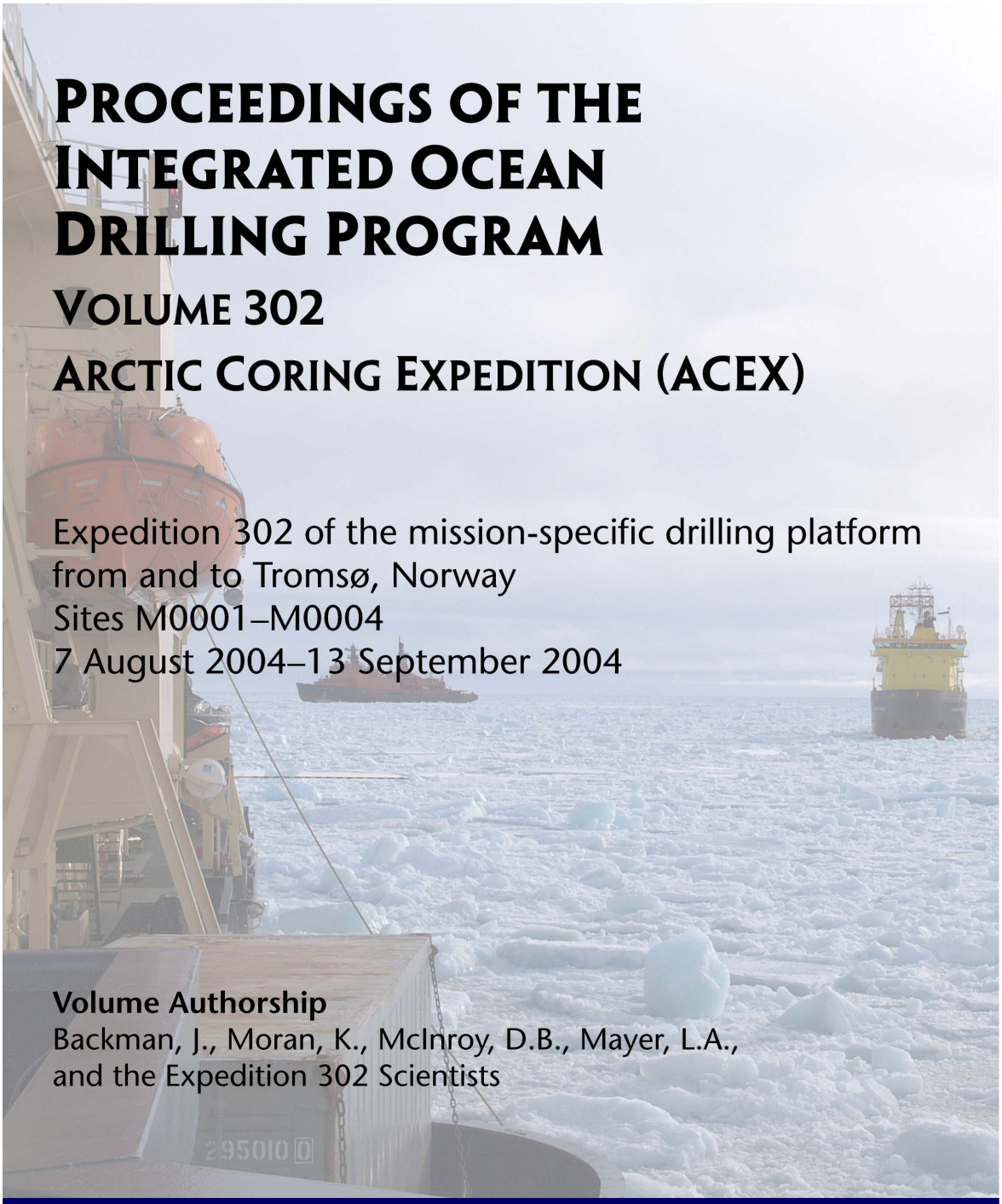

Proceedings of the Integrated Ocean Drilling Program

Volume 302

Arctic Coring Expedition (ACEX)

Expedition 302 of the mission-specific drilling platform
from and to Tromsø, Norway
Sites M0001–M0004
7 August 2004–13 September 2004

Volume Authorship
Backman, J., Moran, K., McInroy, D.B., Mayer, L.A.,
and the Expedition 302 Scientists

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Ministry of Science and Technology (MOST), People's Republic of China

National Science Foundation (NSF), United States

Abbreviations for names of organizations and publications in IODP reference lists follow the style given in *Chemical Abstracts Service Source Index* (published by American Chemical Society).

The bulk of the shipboard-collected core data and a complete set of the logging data from this expedition are accessible at **iodp.wdc-mare.org.** If you cannot access this site or need additional data, please contact

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Some close-up core photographs have been tonally enhanced to better illustrate particular features of interest.

Cover photograph shows the *Oden* (left), *Sovetskiy Soyuz* (middle), and drilling vessel *Vidar Viking* (right) on location in the Arctic sea ice. Photograph by Jens Matthiessen.

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Foreword

By Integrated Ocean Drilling Program Management International, Inc.

The Integrated Ocean Drilling Program (IODP) is the most ambitious ocean exploration and drilling program ever undertaken. With multiple platforms and multiple partners, our research spans the globe and truly represents international collaboration and diplomacy among scientists and nations interested in attaining scientific goals.

The *Proceedings* present the scientific and engineering results of IODP drilling projects, each an important component of an international program designed to better understand Earth, its environmental changes and processes, the deep biosphere, and climate change.

The collective effort required to conduct each IODP expedition is colossal. Beginning with scientists who submit ocean drilling research proposals, there are others who evaluate, rank, and prioritize proposals. Scientists also schedule the science operations, select science party members from scores of international scientists qualified to participate, plan platform operations, ready the drillship, and choose borehole locations. There are onboard logistics to manage and critical communications to coordinate among various academic institutions, governments, and national science organizations. And the resulting data must be managed and made accessible to scientists, particularly those who will prepare future proposals. Every aspect of planning an IODP expedition takes a village—or several. There are many participants and many more stakeholders.

Ocean-drilling achievements, however complex, help us understand extraordinary linkages and interpret relationships as they exist in various parts of the Earth system. Achievements in two legacy drilling programs (the Ocean Drilling Program and Deep Sea Drilling Project) have validated the scientific concepts behind plate tectonics, contributed to the understanding of ocean circulation changes, and extended our knowledge of long- and short-term climate change—scientific information at the foundation of our current drilling program.

IODP drilling platform operations are conducted by three Implementing Organizations (IOs). Riserless platform operations are conducted by the JOI Alliance, comprising the Joint Oceanographic Institutions, Inc., Texas A&M University through the Texas A&M Research Foundation, and Lamont-Doherty Earth Observatory of Columbia University. Riser platform operations are conducted by the Japan Agency for Marine-Earth Science and Technology through Japan's Center for Deep Earth Exploration in cooperation with the Center for Advanced Marine Core Research at Kochi University. Mission-specific platform operations are conducted by the European Consortium for Ocean Research Drilling, Science Operator, comprising the British Geological Survey, Bremen University, and the European Petrophysics Consortium. The European IO currently represents the ocean-drilling efforts of 16 nations in Europe, plus Canada. At the start of this drilling project, IODP involved 20 nations.

The discoveries discovered in this volume build upon layers of knowledge and science developed over roughly the last fifty years. Expedition *Proceedings* are published by IODP Management International for IODP under the sponsorship of the U.S. National Science Foundation (NSF), Japan's Ministry of Culture, Education, Sports, Science and Technology, and other IODP members. The material is based upon research supported under Contract OCE-0432224 from NSF.

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*At time of expedition.

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IODP Japanese Implementing Organization: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Web site: **www.jamstec.go.jp/jamstec-e/odinfo/cdex_top.html**

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IODP U.S. Implementing Organization: JOI Alliance

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With the completion of the Arctic Coring Expedition (ACEX), Integrated Ocean Drilling Program (IODP) Expedition 302, a new chapter in Arctic scientific drilling exploration has begun. After many years of planning, a paleoceanographic drilling leg has been successfully completed in one of the most difficult environments on Earth—for the very first time.

When proposing the concept of a multiship operation to the central Arctic Ocean in early 1998, we were naïve about the long road ahead—one that turned out to be quite bumpy at times. Luckily, there was a tremendous amount of help around to assist in navigating this road. The continuous, constructive, and unfailing support provided by the Ocean Drilling Program (ODP) and IODP scientific advisory communities throughout the many review cycles of the drilling proposal gave us the incentive to keep going.

Our co-proponents must be acknowledged for their major contribution in developing the proposed science and collecting seismic survey data. Larry Mayer worked with us from the very beginning. Martin Jakobsson produced a new view of the Arctic Ocean Basin with his revolutionary International Bathymetric Chart of the Arctic Ocean (IBCAO). Wilfried Jokat and Yngve Kristoffersen provided the critical reflection seismic survey data. Bernard Coakley and Margo Edwards supplemented these data with higher-resolution surveys from Scientific Ice Expeditions (SCICEX). René Forsberg, Ruth Jackson, Evgeny Musatov, and Nikita Bogdanov provided scientific support and critiques that kept the proposal at its high ranking throughout the review process.

During the scientific planning phase, Ted Moore was always there with strong support and sage advice within the ODP/IODP advisory structures. And throughout the entire planning time, John Farrell was invaluable in making sure that we safely navigated through some major political roadblocks. He helped secure funds for the planning work that the Swedish Polar Research Secretariat (SPRS) subsequently carried out.

Planning the operations began in the very early days with informal, but critical, discussions with Harry Hogeboom and Marius Lengkeek. But it was the JOIDES Arctic Detailed Planning Group (Jan Backman, Kate Moran, Margo Edwards, Tim Francis, Michal Gelfgat, Martin Hovland, Tom Janecek, Wilfried Jokat, Anders Karlqvist, Heidimarie Kassens, Kozo Takahashi, Chris Wiley, David Rea, Alister Skinner, Gene Pollard, and Trevor Williams) who first framed the operation in some detail. This group passed their conceptual strategies to SPRS, specifically to Anders Karlqvist, who made the first firm commitment of funds and an institutional commitment to ACEX. With the able leadership from his logistics engineer Ulf Hedman, Anders fleshed out these plans that have now been completed with Expedition 302. It is no wonder he's called the Ulfinator—Ulf conducted or enabled the hard work to be completed each and every day from planning to the completion of the expedition. SPRS also provided top-notch logistics (led by Ulf), ice management (led by Arno Keinonen with a strong Russian and Canadian team), weather forecasting (Bertil Larsson), incredible information technology (led by Per Frejvall with a substantial sponsorship from Ericsson Response and Ingmar Pomlin), and, of course, fleet management (led by Anders Backman). Collectively, their work has set a very high standard for those who follow; thank you one and all.

Also, during the planning phase of ACEX, IODP's ECORD Managing Agency (EMA) did not even exist. Not only was EMA able to invent itself and bring together the European members in IODP during this time, but it also set up the ECORD Science Operator (ESO), led by the British Geological Survey (BGS), in very short order. BGS began to get ready even before any group was officially in place and led a strong group that includes the University of Bremen and the European Petrophysical Consortium (EPC) (University of Leicester, the Université de Montpellier 2, RWTH Aachen and Vnje Universiteit of Amsterdam). They took on Expedition 302 and made it happen during a very tumultuous time. There are many to thank in ESO—Alister Skinner, Dan Evans, Colin Brett, Brice Rea, Ursula Röhl, Tim Brewer, Heike Delius, Alex Wuelbers, Hans Wallrabe-Adams, Dave McInroy, Davie Baxter, Dave Wallis, Graham Tulloch, Luzie Schnieders, Colin Graham, Martin Kölling, Walter Hale, and Åsa Wallin.

Early on, it was clear that our biggest challenge would be maintaining location in heavy sea ice. We had always known that if this could be achieved, then we would be successful. The station-keeping was much more than we could have ever anticipated—we were able to stay on location in 9/10, multiyear ice. This is a landmark feat that will allow scientists to continue to explore this least known of our oceans through scientific ocean drilling for many years to come.

With Anders Backman and Anders Vikström leading the fleet, the three ships performed spectacularly. The *Oden* was not only a welcome, comfortable, and happy home for many of us during the expedition, but a very big thanks goes to Captain Tomas Årnell and his officers, engineers and crew who demonstrated the *Oden's* excellence as the last defense in protecting the *Vidar Viking* against the oncoming ice.

Captain Jørgen E. Haave and his officers did an outstanding job in maintaining station aboard the drillship *Vidar Viking* by keeping manual watch on the wheel, day after day.

And we had the best commuting system ever—we'll not soon forget our daily helicopter trips to and from the *Vidar Viking*—thanks to Sven Stenvall, Thomas Rönnqvist, and Jim Holmström.

Thanks also to Captain Stanislav Smith and his crew from the *Sovetskiy Soyuz* who provided the first attack on the large ice floes. This ship's great power and able crew also safely led us into and out of the ice pack in record time.

We cannot end without mentioning our Cornish drilling cohorts from Seacore Ltd. These are the folks who actually delivered the goods—the hard and soft core. Without exception, they (Tony Halliday, Danny Bennets, Shaun Curnow, Roy Mitchell, Julian Pearce, Allan Pope, Graeme Thomas, Pete Thornton, and Lynton Williams) worked tirelessly, with inventiveness, good humor, and grace.

Thank you also to Alain Kayo, of Schlumberger Wireline, for carrying out the Expedition 302 logging program.

Our science party was exemplary—you were "brave and calm" while patiently waiting for core. We can't really thank you completely yet, as our work has just begun with these initial Expedition Reports chapters. We look forward to completing this adventure by opening up new insights into the Arctic Ocean's past. Finally, we thank Meghan Paulson for translating the DIS core descriptions into barrel sheet form for this volume.

Contents

Expedition reports

Chapters

Core descriptions

Visual core descriptions (VCDs), smear slide data tables, and digital images are included in this section. VCDs are combined into one PDF file. ASCII versions of smear slide data tables are also available in the EXP_REPT\TABLES directory.

Expedition research results

Data reports

Pending

Syntheses

Pending

Supplementary material

Supplementary material for this volume includes extended coring summaries for each site in PDF and detailed lithology descriptions in Microsoft Excel.

COR_SUM

LITH

Drilling location maps

A site map showing the drilling locations for this expedition and maps showing the drilling locations of all Integrated Ocean Drilling Program (IODP), Ocean Drilling Program (ODP), and Deep Sea Drilling Project (DSDP) drilling sites are available in PDF format. These maps were produced using Generic Mapping Tools (GMT) of Paul Wessel and Walter H.F. Smith (**gmt.soest.hawaii.edu**).

IODP Expedition 302 site map

IODP map (Expeditions 301 and 302)

ODP map (Legs 100–210)

DSDP map (Legs 1–96)

Expedition-related bibliography

IODP publications

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Journals/Books*

Pending

Conferences*

Pending*

Index

Pending

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