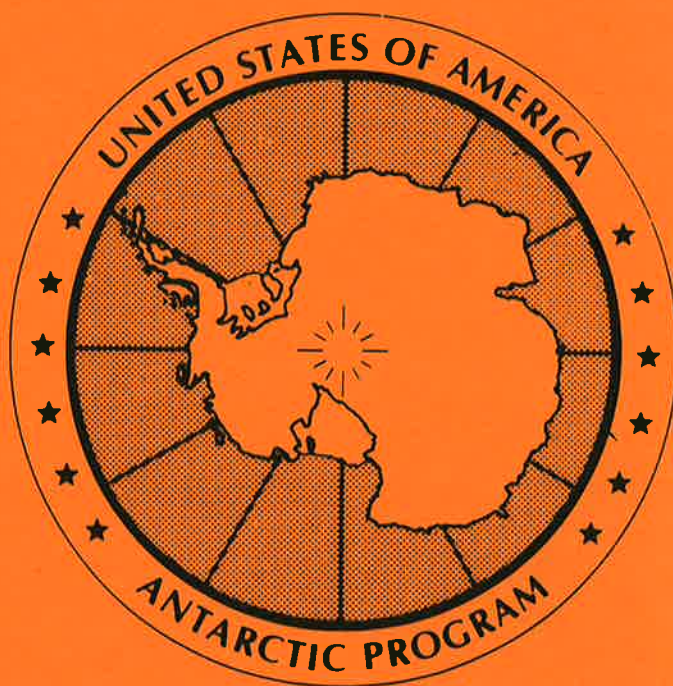


First Annual West Antarctic Ice Sheet (WAIS) Science Workshop



*Proceedings of a workshop held at
the Sheraton National Hotel
Arlington, Virginia
September 13-14, 1992*



First Annual West Antarctic Ice Sheet (WAIS) Science Workshop

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Proceedings of a workshop sponsored by the
NASA Goddard Space Flight Center
and the National Science Foundation
and held at the
Sheraton National Hotel
Arlington, Virginia
September 13–14, 1992



National Aeronautics
and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

1993

Preface

The West Antarctic Ice Sheet (WAIS) initiative was first formulated under the name SeaRISE at a workshop held in January 1990, where a distinguished group of Antarctic earth scientists recommended to the National Science Foundation (NSF) that a multidisciplinary study be initiated to assess the potential for rapid changes occurring in the marine-based West Antarctic ice sheet (NASA Conference Publication 3075). In answer to the response from NSF's Division of Polar Programs (DPP) that a more detailed implementation plan was needed, a second workshop was held in October 1990, at which an even greater community representation drafted the WAIS Science and Implementation Plan (NASA Conference Publication 3115).

The plan was well received by DPP. To adequately fund the program, DPP proposed an initiative to NSF. Although this initiative proved very competitive within NSF, it ultimately failed to secure additional funding. Nevertheless, DPP committed approximately two million dollars of its core budget in FY92 to scientific activities contained within the WAIS plan. Thus, the WAIS project began, albeit at a more modest level than recommended by the WAIS Science and Implementation Plan.

In September 1992, the first WAIS Science Workshop was convened in Arlington, Virginia. This document records the events of that meeting. Sixty scientists attended the two-day workshop and many expressed their delight at the quality and breadth of the research discussed. DPP's Polar Operations Section graciously supported the meeting by permitting it to be held under its auspices at the facilities used for its annual Antarctic Orientation Meeting. This greatly eased the travel and financial burdens of many of the workshop participants. Even though this required that the two-day workshop begin on a Sunday, attendance at both day's sessions was excellent. It is hoped that future workshops will be held in a similar fashion on an annual basis.

CONTENTS

Executive Summaryix

Agendaxi

Session 1: History of the West Antarctic Ice Sheet

Reconstruction of Late Wisconsinan Ice Sheet
and Sea-Level Implications3
John B. Anderson

Lithology and Chronology of Ice-Sheet Fluctuations
(Magnetic Susceptibility of Cores From the Western Ross Sea)4
Anne E. Jennings

Macrofossil Records of West Antarctic Ice-Sheet Retreat
During the Holocene5
Paul Arthur Berkman

The Diatom Record From Beneath the West Antarctic Ice Sheet
and the Global Proxy Perspective6
Reed P. Scherer

Reconnaissance and Deep-Drill Site Selection
on Taylor Dome, Antarctica7
Pieter M. Grootes and Edwin D. Waddington

Irregular Oscillations of the West Antarctic Ice Sheet9
Douglas R. MacAyeal

Summary Discussion11

Session 2: Current State of the West Antarctic Ice Sheet

Velocities of Thwaites and Land Glaciers15
B. K. Lucchitta, K. F. Mullins, and J. G. Ferrigno

Condition of the Ross Ice Shelf Derived From AVHRR Imagery18
Gino Casassa

SPOT Satellite Mapping of Ice Stream B19
Carolyn J. Merry

The Mass Balance of the Ice Plain of Ice Stream B
and Crary Ice Rise20
Robert A. Bindshadler

Session 2: Current State of the West Antarctic Ice Sheet (cont.)

Changes on the Ice Plain of Ice Stream B and Ross Ice Shelf	21
<i>S. Shabtaie</i>	
Surface Velocity Fields of Ice Streams D and E Derived From Repeat Satellite Imagery	22
<i>T. A. Scambos</i>	
Radar Studies of the West Antarctic Ice Streams	23
<i>Robert W. Jacobel</i>	
Mass Balance Assessment Using GPS	24
<i>Christina L. Hulbe</i>	
Recent Acceleration of Thwaites Glacier	25
<i>J. G. Ferrigno</i>	
Airborne Gravity and Other Geophysical Techniques for Understanding the Lithosphere Beneath the West Antarctic Ice Sheet	26
<i>Robin E. Bell, Donald D. Blankenship, Steven M. Hodge, John M. Brozena, and John C. Behrendt</i>	
Aerogeophysical Evidence for Active Volcanism Beneath the West Antarctic Ice Sheet	27
<i>Donald D. Blankenship, Robin E. Bell, Steven M. Hodge, John M. Brozena, and John C. Behrendt</i>	
Summary Discussion	29

Session 3: Internal Dynamics of the West Antarctic Ice Sheet

The Role of the Margins in Ice Stream Dynamics	33
<i>Keith Echelmeyer and William Harrison</i>	
Thermal Control of Ice-Stream Margins	34
<i>Charles F. Raymond</i>	
Basal Hydraulic Conditions of Ice Stream B	35
<i>Hermann Engelhardt and Barclay Kamb</i>	
In Search of Ice-Stream Sticky Spots	36
<i>Richard B. Alley</i>	
Summary Discussion	37

Session 4: Interactions of the Environment and the West Antarctic Ice Sheet

Geologic Controls on the West Antarctic Ice Sheet	41
<i>Sridhar Anandakrishnan</i>	
Effect of Subglacial Volcanism on Changes in the West Antarctic Ice Sheet	42
<i>John C. Behrendt</i>	
Sensible and Latent Heat Flux Estimates in Antarctica	43
<i>Charles R. Stearns and George A. Weidner</i>	
Surface Winds Over West Antarctica	44
<i>David Bromwich</i>	
Modeling Ice Streams: Derived Quantities	45
<i>James Fastook</i>	
Summary Discussion	47
Discussion With NSF	49
WAIS Working Group	51
Epilogue	53
List of Attendees	55

Executive Summary

This workshop represents a milestone in interdisciplinary Antarctic research. Never before have Antarctic scientists from so many disciplines met to discuss their current research, exchange their ideas and concerns, and attempt to collectively answer the same question. To answer this question is the goal of the WAIS project: *What is the future behavior and potential for rapid collapse of the West Antarctic ice sheet?* This question must be answered. It is central to the importance of Antarctica in future global climate change, particularly future change in sea level.

The workshop was organized into sessions corresponding to the four objectives identified as necessary to reach the WAIS goal. These objectives are focused on the *history, current behavior, internal dynamics and environmental interactions* of the West Antarctic ice sheet. Presentations were organized by their relevance to each objective rather than by discipline and were aimed at the multi-disciplinary audience. Liberal amounts of time were allowed for questions and discussion. Thus, the workshop provided a forum for Antarctic researchers to broaden their knowledge of the physical environment and its history by listening to the research of others and discussing the ramifications of that unfamiliar research for their own work. At the end of each objective session, a discussion was held to assess the current state of knowledge aimed at achieving that objective, to identify the questions remaining to be answered, and to describe the approaches best taken to answer those questions. These summary discussions are reported in this document, along with an abstract of each presentation. In addition, each session is briefly summarized below.

History

The research presented left no doubt that the West Antarctic ice sheet has had a very dynamic history. Although the studies discussed at the workshop varied widely in temporal resolution and record length, this viewpoint is held by almost every discipline within WAIS. Intercomparison of records will be beneficial to understanding the various time-scales of ice-sheet behavior. Answering the question of what forces the changes can be best served by obtaining more complete and more detailed records of these changes.

Current Behavior

There also was ample evidence presented of changes taking place today. The textbook equilibrium (or steady-state) condition is nowhere to be found. In some places the changes are modest, but in many areas dramatic changes are underway. Most of the ice sheet remains unmeasured, however, and the obvious need is to extend our measurements to those areas to obtain a more comprehensive picture of the current state of the ice sheet. New techniques are making this task more practicable.

Internal Dynamics

The complexity of the internal dynamics of the ice streams became apparent from a number of papers. While most of the competing mechanical and thermal processes involved in ice flow are known, their relative importance is an area of increasing debate. In places where the subglacial till is very weak, the sides of the ice stream offer significant resistance to flow. The positions of the sides depend on a sensitive balance of heat generation and advection, leading to the possibility of migration of ice-stream margins. It was warned that detailed, but isolated, field studies can inadvertently narrow our perspective of what is a large range of rapid ice-flow conditions. Sticky spots are expected to exist but their characteristics are still vague.

Environmental Interactions

The debate on ice-flow mechanics spilled over into discussions of how the environment immediately adjacent to the ice sheet might be influencing strongly the nature of ice flow. Substantial heat input from subglacial sources was mooted as having a significant impact on the character of the ice sheet and possibly on the initiation of ice streams. In addition, the importance of interactions with the oceans and the atmosphere cannot be dismissed before more studies are carried out. Models are the essential tools in understanding these interactions, but they only crudely account for the necessary interactions.

In a break from the presentation of scientific results, the workshop included an open discussion between staff of NSF/DPP and the attending scientists. DPP still strongly supports WAIS, and scientists urged DPP to reconsider proposing an initiative in anticipation of increased funding requirements by ice-coring activities in West Antarctica recommended by the U.S. Ice Core Working Group.

Finally, the WAIS Working Group was reconstituted into a combination of disciplinary representatives and at-large members. Positions were filled by acclamation from the audience and are included in this report. The Working Group chose Hal Borns as the new chairperson.

FIRST ANNUAL WEST ANTARCTIC ICE SHEET (WAIS) SCIENCE WORKSHOP

Final Agenda

Sunday, September 13, 1992

9:00 Bindschadler Welcome and Introductions

History of the West Antarctic Ice Sheet

9:10	Anderson	Reconstruction of Late Wisconsinan Ice Sheet and Sea-level Implications
9:30	Jennings	Chronology and Lithologic Record of Ice-sheet Fluctuations
9:50	Prentice	Macrofossil Records of WAIS Retreat During the Holocene (for Berkman)
10:10	Harwood	Paleoclimatological Record Derived From Subglacial Diatoms (for Scherer)
10:30	Nishiizumi	In-situ Produced Cosmogenic Nuclides in Terrestrial Surface Rocks
10:50	White	Isotopes, Ice Cores and Temperature Reconstructions
11:10	Groote	Reconnaissance and Deep-drill Site Selection on Taylor Dome
11:30	MacAyeal	Climatic Response of the West Antarctic Ice Sheet to the Glacial Cycle
11:50		Summary Discussion

Current State of the West Antarctic Ice Sheet

Poster	Lucchitta	Glacier Velocities on the Bakutis Coast
1:30	Casassa	Flow Stripes on the Ross Ice Shelf
1:50	Merry	SPOT Satellite Mapping of Ice Stream B
2:10	Bindschadler	Mass Balance of the Ice Plain of Ice Stream B and Crary Ice Rise
2:30	Shabtaie	Changes on the Ice Plain of Ice Stream B and Ross Ice Shelf
2:50	Scambos	Velocity and Strain-Rate Fields of Ice Streams D and E Derived From Repeat Satellite Imagery
3:10	Jacobel	Radar Studies of the West Antarctic Ice Streams
3:30	Hulbe	Use of Precision GPS in Antarctica

3:50	Ferrigno	Recent Acceleration of Thwaites Glacier
4:10	Bell	Airborne Gravity and Other Geophysical Techniques for Understanding the Lithosphere Beneath the West Antarctic Ice Sheet
4:30	Blankenship	Aerogeophysical Evidence for Active Volcanism Beneath the West Antarctic Ice Sheet
4:50		Summary Discussion

Monday, September 14, 1992

Internal Dynamics of the West Antarctic Ice Sheet

9:00	Echelmeyer	Ice Stream B Margin: Stress, Strain and Temperature
9:20	Raymond	Ice Stream Margin
9:40	van der Veen	The Role of Lateral Drag in Ice Stream B Dynamics
10:00	Novick	Character of the Deformable Layer Beneath WAIS Ice Streams
10:20	Englehardt	Basal Water Pressure and Water Flow of Ice Stream B
10:40	Alley	Basal Restraint of Ice Flow/Deforming Beds
11:00		Summary Discussion

Interactions of the Environment and the West Antarctic Ice Sheet

12:50	Anandakrishnan	Geologic Controls on WAIS
1:10	Behrndt	Speculation on the Effect of Subglacial Volcanism on Changes in the West Antarctic Ice Sheet
1:30	Jacobs	Oceanographic Interactions
1:50	Stearns	Sublimation on the Ross Ice Shelf
2:10	Bromwich	Surface Winds over West Antarctica
2:30	Fastook	Modeling Ice Streams: Derived Quantities
2:50		Summary Discussion
3:20		International Programs
3:40		Dialogue with NSF/DPP Science Section Managers
4:20		Dialogue with NSF/DPP Polar Operations Staff
5:00		Election of New Working Group Members and Chair

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE July 1993		3. REPORT TYPE AND DATES COVERED Conference Publication
4. TITLE AND SUBTITLE First Annual West Antarctic Ice Sheet (WAIS) Science Workshop			5. FUNDING NUMBERS Code 971	
6. AUTHOR(S) Edited by Robert A. Bindschadler				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Goddard Space Flight Center Greenbelt, Maryland 20771			8. PERFORMING ORGANIZATION REPORT NUMBER 93A01457	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, D.C. 20546-0001			10. SPONSORING/MONITORING AGENCY REPORT NUMBER CP-3222	
11. SUPPLEMENTARY NOTES Other sponsors: National Science Foundation/Division of Polar Programs				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified-Unlimited Subject Category 46 Report available from the NASA Center for AeroSpace Information, 800 Elkridge Landing Road, Linthicum Heights, MD 21090; (301) 621-0390.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This document is a compilation of abstracts presented at a 2-day workshop focused on interdisciplinary Antarctic research. The goal of the West Antarctic Ice Sheet (WAIS) Science Workshop was to answer the question, "What is the future behavior and potential for rapid collapse of the West Antarctic Ice Sheet?" The question is central to the importance of Antarctica in future global climate change, particularly future change in sea level. The workshop was organized into four sessions corresponding to the four objectives identified as necessary to reach the WAIS goal: history, current behavior, internal dynamics, and environmental interactions. Presentations were organized by their relevance to each objective, rather than by discipline. The workshop concluded with an open discussion between the NSF/DPP staff and the attending scientists.				
14. SUBJECT TERMS Antarctica, Ice Sheet, Earth Science, Sea Level, Oceanography, Geology, Glaciology, Geophysics, Meteorology, Ice Cores			15. NUMBER OF PAGES 55	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

National Aeronautics and
Space Administration

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