antarctica and will include environmental sounds. He also will produce radio reporting and sound art, a web site, and articles for print media. Mr. Kaiser, a guitarist and composer, represents a range of musical idioms, and his works have sold more than 850,000 albums.

Field season: Mr. Kaiser will work out of McMurdo Station in November 2001 - January 2002.

Envisioning Antarctica: history and nature of antarctic images

William L. Fox
2230 NE Halsey St., Apt. B
Portland, Oregon 97232
503-335-3815
wlfox@earthlink.net

Objective: Mr. Fox is writing a book, which the University of Georgia Press will publish, for general audiences about how we have represented the Antarctic through visual images. This interdisciplinary book will trace the historical lineage of antarctic art, cartography, and exploration, explain how it is related to today's activities, and point to its future value. Mr. Fox has written four nonfiction books about how we transform land into landscape through art, architecture, and memory. Also, he led treks in the Himalaya and taught climbing in the southwestern United States.

Field season: Mr. Fox will work out of McMurdo Station in November 2001 - January 2002.

A book about the doing of antarctic science

Meredith Hooper
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Fortis Green, London N2 9HX England
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meredith@hooper.demon.co.uk

William R. Fraser
Department of Biology
Montana State University
Bozeman, Montana 59717
406-994-4548
ubiwf@montana.edu

Objective: This project brings together an established scientist and an established writer to create a book about the doing of antarctic science. It hinges on a working collaboration between scientist and writer in the field and is driven by the desire to involve a wide audience in the process of scientific research in Antarctica. Dr. Fraser's research is described elsewhere in this document. Ms. Hooper is a Visiting Research Fellow of the Royal Institution Center for the History of Science and Technology in London and has published extensively. She has worked in Antarctica with the U.S. and Australian programs.

Field season: Ms. Hooper will be a member of Dr. Fraser's field team at Palmer Station in January-February 2002.

Teachers Experiencing Antarctica (TEA)

Eight TEA teachers and one teacher from Sweden will join eight Antarctic research projects during the 2001-2002 field season. Teachers Experiencing Antarctica (http://tea.rice.edu) is an NSF program that selects teachers to work with investigators who volunteer to accept them on their teams. (NSF funds a similar program for the Arctic.) TEA is part of NSF's strategy to integrate research and education in order to infuse education with the joy of discovery and an awareness of its connections to exploration.

The TEA goal is to immerse teachers in research as part of their professional development, to infuse polar research into the classroom in engaging and innovative ways that underscore the societal relevance of science and the scientific process, and to maintain a Polar Learning Community of teachers, students, school districts, and researchers.

NSF funds the extra cost of supporting each teacher, including the following:

- a substitute at the teacher's school while the teacher is away,
- travel by the teacher to the investigator's institution before the Antarctic trip,
- travel by the teacher to Antarctica (and related expenses), and
- travel by the investigator to the teacher's school district for joint presentations before and/or after field work.

The Foundation's Division of Elementary, Secondary, and Informal Education funds the teacher-related expenses. Office of Polar Programs support consists of funding extra Principal Investigator expenses, increasing the investigator's field party size by one person (when possible), and providing U.S. Antarctic Program operational, communications, and management support.

Here are this season's eight TEA teachers and one Swedish teacher and their research hosts. For more information about each TEA teacher, see the TEA web site (http://tea.rice.edu).

- **Marietta Cleckley**, Uniondale High School, Uniondale, New York, is joining project EO-318-O, Mahlon Kennicut, Texas A & M University, Spatial and Temporal Scales of Human Disturbance, McMurdo.

- **Susan Cowles**, Linn-Benton Community College, Albany, Oregon, is joining project BO-045- P, Hugh Ducklow, College of William and Mary, Transport and Fate of Persistent Organic Pollutants in Antarctic Coastal Seas, Palmer.

- **Jennifer Curtis**, Shoultes Elementary School, Marysville, Washington, is joining project GO-180-O, Sridhar Anandakrishnan, University of Alabama, Antarctic Network of Unattended Broadband Integrated Seismometers (ANUBIS), McMurdo.

- **Jan French**, Country Day School, Cincinnati, Ohio, is joining project IU-153-A, Paul Mayewski, University of Maine, United States Component of the International Trans Antarctic Expedition, West Antarctica.

- **Tina Marie King**, West Elementary School, Mt. Juliet, Tennessee, is joining project BO-043-O, Sam Bowser, New York State Department of Health, Seasonal Dynamics of Giant Agglutinated Foraminifera, McMurdo.

- **Jason Petula**, Tunkhannock Area High School, Tunkhannock, Pennsylvania, is joining project AA-130-O, Robert Morse, University of Wisconsin Madison, Antarctic Muon and Neutrino Detector Array (AMANDA), South Pole. A Swedish high-school teacher, Mats Pettersson, will be a member of the Swedish AMANDA research team; he and Jason Petula will collaborate.

- **Juanita Ryan**, Toyon Elementary School, San Jose, California, is joining project GO-058-O, Ralph Harvey, Case Western Reserve University, Antarctic Search for Meteorites, Victoria Land.

- **Timothy J. Vermaat**, Chenango Forks Central School, Binghamton, New York, is joining project GO-081-O, Philip Kyle, New Mexico Institute of Mining and Technology, Volcano Observatory: Gas Emissions and Seismic Studies, Mount Erebus.

TEA depends on the generosity of U.S. Antarctic Program investigators volunteering to accept a teacher on their teams. NSF greatly appreciates this collaboration and support, and it has received positive comments from investigators who have hosted a teacher in prior seasons.

Investigators: If you are willing to host a teacher in a future season, contact Guy G. Guthridge (gguthrid@nsf.gov, 703-292-7414), Manager, Antarctic Information, in NSF's Office of Polar Programs.

For future seasons, investigators may nominate teachers, and teachers may nominate themselves, by using the application at http://tea.rice.edu/. The next deadline is 15 May 2002, for deployment to Antarctica during the 2003-2004 austral summer. NSF selects TEA teachers in a competitive process that requires each teacher to apply in response to NSF criteria.

Scouting in Antarctica

Cooperative programs between the National Science Foundation and America's two major scouting organizations—Girl Scouts of the USA and Boy Scouts of America—provide for a National competition every two years to select a Scout for participation in the U.S. Antarctic Program.

The goal is to acquaint the Boy Scout or Girl Scout with a variety of science disciplines and with career opportunities in polar research and operational support. The Scout, through Scouting publications and sites on the Scouting home pages, shares his or her Antarctic experience with the many other members of the two scouting groups. Inclusion of a Scout in the American Antarctic experience began when Paul Siple joined a Richard E. Byrd expedition 70 years ago.

For the 2001-2002 U.S. Antarctic Program season, Eagle Scout Timothy Brox of Fresno, California, was selected from among candidates who applied Nationwide. Mr. Brox graduated from Clovis West High School in 2001, where he received a variety of science awards. While a junior at Clovis, his research on bioremediation of oil spills led to a gold medal at the California State Science Fair. Mr. Brox will delay entry into college for a year in order to give full attention to his participation in the U.S. Antarctic Program.

Contact Information
Mr. Timothy Ian Brox
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tbrox@worldnet.att.net

During the 2001-2002 field season, Mr. Brox will work out of McMurdo Station and South Pole Station from mid-October 2001 to mid-January 2002 with eight or so selected science projects, which are yet to be determined. Mr. Brox will be spending approximately 10 to 14 days with each project, and will then join scientific researchers at Palmer Station or aboard a U.S. Antarctic Program research vessel. Mr. Brox will be an integral working member of these project teams, contributing to and learning from the science objectives. He may also work with selected work centers at McMurdo Station and at Palmer Station.

Following this season's participation by a Boy Scout, the next opportunities will be for a Girl Scout in the 2002-2003 season and a Boy Scout in the 2003-2004 season. Scouts apply through their scouting headquarters, not through NSF, and they must be seriously interested in science, and must have graduated from high school when they begin their travel to Antarctica.

USAP Environmental, Health, and Safety Initiatives

The participation, cooperation, and patience of all USAP participants are required for the successful implementation of the Environmental, Health, and Safety (EHS) initiatives of the USAP. These initiatives were established in 1987 by a Safety Review Panel appointed by the Director of the National Science Foundation (NSF). The goals of these initiatives are to clean up the debris from past antarctic activities, improve USAP participant health and safety, and minimize the environmental impact of current activities.

The United States has enacted environmental protection regulations (45 CFR 670-672) which are applicable to all USAP participants. It is imperative that all materials and wastes be managed in a manner consistent with guidelines and procedures developed by the USAP support contractor: Raytheon Polar Services Company (RPSC). One of the major elements of compliance with these regulations is the establishment of an aggressive waste management program. The cooperation of every person working in the USAP is essential for the waste management program to work effectively and for the USAP to attain compliance. Proper identification and segregation of wastes at the point-of-generation are the keys to a successful program.

The recycling programs at McMurdo and South Pole Stations include segregating glass, aluminum cans, scrap metal, wood, cardboard, paper, wire, copper, brass, and some hazardous wastes. The recycling programs at Palmer Station and on board the USAP research vessels are similar in scope; however, the segregation processes are less stringent because the recycled materials are sent to locations that do not require extensive segregation.

For the 1999-2000 season, approximately 3.75 million pounds (1,875 tons) of recyclables, waste, and equipment were removed from U.S. stations and field camps. Historically, the USAP has recycled approximately 60-70% of all waste generated. The remaining waste is incinerated, treated, or landfilled at United States facilities in accordance with U.S. environmental regulations. The preferred waste management strategy is pollution prevention. Participation in this waste minimization effort has reduced waste by approximately 9% annually since 1994. Whenever possible, USAP participants should select reusable rather than disposable products, and substitute nonhazardous materials for hazardous materials. The backpacking philosophy of "pack it in, pack it out" should be adopted whenever possible. For example, boxes and packing material may be saved and reused. RPSC will provide guidance to all participants through routine orientations ("waste briefings") and specialized instruction for those participants generating hazardous or radioactive wastes.

A clear understanding of the waste management program and the various categories of waste is essential. It is imperative that hazardous waste be managed appropriately, including proper packing, labeling, and characterization. (Note: Materials such as batteries, aerosol cans, fuels, oils, and glycols are managed as hazardous wastes.) Improperly labeled containers can result in delays in the field, costly chemical analysis to identify the waste, and potential noncompliance. All participants are required to follow the guidance that will be provided by RPSC waste management specialists.

If USAP participants will be using chemicals, they should plan on sending only what is needed to Antarctica to avoid leaving behind unused chemicals. Placing any waste other than water from sinks and showers or human waste into a waste-water system is not acceptable unless it is specifically approved by the NSF.

Another important facet of the EHS initiatives is the NSF's environmental impact assessment program. Under this program, if an activity may have at least a minor or transitory environmental impact, then appropriate documentation highlighting the alternatives and the potential impacts of each must be completed. The intent of this program is to ensure that environmental considerations are taken into account in the planning stage of an activity to prevent avoidable environmental impacts. RPSC has been directed to conduct audits of research activities to determine compliance with these environmental impact assessment requirements. If audited, researchers can discuss with RPSC auditors any difficulties or challenges that they may experience in understanding and meeting the requirements. Part of the auditing process is to find more efficient ways to meld environmental protection into the conduct of scientific research in Antarctica. Further information on this program may be obtained from the NSF/OPP Environmental Officer or the RPSC Environmental Manager.

By taking the time to be aware of and comply with the waste management protocol and the environmental review program for each station, field camp, and research vessel, USAP participants can ensure that their work in Antarctica has minimal impacts.

Each year, waste management specialists provide detailed instructional information and technical assistance to ease the burden of waste management and to ensure that all participants are in compliance with the regulations. USAP participants are encouraged to take the time to become familiar with this guidance and ask for assistance or advice. It is the duty of all USAP participants to comply with these new regulations and to establish the United States as an exemplary visitor to Antarctica.

With respect to health and safety, the USAP is a program in transition. We will continue past practices that have been proven effective and are implementing changes, where necessary, to provide the NSF and USAP participants with world-class safety performance. To that end, RPSC promotes an environment for the USAP that integrates health and safety requirements and issues into every activity at every site. But you are ultimately responsible for your behaviors and contributions to the Program. The remote location and extreme environment of Antarctica, combined with limited medical services, make it imperative participants not take risks which may cause injury to them or their fellow colleagues. This includes compliance with USAP health and safety procedures.

USAP participants will have increased responsibilities for health and safety, as will RPSC supervisors. By taking the time to become aware of the health and safety requirements of the USAP, all participants can ensure not only their safe return from Antarctica, but the safe return of others.

United States Antarctic Program
Science Event Numbering System

Example:
OO-283-M

$X_{[1]}X_{[2]}$-000-$X_{[3]}$

$X_{[1]}$ $X_{[2]}$ and $X_{[3]}$ are alpha

000 are numeric

$X_{[1]}$ indicates the Antarctic Program under which the project is funded.

A **Antarctic Aeronomy & Astrophysics Program**
B **Antarctic Biology & Medicine Program**
E **Antarctic Environmental Monitoring Program**
G **Antarctic Geology & Geophysics Program**
I **Antarctic Glaciology Program**
O **Antarctic Ocean & Climate Systems Program**
T **Technical project**
W **Writers & Artists Program**

$X_{[2]}$ indicates if this is a meta project. That is, is this particular project linked to a larger effort? If so, this indicates that research collaboration is in the same location and during the same general time period.

A **Antarctic Muon and Neutrino Detector Array (AMANDA) project**
B **Long-Duration Ballooning (LDB) project**
C **Center for Astrophysical Research in Antarctica (CARA)**
F **Ford Ranges project**
G **Global Ocean Ecosystems Dynamics (GLOBEC)**
I **Siple Dome Ice Coring project**
M **McMurdo Long-Term Environmental Research (LTER) project**
O **NOT PART OF A META PROJECT**
P **Palmer Long-Term Environmental Research (LTER) project**
U **U.S. International Trans-Antarctic Scientific Expedition (ITASE)**

000 are sequential numbers from 001 - 999. This number does not track one-to-one with the NSF grant number. In many cases, the three-digit number adheres to tradition (i.e., the 3 digits are the same as the previous numbering system). The three numbers are now assigned based upon availability.

$\mathbf{X}_{[3]}$ is a location designator. If the project has subcomponents and/or research at different locations during the same research season, then a location designator is assigned to the science-event number.

NOTE: An "**O**" indicates that there are no subcomponents.

R/V *Laurence M. Gould*	**L**
McMurdo Station	**M**
R/V *Nathaniel B. Palmer*	**N**
Palmer Station	**P**
South Pole Station	**S**

If the projects have subcomponents, but the subcomponent does not refer to a location, then $X_{[3]}$ is a letter--starting with A, then B, then C, and so on in consecutive order.

Overview of the Antarctic Aeronomy and Astrophysics Program

The polar regions have been called Earth's window to outer space. Originally, this term applied to the study of auroras and phenomena related to the interaction of solar plasmas and fields. In this context, the polar upper atmosphere is a screen on which the results of such interactions can be viewed and through which evidence of other processes can pass. Today, this concept has been extended to the study of other phenomena. With the discovery of polar stratospheric ozone depletion, a window previously thought "closed" (the ultraviolet window) is now known to "open" in certain seasons. In astronomy and astrophysics, favorable atmospheric conditions and the unique location of the South Pole enable scientists to probe the structure of the Sun and the universe with unprecedented precision.

The Antarctic Aeronomy and Astrophysics Program supports studies of the following three regions:

- The stratosphere and the mesosphere: Current research focuses on stratospheric chemistry and aerosols, particularly in the context of the ozone hole.
- The thermosphere, the ionosphere, and the magnetosphere: These regions derive many characteristics from the interplay of ionized plasmas and energetically-charged particles with geomagnetic and geoelectric fields. The upper atmosphere, particularly the ionosphere, is the ultimate sink of solar wind energy transported into the magnetosphere. Also, particle precipitation, which partially results from resonant wave-particle interactions, and Joule heating from currents driven by electric fields dissipate the energy in the ionosphere.
- Astronomy and astrophysical studies: Projects consider regions outside the magnetosphere, including sun and cosmic rays. Astrophysical studies are primarily conducted at Amundsen-Scott South Pole Station or on long-duration balloon flights launched from McMurdo Station.

Research projects sponsored by this program require or benefit from the unique conditions of the Antarctic, contribute to the understanding of Antarctica's role in global environmental change, promote interdisciplinary study of geosphere-biosphere interactions in the middle and upper atmosphere, and improve understanding of the coupling of Earth's polar atmosphere with the magnetosphere and of the ways in which solar activity affects both.

AMANDA- Antarctic Muon and Neutrino Detector Array

AA-130-O

Dr. Robert Morse, Principal Investigator
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Department of Physics
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Web: amanda.berkeley.edu/amanda/amanda.html

Research Objectives

Neutrinos are elementary particles. They are believed to have very little or no mass, no electrical charge, and can take any of three forms. Coursing through the universe, they interact only rarely with other particles. AMANDA's primary objective is to discover the sources — both within our galaxy and beyond — of the shower of very-high-energy neutrinos descending on (and usually passing through) the Earth.

AMANDA uses an array of photomultiplier tubes (embedded between 1 and 2 kilometers into the ice) near the South Pole to create a Cherenkov detector out of the natural ice. Originally, 20 strings were installed in the ice, and during the 1999-2000 field season 6 more strings, known as the AMANDA-2 detector, were added. This system detects high-energy neutrinos originating off the planet that have passed through Earth. Such sources of origin could be diffuse, made up of contributions from many active galactic nuclei (AGNI); or they could be point sources of neutrinos - coming from supernova remnants (SNRs), rapidly rotating pulsars, neutron stars, individual blazars, or other extragalactic point sources.

Recently, new sources of high-energy gamma rays have been discovered, such as the source Mrk-421, discovered by NASA's Compton Gamma-Ray Observatory (CGRO) and Mt. Hopkins Observatory. AMANDA is designed to study just such objects, which are believed to emit high-energy neutrinos copiously. To date, neutrino astronomy has been limited to the detection of solar neutrinos, plus one brief, spectacular burst from the supernova that appeared in the Large Magellanic Cloud in February 1987 (SN-1987a). Only now is it becoming technically feasible to build large neutrino telescopes. As one of the first-generation detectors, AMANDA promises to make seminal contributions to this new branch of neutrino astronomy. [NSF Award # 99-80474]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-February 2002 AND throughout the 2002 austral winter
Research Locations:	Martin A. Pomerantz Observatory (MAPO) in the Dark Sector and in the back of the Science Building under the dome

Team Members

Jens Christopher Ahrens	Giles Barouch	Dave Besson
Sebastian Boeser	Christian Bohn	Don Box
Thomas Burgess	Jodi Cooley	Douglas Cowen
Carlos P de los Heros	Jean-Paul Dewulf	Thomas Feser
Kael Hanson	Rellen Hardtke	Tonio Hauschildt
Marc Hellwig	Gary Hill	Per Olof Hulth
Stephan Hundertmark	Albrecht Karle	Marek Kowalski
Ilya Kravchenko	Matthias Leuthold	James Madsen
Bill Mason	Yulia Minaeva	Robert Morse
Philip Olbrechts	Arvid Pohl	Mathieu Ribordy
Darryn Schneider	David Steele	Peter Steffen
Robert Stokstad	Karl-Heinz Sulanke	Christian Wiedemann
Ralf Wischnewski	TBD (10)	

Field-Season Overview

During this season, there will be no drilling of holes in the ice nor string deployments for the AMANDA project. There are currently 26 strings in the ice. Each string is hard-wire cabled to computers in the Martin A. Pomerantz Observatory (MAPO) facility. These computers analyze gigabytes of data to sort out true neutrino events.

This season, the project team members will work at the South Pole from late October 2001 to mid-February 2002 to calibrate (via computers) and analyze the new data from the twenty-six strings (i.e., the data from the 2001 austral winter and from the 2001-2002 austral summer).

Support contractor personnel will survey the surface area of this project's string deployments to fine tune the location of the holes where the strings go into the ice and place permanent steel markers on top of the holes.

Two project team members plan to winter-over at South Pole Station to collect data throughout the 2002 austral-winter season and to send this data to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Eivind Jensen

Long Duration Balloon Program

AB-145-O

Mr. Steven Peterzen, Project Manager
National Aeronautics and Space Administration
National Scientific Balloon Facility (NSBF)
FM 3224
Palestine, TX 75801

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Fax: (903) 723-8056
E-Mail: steven@master.nsbf.nasa.gov
Web: master.nsbf.nasa.gov

Research Objectives

Free-flying balloons possess many advantages as a means of high-altitude exploration; compared to satellites they remain much longer in a specific location, and cost a fraction to launch. The National Scientific Balloon Facility's (NSBF) effort in Antarctica, known as the Long-Duration Balloon (LDB) program, launches high-altitude balloons carrying scientific payloads into the stratosphere. [NASA Award]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-February 2002
Research Locations:	Long-Duration Balloon (LDB) Site at Williams Field, McMurdo; Payload recovery site to be determined

Team Members

Dwight Bawcom	Frank Candelaria	Reid Chambers
Mark Cobble	Robbert Crabill	Andrew Denny
Derek Dolbey	Gerald Gregg	David Gregory
Scott Hadley	Erich Klein	Bobby Meazell
Mark Metzger	Keith Parkes	Robert Redinger
Robert Salter	Ira Smith	William Stepp
Bryan Stilwell	David Sullivan	Thomas Thomas
Mark Wefel	Robin Whiteside	

Field-Season Overview

The National Scientific Balloon Facility (NSBF) team members plan to launch, track, and recover two long-duration, stratospheric, helium balloons with payloads of scientific instruments supporting the following science projects:

Project AB-148-O:	Dr. John Ruhl's BOOMERanG study of the Cosmic Microwave Background
Project AB-149-O:	Dr. Walter Binns' TIGER study of galactic cosmic rays

The balloons will be launched from the Long-Duration Balloon Facility at Williams Field near McMurdo Station. NSBF personnel will monitor the balloons via remote telemetry as the balloons circumnavigate the continent. Prior to launching, team members will conduct a data retrieval test flight with an LC-130 aircraft, in case such a retrieval becomes necessary. The LDB project will also launch up to five small balloons with instruments to determine stratospheric conditions before launching the large balloons.

When the balloons return to the McMurdo area, team members will terminate the flights by radio commands sent to the gondola from a helicopter, a Twin Otter, or an LC-130 aircraft. Depending on the locations of the payloads, team members will travel via helicopter, Twin Otter, or LC-130 aircraft from McMurdo Station to the drop sites for recovery. Team members will break down the gondolas at the landing site, remove data disks and instrumentation, and return these components to McMurdo Station. If possible, the gondolas themselves will also be recovered.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Hope Stout

Boomerang - Long Duration Balloon (LDB)
AB-148-O

Dr. John Ruhl, Principal Investigator
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Department of Physics
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Santa Barbara, CA 93106

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E-Mail: ruhl@physics.ucsb.edu
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Research Objectives

Cosmic microwave background radiation (CMBR) is a relic left over from the early universe. It has its origin in the "big bang," in which the universe was created. The variations in brightness on the sky of the CMBR carry the imprint of the distribution of matter about 300,000 years after creation, and the linear polarization of the CMBR can provide information from even earlier times, just a fraction of a second after creation.

In 1998, we launched our first BOOMERANG instruments, using a stratospheric long-duration balloon (LDB) that circumnavigated Antarctica in 10.5 days. The balloon carried the instruments above more of the atmosphere that interferes with measurements. Although we continue to analyze the CMBR data obtained by this long-duration balloon flight, we have modified our instrument payload to measure polarization and are planning another Antarctic flight during the 2001-2002 austral summer. [NSF Award # 99-80654]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-February 2002
Research Locations:	Long-Duration Balloon (LDB) Site at Williams Field, McMurdo; Payload recovery site to be determined

Team Members

Andrea Boscaleri	Paolo de Bernardis	Kathleen Deniston
Giuseppe di Stefano	Eric Hivon	Viktor Hristov
Armando Iacoangelli	Bill Jones	Ted Kisner
Andrew Lange	Carolyn MacTavish	Silvia Masi
Pete Mason	Phil Mauskopf	Vjera Miovic
Tom Montroy	Sasa Nedeljkovic	Barth Netterfield
Enzo Pascale	Francesco Piacentini	John Ruhl
Eric Torbet	James Watt	

Field Season Overview

The researchers plan to image the cosmic microwave background radiation using a millimeter-wave sensitive telescope. Team members will work with National Scientific Balloon Facility personnel to launch their BOOMERanG telescope from the Long Duration Balloon Facility at Williams Field. The balloon carrying the telescope will circumnavigate Antarctica at high altitude.

Once the flight is complete and the balloon has returned to the McMurdo area, team members will terminate the flight by a radio command sent to the gondola from a helicopter, a Twin Otter, or an LC-130 aircraft. Depending on the distance from McMurdo Station, team members will travel via helicopter, Twin Otter, or LC-130 aircraft to recover the payload. They may camp at the drop site while breaking down the gondola for return to McMurdo Station.

The data disks and instrument will be returned to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Hope Stout

The Trans-Iron Galactic Element Recorder (TIGER)

AB-149-O

Dr. Walter Binns, Principal Investigator
Washington University
Physics Department
CB1105
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St. Louis, MO 63130

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Web: NA

Research Objectives

The Trans-Iron Galactic Element Recorder (TIGER) experiment was selected in 1998 as the science payload for flight aboard the first Ultra-Long Duration Balloon, a new NASA mission category. The primary science objective of TIGER is to measure ultra-heavy galactic cosmic rays. These measurements will enable us to determine the source of the material that is accelerated as galactic cosmic rays and the mechanism for injecting that material into the cosmic-ray accelerator. Additionally, TIGER serves as an engineering model of the ENTICE experiment, one of two instruments that make up the Heavy Nuclei eXplorer mission, recently selected by NASA for a Small Explorer Mission Concept Study.

Using a high-altitude balloon from the Long-Duration Balloon (LDB) program, we will fly the TIGER experiment on two revolutions around Antarctica to obtain a long collecting time for galactic cosmic rays. We will monitor the experiment with electronic ground support equipment at the LDB facility near McMurdo Station for line-of-sight data. Following the flight, we will recover the instrument and ship it back to the United States. [NASA award]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to late January 2002
Research Locations:	Long-Duration Balloon (LDB) Site at Williams Field, McMurdo; Payload recovery site to be determined

Team Members

Walter Binns	Dana Braun	Eric Christian
Jay Cummings	Georgia DeNolfo	Paul Dowkontt
John Epstein	Sven Geier	Steve Holder
Martin Israel	Jason Link	John Mitchell
Lauren Scott	Garry Simburger	

Field Season Overview

The researchers plan to conduct measurements of ultra-heavy galactic cosmic rays using the Trans-Iron Galactic Element Recorder (TIGER). Team members plan to work with National Scientific Balloon Facility personnel to launch the TIGER from the Long Duration Balloon Facility at Williams Field. The balloon carrying the instrument will circumnavigate Antarctica twice at high altitude.

Once the flight is complete and the balloon has returned to the McMurdo area, team members will terminate the flight by a radio command sent to the gondola from a helicopter, a Twin Otter, or an LC-130 aircraft. Depending on the distance from McMurdo Station, team members will travel via helicopter, Twin Otter, or LC-130 aircraft to recover the payload. They may camp at the drop site while breaking down the gondola for return to McMurdo Station.

The TIGER and data disks will be returned to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Hope Stout

Center for Astrophysical Research in Antarctica (CARA)

AC-370,371,372,373,374,375,376,378-O

Dr. John Carlstrom, Project Director
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Astronomy and Astrophysics
5640 South Ellis Avenue
Chicago, IL 60637

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E-Mail: jc@hyde.uchicago.edu
Web: NA

Research Objectives

Astronomers probe the infrared (IR) spectrum at submillimeter scales in search of data that could suggest answers to some of the seminal questions about the formation of the Universe, such as:

- How do stars form from interstellar gas?
- How did the planets form?
- What was the nature of primeval galaxies?
- How were matter and energy distributed in the early Universe?

Antarctica is an ideal spot for such research. The cold temperatures and lack of water vapor in the atmosphere above the polar plateau make the infrared spectrum of sky in that region consistently clearer and darker than anywhere else on Earth. These conditions enable scientists to collect measurements that would be extremely difficult or impossible from other sites.

To capitalize on these advantages, the University of Chicago and several other collaborating institutions in 1991 established the Center for Astrophysical Research in Antarctica (CARA), one of 17 Science and Technology Centers funded by the National Science Foundation. CARA's scientific mission is to investigate the conditions for astronomy at the South Pole and other sites on the polar plateau, and to establish an observatory at the South Pole. Currently, CARA supports research using three major telescope facilities:

- The Astronomical Submillimeter Telescope/Remote Observatory (AST/RO) project uses a 1.7-meter diameter telescope to survey interstellar gas in the galactic plane, the galactic center, and the Magellanic Clouds.
- The South Pole Infrared Explorer (SPIREX) project uses a 0.6-meter diameter telescope to observe distant galaxies, cool stars, and heavily obscured star-forming regions.

- The Cosmic Background Radiation Anisotropy (COBRA) project helps researchers test current theories of the origin of the Universe.

In addition to projects using these three telescopes, CARA's Advanced Telescopes Project collects data on the quality of polar plateau sites for astronomical observations, and configures plans for future telescopes and facilities.
[NSF Award # 97-25767]

The following projects are currently part of CARA:

AC-370-O: CARA-wide Operations and Activities

AC-371-O: Antarctic Submillimeter Telescope and Remote Observatory (AST/RO)

AST/RO, located in the dark sector of Amundsen-Scott South Pole Station, is a 1.7-meter diameter, submillimeter-wave telescope for astronomy and aeronomy studies at wavelengths between 200 and 2000 microns. The telescope operates continuously through the austral winter and is being used primarily for spectroscopic studies of neutral atomic carbon and carbon monoxide in the interstellar medium of the Milky Way and Magellanic Clouds. The telescope is available to the worldwide astronomical community on a proposal basis, and many individual projects are carried out each year. In addition to ongoing maintenance, operations, and site testing, we will begin preparing this austral summer for installation of a new 1.4 THz hot-electron bolometer detector system (the TREND project).

AC-372-O: Automated Astrophysical Site Testing Observatory (AASTO)

Our objective is to categorize those conditions on the Antarctic plateau, from the ultraviolet to the sub-millimeter, that are relevant to a future large telescope. By the end of 2001, we will have completed almost all of our measurements of the South Pole and plan to move the AASTO to the new French-Italian station at Dome C at the end of the 2001-2002 field season. We also will continue refining the AASTO power system, and examining alternative energy sources.

AC-373-O: Degree Angular Scale Interferometer (DASI)

DASI is a 13-element interferometer designed to measure anisotropies in the Cosmic Microwave Background Radiation (CMBR) and to determine its angular power spectrum. The unique imaging capabilities of DASI and its angular coverage ($140 < l < 910$) complement the VIPER telescope, especially its future millimeter and submillimeter capabilities (to be provided by ACBAR), as well as the MAP satellite and other CMBR experiments. During austral winter 2000, DASI measured the angular power spectrum of the CMB anisotropy over scales of 0.2 to 1.5 degrees and was able to test predictions of the "inflation" model for the origin of the universe as well as the total energy density and the density of normal matter in the universe. During the 2001-2002 austral summer, we will perform yearly cryogenic maintenance on the receivers. We also plan to install new 100 GHz receivers to enable fine-scale CMB observations (current receivers operate at 30 GHz).

AC-374-O: South Pole Infrared Explorer (SPIREX)

Before beginning our infrared astronomy project, we will conduct an assessment of CARA's observatory site.

AC-375-O: Viper Telescope

VIPER, a 2-meter class telescope, extends our observations to structures in the cosmic microwave background having smaller angular scales. Our primary goal is to determine the power spectrum of the CMBR anisotropy, over the range of angular scales where cosmological models differ most in their predictions. During the 2001 austral winter, VIPER hosted ACBAR, which was used to study galaxy clusters and to map fine-scale structure in the CMB. During the 2001-2002 austral summer, we will test SPARO in preparation for future observations but will reinstall ACBAR for the 2002 austral winter.

AC-376-O: Submillimeter Polarimeter for Antarctic Remote Observing (SPARO)

SPARO, which was deployed to the South Pole in 1999, operates on the Viper 2-meter telescope. A 9-pixel, 450-micron polarimetric imager, it requires only infrequent cryogen refills, thus simplifying maintenance during the winterover. The South Pole offers superb conditions for SPARO observations, extending submillimeter polarimetry (measurement of the polarization of thermal emission from magnetically aligned dust grains) to regions of low-column density that cannot be studied from other sites. SPARO resembles polarimeters in the University of Chicago array designed for other telescopes, but those instruments (for example, at the Caltech Submillimeter Observatory and the Owens Valley Radio Observatory) provide much better angular resolution. SPARO's geographic location, however, yields a much enhanced submillimeter sensitivity to extended emission.

AC-378-O: Arcminute Cosmology Bolometer Array Receiver (ACBAR) Instrument

We plan to install the ACBAR receiver on the Viper telescope, and get it ready for winter observations. ACBAR, a 16-element, 300 mK bolometer array, will be used to map the CMBR with high-angular resolution. We will try to characterize how the structure may have formed and evolved by searching for clusters of galaxies, and also will study nearby clusters with targeted observations.

The following list contains Principal Investigator contact information for each CARA project:

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Field Research Plan

Logistics

Dates in Antarctica:	The CARA projects will have various durations of deployment from late October 2001 to mid-February 2002. Four project members will remain at South Pole throughout the 2002 austral-winter months
Research Locations:	Dark Sector at South Pole: MAPO Facility, AST/RO Facility, and AASTO Building

Team Members

AC-370-O

Judith Bausch
Larry Fiscelli
Charles Kaminski
Randall Landsberg
Jason Lelchuk
Robert Loewenstein
Nancy Odalen
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Robert Spotz
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AC-371-O

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Jacob Kooi
Craig Kulesa
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Antony Stark
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Wilfred Walsh
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AC-372-O

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AC-375-O

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Matthew Newcomb
Jeffrey Peterson
Kevin Peterson

AC-376-O

David Chuss
Christopher Greer
Giles Novak

AC-378-O

Michael Daub
Jonathan Goldstein
William Holzapfel
Chao-lin Kuo
John Ruhl
Marcus Runyan
Eric Torbet

Field-Season Overviews

AC-370-O: Center for Astrophysical Research in Antarctica (CARA): Polar Operations

The project team members plan to work from the Martin A. Pomerantz Observatory (MAPO) to coordinate the activities of all the CARA projects and provide administrative support, technical assistance, and labor as needed.

AC-371-O: Astronomical Submillimeter Telescope/Remote Observatory (AST/RO)

The project team members plan to service all existing receivers, refrigerators, and coldheads on the AST/RO 1.7-meter diameter submillimeter-wave telescope. This telescope operates continuously through the austral winter and is being used primarily for spectroscopic studies of neutral atomic carbon and carbon monoxide in the interstellar medium of the Milky Way and Magellanic Clouds. This telescope is used to study wavelengths between 200-2000 microns.

In addition to ongoing maintenance, operations, and site testing conducted by the project team members, the support contractor will facilitate preparations that will begin this austral summer for installation of a new 1.4-THz hot-electron bolometer detector system (the TREND project).

AC-372-O: Automated Astrophysical Site Testing Observatory (AASTO)

The project team members plan to perform annual maintenance on the AASTO. This automated geophysical observatory (AGO) is configured to perform astrophysical and atmospheric observations across a broad-wavelength spectrum (i.e., visible to submillimeter).

AC-373-O: Degree Angular Scale Interferometer (DASI)

In the 2001-2002 austral summer, the receivers will once again undergo yearly cryogenic maintenance. The team members also plan to install new 100-GHz receivers to enable fine scale cosmic microwave background (CMB) observations (current receivers operate at 30 GHz). The DASI telescope will also undergo substantial maintenance. DASI will have one winterover team member for the austral 2002 winter season.

AC-374-O: Infrared Projects

At press time, this season's work had not been determined.

AC-375-O: Viper Telescope

Data from Viper are typically collected primarily during each austral-winter season. The 2001-2002 austral-summer season will be an intensive period of maintenance and testing.

Last austral winter, Viper hosted ACBAR (AC-378-O), which was used to study galaxy clusters and to map out fine scale structure in the cosmic microwave background (CMB). This austral summer, the team members will be testing

SPARO (AC-376-O) in preparation for future observations. The team members will re-install ACBAR for the start of the austral-winter season.

AC-376-O: Submillimeter Polarimeter for Antarctic Remote Observations (SPARO) Instrument

The project team members plan to re-install the SPARO instrument on the Viper telescope, which is located on a tower adjacent to the MAPO building opposite the DASI tower.

The team members plan to operate the SPARO instrument and gather data during the austral-summer months. They also plan to calibrate the instrument in preparation for operation during the 2002 austral-winter months. (*Note*: The majority of data will be gathered during the austral winter.) SPARO will be installed and removed twice during the austral summer with the aid of a crane supplied by the support contractor and with assistance of the support contractor construction personnel.

AC-378-O: Arcminute Cosmology Bolometer Array Receiver (ACBAR) Instrument

The project team members plan to re-install the ACBAR receiver on the Viper telescope, which is located on a tower adjacent to the MAPO building opposite the DASI tower, and prepare the receiver for austral-winter observations. It is planned that ACBAR will be installed and removed twice during the austral summer with the aid of a crane supplied by the support contractor and with assistance of the support contractor construction personnel.

ACBAR will be used to map the cosmic microwave background radiation with high-angular resolution, characterize the evolution of the structure formation by searching for clusters of galaxies using the Sunyaev-Zeldovich effect, and study the nearby clusters with targeted observations.

Preliminary observations and calibrations are planned for the 2001-2002 austral-summer season. The majority of the science data will be gathered during the 2002 austral winter.

NSF/OPP Program Manager
Dr. Dennis Peacock

RPSC Point-of-Contact
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A Continuation of Magnetometer Data Acquisition at McMurdo and South Pole

AO-101-M/S

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Research Objectives

The magnetosphere is that region of space surrounding a celestial object (such as the Earth or the sun) where the object's magnetic field is strong enough to trap charged particles. Magnetometers have been installed at selected sites in both polar regions to measure changes in the magnitude and direction of Earth's magnetic field. The unique climatic conditions in Antarctica also permit scientists to view the atmosphere optically (see project AO-104-O) and to correlate such hydromagnetic-wave phenomena with particle-precipitation measurements.

In this project, we are measuring such variations with magnetometers installed at conjugate sites in both hemispheres: at McMurdo Station and Amundsen-Scott South Pole Station in Antarctica, and at Iqaluit in the Northwest Territories in Canada. The antarctic systems gather unique data related to the coupling of the interplanetary medium into the dayside magnetosphere, including the magnetospheric cusp region. The data also shed light on the causes and propagation of low-frequency hydromagnetic waves throughout the magnetosphere.

The Antarctic magnetometers continue to measure the magnitude and direction of variations in Earth's magnetic field in the frequency range from 0 to about 0.1 hertz, with resolution of about one nanoTesla. These data are being analyzed in the context of other concurrent data acquired by the six automatic geophysical observatories (AGOs) that are a part of the Polar Experiment for Geophysical Upper Atmosphere Investigations (PENGUIn) program (project AO-112-0); and the data will also be ranged against data obtained from magnetometers operated by Bell Laboratories in the continental United States.
[NSF Award # 89-21094]

Field Research Plan

Logistics

Research Locations: McMurdo Station -- Arrival Heights
South Pole Station -- Cusp Lab in Skylab Building

Team Members

No deploying project personnel

Field-Season Overview

The support contractor's science technicians will work year-round in support of this project at the Arrival Heights Facility (McMurdo) and at the CUSP Lab (South Pole) to perform daily checks of the equipment operation and maintain a log of panel meter readings.

The science technicians will fax copies of the panel meter readings log to the Principal Investigator at monthly intervals. The technicians will check outside sensor mount levels at both sites during the 2001-2002 austral-summer season and make releveling adjustments as necessary. They will also perform electronic trouble shooting and repairs as required under the direction of the Principal Investigator. Data acquisition is by the University of Maryland's data recording system at both locations.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RSPC Points-of-Contact
Mr. Jesse Alcorta (McMurdo)
Mr. Paul Sullivan (South Pole)

Conjugate and High Time Resolution Studies of ULF Waves and Magnetospheric Dynamic Using Ground Based Induction Magnetometers at Four High Latitude Manned Sites

AO-102-M/S

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Research Objectives

The Earth's magnetic field arises from its mass and motion around the polar axis, but it creates a powerful phenomenon at the edge of space known as the magnetosphere, which has been described as a comet-shaped cavity or bubble around the Earth, carved in the solar wind. When that supersonic flow of plasmas emanating from the Sun encounters the magnetosphere, the result is a long cylindrical cavity, flowing on the lee side of the Earth, fronted by the blunt nose of the planet itself . With the solar wind coming at supersonic speed, this collision produces a "bow shock" which occurs several Earth radii in front of the magnetosphere proper.

One result of this process is fluctuations in Earth's magnetic field, called "micropulsations," which can be measured on time scales between 0.1 second and 1,000 seconds. It is known that magnetic variations can significantly affect power grids and pipelines. We plan to use magnetometers (distributed at high latitudes in both the Antarctic and Arctic) to learn more about how variations in the solar wind can affect the Earth and manmade systems.

We will study these solar-wind-driven variations and patterns at a variety of locations, and over periods of time up to a complete solar cycle. Since satellite systems are now continuously observing solar activity and also monitoring the solar wind, it is becoming feasible to develop models to predict the disruptions caused by such magnetic anomalies. And while our work is geared specifically toward a better understanding of the world and its manmade systems behavior, it will also involve space weather prediction. [NSF Award # 99-09212]

Field Research Plan

Logistics

Research Locations: McMurdo Station—Arrival Heights
South Pole Station—Quiet Sector

Team Members

No deploying project personnel

Field-Season Overview

This research project, which measures the interaction between the Earth's magnetic field and the solar wind with ground magnetic pulsation detectors, has been operating in Antarctica since 1973. The project's magnetometers are located in Arrival Heights at McMurdo Station and in the Quiet Sector at South Pole Station.

The support contractor's science technicians at both stations will support this project on a year-round basis by performing daily equipment checks, trouble-shooting, and repairing the equipment as necessary. The science technicians will also send data to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Jesse Alcorta (McMurdo)
Mr. Paul Sullivan (South Pole)

Antarctic Auroral Imaging
AO-104-O

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Research Objectives

Scientists are only beginning to essay quantitative studies on the dynamic behavior of the magnetosphere. In the past, detail-oriented explorations with space satellites have enabled them to map the average distribution of magnetospheric energetic particle plasma content. But the dynamics of auroral phenomena - when particles from the magnetosphere precipitate into the atmosphere, producing fluorescence - have been hard to quantify through optical means. Amundsen-Scott South Pole Station is uniquely situated to observe aurora because the darkness of polar winter permits continuous optical monitoring; at most other sites, the sky becomes too bright near local mid-day.

The aurora can actually be regarded as a two-dimensional projection of the three-dimensional magnetosphere, because particles tend to travel along the magnetic field line. By observing the dynamics and the morphology of the aurora, scientists get a reliable glimpse into the dynamics of the region of the three-dimensional magnetosphere associated directly with it. This method relies on knowledge relating the type of aurora to both specific energies of precipitation as well as to specific regions of the magnetosphere.

We are deploying an intensified optical, all-sky imager (operating in two parallel wavelength channels, 4,278 and 6,300 Angstroms) to record digital and video images of auroras in the winter darkness. These wavelength bands allow us to discriminate between more- and less-energetic electron auroras and other precipitation. The South Pole Station observations of the polar cap and cleft regions entail measuring auroral-precipitation patterns and then interpreting the results in terms of the coordinated observations of (magnetic) radio-wave absorption images as well as (high-frequency) coherent-scatter radar measurements.

We expect this work to provide insight into the sources and energization mechanisms of auroral particles in the magnetosphere, as well as other forms of energy inputs into the high-latitude atmosphere. [NSF Award # 98-18086]

Field Research Plan

Logistics
Research Location: Aurora Lab in Skylab Building

Team Members
No deploying project personnel.

Field-Season Overview

This project operates a special-purpose all-sky imager (located in the Aurora Lab), which records digital and video images of the Antarctic aurora during the winter darkness. The support contractor's science technician and several other research project personnel will service the all-sky imager equipment.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
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Global Thunderstorm Activity and its Effects on the Radiation Belts and the Lower Ionosphere

AO-106-P

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Research Objectives

Tracking dynamic storms is a challenge, but lightning associated with thunderstorms can provide scientists an indirect way of monitoring global weather. This project employs very-low-frequency (VLF) radio receivers at Palmer Station, Antarctica, operated in collaboration with the British and Brazilian Antarctic Programs, both of which operate similar receivers. All are contributors to the Global Change Initiative.

The VLF receivers measure changes in the amplitude and phase of signals received from several distant VLF transmitters. These changes follow lightning strokes because radio (whistler) waves from the lightning can cause very energetic electrons from the Van Allen radiation belts to precipitate into the upper atmosphere. This particle precipitation then increases ionization in the ionosphere, through which the propagating VLF radio waves must travel. Because the orientations to the VLF transmitters are known, it is possible to triangulate the lightning sources that caused the changes. Once the direction of the lightning source is known, it can be subjected to waveform analysis and used to track - remotely - the path of the thunderstorms. The data will also be correlated with data from the Antarctic Automatic Geophysical Observatory (AGO) network, and will be used by scientists engaged in magnetospheric and ionospheric research. [NSF Award # 99-10565]

Field Research Plan

Logistics

Dates in Antarctica:	late February 2002 to early April 2002
Research Location:	Palmer Station

Team Member

TBD

Field-Season Overview

The researchers plan to continue measuring lightning electromagnetic signatures from around the globe in very low and extremely low frequencies. The team member plans to travel on the R/V *Laurence M. Gould* (cruise LMG02-1B) to Palmer Station in late February 2002 to upgrade the project's recording equipment. The team member will depart Palmer Station on cruise LMG02-02.

The VLF radiometer will operate year round in the Clean Air/VLF Hut at Palmer Station. The support contractor's science technician will archive the data and return it regularly to the home institution. The science technician will also maintain and calibrate the equipment when necessary. The data will be correlated with data collected by the Automatic Geophysical Observatory network in Antarctica.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
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ELF/VLF Waves at South Pole
AO-106-S

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Research Objectives

Atmospheric scientists orient their studies around different strata, or regions, and the boundaries and interactions between these regions are of particular interest. How are the upper atmosphere regions coupled electrodynamically? What can we learn by measuring the energy that is being transported between the magnetosphere and the ionosphere? These are but two of the questions the U.S. Antarctic Program's automatic geophysical observatory (AGO) program is designed to explore.

Plasmas occur in the magnetosphere and the ionosphere, and they can be transported and accelerated by a variety of different wave-particle interactions. One important dynamic in this system is particle precipitation that is driven by extra-low-frequency/very-low-frequency (ELF/VLF) waves. Thus, measuring ELF/VLF waves from the multiple sites of the AGO network provides a powerful tool for remote observations of magnetosphere processes.

This project maintains a system at Amundsen-Scott South Pole Station to measure magnetospheric ELF/VLF phenomena, and to correlate the data with measurements made by the AGO system. This season provides an acid test for the reliability of the new digital recording system (compared to the reel-to-reel analog system), which provides higher quality data. [NSF Award # 99-09872]

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Field Research Plan

Logistics

Dates in Antarctica: early to mid-December 2001
Research Location: CUSP Lab in Skylab Building

Team Members

Umran Inan

Field-Season Overview

The support contractor's science technician will work year-round to change data tapes, conduct routine instrument checks, and perform monthly calibration on this project's ELF/VLF recording equipment in the CUSP Lab.

In early December 2001, the project team member will deploy a new data acquisition system in the CUSP Lab and instruct the science technician on how to run it.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

Study of Polar Stratospheric Clouds by LIDAR

AO-107-O

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Research Objectives

The appearance each spring of the stratospheric ozone hole above Antarctica is driven by chlorine compounds interacting on the surfaces of clouds that formed the previous polar winter, known as polar stratospheric clouds (PSCs). This is one explanation for why ozone depletion is much more severe in polar regions than elsewhere.

This project uses an optical radar (LIDAR, LIght Detection And Ranging) to study the PSCs, stratospheric aerosol, and the thermal behavior and dynamics of the atmosphere above McMurdo Station. Continuous LIDAR observations provide insight on the formation, evolution, and other peculiar characteristics of these PSCs.

Such an observational activity is also performed in the frame of the Network for Detection of Stratospheric Changing (NDSC, www.ndsc.ws). McMurdo Station is considered the NDSC primary site for LIDAR observations and monitoring of aerosol and clouds in the Earth stratosphere. Such data also provide a complement to the information gained from balloon-borne instruments in project AO-131-O, and thus collaborative activities are being coordinated with the University of Wyoming. [NSF Award # 90-17805]

Field Research Plan

Logistics

Dates in Antarctica:	late August 2001 to early October 2001 AND late January 2002 to early February 2002
Research Location:	Crary Science and Engineering Center (CSEC)

Team Members

Alberto Adriani   Francesco Cairo

Field-Season Overview

The researchers plan to operate the LIDAR located in Phase II of the CSEC, as part of an on-going study of polar stratospheric clouds and stratospheric thermal dynamics. The team members will coordinate LIDAR observations with ozonesonde and atmospheric aerosol balloon launches by project AO-131-O (Dr. Deshler).

One team member will train the support contractor's winter-over science technician in LIDAR operation, and the science technician will operate the LIDAR at regular, pre-arranged times during the 2002 austral-winter season. The McMurdo weather office will support this project by taking winter meteorological soundings.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Robbie Score

A VLF Beacon Transmitter at South Pole (2001-2004)

AO-108-O

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Research Objectives

This is a three-year effort to establish and operate a very-low-frequency (VLF) beacon transmitter at South Pole for the continuous measurement of solar effects on Earth's mesosphere and lower ionosphere. Specifically, the transmitter will produce data on solar proton events, relativistic (>300 keV) electron precipitation from Earth's outer radiation belts, and energetic electron precipitation and Joule heating components of high-latitude/polar-cap magnetosphere-ionosphere coupling processes.

The relativistic electron population, as measured at geosynchronous orbit, exhibits pronounced fluctuations in association with substorm and solar activity. During an event, these highly energetic electrons can penetrate to altitudes as low as 30 to 40 kilometers, producing ionization and x-rays and possibly affecting chemical reactions involving ozone production. The extent of relativistic electron precipitation will be observed by means of amplitude and phase variations of the South Pole VLF signal as received at various Antarctic stations. The South Pole beacon will synergistically enhance other Antarctic upper atmospheric research, such as the Automatic Geophysical Observatory (AGO) programs and the southern hemisphere coherent HF radar network (SUPERDARN). The proposed program also strongly complements ongoing satellite-based measurements of trapped and precipitating high-energy electrons both at low altitudes (SAMPEX) and high altitudes (POLAR).

The beacon will transmit at approximately 20 kHz, radiating 1 kW of total power with a horizontal dipole antenna, approximately 6.25 km long from tip to tip. It will be operating under computer control with a synoptic schedule of about 1 minute out of every 15 minutes. [NSF Award # 00-93381]

Field Research Plan

Logistics

Dates in Antarctica: mid-December 2001
Research Location: CUSP Lab in Skylab Building

Team Members

Umran Inan

Field-Season Overview

This three-year project plans to establish and operate a VLF Beacon Transmitter at South Pole for the purpose of continuous measurement of both steady and burst precipitation of relativistic (>300 keV) electrons from the Earth's magnetosphere.

The project team member plans to do a site survey and identify a site and begin the planning of the antenna construction for the VLF beacon, which will be sent to the South Pole this austral summer season. This austral summer season will be a preparation season—the VLF beacon will not be set up this year. The construction of the VLF beacon antenna will take place during the 2002-2003 season.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

South Pole Air Shower Experiment - 2 (SPASE-2)

AO-109-O

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Research Objectives

Cosmic rays consist of protons and other atomic nuclei, accelerated (scientists believe) to high energy levels in such distant astrophysical sources as supernova remnants. As cosmic rays from space arrive at the Earth, they interact in the upper atmosphere. The South Pole Air Shower Experiment-2 (SPASE-2) is a sparsely filled array of 120 scintillation detectors spread over 15,000 square meters at South Pole. This array detects the charged particles (primarily electrons) that are produced by interactions of these very high energy cosmic rays.

A nine-station subarray called VULCAN has been constructed to detect the Cherenkov radiation (light emitted by a charged particle moving through a medium at a higher speed than the speed of light within that material, analogous to the shock wave produced by objects moving faster than the speed of sound) produced high above the ground in the same showers. The SPASE array is located less than half a kilometer from the top of AMANDA and is designed to complement AMANDA's neutrino detecting capacity. (See project AA-130-OO).

SPASE-2 has the following two goals:

- First, to investigate the high-energy primary (galactic in origin) cosmic radiation, by determining the relative contribution of different groups of nuclei at energies above approximately 100 teraelectronvolts. This can be done by analyzing coincidences between SPASE and AMANDA. Such coincident events are produced by high-energy cosmic-ray showers with trajectories that pass through SPASE (on the surface) and AMANDA (buried 1.5 to 2 kilometers beneath it). AMANDA detects the high-energy muons penetrating the Earth in those same showers for which SPASE detects the low-energy electrons arriving at the surface. The ratio of muons to electrons depends on the mass of the original primary cosmic ray nucleus. The VULCAN detector further permits the calculation of two other ratios that also depend on primary mass in readings from the showers it detects.

- Second, to use the coincident events as a tagged beam. This construction permits us to investigate and calibrate certain aspects of the AMANDA response.

This project cooperates with the University of Leeds in the United Kingdom. [NSF Award # 99-80801]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to late January 2002
Research Locations:	SPASE-2 building and array in the Dark Sector, Science Building under the Dome

Team Members

Xinhua Bai   Jerry Poirier   Xian-Wu Xu

Field-Season Overview

The South Pole Air Shower Experiment (SPASE-2) will continue on year-round. During the austral summer, the team members will work in the computer room of the Science Building under the dome to calibrate and optimize the SPASE-2 array, which is located on the surface of the ice in the Dark Sector.

Also, during this austral summer, the support contractor will provide equipment for digging near the edge of the SPASE-2 array for a water tank to be installed. Also, the contractor will deliver liquid water to fill the tank (approx. 1400 gallons). The project team members will take an ice core sample (3 feet long) from the tank which was installed last season to get a detailed look at the ice quality.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Eivind Jensen

High-Latitude Antarctic Neutral Mesospheric and Thermospheric Dynamics and Thermodynamics

AO-110-M/S

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Research Objectives

South Pole is a unique and interesting spot from which to observe the dynamical motion of the atmosphere. The fact that it is on the axis of Earth's rotation strongly restricts the types of wave motion that can occur there, as compared to lower latitude sites. Antarctica attracts atmospheric scientists for many reasons; a primary draw is that neutral winds perforce can only blow across the Earth's rotational axis. This simple condition has a profound influence on the large-scale dynamics of the atmosphere at high latitude, as only zonal wave-number one mode horizontal motions are possible. The extent of this restrictive effect is being simultaneously studied with observations equatorward of South Pole, specifically Arrival Heights (78 degrees S).

The resulting simplifications may help in understanding the behavior of the global atmosphere. For example, how do scientists measure the wind speed of the atmosphere? One direct method is by determining the Doppler shift of naturally occurring emissions in the upper atmosphere as they flow along at predictable heights. Hydroxyl radicals (OH), for example, are confined to a fairly narrow band near 90 kilometers altitude.

This study uses a high-resolution Fabry-Perot interferometer (located at Amundsen-Scott South Pole Station and Arrival Heights, which is located just outside of McMurdo Station) to make simultaneous azimuthal observations of the individual line spectra of several upper atmospheric trace species, most importantly the hydroxyl radical (OH) and atomic oxygen. The observed Doppler shift of the emission lines provides a direct measure of the line-of-sight wind speed, while the wind field structure can also be derived from these multi-azimuth measurements. The simultaneously observed line widths also provide a direct measurement of kinetic temperature. [NSF Award # 99-09743]

Field Research Plan

Logistics

Dates at McMurdo:	early January 2002 to late January 2002
Dates at South Pole:	late January 2002 to early February 2002
Research Locations:	McMurdo Station: Arrival Heights
	South Pole: Aurora Lab in Skylab

Team Members

Gonzalo Hernandez	Michael McCarthy
Ruth Wilton-Godberfforde	Bryan Venema

Field-Season Overview

The project team members plan to study the dynamic motion of the upper atmosphere using high-resolution Fabry-Perot Interferometers located at McMurdo Station and at South Pole Station. These interferometers measure the line spectra of upper atmospheric trace chemical species, primarily the hydroxyl radical and atomic oxygen. A lidar will also be installed at McMurdo Station this season to make additional measurements.

Team members will work at McMurdo Station to perform routine service on the Fabry-Perot Interferometer (FPI) and ancillary equipment at Arrival Heights. Team members will also install and calibrate a lidar in a new vibration-free darkroom at the Arrival Heights facility. All team members will then travel via LC-130 aircraft to South Pole, where they will work in the Aurora Lab to perform routine service on the Fabry-Perot Interferometer (FPI) and ancillary equipment. They also plan to provide on-site training to the support contractor's winter-over science technician for the operation of the FPI.

The research team will then return via LC-130 aircraft to McMurdo Station to troubleshoot the newly installed lidar and train the support contractor's winter-over science technician in the operation of the FPI.

Observation of the doppler shift and width of natural emission lines will be made year-round. The support contractor's science technicians will operate the high-resolution spectrometers, which will be in self-calibration mode during the austral summer and in 24-hour data-acquisition mode during the austral winter. The McMurdo science technician will also remove snow buildup around the lidar and otherwise maintain the instrument. Both science technicians (McMurdo & South Pole) will periodically send data to the home institution via the Internet.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Curt LaBombard (McMurdo)
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Riometry in Antarctica and Conjugate Regions
AO-111-M/S

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Co-Principal Investigator: Dr. Allan Weatherwax
University of Maryland

Research Objectives

We will continue our studies of the high magnetic latitude ionosphere and magnetosphere, using galactic radio-noise absorption techniques (riometry). Several years ago, we developed new imaging riometers that are now being operated at Iqaluit, Canada; Sondestromfjord, Greenland; and South Pole and McMurdo stations, as well as in all six of the Automatic Geophysical Observatories (AGO) operated by the National Science Foundation in Antarctica.

Additionally, we operate broad-beam riometers at Iqaluit, McMurdo, and South Pole and auroral photometers at McMurdo and South Pole stations. We also have provided imaging riometers for the British Halley Bay and the Australian Davis stations, both in Antarctica, thus considerably extending coverage. In the next few years, we will build imaging riometers systems for some of the British AGOs. The instruments work synergistically with a number of other instruments that are operated at all of these sites by other investigators.
[NSF Award # 00-03881]

Field Research Plan

Logistics

Dates at McMurdo:	mid-January 2002 to late January 2002
Dates at South Pole:	mid-January 2002
Research Locations:	McMurdo Station: Arrival Heights South Pole Station: CUSP Lab in Skylab

Team Members

Alan Weatherwax	TBD

Field-Season Overview

The researchers plan to use imaging and broadbeam riometers and optical photometers to study the processes of energy transfer from the solar wind to Earth's magnetosphere and ionosphere at high geomagnetic latitudes. The emphasis will be on understanding the ionospheric signatures of dayside auroral phenomena associated with the particle entry into the cusp and boundary layers, as well as the nightside substorm effects associated with the magnetotail and plasma sheet.

The project team members plan to work primarily in the CUSP Lab at the South Pole Station for one week in mid-January 2002 and in the Arrival Heights facility at McMurdo Station for approximately one week during mid-to-late January 2002. They will update data collection hardware and software on the two data-acquisition system computers. They will also perform general maintenance on the riometer/photometer systems.

While in Antarctica, the team members will train the support contractor's science technicians at McMurdo Station and South Pole Station to electronically troubleshoot the instruments and computers and to perform data collection. The science technicians will provide year-round instrument maintenance and data transmittal to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Jesse Alcorta (McMurdo)
Mr. Paul Sullivan (South Pole)

Polar Experiment Network for Geophysical Upper-Atmospheric Investigations

AO-112-O

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Research Objectives

The data obtained from automatic geophysical observatories (AGO) help researchers understand the Sun's influence on the structure and dynamics of the Earth's upper atmosphere. The ultimate objective of this research into how the solar wind couples with the Earth's magnetosphere, ionosphere, and thermosphere is to be able to predict solar/terrestrial interactions that can interfere with long-distance phone lines, power grids, and satellite communications.

A consortium of U.S. and Japanese scientists are working with a network of six AGOs, established on the east antarctic polar plateau and equipped with suites of instruments to measure magnetic, auroral, and radiowave phenomena. The AGOs are totally autonomous, operate year-round, and require only annual austral summer service visits.

When combined with measurements made at select manned stations, these arrays facilitate studies on the energetics and dynamics of the high-latitude magnetosphere, on both large and small scales. The research will be carried out along with in situ observations of the geospace environment by spacecraft, in close cooperation with other nations working in Antarctica and in conjunction with conjugate studies performed in the Northern Hemisphere. PENGUIn AGO data will be sent to Augsburg College in Minnesota, where the data will be processed and distributed to PENGUIn investigators. [NSF Award # 98-18176]

Field Research Plan

Logistics
Research Locations: AGO sites 1 - 6

Team Members
No deploying team members

Field-Season Overview

This project will continue the acquisition of upper atmospheric physics data from the instruments that have been deployed at the six Automatic Geophysical Observatories (AGOs P1 – P6) in Antarctica. The AGO facilities will be maintained by the NSF/OPP contractor, Raytheon Polar Services, under project TO-296-O (AGO Servicing Program). Team members from project TO-296-O will service and refuel each site annually and conduct routine calibration of the instruments.

The accumulated year's data from each AGO site will be brought out during the annual visit by the project TO-296-O team members and then sent to Augsburg College where it will be processed and distributed to the PENGUIn investigators.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
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All-Sky Imager at South Pole

AO-117-O

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Research Objectives

The South Pole is a unique platform for observing aurora during the austral-winter season; as a point on the earth's rotational axis, the pole provides a unique vantage to observe the airglow and to discern the characteristics of acoustic gravity waves in the polar region, as they vary in altitude/wavelength.

We can observe aurora continuously throughout the 24 hours in a day, which allows us to collect data on the following:

- the dayside polar cusp/cleft aurora (due to the direct entry of the solar wind);
- afternoon aurora that are closely associated with the night side magnetospheric storm/substorm activities; and
- on the polar cap aurora, which is dependent on the polarity of the interplanetary magnetic field.

Research has shown that these auroras come from the precipitation of low-energy particles entering the magnetosphere from the solar wind. Since 1965, data have been acquired at the South Pole using a film-based, all-sky-camera system. With the advance of technology, we are now able to obtain digital images and process large amounts of information automatically.

The current technology is known as the all-sky-imager (ASI), a digital CCD imager monitored and controlled by the Japanese NIPR (National Institute of Polar Research) using a satellite internet system and modern telescience techniques. ASI is equipped with interference filters for auroral emissions of N2+427.8 nm, OI 557.7 nm, and OI 630.0nm; an OH (hydo-oxide 730 nm) and/or NaD(589nm) filter is also available, while a panchromatic image can be obtained without the filter.

These international collaborations should enhance knowledge of the magnetosphere, the ionosphere, and of upper/middle atmosphere physics. The HF (high frequency) radars at Halley Bay, Sanae and Syowa Station yield the vector velocity of ionospheric plasma over the South Pole. These studies should provide further insight into the physics of the magnetosphere, the convection of plasma in the polar cap, and solar wind effects; specifically dayside auroral structure, nightside substorm effects, and polar-cap arcs. The preliminary image data are available on http://www.isc.nipr.ac.jp/asi-dp_db/. [U.S. – Japanese joint project]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 for approximately one week
Research Location(s):	Aurora Lab in Skylab Building

Team Members

Yusuke Ebihara	Shu Takeshita

Field-Season Overview

The support contractor's operations personnel will assist the project team in unmounting the current all-sky imager (ASI) and replace it with new ASI instruments. The project team members will work in the Aurora Lab to maintain the ASI instruments (i.e., optical camera, workstation, and data recorder) and to check and calibrate the absolute intensity of the optical device.

The ASI is remotely operated through a satellite link by researchers at the National Institute of Polar Research (NIPR) in Japan during the polar night. During the 2002 austral-winter months, the support contractor's on-site science technician will assist in running the instrument by turning on and off power as required, changing data tapes, periodically checking the condition of the glass radome, turning on and off a moon blocker, and performing repairs as necessary.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Eivind Jensen

Solar and Heliospheric Studies with Antarctic Cosmic Ray Observations

AO-120-M/S

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Research Objectives

Cosmic rays — penetrating atomic nuclei and electrons from outer space that move at nearly the speed of light — continuously bombard the Earth. Colliding with air, nuclei in the upper atmosphere, they create a cascade of secondary particles that shower down through the atmosphere. Neutron monitors deployed in Antarctica provide a vital three-dimensional perspective on this shower and how it varies along all three axes. Accumulated neutron-monitor records (begun in 1960 at McMurdo Station and in 1964 at Amundsen-Scott South Pole Station) provide a long-term historical record that supports efforts to understand the nature and causes of solar/terrestrial and cosmic-ray variations, as they are discerned occurring over the 11-year sunspot cycle, the 22-year Hale cycle, and even longer time scales.

This project continues a series of year-round observations at McMurdo and Amundsen-Scott South Pole Stations, recording cosmic rays with energies in excess of 1 billion electronvolts. These data will advance our understanding of a number of fundamental plasma processes occurring on the Sun and in interplanetary space. At the other extreme, we will study high time-resolution (10-second) cosmic-ray data to determine the three-dimensional structure of turbulence in space. [NSF Award # 98-16129]

Field Research Plan

Logistics

Dates in Antarctica:	early January 2002 to late January 2002
Research Locations:	McMurdo: CosRay Facility
	South Pole: CosRay Lab in Skylab

Team Members

Leonard Shulman   Paul Evenson

Field-Season Overview

One project team member plans to work at the South Pole Station to provide oversite while the support contractor's operations personnel remove three detector boxes from the existing neutron monitor platform, raise the platform approximately 10 feet on new legs, and replace detectors on the platform. The team member will also perform routine maintenance and calibration of the neutron monitors in the CosRay Lab at the South Pole. The team member will also provide training for the winter-over science technician in project operations.

The project team member will also perform routine maintenance and calibration of the neutron monitors at the McMurdo Station CosRay Facility.

Another team member will travel to Adelaide, Australia, to meet the icebreaker *Polar Sea* and service the neutron monitor on board this icebreaker during the port call.

At both CosRay Laboratories (in the Skylab Building at South Pole and at the CosRay Facility at McMurdo), the support contractor's science technicians will maintain the neutron monitors throughout the 2002 austral-winter months. The technicians will collect daily data, perform system checks, troubleshoot and repair the system if necessary, and transmit data to the home institution on a weekly basis.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Jesse Alcorta (McMurdo)
Mr. Paul Sullivan (South Pole)

Effects of Enhanced Solar Disturbances During the 2000-2002 Solar-Max Period on the Antarctic Mesosphere-Lower-Thermosphere (MLT) and F Regions Composition, Thermodynamics, and Dynamics

AO-129-O

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Research Objectives

We will use observations in the visible and near-infrared of upper-atmospheric emissions above South Pole Station to study the heating effects of auroral electrical currents in the ionosphere, as well as planetary waves and atmospheric tides. The project is particularly timely for two reasons: First, the sun is now in the period of maximum activity, and second, NASA launched the TIMED (Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics) satellite in December 2000. TIMED, designed to study those parts of the atmosphere that are the focus of this project, will provide data on the temperature, winds, and tides of Earth's upper atmosphere, especially above the poles as it passes overhead. However, as is often the case with satellites, it is difficult to differentiate between variations in location or time. The South Pole ground-based observations will be valuable in sorting out the time-location question.
[NSF Award # 99-09339]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to early January 2002
Research Locations:	Aurora Lab in the Skylab Facility, Atmospheric Research Observatory (ARO)

Team Members

Justin Bartee   Jonathan Pescue   Gulamabas Sivjee

Field-Season Overview

The project team members will work at the South Pole to maintain and service the Michelson Interferometer, the spectrometer, the photometer, and the data-acquisition system located in the Aurora Lab in the Skylab Building. The support contractor's construction personnel will assist in the installation of a new dome on the roof of the Atmospheric Research Observatory (ARO) in which a new charge-coupled device (CCD) spectrograph will be installed.

Throughout the 2002 austral-winter season, the support contractor's science technician will operate, maintain, and calibrate this project's equipment, record data, conduct data-quality checks, troubleshoot the system, back-up the data, and transmit the data to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Eivind Jensen

In Situ Measurements of Polar Stratospheric Clouds Spanning the Austral Winter, and of Ozone from Late Winter to Early Spring

AO-131-O

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Research Objectives

This project is focused on observations of the character of particles in polar stratospheric clouds (PSCs), which are critical to ozone depletion, and on observations which may provide the first indications of ozone recovery. The observations are obtained from balloon-borne measurements based at McMurdo Station. The PSC particle size distribution measurements will be conducted during the early- and mid-winter period (when PSC activity is greatest), and during late winter, when ozone loss begins. The mid-winter measurements will be completed by science technicians from the civilian support contractor. The ozone measurements will begin late August and continue through October.

The fundamental measurements from the PSC instruments provide estimates of the size and concentration of the particles that form in these clouds. Heterogeneous chemistry, which activates chlorine so that it can then destroy ozone, occurs on the surface of these particles. From these measurements, the particle surface areas and volumes within PSCs can be estimated. These results help scientists quantify chlorine activation and ozone loss models, calculate denitrification/dehydration rates, and estimate particle composition. Further estimates of particle composition will involve methods to infer particle index of refraction, a function of composition, through continuing collaboration with the McMurdo LIDAR measurements of Alberto Adriani, Istituto di Fisica Dell'Atmosfera, Rome (AO-107-O).

In addition to the aerosol measurements, we will maintain annual late winter/spring measurements of ozone profiles. At a minimum, this will continue to provide a measurement base to detect the first signs of ozone recovery. Stratospheric chlorine levels are now peaking. Following this, the lessening of ozone depletion is expected to be altitude dependent. Measurements of vertical ozone profiles provide one of the crucial tools needed to observe the first signs of recovery following the decline in stratospheric chlorine. These measurements are archived in the data base of the Network for the Detection of Stratospheric Change. [NSF Award # 99-80594]

Field Research Plan

Logistics

Dates in Antarctica:	late August 2001 to early November 2001 AND early February 2002 to mid-February 2002
Research Locations:	Ross Ice Shelf, Crary Science and Engineering Center (CSEC)

Team Members

Terry Deshler	Chris Kroger	Chuntao Liu
Donal Lukens	John Marwitz	

Field-Season Overview

The researchers plan to measure the development of the Antarctic ozone hole and the characteristics of polar stratospheric clouds (PSCs) by balloon-borne instruments launched from McMurdo Station. Information on PSCs will be supplemented by LIDAR measurements taken by researchers from project AO-107-O (Dr. Adriani).

Project team members plan to travel via helicopter to recover the instruments, which are expected to be scattered within a 100-nautical-mile-radius of McMurdo Station on the Ross Ice Shelf.

One project team member will train the support contractor's winter-over science technician in instrument preparation, launching techniques, and data acquisition. The science technician and other support contractor personnel in McMurdo will carry out winter balloon launches and record the telemetry data.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Robbie Score

Dynamics of the Antarctic MLT Region Using Ground-Based Radar and TIMED Instrumentation

AO-284-O

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Research Objectives

We will study the dynamics of the mesosphere and lower thermosphere over Antarctica using measurements from instruments on NASA's TIMED satellite and a meteor radar to be installed at Amundsen-Scott South Pole station. Specific science objectives include the space-time decomposition of wave motions; delineation of the spatial climatology over Antarctica with emphasis on the structure of the polar vortex; dynamical response to energetic events; and interannual variability.

The proposed meteor radar is a VHF system that will be able to measure the spatial structure and temporal evolution of the horizontal wind field over the South Pole. We will also use the existing ground-based radars at Davis Station, Syowa Station, Rothera Station, and Scott Base to determine spatial climatology. Wind and temperature measurements to be made by NASA's TIMED satellite during orbits over the South Pole will provide opportunities for combined ground-based, space-based experiments and validation activities.

[NSF Award # 00-00957]

Field Research Plan

Logistics

Dates in Antarctica:	late November 2001 to early December 2001 AND early January 2002 to late January 2002
Research Location:	shack downwind of the South Pole Station

Team Members

James Avery Nikolai Markarov Scott Palo

Field-Season Overview

The researchers plan to continue to study the dynamics of the mesosphere/ lower thermosphere over the Antarctic continent using measurements from the TIMED instruments and a meteor radar, which is installed at the South Pole Station.

The project team members will continue the operation and data collection from the 46.3 MHz radar, which was installed next to the radar shack during the 2000-2001 season. The team members and the support contractor's operations personnel will work to shield the shack to reduce interference. The team members will also repair the antennas and other components located outside the shack and will conduct recalibration efforts of the radar equipment via aircraft overflights in cooperation with the Air National Guard.

This project will continue to operate throughout the 2002 austral-winter season. The support contractor's science technician will monitor the equipment (i.e., provide routine maintenance and occasional troubleshooting and repair) to ensure that it is running appropriately. The technician will also send data to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

Overview of the Antarctic Biology and Medicine Program

The Antarctic Biology and Medicine program funds research that will improve understanding of the physiology, behavior, adaptations, and processes of Antarctic life forms and ecosystems at all organizational levels, ranging from molecular, cellular, and organismal to communities, ecosystems, and global processes. Support is focused on the following areas:

- Marine ecosystem dynamics: Understanding the natural variability of marine ecosystems, correlating the structure and function of the marginal ice-zone ecosystem with oceanic and atmospheric processes, the influence of physical and biological factors on the recruitment of krill, and the role of marine phytoplankton in carbon dioxide cycling are among the research topics.
- Terrestrial and limnetic ecosystems: Organisms in ice-free areas and in perennially ice-covered lakes show remarkable adaptations to extreme environments. The presence of relatively few species eases study of ecosystem dynamics and interpretation of experiments, although more research is needed on adaptive mechanisms and evolutionary processes.
- Population biology and physiological ecology: Research areas include population dynamics of krill and other zooplankton, fish species, marine mammals, and birds, which have been the object of much research and merit further attention in some areas. Long-term observations are improving understanding of manmade and natural changes.
- Adaptation: Research topics include low-temperature photosynthesis and respiration, enzymatic adaptations, adaptive strategies such as development of antifreeze compounds and modifications to circulation systems, and the response of organisms to increased UV-B from the ozone hole. The genetic basis for adaptation is an important avenue of research.
- Human behavior and medical research: Antarctica's extreme climate can induce social, psychological, and physiological stresses, particularly during the winter isolation. Studies have focused on epidemiology, thermal regulation, immune system function, individual behavior, and group dynamics.

The Southern Ocean GLOBEC program (SO-GLOBEC) began in the austral winter of 2001 in the Western Antarctic Peninsula region. The goal of the SO-GLOBEC program is to understand shelf circulation processes and their effect on sea-ice formation and Antarctic krill distribution and to examine the factors that govern krill survivorship and availability to higher trophic levels, including seals, penguins, and whales. The program also supports two Long-Term Ecological Research (LTER) Projects — one in the Palmer Station Area of the Antarctic Peninsula and the other in the McMurdo Dry Valleys. The NSF's LTER Program consists of a network of 24 research sites extending from Alaska to Puerto Rico to Antarctica. The Palmer Station/Antarctic Peninsula LTER program centers on ecological processes that link the extent of annual pack ice to the biological dynamics of different trophic levels within the Antarctic marine community. The McMurdo Dry Valleys LTER project is an interdisciplinary study of the aquatic and terrestrial ecosystems in a cold desert region of Antarctica.

The Role of Natural Legacy on Ecosystem Structure and Function in a Polar Desert: The McMurdo Dry Valleys LTER Program

BM-042-D,F,L,M,P,V,W

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Research Objectives

The largest ice-free area in Antarctica can be found in the McMurdo Dry Valleys, located on the western shore of McMurdo Sound. Among the most extreme deserts in the world, the Dry Valleys are the coldest and driest of all LTER sites. Consequently, the biological systems are limited to microbial populations, microinvertebrates, mosses, and lichens. Yet complex trophic interactions and biogeochemical nutrient cycles develop in the lakes, streams, and soils of the Dry Valleys. In the austral summer, solar energy produces glacial meltwater, providing vital water and nutrients that are a primary influence on the ecosystems. Such material transport and climatic influences shape all ecosystems, but nowhere is this more apparent than in the McMurdo Dry Valleys.

In 1993, this region was selected as a study site for the National Science Foundation's Long-Term Ecological Research (LTER) program. During the first six years of this project, investigators studied the perennially ice-covered lakes, ephemeral streams, and extensive areas of soils to assess the role of physical constraints on the structure and function of the ecosystem. Clearly, the production of liquid water in both terrestrial and aquatic portions of this environment is a primary driver in ecosystem dynamics. Thus, the role of present-day climate variation is extremely important. However, one of the most significant discoveries was that past climatic legacies strongly overprint the present ecological conditions in the McMurdo Dry Valleys.

The McMurdo LTER project focuses on the aquatic and terrestrial ecosystems in the Dry Valleys landscape as a context to study biological processes and to explore material transport and migration. During the second phase of this LTER project, we will extend our research by continuing to investigate the McMurdo

Dry Valleys as an "end-member" system, hoping to better ascertain the role of the past climatic legacies on ecosystem structure and function. We will test a series of eight hypotheses in three major focus areas — hydrology, biological activity/ diversity, and biogeochemical processes — by continuing monitoring projects and long-term experiments.

Understanding the structure and function of the McMurdo Dry Valleys ecosystem requires understanding hydrological response to climate — both now and in the past. Current patterns of biological activity and diversity reflect both past and present distributions of water, nutrients, organic carbon, and biota. Biogeochemical processes responsible for the transport, immobilization, and mineralization of nutrients and other chemicals provide the linkages between the region's biota and the physical environment. The timing, duration, and location of biogeochemical processes — in the past and present — are controlled by water availability. We continue to focus on the integration of the biological processes within and among the lakes, streams, and terrestrial ecosystems that comprise the McMurdo Dry Valleys landscape. Our interdisciplinary research team will continue to use modeling and other integrative studies to synthesize data and to examine the McMurdo Dry Valleys ecosystem.
[NSF Award # 98-10219]

The following list contains Principal Investigator contact information for each McMurdo Dry Valleys project:

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BM-042-F: Glacier Mass Balance, Melt, and Energy Balance

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BM-042-L: **Chemistry of Streams, Lakes, and Glaciers**

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BM-042-M: **Flow, Sediment Transport, and Productivity of Streams**
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BM-042-P: **Lake Pelagic and Benthic Productivity and Microbial Food Webs**
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BM-042-W: **Soil Productivity**
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Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to mid-February 2002
Research Locations:	McMurdo Dry Valleys; Ross Ice Shelf; Crary Science and Engineering Center (CSEC)

Team Members

BM-042-D

Jennifer Lawson	Carrie Olsen	

BM-042-F

Virginia Bulter	Andrew Fountain	Thomas Nylen
Nichole Alhadeff	Martyn Tranter	

BM-042-L

Johanna Laybourn-Parry	W. Berry Lyons	Sarah Tegt
Kathleen Welch		

BM-042-M

Chris Jaros	Diane McKnight	Paul Turner
TBD		

BM-042-P

Sabine Bisson	Christine Foreman	Jill Mikucki
John Priscu	Craig Wolf	

BM-042-V

John Barrett	Ross Virginia	

BM-042-W

Steve Blecker	Nicole DeCrappeo	Andy Parsons
Dorota Porazinska	Diana Wall	Roger Worland
David Wynn-Williams		

Field-Season Overviews

The McMurdo Dry Valleys LTER team members plan to continue their investigation of the long-term ecology of the McMurdo Dry Valleys. Team members will occupy the camps and labs at Lakes Hoare, Fryxell, and Bonney. These camps will serve as bases of operation for sample collection and experimentation on the glaciers, streams, soils, and lakes of the Dry Valley Ecosystem. Field-team members will travel via helicopter between the camps and McMurdo Station, and from the camps to other research sites within the valleys. The team members will also work in the CSEC with the support contractor's Analytical

Chemist to conduct chemical and biological analyses. Additional samples from all projects will be shipped to respective home institutions at the end of the field season.

BM-042-D: Paleoclimatology, Paleoecology, and Meteorological Data Collection

The researchers plan to characterize carbon and nitrogen isotopic signatures and carry out hydrologic balance measurements in Dry Valley lakes. They will also maintain long-term automated lake monitoring equipment and long-term benthic experiments.

With the assistance of support contractor personnel, the project team members will collect lake ice and glacial ice cores. Team members will also collect microbial mat samples from lake and pond moats and from stream mouths, and they will collect water samples, and moat sediment cores. Team members will also collect data from long-term environmental sensors and measure debris movement on the ice cover of Lake Hoare using precision GPS receivers. From McMurdo Station, team members will travel via helicopter or tracked vehicle to the Ross Ice Shelf, where they will collect ice cores.

BM-042-F: Glacier Mass Balance, Melt, and Energy Balance

The researchers plan to monitor the mass balance of selected glaciers in Taylor Valley and maintain weather stations and snow fences in Beacon, Taylor, Wright, and Victoria Valleys.

Team members will set up a temporary meteorological station on the Howard Glacier, install and refurbish satellite reflectors on the Commonwealth Glacier, and measure glacier snow lines and ablation stakes on several glaciers with GPS. Team members will also drill cryconite holes on the Canada Glacier, collect samples, and install conductivity and temperature probes in the holes for winter data collection. Finally, with the assistance of a support contractor mountaineer, team members will extract a snow core from the accumulation zone of the Commonwealth Glacier.

BM-042-L: **Chemistry of Streams, Lakes, and Glaciers**

The researchers plan to monitor the inorganic chemistry of water collected from glaciers, streams, and lakes of the Dry Valleys, in collaboration with other teams involved with LTER lake and stream sampling programs.

The team members will collect rock, water, sediment, snow, and ice samples from several lakes, streams, glaciers, and exposed soil areas. Team members will work closely with project BM-042-M (McKnight) to characterize the dissolved and suspended mineral loads in the Dry Valley streams. With the assistance of a support contractor mountaineer, the team members also plan to collect snow and ice cores on the Commonwealth Glacier.

BM-042-M: **Flow, Sediment Transport, and Productivity of Streams**

The researchers plan to monitor the flow, sediment transport, and productivity of glacial melt streams in the McMurdo Dry Valleys.

Project team members will maintain the current network of 19 stream gauges, collect water quality samples, and make hydrologic measurements. Established stream transects in Taylor Valley will be sampled and surveyed. The team members also plan to sample Lake Fryxell waters at various times and locations, and they will deploy an acoustic doppler velocity meter in the moat. In addition, team members will survey the sediment deposits near former stream gauge sites above Miers Lake.

BM-042-P: **Lake Pelagic and Benthic Productivity and Microbial Food Webs**
The researchers plan to measure the biological, chemical, and physical properties of Dry Valley lakes. Team members will use ice augers and other coring devices to penetrate lake ice caps for the collection of water samples, and for the annual retrieval and deployment of sediment traps and quantum sensors.

BM-042-V: **Soil Productivity**
The researchers plan to study the influence of environmental conditions on carbon and nitrogen cycling and on the abundance and distribution of biota in Dry Valley soils. The project team members will be based in McMurdo and make day trips via helicopter to study sites in the Dry Valleys. Team members will collect soil samples and measure in situ soil CO_2 flux. They will also incubate soils from the Lake Fryxell area in intact soil chambers located in Beacon Valley, and Beacon Valley soils in the Lake Fryxell area.

BM-042-W: **Soil Productivity**
The researchers plan to investigate the effects of climate, environmental change, and changes in food supply on soil biota and soil processes, climatic controls on soil biodiversity, and the role of wind as a link between streams, lakes, and soils. The team members will be based in McMurdo and make day trips via helicopter to study sites in the Dry Valleys, where they will conduct experiments and collect samples. Occasionally, team members will stay for 2-3 days at established Dry Valley camps while they conduct microscopy and other studies.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Ken Doggett

Function and Chemical Nature of Ice-Active Substances Associated with Antarctic Sea Ice Diatoms

BO-001-O

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Research Objectives

Sea-ice diatoms of McMurdo Sound, Antarctica, have been previously shown to be associated with extracellular ice-active substances (IASs) that are present in both the ice platelet layer and congelation ice in which diatoms are found. These molecules have large molecular weights and appear to be glycoproteins. Similar molecules have not been found in temperate water diatoms, and so apparently, they have a function related to cold or icy environments. Previous studies have shown that they are widely distributed in the Southern Ocean, occur in both summer and winter sea ice, and are associated with many if not all sea-ice diatoms.

We will examine additional questions about the function and chemical nature of these unusual substances. Preliminary evidence suggests the IASs have cryoprotective properties. One goal is to explore this possibility, using several approaches including the IASs' ability to prevent freeze-thaw damage in a test enzyme as well as whole cells, and their ability to inhibit the recrystallization of ice, which is a common measure of antifreeze activity in plant studies. The IASs are known to bind to ice crystals. To better understand the binding mechanism, we will conduct additional studies to determine the specific crystal faces to which they bind. A third part of our study will try to better characterize the chemical nature of the carbohydrate and protein moieties of the IASs, using mass spectrometry, amino-acid sequencing, and other techniques. Finally, we will also attempt to raise antibodies against the IASs, as these will have several uses in determining the origin, seasonality, relatedness, and possibly the function of these molecules.

The IASs represent a novel type of ice-binding molecule that is distinct from protein and glycoprotein fish antifreezes. Because of their ubiquity in the Antarctic sea-ice communities and their absence in warmer regions, they appear to have an important role in polar communities. These studies should answer some of the main questions about the nature of these molecules. In addition, the IASs share some properties with fish antifreezes, and so understanding their ice-binding properties and chemical structure will make it possible to better understand how this family of molecules interact with ice. Finally, unlike the fish antifreezes, the IASs are produced in large quantities in nature, and this may make it feasible for them to be used in other applications. [NSF Award # 00-88000]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to mid-January 2002
Research Locations:	McMurdo Sound sea ice, Granite Harbor; Crary Science and Engineering Center (CSEC)

Team Members

Jim Raymond   Mical Samuelson   Jason Villaflor

Field-Season Overview

The researchers plan to study the chemical nature and function of ice-active substances produced by sea ice diatoms.

The project team members will collect sea ice samples from holes drilled by support contractor personnel with the Reed Drill. Team members will also travel via helicopter to Granite Harbor and various locations along the continental coast to collect sea ice and diatom samples.

Ice active substances will be purified and analyzed at the CSEC. Some ice and diatom samples will be returned to the home institution for further analyses.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Iszard

Antifreeze Proteins in Antarctic Fishes: Ecological and Organismal Physiology, Protein Structure-Function and Mechanism, Genetics, and Evolution

BO-005-M

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Research Objectives

Despite temperatures that can dip below 0 °C, Antarctic waters provide a life sustaining environment for a number of fish species. How are they able to take the most frigid waters on earth through their gills without themselves freezing? A primary reason are the so-called antifreeze proteins, an adaptation found in a number of polar and subpolar species. These biological molecules have a similar effect to antifreeze in a mechanical engine.

The Southern Ocean provides the ideal laboratory and molecular biology the ideal probe to study this phenomenon. As the world's coldest marine environment, the near-shore waters of Antarctica, replete with ice crystals, hover just above seawater's freezing point. We are studying the physiology of fish and larvae from these waters to see how ice wants to grow in biological tissues - a crystallization process called nucleation - and how antifreeze glycoproteins (AFGP) inhibit it.

Their evolution of the antifreeze function has enabled the Antarctic notothenioids to colonize their frigid habitats very successfully. We are mounting comprehensive multidisciplinary analyses of this adaptation at the level of the gene as well as the protein. Specifically, we will:

- examine the structure of antifreeze proteins;
- refine the molecular model of how these proteins adsorb ice and inhibit ice crystal growth;
- study the physiological parameters governing the natural growth of ice crystals;
- pinpoint the chromosomal locus of the gene family and its protease progenitor gene;

- sketch its evolutionary history by calibrating the rate of notothenioid nuclear protein coding sequences; and
- focus on when these AFGPs develop during embryogenesis and early larval stages. [NSF Award # 99-09841]

Field Research Plan

Logistics

Dates in Antarctica:	late August 2001 to early February 2002
Research Locations:	McMurdo Sound sea ice; ice edge; Bratina Island; Cape Bird; Crary Science and Engineering Center (CSEC)

Team Members

Arthur DeVries	Chris Cheng-DeVries	Kevin Hoefling
Benjamin Hunt	Steve Allison	Clive Evans
Karin Romisch		

Field-Season Overview

The researchers plan to continue studies of freezing avoidance in McMurdo Sound fishes. Project team members plan to establish fishing stations on the annual sea ice of McMurdo Sound. The support contractor’s operations crew will drill new holes with the Reed Drill as fish captures dwindle at existing holes. Live fish will be transported via tracked vehicle to the aquaria at McMurdo Station, where researchers will study the physiological parameters governing the natural growth of ice crystals and the role of antifreeze glycoproteins (AFGP) in fish tissues.

Team member plan to make day trips via helicopter to the ice edge and to Bratina Island, where there they will deploy fish traps and take conductivity, temperature, and depth (CTD) readings at discrete depths to determine seawater conditions at the collection sites. Team members will also make CTD casts at other sites and at various depths in McMurdo Sound to determine the hydrographic conditions and level of iciness that the different McMurdo Sound fish species encounter. Researchers will travel via helicopter to Cape Bird, where they will deploy a temperature and pressure data logger in about 30 feet of water. The data logger will be left to collect data for one year.

Project SCUBA divers will retrieve developing dragonfish eggs or hatchlings from *in situ* cages set up during the 2000-2001 field season. SCUBA divers will also search for and collect fertilized eggs of other species at various sites in McMurdo Sound for similar studies. Fertilized eggs will be hatched in the CSEC aquarium to study the expression levels of antifreeze glycoproteins during development.

Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Iszard

Use of Long-Term Data Base and Molecular Genetic Techniques to Examine the Behavioral Ecology and Dynamics of a Weddell Seal (*Leptonychotes weddellii*) Population

BO-009-O

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Research Objectives

The Weddell seal (*Leptonychotes weddellii*) is found in regions of pack ice or fast ice close to the antarctic continent. These seals are relatively long-lived, and the waters of McMurdo Sound have provided a continuous environment in which to study their survival and aquatic reproductive patterns. A series of long-term population studies, ongoing since the mid-1960s, have generated a rare and valuable set of data.

Recently developed molecular biology techniques, however, permit scientists to examine the DNA of individual seals as well as groups, and to gain insight into their genetic histories, breeding systems, and reproductive fitness. Breeding males behave characteristically; looking at this behavioral ecology and their mating systems through the lens of their DNA permits scientists to project backwards in time and correlate the seals' reproductive success with the effective size of their populations. Using and building on the long-term data set, our study will also examine how hypotheses can be tested and parameters can be estimated, in producing models and studies of population demographics. We will also explore the population dynamics of the Weddell seal though the lens of immigration and emigration into and out of the group.

Several collaborative efforts will occur this season. In one, blood, scat and diet samples will be collected for researchers studying Weddell seal blood chemistry, health parameters, blood parasites, and diet. In another, some of the seals will be mounted with small video cameras to provide data for Japanese scientists studying diving and other underwater behaviors of free-ranging seals. And a remote camera surveillance will be set up to observe the spacing patterns of adult females on the ice surface and underwater.

As the southernmost breeding mammal in the world, the Weddell seal exemplifies the ability to adapt to environmental extremes. Understanding the mating strategies these seals employ should contribute to a deeper understanding of the evolution and population dynamics of the Pinnipedia (a suborder of aquatic, carnivorous mammals, including all the seals and walruses) in particular, as well as how marine mammals more generally compete. [NSF Award # 97-25820]

Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to mid-February 2002
Research Locations:	McMurdo Sound; Erebus Bay; Big Razorback Island; various sites along the western shore of McMurdo Sound; Cape Washington; Markham Island; White Island, Crary Science and Engineering Center (CSEC)

Team Members

Michael Cameron	Pamela Yochem	Thomas Gelatt
Brent Stewart	Shawn Dahle	Robert Garrot
Robert Montgomery	Mark Myers	Peter Shaughnessy
Donald Siniff		

Field-Season Overview

The project team members plan to continue the long-term behavioral ecology and population dynamics studies of Weddell seals begun in the late 1960s. The team members will set up a camp of sea ice huts near Big Razorback Island, which will serve as their base for the field season. Within the study area, stretching from Cape Evans to Pram Point, all newborn pups will be tagged and tags will be replaced on previously marked adults, and team members will travel via snowmobiles and tracked vehicle to conduct a weekly census to count and record the tag number of all seals. At Big Razorback, a remotely operated underwater camera will be used to examine the spacing patterns of adult females on the ice surface and underwater.

The team members will also travel via helicopter and Twin Otter aircraft to tag seals and collect information on marked seals outside the study area. This will include areas around Ross Island, parts of the continental coast on the western side of McMurdo Sound, Cape Washington, Markham Island, and White Island. The researchers will attach satellite-linked radio transmitters to seals to investigate the emigration of weaned pups and adults, as well as monitor their movements on the ice and underwater. Team members will travel via helicopter and use radio telemetry to track and locate radio-tagged seals.

Concurrent with the population ecology studies, the team members will collect blood and tissue samples for use in a genetic investigation of the breeding system and behavioral ecology of Weddell seals. The research team will also collect blood, scat, and diet samples for collaborative work with scientists studying Weddell seal blood chemistry, health parameters, blood parasites, and diet. In conjunction with these studies, the researchers will continue their investigations of anesthetic agents used in handling Weddell seals.

Frozen seal blood and tissue samples will be prepared in the CSEC and returned to the home institution for further studies.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Iszard

Hunting Behavior and Energetics of Free-ranging Weddell Seals

BO-017-O

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Research Objectives

The focus of our project is the behavioral and energetic adaptations that enable Weddell seals to forage in the cold, dark, Antarctic fast-ice environment. To answer this question, we will test hypotheses related to general foraging strategy, foraging location, searching mode, prey detection, locomotor performance, the cost of diving, and foraging efficiency of free-ranging Weddell seals (*Leptonychotes weddellii*). In addition, we will examine locomotor performance and behavior during diving to estimate the costs associated with hunting and the benefits gained from hunting (type and frequency of prey captures).

This study, which will provide insight into marine mammal foraging tactics and will contribute to the fields of physiology (diving and energetics) and ecology (foraging theory and behavioral ecology), builds on earlier research on Weddell seals in McMurdo Sound. In this investigation, we used an animal-borne video system/data logger to record the behavior, physiology, and locomotor performance of marine mammals at depth. This provided the first observations of Weddell seal hunting strategies, predator-prey interactions, and corresponding estimates of diving metabolism.

The isolated-ice-hole protocol used in the study allows seals to choose the depth and duration of a dive, but they must return to a single place to breathe, which limits their range of movement. They are unable to haul out of the water or interact with other seals and may be exposed to fewer prey than when foraging naturally. The new focus is the behavior and energetics of completely free-ranging seals, for which all significant constraints have been removed. Although the current study has demonstrated important new principles in Weddell seal foraging and has increased understanding of diving behavior and swimming performance, we believe that it is now essential to determine whether those principles apply to unconstrained animals.

The study will continue to employ a multidisciplinary team of scientists with highly skilled technical support. The results will advance the understanding of the foraging ecology of Weddell seals and create a basis for similar research on other species of marine mammals that are more difficult to study in the open ocean. Finally, by extending the study from an isolated ice hole to completely free-ranging conditions, we will provide new insight into the role of Weddell seals as apex predators in the Antarctic marine ecosystem. [NSF Award # 99-09422]

Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to mid-December 2001
Research Locations:	McMurdo Sound; Crary Science and Engineering Center (CSEC)

Team Members

Randall Davis	Donald Calkins	Lee Fuiman
William Hagey	Markus Horning	Jesse Purdy
Mathew Rutishauser	Terrie Williams	

Field-Season Overview

The project team members plan to study the foraging behavior of Weddell seals. They will determine how these behaviors vary with location, season, prey type, and environmental conditions. The researchers will estimate the energetic costs, benefits, and efficiency for different foraging behaviors, modes of locomotion, and prey types.

Immediately after arriving at McMurdo Station, the project PI will identify a location on the sea ice for the field camp. From the field camp, team members will travel on snowmobiles and tracked vehicles to natural cracks in the sea ice, where they will capture adult male and non-pregnant female seals with a purse-string net. The seals will be transported back to the field camp in a seal sled towed behind a tracked vehicle. At the field camp, team members will weigh the seals and attach a video recorder/data logger to the seal's fur. Satellite, VHF, and sonic transmitters will also be glued to the fur. The seal will then be released to resume normal behavior, during which the video camera will record foraging behavior and the data logger will record depth, swim speed, compass bearing, ambient temperature, light levels, and dissolved oxygen.

Researchers will re-locate instrumented seals by means of satellite transmitters, VHF transmitters, and sonic transmitters. Daily, satellite-based locations, accurate to within 1 kilometer, will be delivered by email to the field camp. Team members will travel via tracked vehicle, snowmobile, or helicopter, using telemetry to search for and pinpoint the locations of seals. Instrumented seals will be re-captured and the instrument packages removed.

Data and video footage from the instruments and camera will be analyzed at the field camp.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Curt LaBombard

The Chemical Ecology of Shallow-Water Marine Macroalgae and Invertebrates on the Antarctic Peninsula

BO-022-O

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Co-Principal Investigator: Dr. James McClintock
University of Alabama, Birmingham

Research Objectives

In a number of plant species, evolution has adapted the basic strategy of developing chemical substances designed to defend the organism. One general group of these substances are classified as defensive secondary metabolites. This project will probe three “cost/benefit” ideas that are often woven into viable theories on the evolution of chemical defenses.

First, the Resource Availability Model of chemical defense. The proposed research will examine whether macroalgae grown under carbon limitation (reduced light) will produce quantitatively higher levels of defensive compounds than will those grown in an optimal light environment; also whether Antarctic macroalgae found in the nutrient-rich peninsula region are likely to develop chemical defenses that include nitrogen compounds.

Second, the Optimal Defense Theory in macroalgae and invertebrates. The proposed research will determine the extent to which chemical defenses are more abundant in tissues with a high energy content, such as reproductive tissue and offspring (larvae); also whether larvae relying on lecithin for nutrition have a higher incidence of chemical defense than do larvae relying on plankton.

Finally, using previous work in the Ross Sea as a starting point, the investigation will map how chemical defenses may vary across different areas; if they do vary, we will seek out possible underlying evolutionary factors.

The program should advance our understanding of the evolution of chemical defenses in general, as well as the nature and role of bioactive agents in the specific ecology of Antarctic marine benthos (organisms living at the bottom of, or in very deep, marine environments). [NSF Award # 98-14538]

Field Research Plan

Logistics

Dates in Antarctica: late October 2001 to late January 2002
Research Locations: Palmer Station

Team Members

Charles Amsler	Margaret Amsler	Bill Baker
Katrin Iken	James McClintock	Kevin Peters
Chris Petrie		

Field-Season Overview

The researchers plan to investigate the evolution of chemical defenses in marine plants and animals. The project team members will travel to Palmer Station on board the *R/V Laurence M. Gould* (cruise LMG01-8B). They will scuba dive to collect macroalgae and marine invertebrates and work in the Palmer Station laboratory and aquarium to prepare and analyze the collected material. Team members will also conduct bioassays and *in situ* field experiments.

The team members will depart Palmer Station on board the *R/V Laurence M. Gould* (cruises LMG01-09 and LMG02-01). Samples will be returned to the home institutions for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Rob Edwards

Dynamics of Predator-Prey Behavior in the Antarctic Ocean

BO-023-O

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Research Objectives

Our project will bring two groups of undergraduate students to the Antarctic, where they will participate in collecting data on seabird abundance and behavior. The objective is to combine research on the dynamics of seabirds that feed on Antarctic krill (*Euphausia superba*) with the teaching of mathematical modeling of foraging behavior and spatial statistics. Students also will acquire a broad collection of skills by collecting data on physical and biological oceanography as part of this research.

The research goal is to learn how foraging seabirds in the Antarctic respond to changes in the abundance and distribution of their prey, primarily krill. The approach will be to study bird behavior near krill swarms and to contrast this behavior to that in areas lacking krill. From these comparisons, we will build foraging models that will make predictions about the dispersion of birds under differing levels of krill abundance. Long-term, we hope to be able to predict the impact of future changes in krill stocks on seabirds.

We will conduct our field work near Elephant Island during two field seasons. In each season, we will survey the insular shelf north of Elephant Island and record the abundance, distribution, and behavior of seabirds. The primary objective will be to quantify the link between prey abundance and bird behavior, with the long-term goal of using information on bird behavior to index long-term changes in the prey base.

The goal of the teaching portion of this project is twofold. First, the project will expose inner city college students to a spectacular and economically important ecosystem. Through their work on an oceanographic research vessel, students will be exposed to diverse research topics and methods, ranging from behavioral ecology to physical oceanography. Second, back at Staten Island, students will participate in the development of a mathematical biology initiative at the College of Staten Island. Here students will be encouraged to apply basic mathematical reasoning and computer modeling to a real problem — that of determining how foraging choices made by seabirds can ultimately impact their reproductive success.[NSF Award #99-83751]

Cruise Research Plan

Logistics

Cruise LMG01-9	
Departs:	Punta Arenas, Chile, 2 December 2001
Arrives:	Punta Arenas, Chile, 28 December 2001
Research Location:	North of Elephant Island

Team Members

Richard Veit	Bala Sundaram	TBD (8)

Cruise Overview

The researchers are studying the spatial correlation between seabirds and their prey, primarily krill. Specifically, they are seeking to determine whether there are any particular spatial arrangements of krill to which feeding birds are especially attracted. The research team will work aboard the *R/V Laurence M. Gould* during cruise LMG01-9 to observe and identify seabirds and look for accumulations of krill. During transits between Punta Arenas and Antarctica, team members will maintain a constant seabird observation schedule.

In Antarctica, the researchers will sample six parallel transects, each 25 nautical miles long, in the area north of Elephant Island. Each transect will be sampled three times, using an acoustic transducer to search for krill and IKMT net tows to collect krill samples. The researchers will also take conductivity, temperature, and depth (CTD) readings. Team members will maintain a constant, 24-hour watch for seabirds during the time the vessel is in the transect study area. Researchers will record the numbers, species, and behavior of all birds seen.

Some samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Dr. Karl Newyear

Studies on the Impact of Sewage-Associated Microorganisms on Indigenous Seal and Bacterial Populations and Drinking Water Quality

BO-024-O

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Research Objectives

Human impacts on the environment are typically complex and often reverberate through a wide ecological spectrum. While a comparatively pristine environment, Antarctica is still a populated continent, with all of the inherent issues and challenges of environmental protection. For years, human sewage has been released into the seawater at McMurdo Station, untreated except for the process of maceration (which dilutes or softens a material by steeping it in liquid). What are the impacts on the marine ecosystem?

This project focuses on bacteria known to thrive in the sewage deposits, tracing their progress into the drinking-water intake at Intake Jetty, and also into other organisms and indigenous species, such as Weddell seals. One of the bacteria previously associated with this problem is clostridium perfringens, which researchers have suspected were colonizing Weddell seals in the area of the sewage. These and other deposit-feeding invertebrates appear to assimilate the nutrients associated with the sewage and to increase body mass and organ sizes.

These earlier results are driving this work, which will use more advanced genetic molecular biology and more sensitive culture-based techniques to determine a number of issues. Are the sewage-associated bacteria and viruses the specific ones that are colonizing Weddell seals? Are these microorganisms exchanging their DNA with indigenous species, thus potentially altering the procaryotic gene pool of this ecosystem? Are they entering the drinking water system at McMurdo Station? The microbiological quality of marine and drinking waters at McMurdo Station is currently monitored, but are we underestimating the risks to the marine environment and to human health?

The results from this study should help to evaluate current monitoring systems and to design remediation efforts. A sewage treatment plant is currently planned for McMurdo Station, and these data will provide a baseline for efforts and studies of ecosystem recovery. The data will shed light not only on the coastal waters off of McMurdo Station, but also on other coastal waters around Antarctica that may be similarly affected by the discharge of untreated human sewage. [NSF Award # 99-80425]

Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to mid-November 2001
Research Locations:	the sea ice in the vicinity of McMurdo Station; Crary Science and Engineering Center (CSEC)

Team Members

Diane Edwards	John Lisle	Jim Smith

Field-Season Overview

The researchers plan to study the extent and effects of untreated sewage discharge from McMurdo Station into the waters of McMurdo Sound. Project team members will investigate whether Weddell seals are being colonized by human microorganisms, whether sewage-associated bacteria are exchanging their DNA with indigenous species, and whether sewage-associated bacteria and viruses are entering the drinking water system at McMurdo Station.

Support contractor personnel will use the Reed Drill to drill holes through the ice in front of McMurdo Station and in Winter Quarters Bay. The project team members will collect sea water samples from various depths using niskin bottles. The Science Diving Coordinator will dive to collect benthic sediment samples for this project, and members of project BO-009-O (Dr. Siniff) will collect Weddell seal fecal samples. Project team members will also take samples of McMurdo Station drinking water. Sea water, fresh water, sediment, and fecal samples will be analyzed in the CSEC. Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Robbie Score

Temperature Compensation in Antarctic Pteropods: An Integrative Approach

BO-030-O

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Research Objectives

Life in frigid polar waters reveals many adaptations; creatures have developed physiologic specializations so as to function and react more effectively in the cold. The long-standing hypothesis holds that animal taxa indigenous to these climates evolved the ability to regulate basal and active metabolic rates better than their temperate-zone counterparts; but this theory remains contentious and - in any event - has been applied only to fish and benthic invertebrates. Polar pteropods, small gastropod molluscs commonly found in Antarctic zooplankton, are abundant, metabolically active, and provide a different species (another taxon) in which to probe thermal compensation mechanisms that may serve the physiological processes underlying locomotion.

To explore these phenomena, we will use two different sister pteropod species, one from the polar and one from a temperate zone. Experiments will focus on basal and metabolic rates and mitochondrial energetics; also on biomechanical and on neural responses to different water temperatures and viscosities - all in the context of locomotor performance. The neurons that underlie the swim-system will be evaluated at different temperatures, with particular reference to resting potentials, firing thresholds, action potential durations, and ion-channel kinetics. A central question is the extent to which all three aspects (metabolic, biomechanical, and neural) may contribute to a coordinated ability to compensate for thermal conditions and extremes in polar pteropods.

Not only should this investigation provide fundamental physiological and behavioral information for this taxon, but we hope to systematically evaluate the hypothesis of cold adaptation across organizational levels in pteropods. We may also be able to shed light more generally on the nature of thermal and locomotor constraints for the many invertebrate taxa living and moving within polar waters.
[NSF Award # 99-80360]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to late February 2002
Research Locations:	Sea ice in front of McMurdo Station; Ross Ice Shelf transition zone; Cape Evans; Cape Royds; Wohlschlag Bay; Crary Science and Engineering Center (CSEC)

Team Members

Robert Dudley	Brendan Borrell	Josh Rosenthal
Francisco Bezanilla	Brad Seibel	Jeremy Goldbogen

Field-Season Overview

The researchers plan to evaluate the metabolic, biomechanical, and neural responses to variable water temperatures in two species of Antarctic pteropods—small gastropod molluscs that are commonly found in the Ross Sea zooplankton.

Support contractor operations personnel will use the Reed Drill to create 1.3-meter holes in the sea ice at several locations, including Cape Evans, Cape Royds, the Ross Ice Shelf transition zone, and directly in front of McMurdo Station. The project team members will travel by foot, tracked vehicle, and helicopter to collect pteropod samples using plankton nets lowered through these holes. They will also collect samples at the ice edge in Wohlshlag Bay. Team members will record data on pteropod distribution, abundance, and body size at these sites.

At the CSEC, the researchers will film pteropod swimming behavior with high speed video, measure metabolism in respirometers, and conduct other experiments to evaluate pteropod physiology. Specimens will be stored in the Phase III aquarium of the CSEC.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Rider

Factors Regulating Population Size and Colony Distribution of Adelie Penguins in the Ross Sea

BO-031-O

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Research Objectives

Over the past few decades, the Adélie penguin (Pygoscelis adeliae) colonies in the Ross Sea region have grown dramatically in size. What demographic mechanisms might account for this change? This collaborative project will investigate one such possible effect: documented changes in the region's climate. We will look at the birds' nesting habitat as a function of access to food, and hope to distinguish the relative importance of the key resources that constrain the growth of colonies. A number of behavioral and demographic mechanisms may influence a colony's growth, relative to its initial size and distribution pattern. One, for example, is a phenomenon known as philopatry: how breeding effort and success may relate to the balance achieved by immigration/emigration.

As the first empirical study to consider the geographic structuring of a seabird population, we expect our results to increase understanding of how populations regulate themselves, and the patterns they follow when they disperse. We also hope to elucidate the effects of climate change (as indicated by changes in the extent of sea-ice cover) on penguin populations. The results should also provide a context in which to interpret conflicting data on penguin population trends from existing programs; in particular, fluctuations in Adélie penguins have been analyzed as an indicator of such anthropogenic impacts on antarctic resources as fishery catches and disturbances created by tourism. But it is problematic trying to distinguish changes due to man from those caused by nature, without the regional perspective on penguin life history this project is undertaking to develop.

Our six years of research include intensive field study of various Ross Island penguin colonies - this season colonies at Cape Royds (4,000 breeding pairs), Cape Bird (35,000), Beaufort Island (35,000), and Cape Crozier (170,000). We quantify reproductive effort and success, food availability (access to food), diet quality, habitat use, and immigration/emigration relative to colony size and environmental conditions (i.e., pack-ice cover).

During the 2000-01 summer season, the arrival of iceberg C16 provided a natural experiment the results of which provided insights into the competitive effects of one colony on its neighboring colonies. The iceberg blocked the very numerous Cape Crozier penguins from foraging as far west as they normally do, thus, allowing the smaller numbers of Cape Bird and Beaufort Island penguins to forage much farther east than normal. As C16 has remained through the winter, we will continue to pursue this experiment in competition for spatially limited food resources. Moreover, the very large iceberg B15A has since grounded in a way that may block the return of penguins to Capes Bird and Royds in the 2001-2002 season. This may provide a second natural experiment in regard to the processing that affects the tendency of young penguins to return to their birth place and of adults to return to the colony where they formerly bred.

Landcare Research New Zealand (LCRNZ) has collected data and tested new equipment during two preliminary field seasons. This project will build on their results, and they will collaborate with us throughout the lifetime of the project. The LCRNZ work is independently funded. Researchers from the University of California-Santa Cruz, the University of Wisconsin, Point Reyes Bird Observatory, and Beigel Technology will collaborate with those from H.T. Harvey and Associates and LCRNZ to accomplish the project's goals. [NSF Award #98-14882]

Field Research Plan

Logistics

Dates in Antarctica:	early December 2001 to late January 2002
Research Locations:	Capes Crozier, Royds, and Bird; Mt. Bird; Beaufort Island

Team Members

David Ainley	Grant Ballard	Hannah Nevins
Michelle Hester	Lisa Ballance	Sarah Miller
Josh Adams	Nathaniel Polish	Sophie Webb
TBD		

Field-Season Overview

The researchers plan to compare the breeding and foraging ecology of Adelie penguins among four differently sized colonies: Capes Royds, Cape Bird, Beaufort Island, and Cape Crozier.

Project team members will deploy via helicopter to Cape Royds and Cape Crozier, where they will camp until the end of the field season. The work at Cape Bird will be conducted by biologists from LandCare Research New Zealand. Team members will also travel via helicopter to two radio telemetry sites on Mount Bird. Both sites will be visited simultaneously, and there will be several visits over the course of a month. Penguins will be observed from these sites using remote radio telemetry to monitor their behavior.

The PI and one or two other team members will travel via icebreaker to Beaufort Island, where they will deploy to the island via helicopter or small boat from the ice-breaker. On the island, they will attach transmitters to penguins and leave a data logger, which they will recover approximately one month later. If conditions permit, the research team will conduct work along the north shore of Ross Island related to the impact of large, grounded icebergs on penguin foraging behavior.

Chilled penguin blood samples will be returned to the home institution for further study.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Rider

Abandoned Penguin Colonies in Antarctica

BO-034-O

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Research Objectives

Climate change is assumed to be a pivotal factor in the success of many species. This project will investigate the history of Adélie penguins in late Holocene Antarctica. By locating and examining the fossil remains of former colonies, scientists hope to develop a model of when they thrived and when colonies were abandoned - and thus their success - relative to climate change. This model could inform current science on the relationship between climate and population dynamics.

Our study will integrate data from the ecological, geological, and paleobiological records with satellite-imagery analyses. The climate factor will be inferred by data contemporaneous with the fossil evidence, in particular the extent of the sea-ice and marine productivity. The population factor will be developed through field and laboratory investigations of abandoned colonies along coastal Antarctica.

Researchers will first collect surface and subsurface bones, feathers, and eggshell fragments preserved at these sites; later, in the lab, scientists can reconstruct the occupation history of each abandoned colony, through standard and radiocarbon analyses. Sediments from each site will be sifted to recover organic remains (such as squid beaks and fish otoliths) believed to be staples of the penguin diet. Statistical analysis of such indicators can trace the changing size of the colony at specific prehistoric times, and thus prey consumption becomes a proxy for population success. This timeline can then be matched to past episodes of climate change, which are well documented for the late Pleistocene and Holocene in ice-core and marine sediment records.

We expect these ancient responses by penguins to climate change, as indicated by the paleoecological record, to parallel those observed in Antarctica today, where regional warming has been documented over the past 20 to 50 years. Ultimately we will be able to test the hypothesis that Adélie penguins - for decades and centuries - have been responding to climate change in a predictable manner, and that those responses can be anticipated, relative to fluctuations in sea-ice extent and marine productivity. [NSF Award # 99-09274]

Field Research Plan

Logistics

Dates in Antarctica:	mid-January 2002 to early March 2002
Research Locations:	Seymour Island

Team Members

Steven Emslie

Field-Season Overview

The researcher will be joining a team from the Swedish Antarctic program, which is arranging logistical support through the Argentine Antarctic program.

The researcher plans to travel from Argentina to Seymour Island in mid-January 2002 via an Argentinean C-130 aircraft. While on Seymour Island, the researcher will be working with the Swedish Antarctic program to conduct field work to accomplish the following objectives:

- Locate and excavate abandoned penguin colonies on ice-free terrain,
- Collect organic remains (penguin bones, eggshell, fish bones, and otoliths) from ornithogenic sediments,
- Obtain radiocarbon dates on penguin bones and tissue to determine an occupation history for penguins in the Antarctic Peninsula,
- Sample active colonies of Adelie and chinstrap penguins to obtain similar information on occupation history of these sites and dietary remains from guano.

The sediments will be screened and washed in the field, coarse fractions will be sorted in the field, and fine sediments will be shipped back to the U.S. for further study. The researcher will travel from Seymour Island back to Argentina in early March 2002 via an Argentinean C-130 aircraft.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. John Evans

Investigation on Deterioration in the Historic Huts of the Ross Sea Region of Antarctica

BO-038-O

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Research Objectives

During the first two decades of the 20th century - Antarctica's "Heroic Era" - Europeans mounted a handful of expeditions in hopes of reaching (and claiming) the geographical South Pole. Base camps established in the McMurdo Sound region - by Scott at Cape Evans and by Shackleton at Cape Royds - were abandoned once the expeditions were over, leaving behind the huts that were built for shelter and storage, as well as thousands of artifacts. Over the past 90 years, the extremes of the polar environment have actually protected some of the artifacts from rapid decay, but conservators have become concerned about serious degradation of what are important historical, archaeological sites.

Some of the most exigent threats include:

- Wood in contact with the ground is being destroyed by a specific wood-destroying fungus. Various molds and cellulose-degrading fungi are attacking artifacts made of leather, textiles, and other organic materials.
- Exterior wood is being degraded by non-biological deterioration processes as well, including salt, ultraviolet radiation, and wind erosion.
- Chemical damage within the huts is apparent, and the soils on site are contaminated with aromatic hydrocarbons from petroleum products.

We plan to identify the biological and non-biological agents responsible for causing the deterioration, study the mechanisms and progressive sequence of events taking place during decay processes, test methods to be used to control future deterioration, determine the extent of environmental pollutants in soils at the historic sites, and evaluate chemical spills within the huts.

The goal is to provide the scientific data required by conservators to help protect these important historic sites for future generations. But the project should

also shed scientific light on these unique deterioration processes, as well as augment scientific understanding of the biology of Antarctic microorganisms and the biodiversity of microbes present in this unusual environment.
[NSF Award # 99-09271]

Field Research Plan

Logistics

Dates in Antarctica:	early January 2002 to mid-January 2002
Research Locations:	Cape Evans; Cape Royds; Hut Point; Dry Valleys; Mount Fleming

Team Members

Robert Blanchette	Benjamin Held	Joel Jurgens

Field-Season Overview

In this collaborative project with the New Zealand Antarctic Program project K-021, the researchers plan to study the level of deterioration of the historic huts in the McMurdo Sound region. Team members from both projects will travel via helicopter to set up tent camps near the historic huts at Cape Evans and Cape Royds, where they will collect soil and wood samples. They will also make a helicopter day trip to the site of a 1960s-era hut in the Dry Valleys, where they will take similar samples. Team members will also travel via helicopter to Mount Fleming in the upper Wright Valley, where they will set up camp for one day and collect soil samples.

The soil and wood samples will be returned to the U.S. and to New Zealand, where they will be tested for microbial diversity. Microbe populations from the Dry Valleys will be compared to those collected at the hut sites. The researchers will attempt to determine the extent of both non-biological and biologically mediated deterioration in the huts, and then evaluate methods to control this decay.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Iszard

The Distribution and Diets of Penguins in Winter: Implications for Demography

BO-040-O

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Research Objectives

How well organisms thrive in their environment often reveals itself in basic ecological relationships. For two decades at Admiralty Bay on King George Island in the Antarctic Peninsula region, data have been collected on several species of penguins, including the Adélie, gentoo and chinstrap. Looking at some of the basic aspects of the lives of these predators - such as survival and recruitment, population size and breeding success, and diets and foraging ecology - scientists have been able to develop and test key hypotheses about variability in the Antarctic marine ecosystem.

This project focuses on one of these relationships. As the extent of sea-ice cover changes with the season and year-by-year, krill (in the Southern Ocean a key food web species that accounts for nearly 100 percent of the prey eaten by dominant predators such as baleen whales, seals, and penguins) are more or less abundant, directly affecting the population biology of the penguins. Years with heavy winter and extensive sea ice paradoxically favor krill recruitment, because larval krill find refuge and food in the sea-ice habitat. The long-term seabird research indicates that in those same, heavy sea-ice years, Adélie but not chinstrap penguins are also favored.

To explore these relationships, we will capture adult and juvenile penguins periodically to band, measure, and weigh them, and to collect blood and diet samples for genetic and physiologic studies. During the breeding season, the penguins and the sea-ice will be observed by satellite. Another aspect of the population biology of penguins relates to the possible impact of commercial fishing, so this study will provide useful information to the Convention for the Conservation of Antarctic Marine Living Resources, which is the part of the Antarctic Treaty System that focuses on fisheries management.

[NSF Award # 99-80641]

Field Research Plan

Logistics

Dates in Antarctica: mid-October 2001 to early March 2002
Research Location(s): Copacabana Field Station on King George Island

Team Members

Robert Hollingshead	Marc Romano	Laina Shill
Conrad Thiessen	Susan Trivelpiece	

Field-Season Overview

The researchers plan to continue a long-term study of the breeding biology and demography of Adelie, Chinstrap, and Gentoo penguins at Admirality Bay, King George Island, South Shetland Islands, Antarctica.

Four field-team members will travel to the Copacabana Field Camp (Copa) in early October 2001 on board the R/V *Laurence M. Gould* (cruise LMG01-08A). The Co-Principal Investigator will function as the team leader for opening up the camp and will then depart the station by commercial tour ship in mid-November 2001. The Co-PI will be replaced by another field-team leader who will arrive at Copa via the R/V *Nathaniel B. Palmer* (cruise NBP01-06) in mid-November 2001.

The team members will capture adult and juvenile penguins periodically throughout the season for banding, weighing, and morphometric measurements. Blood samples will be collected for physiological and genetic studies. Team members will also attach radio tags and satellite transmitters to track bird movements, and time/depth recorders to collect diving and foraging data.

The field-team members will close the Copa camp, and all personnel will depart in early March 2002 on a research vessel chartered by the National Oceanic and Atmospheric Administration's Antarctic Marine Living Resources program. They will return samples to the home institution for further studies.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. John Evans

Seasonal Dynamics of Giant Agglutinated Foraminifera

BO-043-O

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Research Objectives

A seasonal study of the dominant agglutinated foraminiferal assemblage in Explorers Cove, McMurdo Sound, Antarctica, is the focus of our research. Studies have shown that the agglutinated foraminifera ("forams") at this locality consume a wide variety of prey, ranging from bacteria through a taxonomically diverse group of metazoans, including juvenile invertebrates. These studies have been restricted to specimens collected in October, November, and early December, immediately following the austral winter and before the austral summer burst of under-ice and benthic primary productivity. Little information is available regarding the foraminiferal response to this summer food pulse.

Our objectives are to document austral spring to late-summer changes in relevant abiotic and biotic factors in the Explorers Cove benthos and to characterize corresponding responses in agglutinated foram community structure (species composition, densities, size distribution, etc.). Traditional sediment coring, biomass determinations, and microscopic sorting methods will accomplish these first goals. Additionally, we will employ an *in-situ* approach for documenting fine-scale changes using novel underwater microscopy equipment. Molecular tools to examine seasonal foram community dynamics — initially focusing on the timing of reproductive events (multiple fission, gametogenesis, etc.) — will be perfected.

Additional work will focus on newly refined sediment core embedding methods to explore the fine-scale seasonal changes in foram life position. In related lab experiments, we will analyze the trophic mechanisms of the key agglutinated species. We will use time-resolved stable isotope analyses of lipids extracted from freshly collected and "snap frozen" forams to determine if and how these mechanisms change in response to available food sources.

These combined approaches will lead to a more complete understanding of the roles played by larger agglutinated forams in the Explorers Cove benthic food web and of how these roles change with respect to the summer food pulse. Because Explorers Cove and its agglutinated foram assemblage are closely comparable to many bathyal and abyssal deep-sea localities, the results of these studies will have wide significance in the ocean sciences.

To expand our research, we will also collaborate with investigators from Russia. The objectives of this collaborative study are to:

- test the universality of meltwater turbidity impacts documented in the Arctic,
- adapt modern biochemical and molecular assays to assess changes in the living foraminiferal assemblage in response to glacial meltwater, and
- explore ways of revealing the imprint of glacial proximity in the Antarctic fossil record.

In sum, this collaboration will provide important insights into marine processes associated with global climate change. [NSF Award # 00-03639]

Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to late February 2002
Research Locations:	McMurdo Sound; Explorer's Cove; Marble Point; Crary Science and Engineering Center (CSEC)

Team Members

Stephen Alexander	Joan Bernhard	Sam Bowser
Doug Coons	Philip Forte	Steven Hanes
Sergei Korsun	Jan Pawlowski	Neal Pollock

Tina King (Teacher Experiencing Antarctica)

Field-Season Overview

The researchers plan to study seasonal changes in benthic foraminifera, particularly in regard to glacial meltwater input. The researchers also plan to chart the genetic diversity of foraminifera in the McMurdo Sound region.

Project team members will travel via helicopter to Explorer's Cove, where they will SCUBA dive to collect foraminifera. Team members will also travel via helicopter to Marble Point and via snowmobile to the Ferrar Glacier fjord to SCUBA dive and collect benthic foraminifera at these sites. The researchers will return via helicopter to McMurdo Station on a regular basis to transport live foraminifera to the CSEC for experiments. While in McMurdo, they will travel via tracked vehicle to dive sites in the McMurdo vicinity to SCUBA dive and collect additional samples.

During the field season, the researchers will travel via helicopter to the "dirty ice" to take ice cores. From these cores, the researchers plan to recover specimens of ancient foraminifera for genetic comparison to modern specimens. Three team members will board the USCG icebreaker *Polar Star* for the refueling transit to Marble Point. Using a box core, the researchers will take a series of ocean bottom sediment samples from six sites along the route. These samples will be sorted and foraminifera extracted on the vessel for later study.

Samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Points-of-Contact
Mr. Rob Robbins (McMurdo)
Dr. Karl Newyear (Polar Star)

Transport and Fate of Persistent Organic Pollutants (POPs) in Antarctic Coastal Seas

BO-045-N/P

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Research Objectives

The Antarctic region is typically considered pristine, being distant and largely sheltered from the industrialized world. But concern about the movement of persistent organic pollutants (POPs) throughout the global environment via long-range atmospheric transport has escalated greatly in the last two decades. The potential for POP contamination via atmospheric transport, cold condensation, and deposition on sea ice present an intriguing and uniquely polar issue.

The overall goal of our project is to understand the interactions among atmospheric deposition, sea ice coverage and melting, solar irradiance, and microbial decomposition in mobilizing persistent organic pollutants in Antarctic foodwebs. In cooperation with the Palmer Long-Term Ecological Research (LTER) program our work aims to document the accumulation of selected model POPs in sea ice and the water column along the west Antarctic Peninsula. Furthermore, key physical and biological/chemical processes influencing POP removal rates, turnover, and residence times would also be investigated.
[NSF Award # 00-87872]

Cruise and Field Research Plan

Logistics

Cruise NBP01-05	
Departs:	Punta Arenas, Chile, 1 September 2001
Arrives:	Punta Arenas, Chile, 19 October 2001
Cruise Research Locations:	Marguerite Bay, selected lines in LTER Grid, Avian Island, Emperor Island, Dion Islands
Dates at Palmer Station:	early January 2002 to early March 2002
Palmer Research Locations:	Palmer Station vicinity and nearby islands; Palmer LTER inshore sampling grid

Team Members

Amy Chiuchiolo
Michelle Cochran
Rebecca Dickhut
Hugh Ducklow
Shelby Walker
Susan Cowles (Teacher Experiencing Antarctica)

Cruise and Field Overview

The researchers plan to measure the concentrations of several, persistent organic pollutants in the air, ice, sea water, and plankton of the Antarctic ecosystem. The season will consist of two parts: a winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05) and a Palmer Station program.

During the cruise, project team members will install automated air samplers on the forward mast of the research vessel. Team members will also collect sea ice, sea water, and plankton samples at sites determined in consultation with Palmer LTER team members. Samples will be processed and analyzed in the onboard laboratory.

Team members will travel to and from Palmer Station via the *R/V Laurence M. Gould*. At Palmer Station, project team members will install automatic air samplers and collect sea ice, sea water, and plankton samples. Samples will be processed and analyzed in the Palmer Station laboratory.

Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Points-of-Contact
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Dr. Karl Newyear (*R/V Nathaniel B. Palmer*)

Interannual Variability in the Antarctic-Ross Sea (IVARS): Nutrients and Seasonal Production

BO-047-O

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Research Objectives

During the past few decades of oceanographic research, scientists have recognized that significant variations in biogeochemical processes occur among years. Interannual variations in the Southern Ocean are known to occur in ice extent and concentration, in the composition of herbivore communities, and in bird and marine mammal distributions and reproductive success. However, little is known about the interannual variations in production of phytoplankton or the role that these variations play in the food web. Our project will collect time-series data on the seasonal production of phytoplankton in the southern Ross Sea, Antarctica. We will assess the interannual variations of the production of the two major functional groups of the system, diatoms and *Phaeocystis Antarctica*, a colonial haptophyte.

The Ross Sea provides a unique setting for this type of investigation for a number of reasons. For example, a de facto time-series has already been initiated in the Ross Sea through the concentration of a number of programs in the past 10 years. It also is well known that the species diversity is reduced relative to other systems and its seasonal production is as great as anywhere in the Antarctic. Most importantly, seasonal production of both the total phytoplankton community (as well as its two functional groups) can be estimated from late summer nutrient profiles.

To collect water-column nutrient and particulate-matter data at specific locations, we will conduct short cruises on the U.S. Coast Guard icebreakers in the southern Ross Sea in the late summer of each of five years. Additionally, two moorings with *in-situ* nitrate analyzers moored at 15 meters will be deployed, thus collecting for the first time in the Antarctic a time-series of euphotic zone nutrient concentrations over the entire growing season. All nutrient data will be used to calculate seasonal production for each year in the southern Ross Sea and compared to previously collected information, thereby providing an assessment of interannual variations in net community production. Particulate-matter data will allow us to estimate the amount of export from the surface layer by late summer, and therefore calculate the interannual variability of this ecosystem process.

Interannual variations of seasonal production (and of the major taxa of producers) are a potentially significant feature in the growth and survival of higher trophic levels within the food web of the Ross Sea. They are also important in understanding the natural variability in biogeochemical processes of the region. Because polar regions such as the Ross Sea are predicted to be impacted by future climate change, biological changes are also anticipated. Placing these changes in the context of natural variability is an essential element of understanding and predicting such alterations.

This research thus seeks to quantify the natural variability of an Antarctic coastal system and ultimately to understand its causes and impacts on food webs and biogeochemical cycles of the Ross Sea. [NSF Award # 00-87401]

Field Research Plan

Logistics

Dates in Antarctica:	mid-December 2001 to late February 2002
Research Locations:	USCG Icebreaker Polar Sea, McMurdo Sound

Team Members

Howard Ballenger	Scott Lerberg	Jill Peloquin
Walker Smith	TBD (4)	

Cruise Overview

The researchers plan to study the interannual variablility of phytoplankton production in the southern Ross Sea. The research team will travel on the USCG icebreaker *Polar Star* to two locations in the southern Ross Sea to deploy sensor moorings. The first location will be near 77° S and 178° W. The second location will be north of Ross Island and close to the coast of Victoria Land.

All team members will board the *Polar Star* in Hobart, Tasmania and travel with it to the Ross Sea, where they will begin to sample the water column. Using the CTD rosette, the researchers will collect water samples and conductivity, temperature, and depth data until the vessel arrives at a mooring station. Project team members will then deploy the moorings, each of which has multiple instruments designed to collect high resolution time series samples. The researchers will use the vessel's CTD rosette to collect water samples and data at the mooring stations and at a series of stations between the moorings. Phytoplankton samples will be isolated and incubated on the vessel.

The research team will return to CONUS, then redeploy to McMurdo Station later in the season to recover the moorings. From aboard the *Polar Star*, team members will recover the instruments and samples via an acoustic release. During this recovery phase, additional CTD rosette casts will be made at the mooring stations and at selected stations between the moorings.

Some water and sediment samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Rob Robbins (McMurdo)
Dr. Karl Newyear (Polar Star)

Facultative Sex Ratio Adjustment by Female King Penguins, in Response to Mate Quality

BO-068-O

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Research Objectives

Considerable evidence has accumulated suggesting that female birds may exert control over the sex ratio of their offspring. Under optimal conditions, more female chicks are produced; under poor environmental conditions, more of the young are males. There are several plausible explanations for this. In some cases, young males disperse and so under stressful conditions do not compete with parents or siblings. In other instances where habitat conditions are favorable, mothers with new chicks are assisted by older female offspring, increasing reproductive success. In species that lay clutches with multiple eggs, there can be chicks of both sexes and self-assessment of parent condition may not be as crucial. However, in other species such as penguins, only one or two eggs are laid during each breeding season. In this situation, the application of the strategy of sex-ratio allocation requires that females must be very capable of assessing their condition and that of their mates.

Our project focuses on the sex ratio of king penguin chicks relative to the condition of the parents to determine if females are controlling the gender of chicks. To determine the sex of the chicks, we will do DNA analyses of blood samples, a new method to be tested on king penguins in this project. Quantifying parental condition will be done by several standard methods, including measures of body size, parasite load, and immunocompetence. Our study will also explore the possibility that plumage coloration is an indicator of condition in penguins as it is in other bird and fish species. Plumage color is from diet-derived carotenoids and may be a useful proxy for evaluating health and fitness.

Penguins are dominant predators in their environment, and shifts in a population parameter as fundamental as offspring sex ratio might reflect changes in climate or in distribution and abundance of food resources. The results of this work, which will be conducted in collaboration with scientists from the French

Antarctic Program, will provide a better understanding of penguin population dynamics and the complex mechanisms of environmental biofeedback.
[NSF Award # 01-28913]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to late December 2001
Research Location:	French research station on Possession Island

Team Member

Paul Nolan

Field-Season Overview

The project team member will be transported to and from the French research station on Possession Island via the French vessel *Marion Dufresne*. (Note: The team member will board and depart the vessel at Reunion Island in the western Indian Ocean.)

Once on Possession Island, the team member will study penguins at a nearby colony. Samples of biological material will be returned to the U.S. for further study.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. John Evans

Phylogeny, Reproductive Mode, and Parasitism in Antarctic Cidaroid Sea Urchins

BO-069-O

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Research Objectives

The origin of Antarctic biota remains uncertain. Shallow-water, circum-Antarctic habitats have been isolated from the rest of the world since Antarctica separated from Australia 40 million years. With the separation of Antarctica from South American 25 million years ago, and the inception of the Antarctic Circumpolar Current and the Polar Frontal zone, the isolation of Antarctic biota from the rest of the world's oceans was nearly complete. The exception is the deep sea, which is replenished by cold, sinking Antarctic bottom water. Many Antarctic species are endemic with apparent affinities to species in the deep sea. A major question about the Antarctic biota is whether deep-sea organisms invaded and radiated into the Antarctic benthos after it was isolated and cooled or whether Antarctic biota is a refugium and/or source of deep-sea organisms and Antarctic species invaded the deep sea.

We will focus our research on cidaroid sea urchins, as part of an international Antarctic deep-sea biodiversity program to be conducted on the German Antarctic program's research vessel *Polarstern*. The cruise will be conducted in the Scotia and Weddell Seas. Material collected from the Antarctic shelf to the floor of the adjacent deep sea will form the basis for a phylogenetic analysis to help resolve origin of this group of organisms. Studies will also include a focus on larval development, which is unknown in some species. Finally, we will examine a fungus-like parasite that occurs on the spines of some species of Antarctic cidaroids to place this parasite into a recognized higher taxonomic category and to open the possibility for understanding how it influences echinoid development.

This project will provide new information on an understudied part of the world's ocean and will contribute to the study of the world's biodiversity.
[NSF Award # 01-24131]

Cruise Research Plan

Logistics

Cruise Dates:	late January 2002 to late March 2002
Research Location:	Scotia and Weddell Seas

Team Members

Susanne Lockhart Richard Mooi John Pearse

Cruise Overview

The team members will embark on the German ship R/V *Polarstern* in late January 2002 from Punta Arenas, Chile, to participate in ANDEEP I and ANDEEP II. They will cruise on the R/V *Polarstern* in the Scotia Sea and the Northwest Weddell Sea to collect benthic organisms by trawls, dredges, box cores, and other equipment. The team members will attempt to spawn all of the cidaroid sea urchins collected, then preserve them for future analyses.

The team members will disembark from the R/V *Polarstern* in late March 2002 at Punta Arenas, Chile, and will have samples shipped back to the United States for further study.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. John Evans

Evolutionary Loss of the Heat Shock Response in Antarctic Fishes

BO-134-O

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Research Objectives

The heat-shock response (HSR) — the enhanced expression of one or more classes of molecular chaperones (termed heat-shock proteins or Hsps) in response to stress induced by high temperatures — is commonly viewed as a "universal" characteristic of organisms. In previous studies, I examined the occurrence of the heat-shock response in a highly cold-adapted, stenothermal Antarctic teleost fish, *Trematomus bernacchii*, to determine whether this response has persisted in a lineage of fish that has encountered very low, stable temperatures for at least the past 14 to 25 million years. The results demonstrated that the HSR has been lost in *T. bernacchii.* My current investigation is designed to extend this initial and evolutionary significant observation.

This investigation has two primary objectives:

- To establish how widespread the loss of the HSR might be in the suborder Nothothenoioidei, including Antarctic and non-Antarctic members of the group.
- To determine the nature of the lesion in gene expression that accounts for the loss of the expression of stress-inducible genes in Antarctic species.

For both objectives, I will conduct experiments on closely related cold temperate species from New Zealand waters to gain phylogenetic and comparative insight into the nature of this profound change in environmental regulation of gene expression.

The results will contribute to our knowledge of the environmental physiology and evolutionary biology of the Antarctic notothenioid fishes and will extend our understanding of the extreme stenothermality in these fish. If evolution at subzero temperatures has indeed altered the gene expression patterns for molecular chaperones in Antarctic fish, this opens up an entire area of study into how cells respond to temperature at a molecular level.

The heat-shock response is the quintessential example of the environmental regulation of gene expression and, although the HSR is a well-described cellular phenomenon, there is not a great deal of information regarding how the response is regulated in ectothermic animals in nature. The lesions in the Hsp gene expression in Antarctic notothenioids may serve to highlight aspects of the "cellular thermostat" and provide key information about the mechanism by which environmental stress is transduced into a molecular response. [NSF Award # 00-87971]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to early January 2002
Research Locations:	Cape Evans; Cape Royds; New Harbor; Ross Ice Shelf Transition; McMurdo Sound sea ice; Crary Science and Engineering Center (CSEC)

Team Members

Bradley Buckley	Gretchen Hofmann	Sean Place
Allison Whitmer	Mackenzie Zippay	

Field-Season Overview

The researchers plan to investigate the lack of stress-induced gene expression in Antarctic notothenioid fishes.

Support contractor personnel will use the Reed Drill to drill fishing holes through the sea ice near McMurdo Station. The project team members will travel via snowmobile and tracked vehicle to these fishing holes to collect fish by line and by traps placed on the bottom. Team members will also travel via helicopter to Cape Evans, Cape Royds, and New Harbor to collect fish. Fish will be transported back to McMurdo Station and kept in aquaria until needed for experiments. Biochemical and genetic analyses will be conducted in the CSEC.

Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Robbie Score

Diversity, Vertical Distribution, and Metabolic Activities of Inorganic Sulfur-Cycling Prokaryotes in Lake Fryxell, Antarctica

BO-174-O

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Co-Principal Investigator: Dr. Laurie A. Achenbach
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Research Objectives

Cold environments comprise more than 90 percent of Earth's biosphere, yet relatively little is known about the diversity, physiology, phylogeny, and metabolic activities of cold-loving (psychrophilic) microorganisms. Our project focuses on bacteria involved in the sulfur-cycling process in the lakes of the McMurdo Dry Valleys, specifically Lake Fryxell, a meromictic lake that contains significant levels of sulfide in the water column. The sulfide, produced by sulfate-reducing bacteria, fuels the autotrophic metabolisms of anoxygenic phototrophs and sulfur-oxidizing chemolithotrophs.

Our research approach includes *in-situ* biodiversity studies, isolation and laboratory culture, and molecular analysis of metabolic activity. Each of these objectives will be pursued using a combination of traditional research strategies coupled with novel experimental techniques. The prime objective, however, is to dissect the microbiology and microbial ecology of sulfur cycling that occurs at 0 ºC in Lake Fryxell. Using metabolic genes rather than ribosomal RNA genes as molecular targets, we will focus on Proteobacteria with the biodiversity studies. Targeted genes include:

- *pufM* — the gene encoding a key photosynthetic reaction-center protein for purple bacteria (an abundant and diverse group of phototrophs found in Lake Fryxell),
- *csoS1* — a gene encoding part of the carboxysome (a structure involved in autotrophic processes in sulfur chemolithotrophs), and
- *dsr* — a gene encoding a key enzyme in sulfate reaction.

We will use a combination of methods, including extincting dilution, high-throughput microtiter plate, and archaeal-targeted enrichments to isolate and culture key representatives of each major group of sulfur-cycling bacteria (prokaryotes). Molecular measurements of metabolic activity *in situ* will be combined with these biodiversity and laboratory culture results. Collectively, our results will:

- reveal for the first time the biodiversity of sulfur-cycling prokaryotes active in an important nutrient cycle at permanently cold temperatures;
- make available new genetic resources of psychrophilic phototrophs, sulfur chemolithotrophs, and sulfate-reducing bacteria for basic research and for biotechnological exploitation; and
- reveal the most ecologically significant sulfur-cycling prokaryotes in Lake Fryxell and identify metabolically important organisms that remain to be cultured.

In addition to advancing an understanding of the microbial sulfur cycle, the results of our research will contribute to recognizing and culturing microbial life outside planet Earth, and should reveal the limits, in terms of low temperature, to which microbial sulfur-cycling can occur on Earth. [NSF Award # 00-85481]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to mid-December 2001
Research Locations:	Lake Hoare and Lake Fryxell in Taylor Valley, Don Juan Pond in Wright Valley, Crary Science and Engineering Center (CSEC)

Team Members

Michael Madigan	Laurie Achenbach
William Sattley	Elizabeth Karr

Field-Season Overview

The researchers plan to study the biodiversity and vertical distribution of sulfur-cycling prokaryotes in Dry Valley Lakes, primarily Lake Fryxell in Taylor Valley. As part of this research, the project team members will isolate and culture anoxyphototrophic, sulfur chemolithotrophic, and sulfate-reducing prokaryotes.

The project team members will travel via helicopter to Lake Fryxell where they will drill a sample hole through the ice on Lake Fryxell and cover it with a Scott tent. The team members will then take samples of the lake water at various depths and, if possible, the microbial mat in the surrounding moat. The researchers will return immediately via helicopter to McMurdo Station, where they will analyze the samples in the CSEC.

Traveling via helicopter, team members will make several additional day trips to Lake Fryxell to take lake water and moat microbial mat samples. The researchers will also take water samples from Lake Hoare and Don Juan Pond. All samples will be processed in the CSEC. Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Rider

Gene Expression in Extreme Environments: Extending Microarray Technology to Understand Life at its Limits

BO-179-O

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Research Objectives

One of the most challenging requirements for the study of life in extreme environments is studying the organisms inhabiting these environments *in situ* and understanding the unique aspects of life and adaptations required for survival. The Antarctic marine psychrophiles provide an excellent model group of extreme microorganisms for this work, since very little is known about their biological and functional diversity or specific metabolic adaptations to life at -1.8 ºC. Our overall goal is to develop genomic approaches for studying microorganisms sampled directly from extreme environments and thus, circumventing the requirement for cultivation.

The specifics objectives are:

- to sequence six large bacterial genomic DNA fragments isolated directly from Antarctic marine psychrophiles;
- to construct two different types of DNA microarrays designed to identify genes being actively expressed in uncultivated microorganisms living in the sub-zero marine waters of the Antarctic;
- to optimize specific aspects of microarray technology for use with environmental samples; and
- to develop a transferable methodology that will be useful for other researchers in accessing gene expression information directly from the natural environment.

We will use an Antarctic genomic DNA library comprised of large (40 kb) genomic fragments of planktonic archaeal and bacterial DNA created in earlier studies to develop targeted and shotgun DNA microarrays. The application of DNA microarray technology to studies of life in extreme environments offers an outstanding opportunity for identifying new genes for biotechnological use. Discovering specific adaptations to extreme environments by detecting genes that are uniquely expressed in the natural environment is an ultimate goal of the research. [NSF Award # 00-85435]

Field Research Plan

Logistics

Dates in Antarctica:	mid-September 2001 to mid-November 2001
Research Locations:	Palmer Station

Team Members

Brandon Carter | Alison Kelley | Alison Murray

Field-Season Overview

The researchers plan to investigate gene expression in the marine bacterioplankton near Palmer Station. The project team members will travel to Palmer Station on board the *R/V Laurence M. Gould* (cruise LMG01-08). They will travel via Zodiac inflatable boat (if sea ice conditions permit) to sample seawater in Arthur Harbor and the surrounding region. They will also sample seawater from the Palmer pump house, and they will collect ice cores, brash ice pieces, and marine benthic sediment. Samples will be processed immediately in the Palmer Station laboratory.

The team members will depart Palmer Station on board the *R/V Laurence M. Gould* (cruises LMG01-8B). Samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Rob Edwards

Diving Biology of Emperor Penguins

BO-197-O

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Research Objectives

Because the emperor penguin (Aptenoidytes forsteri) lives within the pack ice zone of the Antarctic, its advanced ability to dive has been the subject of interest for many years. Emperor penguins routinely hunt for food for between 2 and 10 minutes, at depths ranging from 50 to 500 meters. These birds have reached a measured depth of nearly 550 meters. The longest dives are not the deepest, however; the recorded longest of twenty-two minutes was nowhere near that record depth.

Emperor penguins provide an excellent model to investigate the physiology and behavior of diving birds and mammals; in this study specifically, thermoregulation, underwater behavior, and the homoeostatic regulation of myoglobin. Working with emperors (captured from McMurdo Sound) in a man-made corral with dive holes, we hope to elucidate both the physiological and behavioral mechanisms underlying the breath-holding capacity of these diving birds.

To probe how these physiological limits may affect the natural diving behavior and ecology of the penguins, we will focus on the role of decreased body temperature in extending the duration of aerobic metabolism during diving; also we will explore how organs and tissue tolerate oxygen deprivation. Mounting a small camera on some birds will permit us to examine their behavior during their dives and to correlate changes in body core and muscle temperature with which prey they ingest as well as with their wingstroke frequency.

At the molecular biology level, we will examine transcriptional control of the myoglobin gene to probe the high myoglobin concentration of emperors and the large increases in myoglobin concentration during chick development. All animals will be released at the ice edge at the end of the study. [NSF Award # 98-14794]

Field Research Plan

Logistics

Dates in Antarctica:	early October 2001 to mid-December 2001
Research Locations:	Cape Washington; McMurdo Sound sea ice; Cape Crozier; Crary Science and Engineering Center (CSEC)

Team Members

Paul Ponganis	Robert van Dam	Katherine Ponganis
David Levenson	Greg Marshall	Gerald Kooyman
Torre Knower	Christine Vitulli	

Field-Season Overview

The researchers plan to study how emperor penguins maintain body temperature while diving in frigid waters and ingesting cold prey. They will also investigate the role of hypothermia in extending dive duration.

The project team members will set up a camp at a remote site on the sea ice in McMurdo Sound, then travel via helicopter to locate penguins at the ice edge. Penguins will be captured, transported back to camp by snowmobile and sled (or helicopter if necessary), and kept in a penguin corral with a dive hole. Instruments will be attached to the birds' feathers to record diving data. Team members will observe the birds underwater by use of a sub-ice observation chamber and by SCUBA diving.

Project team members will make a one-day trip via Twin Otter aircraft to Cape Washington to collect biopsy samples. Two team members will remain at Cape Washington for one week to complete a census, then return via Twin Otter to McMurdo. Researchers will also travel via helicopter to Cape Crozier to conduct a penguin census at that colony.

At the CSEC, blood and tissue samples will be analyzed by team members investigating the regulation of myoglobin gene expression in emperor penguins. Some penguin blood and tissue samples will be returned to the home institution for further analyses.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Ms. Melissa Iszard

Dispersal of Planktonic Invertebrate Larvae and the Biogeography of the Antarctic Benthos

BO-281-O

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Research Objectives

Because continental drift has isolated Antarctic ecosystems since the Early Oligocene (about 40 million years ago), most invertebrate fauna commonly found there are native only to that region. Despite this extensive isolation, however, some benthic groups consist of significant proportions of non-native species - from 20 to more than 50 percent. To account for such species, scientists have proposed that intermittent reciprocal exchange must occur between populations resident on South America and Antarctica.

One hypothesis is that geographical distribution could be maintained and genetic exchange accomplished through the passive dispersal of planktonic larvae. This project is targeted at this hypothesis; our objective is to show that this dispersal actually occurs. We must demonstrate two facts:

- Larvae of sublittoral species actually can be found across the Drake Passage; further, that these do belong to species that can be found in south american and Antarctic faunas.
- A hydrographic mechanism exists that can explain how passive transport of larvae occurs between the two continents.

To address these two requirements, we will make transects of plankton samples across the Drake Passage and examine the possibility of cross-frontal exchange of larvae at the subAntarctic and polar fronts of the Antarctic Circumpolar Current; we will also explore the possible transport of larvae in mesoscale rings. Our results should demonstrate that other species may be profitably examined using molecular techniques that compare individuals from bottom populations of South America and Antarctica. [NSF Award # 99-10164]

Cruise Research Plan

Logistics

Cruise LMG01-9	
Departs:	Punta Arenas, Chile, 2 December 2001
Arrives:	Punta Arenas, Chile, 28 December 2001
Research Locations:	Drake Passage; Bransfield Strait; Gerlache Strait

Team Members

Hal Caswell	Annette Frese	Heidi Fuchs
Kenneth Halanych	Judith Kleindienst	Nicole Petrin
Amelie Scheltema	Konrad Scheltema	Rudolf Scheltema
Isabelle Williams		

Cruise Overview

The researchers are investigating whether there is a passive reciprocal exchange of free-drifting, planktonic, invertebrate larvae between South America and Antarctica. Team members plan to search for the larvae of sublittoral species in the Drake Passage and evidence of a hydrographic mechanism that may explain passive larval transport.

Working aboard the *R/V Laurence M. Gould* during cruise LMG01-9, the researchers will make a series of plankton tows along a track from Staten Island in the north to King George Island or Elephant Island in the south. These tows will be made during both the southbound and the northbound transits. Additional tows may be made at hydrographic fronts or eddies. Team members will also deploy expendible bathythermographs to profile the water column. The Acoustic Doppler Current Profiler will be used to locate hydrographic “rings.”

In addition, the researchers plan to collect plankton samples in Bransfield Strait and Gerlache Strait to determine which larvae are available for dispersal across the Drake Passage. Bottom samples will be collected in the Bransfield Strait using a dredge, a bottom grab, or an otter trawl. The adult benthic invertebrates collected by these methods will be used as aids in identifying collected planktonic larvae.

Some samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Dr. Karl Newyear

Antarctic Killer Whales

BO-289-O

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Research Objectives

Twenty years ago a new species of killer whale was described from Antarctica — smaller than the typical worldwide species and with a different color pattern. We have collected a couple dozen samples of the typical form of killer whale from all around the continent, but we have not yet sampled the diminutive form that is resident around McMurdo. We would like to sample these and use molecular genetics to see if there are in fact two species of killer whales.

Working aboard a U.S. Coast Guard icebreaker in the Ross Sea area and enroute to McMurdo from Christchurch, we will collect non-lethal biopsy tissue samples from live, free-swimming killer whales. Samples will be used for molecular genetic study of killer whale systematics. [NOAA award]

Cruise Research Plan

Logistics

Cruise Dates:	early December 2001 to early January 2002
Research Locations:	USCG Icebreaker *Polar Star*, McMurdo Sound

Team Members
Robert Pitman

Cruise Overview

The researcher plans to collect small tissue samples from free-ranging killer whales (*Orcinus orca*) in McMurdo Sound. The samples will be used in a molecular genetics study to determine whether the McMurdo killer whale population represents a different species.

The researcher will board the USCG *Polar Star* in Hobart, Tasmania for the southbound voyage. When the vessel arrives in the southern Ross Sea, the researcher will begin sample collection. Operating either from the *Polar Star* itself or from a small boat launched from the *Polar Star*, the researcher will attempt to withdraw small biopsies from the whales' skin using darts. The researcher will retrieve the darts by hand from a small boat or by long-handled net from the *Polar Star*. If conditions permit, the researcher may work from the ice near a lead where whales are swimming, recovering the darts with an attached tether.

Tissue samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Rob Robbins

Origin and Evolution of Antarctic and Deep-Sea Macroinfauna: Systematics and Reproductive Patterns of Polychaetes

BO-292-O

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Research Objectives

The International Antarctic Benthic Deep-Sea Biodiversity Program begins planned field work on the German research icebreaker *Polarstern* during the 2001-2002 austral summer. Our research for this program addresses the following themes:

- the origins of the deep-sea benthic fauna in relation to the Antarctic shelf and links to the deep-sea faunas of the Atlantic and Pacific Oceans;
- the development of hypotheses to explain high biodiversity in the deep sea;
- the deep-sea benthic community structure in the Southern Ocean; and
- the biological process, including the reproduction and larval development of benthic invertebrates.

Within this plan, we will focus on seven polychaete families. During two cruises, we will collect materials to map the spatial and bathymetric distributions of polychaete families while incorporating GIS mapping software. We will also examine the systematics of the selected polychaete families and will observe larval and post-larval stages to understand the mode of larval dispersal for Antarctic and deep-sea polychaetes. This information will contribute to an understanding of the origins and evolution of these families in the Southern Ocean. [NSF Award # 00-86665]

Cruise Research Plan

Logistics

Cruise Dates:	late January 2002 to late March 2002
Research Locations:	Scotia and Weddell Seas

Team Members

James Blake	Laurence Carpenter	Robert Diaz
Craig McClain	Joan Tracey	

Cruise Overview

Team members will embark on the German ship R/V *Polarstern* in late January 2002 from Punta Arenas, Chile, to conduct deep-sea benthic sampling with a box core, multicore, and epibenthic sled off the South Shetland Islands, Elephant Islands, and in the Weddell Sea. They will also collect near-surface plankton with a hand-deployed plankton net. The team members will also take bottom photographs using a sediment profile imaging camera with a supplemental surface planview camera.

Sediment samples from selected multicore and selected box core subsamples will be examined for presence of benthic polychaete larvae; these will be extracted and kept alive for study. Photographs and notes will be taken of living larvae; others will be preserved for further study. The photographs and specimens will be taken by the PI back to his laboratory after the survey. The camera samples will be analyzed for biological and physical properties including evidence of bioturbation, colonization, disturbance, and general sedimentary properties.

The team members will disembark from the R/V *Polarstern* in late March 2002 at Punta Arenas, Chile, when the cruise work is complete.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. John Evans

Development of a Classification Scheme for Species/Habitat Associations and Biodiversity in Antarctic Benthic Communities: An International Collaboration

BO-320-O

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Research Objectives

Collaborating with investigators from the Italian Antarctic program, we are seeking to develop a species/habitat classification scheme for Antarctic benthic communities at Terra Nova Bay. We will employ an acoustic seafloor mapping system to produce a detailed and spatially accurate Geographic Information System (GIS) map of physical habitat diversity and develop an appropriate scheme for classifying this diversity.

Working with Italian biologists, we will use their georeferenced Remotely Operated Vehicle (ROV) video imagery taken of Terra Nova Bay biotic communities and attempt to relate spatial patterning of epifaunal biodiversity with variation in habitat types from 20-200 meters water depth. This product will provide the first step toward developing a classification scheme for species/habitat associations in nearshore Antarctic marine environments. We will test the hypothesis that acoustic habitat classification techniques can be used to accurately predict epifaunal species distributions and biodiversity in the nearshore systems. If successful, the approach and associated geophysical classification scheme would provide a cost-effective tool for screening and initial assessment of marine areas proposed as Antarctic Specially Protected Areas (ASPAs).

A byproduct of this work will be establishing a physical baseline map of the proposed Terra Nova Bay ASPA that can be used for assessing or monitoring habitat change due to natural or anthropogenic disturbance. Follow-up surveys could be done on an as-needed basis after episodic events or as part of a regular, acoustic mapping program to assess rates and changes characteristic to the area. [NSF Award # 98-15251]

Field Research Plan

Logistics

Dates in Antarctica:	mid-January 2001 to mid-February 2002
Research Locations:	Terra Nova Bay

Team Members

Rikk Kvitek	Pat Iampietro

Field-Season Overview

In collaboration with researchers from the Italian Antarctic Program, the project team members plan to create a high-resolution map of the sea floor in Terra Nova Bay.

Team members will travel via Twin Otter aircraft from McMurdo Station to the Italian base at Terra Nova Bay. Using a small boat supplied by the Italians, the team members will conduct a multi-beam and side-scan sonar hydrographic survey of the bay. The data will be linked with biotic data collected by Italian researchers.

The team members will return to McMurdo Station via Twin Otter aircraft.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Point-of-Contact
Mr. Howard Tobin

Palmer Long-Term Ecological Research (LTER) on the Antarctic Marine Ecosystem: An Ice-Dominated Environment

BP-013,016,021,028,032,046-L/N/P

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Research Objectives

The Palmer Long-Term Ecological Research (LTER) project is focused on one major ecological issue: To what extent does the advance and retreat of sea ice each year physically determine spatial and temporal changes in the structure and function of the antarctic marine ecosystem?

Evidence shows this dynamic variability of sea ice to have an important (perhaps determinant) impact on all levels of the food web, from total annual primary production to breeding success in top predators. For example, variability in sea ice may affect prey and predators directly by controlling access to open water or preferred habitats; or indirectly, as changes in the sea-ice cover affect other species that serve as food. Four hypotheses driving our research are that sea ice is a major factor that regulates the following:

- the timing and magnitude of seasonal primary production;
- the dynamics of the microbial loop and particle sedimentation;
- krill abundance, distribution, and recruitment; and
- survivorship and reproductive success of top predators.

These factors probably differ for key species, as the magnitude and timing of sea ice changes can have specific local impacts. What remains unclear are the ramifications for the whole Antarctic ecosystem. As one of the basic examples: Greater sea-ice areal coverage promotes more available krill (a primary food), which enhances the survivorship and reproductive success of Adélie penguins.

Overall objectives of the Palmer LTER project are to:

- document not only the interannual variability of annual sea ice and the corresponding physics, chemistry, optics, and primary production within the study area; but also the life-history parameters of secondary producers and top predators;

- quantify the processes that cause variation in physical forcing and the subsequent biological response among the representative trophic levels;
- construct models that will link ecosystem processes to environmental variables and which will also simulate spatial/temporal ecosystem relationships; and
- employ such models to predict and validate ice/ecosystem dynamics.

A key challenge for the Palmer LTER project is to characterize and understand the many cross-linkages that have developed in the antarctic ecosystem. Environmental phenomena vary, over time and across areas, having both physical and biological consequences; these changes in turn can develop other loops and linkages that influence each other. [NSF Award # 96-32763]

The following list contains Principal Investigator contact information for each Palmer LTER project:

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BP-016-L/N/P: Phytoplankton Ecology Component

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BP-021-L/N: Modeling Component

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BP-028-L/N/P: Prey Component
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BP-032-L/N/P: Bio-optical Component
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BP-046-L/N: Microbiology and Carbon Flux Component
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Cruise & Field Research Plans

Logistics
All projects will participate in the following cruises:

Cruise NBP01-05 (LTER Winter Cruise)

Departs:	Punta Arenas, Chile, 1 September 2001
Arrives:	Punta Arenas, Chile, 19 October 2001
Cruise Research Locations:	Marguerite Bay, selected lines in LTER Grid, Avian Island, Emperor Island, Dion Islands

Cruise LMG02-01 (LTER Summer Cruise)

Departs:	Punta Arenas, Chile, 2 January 2002
Arrives:	Punta Arenas, Chile, 1 February 2002
Cruise Research Locations:	Palmer LTER Grid Lines 200-500, from Anvers Island to northern Marguerite Bay, south of Adelaide Island

BP-013-L/N/P

Dates at Palmer Station:	mid-October 2001 to early April 2002
Palmer Research Locations:	all local islands around Palmer Station (including Torgerson, Humble, Hermit, Stepping Stones, Cormorant, Short Cut, and Litchfield); Cape Monaco (on Anvers Island); Joubin Islands

BP-016-L/N/P

Dates at Palmer Station:	mid-October 2001 to early April 2002
Palmer Research Location:	Palmer Inshore Sampling Grid

BP-021-L/N
(No Palmer Station research)
(No deploying team members on Cruise LMG02-01)

BP-028-L/N/P

Dates at Palmer Station:	mid-October 2001 to early January 2002 AND early February 2002 to early March 2002
Palmer Research Location:	Palmer Inshore Sampling Grid

BP-032-L/N/P

Dates at Palmer Station:	mid-October 2001 to early January 2002 AND early February 2002 to early March 2002
Palmer Research Location:	Palmer Inshore Sampling Grid

BP-046-L/N
(No Palmer Station research)

Team Members

BP-013-L/N/P

Chris Denker	William Fraser	Heidi Geisz
Meredith Hooper	Donna Patterson	TBD

BP-016-L/N/P

Lisa Ferber	Irene Garibotti	Wendy Kozlowski
Karen Pelletreau	Michael Thimgan	Karie Sines
Maria Vernet		

BP-021-L/N

Richard Iannuzzi

BP-028-L/N/P

Charles Boch	Amy Kaiser	David Kushner
Dan Martin	Timothy Newberger	Stephanie Oakes
Langdon Quetin	Holly Rodrigues	Robin Ross
Jordan Watson	Jennifer White	TBD (6)

BP-032-L/N/P

Enrique Curchitser	Kirk Ireson	Yuko Kawano-Massom
Robert Massom	Ray Smith	Sharon Stammerjohn
TBD (2)		

BP-046-L/N

Christopher Carrillo	Matthew Church	My Christensen
Anne Gasc	Thomas Johnston	Paul Morris
Tamara Pease	TBD (2)	

Cruise and Field-Season Overviews

BP-013-L/N/P: Seabird Component

Researchers in this component of the Palmer LTER plan to continue their studies of seabird communities, emphasizing the sources and quantity of food consumed within the foraging range of the birds. The season will consist of three parts: a winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05), a Palmer Station program, and the annual LTER summer cruise aboard the R/V *Laurence M. Gould* (LMG02-01).

During both research cruises, project team members will study the foraging range of seabirds, observe seabird behavior, and conduct seabird censuses. Team members will travel via Zodiac inflatable boat from the research vessels to islands and ice floes to census penguin colonies, deploy and retrieve satellite transmitters, and perform stomach lavage.

During the Palmer Station program, team members will travel daily via Zodiac inflatable boats from the station to local islands to monitor seabird colonies. Colony boundaries and nest locations will be mapped using differential GPS. Team members will attach satellite transmitters to penguins and giant petrels to track the large scale movements of individuals and document feeding behavior. Team members will also extract the stomach contents of birds in the field and analyze them in the Palmer Station laboratory.

BP-016-L/N/P: Phytoplankton Ecology Component

Researchers in this component of the Palmer LTER plan to continue their investigation of primary production rates, phytoplankton community structure and light absorption properties, and the relationship of these parameters to physical forcing. The season will consist of three parts: a winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05), a Palmer Station program, and the annual LTER summer cruise aboard the R/V *Laurence M. Gould* (LMG02-01).

During both research cruises and while at Palmer Station, the project team members will collect water and plankton samples, carry out incubations and other experiments to estimate rate processes, and conduct other biological and chemical analyses. Team members will also conduct underwater irradiance measurements. A support contractor analytical technician will assist this group by performing nutrient analyses.

Frozen water-column samples will be shipped to the home institution for further studies.

BP-021-L/N: Modeling Component

Researchers in this component of the Palmer LTER plan to continue their studies of water temperature and salinity. During the *R/V Nathaniel B. Palmer* winter cruise (NBP01-05), the project team member will collect water samples and deploy CTDs, expendable bathythermographs (XBTs) and expendable CTDs (XCTDs).

No project team members will deploy on the annual Palmer LTER summer cruise (LMG02-01). A support contractor and other LTER researchers aboard the R/V *Laurence M. Gould* will collect water samples and deploy CTDs, XBTs and XCTDs for this project. Meteorological data will be automatically and continuously logged by shipboard systems. All data will be transmitted to the researchers at the home institution, who will compile water-column data, along with weather data and readings from the shipboard acoustic doppler current profiler (ADCP), for future modeling and interpretation.

Researchers in this project will also continue compiling, modeling, and managing the data collected by all Palmer LTER projects.

BP-028-L/N/P: Prey Component

Researchers in this component of the Palmer LTER plan to continue their investigation into the effects of interannual variations in pack ice extent and food resources on the macrozooplankton. The emphasis will be on Antarctic krill recruitment and production, as well as on interactions among krill, their food sources, and their predators. The season will consist of three parts: a winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05), a Palmer Station program, and the annual LTER summer cruise aboard the R/V *Laurence M. Gould* (LMG02-01).

During both research cruises, project team members will scuba dive to collect krill and conduct underwater video surveys of krill schools and their food. Nets will also be used to collect zooplankton, krill, and fish larvae for on-board experiments. Team members will conduct bioacoustic surveys to locate and map krill schools, and they will work closely with members of project BP-013-L,N,P to identify areas of high seabird concentration. Intensive net and acoustic tows will be made in these areas.

At Palmer Station, the team members plan to use a specially equipped Zodiac inflatable boat to conduct acoustic surveys and locate krill schools. Team members will also conduct net tows to collect krill, and the captured animals will be used in growth experiments in the Palmer Station aquarium. Specimens will also be frozen for future analyses.Cultures of Antarctic phytoplankton species will be grown in incubators in the laboratory and aquarium.

Some samples will be shipped to the home institution for analysis.

BP-032-L/N/P: Bio-optical Component

Researchers in this component of the Palmer LTER plan to continue their investigation into the processes controlling the space/time variability of phytoplankton productivity and biomass. The season will consist of three parts: a winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05), a Palmer Station program, and the annual LTER summer cruise aboard the *R/V Laurence M. Gould* (LMG02-01).

During both research cruises, project team members will make sea ice observations and collect ice cores and water samples. These samples will be processed and analyzed in on-board laboratories. Team members will also measure the bio-optical properties of water and ice, and they will collect depth, weather, and satellite data for use in system modeling. If possible, the team members will service the three Automatic Weather Stations (AWS) in the Palmer area.

At Palmer Station, the team members will use a specially outfitted Zodiac inflatable boat to conduct bio-optical profiling and to measure hydrographic properties. Team members will also collect water samples and return them to the station's aquarium for filtration and analysis.

The support contractor's science technician will assist this project by collecting satellite and AWS data, including sea surface temperatures, ozone concentrations, ocean color, cloud cover and other weather parameters, and images of Antarctic Peninsula sea ice.

Some samples will be shipped to the home institution for further analysis.

BP-046-L/N: Microbiology and Carbon Flux Component

Researchers in this component of the Palmer LTER plan to continue their study of the microbiology and carbon flux of the Southern Ocean. Project team members will travel on the winter cruise aboard the *R/V Nathaniel B. Palmer* (NBP01-05) and on the annual LTER summer cruise aboard the *R/V Laurence M. Gould* (LMG02-01).

During both cruises, team members will recover sediment traps, perform conductivity, temperature and depth (CTD) measurements in the water column, and collect water and ice samples. Samples will be analyzed and used in experiments in the on-board laboratories.

Some samples will be returned to the home institution for further analysis.

NSF/OPP Program Manager
Dr. Polly Penhale

RPSC Points-of-Contact
Mr. Robert Edwards (Palmer)
Dr. Karl Newyear (research vessels)

Overview of the Antarctic Environmental Monitoring Program

Recognizing that scientific research and related logistic support can have effects on the Antarctic environment, the Antarctic Treaty Consultative Parties adopted recommendations on environmental monitoring in Antarctica to verify predicted effects and detect unforeseen effects. The Protocol on Environmental Protection to the Antarctic Treaty also requires monitoring of environmental impacts. The U.S. Antarctic Program (USAP) is developing an environmental monitoring program to measure the impacts from science and operations at its research stations in Antarctica. The primary purpose for developing a monitoring program is to provide the basis for sound environmental management decisions and improvements in management activities. Data obtained from the monitoring program will be used to document baseline conditions, verify operational impact, and monitor recovery from accidental impacts to the environment.

Spatial and Temporal Scales of Human Disturbance: McMurdo Station, Antarctica

EO-318-0

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Co-Principal Investigator: Dr. Gary Wolff
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Research Objectives

Antarctica represents perhaps one of the most carefully tended and strictly monitored habitats on Earth. Aside from the manifest desire to protect the flora, fauna, and the atmosphere of a relatively pristine environment, there is the value the extreme southern latitudes provide as a virtual baseline barometer of global pollution. The Antarctic Treaty's Protocol on Environmental Protection, supplemented by the policies and practices of the nations who work and do science there, have combined to focus scrutiny on any anthropogenic impacts that can be foreseen or detected.

This three-year project will establish a system of observations that should enable the United States to be more aware of any such impacts — on both marine and terrestrial habitats — in and around McMurdo Station, locating them precisely and tracking them over time.

Using a combination of aerial photography and point-data sampling grids at various spatial scales, we will measure a series of attributes indicative of change within these two habitats. Our objectives are to determine:

- the spatial and temporal scales of change and its origin;
- how efficiently this observational system documents relevant changes in important habitat characteristics; and
- the usefulness of various approaches to reference or control locations.

We will use GIS techniques and geostatistical methods to organize these diverse data sets into a coherent, coordinated framework. The results should provide fundamental scientific information for developing a long-term strategy to document and minimize the impacts of future science and support operations on Antarctic resources and values. [NSF Award # 99-09445]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to mid-December 2001
Research Locations:	Cape Bird; Pegasis ice runway; Black Island; Strand Moraines; Marble Point; McMurdo Station; Winter Quarters Bay; Hut Point; sewage outfall; Crary Science and Engineering Center (CSEC)

Team Members

Stephen Sweet	Guy Denoux	Andrew Klein
Sally Morehead	Paul Montagna	Marietta Cleckly
Kristi Jones		

Field-Season Overview

Project team members will make day trips by helicopter to Cape Bird, Black Island, the Strand Moraines, and Marble Point to collect soil samples. Members from this team will also collect soil samples on a grid of locations around McMurdo Station.

The researchers will collect surface ice cores at the sea ice runway and at the Pegasis permanent ice runway, and they will collect water samples and marine benthic sediment samples from locations around McMurdo Station. Support contractor personnel will use the Reed Drill to make several holes through the sea ice in Winter Quarters Bay, around Hut Point, and near the McMurdo Station sewage outfall. Through these holes, researchers will collect water samples with niskin bottles and sediment samples with a grab sampler. The support contractor's Scientific Diving Coordinator will dive to collect additional marine benthic sediment samples.

Team members will analyze all seawater, soil, and benthic sediment samples in the CSEC. The contractor analytical technician will assist with these analyses. Some soil samples will be returned to the home institution for further studies.

NSF/OPP Program Manager
Dr. Joyce Jatko

RPSC Point-of-Contact
Mr. Rob Robbins

Overview of the Antarctic Geology and Geophysics Program

Antarctica represents about 9 percent of Earth's continental crust and has been in a near-polar position for more than 100 million years. It is covered by a continental ice sheet with an average thickness of three kilometers. There is unequivocal evidence that for a long period after the continent arrived at its high-latitude position, extensive continental ice sheets did not exist there. The ice sheets, through their interaction with and effect on oceanic and atmospheric circulation, play a key role in modulating global climate.

Some important program goals include the following:

- determining the tectonic evolution of Antarctica and its relationship to the evolution of the continents from Precambrian time to the present;
- determining Antarctica's crustal structure;
- determining the effect of the dispersal of Antarctic continental fragments on the paleocirculation of the world oceans, on the evolution of life, and on global paleoclimates and present climate;
- reconstructing a more detailed history of the ice sheets, identifying geological controls to ice sheet behavior, and defining geological responses to the ice sheets on regional and global scales; and
- determining the evolution of sedimentary basins within the continent and along continental margins.

All of these problems involve the need for an improved understanding of where, when, and how Antarctica and its surrounding ocean basins were accommodated in the interplate movements inferred from studies of global plate kinematics. In short, the program encourages investigation of the relationships between the geological evolution of the Antarctic plate and paleocirculation, paleoclimate, and the evolution of high-latitude biota.

In geophysics, the continent and its environs have a central role in the geodynamic processes that have shaped the present global environment. The tectonic role of the Antarctic continent in the breakup of Gondwanaland, the close interaction of the Antarctic crust and ice sheet with their attendant effects on the planet's fluid systems, and Antarctica's present-day seismically quiescent role defines the important thrusts of geophysical research in the high southern latitudes.

GPS Measurement of Isostatic Rebound and Tectonic Deformation in Marie Byrd Land, West Antarctica

GF-121-O

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Research Objectives

The Ross embayment and western Marie Byrd Land are part of the west Antarctic rift system. Most scientists agree that this region is undergoing active deformation, but the rates and causes of deformation remain essentially unknown. Tectonic extension may be occurring in the Ross embayment as West and East Antarctica continue to separate. Crustal uplift could be occurring in western Marie Byrd Land due to isostatic rebound following the last glacial age.

If tectonic extension is occurring in the embayment — depending on its magnitude — it could greatly influence global plate circuit calculations. It could also constrain our understanding of the history of extension in the embayment and the consequent uplift history of the TransAntarctic Mountains. Postglacial rebound in western Marie Byrd Land would depend on when and how the ice sheet was configured during the Last Glacial Maximum. The big question is whether the ice sheet collapsed in mid-Holocene time.

For this study, we have installed three continuous and autonomous global positioning system (GPS) stations on outcrops in western Marie Byrd Land, on baselines of around 100 kilometers. Since the 2000-2001 austral summer, these stations have gathered data and will continue to gather over three years, operating in concert with GPS stations being installed in the TransAntarctic mountains in a separate project. The result will be a baseline array deployed all across the Ross embayment. The array also detects strain gradients in western Marie Byrd Land. This system should determine crustal strain rates to an accuracy of 1 millimeter per year for horizontal and 2 millimeters per year for vertical. The strain data from western Marie Byrd Land and the TransAntarctic Mountains should enable us to construct both tectonic extension and glacial rebound models.

This is a joint project between the University of California at Santa Barbara scientists and a team at the Jet Propulsion Laboratory at the California Institute of Technology. [NSF Award # 97-25876]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to late November 2001 AND late December 2001 to mid-January 2002
Research Locations:	Rockefeller, Phillips, and Clark Mountains

Team Members

Charles Day	Ann Devereaux	Andrea Donnellan
Ricardo Hassan	Bruce Luyendyk	

Field-Season Overview

The researchers plan to continue their investigation into the rates and causes of crustal deformation in the Ross Embayment and Western Marie Byrd Land.

Project team members will travel by LC-130 aircraft from McMurdo Station to the Siple Dome field camp. From there, the team members, accompanied by a support contractor antenna rigger, will travel via Twin Otter aircraft to each of three continuous GPS stations in Marie Byrd Land. At each site, the team members will download data collected over the winter, assess the instruments, and perform repairs as necessary. The team members will then return via Twin Otter to Siple Dome, and via LC-130 aircraft to McMurdo Station, where they will depart the continent.

Project team members will return to Antarctica later in the season and repeat the same logistics (i.e., travel sites and aircraft transport). Data will again be retrieved from the instruments. If the GPS stations are scheduled to remain on site, any problems discovered and not repaired during the first visit will be addressed. If the instruments are scheduled to be removed, the GPS stations will be dismantled and returned to McMurdo Station.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Andy Young

2001-2002 Geodesy, Remote Sensing, and Mapping Program

GO-052-L/M/P/S

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Research Objectives

Geodetic surveying, aerial photography, remote sensing (principally using several varieties of satellite imagery), and mapping are all activities necessary for the successful operation of a multifaceted scientific and exploration effort in Antarctica. The U.S. Geological Survey provides these support activities to the U.S. Antarctic Research Program.

Year-round data acquisition, cataloging, and data dissemination activities will continue in the U.S. Antarctic Resource Center for geospatial information. Field surveys will be conducted in support of specific research projects, and as part of a continuing program to collect the ground-control data necessary to transform existing geodetic data to an earth-centered system suitable for future satellite mapping programs. LandSat data will be collected as part of satellite image mapping activities; this will permit continued publication of additional 1:50,000 scale topographic maps in the McMurdo Dry Valleys region. Such topographic studies provide a uniform base map on which to ensure that scientific information (from geology, glaciology, biology, and other areas) is spatially accurate. These, as well as the satellite image maps, are used by scientists to plan and execute future research work. Spatially-referenced, digital cartographic data will be produced in tandem with the published maps.

Additionally, this austral summer we will collaborate with the National Aeronautics and Space Administration Airborne Topographic Mapper Program to collect very high-resolution elevation data in portions of the McMurdo Dry Valleys and vicinity. The detailed land surface characterizations will be tested for feature recognition in the Beacon Valley, glacier studies in the Taylor Valley, and geologic applications in the Mt. Discovery area. The data will be tested for positional accuracy and resampled to provide regularly spaced observations for use in models and science. The USGS team will work with selected scientists to develop elevation data at resolutions that best serve their research needs. The data will then be used to develop elevation models at a variety of resolutions, as appropriate.

Very high-resolution data also will be collected for use by the ICESat research community to calibrate their 70-meter elevation data in Antarctica. The McMurdo Dry Valleys comprise a primary site for calibration and validation of NASA's ICESat satellite, scheduled for launch in December 2001. The primary sensor on ICESat is a laser altimeter, designed to measure very precisely the surface elevation within the 70-meter footprint of the laser. Because the altimeter will be operated with off-nadir pointing, mounting angle calibration is equally important with range calibration. A calibration site for such a sensor requires precise knowledge of local topography of a stable, snow-free surface region with minimal vegetation. To facilitate angle calibration, it is also highly desirable to have variable surface slopes of moderately large amplitude (10-20 deg). With accurately measured surface elevations, the Dry Valleys provide a near ideal calibration site for ICESat. Furthermore, the Dry Valleys are in the region of the maximum altitude for the orbit of ICESat, allowing verification of any measurement errors by comparisons with measurements from other parts of the world. There is no other site in the world that can provide this unique combination of features.

Every year, the ice at the South Pole migrates up to 30 feet across the continent, requiring a new GPS survey to determine the exact location of the geographic South Pole. Consequently, team members will conduct a survey to establish the new location of the geographic South Pole. The South Pole marker will be moved to the new location on the first day of the year 2002.

At Palmer Station, a RPSC science technician will continue to operate the GPS reference station for USGS. [NSF Award # 98-17876]

Field Research Plan

Logistics

Dates at McMurdo:	early November 2001 to mid-January 2002
McMurdo Research Locations:	South Victoria Land; Cape Roberts; McMurdo Dry Valleys; Royal Society Range; Ross Island; Williams Field; Crary Science and Engineering Center (CSEC)
Dates at South Pole:	mid-December 2001 to late December 2001
South Pole Research Location:	GPS Observatory in Skylab Building
Dates at Palmer:	No deploying project personnel
Palmer Research Locations:	Palmer Station and local islands

Team Members

GO-052-L

Ernest Brunson, USGS	Katherine Buoni, USGS	Earl Frederick, EG&G
Cheryl Hallam, USGS	William Krabill, NASA	Douglas Levin, UM
Serdar Manizade, EG&G	Richard Mitchell, EG&G	Jerry Mullins, USGS
Robbie Russell, EG&G	Barbara Ryan, USGS	John Scott, EG&G
John Sonntag, EG&G	Robert Swift, EG&G	Alan Waller, EG&G
James Yungel, EG&G		

GO-052-M

Matt Amos (LINZ)	Robert Glover	Larry Hothem
Bradish Johnson	John Manning (AUSLIG)	Jane Turner

GO-052-P

No deploying project personnel

GO-052-S

Larry Hothem	Robert Glover

Field-Season Overviews

The researchers of the geodesy, remote sensing, and mapping program plan to continue their work of establishing geographic positions in Antarctica and deploying instruments for the continuous, remote acquisition of geographic and geophysical data.

GO-052-L: LIDAR Elevation Data Research in the McMurdo Dry Valleys

The researchers plan to collaborate with the National Aeronautics and Space Administration (NASA) Airborne Topographic Mapper and SEASat Programs to collect very high-resolution elevation data in portions of the McMurdo Dry Valleys and vicinity.

At Williams Field, the project team members will install a LIDAR and associated GPS equipment in a dedicated Twin Otter aircraft and make a series of flights to map the elevation and topography in the study areas. Other team members will travel via helicopter to deploy and retrieve GPS receivers and collect "ground truth" data in the study areas before and after the Twin Otter flights.

The high-resolution data will be used to develop more accurate elevation models of selected areas in the vicinity of Ross Island. These data will be used by other research teams to study glaciology, geology and biology, and by NASA's ICESat scientists to calibrate the satellite laser altimeter.

GO-052-M: Geodetic Surveys and Mapping (McMurdo Station)

As part of the Trans-Antarctic Mountain Deformation (TAMDEF) program, project team members will travel via helicopter to various sites in the Trans-

Antarctic Mountains and South Victoria Land near McMurdo Station. They will take simultaneous measurements with deployed GPS receivers and other instruments.

Team members will coordinate USGS fieldwork with the GPS measurements of the Italian Geodetic Team at Terra Nova Bay. USGS will also coordinate a continuous operating GPS/GLONASS observatory system and tide gage calibration activities at Cape Roberts with Land Information New Zealand.

The researchers will continue their operation of the GPS/GLONASS receiver and antenna system at the CSEC. The winter-over support contractor science technician will monitor the system during the 2002 austral winter season.

GO-052-P: Geodetic Surveys and Mapping (Palmer Station)

The support contractor's science technician will maintain the continuously operating GPS reference station at Palmer Station. The technician may also assist researchers from various other projects with establishing GPS coordinates for study sites in the local Palmer area as needed throughout the season.

GO-052-S: Geodetic Surveys and Mapping (South Pole Station)

The project team members will provide on-site support for the continuous operation of the GPS geodetic observatory in the CosRay Lab in the Skylab Building at the South Pole Station. They will also perform upgrades and maintenance on the system with assistance, as necessary, by the support contractor's science technician. The team members will also provide training and orientation on the system's operation for the support contractor's winter-over science technician.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Points-of-Contact
Ms. Karen Joyce (McMurdo)
Ms. Cara Sucher (Palmer)
Mr. Paul Sullivan (South Pole)

Stability of Land Surfaces in the Dry Valleys: Insights Based on the Dynamics of Sub-Surface Ice and Sand-Wedge Polygons

GO-053-O

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Research Objectives

The dynamic nature of climate has received growing public attention because of growing concerns about warming and the recent occurrence of seemingly extreme weather events. In this context, understanding the inherent variability of Earth's climate and how humans can affect Earth's environment is becoming increasingly more important. We are studying features of the landscape and soils of the Dry Valley region of Antarctica to provide a more complete understanding of past climatic and environmental conditions.

One important means of improving our understanding of the planetary climate system is to treat the Earth as a natural laboratory and examine its past behavior. One of the most extreme changes in the climate system during the last few million years was the transition from a warm period in the Pliocene to an ice-age world. Scientists believe that during this interval, relatively mild conditions in Antarctica gave way rapidly to intense glacial conditions that catalyzed the growth of what has become the largest ice sheet on Earth. This inference is based on geologic indicators of past climate, from which some scientists suggest that East Antarctica was relatively warm and largely free of glaciers about 3 to 4 million years ago (during parts of the Pliocene). The mild conditions ended abruptly, with rapid ice-sheet growth and development of the very cold, dry climate that now characterizes this region.

A contrasting view, based on substantial geologic evidence, suggests that East Antarctica has been cold and the ice sheet stable for at least 8 million years, and perhaps considerably longer. These views lead to drastically different interpretations of the stability of Earth's climate.

We hope our research will help resolve this important dilemma by introducing independent new evidence and insights derived from studies of the stability of ground ice and land surfaces in the McMurdo Dry Valleys of Antarctica. We will study modern-day processes that have important implications for understanding the occurrence of buried ice found recently in Beacon Valley. This ice may be the oldest ice on Earth, and, if so, will provide strong evidence of long-term stability of the East Antarctic Ice Sheet, and may also provide a rare glimpse into atmospheric conditions millions of years ago.

Specific processes to be investigated include:

- exchange at the ground surface that affects ground temperature;
- water-vapor transport and other processes leading to the formation or loss of ice in the soil; and
- frost cracking due to contraction during rapid cooling of the frozen ground in the winter, and its resulting disruptions of the soil. [NSF Award # 97-26139]

Field Research Plan

Logistics

Dates in Antarctica:	late November 2001 to mid-January 2002
Research Locations:	Cape Evans; Beacon Valley; Wright Valley; Taylor Valley; Victoria Valley; Cape Hobbs; Crary Science and Engineering Center (CSEC)

Team Members

Birgit Hagedorn Bernard Hallet Ronald Sletten

Field-Season Overview

The researchers plan to study the polygon dynamics, water and energy balances of soils, and the micrometeorology at Cape Evans, Cape Hobbs, and at selected sites in the McMurdo Dry Valleys.

The project team members will set up tent camps and remain for three to four days at each site while they conduct their work. They will travel via helicopter from McMurdo Station to the first camp, and from there via helicopter to succeeding camps. The researchers will use the Global Positioning System (GPS) to measure rods that were previously placed to track long-term polygon dynamics. In the Beacon and Victoria Valleys, team members will re-measure Global Positioning System (GPS) markers that were established in 1998 to track movements on the valley floor. They will also download soil temperature and other data from the Campbell dataloggers in these valleys. In the Beacon Valley, team members will create soil pits for the collection of soil, rock, and ground ice samples.
The team members will return to McMurdo Station via helicopter and work in the CSEC laboratory to process samples for return to the home institution.

After this season, scientists from the New Zealand Landcare Institute will assume responsibility for recovering the data and maintaining this project's remote data collection system.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Melissa Rider

The Antarctic Search for Meteorites ANSMET

GO-058-O

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Research Objectives

Since 1976, ANSMET (the Antarctic Search for Meteorites program) has recovered more than 10,000 meteorite specimens from locations along the TransAntarctic Mountains. Antarctica is the world's premier meteorite hunting ground for two reasons. First, although meteorites fall all over the globe at random, the likelihood of finding a meteorite is enhanced if the background material is plain and the accumulation rate of terrestrial sediment is low; this makes the East Antarctic Ice Sheet the perfect medium. Second, along the margins of the sheet, ice flow is sometimes blocked by mountains, nunataks, and other obstructions; this exposes slow-moving or stagnant ice to the fierce katabatic winds, which can deflate the ice surface and expose a lag deposit of meteorites (a representative portion of those that were sprinkled throughout the volume of ice lost to the wind). When such a process continues for millenia, the concentration of meteorites unveiled can be spectacular.

It is important to continue recovering Antarctic meteorites because they are the only currently available source of new, non-microscopic extraterrestrial material. As such, they provide essential "ground truth" about the composition of asteroids, planets, and other bodies of our solar system. ANSMET recovers samples from the asteroids, the Moon, and Mars for a tiny fraction of the cost of returning samples directly from these bodies.

During the 2001-2002 field season, ANSMET's main field party will visit the Meteorite Hills region near the headwaters of the Darwin Glacier. Systematic searching at this site began last season, when 740 meteorite specimens were recovered. This season will extend systematic recoveries to include regions only sporadically visited last year. Two members of this field party will visit the nearby Finger Ridges icefield to further explore that meteorite find site, where three meteorites were recovered in 2000-2001. A second field party dedicated to high level reconnaissance may be deployed to several icefields immediately south of the Beardmore Glacier if an expected support agreement between NASA and NSF can be finalized in time. [NSF Award # 99-80452]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to late January 2002
Research Locations:	Meteorite Hills and Finger Ridge, above the Hillary Coast

Team Members

Nancy Chabot	Catherine Corrigan	Matthew Genge
Ralph Harvey	Linda Martel	David Mittlefehldt
Juanita Ryan (Teacher Experiencing Antarctica)		John Schutt
Maggie Taylor		

Field-Season Overview

The researchers plan to continue meteorite recoveries in the Meteorite Hills area of the Trans-Antarctic Mountains.

The project team members will travel via Twin Otter aircraft from McMurdo Station to Meteorite Hills. There, they will travel by snowmobiles and camp in tents as they survey ice fields and collect meteorites from the surface. GPS receivers will be used to pinpoint and record the location of meteorites. Some team members will travel via Twin Otter aircraft from Meteorite Hills to Finger Ridge, where they will camp in tents and travel by snowmobiles to collect meteorites. These team members will return via Twin Otter to Meteorite Hills.

All project team members will return via Twin Otter aircraft from Meteorite Hills to McMurdo Station. Collected samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Robbie Score

Tracking the West Antarctic Rift Flank

GO-059-O

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Research Objectives

Reconstructing the motion of the Earth's crustal plates throughout geologic time is rarely as simple as looking at a blueprint. Geological evidence often suggests conflicting narratives, and newly developing techniques often provide critical information to further resolve the puzzle. The timing and mechanisms for the formation of the rift system in West Antarctica and the Trans-Antarctic Mountains are one example.

The western side of the West Antarctic rift system extends along the Trans-Antarctic Mountains and then into West Antarctica along the northwestern flank of the Ellsworth-Whitmore Mountains crustal block. However, the expression of the rift flank is quite different along the Trans-Antarctic Mountains compared to its expression in West Antarctica. When did the rift and its associated rift flank form?

Some scientists have suggested a significant component of uplift responsible for much of the relief of the rift flank in the last few million years. However, fission track data from the Ellsworth-Whitmore Mountains crustal block indicate that although most of the erosion exposing the rock strata (denudation) occurred there in Late Jurassic/Early Cretaceous times, a significant component of denudation is permissible in the Cenozoic. In contrast, most of the rock uplift and denudation in the Trans-Antarctic Mountains occurred in the Cenozoic. We hope to shed some light on this controversy by determining the timing of uplift and denudation at key localities to allow us to determine the patterns of uplift and denudation along the West Antarctic rift shoulder.

Our objectives are the following:

- to determine the extent and timing of denudation of the West Antarctic rift flank;
- to further delineate patterns of uplift and denudation along the length of the Trans-Antarctic Mountains;

- to document the thermal history of basement rocks from different crustal blocks; and
- to compare and contrast the thermal histories of East Antarctica (Trans-Antarctic Mountains) and West Antarctica (Ellsworth-Whitmore Mountains crustal block).

We will address these objectives using thermochronologic techniques, specifically apatite fission track thermochronology and 40Ar/39Ar thermochronology. All laboratory work will be undertaken at Syracuse University. Data that integrates both fission track and 40Ar/39Ar thermochronology will lead to a better understanding of the geological evolution of the continent. We know that the Trans-Antarctic Mountains were largely created during the Cenozoic. However, why doesn't a large rift-flank mountain range exist in West Antarctica?

Most of the West Antarctica rift system is buried under floating ice shelves or the West Antarctic ice sheet and its history is poorly known. By determining the uplift and denudation history, and the tectonic evolution of the rift flank, we will be able to constrain further the history of the rift zone itself.
[NSF Award # 00-03957]

Field Research Plan

Logistics

Dates in Antarctica:	late November 2001 to early January 2002
Research Locations:	Reedy Glacier area

Team Members

Paul Fitzgerald	Suzanne Baldwin	Simon Kline
Graeme Dingle	Jarg Pettinga	

Field-Season Overview

The researchers plan to study the tectonic and geological evolution of the West Antarctic Rift System and the Trans-Antarctic Mountains. The project team members will travel via LC-130 aircraft to Amundsen-Scott South Pole Station and from there via Twin Otter aircraft to the Reedy Glacier area. Team members will establish field camps and travel via snowmobile and Twin Otter aircraft to access rock outcrops and collect rock samples.

Team members will return via Twin Otter aircraft to South Pole Station, and from there via LC-130 aircraft to McMurdo Station. Rock samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Alana Jones

Evolution and Biogeography of Late CretaceousVertebrates from the James Ross Basin, Antarctic Peninsula

GO-061-O

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Co-Principal Investigator: Dr. James E. Martin
South Dakota School of Mines and Technology

Research Objectives

We are collaborating with investigators from the Argentine Antarctic Institute (Instituto Antartico Argentino or IAA) to study the Late Mesozoic vertebrate paleontology of the James Ross Basin in the Antarctic Peninsula region. The Campanian through the Maastrichtian ages (80 to 65 million years ago) is an important time interval for vertebrate biogeography (i.e., dispersals and separations due to moving landmasses) and evolution between Antarctica and other Southern Hemisphere continents (including India; i.e., Gondwana). Moreover, the dispersal of terrestrial vertebrates (e.g., dinosaurs and marsupial mammals) from North America to Antarctica and beyond via Patagonia and the Antarctic Peninsula, as well as the dispersal of modern birds from Antarctica northward, present important unresolved questions in paleontology. These dispersal events include vertebrates not only in the terrestrial realms but also in marine settings. Both widely distributed and localized marine reptile species have been identified in Antarctica, creating questions concerning their dispersal in conjunction with the terrestrial animals.

The Antarctic Peninsula and Patagonia represent the western-most portion of the Weddellian Paleobiogeographic Province, a region that extends from Patagonia through the Antarctic Peninsula and western Antarctica to Australia and New Zealand. Within this province lie the dispersal routes for interchanges of vertebrates among South America, Madagascar and India, and Australia.

As the result of previous work, we postulate that an isthmus between more northern South America and the Antarctic craton served to bring typical North American terrestrial dinosaurs, such as hadrosaurs (duck-billed dinosaurs), and marsupials and marine reptiles swimming along the coast, to Antarctica in the latest Cretaceous. This region has also served as the cradle for the evolution, if not the origin, for groups of modern birds and the evolution of a suite of typical southern hemisphere plants.

To confirm and expand upon these hypotheses, investigations into the latest Cretaceous deposits of the James Ross Basin, Antarctica Peninsula must be continued. The Cape Lamb and Sandwich Bluff geological units of the Lopez de Bertodano Formation in the James Ross Basin along the eastern Antarctic Peninsula exhibit a mixture of marine and terrestrial deposits. From these sedimentary deposits, researchers have already recovered plesiosaur and mosasaur marine reptiles; plant-eating dinosaurs; a meat-eating dinosaur; and a variety of modern bird groups, including shorebirds, wading birds, and lagoonal birds.

During January 2002 and 2003, we will undertake fieldwork to recover new specimens to test biogeographic and evolutionary hypotheses concerning Late Cretaceous vertebrates in Gondwana and will explore the eastern slopes of Cape Lamb, Sandwich Bluff, and False Island Point on Vega Island, and the Santa Marta Cove area of James Ross Island. Our research will result in important new insights about the evolution and geographic dispersal of several vertebrate species and provide data important to understanding the development and evolution of life on Earth. [NSF Award # 00-03844]

Field Research Plan

Logistics

Dates in Antarctica:	mid-January 2002 to mid-February 2002
Research Locations:	Antarctic Peninsula Region: Cape Lamb and False Island Point on Vega Island

Team Members

Judd Case   Allen Kihm   James Martin

Field-Season Overview

This project will collaborate scientifically with the Instituto Antartico Argentino (IAA), which will arrange for logistical support from the Argentine military, including both fixed-wing (C-130 aircraft) and helicopter support. In mid-January 2002, the field-team members will be transported to Seymour Island in the Antarctic Peninsula region, from Rio Gallegos, Argentina, via an Argentine military C-130 aircraft. From there, they will be transported to Vega Island and supported there by an Argentine military helicopter.

On Vega Island, the team members will set up a field tent camp and collect fossil vertebrates and complete a biostratigraphic survey.

The team members will return to Seymour Island via helicopter and then travel via an Argentine C-130 aircraft back to Rio Gallegos, Argentina, in mid-February 2002.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. John Evans

Global Climate Change and the Evolutionary Ecology of Antarctic Mollusks in the Late Eocene

GO-065-O

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Co-Principal Investigator: Dr. Daniel B. Blake
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Research Objectives

The Eocene epoch ran from about 65 to 55 million years ago, when evidence suggests that global climate change had an important influence in Antarctica. Formerly cool-temperate conditions in the region began to shift to the polar climate that has persisted until now. As temperatures dropped, shallow-water, Antarctic marine communities began to change, and these effects are still evident in the peculiar ecological relationships observed among species living in modern Antarctic communities.

In particular this Late Eocene cooling reduced the abundance of fish and crabs, which in turn reduced skeleton-crushing predation on invertebrates. Thus, dense populations of ophiuroids (brittlestars) and crinoids (sea lilies) began to appear in shallow-water settings. These low-predation communities appear as dense fossil echinoderm assemblages in the upper portion of the Late Eocene La Meseta Formation on Seymour Island, off the Antarctic Peninsula. Dense ophiuroid and crinoid populations remain common in shallow-water habitats in Antarctica today, but at temperate and tropical latitudes they have generally been eliminated by predators. The persistence in Antarctica of these populations is an important ecological legacy of climatic cooling in the Eocene.

For the Antarctic ophiuroids and crinoids, the influence of declining predation is now well documented; but the effects of cooling on the more abundant mollusks have not been investigated. Our project will examine the evolutionary ecology of gastropods (snails) and bivalves (clams) in this same Late Eocene time frame. Based on the predicted responses of mollusks to declining temperature and changing levels of predation, we will test a series of hypotheses in the La Meseta

Formation on Seymour Island. The shapes of gastropod shells, the activities of gastropods that prey on other mollusks by drilling holes in their shells, and the effects of predation on the thickness of mollusk shells, should have changed significantly through late Eocene time.

Since Seymour Island contains the only Antarctic fossil outcrops readily accessible from this crucial period in Earth's history, such investigations provide a unique opportunity to learn how climate change may have affected Antarctic marine communities. In practical terms, models suggest that global climate change — over the next few decades to centuries — is predicted to increase upwelling in some temperate coastal regions, which would lower water temperatures. Recent ecological evidence suggests this could lower predation in those areas. Our model of the La Meseta faunas' response to global cooling in the late Eocene should enhance understanding of the dynamic structure of modern benthic communities. [NSF Award # 99-08828]

Field Research Plan

Logistics

Dates in Antarctica:	early December 2001 to early January 2002
Research Location:	Seymour Island

Team Members

Daniel Blake	Alex Glass
Linda Ivany	Ryan Moody

Field-Season Overview

The researchers plan to work on Seymour Island for approximately 30 days to study and collect fossil mollusks to document the effects of global cooling in the early Cenozoic Period.

In early December 2001, the field-team members will travel to Seymour Island on the southbound leg of the R/V *Nathaniel B. Palmer* (cruise NBP01-07). They will establish a temporary field camp on the northwest side of Seymour Island where they will examine outcrops of Eocene age and collect samples of fossil mollusks for morphological and geochemical studies at the home institution.

In early January 2002, the field-team members will remove the field camp and leave Seymour Island via the northbound leg of cruise NBP01-07.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. John Evans

Dry Valleys Seismic Project
GO-078-O

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Research Objectives

One recurrent issue in seismography is noise; that is, background phenomena that can interfere with clear and precise readings. The Dry Valleys Seismograph Project — a cooperative undertaking with the New Zealand Antarctic Program — was established to record broadband, high-dynamic-range, digital seismic data from the remote Wright Valley, a site removed from the environmental and anthropogenic noise ubiquitous on Ross Island.

The Wright Valley site provides one of the few locations on the continent with direct access to bedrock. The station there consists of a triaxial broadband borehole seismometer (100 meters deep) and a vertical short-period instrument at 30 meters. The seismological data are digitized at the remote location, telemetered by repeaters on Mount Newell and Crater Hill, and received eventually by the recording computer at the Hatherton Laboratory at Scott Base, where a backup archive is created.

These data will eventually reach the international seismological community; from Hatherton they pass along a point-to-point protocol link to the Internet at McMurdo Station and thence to the Albuquerque Seismological Laboratory for general distribution. This data set has beautifully complemented the data from other seismic stations operated by the Albuquerque Seismological Laboratory at Amundsen-Scott South Pole Station, Palmer Station, and Casey, an Australian base. [NSF Award # 99- Seismi]

Field Research Plan

Logistics

Dates in Antarctica:	mid-October 2001 to late January 2002
Research Locations:	Dry Valleys; McMurdo Station; Scott Base

Team Members

Glen Breem	Don Byrd	Ralph Himmelsbach
Jason Motyka	Tim Nuther	Jeffery Roberts

Field-Season Overview

The project team members plan to perform corrective maintenance and repairs on the seismic stations at the Vanda borehole site and on Mount Newall. The researchers will travel via helicopter from McMurdo Station to the Dry Valleys, where they will establish tent camps at the two sites. Fuel will be transported to both sites via helicopter slingload, and project team members will transfer the fuel to the seismic stations using an electric pump.

The team members will return via helicopter to McMurdo Station, where they will assess the re-routing of field data communications from Scott Base to the Comprehensive Test Ban Treaty (CTBT) hub at McMurdo Station. They will also train the winter-over science technician on how to operate the seismic and remote power systems. Data from the stations will be collected year-round and transmitted to the CTBT office in Vienna.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Thomas Barfield

Mount Erebus Volcano Observatory: Gas Emissions and Seismic Studies

GO-081-O

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Research Objectives

Mount Erebus on Ross Island is Antarctica's most active volcano. It is also the only volcano in the world with a persistent convecting lake of molten, alkali-rich phonolitic magma in its summit crater. This makes Erebus one of the few volcanoes on Earth with nearly continuous, small explosive activity and continuous internal earthquake (seismic) activity. As such, it provides the ideal natural laboratory to study these phenomena: How gas is given off by magma, and the seismic activity that results from a convecting magma conduit.

This project entails a combination of seismic studies and gas emission rate measurements, designed to elucidate the nature and dynamics of the magmatic plumbing system, as well as eruptions and degassing from the lava lake.

The gas studies will provide some of the first data available on carbon-dioxide degassing from a highly alkalic magma system. They should also help to evaluate how much lead from Mount Erebus (relative to lead released by marine aerosols) gets into the snow on the East Antarctic Ice Sheet, and thus shed light on hypotheses about the anthropogenic origins of lead.

Further goals of the gas studies are to:

- examine the role of Erebus as a source of gas and aerosols to the Antarctic environment;
- understand the role of volcanism as a source of carbon-dioxide emissions to the atmosphere, especially for a highly alkalic magma;
- understand the evolution of the main volatile substances (water vapor, carbon-dioxide, total sulfur, fluorine, and chlorine) in the Erebus magmatic system, as well as their role in the eruptive behavior of Erebus; and
- correlate the nature of the gas emissions with the observed seismic activity.

The seismic studies of the volcano will continue and we will service the existing array including a permanent broadband seismic station added to the array in 2000/2001.

Deformation studies to monitor the movement of magma inside the volcano will be continued using GPS campaign-style geodetic measurements, supplemented by an array of four permanent continuous operating GPS stations. The array consists of three, single frequency, L1 stations and a dual frequency station. The latter station and its associated meteorological package will become part of the global SuomiNet array, providing real-time, atmospheric, precipitable water vapor measurements and other geodetic and meteorological information.

The resultant data should enhance the collection of earthquakes that we are using in a computer model of the interior of the volcano, as well as provide a tool that scientists can use for volcano surveillance, eruption monitoring, and for detecting subtle changes in the internal behavior of volcanoes. The broadband data will support a detailed study of the explosion mechanism, especially the very-long-period signals they emit. It should also help us detect temporal and spatial variability in earthquake mechanisms, which in turn might provide more insights into how variations in gas emissions may be implicated.

[NSF Award # 98-14921]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to late December 2001
Research Locations:	Mount Erebus, Crary Science and Engineering Center (CSEC)

Team Members

Christina Calvin, Jessie Crain, Emily Desmarais, Richard Esser, Jeffrey Johnson, Phil Kyle, Timothy Vermaat (Teacher Experiencing Antarctica)

Field-Season Overview

The researchers plan to monitor Mount Erebus volcanic activity and evaluate the impact of gas emissions on the Antarctic environment. They will use a network of ten permanent seismic stations to provide an understanding of the eruptive behavior and dynamics of the mountain.

The project team members will travel via helicopter to Mt. Erebus, where they will stay in the Lower Erebus Hut while they conduct their work. Team members will travel via snowmobile and helicopter to repair and maintain seismic stations, GPS stations, wind generators, and environmental sensors. Team members will also travel via snowmobile and helicopter to make measurements and take samples of volcanic gas emissions.

Project team members will return via helicopter to McMurdo Station. The support contractor's science technician will maintain the seismic monitoring equipment in the CSEC year-round and periodically send data to the home institution.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Rhonda Rodriguez

Late Pleistocene to Holocene Glacial History of West Antarctica

GO-083-O

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Research Objectives

Our research focuses on the glaciomarine geology of the continental shelves of West Antarctica and the Antarctic Peninsula. Scientists have hypothesized that the different glacial systems of the Antarctic Peninsula region have been more responsive to climate change and sea-level rise than either the West Antarctic or East Antarctic ice sheets. This responsiveness is due mainly to the smaller size of these ice masses and the higher-latitude location of the Peninsula. Ice shelves of the Antarctic Peninsula are currently retreating at rates of up to 1 kilometer per year. But are these changes due to recent atmospheric warming in the region or are they simply the final phase of retreat since the last glacial maximum?

We hypothesize that the history of glacial retreat in the Antarctic Peninsula region has been quite complex, with different glacial systems retreating at different rates and at different times. This complex recessional history reflects the different sizes as well as different climatic and physiographic settings of glacial systems in the region. An understanding of the Late Pleistocene to Holocene glacial history of Antarctic Peninsula glacial systems is needed to address how these systems responded to sea-level and climate change during that time interval.

Our objectives are to acquire new marine geological and geophysical data from the continental shelf to determine if and when different glacial systems were grounded on the shelf, to establish the extent of grounded ice, and to examine the history of glacial retreat. We will build on an extensive seismic data set and hundreds of sediment cores collected along the Peninsula during cruises in the 1980s. Key to this investigation is the acquisition of swath bathymetry, side-scan sonar, and very-high-resolution, sub-bottom (chirp) profiles from key drainage outlets. These new data will provide the necessary geomorphologic and stratigraphic framework for reconstructing the Antarctic Peninsula glacial record. Anticipated results will help constrain models for future glacier and ice-sheet activity. [NSF Award # 99-09734]

Cruise Research Plan

Logistics

Cruise NBP02-01

Departs:	Punta Arenas, Chile, 18 January 2002
Arrives:	Punta Arenas, Chile, 04 March 2002
Research Locations:	Drake Passage to Weddell Sea (Antarctic Peninsula region)

Team Members

John Anderson	David Heroy	Craig Meyer
Amanda Mosola	Timothy Myers	Lisa Oakes
Stephanie Shipp	Alex Simms	Marco Taviani
Julia Wellner		

Cruise Overview

This project plans to reconstruct the West Antarctic Ice Sheet (WAIS) configuration during the Last Glacial Maximum (LGM), study its retreat history, and examine the interaction of individual paleo-ice streams and the beds on which they rested.

The cruise team members will work on-board the R/V *Nathaniel B. Palmer* (cruise NBP02-01) to acquire marine geological and geophysical data from the Antarctic continental shelf to determine if and when different glacial systems were grounded on the continental shelf, to establish the extent of grounded ice, and to examine the history of glacial retreat.

The team members will collect multibeam data (with the equipment that is mounted in the hull of the ship) in the area of the Antarctic Peninsula region to determine where they will collect samples. Then, they will use the grab-sampler to see what the bottom sediment is made of to determine where they will take piston and kasten cores. Then, they will use the following equipment for sub-bottom profiling: deep-tow side-scan sonar, bathy-2000, simrad.

The team members will work within the on-board laboratory space to conduct data analysis.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Don Michaelson

A GPS Network to Determine Crustal Motions in the Bedrock of the West Antarctic Ice Sheet: Phase I - Installation

GO-087-O

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Co-Principal Investigator: Dr. Michael G. Bevis
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Research Objectives

The primary objective of this collaborative research program is to initiate a Global Positioning System (GPS) network to measure crustal motions in the bedrock surrounding and underlying the West Antarctic Ice Sheet (WAIS). Evaluating the role of both tectonic and ice-induced crustal motions of the WAIS bedrock is a critical goal for understanding the past, present, and future dynamics of WAIS and its potential role in future global change scenarios, as well as improving our understanding of the role of Antarctica in global plate motions.

The extent of active tectonism in West Antarctica is largely speculative, as few data exist that constrain its geographic distribution, directions, or rates of deformation. Recent geophysical data indicating active subglacial volcanism and control of ice streaming by the presence of sedimentary basins have highlighted active tectonism and the influence of bedrock on the WAIS. The influence of bedrock crustal motion on the WAIS and its future dynamics is a fundamental issue. Existing GPS projects, located only on the fringe of the ice sheet, do not address the regional picture. It is important that baseline GPS measurements on the bedrock around and within the WAIS be started so that a basis is established for detecting change.

To measure crustal motions, we will build a West Antarctica GPS Network (WAGN) of at least 15 GPS sites across the West Antarctica interior, which is approximately the size of the contiguous United States from the Rocky Mountains to the Pacific coast, over two years beginning during the 2001-2002 austral summer. The planned network is designed using the Multi-modal Occupation Strategy (MOST). In this system, a small number of independent GPS "roving" receivers make differential measurements against a network of continuous GPS stations for comparatively short periods at each site. This experimental strategy — successfully implemented by a number of projects in California, South America, the southwest Pacific, and Central Asia — minimizes logistical requirements, an essential element of applying GPS geodesy in the scattered and remote outcrops of the WAIS bedrock.

The WAGN program will be integrated with the GPS network that has been established linking the Antarctic Peninsula with South America through the Scotia Arc (Scotia Arc GPS Project). It will also interface with stations currently measuring motion across the Ross Embayment and with the continent-wide GIANT program of the Working Group on Geodesy and Geographic Information Systems of the Scientific Committee on Antarctic Research (SCAR). The GPS network will be based on permanent monuments set in solid rock outcrops that will have near-zero set-up error for roving GPS occupations and that can be directly converted to a continuous GPS site when future technology makes autonomous operation and satellite data linkage throughout West Antarctica both reliable and economical. The planned network both depends on and complements the existing and planned continuous networks. It is presently not practical, for reasons of cost and logistics, to accomplish the measurements proposed herein with either a network of continuous stations or traditional campaigns.

The WAGN will complement existing GPS projects by filling a major gap in coverage among several discrete crustal blocks that make up West Antarctica — a critical area of potential bedrock movements. If crustal motions are relatively slow, meaningful results will only begin to emerge within the five-year maximum period for an individual funded project. Hence, this austral summer we will only initiate the network and test precision and velocities at the most critical sites. Once built, however, the network will yield increasingly meaningful results with the passage of time. Indeed, the slower the rates turn out to be, the more important it is to start measuring early. We anticipate that the results of this project will initiate an iterative process that will gradually resolve into an understanding of the contributions from plate rotations and viscoelastic and elastic motions resulting from deglaciation and ice-mass changes. Velocities obtained from initial reoccupation of the most critical sites will dictate the timing for reoccupation of the entire network when detectable motions have occurred.
[NSF Award # 00-03619]

Field Research Plan

Logistics

Dates in Antarctica:	early January 2002 to early February 2002
Research Locations:	South Pole Station; Dufek Massif; Mount Howe; Pecora Escarpment; Whichaway Nunataks

Team Members

Michael Bevis	Ian Dalziel	J.R. Roberts
Robert Smalley	Frederick Taylor	TBD (2)

Field-Season Overview

The researchers plan to measure net crustal motion in the bedrock surrounding and underlying the West Antarctic Ice Sheet.

Project team members will travel via LC-130 aircraft to South Pole Station. From there, team members will travel via Twin Otter aircraft to a series of four remote sites, where they will establish temporary camps and deploy precision GPS receivers. One of these sites will be a reference GPS station which will operate continuously while the other receivers are being deployed from South Pole.

After collecting data at each site, the team members will return via Twin Otter aircraft to South Pole Station. These project team members will return via LC-130 aircraft from South Pole to McMurdo Station.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Alana Jones

A Broadband Seismic Experiment to Investigate Deep Continental Structure Across the East-West Antarctic Boundary

GO-089-O

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Co-Principal Investigator: Dr. Sridhar Anandakrishnan
University of Alabama

Co-Principal Investigator: Dr. Andrew Nyblade
Pennsylvania State University

Research Objectives

Antarctica in shape looks generally like Australia, though half again as large; but beneath its enormous ice sheet lies evidence of its origin. East Antarctica has a bedrock continent-like foundation, while the ice sheet over West Antarctica — a third the area — in fact covers a series of "islands." West Antarctica shares a geologic history with the South American Andes Mountains, the result of plates colliding and subducting. East Antarctica is more like a large coherent chunk that broke free of the supercontinent Gondwanaland and drifted to a new position at the bottom of the world. The boundary between these two regions (with their disparate geologic pedigrees) is called the east-west Antarctic boundary, and the crust and upper mantle here reveal many important and interesting distinctions, which tell the basic story of the tectonic development of Antarctica.

In November 2000, we began making seismic measurements — using three different arrays and a total of 44 seismic stations — all geared to evaluating geodynamic models of the evolution of Antarctica that rely on data about the crust and upper mantle. To analyze the data, we will use a variety of proven modeling techniques, including body- and surface-wave tomography, receiver function inversion, and shear-wave splitting analysis.

One basic question is, How were the TransAntarctic Mountains formed? Though widely considered a classic example of rift-flank uplift, there is little consensus about the exact uplift mechanism. Many theories, ranging from delayed phase changes to transform-flank uplift, have been proposed. All of these make various assumptions about upper mantle structure beneath and adjacent to the rift-side of the mountain front.

Another focus will be the structure of the east Antarctic craton, the highest ice block in the world. Was this anomalous elevation a prime driver in the onset of glaciation there? More to the point, how did it arise? Proposed models include isostatic uplift from thickened crust, anomalously depleted upper mantle, and thermally modified upper mantle, as well as dynamic uplift. How far the old continental lithosphere extends is also uncertain. In particular, it is unknown whether the old lithosphere extends to the western edge of East Antarctica beneath the crustal rocks deformed during the Ross Orogeny (formation).

When completed and analyzed, this comprehensive set of data and theory testing will enable new maps of the variation in crustal thickness, upper mantle structure, anisotropy, and mantle discontinuity topography across the boundary of East and West Antarctica, providing a much enhanced foundation for understanding the geodynamics of the Antarctic. [NSF Award # 99-09603]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to late December 2001 AND early January 2002 to early February 2002
Research Locations:	Ross Island; Dry Valleys; Trans-Antarctic Mountains; East Antarctic Polar Plateau

Team Members

Sridhar Anandakrishnan	Margaret Benoit	Jerry Bowling
Jesse Fisher	Julliette Florentin	Jennifer Kabo
Bruce Long	Yongtao Luo	Andy Nyblade
Timothy Parker	John Pollack	Patrick Shore
Rigobert Tibi	Donald Voight	Douglas Wiens
TBD		

Field-Season Overview

The researchers plan to study the tectonic development of Antarctica. The project team members will travel via helicopter and Twin Otter aircraft to install new broadband seismic stations and upgrade existing stations at several locations near McMurdo Station. Some team members will travel via LC-130 aircraft to the TAMSEIS Field Camp, and via Twin Otter aircraft from the TAMSEIS camp to install seismic stations in that area. TAMSEIS team members will return via LC-130 aircraft to McMurdo Station and all researchers will depart the continent.

Later in the austral-summer season, project team members will return to Antarctica and travel via helicopter and Twin Otter aircraft to revisit and service seismic stations near McMurdo. These team members will also provide training to the support contractor's winter-over science technician. During the austral-winter season, the science technician will download data and make repairs as necessary to the seismic station installed at McMurdo.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Alana Jones

Global Seismograph Network at Palmer and South Pole Stations

GO-090-P/S

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Research Objectives

Seismology, perhaps as much as any other science, is a global enterprise. Seismic waves resulting from earthquakes and other events can only be interpreted through simultaneous measurements at strategic points all over the planet. The measurement and analysis of these seismic waves are not only fundamental for the study of the earthquakes, but also serve as the primary data source for the study of the Earth's interior. To help establish the facilities required for this crucial scientific mission, IRIS (the Incorporated Research Institution for Seismology) was created in 1985.

IRIS is a consortium of universities with research and educational programs in seismology. Ninety-seven universities are currently members, including nearly all U.S. universities that run seismological research programs. Since 1986, IRIS (through a cooperative agreement with the National Science Foundation and in cooperation with the U.S. Geological Survey) has developed and installed the Global Seismographic Network (GSN). The GSN now has about 135 broadband, digital, high-dynamic-range, seismographic stations around the world, all with real-time communications.

The GSN seismic equipment at Amundsen-Scott South Pole Station and at Palmer Station, Antarctica, were installed jointly by IRIS and USGS, who together continue to operate and maintain them. The GSN sites in Antarctica are vital to seismic studies of Antarctica and the Southern Hemisphere. The state-of-the-art seismic instrumentation is an intrinsic component of the National Science Foundation effort to advance seismology and Earth science globally.
[NSF Award # 95-29992]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to mid-December 2001 AND early January 2002 to early February 2002
Research Locations:	Palmer Station; Quiet Sector at South Pole

Team Members

GO-090-P
No deploying project personnel

GO-090-S

Donald Anderson	Kent Anderson	Rhett Butler
Edward Kromer	Kyle Persefield	

Field-Season Overviews

The researchers plan to continue collecting digital seismic data as part of a global data collection network.

GO-090-P: Palmer Station

The support contractor's science technician will perform year-round, daily, data tape changes and periodic maintenance of the project's three seismometers. The station's data acquisition system will be maintained by U.S.-based researchers via the Internet.

GO-090-S: South Pole

The project team members plan to perform annual maintenance inspection and calibration of the seismometers in the existing seismic vault in the Quiet Sector.

The Ice Core Drilling Services (ICDS) personnel will drill new boreholes for the placement of instruments in the next field season. The support contractor's construction personnel will build a new remote observatory building in the Quiet Sector. The project team members will install one prototype borehole seismometer in a new location that is yet to be determined.

The support contractor's science technician will perform daily operations and maintenance of the seismic station year-round. Twice a year, the science technician will calibrate the gravity meters. This technician will also check the vault equipment in the Quiet Sector twice a month.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Points-of-Contact
Ms. Cara Sucher (Palmer)
Mr. Paul Sullivan (South Pole)

Development of a Luminescence Dating Capability for Antarctic Glaciomarine Sediments: Tests of Signal Zeroing at the Antarctic Peninsula

GO-092-O

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Research Objectives

Quaternary (the last 2 million years) marine sediments surrounding Antarctica record the waxing and waning of ice shelves and ice sheets, as well as other paleoclimatic information, yet accurate chronologies of these sediments are difficult to obtain. Such chronologies provide the essential foundation for study of geological processes in the past. Within the range of radiocarbon (^{14}C) dating (less than 30,000-40,000 years), ^{14}C dates can be inaccurate because of a variable ^{14}C reservoir effect. Beyond 30,000 to 40,000 years, few methods are applicable.

Photon-stimulated-luminescence sediment dating (photonic dating) of eolian and waterlain deposits in temperate latitudes spans the range from decades to hundreds of thousands of years, but marine sediments in and around Antarctica pose special difficulty because of the potentially restricted exposure to daylight (the clock-zeroing process) of most detrital grains before deposition. Our research will test the clock-zeroing assumption in representative Antarctic glaciomarine depositional settings to determine the potential reliability of photonic dating of Antarctic marine sediments.

Limited luminescence dating and signal-zeroing tests using glaciomarine and marine deposits have been conducted in the northern temperate and polar latitudes, but the effects on luminescence of the different glaciomarine depositional processes have never been studied in detail. Furthermore, the depositional settings around Antarctica are almost entirely polar, with consequent specific processes operating there. For example, transport of terrigenous suspensions by neutrally buoyant “cold-tongue” (mid-water) plumes may be common around Antarctica, yet the effect of such transport on luminescence zeroing is unknown. Typical marine cores taken near Antarctica may contain an unknown fraction of detrital grains from cold-tongue and near-bottom suspensions. Thus, the extent to which the polar glaciomarine depositional processes around Antarctica may limit the potential accuracy of photonic dating of marine cores is unknown, and the age could be overestimated if grains are not exposed to daylight before deposition.

We will collect detrital grains from a variety of "zero-age" (modern) marine depositional settings within the Antarctic Peninsula, where representative Antarctic depositional processes have been documented and where logistics permit access. We will collect suspensions from four fjords representing a transect from polar through subpolar conditions and from two stations at up to three depths (surface and two deep plumes) for each station. We also will deploy sediment traps at two of the fjord settings and collect core-top sediments from several sites. All samples will be shielded from light and transported to Reno, Nevada, for luminescence analyses.

By systematically studying the effectiveness of luminescence-clock-zeroing in Antarctic glaciomarine settings, we will determine if photonic dating can be reliably applied to Antarctic marine sediments in the future. Refined sedimentological criteria for the selection of future samples for photonic dating are expected from this project. A photonic-dating capability would provide a numeric geochronometer extending well beyond the age range of ^{14}C dating. Such a capability would us permit to answer a number of broader questions about the timing and extent of past glaciations near and on the Antarctic shelves. [NSF Award # 99-09665]

Cruise Research Plan

Logistics

Cruise NBP01-07

Departs:	Punta Arenas, Chile, 5 December 2001
Arrives:	Punta Arenas, Chile, 13 January 2002
Research Locations:	Brialmont Cove, Andvord Bay, Lallemand Fjord, Admiralty Bay

Team Members

Glenn Berger	Eugene Domack	Robert Gilbert
Scott Ishman	Katy McMullen	Dave Tewksbury
Anna Rubin	David Amblas	Dianne Duran
Andrew McClosky	TBD (3)	

Cruise Overview

This project plans to test the zeroing of light-sensitive luminescence in silt-size feldspar grains from representative glaciomarine depositional settings in Antarctica—specifically in the Antarctic peninsula region.

The cruise team members will work on-board the R/V *Nathaniel B. Palmer* (cruise NBP01-07) to collect the following: suspended particulate matter (SPM) from sediment plumes from each of four fjords, core-top sediment from each of the same fjords, and sediment trap material from each of two fjords. These samples will be collected so as to prevent exposure to daylight.

The sediment plumes will be captured with 30-liter niskin bottles mounted on a CTD frame. The bottom sediment will be collected with gravity core equipment that will not allow light in. Then the collected sediment will be taken to a biology lab, which will be sealed off so no light gets in.

The team members will also conduct swath mapping (using Seabeam equipment) of the seafloor, collection of strategic jumbo piston cores, and retrieval of a mooring in the Palmer Deep.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Don Michaelson

Permian-Triassic Basin History of Southern Victoria Land and the Darwin Mountains

GO-094-O

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Research Objectives

The Earth is believed to have once consisted of a single land mass, a super-continent called Pangea, composed of all the continental crust that now makes up the various continental and island surfaces. As tectonic forces began to break up the land mass about 150 million years ago, Gondwanaland was born (as was Laurasia); its southern portion would eventually become Antarctica. Before this split, around 250 million years ago, geologic features extended across what would become separate continents. One of the largest depositional basins was the "Gondwanide foredeep," more than 10,000 kilometers long, extending across the land that would become southern South America, South Africa, the Falkland Islands, Antarctica, and Australia.

Antarctica's central location in this ancient assemblage, between South Africa and Australia, make southern Victoria Land and the Darwin Mountains key areas for testing paleogeographic and paleoclimatic models. Such work will further constrain the paleoenvironmental, tectonic, biotic, and paleogeographic histories of southern Pangea, and provide a unique polar view of the world during an icehouse to greenhouse transition.

Our project is a collaborative sedimentological, palynological, and paleomagnetic study of Permian and Lower Triassic strata in these areas. We will recover paleomagnetic signatures from Permian and Triassic petrified wood, silicified peat, and coal, which were cemented during early diagenesis (the process of undergoing chemical, biological, and physical change until metamorphism is reached). Paleopalynological analyses — the study of fossilized microscopic organisms — will provide time control for the succession.

We hope to be able to:

- determine a Late Paleozoic (as Gondwanaland drifted over the South

Pole) glacial/deglaciation history for southern Victoria Land and the Darwin Mountains,

- document Permian strata to better understand the environments of high-latitude fluvial coal-bearing deposits,
- document Triassic lithofacies to better understand high-latitude conditions during the Early-to-Middle Triassic "coal gap" interval,
- provide a well-constrained stratigraphic framework for the Permian-to-Lower Triassic succession,
- test the diachronous and inversion tectonic models for the Panthalassan Margin of southwestern Pangea, and
- construct better paleogeographic models for Gondwanaland by obtaining new Gondwanaland reference poles for the Permian and Triassic.

[NSF Award # 99-09637]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to early January 2002
Research Locations:	Trans-Antarctic Mountains, Southern Victoria Land

Team Members

John Isbell	Rosemary Askin	Tim Cully
Molly Miller	Keri Wolfe	

Field-Season Overview

The researchers plan to study the sedimentology, palynology, and paleomagnetism of Permian and Lower Triassic rocks between the Skelton Glacier and Allan Hills in Southern Victoria Land. Project team members will travel via Twin Otter aircraft from McMurdo Station to their first campsite at Turnabout Neve. From there, the team members will travel via helicopter and snowmobile to various other sites along the Polar Plateau, where they will camp, collect rock samples, and conduct geological documentation.

At the end of the field season, the project team members will return via Twin Otter aircraft to McMurdo Station. Rock samples will be returned to the home institution for further studies.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Rhonda Rodriguez

Acquisition and Operation of Broadband Seismograph Equipment at Chilean Bases in the Antarctic Peninsula Region

GO-097-O

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Research Objectives

The present-day tectonics and seismological structure of the Antarctic Peninsula and Scotia Plate region are among the most poorly understood of any location in the world. This region offers a unique and complex geodynamic setting, as illustrated by recent changes in the pattern of volcanism and other tectonic activity. We constitute the U.S. component of an international effort, using a large-scale deployment of broadband seismographs to study the seismotectonics and seismic structure of these regions.

During the 1996-97 field season, broadband seismographs were installed at strategic locations: one on the tip of South America and three more in the South Shetland Islands and on the Antarctic Peninsula. In succeeding years, seven more were added to the network, which has yielded excellent data and some suggestive early results. As the project continues, cumulative data should enhance understanding of the seismicity of the South Shetland Trench, an unusual subduction zone where young lithosphere is subducting very slowly.

The continuing collaboration between Washington University and the Universidad de Chile will contribute important seismological data to the Incorporated Research Institution for Seismology (IRIS) data center, as well as to other international seismological collaborators. Such mutual exchanges with other national Antarctic seismology research programs will accumulate data from a variety of other proprietary broadband stations in the region.

These data will support seismic studies of the upper mantle velocity structure of several complicated tectonic regions in the area, including the South Shetland subduction zone, the Bransfield backarc rift, and diffuse plate boundaries in the areas around Patagonia, the Drake Passage, and along the South Scotia Ridge.

Such studies should provide important constraints on the crustal structure beneath the stations; in turn improved structural models will help to pinpoint better locations for future instruments. [NSF Award # 98-14622]

Field Research Plan

Logistics

Dates in Antarctica:	mid-November 2001 to early December 2001
Research Locations:	Chilean Bases in the Antarctic Peninsula region: Frei Base, Prat Base, O'Higgins Base

Team Members

Stacey Robertson	TBD (Chilean)

Field-Season Overview

The team members will travel in mid-November 2001 via the R/V *Nathaniel B. Palmer* (cruise NBP01-06) to the three broadband seismic stations on islands in the Antarctic Peninsula area: O'Higgins, Prat, and Frei Bases.

Data from these broadband seismic stations is used to study the structure and tectonics of the Antarctic Peninsula and the Scotia arc. The team members plan to retrieve data collected by the seismographs over the previous season. As this is the final field season for this project, they will also remove all of the instrumentation.

The team members will leave the Antarctic Peninsula area in early December 2001 via the R/V *Nathaniel B. Palmer* (cruise NBP01-06).

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Don Michaelson

Antarctic Stress Map Project Phase 1: Neogene-Quarternary Volcanic Alignments in the Transantarctic Mountains/Ross Sea Region

GO-099-O

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Co-Principal Investigator: Dr. Terry Wilson
Ohio State University

Research Objectives

Plate tectonics has become the reigning paradigm to explain both the evolution and the current dynamics of the Earth. In addition to the more dramatic movement of the Earth's crustal plates, the crust also contains buoyancy forces that contribute to basic calculations. Distinguishing between these and plate boundary forces is important. The "Antarctic Stress Map Project" (ASMAP) will obtain data on these forces from Neogene/Quaternary volcanic vent alignments within the Trans-Antarctic Mountains and adjacent West Antarctic rift system in the Ross Sea region.

We will map the distribution, alignments, and morphologies of volcanic cones and other volcanic features using high-resolution satellite imagery (e.g., Systeme Probatoire d'Observation de la Terre [SPOT] and Synthetic Aperture Radar [SAR]) and aerial photographs. Field tests will assess any structural associations that we can find between faults and volcanic vent alignments. These data will be coupled with existing chronological and petrological information on the volcanic rocks, as well as other dike and fault data, to interpret alignments and to define neotectonic stress states throughout this sector of Antarctica.

We will be able to analyze the stress regime in the context of other ongoing studies of contemporary tectonics and paleo-kinematics of the Trans-Antarctic Mountains rift flank and adjacent rift system. This new stress field data will help to constrain the role of plate-boundary and crustal buoyancy forces in actively deforming intraplate regions. [NSF Award # 99-09770]

Field Research Plan

Logistics

Dates in Antarctica:	late November 2001 to late December 2001
Research Locations:	Ross Island; Southern Victoria Land; Central Victoria Land

Team Members

Terry Wilson	Timothy Paulsen
Peter Braddock	TBD

Field-Season Overview

The researchers plan to map the position and shape of young volcanic cones and volcanoes throughout Victoria Land, in an effort to understand the tectonic dynamics of the Transantarctic Mountains rift flank and adjacent rift system.

Prior to the field work, project team members will construct maps of volcanic cones using satellite imagery and aerial photographs. Team members will then make day trips in helicopters from McMurdo Station to the site of volcanic cones on Ross Island, Black Island, the Scott Coast, and in nearby regions of the Transantarctic Mountains to conduct aerial photography and ground measurements. Photographs and ground measurements will be used to check the accuracy of satellite maps.

Team members will then travel via helicopter to the Terra Nova Bay region and make day trips in helicopters to volcanic cones in the Central Victoria Land region, where they will also photograph the cones from the air and from the ground. For selected sites, the team members plan to use real-time GPS equipment to obtain highly accurate GPS positions. Team members will make one day trip in a Twin Otter aircraft to photograph volcanic cones along the Borchgrevink Coast in Northern Victoria Land.

The team members will collect a small number of rock samples, and these will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Rhonda Rodriguez

Relative Frequency and Phase of Extreme Expansions of the Antarctic Ice Sheets During the Late Neogene

GO-154-O

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Research Objectives

Expansions and contractions of the Antarctic ice sheets (AIS) have undoubtedly had a profound influence on Earth's climate and global sea level. However, rather than being a single entity, the Antarctic cryosphere consists of three primary elements — the East Antarctic Ice Sheet (EAIS), the West Antarctic Ice Sheet (WAIS), and the Antarctic Peninsula Ice Cap (APIC). The distinguishing characteristics include significant differences in ice volume, substratum elevation, ice-surface elevation, and location with respect to latitude. Various lines of evidence indicate that AISs have undergone significant fluctuations in the past and that fluctuations will continue to occur in the future. The exact nature of the fluctuations has been the subject of many lively debates. According to one line of reasoning, the land-based EAIS has been relatively stable, experiencing only minor fluctuations since forming in the middle Miocene; whereas, the marine-based WAIS has been dynamic, waxing and waning frequently since the late Miocene. According to an alternate hypothesis, the ice sheets advanced and retreated synchronously. These two views are incompatible.

Our first objective is to compare the long-term past behavior of the WAIS to that of the EAIS and APIC. The fluctuations of the AISs involve many aspects (the frequency of changes, the overall magnitude of ice-volume change, etc.), but we are specifically concerned with the frequency and phase of extreme advances of the ice sheet to the continental shelf. Our work will build on previous seismic-stratigraphic investigations of the continental shelves. These studies have clarified many issues concerning the minimum frequency of extreme expansions for the individual ice sheets, but some important questions remain. During the course of the project, we will evaluate the following questions:

1) Were extreme advances of the EAIS and WAIS across the shelf of a similar frequency and coeval? This evaluation is possible because the western Ross Sea continental shelf (Northern Basin) receives drainage from the EAIS, and the eastern Ross Sea (Eastern Basin) receives drainage from the WAIS. In previous studies, researchers have

used regional grids of high-resolution seismic data to evaluate the number of the extreme ice-sheet advances that occurred in theses two areas. However, the existing single-channel seismic grids are incomplete and cannot be used to determine the stratigraphic correlations from the Northern Basin to the Eastern Basin. High-resolution seismic data (approximately 2,000 line-kilometers) must be acquired to address this issue.

2) Were advances of the APIC across the shelf frequent? In previous studies of the Antarctic Peninsula continental shelf, some investigators have inferred that the APIC advanced across the continental shelf at least 30 times since the middle Miocene. This inference is significant because it suggests that the advances of the small APIC were an order of magnitude more frequent than the advances of the EAIS and WAIS. Others contest this glacial-unconformity interpretation of seismic reflections and argue that the advances of the APIC were far fewer. Although recent drilling by the Ocean Drilling Program (ODP) on the Antarctic Peninsula outer continental shelf has sampled some but not all of the glacial units, the sediment recovery was poor. Consequently, the glacial history interpretation is still ambiguous. The existing high-resolution seismic grids from the Antarctic Peninsula contain only one regional strike line on the outer continental shelf. This is inadequate to address the controversy of the glacial-unconformity interpretation and the regional correlation of the recent ODP results. To address these issues, high-resolution seismic data (approximately 1,000 line-kilometers) will be acquired during a January 2002 cruise to the Antarctic Peninsula.

Our second objective is to expand our efforts to integrate research into a graduate-level course at Louisiana State University and to develop a pilot outreach program with a Baton Rouge public high school. The Louisiana Department of Education has adopted scientific standards that apply to all sciences. These standards reflect what ninth through twelfth grade-level students should be able to do and learn. We will target one of these standards — the Science as Inquiry Standard 1 Benchmark — and endeavor to share with the students the excitement of conducting scientific research as a way to encourage them to pursue earth science at the university level. [NSF Award # 00-94078]

Cruise Research Plan

Logistics

Cruise NBP02-01

Departs:	Punta Arenas, Chile, 18 January 2002
Arrives:	Punta Arenas, Chile, 04 March 2002
Research Locations:	outer Antarctic continental shelf region

Team Members

Juan Chow	TBD (4)

Cruise Overview

This project plans to evaluate whether the number of glacial advances across the outer Antarctic continental shelf were frequent or infrequent during the late Neogene. The cruise team members will work on-board the R/V *Nathaniel B. Palmer* (cruise NBP02-01) to acquire three regional strike-oriented single-channel seismic profiles by towing air guns, which give off sonic vibrations that bounce off ocean floor sediment. The resulting sonic reflection data is then received by the streamer and recorded. This data will assist with determining ocean bottom reflection profiling on the outer Antarctic continental shelf.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Mr. Don Michaelson

Advanced Technology for Radar Sounding of Polar Ice (ATRS)

GO-167-O

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Research Objectives

Since its inception in the late 1960s, radar sounding has distinguished itself as perhaps the single most important technique for glaciological work and an important aspect of sub-ice geological research. In the 1970s, the Technical University of Denmark (TUD) designed and constructed an ice-penetrating radar based on then state-of-the-art technology. This venerable system is responsible for the vast majority of all ice-sounding data collected over the ice sheets of Antarctica and Greenland. During the 1990s, the University of Texas (UT) upgraded this same system radar for digital recording and used it for extensive ice-thickness-resolution surveys in both West and East Antarctica.

Currently, three categories for advances in radar ice sounding capability have been identified. These advances are required to achieve scientific progress on several problems at the forefront of glaciological and glacio-geophysical research. The categories are the following:

- improved ice-column penetration for detection of the subglacial interface through thick and/or warm ice and through highly heterogeneous ice;
- improved internal-layer spatial resolution and improved deep-layer detection; and
- the ability to characterize the subglacial interface and, specifically, to identify the presence of water.

Recent interest in the Martian paeleoenvironment and the recognition of possible ice-covered oceans on the Jovian satellites has stimulated research activity in sub-ice detection and characterization problems from both within and outside the terrestrial glaciological community. This activity has culminated in a new design for an ice-penetrating radar that is a test-bed for sounding of planetary ice bodies. A prototype that draws on the best of modern radar technology was developed by the Jet Propulsion Laboratory (JPL) and constructed with the assistance of the University of Kansas (KU). Field tests of this JPL/

KU system in both Greenland and Antarctica indicate that this new radar has the potential for addressing fundamental questions at the forefront of glacio-geophysical research.

From the perspective of the three categories outlined above, these field tests have also revealed some limitations with the current prototype. Our effort focuses on overcoming these shortcomings by merging components of the JPL/KU radar with the UT/TUD radar. The objectives for this new "Multi-Institutional Radar Sounder" (MIRS) are to improve layer resolution and total system sensitivity through pulse compression (relative to the current UT/TUD radar) and to enable material/roughness characterization of the detected interfaces by preserving the complete shape (both magnitude and phase) of the echo waveform along with automatically calibrating the overall system sensitivity. An additional benefit of this system will be the improved ability to "see through" highly scattered ice such as the crevassed regions near ice stream margins or in valley glaciers.

To verify system design and fully establish the capabilities the MIRS, we will do field tests that target a wide range of ice-sheet environments, including both hypothesized and established subglacial water bodies underlying the thickest portions of the East Antarctic Ice Sheet during a series of airborne radar surveys to be conducted in the 2001-2002 austral summer. [NSF Award # 00-86316]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-January 2002
Research Locations:	Williams Field; Onset D Camp; South Pole Station

Team Members

John Holt	Scott Kempf	Anatoliy Mironov
Mathew Peters	Thomas Richter	TBD

Field-Season Overview

The researchers plan to test a new airborne chirped radar system for probing thick and warm ice with better resolution than existing systems.

Project team members will work in a dedicated jamesway at Williams Field to configure the radar and install it in a Twin Otter aircraft. They will then conduct flight operations and radar testing in the McMurdo area. Once McMurdo operations are complete, team members will travel via Twin Otter and LC-130 aircraft to the Onset D Camp at Ice Stream D, where they will again flight test the radar system. Team members will then travel via Twin Otter aircraft to South Pole Station to conduct flight operations and test the radar.

Project team members will return via Twin Otter aircraft to the Onset D Camp, where they will remove the radar system from the aircraft and transfer some instruments to project IO-205-O (Anandakrishnan). Two team members will join the IO-205-O field team. Remaining team members will return via LC-130 aircraft to McMurdo Station.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Alana Jones

A Target for High-Resolution Quaternary and Older Environmental Change Records: Site Survey for Drilling Mackay Sea Valley, Western Ross Sea

GO-170-O

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Research Objectives

Recently, geological successions during approximately the last 1.6 million years of Earth's history (the Quaternary) have been a focus for providing high-resolution records of past environmental changes on which to base future predictions and to assist in deciphering natural variability from human-induced changes. Our objective is to extend the database of high-resolution marine geological records of environmental change that have been established in Antarctica and to address Quaternary and perhaps older environmental changes.

The first phase of our work focuses specifically on a detailed site survey to collect information to be used in precisely locating the best drill sites and to provide data for use in an engineering evaluation of drilling and coring systems to meet sampling requirements. The proposed location is the Mackay Sea Valley (MSV), which is believed to have been formed by erosion associated with early Cenozoic expansion of Mackay Glacier, a major outlet glacier of the East Antarctic Ice Sheet. MSV extends through Granite Harbor and out to the western Ross Sea. Since being eroded, the valley has experienced sediment accumulation, at least in the Quaternary and possibly through earlier times during late Cenozoic.

Coring sites in the MSV are excellent targets because of the following:

- Their great water depth and near shore location, as well as the polar climate, appears to have made the trough a site preserving the highest resolution record of Quaternary marine environmental change known in the Ross Sea sector.
- The sedimentation regime is one of the most intensely studied coastal settings in Antarctica.
- A preliminary geophysical site survey exists.
- The sediments appear to have the potential for good chronological control, based on previous piston core work.

Ultimately, our main goals for the coring study are to:

- apply multi-proxy techniques to extract a high-resolution (decadal to century scale) of the Quaternary in the McMurdo Sound area;
- establish marine-terrestrial correlations with geological and ice-core records both from local sites and elsewhere in Antarctica (e.g., Dry Valleys and Antarctic Peninsula Quaternary geological records; Taylor and Siple Dome ice core records);
- test Antarctic variability with records from the Northern Hemisphere for cross-hemispheric comparisons;
- determine the age of MSV unconformity that may well reflect glacial cutting within the MSV by Mackay Glacier during past Quaternary expansion(s) and provide constraints on Neogene erosion rates; and
- characterize older Quaternary and/or Neogene sediment below the unconformity that potentially could also provide information on Pliocene history of the area.

However, before we can properly achieve these goals, high-quality site-survey information is required. This austral summer's investigation will provide the site data needed for a full assessment of the potential for acquiring high-resolution records of environmental change in the MSV. [NSF Award # 00-03607]

Field Research Plan

Logistics

Dates in Antarctica:	early February 2002 to late-February 2002
Research Location:	Granite Harbor

Team Members

Ross Powell	Ellen Cowan
Graham Standen	TBD

Field-Season Overview

The researchers plan to conduct a detailed site survey of the Mackay Sea Valley, a deep basin in Granite Harbor. Soon after its arrival in the McMurdo Sound area, the USCG icebreaker *Polar Star* will make a series of crescent shaped cuts in the sea ice of Granite Harbor to encourage the breakout of the ice. If the ice breaks out early enough, the project team members will deploy to McMurdo Station, where they will board the USCG *Polar Star*. The icebreaker will proceed to Granite Harbor and, if the harbor is clear, run a grid pattern of transects while towing an acoustic boomer. The acoustic boomer will produce a high-resolution seismic record of the sediment in the Mackay Sea Valley, which the researchers will use to identify marine sediment core sites for a later field season.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Points-of-Contact
Mr. Rob Robbins (McMurdo)
Dr. Karl Newyear (*USCG Polar Star*)

Antarctic Network of Unattended Broadband Inegrated Seismometers (ANUBIS)

GO-180-O

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Research Objectives

Despite much attention in recent years, the structure and dynamics of the Antarctic crust and the composition and geometry of the mantle are still poorly understood. Seismology remains the primary method for studying these structures, as well as processes in the Earth's deeper asthenosphere, but Antarctica lags behind in the effort to improve global seismic imaging and tomography. On this huge continent, there are only eight broadband seismic observatories. Except for the installation at South Pole, those stations are along the margins of the continent and none are in West Antarctica. By contrast, there are 200 permanent stations worldwide in the Federation of Digital Seismograph Networks (FDSN), and some 1,000 more, in national networks not yet integrated into the FDSN.

We have developed a passive seismic network of 11 long-term broadband seismic stations on the continent itself. Because 98 percent of the continent is ice covered, these stations will be installed at the surface of the ice sheet. The body-wave data thus recorded from regional and teleseismic earthquakes can be analyzed at each station for local crustal thickness, lamination, Poisson's ratio (a measure of crustal composition), crust and mantle anisotropy (a measure of current and former stress regimes), and identification of rift zones and crustal block boundaries. In addition, the data from all stations (including the existing peripheral ones) can be used for seismic tomographic analysis to detail lateral variations in these properties.

This year, we will remove all of the stations and return the equipment to the United States. [NSF Award # 99-96272]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-December 2001
Research Locations:	Siple Dome Camp; Byrd Surface Camp; Central West Antarctica; Marie Byrd Land; Ice Stream D

Team Members

Sridhar Anandakrishnan Donald Voigt Joseph Voigt

Field-Season Overview

The researchers plan to study the composition and geometry of the Antarctic crust and mantle, using a passive network of broadband seismic stations and temporary GPS receiver stations.

Project team members will travel via LC-130 aircraft to the Siple Dome Camp, where they will remove a previously installed GPS receiver. From Siple Dome, team members will travel via Twin Otter aircraft to deploy GPS receivers and remove previously installed seismic stations at Byrd Surface Camp and Ice Stream D, and in Marie Byrd Land and Central West Antarctica. The GPS receivers will be recovered at the end of the field season. One seismic station will be transferred to project IO-205-O (Anandakrishnan) and re-installed at the Onset D camp.

Team members and recovered instruments will return via LC-130 aircraft from Siple Dome to McMurdo Station.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Alana Jones

Aeolian Processes in the McMurdo Dry Valleys, Antarctica

GO-183-O

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Co-Principal Investigator: Dr. John Gillies
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Research Objectives

Our project makes use of the unique natural laboratory provided by the McMurdo Dry Valleys to study fundamental processes associated with airflow and sediment transport by wind on rough surfaces.

Using novel instrumentation (Irwin Sensors) that was recently developed and has been tested in field and laboratory wind tunnel experiments, we will quantify the partitioning of wind-shear stress between roughness elements (in this case, boulders) and the intervening surface. The field data will be used to test existing models of shear stress partitioning and to develop new empirical models for the relationship among winds, surface-roughness element distribution and geometry, and sediment-transport rates.

Our research will extend on-going studies of these relations on sparsely vegetated surfaces to rough surfaces without vegetation, such those found in arid terrains on Earth and Mars and will provide fundamental data on shear-stress partitioning between the roughness elements and the intervening surface for a range of rocky desert and sand sheet sites. This will enable testing and improvement of existing theoretical models for shear-stress partitioning.

The research will lead to the development of an improved and universally applicable model for estimating sediment transport by wind on surfaces that are covered by varying densities of roughness elements that will not erode.
[NSF Award # 00-88136]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to early February 2002
Research Locations:	McMurdo Dry Valleys

Team Members

Nicholas Lancaster John Gillies William Nickling

Field-Season Overview

The researchers plan to study the fundamental processes of airflow and sediment transport on rough surfaces. Project team members will travel via helicopter to Lake Fryxell in Taylor Valley, where they will occupy the Lake Fryxell field camp. From this camp, they will travel via helicopter to a series of study sites in the Taylor, Wright, and Victoria Valleys. At each site, they will establish temporary satellite camps, set up instruments, and take measurements.

At the end of the field season, the project team members will return via helicopter to McMurdo Station with all equipment.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Melissa Rider

Ferrar Basaltic Tuff-Breccias Formed by Direct Eruption: Evaluating an Hypothesis

GO-290-O

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Research Objectives

The Mesozoic break-up of Gondwanaland was marked by a major magmatic event, during which voluminous basaltic magmas were erupted at the surface and intrusive sills and dikes were emplaced at depth within the underlying sedimentary sequence. In Antarctica, the extrusive rocks include thick tuff-breccias (coarse pyroclastic rocks) believed to have been formed by subsurface explosive interaction of basaltic magma and water in aquifers.

Volcanic fields, where rising magmas interact explosively with water in aquifers or at the surface, are widespread in modern rift settings. In terms of areal extent and thickness of deposits, depth of magma/water interaction, and dominance of basaltic tuff-breccia, these basaltic pyroclastic rocks in Antarctica constitute a unique volcanic field, when compared to other well-documented examples. Study of the paleovolcanology of these rocks will yield important new information on the origins and emplacement mechanisms of tuff-breccia deposits and on the evolution of volcanic fields in which tuff-breccias form a significant component.

Our goal is to understand the processes involved in forming these exceptionally thick tuff-breccias. The objectives of our research are to:

- document the three-dimensional architecture of the basaltic pyroclastic rocks;
- establish the depth of magma/water interaction;
- evaluate aquifer recharge;
- establish the nature and extent of the volcanic field and its paleovolcanologic setting; and
- evaluate the hypothesis that these tuff-breccias are the result of direct

eruption from volcanic vents.

The large-scale three-dimensional relationships of the pyroclastic rocks will be established by field examination of lateral and vertical changes in facies (rock associations) and by relationships to adjacent rock units. We will collect rock samples for examination of microscopic structures and textures that provide clues to the modes of interaction, eruption, and emplacement. Also, we will systematically sample sedimentary rock fragments in the tuff-breccias for comparison of the lithology and palynology with that of the underlying rock sequence and thus establish the time-dependent changes in depth of magma/water interaction.

Building on reconnaissance work, we expect the results of this study to have broad implications for understanding how phreatomagmatic processes (the explosive interaction between magma and water) form tuff-breccias and the tectonic settings in which it occurs. Results are also expected to develop the paleovolcanologic setting of the Trans-Antarctic Mountains during the Jurassic. [NSF Award # 00-87919]

Field Research Plan

Logistics

Dates in Antarctica:	early November 2001 to mid-December 2001
Research Locations:	Mount Dearborn; Allan Hills, Carapace Nunatak

Team Members

David Elliot	James Elliot	Everett Fortner

Field-Season Overview

The researchers plan to study the volcanic paleohistory of Southern Victoria Land. Project team members will travel via helicopter from McMurdo Station to Mount Dearborn, where they will establish a field camp and travel on foot to examine geological structures and collect rocks. Team members will move camp via helicopter to the Allan Hills, and they will make day trips via helicopter to collect rocks at sites where they will not establish camps.

The team members will return via helicopter to McMurdo Station. Rock samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Rhonda Rodriguez

University NAVSTAR Consortium (UNAVCO) GPS Survey Support

GO-295-O

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Research Objectives

UNAVCO provides year-round support for scientific applications of the Global Positioning System (GPS) to the National Science Foundation's Office of Polar Programs (NSF/OPP) Antarctic Program. This support includes pre-season planning, field support, and post-season follow-up, as well as development work for supporting new applications. UNAVCO maintains a "satellite" facility at McMurdo Station during the austral-summer research season, providing a full range of support services, including geodetic GPS equipment, training, project planning, field support, technical consultation, data processing, and data archiving.

UNAVCO also operates a community differential GPS (DGPS) base station that covers McMurdo Sound and Taylor Valley, provides maintenance support to the MCM4 continuous GPS station as contractual support to the NASA GPS Global Network (GGN), and supports remote continuous GPS stations for scientific investigations.

Using GPS, vector baselines between receivers separated by 100 kilometers or more are routinely measured to within 1 centimeter (that is, 100 parts per billion). UNAVCO is also able to support researchers who are investigating global, regional, and local crustal motions where maximum accuracy (in the millimeter range) of baseline measurement is required. GPS measurements using portable equipment can be completed in a few hours or less. Such expediency lends itself to research applications in global plate tectonics, earthquake mechanics, volcano monitoring, and regional tectonics. [NSF Award # 99-03414]

Field Research Plan

Logistics

Dates in Antarctica:	mid-October 2001 to late January 2002
Research Locations:	Various field locations; Crary Science and Engineering Center (CSEC)

Team Members

Charles Kurnik	Shad O'Neel

Field-Season Overview

The UNAVCO team plans to manage the GPS equipment pool and provide technical support to other research projects. Project team members will occasionally travel to various field locations to assist researchers with GPS operations.

UNAVCO also maintains the differential GPS (DGPS) system used in and around McMurdo Station and the Taylor Valley, as well as continuous GPS stations on Mt Erebus.

Throughout the season, team members will work in the CSEC to test, repair, and stage GPS equipment.

NSF/OPP Program Manager
Dr. Scott Borg

RPSC Point-of-Contact
Ms. Karen Joyce

Overview of the Antarctic Glaciology Program

The Antarctic Glaciology (AG) program is concerned with the study of the history and dynamics of the Antarctic ice sheet including the study of near-surface snow and firn, floating glacier ice (ice shelves), glaciers, ice streams, and continental and marine ice sheets. Program emphases include paleoenvironments from ice cores, ice dynamics, numerical modeling, glacial geology, and remote sensing of ice sheets.

Some specific objectives include the following:

- the correlation of climatic fluctuations evident in Antarctic ice cores with data from arctic and lower-latitude ice cores;
- the integration of the ice record with the terrestrial and marine records;
- the investigation of the physics of fast glacier flow with emphasis on processes at glacier beds; and
- the investigation of ice-shelf stability and the identification and quantification of the feedback between ice dynamics and climate change.

These topics come together in the multidisciplinary West Antarctic Ice Sheet program (WAIS) which is a major initiative of the Office of Polar Programs. The goal of the WAIS program is to predict the ice sheet's future behavior by developing an understanding of its history, current state, internal dynamics and its coupling to the current global climate. The Antarctic Glaciology Program also funds much of the land-based glacial geology supported by the U.S. Antarctic program, especially more geologically recent events during the last 3 million years (between the Pliocene and Recent epochs).

History and Evolution of the Siple Coast Ice Streams System as Recorded by Shear Margin Scars

II-163-O

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Research Objectives

The West Antarctic Ice Sheet (WAIS) has been an object of intense study for years, yet much remains to be specified about its evolution and dynamics — and therefore its possible futures. Almost certainly, those potential futures are vital to the Earth's global climate and its ocean systems. Because its base consists of a series of archipelagos, the WAIS is a marine ice sheet. The Siple Coast Ice Stream system is a principal dynamic process by which the ice sheet drains ultimately into the Ross Sea. This seaward movement runs primarily through the Byrd subglacial trough, its flanks defined by the Ellsworth Mountains; such movement will usually leave behind tell-tale scars in the ice.

This project focuses on scar-like features in this region; some are well known, other margin scars are poorly constrained and need better dating, and still other as-yet unvisited scars require primary identification and exploration. To locate and map these features, we will use Advanced Very High Resolution Radiometer (AVHRR) and Radarsat image data, which will enable us to place them more exactly within the region's known topography.

Our goal for these initial data is a better description of the recent history of the Siple Coast glaciers and a more coherent account of the history of their configuration. For this, we will use low-frequency RES and high-frequency ground-penetrating radar (GPR) profiles to image internal layers and measure the depths of buried crevasses or disrupted layering. These depths, seen in the context of accumulation rates determined from shallow ice cores, will provide "shut-down" ages for when the margin features ceased actively flowing; that is, times after which they could not have formed. The field data should allow us to develop simple ice-flow models — for the margins and inter-ice stream ridges — during

active shearing and after shutdown. One primary output of such models would be closer estimates than we have at present of the initial elevation of a given scar, and the corresponding ice-stream elevation, at the time of shut down.
[NSF Award # 99-09518]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to early February 2002
Research Locations:	Upstream C Camp; Downstream Ridge B/C; Siple Dome

Team Members

Howard Conway	Ted Scambos	Maurice Conway
Ginny Catania	Charles Raymond	

Field-Season Overview

The researchers plan to survey several former glacier margins, now buried, to determine when their active flow ceased.

The project team members will travel via LC-130 aircraft from McMurdo Station to the Siple Dome camp. From there, they will travel via snowmobiles past the Siple Dome Duckfoot, to Downstream Ridge B/C, and finally to Upstream C. They will set up temporary tent camps at each location and travel via snowmobile to specific research sites in the area, where they will take measurements using ground-based, radio echo sounding and GPS surveys. Support contractor personnel will travel via Twin Otter aircraft to set up fuel caches for the team members to use for their snowmobiles.

When their research is complete, the team members will depart Upstream C and return to McMurdo Station via LC-130 aircraft.

NSF/OPP Program Manager	**RPSC Point-of-Contact**
Dr. Julie Palais	Mr. Howard Tobin

High-Precision Borehole Temperature Measurements at Siple Dome, Antarctica, for Paleoclimate Reconstruction and Ice-Dynamics Studies

II-171-O

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Co-Principal Investigator: Dr. Gary Clow
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Research Objectives

1) High precision borehole temperature measurements.

One of the procedures involved in ice coring is high-precision borehole temperature profiling. By constructing continuous temperature logs, scientists can develop data vital to paleoclimate reconstruction and ice dynamics studies. This project will work in the 1-kilometer (km) deep fluid-filled Siple Dome borehole and in several 160 meter-deep holes along a 20 km north-south transect across Siple Dome. The borehole temperature data will be used to:

- establish the conductive heat flux across the basal interface of the ice sheet;
- reconstruct the surface temperature history at Siple Dome, using geophysical inverse methods, known as borehole paleothermometry;
- constrain how thick the ice sheet was during the late Wisconsin, the magnitude of the Wisconsin/Holocene deglacial warming, and the background geothermal heat flux;
- determine calibration constants for the oxygen-isotope paleothermometer at Siple Dome in the past; and
- establish the spatial variability of surface temperature over the last century on the 20-km scale near the main drill site.

We expect the results to provide information needed to assess the short-term stability of the West Antarctic Ice Sheet; also to improve estimates of the pore close-off ages in the past, which should in turn provide a more accurate age-scale for the Siple Dome ice core. Ultimately, this work should enhance our understanding of the magnitude of past temperature changes at this significant southern hemisphere site. [NSF Award # 97-26078]

2) Borehole fingerprinting.

This two-year project focuses on developing a new method for measuring vertical strain rates in polar firn. Vertical strain rate measurements in the firn can aid in the understanding of the dynamics of firn compaction (a key factor in determining ice age/gas age difference estimates for ice cores), can determine ice advection for borehole paleothermometry models, and most importantly can be used to date the shallow sections of ice cores where ambiguities in chemical dating or counting of annual layers hinder dating by traditional methods.

We will use a video-logging tool to create a unique "optical fingerprint" of variations in the optical properties of the firn with depth and to track the movement and deformation of the features of this fingerprint. Preliminary work at Siple Dome, Antarctica, using an improvised logging system, showed a series of optically bright and dark zones as the tool transited up or down the hole. Borehole fingerprinting has the potential to improve measurements of vertical strain in firn holes. [NSF Award # 00-87521]

3) Digital thermometer testing.

We will develop and test digital probes for high precision temperature measurements in boreholes in polar ice sheets. These measurements are key to obtaining calibrated paleotemperature records in the polar regions. The current state-of-the-art system is the USGS Polar Borehole Temperature Logging System (PBTS), which uses analog probe technology with the electronic package at the ice sheet surface. Strong winds can disturb the recording electronics, forcing the field team to modify logistics plans to produce high quality data. Probes that transmit digital signals up the cable would not be affected by these surface conditions, improving the efficiency of field operations. Our objective is to adapt a recently designed digital probe for use with the PBTS system in cold temperatures in polar drilling fluids. These probes will reduce some of the stringent hardware and procedural requirements of the current analog system. We will calibrate these new digital probes alongside the currently used sensors and will test them at Siple Dome as part of our on-going project. The final product (in addition to a working borehole temperature logging system with new digital probes) will be paper published in the *Journal of Glaciology* describing the new probes, the comparisons, and the new research opportunities that digital probes can offer. [NSF Award # 00-87273]

Field Research Plan

Logistics

Dates in Antarctica:	early December 2001 to mid-January 2002
Research Location:	Siple Dome region

Team Members

Gary Clow	Robert Hawley	Nathan Bramall
Ryan Bay	Barry Narod	

Field-Season Overview

The researchers plan to reconstruct past climatic changes in the Siple Dome region of Antarctica using “borehole paleothermometry.”

The project team members will travel via LC-130 aircraft from McMurdo Station to the Siple Dome camp. They will use snowmobiles to travel between the camp and their study sites, where they will take high-precision temperature measurements in existing boreholes. They will also take vertical strain measurements in one borehole and retrieve an array of near-surface dataloggers. A Weatherport structure will be used over each borehole for conducting the temperature measurements.

Midway through the season, two new members will travel via Twin Otter aircraft to the Siple Dome camp to join the research team. One of the original team members will return via Twin Otter to McMurdo. When their research is complete, all remaining team members will return via LC-130 aircraft to McMurdo Station.

Glaciology

NSF/OPP Program Manager
Dr. Julie Palais

RPSC Point-of-Contact
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Construction and Operation of a Biospectrologger in a Borehole in Polar Ice

IO-122-O

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Research Objectives

Our objective is to construct and operate a biospectrologger (BSL) at Siple Dome, Antarctica, during the 2001-2002 field season as part of an existing borehole logging program there. Such an optical device has already been developed and tested for measuring dust in polar ice, but we believe the same general principle can be exploited to study microbes and biomolocules as a function of depth in glacial ice. Microbes adapted to oligotrophic, low-temperature environments are found in glacial ice, frigid lakes, in permafrost and in cold, deep ocean water and sediments. Polar ice contains the lowest concentrations — from a few hundred to about 10^4 cells per cubic centimeter — and were probably transported by wind into the atmosphere, precipitated with snow, and compacted into ice. The great majority are dormant or dead. With varying success, cultivation of microbes recovered from ice cores yields colony-forming units in a fraction (approximately 10^{-4} to approximately 10^{-2}) of dormant cells. Chemical, physical, and biological arguments indicate that as many as 10^3 microbes per cubic centimeter can extract enough energy from acids confined in narrow liquid veins in otherwise solid ice to survive for a few thousand years (or a smaller population for a correspondingly longer time). No search has yet been carried out for living bacteria in liquid veins. [NSF Award # 01-19988]

Field Research Plan

Logistics

Dates in Antarctica: late December 2001 to mid-January 2002
Research Location: Siple Dome region

Team Members

Ryan Bay

Field-Season Overview

This project will be collaborating with project II-171-O (Drs. Waddington & Clow) that will be conducting borehole measurements at Siple Dome. The project team member plans to travel via Twin Otter aircraft to the Siple Dome Field camp to install and operate a biospectrologger (BSL) in the borehole. This device permits rapid study of climate history, solar variability, volcanism, soot, and microorganisms.

NSF/OPP Program Manager
Dr. Julie Palais

RPSC Point-of-Contact
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Ice Dynamics, the Flow Law, and Vertical Strain at Siple Dome

IO-164-O

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Research Objectives

Iceflow near a divide such as Siple Dome is unique because it is predominantly vertical. As ice is deformed vertically, the vertical strain rate dominates and must be known in order to calibrate dynamic models of iceflow. Our project – a collaboration between the Universities of Alaska, Washington and University of California, San Diego – is measuring the vertical strain rate (as a function of depth) at two sites on Siple Dome, Antarctica. We hope to develop a better analysis of the ice core than was possible from recent coring sites in central Greenland.

We use two relatively new, high-resolution systems for measuring the core in hot-water drilled holes. These data, coupled with a determination of the flow-law, are used to interpret the shapes of radar internal layering as indicators of the accumulation patterns and dynamic history of Siple Dome over the past 10,000 years; an improved model should emerge. This model will provide a context in which to interpret the ice core drilled at Siple Dome — both the thicknesses of the annual layers (as indicative of annual accumulation rates) and the borehole temperatures. [NSF Award # 96-15502]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to mid-January 2002
Research Locations:	Siple Dome

Team Members

William Harrison	Eric Husmann

Field-Season Overview

Researchers in this project plan to make final measurements on the strain gauges that have been deployed for four years. These strain gauges are measuring the vertical strain rate beneath Siple Dome and at a flank site approximately 7 kilometers away.

The team members will travel to Siple Dome via Twin Otter aircraft. Once at Siple Dome, the team members plan to download data from the Campbell Scientific dataloggers, make measurements on the fiber optic gauges, and remove all of the equipment that they can from the field. The team members will leave Siple Dome and return to McMurdo Station via an LC-130 aircraft.

Glaciology

NSF/OPP Program Manager
Dr. Julie Palais

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Iceberg Drift in the Near-Shelf Environment: Ross Ice Shelf, Antarctica

IO-190-O

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Research Objectives

Icebergs command a lot of attention. The Titanic disaster illustrates only one important reason. Such a massive piece of glaciology on the move is a process that scientists would like to have better models for. One theoretical benefit entails harnessing the extraordinary freshwater volume of large tabular icebergs — possibly even harvesting it — as a natural resource of potential economic value, especially for water-poor regions of the earth. And though feasibility studies of towing icebergs to such areas in need have largely been dismissed as science fiction, it is tantalizing to realize that tabular icebergs commonly travel thousands of miles as a result of natural processes. Might a better understanding of the behavior and dynamics of icebergs one day lead to such a boon of human economic and social value?

The recent calving of an extraordinarily large iceberg (dubbed B-15) from the Ross Ice Shelf presents a unique opportunity to measure the processes — such as wind-driven and thermohaline currents, tides, sea ice, and winds — that control the drift of large tabular icebergs. Such an event rarely occurs within the logistical reach of the U.S. Antarctic Program and provides us with the opportunity to study iceberg drift, as well as other aspects of iceberg behavior that are associated with the long-term stability of the Antarctic environment.

In this second year of our investigation, our goals are the following:

- to deploy three geodetic-quality GPS receivers (provided by UNAVCO) on iceberg C16 at or about 10 December 2001, and to pick up these receivers at or about 25 January 2002. We will deploy the receivers at the vertices of an equalateral triangle that has one kilometer legs somewhere near the center of C16;
- to install 2 AWS/GPS tracking stations (i.e., standard meteorological “towers” that are approximately 20 feet high) at two of the three vertices

of the equilateral triangle (with 1 km legs) referenced above and to retrieve in late January geodetic-quality GPS receivers that were installed in December; and

- to service and upgrade three AWS/GPS tracking stations currently deployed on iceberg B15a, if we can locate B15a.

With data from these instruments, we hope to constrain parameters that will improve the models of iceberg drift and to improve our ability to predict calving events and the subsequent iceberg drift trajectory. [NSF Award # 00-89902]

Field Research Plan

Logistics

Dates in Antarctica:	early December 2001 to early February 2002
Research Locations:	Icebergs B-15a and C16 in the Ross Sea

Team Members

Douglas MacAyeal	Andrew Bliss	Chuck Kurnick
Jonathan Thom	George Weidner	Matthew Lazzara

Field-Season Overview

The researchers plan to track the movements of two large icebergs that have calved recently from the Ross Ice Shelf. Two project team members and a support contractor mountaineer will travel via Twin Otter aircraft to iceberg C16. After scouting for crevasses, the team members will land on the iceberg, set up two geodetic-quality GPS receivers, perform additional crevasse safety assessments, and identify sites for the future placement of Automated Weather Stations (AWS). The team members will then return via Twin Otter to McMurdo.

A second team of four researchers will board the USCG icebreaker *Polar Star* in McMurdo to return to iceberg C16. The project team members will travel via USCG helicopter to C16 to install two AWS/GPS stations and retrieve the geodetic GPS receivers deployed earlier. The team members will then return via helicopter to the icebreaker, and then return on the icebreaker to McMurdo Station.

If iceberg B15a is located along the southbound route of the icebreaker, two team members will board the icebreaker in Hobart, Tasmania and travel with it to the vicinity of the iceberg. They will then travel via USCG helicopter from the icebreaker to the iceberg to perform maintenance and upgrades on the three AWS/GPS stations that were installed on the iceberg during the previous season. If B15a is close to McMurdo, the researchers will instead travel to it on the icebreaker immediately after working on iceberg C16. If iceberg B15a is inaccessible from both the icebreaker's southbound track and from McMurdo, the effort to service the AWS/GPS stations there will be abandoned.

The data from all AWS/GPS stations will be transmitted via ARGOS satellite to the home institution.

NSF/OPP Program Manager
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RPSC Point-of-Contact
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Deglacial Chronology of the Northern Scott Coast from Relative Sea-Level Curves

IO-196-M

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Research Objectives

A key unresolved question in Antarctic glaciology concerns the stability of the marine-based West Antarctic Ice Sheet (WAIS). Marine-based means that (unlike the base of the East Antarctic Ice Sheet sitting on a lithospheric plate) the substratum for the WAIS is a series of archipelagoes, such that the sheet at its relatively fixed position is grounded on the continental shelf — in the northwestern Ross Sea Embayment off the northern Scott Coast — with plate boundaries nearby. As deglaciation began after the Last Glacial maximum (LGM), the WAIS eventually became unmoored. Scientists believe this was likely the first area of the shelf to become free of grounded ice. Learning how and when (and in what sequence) this has occurred in the past is a critical step for isolating the mechanisms (sea level, climate, ocean temperature, and internal dynamics) that control WAIS dynamics.

Thus, the northern Scott Coast is of particular interest to researchers looking for mechanisms that may have triggered the key stages of deglaciation. But an important first step is to better constrain the age where the inquiry is focused. The Barbados coral record suggests the initial retreat from the Ross Sea Embayment may have begun as early as 17,000 years ago. In contrast, recent glacial geologic mapping and relative sea-level work from the southern Scott Coast suggests that deglaciation here is more recent, during the Holocene (between the present and 11,000 years ago), with southward grounding-line migration past Ross Island shortly before 6,500 carbon-14 years ago. This chronology suggests that rising sea level could not have driven grounding-line retreat to the Siple Coast, because deglacial sea-level rise essentially would already have occurred by mid-Holocene.

To begin to resolve this conflict, one deficiency in the southern Scott Coast work might be corrected. Those data cannot differentiate among the possible

triggering mechanisms because they come from 450 kilometers south of the LGM grounding-line position. We will try to overcome this by constructing relative sea-level curves on a transect along the northern Scott Coast. We hope to get the ages for this work from accelerator mass spectrometer carbon-14 dates of seal skins and shells within raised beaches. These curves should tell us when the grounded ice from the northwestern Ross Sea Embayment cut loose.
[NSF Award # 99-09104]

Field Research Plan

Logistics

Dates in Antarctica:	late December 2001 to mid-February 2002
Research Locations:	Scott Coast; Southern Borchgrevink Coast (Terra Nova Bay region)

Team Members

Brenda Hall	Alex Roy	TBD (2)

Field-Season Overview

The researchers plan to study the relative sea-level history of the Ross Sea and the timing of West Antarctic Ice Sheet retreat.

Project team members will travel via helicopter to Terra Nova Bay, where they will establish a field camp (or stay at the Italian Terra Nova Station). They will make day trips via helicopter to sites along the Southern Borchgrevink and Northern Scott Coasts, where they will travel on foot and use GPS equipment to map the locations and elevations of raised beaches. Team members will also collect organic samples for radiocarbon dating.

Team members will then move camp via helicopter to Granite Harbor, where they will map raised beaches and collect samples. When their work is complete, the researchers will return via helicopter to McMurdo Station.

Samples will be returned to the home institution for analysis.

NSF/OPP Program Manager
Dr. Julie Palais

RPSC Point-of-Contact
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Characterizing the Onset of Ice Stream Flow: A Ground Geophysical Field Program

IO-205-O

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Research Objectives

The objective of our four-year project is to develop a better understanding of the ice streams of the Ross Sea Embayment (A-F) that drain the interior West Antarctic Ice Sheet (WAIS) by rapidly moving vast quantities of ice to the calving front of the Ross Ice Shelf. We will examine the role of these ice streams as buffers between the interior ice and the floating ice shelves. The reasons for their fast flow and the factors controlling their current grounding-line, margin, and head positions are crucial to any attempt to model the WAIS system and predict the future of the ice sheet.

For Antarctic ice streams on the Siple Coast, the transition from no-sliding (or all internal deformation) to motion dominated by sliding is defined as the "onset-region." To fully understand (and adequately model) the WAIS, we must have a better understanding of this onset region. The lateral margins of the ice streams are also a transition that needs better explanation. Hypotheses on controls of the location of the onset region range from the "purely-glaciologic" to the "purely-geologic." Consequently, to model the ice sheet accurately, the basal boundary conditions (roughness, wetness, till properties) and a good subglacial geologic map that shows the distribution, thickness, and properties of the sedimentary basins are required. These parameters can be estimated from seismic, radar, and other geophysical methods.

We will study the transition region of ice stream D in detail with this coupled geophysical experiment. In addition, we will select other locations on ice streams C & D to study, compare, and contrast conditions with the main site on ice stream D. Site-selection for the main camp will be based on existing radar, GPS and satellite data, as well as input from the modeling community.
[NSF Award # 00-86297]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to late January 2002
Research Locations:	Onset D Camp, Ice Stream D, Marie Byrd Land

Team Members

Donald Blankenship	Ed King	David Morse
Jamal Obid	Steffen Saustrup	Paul Winberry
TBD (3)		

Field-Season Overview

The researchers plan to investigate the glacial and sub-glacial processes that coincide with the onset of streaming flow at the West Antarctic ice streams.

Project team members will travel via LC-130 aircraft to the Onset D Camp at Ice Steam D in Marie Byrd Land. Team members will then travel via tracked vehicle and snowmobile to conduct GPS surveys and both shallow and deep radar profiling of the ice along primary survey lines. With Ice Core Drilling Services (ICDS) support, team members will collect a series of firn cores in the study area. Team members will also travel via Twin Otter aircraft to a series of satellite camps. From these camps, team members will travel via snowmobile or tracked vehicles to conduct additional GPS surveys and radar profiles and collect additional firn cores.

Team members will return via Twin Otter aircraft or tracked vehicle to the Onset D Camp, and from there via LC-130 aircraft to McMurdo Station. Firn samples will be returned to the home institution for analysis.

Glaciology

NSF/OPP Program Manager
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Glacial History of Ridge AB
IO-210-O

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Research Objectives

Our study is motivated by the need to improve understanding of how the configuration and activity of the west Antarctic drainage system is changing, and how this affects the stability of the ice sheet. Ridge AB has been chosen for several reasons:

1) Previous studies of inter-stream ridges in West Antarctica have revealed much information about the history of the surrounding ice streams. However, there is an "information-hole" in the southern sector of the ice sheet. We are optimistic that our study of Ridge AB will reveal new information about recent changes in the configuration and activity of Ice Streams A and B.

2) Geologic evidence from Reedy Glacier indicates that ice near Ridge AB was about 700 meters thicker during the last glacial maximum. This helps constrain the magnitude of thinning that has occurred through the Holocene and opens the possibility of linking the history of the West Antarctic Ice Sheet to the geologic record in the Trans-Antarctic Mountains.

Our approach is to first map spatial variations of internal layering, buried crevasses, surface velocity, and accumulation rate. The main investigative tools are high- and low-frequency radar systems, GPS surveying methods, and short (20 meter) firn cores. We will then examine the diagnostic measurements with ice-flow models to infer the glacial history of Ridge AB and the surrounding ice streams. The history will be interpreted in context of the histories that are emerging from the other inter-ice stream ridges, as well as the geologic evidence from Reedy and other outlet glaciers in the Trans-Antarctic Mountains. Our overall goal is to improve understanding of the evolution of the WAIS drainage system.
[NSF Award # 00-87144]

Field Research Plan

Logistics

Dates in Antarctica: late November 2001 to early February 2002
Research Location: Ridge A/B, Siple Coast

Team Members

Howard Conway	Hans-Peter Marshall
Maurice Conway	Ginny Catania

Field-Season Overview

The researchers plan to study the glacial history of Ridge A/B, the ridge between ice streams A and B in West Antarctica.

The project team members will travel via LC-130 aircraft from McMurdo Station to the Siple Dome camp. From there, they will travel via Twin Otter aircraft to Ridge A/B on the Siple Coast. The team members will then travel via snowmobile and use ground-based, ice-penetrating radar and GPS surveys to map features of the ice.

The team members will return via Twin Otter aircraft to the Siple Dome camp, where three members will join the team of project II-163-O and remain in the field. One team member will return via LC-130 aircraft to McMurdo Station.

NSF/OPP Program Manager
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RPSC Point-of-Contact
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United States Component of the International Trans-Antarctic Scientific Expedition (U.S. ITASE)

IU-133-O,153-A,153-B,155-O,158-O,178-O, 185-O,193-O, 311-O, 323-O

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Research Objectives

Research objectives for the U.S. ITASE projects are as follows:

Radar Studies of Internal Stratigraphy and Bedrock Topography along the U.S. ITASE Traverse (IU-133-O)

The U.S. component of the International Trans-Antarctic Scientific Expedition (U.S. ITASE) conducts radar studies to determine the internal stratigraphy and bedrock topography of the terrain along the traverses. This austral summer, team members plan to use one of the traverse tractors to tow a low-frequency, ice-penetrating radar system along the traverse routes. The radar data will depict bedrock topography and internal layers along more than 1,200 kilometers of the West Antarctic Ice Sheet. In addition, the researchers will conduct more detailed studies on grids surrounding each of the ITASE 200-year ice-core sites to characterize accumulation and bedrock topography in these areas. The grids will require 60 to 80 kilometers of radar profiles each, depending on ice thickness and bed topography.

This radar system works as a complement to that operated by the Cold Regions Research and Engineering Laboratory (CRREL). Theirs is a high-frequency radar, most suited to the shallower portion of the record down to approximately 60 meters (m); it can detect near-surface crevasses. Our radar system is most sensitive at depths below 60 m and is able to depict deep bedrock and internal geological layers deep into the ice. [NSF Award # 98-14574]

Science Management for the United States Component of the International Trans-Antarctic Expedition (ITASE) (IU-153-A)

The Science Management Office (SMO) coordinates the effort developed for U.S. ITASE, the broad aim of which is to develop an understanding of the last 200 years of west Antarctic climate and environmental change. ITASE is a multidisciplinary program integrating remote sensing, meteorology, ice coring, surface glaciology, and geophysics. To marshal this effort, SMO runs a series of annual workshops to coordinate the science projects that will be involved in ITASE. They also establish and operate the logistics base that supports ground-based sampling in West Antarctica. [NSF Award # 97-25057]

U.S. ITASE Glaciochemistry (IU-153-B)

Among the research targets for scientists in U.S. ITASE are the impact of anthropogenic activity on the climate and atmospheric chemistry of West Antarctica and the variations in biogeochemical cycling of sulfur and nitrogen compounds over the last 200 years.

Begun during the 1999-2000 austral summer, this five-year project focuses on glaciochemical analyses of the major anions and cations to be found in shallow and intermediate depth ice cores collected on the U.S. ITASE traverses. The ionic composition of polar ice cores provides one of the basic stratigraphic tools for relative dating. These data can also be used to document changes in chemical-species source emissions, which in turn facilitate mapping and characterization of the major atmospheric circulation systems affecting the West Antarctic Ice Sheet. [NSF Award # 98-11857]

Snow and Firn Microstructure and Transport Properties: U. S. ITASE (IU-155-O)

Not all valuable data are buried deep within the ice. The microstructure and bulk properties of snow and firn near and at the surface control the air/snow/firn transport processes; i.e., how heat, vapor, and chemical species in air are incorporated into snow and polar firn. Since many of the snow and firn properties will also affect how radiation in different parts of the electromagnetic spectrum behaves, such field measurements provide a valuable baseline profile against which to range complementary efforts that use remote sensing to map the spatial variations of snow, firn, and ice properties.

This project does the field and lab work to characterize snow and firn properties along the U.S. ITASE traverses in West Antarctica. We provide field measurements of snow and firn properties near the surface (down to 2 meters), including surface roughness, permeability, density, grain size, surface-to-volume ratio, and tortuosity. In the laboratory, firn cores from as deep as 20 meters will be analyzed for these properties and for their microstructure. Ultimately, we will develop a transport model to elucidate the nature of the air/snow/firn exchange and the firnification process at the various sites along the U.S. ITASE traverse. [NSF Award # 98-14676]

Hydrogen Peroxide, Formaldehyde, and Sub-annual Snow Accumulation in West Antarctica: Participation in West Antarctic Traverse (IU-158-O)

Atmospheric photochemistry leaves valuable traces in snow, firn, and ice; it has been verified that the efficiency of atmosphere-to-snow transfer and the preservation of hydrogen peroxide and formaldehyde are both strongly related to temperature and also to the rate and timing of snow accumulation. Thus measurements of these components in the firn and atmosphere will provide data needed to study changes in tropospheric chemistry of the boundary layer over West Antarctica.

This project will collect samples and take atmospheric measurements along the U.S. ITASE traverses. The wide-ranging extent of these traverses will train the scientific lens upon a variety of locations, covering much of the West Antarctic region, and reflecting a range of different depositional environments.

A necessary step to study atmospheric chemistry is to estimate the inter-annual patterns of snow accumulation at sub-annual resolution in the pits and cores. We will measure the concentration of seasonally dependent species (including hydrogen peroxide, nitrate, and chloride) on all samples, which together with stable isotope and ionic analyses by others will provide a highly resolved accumulation record. We will then use a recently developed, physically based, atmosphere-to-snow transfer model in order to elucidate the photochemistry that led to the concentrations in the snow/firn. These snow chemistry data will also shed light on the inter-annual variability of snow accumulation over a wide spatial range in West Antarctica.

In addition, data we develop on current atmospheric levels of hydrogen peroxide, higher peroxides such as methylhydroperoxide, and formaldehyde will constrain model boundary conditions and the state of photochemistry in the austral summer. [NSF Award # 98-14810]

Mass Balance and Accumulation Rate along U.S. ITASE Routes (IU-178-O)

The polar ice sheets and the snow falling on them are important components of the global hydrological cycle. Yet, because of their very large size and remote locations, we have only a limited understanding of their mass balance (rate of thickness change) or the spatial distribution of snow accumulation. Work conducted as part of the U.S. ITASE seeks to improve this understanding.

This five-year project, which is beginning its third year, involves measuring the rate of ice-sheet thickening (or thinning) at selected sites along flow lines, on ice divides, and along elevation contours. The measurements compare the vertical velocity of ice (obtained from precise global positioning system surveys of markers buried 5-20 meters deep in the surface firn) with the local, long-term average snow accumulation rate evident in ice-core stratigraphy. Earlier work demonstrates that very precise rates of thickness change can be measured using this technique.

We are also studying spatial variations in accumulation rates, probing the link between snow accumulation and surface topography. Continuously operating, autonomous instruments will be deployed at several closely spaced sites that have very different slope gradients. The instruments will record snow accumulation, wind speed and direction, firn compaction, and firn temperature. These results will enable us to test hypotheses of the physical processes of snow deposition and erosion.

We shall also investigate the ice flow effects on accumulation rates derived from U.S. ITASE ice-core records. At sites along flow lines, ice cores record the integrated accumulation rate history for a certain distance up-glacier of the core site. Changes in surface topography along this flow line will lead to apparent accumulation rate variations in the ice-core record. By studying local ice dynamics (horizontal velocities, surface slope) around each ice core site, we will be able to better understand the cause of accumulation rate variations in the core records. [NSF Award # 98-15110]

The Physical Properties of the U.S. ITASE Ice Cores (IU-185-O)

Our objective is to examine the visual stratigraphy, physical, and structural properties of the U.S. ITASE ice cores spanning the last 200 years of snow accumulation in Antarctica. First, we will examine visual stratigraphy to delineate the annual layer structure for dating purposes and to determine to as great a depth as possible, accumulation variability over the full length of a stratigraphically dated core. Wind crusts and melt layers will also be identified in each core.

Second, we will measure and analyze depth-density profiles. The rate of snow and firn densification depends on both the rate at which the snow is deposited and the in-situ snow temperature. These data can and will be used to derive average snow accumulation rates for the sites where annual layer structure is difficult to decipher or where stratigraphic analysis fails altogether.

Third, we will also measure the mean crystal size over the full length of a core. Crystal growth is a strongly temperature-dependent process, and measurements to be made on ITASE cores will help to bridge a significant data gap that exists in the mean annual temperature range, -31 to -50 ºC. Additionally, crystal size data can also be used, in conjunction with ice loads based on density profile measurements, to extract mean accumulation rates for these sites where stratigraphic dating of cores proves difficult or impossible to accomplish. This is likely to occur at the lowest accumulation/lowest temperature sites along the ITASE traverse routes. [NSF Award # 99-80434]

Stable Isotope Studies at West Antarctic ITASE Sites (IU-193-O)

As participants in U.S. ITASE, we will perform stable isotope analyses of samples collected during the traverses in West Antarctica. Using instrumental and remote-sensing temperature histories, we will focus on the spatial and temporal distribution of oxygen-18 and deuterium in West Antarctica (where data are particularly sparse) and the calibration of the isotope/climate relationship on a site-by-site basis.

Our objectives are to:

- obtain detailed oxygen-18, deuterium, deuterium-excess, and stratigraphic histories in snowpits at most or all of the U.S. ITASE coring sites;
- provide direct calibration of the isotope/climate relationship at each site, through a combination of direct (automatic weather stations) and indirect (passive microwave satellite) temperature measurements;
- obtain isotope profiles covering the last 200 years; and
- use the results to provide climate histories at high temporal and broad spatial resolution across West Antarctica for the past two centuries.

These climate histories will provide the context to test relationships that have been proposed among isotopes, moisture source conditions, synoptic scale climatology, and site-specific meteorological parameters. They will also enhance our ability to interpret isotope records from older and deeper Antarctic ice cores. [NSF Award # 99-04947]

High Resolution Radar Profiling of the Snow and Ice Stratigraphy Beneath the ITASE Traverses, West Antarctic Ice Sheet (IU-311-0)

Ice core measurements provide historical profiles of snow accumulation and chemistry at only the point where the core was drilled which — along the U.S. ITASE traverses — is every 100 kilometers (km). Subsurface radar, by contrast, provides reflection profiles of continuous horizons, generally related to density and chemistry contrasts; but their continuity strongly suggests that they are isochronal (that is, demonstrate regularity of period). Thus, they can be used to track particular years between core sites and to provide a broad and more meaningful average of year-to-year accumulation rates, given the time versus depth calibrations from the cores.

This project is tracking these reflection horizons between core sites using high-resolution ground-penetrating, short-pulse radar. Our main antenna system uses a pulse centered near 400 MHz, which provides vertical resolution of about 35 centimeters (cm), and records reflections from a depth in firn of about 60 meters (m). During the first year of U.S. ITASE, we tracked some horizons for distances of more than 190 km and found depth variations as great as 22 m over a 5 km stretch. The variations are caused by surface topography, which affects local accumulation rates and ice movement.

We are also using a wide range of frequencies (as high as 10 GHz and as low as 100 MHz) to distinguish between conductivity and density as a cause of the reflections. The horizon tracking develops spatially averaged, historical accumulation rates; these can be correlated with GPS data to find the effects of topography upon local accumulation rates. In addition, the radar is also being used for advanced crevasse detection. [NSF Award # 98-14589]

Deposition of the HFC Degradation Product Trifluoroacetate in Antarctic Snow and Ice (IU-323-0)

Trifluoroacetate (TFA) is a highly persistent, atmospheric degradation product of the halogenated ethane derivatives (HCFC, HFC) that have been introduced as environmentally friendly chlorofluorocarbon (CFC) substitutes. There is concern that the widespread introduction of HCFCs and HFCs will lead to the accumulation of TFA in aquatic ecosystems. Current data on pre-industrial, background concentration of TFA in meteoric and surface waters, including Antarctic ice, are ambiguous and the impact of anthropogenic TFA on these background concentrations is unclear. Ice core records can provide proxy records of background and anthropogenic TFA deposition.

Our primary objective is to use ice cores and snow pits at South Pole to develop a temporal record of TFA deposition, spanning approximately 1,000 years but focused on the past 20 years. The pre-industrial to present record of TFA in near-surface snow and ice at South Pole and in West Antarctica will be unique and will lead to a much better understanding of the origin, transport, and fate of this contaminant over Antarctica and possibly the globe. In addition, understanding the natural and anthropogenic sources, the regional and long-range movement, and the eventual fate of contaminants is critical to assessing potential impacts on Antarctic ecosystems. [NSF Award # 00-87776]

The following list contains Principal Investigator contact information for each U.S. ITASE project:

IU-133-O: Radar studies of Internal Stratigraphy and Bedrock Topography along the U.S. ITASE Traverse

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IU-153-A: Science Management for the United States Component of the International Trans-Antarctic Expedition (ITASE)

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IU-153-B: U.S. ITASE Glaciochemistry

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IU-155-O: Snow and Firn Microstructure and Transport Properties: U. S. ITASE

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IU-158-O: Hydrogen Peroxide, Formaldehyde, and Sub-annual Snow Accumulation in West Antarctica: Participation in West Antarctic Traverse

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IU-178-O: Mass Balance and Accumulation Rate along U.S. ITASE Routes

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IU-185-O: The Physical Properties of the U.S. ITASE Ice Cores

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IU-193-O: Stable Isotope Studies at West Antarctic ITASE Sites

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IU-311-0: High Resolution Radar Profiling of the Snow and Ice Stratigraphy beneath the ITASE Traverses, West Antarctic Ice Sheet

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IU-323-0: Deposition of the HFC Degradation Product Trifluoroacetate in Antarctic Snow and Ice

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Field Research Plan

Logistics (For all U.S. ITASE Projects)

Dates in Antarctica:	late October 2001 to mid-January 2002
Research Locations:	Byrd Surface Camp to Siple Station, Marie Byrd Land

Team Members (For all U.S. ITASE Projects)

Paul Mayewski	Gordon Hamilton	Steve Arcone
Tom Neumann	Allan Delaney	Daniel Dixon
Markus Frey	Brian Welch	Susan Kaspari
David Schneider	V. Blue Spikes	Lynn Peters
Mark Wumkes	Jan French	

Field-Season Overviews

ITASE Traverse Overview

The broad aim of the United States component of the International Trans-Antarctic Scientific Expedition (U.S. ITASE) is to develop an understanding of the last 200 years of West Antarctic climate and environmental change. ITASE, part of the West Antarctic Ice Sheet Initiative (WAIS), is a multidisciplinary program that integrates remote sensing, meteorology, ice coring, surface glaciology, and geophysics. The U.S. component of the ITASE is coordinated through the science management office located at the University of Maine at Orono.

The projects funded as part of the U.S. ITASE are:

IU-133-O Dr. Jacobel
IU-153-B Dr. Mayewski
IU-155-O Dr. Albert
IU-158-O Dr. Bales
IU-178-O Dr. Hamilton
IU-185-O Dr. Meese
IU-193-O Drs. Steig, White, and Shuman
IU-311-O Dr. Arcone
IU-323-O Dr. McConnell

The U.S. ITASE team will conduct a traverse in West Antarctica during the 2001-2002 field season. The ITASE team members and support contractor personnel will fly via LC-130 aircraft from McMurdo Station to Byrd Surface Camp (BSC). The traverse, which will consist of team members traveling in two trains pulled by Challenger 55 Caterpillar tractors, will begin at BSC, extend to old Siple Station, then return to BSC. During the traverse, the team members will take ice cores, collect surface snow and ice samples, take meteorological readings, and collect radar profiles of the ice sheet. Periodically, Twin Otter aircraft will resupply the traverse team and transport samples back to BSC.

At the end of the field season, all U.S. ITASE team members and their samples will be transported from BSC to McMurdo Station on an LC-130 aircraft. Some ice and snow samples will be analyzed at the Crary Science and Engineering Center (CSEC), while others will be returned to the home institutions for analysis.

IU-133-O: Radar studies of Internal Stratigraphy and Bedrock Topography along the U.S. ITASE Traverse

The team members plan to tow a low-frequency, ice-penetrating radar system along the U.S. ITASE traverse routes. The radar data will depict bedrock topography and internal layers of the West Antarctic Ice Sheet (WAIS). When time permits, the researchers will conduct more detailed studies on grids surrounding each of the ITASE 200-year ice-core sites.

IU-153-A: Science Management for U.S. ITASE

Project team members plan to continue their overall management of the U.S. ITASE program. This will include coordinating logistics and sample collection, assisting in sample collection, and maintaining a science management office. Team members will also organize a series of annual workshops to coordinate the science projects involved in ITASE.

IU-153-B: U.S. ITASE Glaciochemistry

The researchers plan to continue their studies of atmospheric chemistry, as a means of elucidating climate variations. They will also examine the impact of anthropogenic activity on the climate and atmospheric chemistry of West Antarctica, as well as variations in the biogeochemical cycling of sulfur and nitrogen compounds over the last 200 years.

Traverse team members will collect ice-core samples for ultra-high resolution analysis and interpretation of soluble ion content. The cores will be sent to the home institution for analysis.

IU-155-O: Snow and Firn Microstructure and Transport Properties: U. S. ITASE

The researchers plan to continue their investigation into snow and firn bulk properties and microstructures. No members of this project will participate in the 2001-2002 ITASE traverse. Other members of the U.S. ITASE traverse team will conduct measurements and collect samples in support of this project. ITASE team members will collect 15-meter firn cores during the traverse, and they will measure the permeability of snow samples at the ITASE coring sites. Firn and snow samples will be shipped to CRREL for analysis.

IU-158-O: Hydrogen Peroxide, Formaldehyde, and Sub-annual Snow Accumulation in West Antarctica: Participation in West Antarctic Traverse

The researchers plan to continue their extended studies of atmospheric photochemistry over West Antarctica and its record in snow, firn, and ice. Project team members will collect snow pit, firn, and ice core samples along the traverse, and they will collect snowpack and fresh surface snow after a snowfall. Team members will also conduct continuous atmospheric chemistry measurements, and they will use solar heated balloons to measure atmospheric ozone and boundary layer height. Recently fallen snow samples will be analyzed at the CSEC at the end of the field season. Other samples will be sent to the home institution for analysis.

IU-178-O: Mass Balance and Accumulation Rate along U.S. ITASE Routes

The researchers plan to continue their study of the mass balance and accumulation rate of ice along the traverse routes. Team members will use markers and GPS to record the horizontal and vertical velocities of subsurface ice, thereby measuring the rate of ice-sheet thickening or thinning along flow lines, ice divides, and elevation contours in West Antarctica.

Team members will install a series of recording instruments to provide continuous records of firn densification and changes in snow-surface elevation. Other recording instruments will measure wind-speed and direction as well as snow accumulation. Project team members will also travel via Twin Otter aircraft to conduct a re-survey of sites from the 2000-2001 traverse. The data will be returned to the home institution for analysis.

IU-185-O: The Physical Properties of the U.S. ITASE Ice Cores

The researchers plan to examine the visual stratigraphy and the physical and structural properties of the U.S. ITASE ice cores, which span the last 200 years of snow accumulation in Antarctica.

Since no members of this project will participate in the 2000-2001 ITASE traverse, other members of the U.S. ITASE traverse team will conduct on-site weighing of samples for this project for snow/firn/ice density calculations. Ice cores drilled by the drilling team (approximately 1 meter in length) and smaller samples from snow pits will be carefully weighed. It is necessary to do this in the field, as the exterior portion of snow and firn cores may deteriorate during transport. Therefore, field measurements will be the most accurate.

Collected samples will be returned to the home institution for additional studies including grain size analyses. The researchers will participate in the core processing line in Denver to complete visual stratigraphic analysis including annual layer, crust, and melt layer identification.

IU-193-O: Stable Isotope Studies at West Antarctic ITASE Sites

The researchers plan to examine the spatial and temporal distribution of oxygen-18 and deuterium in West Antarctica. A project team member will collect snow-pit and ice-core samples along the traverse route. The team member will also collect snow density and accumulation data. Samples will be returned to the home institution for analysis.

IU-311-0: High Resolution Radar Profiling of the Snow and Ice Stratigraphy beneath the ITASE Traverses, West Antarctic Ice Sheet

The researchers plan to use high-resolution, ground-penetrating radar to profile the snow and ice beneath the ITASE traverse routes. Team members will both push and drag radars along the traverse. The pushed antenna will extend six meters in front of the lead vehicle to detect crevasses. The dragged radar antenna and a GPS antenna will be used to profile the top 60 meters of firn. The radar team will also obtain profiles of stratigraphy through the firn-ice transition near the core site camps. The researchers will compile and process data enroute and enter GPS positions on the radar data.

IU-323-0: Deposition of the HFC Degradation Product Trifluoroacetate in Antarctic Snow and Ice

The researchers plan to study the recent deposition of trifluoroacetate, an atmospheric degradation product of halogenated ethane coolants, in Antarctica. No member of this project will deploy to the field for the 2001-2002 ITASE traverse. In support of this project, other members of the U.S. ITASE team will collect surface snow, snow pit, and ice core samples along the ITASE traverse route. These samples will be shipped to the home institution for analysis.

NSF/OPP Program Manager
Dr. Julie Palais

RPSC Point-of-Contact
Mr. Andy Young

Overview of the Antarctic Oceans and Climate Systems Program

Antarctic oceanic and tropospheric studies focus on the structure and processes of the ocean-atmosphere environment and their relationships with the global ocean, the atmosphere, and the marine biosphere. As part of the global heat engine, the Antarctic has a major role in the world's transfer of energy. Its ocean/atmosphere system is both an indicator and a component of climate change. The ocean and climate systems program sponsors research that will improve understanding of high-latitude oceanic environment, including the global exchange of heat, salt, water, and trace elements, sea-ice dynamics, and tropospheric chemistry and dynamics.

Major program elements include the following:

- Physical oceanography: the dynamics and kinematics of the polar oceans; the interaction of such forces as wind, solar radiation, and heat exchange; water-mass production and modification processes; ocean dynamics at the pack-ice edge; and the effect of polynyas on ventilation.
- Chemical oceanography: the chemical composition of seawater and its global differentiation, reactions among chemical elements and compounds in the ocean, fluxes of material within ocean basins and at their boundaries, and the use of chemical tracers to study time and space scales of oceanic processes.
- Sea-ice dynamics: the material characteristics of sea ice from the individual crystal level to the large-scale patterns of freezing, deformation, and melting.
- Meteorology: atmospheric circulation systems and dynamics, including the energy budget; atmospheric chemistry; transport of atmospheric contaminants to the Antarctic; and the role of large and mesoscale systems in global exchange of heat, momentum, and trace constituents.

CORC-Arches
OO-124-O

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Research Objectives

Better understanding of rapid climate change is one of the most pressing issues for climate sciences in the twenty-first century. We know that human activities are changing such important elements of Earth's climate system as the composition of the radiative active gases in the atmosphere. However, we are less certain about the responses of the coupled climate system, particularly strong amplifiers of climate perturbations and sources of nonlinear responses. Processes in the ocean like deep convection with its connection to the global ocean circulation, sea ice and its impact on the planet's albedo and regime shifts of coupled ocean atmosphere phenomena could trigger rapid climate change. Modern observations can further our understanding by providing insight into the processes that are thought to play an important role, providing the data to validate global climate models that are then used for a more complete assessment of possible system responses, and, if maintained over a long time period, enabling researchers to directly track the state of the climate system and provide the baseline from which predictions can be attempted.

As part of our effort to accomplish these objectives, we will continue our long-term observations of the outflow of Weddell Sea Bottom and Deep Water and other components identified as being sensitive indicators of climate change in the Southern Ocean, analyze ice-ocean-atmosphere interactions in the historical data sets and coupled climate models with emphasis on ocean-heat transport variability, and investigate deep-water formation processes and variability and their importance for the large-scale circulation.

This austral summer working aboard the research icebreaker *Nathaniel B. Palmer*, we will recover and redeploy three instrument moorings originally deployed during cruise 99-3 of the *Laurence M. Gould* near the South Orkney Plateau. Time permitting, we hope to occupy CTD/tracer stations along the track between the current meter sites. The CTDs record current, temperature, and salinity variability within 500 meters of the ocean bottom. We will also obtain water samples at the moorings and between sites for current-temperature-density profiles and tracer chemistry. [NOAA award]

Cruise Research Plan

Logistics

Cruise NBP01-06

Departs:	Punta Arenas, Chile, on 9 November 2001
Arrives:	Punta Arenas, Chile, on 1 December 2001
Research Location:	Weddell Sea

Team Members

Eugene Gorman	Bruce Huber
Philip Mele	Philippe Collon

Cruise Overview

The team members plan to work on board the R/V *Nathaniel B. Palmer* during cruise NBP01-06 to recover, service, and replace two oceanographic moorings located in the vicinity of the South Orkney Plateau, in the northwestern Weddell Sea in the Southern Ocean. They will also use the on-board CTD system to obtain CTD profiles and water samples for tracer chemistry at the mooring sites and sites in between.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Don Michaelson

Longwave Radiation Processes on the Antarctic Plateau

OO-201-O

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Research Objectives

Thermal infrared (“longwave”) radiation is an important component in the energy balance between the atmosphere and Earth’s surface. On the Antarctic continent, radiation processes dominate the surface energy budget. In summer, the budget involves four terms — incoming solar (or short-wave) radiation, reflected solar radiation, long-wave radiation emitted by the atmosphere, and long-wave radiation emitted by the snow surface. In winter, after the sun sets, the short-wave terms fall to zero. The emitted long-wave radiation increases with temperature, so the surface temperature is determined by the balance of radiation fluxes.

Our project entails an experimental study of long-wave radiation processes near the surface at Amundsen-Scott South Pole Station. We have been taking high-resolution spectral measurements of the long-wave radiation at the snow surface. A Fourier-transform Interferometer installed in late 2000 operated for a full year, and at the beginning of the 2001-2002 austral summer, we will remove our instruments and collect the recorded data. Supporting observations were also made of how temperature and humidity vary with height in the lower atmosphere and of the ice crystals in the atmospheric boundary layer. The research also has included experiments concerning the emission characteristics of snow, of ice crystals in the atmosphere, of clouds, and of greenhouse gases near the surface.

Determining the concurrent environmental conditions (such as cloud-base altitude, temperature, and humidity-structure) and the sizes and concentrations of ice crystals contributes to the newly developing climatology of cloud properties and should improve climate models with more detailed radiation processes.
[NSF Award # 97-26676]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to mid-November 2001 (*Note*: Two team members have been on site during the 2001 austral winter season)
Research Locations:	Boundary of the Clean Air Sector, Atmospheric Research Observatory (ARO)

Team Members

James Campbell   Steve Hudson   Michael Town

Field-Season Overview

The project team members plan to complete their year-long experiment by continuing to measure heat emission from the atmosphere and snow surface using a Fourier transform infrared spectrometer. They will use these measurements to retrieve properties of the atmosphere (clouds, temperature, humidity) and the surface (snow temperature and emissivity).

When this experiment has been completed, all project equipment will be returned to the United States, except for the Micropulse Lidar (MPL), which will remain on-site for the 2002 austral winter. A team member will also refurbish the MPL 2002, which will remain in the ARO building.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

Antarctic Meteorological Research Center (AMRC)

OO-202-O

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Research Objectives

The Antarctic Meteorological Research Center (AMRC), one of three research centers in the Crary Science and Engineering Center at McMurdo Station, is a resource for meteorological research and a test bed for improving operational synoptic forecasting. The Man-Computer Interactive Data Access System (McIDAS), a versatile computer-based system developed by the University of Wisconsin for organizing, manipulating, and integrating environmental data forms the basis of AMRC. It captures the flow of Antarctic meteorological information from polar-orbiting satellites, automatic weather stations, operational station synoptic observations, and research project data. It also receives environmental data products, such as weather forecasts, from outside Antarctica, and acts as a repository for existing archived data bases.

The AMRC was established in the 1992-93 austral-summer season and consisted of work stations capable of manipulating and displaying Advanced Very High Resolution Radiometer (AVHRR) data based on the existing satellite-imagery-acquisition system. This was followed by the acquisition and integration of a system that provided data collection, data display and archiving, scientific applications, network communications, and remote user access.

The system currently produces the Antarctic Composite Infrared Image (ACII), a mosaic of images from four geostationary and three polar-orbiting satellites, and is used for both forecasting and research purposes. The current phase maintains continuity of product generation and user support.
[NSF Award # 99-08842]

Field Research Plan

Logistics

Dates in Antarctica: late December 2001 to late January 2002
Research Locations: Crary Science and Engineering Center (CSEC); Mac Weather

Team Member

Matthew Lazzara

Field-Season Overview

The project team member plans to work in the CSEC and at Mac Weather to upgrade the data reception and processing capabilities of the Antarctic Meteorological Research Center (AMRC). The team member will also work with support contractor personnel to upgrade the AMRC tape archiving system.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Andy Archer

A Study of Atmospheric Oxygen Variability in Relation to Annual to Decadal Variations in Terrestrial and Marine Ecosystems

OO-204-O

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Research Objectives

Oxygen, the most abundant element on the Earth, comprises about a fifth of the atmosphere. But much of the Earth's oxygen resides in other chemical species — in water, rocks, and minerals and, of course, in flora and fauna that recycle it (both directly and as carbon dioxide) through the processes of photosynthesis and respiration. Thus scientists are interested in measuring the concentration of molecular oxygen and carbon dioxide in air samples.

Our project includes a subset of sample collections being made at a series of baseline sites around the world. These data should help to improve estimates of the processes whereby oxygen is cycled throughout the global ecosystem, specifically, through photosynthesis and atmospheric mixing rates. The data will also allow better predictions of net exchange rates of carbon dioxide with biota on land and in the oceans.

An important part of the measurement program entails developing absolute standards for oxygen-in-air, to ensure stable long-term calibration. We are also conducting surveys of the oxidative oxygen/carbon ratios of both terrestrial- and marine-based organic carbon, hoping to improve the quantitative basis for linking the oxygen and carbon dioxide geochemical cycles.

These results should help enhance our understanding of the processes that regulate the buildup of carbon dioxide in the atmosphere and of the change processes — especially climate change — that regulate ecological functions on land and in the sea. [NSF Award # 96-12518]

Field Research Plan

Logistics
Research Location: Palmer Station

Team Members
No deploying project personnel

Field-Season Overview

The researchers plan to continue measuring variations in the concentration of oxygen and carbon dioxide in air samples from Palmer Station, Antarctica. The Palmer Station physician will collect air samples from behind the T-5 building for this project on a semi-weekly basis. The samples will be returned in airtight flasks to the home institution for analysis.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Cara Sucher

Mesoscale, Seasonal, and Inter-annual Variability of Surface-Water Carbon Dioxide in the Drake Passage

OO-214-O

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Co-Principal Investigator: Dr. Colm Sweeney
Lamont-Doherty Earth Observatory

Research Objectives

We will install and maintain equipment, as well as analyze the obtained data, on the research vessel *Laurence M. Gould*. The equipment is designed to measure dissolved carbon dioxide (pCO_2) along with occasional total carbon dioxide (TCO_2) in surface waters on transects of Drake Passage. This work extends similar measurements made aboard the USAP's icebreaking research vessel *Nathaniel B. Palmer* and complements similar surface temperature and current data.

The Southern Ocean is an important component of the global carbon budget. Low surface temperatures with consequent low vertical stability, ice formation, and high winds produce a very active environment for the exchange of gaseous carbon dioxide between the atmospheric and oceanic reservoirs. The Drake Passage is the narrowest point through which the Antarctic Circumpolar Current and its associated fronts must pass and is the most efficient location for the measurement of latitudinal gradients of gas exchange. The complementary temperature and current data, supplemented by satellite imagery, will allow not only the quantitative description of the sources of pCO_2 variability and the calculation of air-sea CO_2 fluxes but also estimates of the net production and carbon export by the biological community. [NSF Award # 00-03609]

Cruise Research Plan

Logistics

Measurements will be taken on both USAP research vessels during the 2001-2002 season.

Team Member

Colm Sweeney

Cruise Overview

The team member will install the pCO_2 equipment onboard the R/V *Laurence M. Gould* during the maintenance period in November 2001. This equipment will be fully functional by January 2002 for cruise LMG02-01.

Shipboard contractor electronics/computer/science technicians on both the R/V *Laurence M. Gould* and R/V *Nathaniel B. Palmer* will operate the pCO_2 equipment and send data to the principal investigator. The data from this equipment compliments the data from other underway systems on both research vessels (i.e., acoustic doppler current profiler (ADCP), expendable bathythermograph (XBT), thermosalinograph (TSG), and weather systems) to give a more complete picture of environmental conditions across the Drake Passage.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
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Mr. Bob Kluckholn

Isotopic Measurements of Atmospheric H2

OO-221-O

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Research Objectives

We are investigating the atmospheric hydrogen (H_2) budget using isotopic measurements. H_2 is the second most abundant reactive gas in the troposphere and is directly tied to the cycling of carbon monoxide (CO), methane (CH_4), and non-methane hydrocarbons via the photochemical formation and destruction of formaldehyde (HCHO). Currently, the global H_2 budget is balanced only to within about 50%. Measurements are being made of the ratio of deuterium to hydrogen in marine locations, in areas during biomass burning, and in H_2 produced by the photolysis of HCHO, and during soil uptake of H_2. The degree of enrichment of deuterium in these samples will indicate the relative importance of the soil and the photochemical sinks for H_2. This work is helping to resolve the current discrepancies in the global budget of H_2 and contribute to the overall understanding of the importance of increasing concentrations of CO, CH_4, and H_2 in the troposphere. Also, if H_2 becomes an important energy source in the future, it will become even more important to understand its global budget. [NSF Award # 00-91878]

Cruise Research Plan

Logistics

Cruise Dates:	early November 2001 to late December 2001
Research Locations:	Cruise track of the USCG Icebreaker *Polar Star,* starting at Seattle, Washington, going to Hobart, Australia, and then to McMurdo Station, Antarctica

Team Member

Katherine Cox

Cruise Overview

This project will conduct isotopic measurements on hydrogen isolated from whole air samples to improve the current understanding of the atmospheric hydrogen budget.

The team member will continue periodic measurements while on board the USCG Icebreaker *Polar Star* as it travels from Seattle, Washington, to Hobart, Australia, and then to McMurdo Station, Antarctica. Once at McMurdo Station, the team member will travel via aircraft to New Zealand.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Rob Robbins

Measurements of the Size, Shape, Scattering Phase Function, and Extinction Coefficient of Ice Crystals at South Pole Station

OO-226-O

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Research Objectives

Clouds are both the cause and result of atmospheric phenomena; one of their primary roles is as a reflector of solar energy — coming both from space and radiated/reflected from the Earth. And what are clouds? Broadly, clouds form when rising damp air expands to the point that it approaches saturation. With nowhere else to go, water molecules condense onto any local, available aerosol particles — the aggregation becomes a cloud. A number of theoretical and experimental studies have demonstrated that a cloud particle's size as well as its shape — and specifically ice crystals — strongly determine how it will reflect and radiate light (and energy).

Looking especially at cirrus clouds, this project will classify cloud particles by size and shape and will also investigate the light-scattering properties of ice crystals in the atmosphere above Amundsen-Scott South Pole Station. In cooperation with an ongoing radiation transfer program, we will deploy two high-resolution, digital cloud-particle imagers. The particle images, concentrations, and size distributions will be processed on site. Our software permits us to reject artifacts, and to compute various size and shape parameters, scattering characteristics, and ice/water proportions.

These data will complement several concurrent experiments concerning the emission characteristics of snow, ice crystals in the atmosphere, and greenhouse gases near the surface. With measurements of such environmental conditions as cloud-base altitude, temperature, and humidity structure, our data should allow us to develop new algorithms to substantially improve representations of radiation processes in general circulation models. We also expect to enhance the climatology of cloud-particle and cloud properties. [NSF Award # 99-09593]

Field Research Plan

Logistics

Dates in Antarctica:	mid-January 2002 to early February 2002
Research Locations:	Atmospheric Research Observatory (ARO) and edge of Clean Air Boundary

Team Members

Brad Baker	Jean-Francois Gayet	Darren O'Conner
Paul Lawson	Patrick Zmarzly	

Field-Season Overview

The project team members plan to install and operate three optical instruments on the roof of the SPARCLE building, which is located on the edge of the Clean Air Boundary. These instruments will measure the size, shape, and scattering phase function of ice crystals at South Pole Station. Other occasional measurements will be taken on the roof of the ARO building. The instruments will be mounted on wooden stands that will be constructed by the support contractor's construction personnel.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

South Pole Monitoring for Climatic Change - U.S. Department of Commerce, NOAA, Climate Monitoring and Diagnostics Laboratory

OO-257-O

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Research Objectives

The National Oceanic and Atmospheric Administration (NOAA) has been conducting studies to determine and assess the long-term buildup of trace atmospheric constituents that influence climate change and the ozone layer. Time-series analyses of long-term data provide insight into several phenomena of particular interest. These include the following:

- seasonal and temporal variations in greenhouse gases,
- stratospheric ozone depletion,
- trans-Antarctic transport and deposition,
- the interplay of the trace gases and aerosols with solar and terrestrial radiation fluxes that occur on the polar plateau, and
- the development of polar stratospheric clouds over Antarctica.

Project scientists measure carbon dioxide, methane, carbon monoxide, stable isotopic ratios of carbon dioxide and methane, aerosols, halocarbons, and other trace constituents. Flask samples are collected and returned for analysis at the NOAA/CMDL and cooperative institutions' laboratories; concurrent in situ measurements are made of carbon dioxide, nitrous oxide, selected halocarbons, aerosols, solar and terrestrial radiation, water vapor, surface and stratospheric ozone, wind, pressure, air and snow temperatures, and atmospheric moisture. Personnel at Palmer Station also will collect air samples to support this project.

These measurements allow us to determine the rates at which concentrations of these atmospheric constituents change and will suggest likely sources, sinks, and budgets. To further determine how the rates of change of these parameters affect climate, we are collaborating with climate modelers and diagnosticians. [NSF Award # 90-17842]

Field Research Plan

Logistics

Dates in Antarctica:	late October 2001 to late January 2002 AND 2002 austral-winter season
Research Locations:	Atmospheric Research Observatory (ARO), Balloon Inflation Facility (BIF)

Team Members

Andrew Clarke	Ed Dlugokencky	Geoff Dutton
Bob Evans	Loreen Lock	Tom Mefford
Steve Montzka	Russ Schnell	Scott Wingerter
TBD (2)		

Field-Season Overview

The project team members plan to continue their long-term measurements of trace atmospheric constituents that influence climate. In early November, the team members will relieve the 2001 winter-over team members and continue the atmospheric monitoring program, which includes monitoring surface and stratospheric ozone, carbon dioxide, water vapor, ozone-depleting compounds, and other trace constituents of the atmosphere.

At various times during the season, the team members will conduct the following experimental procedures:

- Sampling air upwind of the station, in the Clean Air Sector, using machines that suck air through chemical analyzers through the roof of the ARO;
- Measuring ozone in the atmosphere optically, using a Dobson UV spectrometer operating through a window in the ARO;
- Sampling ozone in the upper air (from the surface to over 30 kilometers), using ozonesondes connected to high-altitude balloons launched from the BIF; and
- Collecting air samples in the Clean Air Sector, near the snow surface upwind of the ARO.

Samples and data will be returned to the home institution for analysis. Two of the team members will remain at the station during the 2002 austral winter to operate and maintain the equipment and continue the research.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Eivind Jensen

Drake Passage XBT Program
OO-260-O

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Research Objectives

The Antarctic Circumpolar Current (ACC) is a powerful force that drives waters in the Southern Ocean — four times as fast as the Gulf Stream, for example. The current is even stronger wherever the distance between Antarctica and neighboring land is narrowed. These are the so-called chokepoints, such as the Drake Passage off the tip of South America and the sea regions between Antarctica and both the Cape of Good Hope and Tasmania. To determine the fluctuations in the transport of the ACC, scientists deploy bottom pressure gauges and similar instruments; this data can then be ranged against currents in the subtropical and subpolar gyres and to the wind field over the southern oceans.

Since 1996, scientists in this research project have been collecting data to characterize the water mass variability in the Drake Passage, to describe temperature and circulation variability in the Southern Ocean, and to define the role of the Southern Ocean in the global climate system.

This season, using high-density expendable bathyermographs (XBTs) launched from the USAP's research vessel *Laurence M. Gould*, we will measure current, temperature, and depth for seasonal and year-to-year temperature fluctuations in the upper ocean within the Drake Passage. Since the water changes more rapidly there, we will execute frequent casts across the Sub-Antarctic, Polar, and ACC fronts. [NSF Award # 00-03618]

Cruise Research Plan

Logistics
Data collection is planned on selected R/V *Laurence M. Gould* cruises within the Drake Passage during the 2001-2002 field season.

Team Members
No deploying project personnel

Cruise Operations
In this on-going project, the researchers plan to continue to monitor the seasonal and year-to-year variability in upper-ocean characteristics within the Drake Passage using high-density expendable bathythermograph (XBT) and expendable conductivity-temperature-depth probe (XCTD) observations. This project characterizes the water mass variability in the Drake Passage, with a view to describing temperature and circulation variability in the Southern Ocean and defining the role of the Southern Ocean in the global climate system.

Approximately 60 XBT casts will be made on each selected southbound R/V *Laurence M. Gould* crossing of the Drake Passage, as weather conditions allow. Shipboard contractor personnel will use a permanently installed autolauncher to deploy XBTs while the vessel is underway. The Sippican MK-12 Oceanographic Data Acquisition system will be used to record the data. The casts will be made from the 200-meter bathymetric contour off Isla de la Estados (in Argentine territorial waters) to the 200-meter contour off Antarctica.

Data from the casts will be sent via FTP over the internet or via original data disks to the home institution for analysis and processing.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Olsgaard

Collection of Atmospheric Air for the NOAA/ CMDL Worldwide Flask Sampling Network

OO-264-O

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Research Objectives

The National Oceanic and Atmospheric Administration (NOAA) has been conducting studies to determine and assess the long-term buildup of trace atmospheric constituents that influence climate change and the ozone layer. Time-series analyses of long-term data provide insight into several phenomena of particular interest. These include the following:

- seasonal and temporal variations in greenhouse gases,
- stratospheric ozone depletion,
- trans-Antarctic transport and deposition, and
- the interplay of the trace gases and aerosols with solar and terrestrial radiation fluxes that occur on the polar plateau.

Personnel at Palmer Station will collect air samples to be analyzed for carbon dioxide, methane, carbon monoxide, and stable isotopic ratios of carbon dioxide and methane. Flasks will also be collected for analysis of halocarbons, nitrous oxide, and other trace constituents.

These measurements allow us to determine the rates at which concentrations of these atmospheric constituents change and will suggest likely sources, sinks, and budgets. To further determine how the rates of change of these parameters affect climate, we are collaborating with climate modelers and diagnosticians. [NSF/ NOAA agreement]

Field Research Plan

Logistics

Research Location: Palmer Station

Team Members

No deploying project personnel

Field-Season Overview

The researchers plan to continue long-term measurements of trace atmospheric constituents that influence climate and the ozone layer. The Palmer Station physician will collect one or two air samples per week from behind the T-5 building at Palmer Station, and environmental conditions at the time of collection will be logged. Sampling may occasionally be deferred until certain meteorological criteria are met.

All samples will be returned to the NOAA laboratory on a regular schedule for analysis.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Cara Sucher

University of Miami/Department of Energy-Environmental Measurements Laboratory Remote Atmospheric Measurements Program (RAMP)

OO-275-O

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Research Objectives

Radionuclides are atoms emitting radioactive energy, some of which occur naturally in the surface air. It is these — as well as nuclear fallout and any accidental releases of radioactivity — that the Environmental Measurements Laboratory's (EML) Remote Atmospheric Measurements Program (RAMP) is designed to detect and monitor. Since 1963, EML — as part of the U.S. Department of Energy — has run the Global Sampling Network to monitor surface air. The RAMP system provides on-site analysis in thirteen different locations around the world, including Palmer Station, Antarctica. Using a high-volume aerosol sampler, a gamma-ray spectrometer, and a link to the National Oceanic and Atmospheric Administration's ARGOS satellite system, these researchers will continue sampling air at Palmer Station for anthropogenic radionuclides. [DOE Award]

Field Research Plan

Logistics
Research Location: Palmer Station

Team Members
No deploying project personnel

Field-Season Overview

As part of the U.S. Department of Energy/Environmental Measurements Laboratory's Remote Atmospheric Measurements Program (RAMP), the researchers plan to continue sampling air at Palmer Station for anthropogenic radionuclides. Throughout the year, the support contractor's science technician will operate the RAMP high-volume aerosol sampler, gamma-ray spectrometer, and satellite data transmission system in the T-5 building at Palmer Station. Each week, the technician will count one sample (i.e., filter) and one background, and perform one calibration.

The filters will be sent back to the Environmental Measurements Laboratory for analysis and archiving.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Ms. Cara Sucher

Antarctic Automatic Weather Station Program: 2001- 2004

OO-283-M/P/S

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Research Objectives

A network of nearly 50 automatic weather stations (AWSs) has been established on the Antarctic continent and several surrounding islands. These facilities were built to measure surface wind, pressure, temperature, and humidity. Some of them also track other atmospheric variables, such as snow accumulation and incident solar radiation.

Their data are transmitted via satellite to a number of ground stations, and put to several uses, including operational weather forecasting, accumulation of climatological records, general research purposes, and specific support of the U.S. Antarctic Program — especially the Long-Term Ecological Research (LTER) program at McMurdo and Palmer Stations.

The AWS network has grown from a small-scale program in 1980 into a significant data retrieval system that is now extremely reliable, and has proven indispensable for both forecasting and research purposes. This project maintains and augments the AWS, as necessary. [NSF Award # 00-88058]

Field Research Plan

Logistics

Dates at McMurdo:	late December 2001 to early February 2002
McMurdo Research Locations:	Automatic Weather Stations in the McMurdo, Ross Sea, and Ross Ice Shelf regions
Dates at South Pole:	early January 2002 to late January 2002
South Pole Research Locations:	Henry and Nico AWS sites

Dates at Palmer:	No deploying project personnel
Palmer Research Locations:	AWSs in the Palmer Station vicinity (Bonaparte Point, Hugo Island, and Racer Rock)

Team Members

Matthew Lazzara	Chris Shuman
George Weidner	TBD (2)

Field-Season Overviews

The researchers plan to continue placing and servicing Automatic Weather Stations (AWS) in Antarctica, and providing Antarctic weather and climate data to USAP and other researchers.

OO-283-M: McMurdo Station

Project team members based at McMurdo Station will travel via Twin Otter aircraft to service AWS sites on the Ross Ice Shelf and via helicopter and snowmobile to service AWS sites around the Ross Island region. The team members will also travel via LC-130 aircraft to Byrd Surface Camp or Siple Dome Camp, and via Twin Otter aircraft from these camps to service AWS stations near those locations. Additional AWS may be installed in West Antarctica and on the Ross Ice Shelf.

One team member will travel with the U.S. Coast Guard icebreaker *Polar Star* to service selected AWS along the Adelie Coast. This team member will transit to shore from the icebreaker via helicopter or small boat.

OO-283-P: Palmer Station

Support contractor personnel and/or several members of the Palmer Long-Term Ecological Research (LTER) program will service the three AWSs in the Palmer Station vicinity during the 2001-2002 austral summer season.

They will travel on foot from Palmer Station to the Bonaparte Point AWS. To reach more distant AWSs, they will travel on the R/V *Laurence M. Gould* to the islands where the AWSs are located, then take Zodiac inflatable boats from the research vessel to the shore. In each case, they will perform preventative maintenance and diagnose, troubleshoot, and repair (if necessary) the stations.

OO-283-S: South Pole Station

Project team members will travel via LC-130 aircraft from McMurdo Station to South Pole, and from there via Twin Otter aircraft to service two AWS sites (Nico AWS site and Henry AWS site) located approximately 100 km from South Pole Station. Once the team members are at these AWS sites, they will also raise the sensors because of snow accumulation.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Ken Doggett (McMurdo)
Mr. Rob Edwards (Palmer)
Mr. Paul Sullivan (South Pole)

Does Iron Fertilization Lead to Enhanced Carbon Sequestration

OO-288-O

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Research Objectives

While it has been shown that the addition of iron can stimulate phytoplankton growth and alter upper ocean biogeochemistry, little is known about the net effect of iron availability on sinking particle fluxes. If iron played an important role in past variations in $CO_{2,}$ or if there will be long-term effects of iron on CO_2 due to deliberate manipulation of ocean ecosystems, then it becomes essential to quantify the net change in export fluxes of carbon and associated elements in response to iron loading.

For this reason, we will quantify changes in particulate organic carbon and particulate organic nitrogen export during the Southern Ocean Iron Experiment (SOFeX) using the naturally occurring radionuclide thorium-234. Using time-series profiles of thorium-234 obtained both inside and outside of the SOFeX study area, we will be able to study the export response to changes in iron loading and community structure, as well as assist in the calculation of the carbon and nutrient fluxes in response to the iron additions.

Information on the export response of the upper ocean to iron enrichment will be used to understand past oceanic responses to iron/dust inputs and assess future impacts of deliberate iron fertilization proposed to offset carbon dioxide emissions. [NSF Award # 99-87501]

Cruise Research Plan

Logistics

Dates in Antarctica: early February 2002 to mid-February 2002
Research Location: USCG Icebreaker *Polar Star*

Team Members

TBD (12)

Cruise Overview

The researchers plan to re-occupy a site in the Southern Ocean that will have been enriched with iron sulphate in order to test a hypothesis that iron fertilization leads to enhanced carbon sequestration.

Project team members will deploy to McMurdo Station and board the USCG *Polar Star* for its northbound voyage. Following a radio beacon on a buoy, the vessel will arrive at the previously enriched area and project team members will sample the water column using plankton nets, niskin bottles on the CTD rosette, and other equipment. The ship's crew will assist with sample collection and equipment handling, and in the recovery of drifter buoys, optical buoys, and sediment traps left by the *R/V Melville*.

The team members will disembark the USCG *Polar Star* in Valparaiso, Chile. Water, sediment, and plankton samples will be returned to the home institution for study and analysis.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Points-of-Contact
Mr. Rob Robbins (McMurdo)
Dr. Karl Newyear (*Polar Star*)

Measurement of Combustion Effluent Carbonaceous Aerosols in the McMurdo Dry Valleys, Antarctica

OO-314-O

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Research Objectives

Though Antarctica remains comparatively pristine, there is heightened awareness of the potential impact of human presence and scientific work on the Antarctic environment. To continue a series of assessments of the long-term environmental impact of the U.S. Antarctic Program's operations, we plan to generate a database detailing the abundance of carbonaceous aerosols in the McMurdo Dry Valleys.

The Long-Term Ecological Research (LTER) study site in the McMurdo Dry Valleys supports a fragile, nutrient-limited ecosystem that could be significantly affected by human activities. Of special concern are deposits of particles from carbonaceous aerosols ("black carbon"). These could result from the exhaust of diesel power generators and helicopter operations within the McMurdo Dry Valleys; it is even possible that combustion products from McMurdo Station about 100 kilometers away could migrate to the study area.

For three austral summers, we will deploy a real-time optical analyzer at the LTER site to measure the concentration of black carbon, polycyclic aromatic hydrocarbons, and other filterable organic compounds useful in fingerprinting combustion products. [NSF Award # 98-15140]

Field Research Plan

Logistics

Dates in Antarctica: mid-November 2001 to early December 2001
Research Location: Lake Hoare and Lake Bonney in Taylor Valley

Team Members

Tony Hansen
Joseph Mastroianni

Field-Season Overview

The researcher plans to study the long-term environmental impacts of human activities on the Antarctic Dry Valleys ecosystem by examining anthropogenic combustion products.

Project team members will travel via helicopter to Taylor Valley, where they will place a conventionally powered, optical particle analyzer downwind of the Lake Bonney Camp. Team members will then travel via helicopter to Lake Hoare, where they will set up an autonomous, solar-powered particle analyzer downwind of the Lake Hoare camp. The team members will return via helicopter to McMurdo Station.

The instruments will run automatically for the duration of the 2001-2002 season. Data will be collected and data disks replaced by support contractor personnel. Full data disks will be returned to the Crary Science and Engineering Center (CSEC) at McMurdo Station, where the data will be emailed to the home institution.

Support contractor personnel will remove both instruments at the end of the season and return them via vessel to the home institution.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Andy Young

Shipboard Acoustic Doppler Current Profiling on R/V *Nathaniel B. Palmer* and R/V *Laurence M. Gould*

OO-315-O

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Research Objectives

Currents in the Southern Ocean have a profound influence on the world's oceans — and therefore upon global temperature and the planet's ecosystem — yet some remote regions receive little scientific attention. Using Doppler technology (sound-wave transmission and reflection), this project is exploring upper ocean current velocities and will try to generate a quality-controlled data set in one such sparsely sampled and remote region, which nonetheless appears to play a significant role in global ocean circulation. We will develop and maintain a shipboard acoustic Doppler current profiler (ADCP) program on board the USAP research vessels *Nathaniel B. Palmer* and *Laurence M. Gould*.

Part of our long-term science goal is to characterize the temporal and spatial velocity structure in the Southern Ocean. This entails measuring the seasonal and annual changes in upper ocean currents within the Drake Passage and combining this information with similar temperature observations, to see how the heat exchange varies and how it drives upper ocean currents. [NSF Award # 98-16226]

Cruise Research Plan

Logistics

Measurements will be taken on all cruise tracks of both USAP research vessels during the 2001-2002 season.

Team Members

Teresa Chereskin Jules Hummon

Cruise Overview

This project plans to continue the underway collection of oceanographic and weather data in an effort to characterize upper ocean current and thermohaline variability in the Southern Ocean.

Shipboard USAP support-contractor electronics technicians will operate the Acoustic Doppler Current Profilers (ADCP), thermosalinographs, and weather instruments for this project while the USAP research vessels (i.e., R/V *Laurence M. Gould* and R/V *Nathaniel B. Palmer*) are underway during the 2001-2002 season. These instruments will measure ocean currents, backscatter, surface temperature, surface salinity, and weather parameters. The electronics technicians will download and process data from these instruments and send the data to the home institution.

The two team members plan to travel to Punta Arenas, Chile, in September 2001 to upgrade and test the the ADCP system on board the R/V *Laurence M. Gould.*

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Olsgaard

Field Experiments and Modeling of the Breakup of Antarctic Sea Ice

OO-316-O

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Research Objectives

The sea-ice in Antarctica comes and goes with the seasons — from as few as 4 million square kilometers in February to as many as 20 million in September. For scientists, this marks something of a moving target, yet the internal dynamics of the ice pack could be much better understood than they are at present.

This project focuses on how the Antarctic sea-ice cover responds to stresses applied by wind and ocean waves and how the temperature distribution within the sea ice affects these responses. Researchers will conduct experiments on the deformation and fracture of sea ice in McMurdo Sound by applying a series of controlled stresses and observing their effects. A key effect is the initiation and growth of microcracks within the ice, and large ice floes do not fracture in the same way as small ones do. Thus, for experiments to yield information that is valid for the larger scales that concern scientists, the test scales must be fairly large, some tens of meters. With these maneuvers, we hope to gain detailed information on the microstructure of the ice (such as crystal structure, brine channels, and other flaws in the ice fabric). This will provide a sound theoretical framework to guide the experimental work and the generation of models.

In one component of this project, we are collaborating with the New Zealand Antarctic program; that effort concerns the fracture mechanics of fatigue crack propagation, the use of microstructural observations to verify magnetic resonance measurements of the structure of inclusions in the ice, and the acoustic emissions of fracture zones. [NSF Award # 98-73629]

Field Research Plan

Logistics

Dates in Antarctica: mid-October 2001 to early December 2001
Research Locations: McMurdo Sound sea ice; Crary Science and Engineering Center (CSEC)

Team Members

John Dempsey	David Cole
Saul Shapiro	Geoffrey Morley

Field-Season Overview

The researchers plan to conduct experiments designed to characterize the physical properties of first-year Antarctic sea ice. Using data from these experiments, the researchers will develop physically based models of the breakup of the ice.

Project team members will make day trips via helicopter from McMurdo Station to a work site near the ice edge of McMurdo Sound. A heated, portable instrumentation shelter will be transported with the researchers. At the work site, the team members will use a special ice-cutting machine to cut away a free floating block of sea ice. After creating a "starter crack" in this block, team members will place a loading device in the mouth of the crack and deformation gauges on the surface along the crack. The crack will then be subjected to a series of carefully measured load pressures until the crack propagates through the block.

The team members will also take a series of ice-core samples, which will be returned to the CSEC for a detailed microstructural examination of the ice. Other core samples will be returned to the Cold Regions Research and Engineering Labs (CRREL) in New Hampshire for laboratory experiments.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Andy Young

Record of Atmospheric Photochemistry in Firn at South Pole

OO-324-O

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Research Objectives

Scientists are eager to develop models about Earth's history, based on their knowledge of current, active dynamic processes. One such process vital to the Earth is photochemistry, how the sun's radiant energy affects conversion of oxygen in the atmosphere. By measuring and interpreting the hydrogen peroxide, formaldehyde, and nitric acid concentrations in the snow and firn at South Pole station, we hope to develop a credible history of the oxidation capacity of the atmosphere over the last two centuries. We also hope to evaluate methods that will confirm statistically significant changes in the concentration of these species over that time.

Amundsen-Scott South Pole station is ideal for this work. The extreme cold makes the chemistry relatively simple; the NOAA Climate Modeling and Diagnostics Laboratory provides a context of high quality meteorological and chemical data; and the station is staffed continuously so that samples can be taken year-round.

We will sample air and near-surface snow throughout the year; during the summer, we will sample and analyze snow pits and firn cores, and will model the air/snow chemistry to try to explain the observed concentrations in the firn. The summer conditions will also permit us to sample two snow pits around the perimeter of the snow stake field intensively (for accumulation observations), a process that will establish markers to maintain time control for stratigraphic and chemical horizons. During earlier work at South Pole and in central Greenland, we have developed and tested physically-based models of air-snow exchange of hydrogen peroxide. This project extends that work. [NSF Award # 98-11875]

Field Research Plan

Logistics
Research Location: Clean Air Sector

Team Members
No deploying project personnel

Field-Season Overview
Year-round surface snow sampling inside the Clean Air Sector will be conducted on a weekly to semi-weekly basis throughout the year by NOAA/CMDL personnel at the South Pole. (Note: This is an extension of the work that this project has been doing under a cooperative agreement with NOAA/CMDL for the past few years.)

Samples will be collected, stored, and shipped back to the U.S. at end of season.

NSF/OPP Program Manager
Dr. Bernhard Lettau

RPSC Point-of-Contact
Mr. Paul Sullivan

Index A

2001-2002 USAP Field Season

Alphabetical List of Deploying Research Team Members

Several Team members are yet to be determined. Listed below are the TBDs with their associated Event # and PI Name.

TBD (10)	AA-130-O	Morse	2
TBD (2)	AC-370-O	Pernic	10
TBD (5)	AC-371-O	Stark	10
TBD (6)	AC-372-O	Storey	10
TBD	AO-106-P	Inan	24
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McMurdo Station & USCG Icebreaker Based Projects

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