Earth will be compared with in-situ observations from spacecraft like Wind or ACE. During the years when SMEI is operational, other experiments now being constructed will enhance or replace the functions of the current ones. These include HESSI and the NOAA GOES SXI. The third year of the SMEI mission may overlap with the STEREO mission, and, if operated past this third year, with SOLAR-B. These last two missions are part of NASA's Sun-Earth Connection program.

Operational Use and Data Distribution

The data obtained from the three SMEI detectors will be digitized continuously, then downlinked for reduction and all-sky map production on the ground. The basic SMEI data will consist of time-tagged exposures from each camera covering a 60° x 3° arc of sky. These data will be re-mapped onto sky maps converted to sky intensities through a calibration procedure involving the stars present in each exposure and the known intensities of these stars.

The initial data product from SMEI will consist of a global sky map of brightnesses at about 1° resolution. After the stars and long-term background brightness variations are removed from these sky maps, the residual brightness will reveal variations in the interplanetary Thomson-scattered fluxes. In calibrated form, the all-sky maps will be made routinely available.

Primary Purpose

SMEI's primary purpose as an Air Force experiment is to demonstrate the ability to track CMEs from near the Sun to Earth and thus, to forecast the occurrence of geomagnetic storms. For this purpose, near-real-time data mapping will be required. In the first year, SMEI data will be delivered to AFRL within 24 hours of its downlink from the satellite. During years 2 and 3, SMEI data will arrive at AFRL within 6 hours for processing. Since the estimated processing time at AFRL is 12 hours, it should be possible to release SMEI data to the public within 36 hours. The expected release format will be as whole-sky maps, using AITOFF or similar projections. The SMEI maps will be released to the public, primarily via the Internet, after full testing and calibration of the observations, which we estimate to be approximately nine months after the initial acquisition of data.

The SMEI team intends to provide wide dissemination of the appropriately reduced data. We are prepared to participate with other researchers in the distribution, analysis, and publication of the results using these data. To this end, at the appropriate time, we will make the data available to the community through the National Space Science Data Center (NSSDC) in Greenbelt, Maryland, in compatible formats.

Any researchers who are interested in collaborating in the development of programs to analyze or otherwise utilize the SMEI data should contact the Program Manager, J. C. Johnston (e-mail: Janet.Johnston@hanscom.af.mil) or any of the other team members. These individuals are: Stephen W. Kahler, Dale R. Sinclair, Michael P. Egan, Stephen D. Price, and Paul E. Holladay at the Air Force Research Laboratory, Space Vehicles Directorate, Hanscom AFB, Massachusetts; Joel Mozer at the Air Force Research Laboratory, Space Vehicles Directorate, Sunspot, N.M.; Bernard V. Jackson, Andrew Buffington, and P. Paul Hick at the Center for Astrophysics and Space Sciences, University of California at San Diego, La Jolla, California.; George M. Simnett and Christopher J. Eyles at the Astrophysics and Space Research Group, University of Birmingham, Birmingham, U.K.; Nicholas R. Waltham at the Rutherford Appleton Laboratory, Chilton, Didcot, U.K.; Thomas A. Kuchar at the Institute for Scientific Research, Boston College, Chestnut Hill, Massachusetts, and Peter B. Anderson at the Astronomy Department, Center for Space Physics, Boston University, Boston, Massachusetts.

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New Inferences on Antarctic Ice Sheets and Cenozoic Paleoclimates

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The history and behavior of Antarctic ice sheets over millions of years is increasingly of interest as the rising carbon dioxide levels of today exceed any in the ice core record of the last 0.4 m.y. Yet the changes and events that formed these ancient ice sheets are not well understood. A record of these changes lies in sedimentary strata around the Antarctic margin, and such changes have been the focus of a coordinated effort at the Antarctic margin to acquire seismic and drill core data that are needed to derive and model paleoenvironments of the past 65 m.y. The effort is being led by the Antarctic Offshore Stratigraphy Project (ANTOSTRAT), a group that works under the aegis of the Scientific Committee on Antarctic Research (SCAR).

About 100 scientists from 14 countries met on 8–14 September 2001 in Erice, Italy, to present results of recent field studies and discuss plans and strategies for future data acquisition and paleoclimate modeling efforts.

The southern continent and its surrounding ocean basins have been the target of several science drilling efforts since 1997. All have focused on acquiring geologic cores to decipher various stages and aspects of Antarctica's ice cover and its effects on ocean circulation and paleoclimates. The ocean basin records have clearly documented the long-term cooling of climates over the past 50 m.y. and the large variability over the last 3–5 m.y. They also show events that are either abrupt and brief— such as the Paleocene (55 Ma) warming event, which lasted less than 1 m.y.—or events marked by a distinct shift in the rate at which long-term changes occur, such as the middle-Miocene (15 Ma) increased cooling trend. The explanations for these events include changes in atmospheric gas concentrations of, for example, carbon dioxide and methane; opening of gateways with enhanced ocean circulation; peaks in orbital forcing resulting from Milankovitch cyclicities; and interactions with Northern Hemisphere glaciations. To model such regional and global events, a diverse suite of paleo-environmental information such as topography, bathymetry, paleogeography, paleotemperature, and ice-sheet extent is needed from around Antarctica to attain the desired model resolution.

Presentations of new results at the symposium focused on seismic and drilling studies of five segments of the Antarctic continental margin: the Ross Sea south of New Zealand, the Antarctic Peninsula, Weddell Sea, Prydz Bay, and Wilkes Land regions. ANTOSTRAT has regional working groups in all of these areas. Major drilling programs in three of these areas by the Ocean Drilling Program and the Cape Roberts Project have recovered rocks deposited in Late Cretaceous and younger times. These efforts, as summarized below, illustrate that climates around Antarctica prior to ~34 Ma were much warmer, and climates were cooler from 34 to 15 Ma. They also show that cyclic processes such as ice sheet fluctuations and changes in relative sea level acting on the Antarctic continent during the latter period were similar to those that influenced the Northern Hemisphere during Quaternary times.

The palynomorph, oxygen-isotope, and ice-rafting data from the drill cores yield paleoclimate data indicating a cool-temperate climate with conifer forests in East Antarctica in the Late Cretaceous (85 Ma) that evolved by mid to late Eocene time (35–40 Ma) to cooler climates with rainforest scrub and nearby ice sheets at the coastal regions of Prydz Bay and the Ross Sea. The near-shore cores from the Ross Sea show evidence for continued cooling, sparse tundra-like vegetation, and periodic advances of glaciers on Milankovitch time scales up until early Miocene time, c. 17 Ma, when there is a large time-break in the core record.

In Prydz Bay, the cores do not sample the period from early Oligocene to early Miocene time. Thereafter, paleoclimates until late Miocene times onshore in the Prince Charles Mountains south of Prydz Bay are inferred to be cool to cold, based on inferred polythermal glacial deposits found there. Yet, over the same interval in the Miocene, the drill cores from beneath the continental rise show large systematic and cyclic changes that imply both long-term paleoclimate or paleoceanographic changes, and short-term Milankovitch-period changes in sediment delivery. The changes are thought to be due to deteriorating climates and advances and retreats of glaciers to the continental shelf edge. Systematic changes include decreases in the rate of sediment supply and an increase in the amount of ice-rafting. Cyclic variations are seen in the relative biogenic and terrigenous contents and likely in the organic and iron concentrations that control sediment color. At ODP Site 1165, sediment properties change abruptly in middle Miocene sediments of 14–16 Ma. A positive shift in global deep-sea oxygen-isotope curves is consistent with the Antarctic ice sheet growing at this time.

Cold-to-cool climates around Antarctica and documented evidence of an extensive ice sheet across the three regions drilled is seen continuously in latest Miocene and younger times, since about 6 Ma. In Prydz Bay, massive diamictites deposited under grounded glaciers are ubiquitous across the continental shelf. Similar diamictites were encountered in the Antarctic Peninsula from paleoshelf edges, and their deep-water counterparts with cyclic variations indicative of glacial and interglacial periods were found on the continental rise. A large ice sheet persisted in the Antarctic Peninsula region even through the definitely warmer early Pliocene time. Late Miocene rocks are mostly missing in the Ross Sea, but this is thought to be due to deep erosion of the continental shelf by grounded glaciers. The soft, diatomaeous sediments of the last interglacial period rest upon the strongly compressed diamictites and provide a high-resolution record of climatic variability.

New modeling studies of Antarctic ice sheet history illustrate the importance of past levels of atmospheric carbon dioxide and Milankovitch cyclic variations in orbital parameters during the inception and growth patterns of the ice sheet—cyclicities that are now being recognized in the geologic cores from sites directly in front of, or in canyons downslope from, Miocene ice sheets. A concentration in atmospheric carbon dioxide of about two times that of the present seems to be the optimal threshold for initial development of ice sheets in areas of high topography in central-east Antarctica, and later along the Transantarctic Mountains. Future paleoclimate models will incorporate geologic boundary conditions and iterative glaciologic changes to improve resolution.

The drilling studies and those on regional seismic stratigraphy, shallow ship-board coring, and onshore mapping of Cenozoic strata provide a solid background for future projects, several of which are well along in planning. These include (a) a proposal to IODP to drill in the Ross Sea, Wilkes Land, and Weddell Sea regions—proposals that were part of an integrated circum-Antarctic drilling effort proposed by ANTOSTRAT and which led to ODP Legs 178 and 188; (b) the international ANDRILL project, which would use the same high-speed diamond drilling equipment used by Cape Roberts Project to drill additional sites from sea ice and ice shelf platforms into Cenozoic sedimentary sections of the Ross Sea; (c) SHALDRIL, a U.S.-based effort to install a high-speed diamond drilling rig on the U.S. polar research vessel, M/V *Palmer*, for use in drilling 100–200 m deep holes on the continental shelf, initially in the Antarctic Peninsula region; and (d) a Southern Ocean campaign by IMAGES to acquire 50-m-long cores from sites around Antarctica for use in detailed isotope and paleoclimate studies. These efforts, as described at the symposium, will include large segments of the Antarctic community, and involvement of the broader geoscience community is encouraged.

The Erice symposium was an important forum for presenting and debating a detailed proposal for a new collaborative research project, Antarctic Climate Evolution (ACE). With the strong community interest in paleoclimate research, the proposed project would seek "to enhance knowledge and understanding of the history and behavior of Antarctic ice sheets and climate through Cenozic times by facilitating analysis and synthesis of existing Antarctic geoscience and ice core data, and promoting collection of new data for integration with ice sheet and paleoclimate model studies." ACE would augment the momentum of collaborative research efforts of the past decade on ice sheet history by facilitating acquisition of new data sets that would be collated with earlier data to create a suite of paleoclimate models. ACE would link with autonomous Antarctic science projects and data-support projects via regional and thematic subgroups to help facilitate field programs and modeling efforts. The project would, as proposed, lie under the aegis of SCAR with ties to other science umbrellas.

The meeting participants agreed that ACE should be developed over the next few months by a small group of Antarctic researchers who were put forward, and that input from others in the community should be actively sought.

For additional information about ACE, please contact akcooper@stanford.pangea.edu or see the ACE Web site: http://www.geo.umass.edu/ace/index.html.

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