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In this issue...

Emperor penguins, the largest species of penguin at 3½ feet (115 centimeters) tall, gather near McMurdo Station, on Ross Island in the Ross Sea. Of the 17 species of penguins, only emperors breed during the antarctic winter, when temperatures can drop below –50°C. Seven of the known colonies—new breeding sites are discovered each year—are in the Ross Sea area. U.S. scientists have studied these colonies since the early 1960s, lately using innovative techniques such as tiny satellite transmitters, glued to the birds' feathers, to track their movements and wide-ranging feeding habits and depth recorders that have revealed emperors to be the deepest divers of any known bird. Emperors feed on fish, squid, and krill.

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THE *Antarctic Journal* has had several changes since its inauguration in 1966 as a medium for information about, and related to, the U.S. Antarctic Program. The magazine belongs to you, its contributors and readers. As always, NSF welcomes ideas for improvement. Comments should be sent to Winifred Reuning at *WReuning@nsf.gov* (e-mail) or Editor, Antarctic Journal, Office of Polar Programs, National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230 (703-306-1033).

The *Antarctic Journal* invites contributions from members of the antarctic science, logistics, and policy communities who want to communicate their work and ideas to an audience of specialists and scientifically literate nonspecialists. The *Antarctic Journal* is not peer reviewed. It provides reports on U.S. activities in Antarctica and related activities elsewhere and on trends in the U.S. Antarctic Program. The September 1997 online issue contains author guidelines for the 1997 review issue, as well as information about submitting materials for the new online issues.

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McMurdo breaks 24-year-old weather record

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South Pole Station opening delayed

Bad weather on much of the continent delayed the summer opening of Amundsen–Scott South Pole Station for 12 days, leaving the 28-member winter crew to wait for better weather to return home. Normally, two flights 4 hours apart open the station. The first flight carries about 50 people, who will work at the station during the austral summer, and the second carries about 20 more people plus mail, fresh food, and some cargo.

This year, however, powerful storms hit McMurdo Station on 27 October, the day the two LC-130 Hercules were due to fly from McMurdo to South Pole, and grounded flights for 2 days. Meanwhile at South Pole Station, the temperature stayed near –55˚C, a temperature too cold for the LC-130s. In temperatures below –50˚C, seals and gaskets on the airplanes contract; propellers, engines, landing gear, and skis leak excessively; and hydraulic fluid congeals.

By 3 November, the storm at McMurdo had abated and temperatures at South Pole had risen, and although conditions at South Pole were forecast to be marginal, a flight was attempted. An LC-130 carrying 50 passengers flew to South Pole Station, but after four approaches to the skiway, the pilots decided that attempting a landing was too risky. Visibility was very poor; the crew could see the station only when the plane was immediately above it. They returned to McMurdo.

Storms pounded both stations for the next several days, delaying further attempts. When the weather finally improved, two flights left on 8 November. The first had to turn back 30 minutes into the 3-hour flight when an indicator light signaled that the main door on the aircraft was open. Though the door appeared closed, the risk of an unseen problem was great, so the airplane returned to McMurdo. Later that afternoon, a second LC-130 finally succeeded in completing a flight to the pole and opening the station. The first flight, carrying the bulk of the passengers, made a second attempt and arrived late that same night.

By 12 November, South Pole Station had been prepared for the summer research season, and station managers worked to compensate for the delayed start and maximize the time available to complete the goals for the season.

McMurdo breaks 24-year-old weather record

October 1997 was the coldest, stormiest October at McMurdo Station since 1973. A series of storms hit McMurdo throughout the month disrupting aircraft schedules, delaying the opening of field camps, forcing an early closing for the Cape Roberts Project drill site, demolishing a Jamesway structure on Black Island, and putting the station on "Condition One" (all movement restricted) status during summer business hours for the first time in recent memory.

Storms stranded antarctic travelers at all points in the travel circuit. South Pole winter staff (see South Pole Station opening delayed) were forced to remain at the station for 12 additional days before a flight carrying summer replacement staff, who were stuck at McMurdo, could reach the pole. Siple Dome personnel, scheduled to go to base camp on 28 October, were also caught by the McMurdo storms. Others on their way to Antarctica were held in Christchurch, New Zealand, until the storms abated, personnel could be moved, and bed space could be made available at the station. The delays threaten to take

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a heavy toll on the science schedule for the year, but like their counterparts at South Pole Station, managers at McMurdo are working to overcome the setback.

New Antarctic Research Series volume available

The American Geophysical Union (AGU) announces publication of volume 71 of the Antarctic Research Series, *Geology and seismic stratigraphy of the antarctic margin, 2*, edited by Peter F. Barker and Alan K. Cooper. This volume, which complements the work presented in volume 68, contains 10 studies of marine seismic reflection data and sediment cores gathered from the antarctic continental margin and presents analyses that will help students and scientists better understand the fluctuations and geologic record of the Cenozoic Ice Sheet.

Volume 71 may be purchased online (AGU member and student member price, $42; nonmember price, $60) at:
http://www.agu.org/cgi-bin/agubookstore?book=SEAR0718977.

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Girl Scout joins scientists on the ice

"I have arrived at the place that will be my home until January," wrote Hannah Thomas, the fifth Girl Scout sponsored to visit Antarctica, in her online journal on 20 October 1997. "Antarctica! I can't get used to it.... The lack of color and the crispness of the environment may make Antarctica seem very harsh, but Antarctica's beauty is incredible and so pure. There are no trees to soften the outline of a mountain range and no flowers on the ground to distract the eye from the clear blue of the sky. Everything is simple and rugged—and that is the beauty of this land."

Hannah, a 14-year veteran of Girl Scouts, is the 1997 scholarship recipient of the Antarctic Research Project, cosponsored by the National Science Foundation (NSF) and the Girl Scouts of the U.S.A. Selected from a group of 55 applicants, all 18 to 20 years old, Hannah took a semester off from her studies at Mount Holyoke College and left her home in New York State, to travel to Antarctica and assist with scientific research there. Hannah is no stranger to science. By majoring in geology and minoring in biology, she is following family tradition: both her parents and her older sister are geologists. Although as a child, Hannah swore she would never follow the same path—especially after years of what she and her sister called the "geology tourism" of their family vacations—she fell in love with geology during her first freshman course in the subject and knew it was the field for her. "Because geology is the science of the Earth, and all life and life interactions are centered around our planet," she writes, "geology is the basis of all science." She adds, "Maybe, though, I'm just a bit biased."

Hannah's love for science is linked to her desire for discovery. "Science helps me understand the world in which I live," she writes in her online journal, "and my impact upon it. Because I love the mysteries of nature, I love the tools science provides me with to understand them."

To earn one of her many awards as a Girl Scout, Hannah has taught Brownies, the youngest scouts, about science, in part by sharing what she learned when she worked for two summers during high school as an intern doing field research on bees and wasps at Skidmore College. She is eager to teach younger scouts that people who fall in love with science and become scientists are not necessarily people for whom science and math have always come easy. "I often struggled with the mathematics in my science classes," she reports, "a struggle that began in elementary school." When her performance on a standardized math test threatened to hold her back a grade in mathematics, her fifth grade teacher spotted "math phobia" in Hannah's approach to numbers and, by tutoring her during the summer and after school, was able to teach her to break numbers and number problems into what Hannah calls "small, friendly units." Now, instead of freezing when she encounters numbers on an exam, she can deal with the smaller units one at a time and succeed.

NSF's goal for the Antarctic Research Project is to increase the visibility of science and the U.S. Antarctic Program in both the Girl Scouts and the Boy Scouts, who have a similar program. Through the project, NSF hopes to give exceptional scouts, during a formative stage in their careers, an opportunity to work with scientists in the field. Hannah shares NSF's goal of wanting to spotlight science and spark interest in it. "One of my career goals," she wrote in her application for the project, "is not only to be involved in science but to present science in a way that is accessible and understandable to the general public, through the spoken and written word." She felt that her participation in the Antarctic Research Project would give her a unique opportunity to be involved in research, and she vowed to find ways to share what she learns with others. Through her online journal, she is doing just that.

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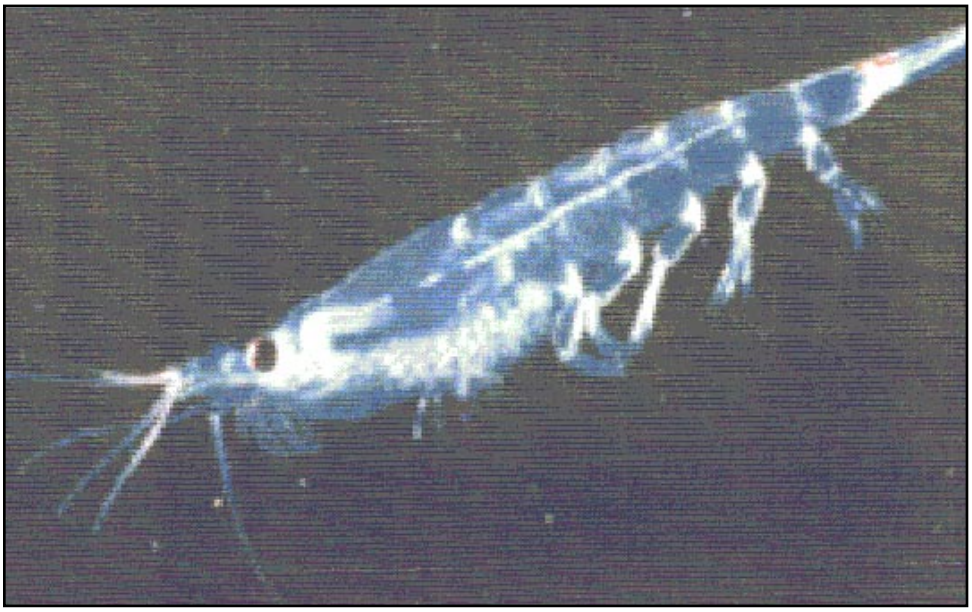
Science notebook—News from Antarctica and beyond

Rising ocean temperatures affect krill and other marine organisms

KRILL (*Euphausia superba*) like cold winters. The small, shrimplike crustaceans feed on algae that grow on the underside of sea ice, so—according to an article in the 26 June 1997 issue of *Nature*—in years when cold weather prevails and the sea ice is extensive, krill populations thrive. In warmer years, their numbers shrink. Decreased populations of krill affect the entire antarctic food chain as well as commercial fishers who harvest them.

Valerie Loeb from Moss Landing Marine Laboratory in California worked with American and German colleagues to study the effect of fluctuating winter temperatures on the population of krill in the area around Elephant Island, just off the tip of the Antarctic Peninsula. The research team theorized that because, in general, winters in Antarctica have gotten warmer over the past 50 years—only one or two of every five recent winters produces extensive sea ice as compared to four out of every five winters 50 years ago—krill populations may be decreasing. Loeb and her fellow researchers found that, compared with counts done a decade ago, krill populations had decreased by a factor of 10.



Krill (*Euphausia superba*), despite their small size, are a key link in the southern ocean food chain, contributing to its amazing abundance. Fish, birds—including, of course, penguins—and whales all consume large quantities of the shrimplike crustaceans. Even human fishers harvest the krill to be cooked and peeled and made into sausage, fish paste, or livestock feed. Because krill are so vital to the entire antarctic food chain, scientists are monitoring the natural fluctuations in krill populations as well as the impact of commercial harvesting.

Krill compete for algae with gelatinous creatures called *salps*. When there are fewer algae to go around, the competition is keen. In the years when salps thrive and krill decline, the effect on the rest of the food chain can be dramatic because many vertebrates that eat krill—fish, whales, and penguins, for example—won't eat salps instead.

Other marine biologists believe that the increased salp blooms may not curb krill populations. Robin Ross, a biological oceanographer from the University of California's Santa Barbara Marine Science Institute, notes that migration should be factored into the equation. "Centers of abundance in krill seem to shift from year to year," she comments.

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Will higher ocean temperatures cause antarctic ice shelves to thicken?

ON the face of it, it sounds like a contradiction, that the 2.5˚C warming of the ocean, noted over the past 50 years, could actually reduce the rate of melting for antarctic sea ice. K.W. Nicholls, writing in the 31 July 1997 issue of *Nature*, however, purports that this contradiction is, in fact, what is happening beneath the Filchner–Ronne Ice Shelf in the southern Weddell Sea near the Antarctic Peninsula.

Floating ice shelves, such as the Filchner–Ronne, are sensitive to climate change on both their upper and lower surfaces. Nicholls took measurements to examine what is happening to the lower surface of the Filchner–Ronne. Relatively warm (–1.9˚C) High Salinity Shelf Water (HSSW) forms north of the ice front at the seaward edge of the ice shelf. From the edge of the shelf, the HSSW flows beneath the shelf toward land until it reaches the base of the Filchner–Ronne, where the huge ice mass attaches to the land mass. This influx of warmer water causes melting of this ice base.

Nicholls noted that summer conditions do not increase the temperature of the HSSW—it remains fixed at –1.9˚C—but they do decrease the volume of HSSW that flows beneath the ice shelf. The reduced volume of the warmer water means a reduced influx of heat to the base of the ice shelf, so the ice thickens. "Seasonal warming," writes Nicholls in the *Nature* article, "results in a corresponding reduction in the melting at the base of the Filchner–Ronne Ice Shelf.... To the extent that this is an analogue for a warming climate, it suggests that for as long as HSSW dominates the oceanographic conditions over the continental shelf, the response of the ice shelf to a warming climate will be for it to thicken, reinforcing rather than threatening its longevity."

Antarctic whaling records suggest that the sea-ice cover has decreased

WILLIAM K. de la Mare, a climatologist from Tasmania, Australia, turned to a previously untapped source for long-term data about the behavior of sea ice around Antarctica. The International Whaling Commission maintains computerized records of 1.5 million whaling catches, every whale caught by factory ships in antarctic waters from 1931 to 1987, when commercial whaling there stopped. The whaler's logbooks note the precise latitude, longitude, date, and species for each catch. Because whales, especially the blue whale, are known to congregate near the ice edge, the records of the catches, de la Mare reasoned, should give a good indication of where the ice edge was on a particular day at a particular geographic point.

By combing the records and plotting what he found, de la Mare determined that the seasonal sea ice was constant until about 1954, when it began to shrink, ultimately reducing in size by 25 percent. It stabilized 19 years later and has stayed about the same from 1973 to the present. De la Mare published his findings in *Nature*.

Climatologists believe that the mass of the antarctic sea ice is a crucial factor regulating global climate. Whether the variation in the position of the ice edge indicated by the whaler's records is an indication of significant and long-term climate change or simply a natural cyclical variation, however, is unknown.

1997 ozone records

NEW Zealand researchers at Scott Base, Antarctica, report that this year's spring ozone hole was once again severe. The extent and depth of the ozone hole are about the same as each of the past 5 years: ozone is depleted by about 60 percent over levels before 1980. U.S. National Aeronautics and Space Administration satellite data show that the ozone depletion extends for 25 million square kilometers. In addition, unusual circulation pat-

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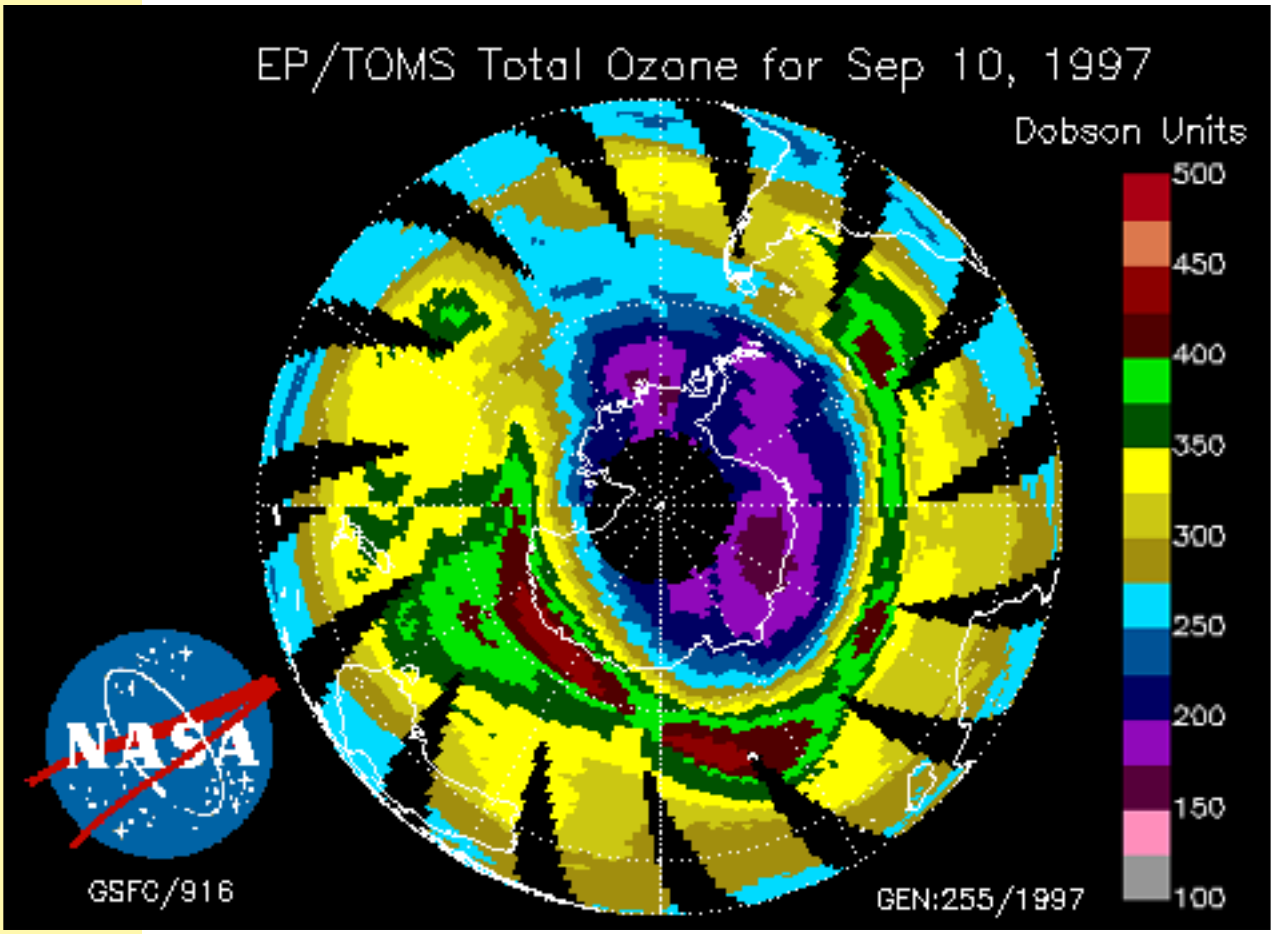
terns this year carried the ozone-poor air over New Zealand, although a threat to health is not indicated. An ozone monitoring facility in Central Otago, New Zealand, reported that on 10 August 1997, ozone levels were the lowest on record, 35 percent below normal.

Ozone readings at Scott Base dipped to 136 Dobson units, close to the lowest on record. Virtually all of the ozone between 14 and 20 kilometers altitude has been destroyed. Annually, the depletion peaks in October and levels return to normal by December.

The annual ozone depletion is expected to continue for the next 20 years despite the fact that international legislation has worked to phase out the use of ozone-depleting chlorofluorcarbons (CFCs). It will take 20 years, experts believe, for pollutants already released into the atmosphere to dissipate and for the damage to be reversed.

Made using an orthographic projection looking down on the Earth from 60˚S, this sequence of Southern Hemisphere images from 5 days in September, October, and November shows the spring ozone hole forming. Ozone values less than 225 Dobson units, indicated by violet colors, are termed the "ozone hole." The black circle in the middle of the 10 September image is due to polar night, when the total ozone mapping spectrometer (TOMS) cannot measure the ozone. This image, along with others, may be viewed as an animated gif at http://jwocky.gsfc.nasa.gov/eptoms/ep.html. The main link to the National Aeronautics and Space Administration's TOMS page is http://jwocky.gsfc.nasa.gov/.



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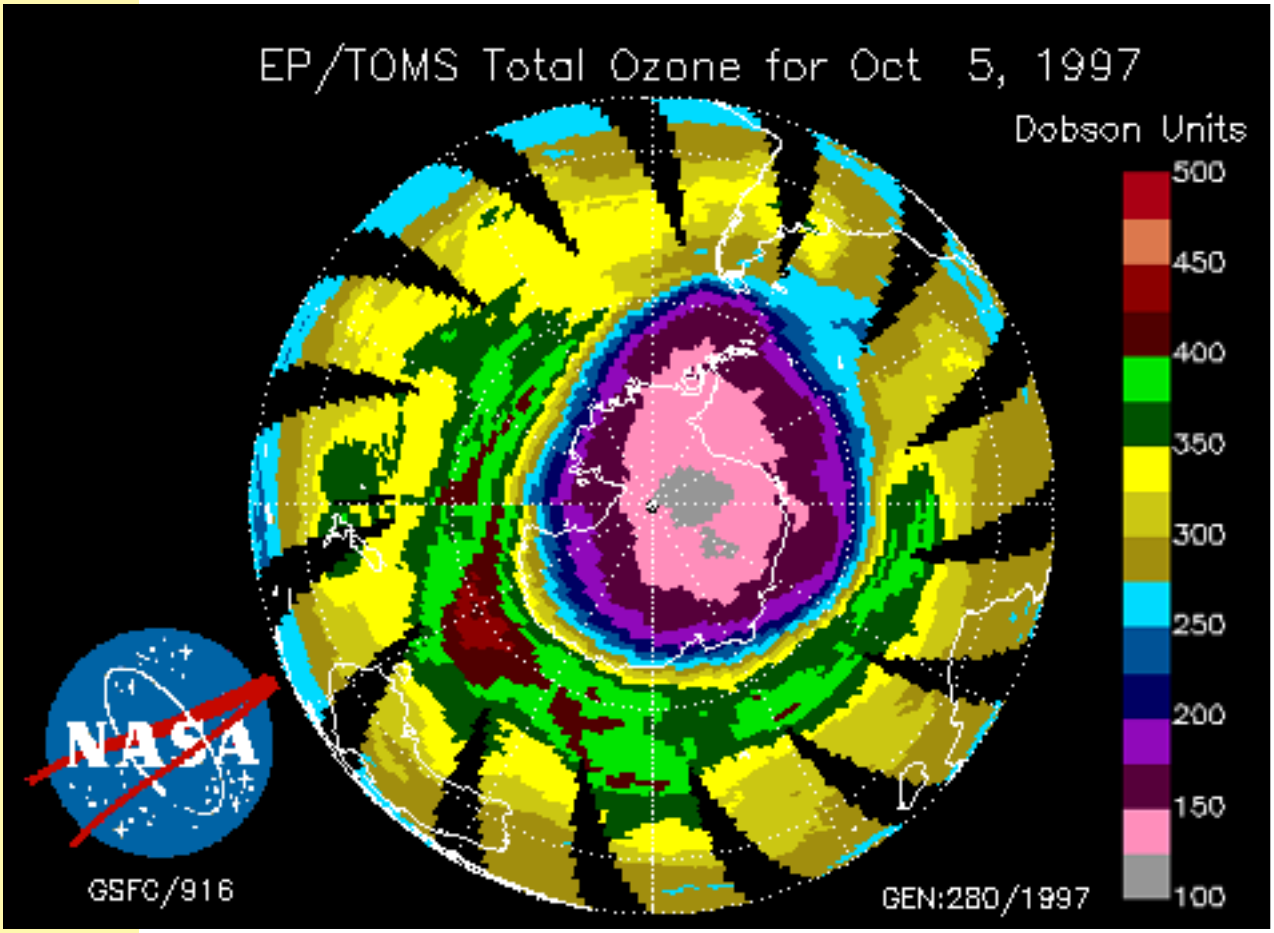

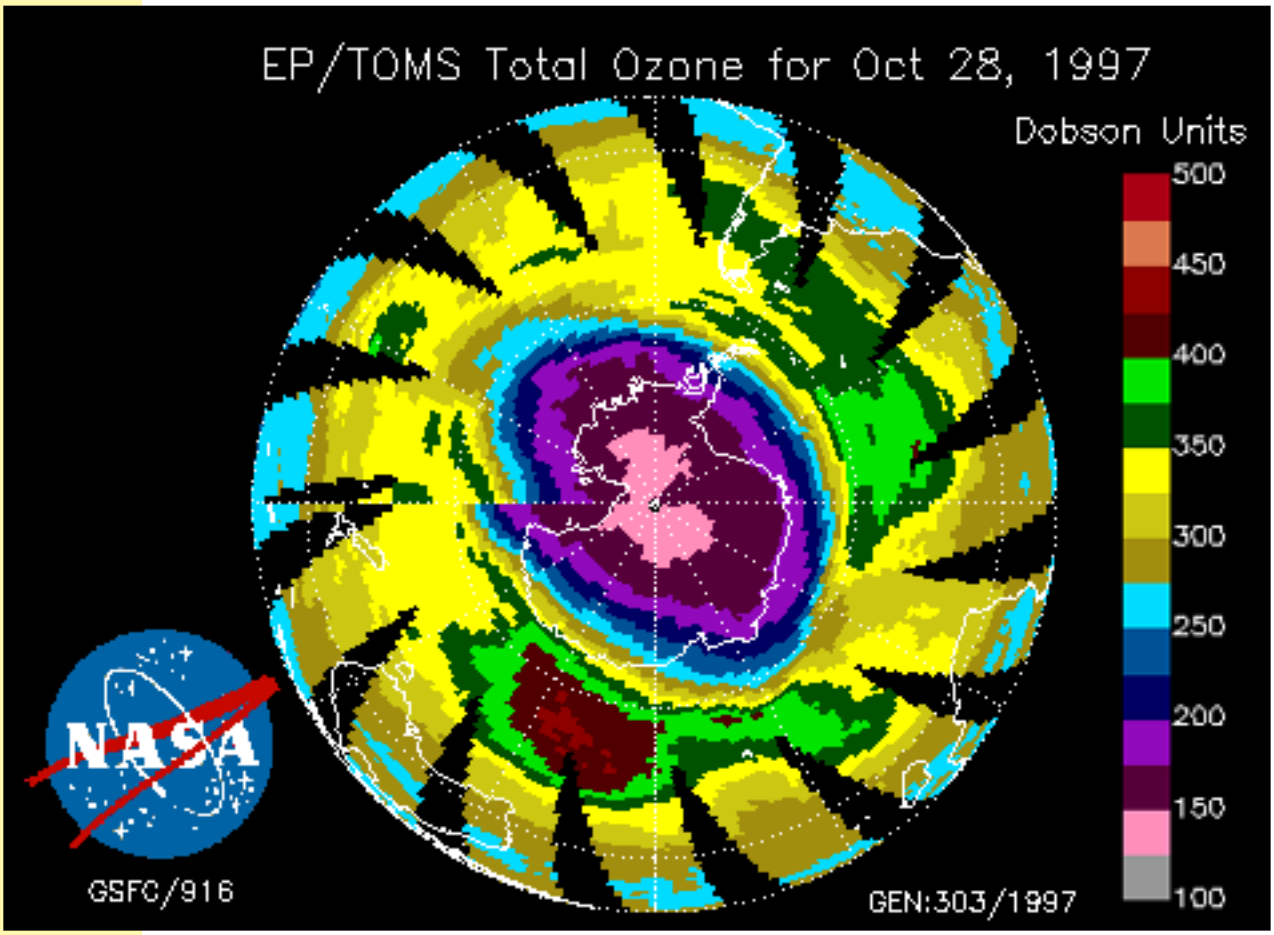

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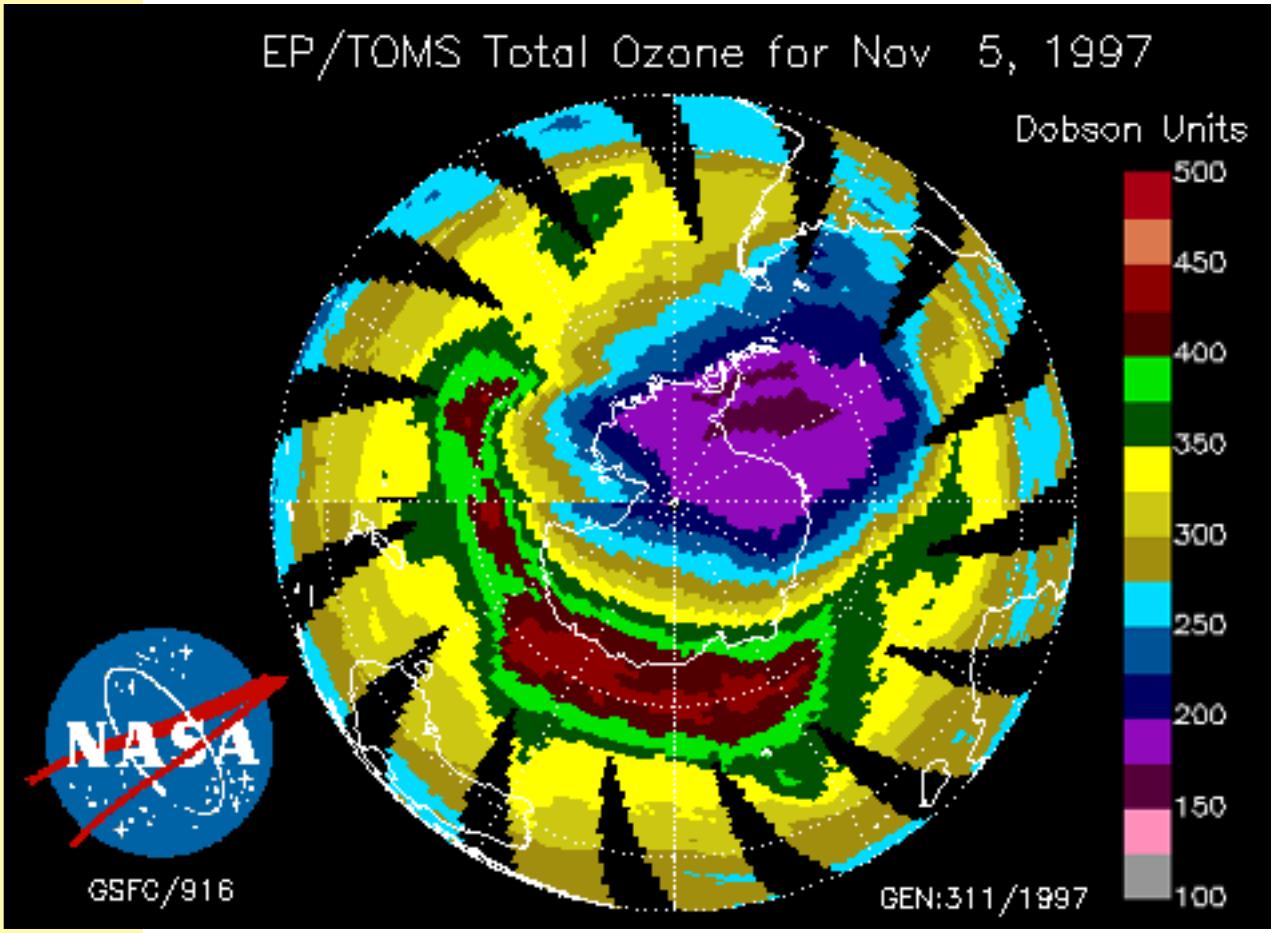

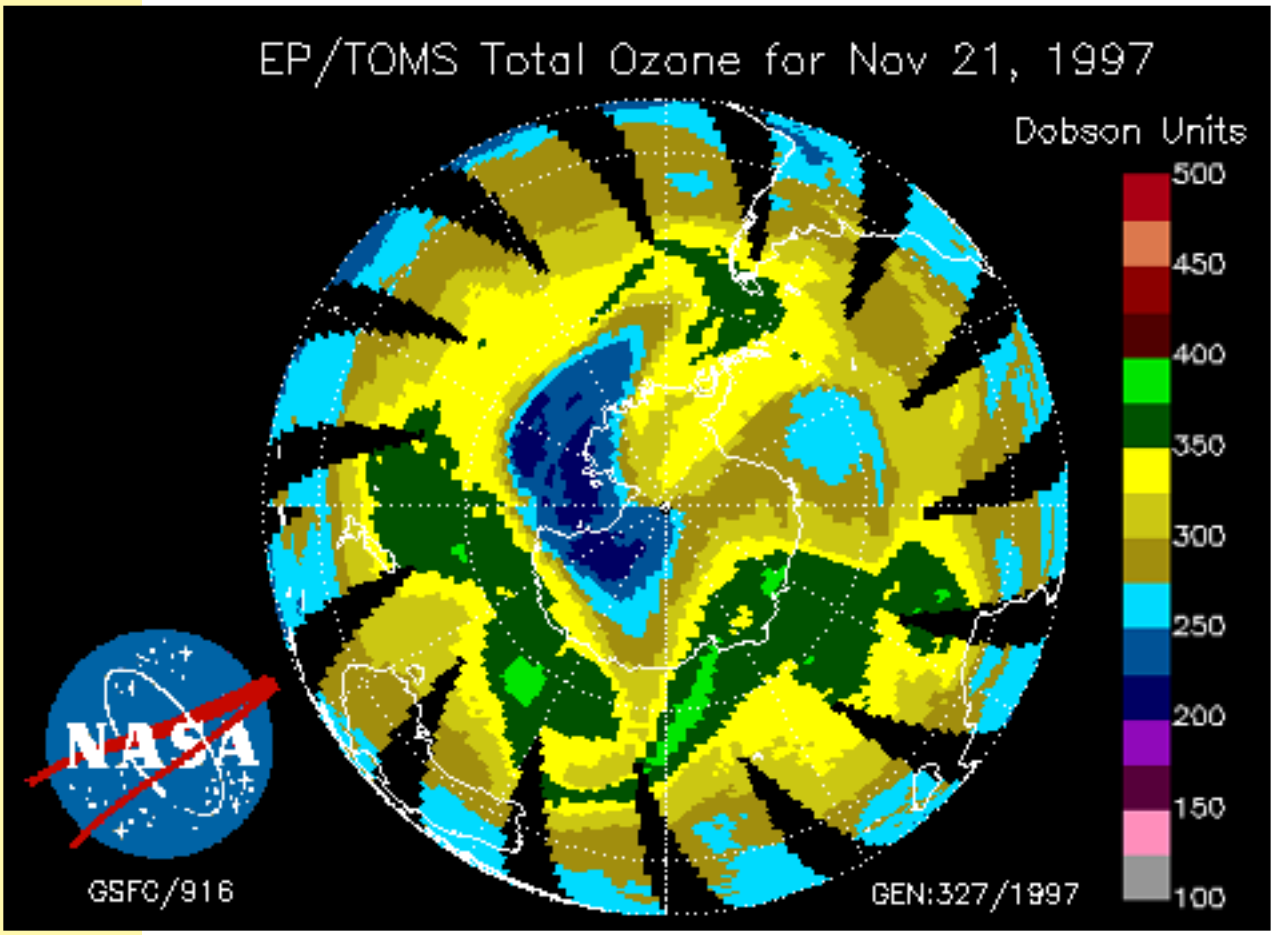

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The National Museum of Natural History

William E. Moser and Jennifer C. Nicol, Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560

The Smithsonian Institution's National Museum of Natural History (NMNH) shares a 34-year history of cooperative studies in the natural history of polar environments with the National Science Foundation (NSF). Collaboration began in 1963 when the then recently formed Smithsonian Oceanographic Sorting Center (SOSC) received a grant from the NSF Office of Polar Programs to serve as a national archiving and distribution center for natural history specimens and associated data collected by researchers working in Antarctica under the United States Antarctic Research Program [USARP (now USAP, United States Antarctic Program)] (Landrum and Sandved 1969). Beginning in 1973, specimens and data from the Arctic were included as well (Landrum 1975). In May, 1992, the SOSC was abolished as a separate unit and administrative oversight of SOSC activities was delegated to NMNH Department of Invertebrate Zoology. Under a new cooperative agreement with NSF in August 1995, the NMNH will continue the original SOSC polar mission.

To encourage cooperation and dissemination of information, NSF-sponsored investigators working in polar regions are expected by NSF to deposit natural history specimens and associated data at the NMNH at the conclusion of their studies.

Early cataloging activities of the SOSC

The SOSC sorted, identified, and curated bulk polar specimen collections. Arriving in crates, drums, and barrels, the specimens had been collected during antarctic cruises of the USNS *Eltanin*, R/V *Hero*, *Polar Duke*, *Islas Orcadas*, USCGC *Glacier*, and others and from island stations in the Arctic Ocean. Since 1963, more than 40 million specimens have been processed by SOSC or NMNH staff. Initial rough sorting of specimens to phylum or group at the SOSC was followed by careful fine sorting to the lowest practical taxonomical level (usually order or family). Some groups such as the Copepoda and macroscopic Algae were classified to the genus level.

The contributions SOSC's taxonomic work made to the scientific community were broad and far-reaching:

- During the early years of the SOSC's participation in USAP, SOSC staff developed a variety of innovative collection processing and sorting techniques, particularly those needed for efficient processing of enormous volumes of microorganisms.

- The SOSC staff prepared numerous taxonomic keys for specialists and identification guides for general use.

- The NSF Office of Summer Education Programs funds were awarded to the SOSC to provide basic taxonomic training to high-school and university students (Wallen, Fehlmann, and Stoertz 1968; Anonymous 1969).

- Research in collection-management procedures such as archival glassware, relaxing agents, fixatives/post-fixatives, and preservatives (including those that maintained color, as well as fungal- and bacterial-inhibiting compounds) also was conducted (Anonymous 1969).

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- The SOSC staff frequently participated in field studies in polar regions and were often consulted for their expertise in specimen collection and fixation/preservation techniques.

- After demonstrating success using a centralized location to process large numbers of specimens and associated data from large collection expeditions, the SOSC was used as a model to establish several oceanographic sorting centers throughout the world (Wallen et al. 1968).

A readily accessible storehouse of antarctic records

The SOSC also functioned as a data-management center and data clearinghouse for information related to the natural history of polar marine environments. In 1963, with funds from the NSF Office of Polar Programs, the SOSC created the Antarctic Records Program (SOSC-ARP) (Fehlmann 1966). The SOSC-ARP summarized and recorded collection data that accompanied the bulk natural history specimens sent to SOSC and maintained a file of antarctic collecting permits. Unified data standards were established by the SOSC-ARP to institute consistent documentation of data.

Initially, data were recorded on standardized specimen labels and taxonomic cards. In 1967, SOSC-ARP record keeping was automated and consolidated using two SCM Typetronic units (Wallen et al. 1968). These machines could print multiple copies of specimen labels and taxonomic cards and store information that could be fed into a mainframe database, which served as a record of all material processed at the SOSC. Using a Cal-Comp plotter, geographic plots of certain taxa and station data were prepared from this database (Landrum 1980). Vessel and cruise logs also were entered into the computer and summary logs were printed for general use. Relatively rapid storage and retrieval of data were possible.

To speed processing and to ensure standardization of collected data, SOSC staff frequently participated in ship-based antarctic expeditions. Initially, data collection was recorded manually, but later, shipboard computers were used for field entry of collection data (Landrum 1972). Recently, specific information about collection sites—information that could be easily incorporated into NMNH data standards—has been derived by shipboard data technicians using computerized navigational systems.

Specimen distribution

Another vital function of the SOSC was to ensure that natural history specimens were readily and widely available for study by qualified researchers. To guarantee the dissemination of material, the SOSC formed eight advisory committees (Landrum and Sandved 1969) covering the following disciplines:

- algae,
- arthropods,
- higher invertebrates,
- lower invertebrates,
- meiobenthos,
- mollusks,
- vertebrates, and
- worms.

Each committee was composed of five scientists, each having recognized expertise in his or her discipline. The committees advised the SOSC on the most appropriate distribution of material in their assigned taxa.

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To encourage research in "orphan" polar taxa, the SOSC offered the Cooperative Systematics Program, which provided NSF subcontracts to researchers interested in the systematics of lesser known organisms (Landrum 1975, 1981). The results of these studies were published in the *Antarctic Research Series* and scientific journals.

An archive for photos and slides

In accordance with its NSF polar archiving and distribution initiative, the SOSC managed a collection of 20,300 black-and-white frames of bottom photographs from the southern oceans and subantarctic ocean regions (figure 1) from 1,064 camera stations taken on the USNS *Eltanin*, R/V *Hero*, and USCGC *Glacier* cruises that circumscribed three-fourths of the antarctic continent (Simmons and Landrum 1973). The actual area observed from the stations is approximately equivalent to 12 football fields (Simmons and Landrum 1973). Color transparencies from 143 camera stations were also archived. Accompanying data (e.g., direction, position, and station) were stored in a computer mainframe database to allow for relatively rapid retrieval of information.

Figure 1. Photograph from a depth of 594 meters, half-square-meter area of fine grain sediment of the Ross Sea floor from cruise 32 of the USNS *Eltanin* (camera station 21, 78°29'S 164°57'W to 78°31'S 164°24'W), showing a diversity of invertebrate life.

These photographs of relatively unexplored areas of polar seafloor are invaluable to marine geologists, biologists, and physical oceanographers. Over 60,000 copies of photographs and their accompanying data have been shipped to researchers for use in more than 30 publications (Simmons and Landrum 1973).

Present-day activities: Building on past accomplishments

The NMNH maintains a large collection of polar natural history specimens, including 200,000 lots of unidentified and uncataloged invertebrates and approximately 31,115 lots

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of identified, cataloged invertebrates of which 2,049 lots are types. Approximately 19,763 lots of polar specimens are currently on loan to scientists in 191 institutions. Acquisition and collection data for the specimens are readily accessible in several computerized databases and files. Polar station data, a shelf inventory of all uncataloged material, and records of all loaned material are also accessible in computerized databases.

The NSF provides funding for three full-time collection/data technicians and one part-time data manager. Current project activities include curating and archiving collections of

- antarctic bryozoans (approximately 10,000 lots identified by Judith Winston, Virginia Museum of Natural History),
- sponges (approximately 4,800 lots and spicule preparations identified by Vladimir Koltun, Russia Zoological Institute), and
- mollusks (approximately 2,000 lots identified by Richard Dell, Dominion Museum, New Zealand) for permanent deposition at NMNH.

Polar material of various taxa, such as octocorals (identified by Ted Bayer, NMNH), and polychaetes also are being curated and retrospectively cataloged into the main NMNH collections computer database. Additional projects include the development of a database of all types of polar invertebrates archived at NMNH and various Geographic Information System (GIS) maps from the database of USAP program stations (figure 2).

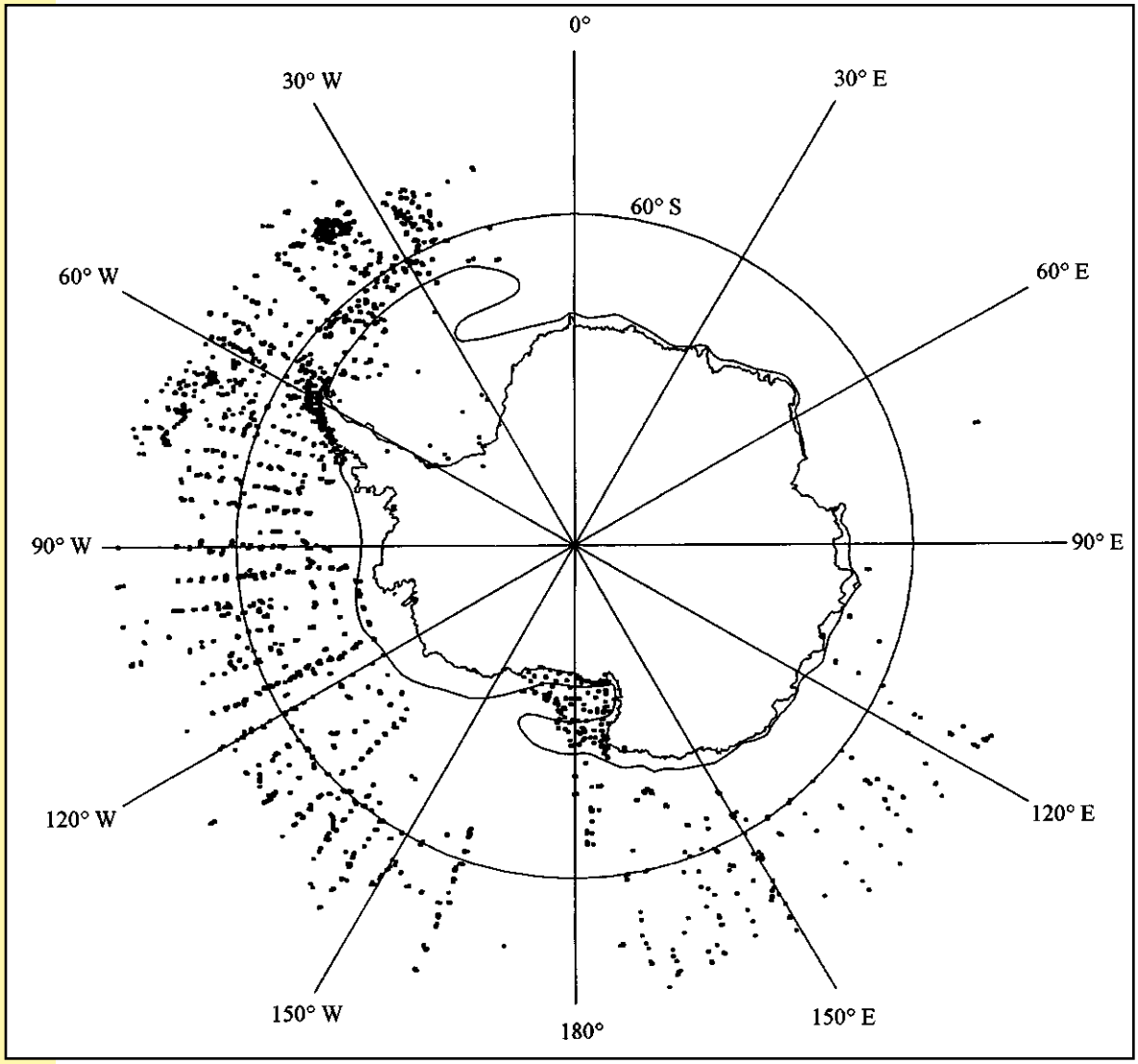

Figure 2. GIS map of the USAP marine collection sites, including and below 50°S.

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A World Wide Web page with links to a searchable polar station data file, images, and other related data, scheduled to be loaded on the Smithsonian Institutions's gopher server, is currently under construction. The address is
http://www.nmnh.si.edu/iz/usap.html

Other services provided by the staff include lending polar specimens for study by qualified researchers, providing access to polar station data, and preparing of custom GIS maps showing the ecological distribution of polar taxa.

Borrowing unstudied polar specimens

The NMNH has extensive archived unidentified holdings of plankton and a variety of invertebrate groups (figure 3). At present, the most numerous unstudied holdings include the amphipods, polychaetes, and bivalves. Upon request, the NMNH polar specimen holdings may be lent to qualified researchers in the United States and abroad. Loans are not made to graduate students, but permanent university faculty may borrow specimens for graduate student use. Written or e-mail requests for loans should be directed to either the Chairman of the Department of Invertebrate Zoology or the USAP

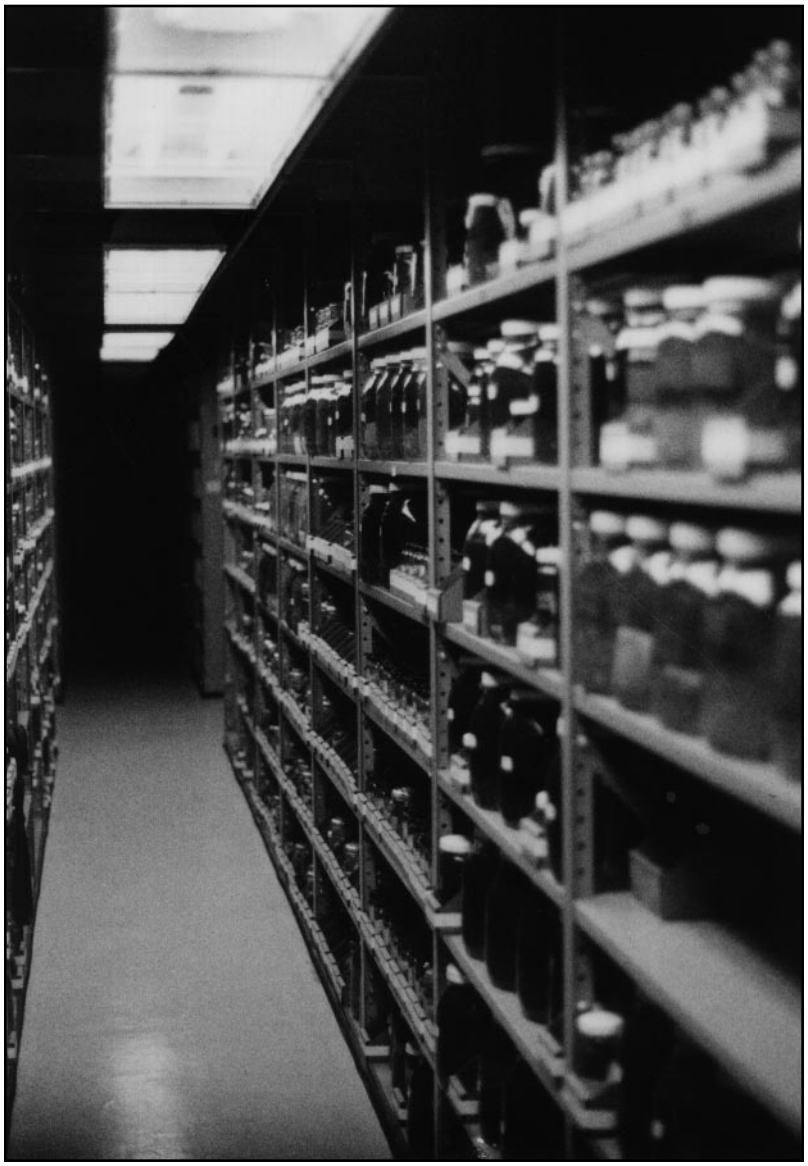

Figure 3. Partial specimen holdings of uncataloged and unidentified polar invertebrates.

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program manager. To protect the integrity of the specimens, loans are typically made with the following conditions:

- The loan is granted to the researcher's institution and not directly to the researcher.
- The initial loan period may not exceed 6 months for type specimens and 12 months for nontypes. On written request, most loans may be renewed for an additional 6- or 12-month period.
- Permission to dissect; to make scanning electron microscope, transmission electron microscope, or histological preparations; or to make any other physical alteration of the specimens must be requested in writing before such specimen manipulations are allowed. All preparations made must be returned to NMNH when the loan is returned.
- The NMNH reserves the right to grant or deny any loan requests.

Past, present, and future

As research support needs have changed in recent years, the USAP program at the NMNH has evolved from a predominantly sorting and processing activity to a program charged with managing the massive collection of polar invertebrates and their associated data. The ultimate goal is to make the specimens and related data more accessible to polar scientists worldwide. In 1997, we expect to initiate an awards program that will help fund systematic research projects based on our polar collections.

The NMNH will continue to function as a national archiving and distribution center for polar natural history specimens and associated data. The NMNH looks forward to another 30 years of cooperative polar research with NSF.

The authors gratefully acknowledge Valorie Barnes, Cheryl Bright, David Clayton, and Angie Cotton for their technical support and assistance; Dan Cole for assistance in the preparation of GIS maps; and Don Gourley and NMNH Collections Program for the World Wide Web assistance. This program is funded by National Science Foundation cooperative agreement OPP 95-09761.

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Current Antarctic Literature highlights

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Foundation awards of funds for antarctic projects, 1 February 1997 through 31 May 1997

Award numbers for all awards initiated by the Office of Polar Programs (OPP) contain the prefix "OPP." However, funding of awards is sometimes shared by two or more antarctic science or support programs within OPP or between OPP antarctic and arctic science or support programs. For these awards, a listing is included under the heading for each OPP program that funded the project. The first amount represents the funds provided by that individual program, and the second amount, in parentheses, is the total award amount. All of these contain the OPP prefix. Additionally, investigators may receive funds for antarctic research from other divisions or offices of the National Science Foundation, as well as from OPP. When awards are initiated by another NSF division, the three-letter prefix for that program is included in the award number; "DEB" denotes Division of Environmental Biology, Directorate for Biological Sciences; "INT" denotes Division of International Programs, Directorate for Social, Behavioral, and Economic Sciences; "ATM" denotes Division of Atmospheric Sciences, Directorate for Geosciences. As with awards split between OPP programs, antarctic program funds are listed first, and the total amount is listed in parentheses.

Biology and medicine

Ainley, David G. H.T. Harvey and Associates, Alviso, California. Factors regulating population size and colony distribution of Adélie penguins in the Ross Sea. OPP 95-26865. $129,149. ($303,973)

Arrigo, Kevin R. National Aeronautics and Space Administration, Greenbelt, Maryland. Research on Ocean-Atmosphere Variability and Ecosystem Response in the Ross Sea (ROAVERRS). OPP 97-41970. $65,441.

Azam, Farooq. Scripps Institution of Oceanography, La Jolla, California. Bacterial production uncoupled from primary production: Implications for dissolved organic matter fluxes in the southern oceans. OPP 95-30851. $43,333. ($171,484)

Azam, Farooq. Scripps Institution of Oceanography, La Jolla, California. Development of a nonradioisotopic method to measure bacterial production in the sea. OPP 97-08153. $50,000.

Baker, Bill J. Florida Institute of Technology, Melbourne, Florida. The chemical ecology of shallow-water antarctic marine invertebrates. OPP 95-26610. $95,819. ($191,621)

Barber, Richard T. Duke University, Durham, North Carolina. Primary production in the southern oceans. OPP 95-31981. $55,000. ($220,000)

Bengtson, John L. Alaska Fisheries Science Center, Seattle, Washington. Workshop on the role of pack-ice seals in antarctic ecosystems. OPP 96-15719. $39,400.

Bosch, Isidro M. State University of New York, Geneseo, New York. Ultraviolet photobiology of the developmental planktonic stages of antarctic benthic invertebrates. OPP 95-28089. $64,217. ($134,655)

Boster, James S. University of California, Irvine, California. Social structure, agreement, and conflict in groups in extreme and isolated environments: A cross-cultural comparison. OPP 96-10232. $0. ($29,383)

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Bronk, Deborah A. University of Georgia, Athens, Georgia. New and regenerated production in the southern oceans: Ross Sea studies. OPP 95-30732. $13,237. ($56,364)

Bronk, Deborah A. University of Georgia, Athens, Georgia. New and regenerated production in the southern oceans: Ross Sea studies. OPP 97-41057. $5,000.

Cochlan, William P. University of Southern California, Los Angeles, California. New and regenerated production in the southern ocean: Ross Sea study. OPP 95-30716. $49,261. ($229,180)

Davis, Randall W. Texas A&M University, College Station, Texas. Weddell seal foraging: Behavioral and energetic strategies for hunting beneath the antarctic fast-ice. OPP 96-14857. $55,556.

Day, Thomas A. Arizona State University, Tempe, Arizona. Impacts of climate change on antarctic vascular plants: Warming and ultraviolet-B radiation. OPP 96-15268. $135,296.

Delong, Edward F. University of California, Santa Barbara, California. Antarctic marine archaebacteria: Biological properties and ecological significance. OPP 94-18442. $120,808. ($234,428)

Detrich, H. William. Northeastern University, Boston, Massachusetts. Structure, function, and expression of cold-adapted tubulins and microtubule-dependent motors from antarctic fishes. OPP 94-20712. $143,834. ($284,460)

DeVries, Arthur L. University of Illinois, Champaign, Illinois. Role of antifreeze proteins in freezing avoidance in antarctic fishes: Ecological and organismal physiology, structure-function and mechanism, genetics, and evolution. OPP 96-15023. $197,909.

Fuiman, Lee A. University of Texas, Austin, Texas. Weddell seal foraging: Behavioral and energetic strategies for hunting beneath the antarctic fast-ice. OPP 97-08151. $20,632.

Garrison, David L. University of California, Santa Cruz, California. Ecological studies of sea-ice communities in the Ross Sea, Antarctica. OPP 96-14201. $135,659.

Gosz, James R. University of New Mexico, Albuquerque, New Mexico. The network office of the U.S. Long-Term Ecological Research network for an association of institutions. DEB 96-34135. $110,000. ($1,090,000)

Grebmeier, Jacquelin M. University of Tennessee, Knoxville, Tennessee. Research on Ocean-Atmospheric Variability and Ecosystem Response in the Ross Sea (ROAVERRS). OPP 94-20683. $54,615.

Green, William J. Miami University, Oxford, Ohio. Microbial and geochemical controls on metal cycling in Lake Vanda. OPP 97-42405. $8,500.

Johnson, Jeffrey C. East Carolina University, Greenville, North Carolina. Social structure, agreement, and conflict in groups in extreme and isolated environments: A cross-cultural comparison. OPP 95-30404. $46,350. $61,350.

Jones, Cynthia. Old Dominion University, Norfolk, Virginia. Retroactive determination of movement at age in relation to water mass in Patagonian toothfish through laser-based elemental analysis of otoliths. OPP 96-14756. $26,202.

Karentz, Deneb. University of San Francisco, San Francisco, California. Ultraviolet photobiology of planktonic development stages of antarctic benthic invertebrates. OPP 95-28241. $93,091. ($179,698)

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Kirchman, David L. University of Delaware, Newark, Delaware. Bacterial production uncoupled from primary production: Implications for dissolved organic material fluxes in the southern oceans (Joint Global Ocean Flux Study). OPP 97-42330. $4,375.

Kooyman, Gerald L. Scripps Institution of Oceanography, La Jolla, California. Critical habitat of emperor penguins breeding in the western Ross Sea. OPP 96-15390. $83,634.

Lizotte, Michael P. University of Wisconsin, Oshkosh, Wisconsin. Research on Ocean-Atmosphere Variability and Ecosystem Response in the Ross Sea (ROAVERRS). OPP 94-20678. $52,939.

Manahan, Donal T. University of Southern California, Los Angeles, California. Metabolic physiology during embryonic and larval development of antarctic echinoderms. OPP 94-20803. $138,113. ($268,408)

Marra, John. Columbia University, New York, New York. Primary production in the southern oceans. OPP 95-30611. $65,000. ($260,000)

McClintock, James B. University of Alabama, Birmingham, Alabama. The chemical ecology of shallow-water antarctic marine invertebrates. OPP 95-30735. $57,866. ($117,413)

Nevitt, Gabrielle. University of California, Davis, California. Mechanisms of olfactory foraging by antarctic procellariiform seabirds. OPP 96-15061. $10,469.

Olson, Robert J. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Regulation of primary productivity in the southern oceans: Phytoplankton photosynthesis characteristics from individual cell measurements. OPP 95-30718. $69,500. ($249,500)

Palinkas, Lawrence A. University of California, San Diego, California. Social structure, agreement, and conflict in groups in extreme and isolated environments: A cross-cultural comparison. OPP 96-10231. $11,122. ($26,122)

Petzel, David H. Creighton University, Omaha, Nebraska. The role and regulation of chloride cells in antarctic fish. OPP 96-13738. $93,845.

Reed, H.L. H.M. Jackson Foundation for Military Medicine, Bethesda, Maryland. The polar T_3 syndrome: Metabolic and cognitive manifestations and their hormonal regulation and impact on performance. OPP 94-18466. $120,948. ($162,348)

Sidell, Bruce D. University of Maine, Orono, Maine. Evolution of an oxygen-binding hemoprotein in a unique environment: Myoglobin in the hemoglobinless antarctic icefishes. OPP 94-21657. $147,603. ($287,534)

Siniff, Donald B. University of Minnesota–Twin Cities, Minneapolis, Minnesota. Possible linkages between ecosystem measures and the demographics of a Weddell seal population. OPP 97-41415. $80,000.

Smith, Walker O. University of Tennessee, Knoxville, Tennessee. Primary production in the southern oceans. OPP 95-31990. $57,666. ($235,509)

Williams, Terrie M. University of California, Santa Cruz, California. Weddell sea foraging: Behavior and energetic strategies for hunting. OPP 96-18384. $40,967.

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Anandakrishnan, Sridhar. Pennsylvania State University, University Park, Pennsylvania. Antarctic network of unattended broadband integrated seismometers (ANUBIS). OPP 96-15147. $149,434.

Anderson, John B. Rice University, Houston, Texas. GLACIER: A collaborative antarctic curriculum. OPP 95-53878. $25,000. ($263,978)

Anderson, John B. Rice University, Houston, Texas. Mechanism and timing of west antarctic ice sheet retreat at the end of the Last Glacial Maximum. OPP 95-27876. $155,697. ($305,868)

Andrews, John T. University of Colorado, Boulder, Colorado. Late Quaternary history of the western and east-central Ross Sea, Antarctica: A contribution to the West Antarctic Ice Sheet (WAIS) initiative. OPP 96-14287. $108,451.

Ashworth, Allan C. North Dakota State University, Fargo, North Dakota. The paleoenvironment of the Meyer Desert Formation, Transantarctic Mountains. OPP 96-15252. $103,471.

Askin, Rosemary A. Ohio State University, Columbus, Ohio. Initial palynological characterization of Cape Roberts drill cores. OPP 95-27013. $6,830. ($13,429)

Babcock, Loren. Ohio State University, Columbus, Ohio. Earliest crayfish: Paleobiologic, paleoecologic, and paleoclimatic implications. OPP 96-14989. $51,348.

Bell, Robin E. Columbia University, New York, New York. Lithospheric controls on the behavior of the west antarctic ice sheet: Corridor Aerogeophysics of Eastern Ross Transect Zone (CASERTZ). OPP 93-19854. $148,137. ($302,227)

Berkman, Paul A. Ohio State University, Columbus, Ohio. U.S.–Japan cooperative science: Cenozoic environmental variability in antarctic coastal areas. INT 96-03369. $2,500. ($32,675)

Bindschadler, Robert A. National Aeronautics and Space Administration, Greenbelt, Maryland. Workshops for the West Antarctic Ice Sheet (WAIS) project. OPP 97-41130. $7,310. ($14,621)

Cande, Steven C. Scripps Institution of Oceanography, La Jolla, California. Early Tertiary tectonic evolution of the Pacific-Australia-Antarctic Plate circuit. OPP 97-40959. $6,912.

Case, Judd A. St. Mary's College, Moraga, California. Maestrichtian land mammals of Vega Island, Antarctic Peninsula. OPP 96-15933. $14,118.

Cooper, Alan K. U.S. Geological Survey, Menlo Park, California. Antarctic seismic data library system. OPP 96-18700. $25,000.

DePaolo, Donald J. University of California, Berkeley, California. Metamorphism and intrusion chronology and tectonic evolution of the central and southern Transantarctic Mountains using samarium-neodymium isotopes. OPP 97-41034. $19,992.

Elliot, David H. Ohio State University, Columbus, Ohio. Jurassic volcanic rocks in the Transantarctic Mountains: A test of a model for continental flood basalt magmatism in Antarctica. OPP 94-20498. $60,551. ($188,781)

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Elliot, David H. Ohio State University, Columbus, Ohio. Workshop on earth science investigations of the central and southern Transantarctic Mountains. OPP 97-10357. $13,097.

Encarnacion, John P. St. Louis University, St. Louis, Missouri. Constraints on the tectonomagmatic evolution of the Pacific margin of Gondwanaland from uranium-lead geochronology of magmatic rocks in the Transantarctic basement. OPP 96-15398. $48,292.

Engelhardt, Hermann F. California Institute of Technology, Pasadena, California. Workshop on subglacial rock drilling, 19–20 June 1997, Pasadena, California. OPP 96-15386. $15,000. ($30,201)

Grunow, Anne M. Ohio State University, Columbus, Ohio. Geological and geophysical investigations of the east antarctic margins: A workshop discussion at the Byrd Polar Research Center in Columbus, Ohio, 21–23 February 1997. OPP 97-05586. $20,012.

Grunow, Anne M. Ohio State University, Columbus, Ohio. Magma flow directions in Ferrar intrusive rocks using anisotropy of magnetic susceptibility methods. OPP 97-11722. $12,468.

Hammer, William R. Augustana College, Rock Island, Illinois. Continued research on the Triassic and Jurassic vertebrate faunas from the Transantarctic Mountains. OPP 96-14928. $126,644.

Hays, James D. Columbia University, New York, New York. Investigating iceberg calving from antarctic ice sheets through isotope stage 11. OPP 96-15060. $110,000.

Isbell, John L. University of Wisconsin, Milwaukee, Wisconsin. Earliest crayfish: Paleobiologic, paleoecologic, and paleoclimatic implications. OPP 96-15045. $43,310.

Keil, Klaus. University of Hawaii–Manoa, Honolulu, Hawaii. Support for the 60th Annual Meteoritical Society Meeting, Maui, Hawaii, 21–25 July 1997. OPP 97-07077. $10,000.

Klinkhammer, Gary. Oregon State University, Corvallis, Oregon. A survey of hydrothermal vents in Bransfield Strait, Antarctica. OPP 97-40689. $11,187.

Klinkhammer, Gary. Oregon State University, Corvallis, Oregon. Hydrothermal activity in Bransfield Strait, Antarctica: Sample analysis and data reduction. OPP 96-15259. $92,802.

Kyle, Philip R. New Mexico Institute of Mining and Technology, Socorro, New Mexico. Mount Erebus Volcano Observatory. OPP 94-19267. $78,625. ($155,014)

Lawver, Lawrence A. University of Texas, Austin, Texas. Antarctic tectonics evolution: CD-ROM. OPP 96-15161. $139,178.

Lawver, Lawrence A. University of Texas, Austin, Texas. Scotia Arc Global Positioning System Project (SCARP). OPP 95-26687. $105,418. ($185,411)

Leventer, Amy. University of Minnesota–Twin Cities, Minneapolis, Minnesota. Late Quaternary history of the western and east-central Ross Sea, Antarctica: A contribution to the West Antarctic Ice Sheet (WAIS) initiative. OPP 96-15046. $0. ($26,100)

Luyendyk, Bruce P. University of California, Santa Barbara, California. Glacial marine stratigraphy in the eastern Ross Sea and western Marie Byrd Land and shallow structure of the west antarctic rift. OPP 97-41890. $29,057.

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Miller, Molly F. Vanderbilt University, Nashville, Tennessee. Earliest crayfish: Paleobiologic, paleoecologic, and paleoclimatic implications. OPP 96-14709. $46,949.

Mukasa, Samuel B. University of Michigan, Ann Arbor, Michigan. Geochemical evolution of the lithospheric mantle beneath East Antarctica: Connections to the plate tectonic development of eastern Gondwanaland. OPP 96-15274. $125,421. ($134,921)

Powell, Ross D. Northern Illinois University, De Kalb, Illinois. Antarctic Ice-Margin Evolution Workshop, Hobart, Tasmania, Australia, 6–11 July 1997. OPP 97-12995. $14,000.

Ritzwoller, Michael H. University of Colorado, Boulder, Colorado. Acquisition of global geophysics computer server. OPP 96-14483. $12,500. ($34,500)

Ritzwoller, Michael H. University of Colorado, Boulder, Colorado. The structure of the crust and lithosphere of the Antarctic Plate. OPP 96-15139. $185,000.

Taylor, Edith L. University of Kansas, Lawrence, Kansas. The Shackleton Glacier area: Floristics, biostratigraphy, and paleoclimate. OPP 93-15353. $151,439. ($293,420)

Taylor, Thomas N. University of Kansas, Lawrence, Kansas. Jurassic floras of the Carapace Nunatak area: Evolution and paleoclimatic significance. OPP 96-14847. $82,615.

Webb, Peter-Noel. Ohio State University, Columbus, Ohio. Antarctic Offshore Stratigraphy (ANTOSTRAT) Program Workshop on Antarctic Lake Phanerozoic Earth System Science, Hobart, Australia, 6–11 July 1997. OPP 97-11557. $15,000.

Wiens, Douglas. Washington University, St. Louis, Missouri. A broadband seismic experiment for study of the tectonics and structure of the Antarctic Peninsula and Scotia Sea regions. OPP 95-27366. $103,623. ($212,680).

Wise, Sherwood W. Florida State University, Tallahassee, Florida. Curatorship of antarctic collections. OPP 97-40627. $105,344.

Wise, Sherwood W. Florida State University, Tallahassee, Florida. Workshop on Shallow Drilling Systems for U.S. Antarctic Program Research Vessels, August 1997. OPP 97-10358. $22,190.

Woodburne, Michael O. University of California, Riverside, California. Maestrichtian land mammals of Vega Island, Antarctic Peninsula. OPP 96-15236. $55,187.

Ocean and climate studies

Ackley, Stephen F. Gordon Research Conferences, Kingston, Rhode Island. Gordon Research Conference on Sea-Ice Ecology, March 1997, Ventura, California. OPP 96-10004. $15,000.

Bender, Michael L. University of Rhode Island, Kingston, Rhode Island. The distribution of oxygen in air: Implications for the global carbon cycle. OPP 95-23696. $5,000. ($145,021)

Brzezinski, Mark A. University of California, Santa Barbara, California. Silica cycling and the role of diatoms in the biological pump of the southern oceans. OPP 95-31982. $80,579.

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Gordon, Arnold L. Columbia University, New York, New York. Deep Ocean Ventilation Through Antarctic Intermediate Layers (DOVETAIL). OPP 95-28807. $170,756.

Goyet, Catherine. Woods Hole Oceanographic Institution, Woods Hole, Massachusetts. Distribution, sources, and sinks of dissolved organic matter in the southern oceans. OPP 95-30609. $133,602. ($239,411)

Hedges, John I. University of Washington, Seattle, Washington. Organic geochemical studies in the southern oceans. OPP 95-31763. $97,213. ($197,535)

Jeffries, Martin O. University of Alaska, Fairbanks, Alaska. Dynamic/thermodynamic processes and their contribution to the sea ice-thickness distribution and radar backscatter in the Ross Sea. OPP 96-14844. $96,112.

Keeling, Ralph F. Scripps Institution of Oceanography, La Jolla, California. Atmospheric oxygen variability in relation to annual-to-decadal variations in terrestrial and marine ecosystems. ATM 96-12518. $10,000. ($315,031)

Lee, Cindy L. State University of New York, Stony Brook, New York. Organic geochemical studies in the southern oceans. OPP 95-30891. $79,470. ($174,817)

Martinson, Douglas G. Columbia University, New York, New York. Deep Ocean Ventilation Through Antarctic Intermediate Layers (DOVETAIL). OPP 95-27752. $61,550.

Matano, Ricardo P. Oregon State University, Corvallis, Oregon. Deep Ocean Ventilation Through Antarctic Intermediate Layers (DOVETAIL). OPP 95-27695. $90,144.

Nelson, David M. Oregon State University, Corvallis, Oregon. Silica cycling and the role of diatoms in the biological pump of the southern oceans. OPP 95-30677. $59,123.

Padman, Laurence. Oregon State University, Corvallis, Oregon. Turbulent mixing rear the Filchner–Ronne Ice Shelves. OPP 96-15525. $102,837.

Schlosser, Peter. Columbia University, New York, New York. Deep Ocean Ventilation Through Antarctic Intermediate Layers (DOVETAIL). OPP 95-28805. $53,398.

Smethie, William M. Columbia University, New York, New York. Deep Ocean Ventilation Through Antarctic Intermediate Layers (DOVETAIL). OPP 95-28806. $55,888.

Takahashi, Taro. Columbia University, New York, New York. Measurements of carbon dioxide during the southern ocean Joint Global Ocean Flux Study (JGOFS). OPP 95-30684. $400,000. ($740,000)

Wakeham, Stuart G. Skidaway Institute of Oceanography, Savannah, Georgia. Organic geochemical studies in the southern oceans. OPP 95-31759. $78,893. ($173,565)

Warren, Stephen G. University of Washington, Seattle, Washington. Climate processes on the antarctic plateau. OPP 94-21096. $158,813. ($358,670)

Wendler, Gerd. University of Alaska, Fairbanks, Alaska. Investigations of katabatic wind and its interaction with sea ice. OPP 94-13879. $120,861. ($246,579)

Wettlaufer, John S. University of Washington, Seattle, Washington. Interfacial melting and frost heave in ice. OPP 95-23513. $109,110. ($210,202)

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Arnoldy, Roger L. University of New Hampshire, Durham, New Hampshire. An investigation of magnetospheric boundaries using ground-based induction magnetometers operated at manned stations as part of an extensive ground array. OPP 96-13683. $63,838. ($127,675)

Baker, Kile B. Johns Hopkins University, Baltimore, Maryland. Multiradar studies of the dynamics of the antarctic ionosphere. OPP 94-21266. $50,000. ($167,000)

Bieber, John W. Bartol Research Institute, Newark, Delaware. Solar and heliospheric studies with antarctic cosmic-ray observations. OPP 95-28122. $205,000. ($405,184)

Deshler, Terry L. University of Wyoming, Laramie, Wyoming. *In situ* measurements of polar stratospheric clouds spanning the austral winter and of ozone from late winter to early spring. OPP 96-15198. $177,119. ($197,302)

Dusenbery, Paul B. Space Science Institute, Boulder, Colorado. Space weather outreach. OPP 96-15624. $5,000. ($90,000)

Fraser-Smith, A.C. Stanford University, Stanford, California. The operation of an extremely-low-frequency/very-low-frequency radiometer at Arrival Heights, Antarctica. OPP 96-16251. $15,262.

Gaisser, Thomas K. Bartol Research Institute, Newark, Delaware. South Pole Air Shower Experiment–2 (SPASE-2). OPP 96-15101. $245,000.

Inan, Umran S. Stanford University, Stanford, California. Global thunderstorm activity and its effects on the radiation belts and the lower ionosphere. OPP 96-15855. $84,575.

LaBelle, James W. Dartmouth College, Hanover, New Hampshire. High-latitude electromagnetic wave studies using antarctic automatic geophysical observatories. OPP 96-15138. $55,211.

Morse, Robert M. University of Wisconsin, Madison, Wisconsin. The Antarctic Muon and Neutrino Detector Array–II (AMANDA-II) project. OPP 95-28559. $550,000. ($1,278,600)

Novak, Giles. Northwestern University, Evanston, Illinois. Submillimeter polarimetry of the galactic nucleus. OPP 96-18319. $20,000. ($100,000)

Papen, George C. University of Illinois, Champaign, Illinois. Rayleigh and sodium lidar studies of the troposphere, stratosphere, and mesosphere at the Amundsen–Scott South Pole Station. OPP 97-40524. $67,538.

Rosenberg, Theodore J. University of Maryland, College Park, Maryland. Polar Experiment Network for Geophysical Upper-Atmosphere Investigations (PENGUIN). OPP 95-29177. $450,000. ($891,912)

Wilkes, R. Jeffrey. University of Washington, Seattle, Washington. Antarctic long-duration balloon flight for the Japanese-American cosmic-ray emulsion-chamber experiment (JACEE) collaboration. OPP 95-28397. $42,000. ($84,000)

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Alley, Richard B. Pennsylvania State University, University Park, Pennsylvania. Physical properties of the Siple Dome deep ice core. OPP 95-26374. $75,704.

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Baker, Ian. Dartmouth College. Hanover, New Hampshire. Flow and fracture of ice. OPP 95-26454. $87,000. ($172,000)

Bentley, Charles R. University of Wisconsin, Madison, Wisconsin. An examination of the dynamic stability of the west antarctic ice sheet by numerical modeling. OPP 95-27044. $17,484. ($117,479)

Bentley, Charles R. University of Wisconsin, Madison, Wisconsin. Radar investigations of former shear margins: Roosevelt Island and ice stream C. OPP 96-15322. $109,997.

Berkman, Paul A. Ohio State University, Columbus, Ohio. U.S.–Japan Cooperative Science: Cenozoic environmental variability in antarctic coastal areas. OPP 96-03369. $2,500. ($32,675)

Bindschadler, Robert A. National Aeronautics and Space Administration, Greenbelt, Maryland. West Antarctic Glaciology–V. OPP 96-16394. $124,896.

Bindschadler, Robert A. National Aeronautics and Space Administration, Greenbelt, Maryland. Workshops for the West Antarctic Ice Sheet (WAIS) project. OPP 97-41130. $7,311. ($14,621)

Conway, Howard. University of Washington, Seattle, Washington, Washington. Radar investigations of former shear margins: Roosevelt Island and ice stream C. OPP 96-15347. $55,000.

Denton, George H. University of Maine, Orono, Maine. The origin of a polar ice sheet in East Antarctica. OPP 95-27047. $102,115. ($187,731)

Dunbar, Nelia W. New Mexico Institute of Mining and Technology, Socorro, New Mexico. Volcanic record in antarctic ice: Implications for climatic and eruptive history and ice-sheet dynamics of the south polar region. OPP 95-27373. $80,339. ($160,814)

Dunbar, Nelia W. New Mexico Institute of Mining and Technology, Socorro, New Mexico. Volcanic records from the Siple and Taylor Dome ice cores, Antarctica. OPP 96-15167. $47,395.

Engelhardt, Hermann F. California Institution of Technology, Pasadena, California. Workshop on Subglacial Rock Drilling, 19–20 June 1997, Pasadena, California. OPP 96-15386. $15,201. ($30,201)

Fitzpatrick, Joan J. U.S. Geological Survey, Denver, Colorado. Digital imaging for ice-core analysis. OPP 96-15554. $59,305.

Gow, Anthony J. U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire. Physical and structural properties of the Siple Dome core. OPP 97-41097. $121,989.

Harrison, William D. University of Alaska, Fairbanks, Alaska. Ice dynamics, the flow law, and vertical strain at Siple Dome. OPP 96-15502. $174,987.

Mosley-Thompson, Ellen. Ohio State University, Columbus, Ohio. The quantitative assessment of the Mount Pinatubo signal in antarctic snow. OPP 95-26725. $56,039. ($108,462)

Raymond, Charles F. University of Washington, Seattle, Washington. Siple Dome glaciology and ice-stream history. OPP 93-16807. $42,067. ($150,028)

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Environmental research

Support and services

Saltzman, Eric S. University of Miami School of Marine and Atmospheric Sciences, Miami, Florida. Antarctic ice-core records. OPP 95-26952. $110,000. ($230,000)

Sowers, Todd. Pennsylvania State University, University Park, Pennsylvania. Constructing paleoatmospheric records of the isotopic composition of methane and nitrous oxide. OPP 95-26556. $72,618. ($357,624)

Taylor, Kendrick C. University of Nevada, Desert Research Institute, Reno, Nevada. Recovery and science coordination of an ice core at Siple Dome, Antarctica. OPP 95-26421. $164,702. ($319,403)

Waddington, Edwin D. University of Washington, Seattle, Washington. Ice dynamics, the flow law, and vertical strain at Siple Dome. OPP 96-15417. $11,330.

Wahlen, Martin. Scripps Institution of Oceanography, La Jolla, California. Carbon dioxide and carbon isotopes in the Taylor Dome and Vostok ice cores. OPP 96-15292. $285,000.

Whillans, Ian M. Ohio State University, Columbus, Ohio. Stress transmission at ice-stream shear margins. OPP 96-15127. $12,638.

Zielinski, Gregory A. University of New Hampshire, Durham, New Hampshire. Volcanic record in antarctic ice: Implications for climatic and eruptive history and ice-sheet dynamics of the south polar region. OPP 95-27824. $30,470. ($60,522)

Zielinski, Gregory A. University of New Hampshire, Durham, New Hampshire. Volcanic records from the Siple and Taylor Dome ice cores, Antarctica. OPP 96-14384. $52,994.

Zumberge, Mark A. Scripps Institution of Oceanography, La Jolla, California. Ice dynamics, the flow law, and vertical strain at Siple Dome. OPP 96-15454. $90,467.

Environmental research

Kvitek, Rikk G. California State University, Seaside, California. Entry of sewage-derived organic matter from McMurdo Station, Antarctica, into the benthic food web and its biological consequences. OPP 95-27789. $235,009.

Lowenthal, Douglas H. University of Nevada, Desert Research Institute, Reno, Nevada. PM_{10} (particulate matter less than 10 microns in size) source apportionment at McMurdo Station, Antarctica. OPP 94-17829. $128,274.

Support and services

Currier, Stephen F. National Aeronautics and Space Administration, Wallops Island, Virginia. Operations of the NASA-NSF McMurdo ground station. OPP 97-40539. $389,544.

Knox, Robert A. Scripps Institution of Oceanography, La Jolla, California. Shipboard technician support. OPP 97-03794. $15,698. ($1,130,011)

Kuivinen, Karl C. University of Nebraska, Lincoln, Nebraska. Logistic and engineering support by the Polar Ice Coring Office. OPP 97-40514. $772,939. ($1,491,405)

Kuivinen, Karl C. University of Nebraska, Lincoln, Nebraska. Logistic and engineering support by the Polar Ice Coring Office. OPP 97-41959. $39,953. ($2,245,433)

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Kvitek, Rikk G. California State University, Seaside, California. Entry of sewage-derived organic matter from McMurdo Station, Antarctica, into the benthic food web and its biological consequences. OPP 97-96111. $14,053.

Lewis, Michael R. Jackson and Tull Chartered, Washington, D.C. Communication and engineering support services for the U.S. Antarctic Program. OPP 97-41056. $160,000.

Morse, Robert M. University of Wisconsin, Madison, Wisconsin. The Antarctic Muon and Neutrino Detector Array–II (AMANDA-II) project. OPP 95-28559. $100,000. ($1,278,600)

Onuma, Tsuyoshi. Navy Facilities and Engineering Command, Arlington, Virginia. Engineering support for antarctic program. OPP 97-40784. $1,050,000.

Peterson, Charles H. University of North Carolina, Chapel Hill, North Carolina. Diagnostic indicators of biological community: An experimental test in McMurdo Sound, Antarctica. OPP 96-15849. $95,990.

Shah, Raj N. Capital Systems Group, Inc., Rockville, Maryland. Proposal processing and travel support to Office of Polar Programs, National Science Foundation. OPP 97-40896. $75,955. ($102,259)

Smith, Charles H. Department of Defense, Washington, D.C. Logistic support of the U.S. program in Antarctica. OPP 97-40007. $20,000,000.

Smith, Charles H. Department of Defense, Washington, D.C. Logistic support of the U.S. program in Antarctica. OPP 97-40476. $22,700,000.