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Volume 301

Juan de Fuca Hydrogeology

Covering Expedition 301 of the
riserless drilling platform
from and to Astoria, Oregon (USA)
Sites U1301 and 1026
28 June–21 August 2004

Volume authorship
Fisher, A.T., Urabe, T., Klaus, A.,
and the Expedition 301 Scientists

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

National Science Foundation (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 from this expedition is accessible from Integrated Ocean Drilling Program U.S. Implementing Organization (IODP-USIO) Science Services, Texas A&M University (TAMU), at **iodp.tamu.edu/database/index.html**. If you cannot access this site or need additional data, please contact:

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A complete set of the logging data collected by ODP-USIO Science Services, Lamont-Doherty Earth Observatory (LDEO), is available at **iodp.ldeo.columbia.edu/DATA/IODP/**. If you have problems downloading the data, wish to receive additional logging data, or have questions regarding the 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, by IODP Photographer William Crawford, is of the port side of the JOIDES *Resolution* during Expedition 301.

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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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Woods Hole Oceanographic Institution, USA

*At time of expedition.

Implementing organizations

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We are grateful to the many individuals and organizations whose determination, skill, and creativity were essential to planning, preparing, and completing IODP Expedition 301. We begin by acknowledging the hundreds of scientists, administrators, and support staff who labored many years to bring about the first phase of IODP. We are particularly grateful for the efforts of representatives from the lead agencies and members to IODP who guided the development of planning documents, organized review and oversight panels, and forged the complex international agreements that make IODP possible. The scientific drilling community was pleasantly surprised to begin IODP at-sea operations ahead of schedule, and the Expedition 301 Scientists were humbled to have been selected to participate in this first expedition of the new program.

Planning for Expedition 301 included numerous site surveys and proposal rewrites, along with spirited discussions over several years among proponents and others with interests in the hydrogeology of oceanic crust. Once the Expedition 301 experimental program was placed on the drilling schedule, we had only about 9 months to design, build, and ship numerous engineering and scientific systems before the start of the expedition in June 2004. The efforts extended by USIO administrative, engineering, operations, technical, and scientific staff during this preparation period were extraordinary. The operational plan for achieving high-priority objectives during Expedition 301 was revised (and greatly improved) during several meetings among proponents and USIO staff members, and program funding was found to cover the costs of numerous CORK system components. We would particularly like to acknowledge the efforts of Operations Superintendent Mike Storms, and Engineers Derryl Schroeder, Tom Pettigrew, and Richard Dixon during this time. The *JOIDES Resolution* had been demobilized before Expedition 301, and the vessel had to be transited across the Pacific Ocean and numerous laboratory and engineering systems had to be installed (or reinstalled) and prepared for scientific operations in a short time.

We benefited enormously during Expedition 301 from the hard work, ingenuity, experience, and good humor of the multitalented Transocean personnel, including Core Technicians Joe (Bubba) Attryde and Phil Christie, Operations Manager Wayne Malone, Tool Pusher Jose (Pepe) Estevez, and Drillers Nick Parrish and Charlie Watts. Their heroic efforts, and those of the USIO engineering, operations, and technical staff, were essential for successful assembly and deployment of complex observatory systems, particularly for salvaging and rebuilding the CORK system deployed in Hole 1301B. Several helicopter deliveries of critical parts and supplies were arranged on short notice, and we sincerely thank USIO, Science Services, TAMU, Deputy Director Jack Baldauf for supporting our efforts by approving these deliveries and otherwise working with us to resolve numerous unexpected difficulties before and during the expedition. All of the shipboard technical staff provided outstanding support for scientific activities throughout the expedition, but we would particularly like to highlight the contributions made by Yeoperson Michiko Hitchcox and Curatorial Specialist Paula Weiss. We also thank the officers and crew of the *JOIDES Resolution* for their service.

None of us who were involved in Expedition 301 could have imagined in advance how challenging or rewarding the experience would turn out to be. It was an amazing voyage.

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L. Zühlsdorff, et al.

Scientific and technical design and deployment of long-term subseafloor observatories for hydrogeologic and related experiments, IODP Expedition 301, eastern flank of Juan de Fuca Ridge
A.T. Fisher, et al.

A review of CORK designs and operations during the Ocean Drilling Program
Keir Becker and Earl E. Davis

Methods
Expedition 301 Scientists

Site U1301
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Site 1026
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Core descriptions

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

Site U1301

Visual core descriptions · Smear slides · Thin sections · Alteration log · Vein log

Expedition research results

Data reports

Titles are available in **HTML** pending completion of the volume.

Syntheses

Titles are available in **HTML** pending completion of the volume.

Supplementary material

Supplementary material for this volume includes high-resolution images of Juan de Fuca Ridge (bathemetry and swath maps) in Adobe Illustrator and Site U1301 expanded coring summary, piece log, and structure data in Microsoft Excel. Supplementary data are in the following SUPP_MAT directories:

HI_RES

102_F02.EPS
102_F03.EPS
102_F04.EPS
102_F05.EPS

COR_SUM

U1301D.XLS

PIECELOG

U1301.XLS

STR_DATA

U1301B.XLS

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 301 site map

IODP map (Expedition 301)

ODP map (Legs 100–210)

DSDP map (Legs 1–96)

Expedition-related bibliography

IODP publications

Scientific Prospectus

Fisher, A.T., Urabe, T., Klaus, A., and the Expedition 301 Project Team, 2004. Integrated Ocean Drilling Program Expedition 301 Scientific Prospectus: the hydrogeologic architecture of basaltic oceanic crust: compartmentalization, anisotropy, microbiology, and crustal-scale properties on the eastern flank of Juan de Fuca Ridge, eastern Pacific Ocean. *IODP Sci. Prosp.,* 301. **doi:10.2204/iodp.sp.301.2004**

Preliminary Report

Shipboard Scientific Party, 2004. Juan de Fuca hydrogeology: the hydrogeologic architecture of basaltic oceanic crust: compartmentalization, anisotropy, microbiology, and crustal-scale properties on the eastern flank of Juan de Fuca Ridge, eastern Pacific Ocean. *IODP Prel. Rept.,* 301. **doi:10.2204/iodp.pr.301.2004**

Scientific Drilling journal

Fisher, A.T., Urabe, T., Klaus, A., and the IODP Expedition 301 Scientists, 2005. IODP Expedition 301 installs three borehole crustal observatories, prepares for three-dimensional, cross-hole experiments in the northeastern Pacific Ocean. *Sci. Drill.*, 1:6–11. **doi:10.2204/iopd.sd.1.01.2005**

Proceedings volume

Fisher, A.T., Urabe, T., Klaus, A., and the Expedition 301 Scientists, 2005. *Proc. IODP,* 301: College Station TX (Integrated Ocean Drilling Program Management International, Inc.). **doi:10.2204/iodp.proc.301.2005**

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