



**PROCEEDINGS OF THE  
INTEGRATED OCEAN  
DRILLING PROGRAM  
VOLUME 339 EXPEDITION REPORTS  
MEDITERRANEAN OUTFLOW**

Expedition 339 of the riserless drilling platform  
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Stow, D.A.V., Hernández-Molina, F.J., Alvarez Zarikian, C.A., and the  
Expedition 339 Scientists

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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](http://iodp.tamu.edu/database/index.html). If you cannot access this site or need additional data, please contact:

Data Librarian, Integrated Ocean Drilling Program, Texas A&M University, 1000 Discovery Drive, College Station TX 77845-9547, USA. Tel: (979) 845-8495; Fax: (979) 458-1617; E-mail: [database@iodp.tamu.edu](mailto:database@iodp.tamu.edu)

A complete set of the logging data collected by IODP-USIO Science Services, Lamont-Doherty Earth Observatory (LDEO), is available at [brg.ldeo.columbia.edu/logdb/](http://brg.ldeo.columbia.edu/logdb/). If you have problems downloading the data, wish to receive additional logging data, or have questions regarding the data, please contact:

Database Administrator, Borehole Research Group, Lamont-Doherty Earth Observatory of Columbia University, PO Box 1000, 61 Route 9W, Palisades NY 10964, USA. Tel: (845) 365-8343; Fax: (845) 365-3182; E-mail: [logdb@ldeo.columbia.edu](mailto:logdb@ldeo.columbia.edu)

Supplemental data were provided by the authors and may not conform to IODP publication formats.

Some core photographs have been tonally enhanced to better illustrate particular features of interest. High-resolution images are available upon request.

Cover photograph: shows the view of the *JOIDES Resolution* rig floor from the derrick. Photograph by John Beck.

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# Foreword

## By Integrated Ocean Drilling Program Management International, Inc.

The Integrated Ocean Drilling Program (IODP) is now in the latter half of its decadal program (2003–2013). As envisioned in the Initial Science Plan (ISP), IODP expeditions take advantage of three scientific ocean drilling platforms that enable us to cover unprecedented areas of wide oceans, from ice-covered shallow water to full ocean depths. Drilling miles of depth below seafloor, now part of IODP capabilities, is the major advance from the program predecessors, the Deep Sea Drilling Project and the Ocean Drilling Program. The living Earth is a dynamic system that is continuously evolving. IODP seeks to understand this complex and unique system through scientific ocean drilling, sampling, and experimenting in deep holes, along with advancement of related scientific disciplines. IODP is an international collaboration among scientists and nations with keen aspirations to attain the scientific goals of the ISP. IODP currently includes participating members from 26 nations.

The *Proceedings* present the scientific and engineering results of IODP drilling projects, each designed to better understand the past, present, and future of the Earth system.

IODP expeditions begin with scientists who submit research drilling proposals to test new and innovative ideas, then the proposals progress to international scientific advisors (Science Advisory Structure) who nurture, 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. The science party, collectively and individually, conducts science on board and on shore. The co-chief scientists on each expedition are responsible for synthesizing the scientific results as hallmark of expedition.

Ocean-drilling achievements help us to understand and interpret phenomena in various parts of the Earth system. Achievements in the two legacy drilling programs 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. IODP is truly an expansion and extension of the scientific research conducted by the legacy programs, engaging in cutting-edge research concerning topics of global importance.

IODP drilling platform operations are conducted by three Implementing Organizations (IOs). Riserless platform operations are conducted by the U.S. Implementing Organization (USIO), comprising the Consortium for Ocean Leadership, 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 (ECORD) Science Operator (ESO), comprising the British Geological Survey, the University of Bremen, and the European Petrophysics Consortium. The European IO currently represents the ocean-drilling efforts of 16 nations in Europe, plus Canada.

The discoveries presented 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 Education, Culture, Sports, Science and Technology, and other IODP members. The material is based upon research supported under Contract OCE-0432224 from NSF.

Kiyoshi Suyehiro  
President & Chief Executive Officer  
Integrated Ocean Drilling Program Management International, Inc.  
Tokyo  
[www.iodp.org/](http://www.iodp.org/)



---

# Integrated Ocean Drilling Program

## Integrated Ocean Drilling Program Management International, Inc.

Web site: [www.iodp.org/](http://www.iodp.org/)

### IODP-MI

1001 Connecticut Avenue, NW, Suite 504  
Washington DC 20036  
USA  
Tel: (202) 465-7500; Fax: (202) 955-8363  
E-mail: [info@iodp.org](mailto:info@iodp.org)

### IODP-MI

Tokyo University of Marine Science and  
Technology  
Office of Liaison and Cooperative Research,  
3rd Floor  
2-1-6, Etchujima, Koto-ku, Tokyo 135-8533  
Japan  
Tel: (81) 3-6701-8-3181; Fax: (81) 3-6701-3189

## IODP-MI member organizations\*

Alfred-Wegener-Institute für Polar und  
Meeresforschung, Germany

British Geological Survey, United Kingdom

Cardiff University, United Kingdom

Columbia University, Lamont-Doherty Earth  
Observatory, USA

Federal Institute of Technology (ETH) Zurich,  
Switzerland

Florida State University, USA

Hokkaido University, Japan

Helmholtz Centre for Ocean Research Kiel  
(GEOMAR), Germany

Institut de Physique du Globe de Paris, France

Institut Universitaire Européen de la Mer (IUEM),  
France

Japan Agency for Marine-Earth Science and  
Technology (JAMSTEC), Japan

Kochi University, Japan

Kyushu University, Japan

National Institute of Advanced Industrial Science  
(AIST), Japan

Rutgers University, USA

Texas A&M University, USA

Tohoku University, Japan

Tongji University, People's Republic of China

Universität Bremen, Germany

University of Bergen, Norway

University of California at San Diego, Scripps  
Institution of Oceanography, USA

University of California at Santa Cruz, USA

University of Hawaii, USA

University of Leicester, United Kingdom

University of Miami, USA

University of Southampton, National Oceanography  
Centre, United Kingdom

University of Tasmania/IMS, Australia

University of Texas at Austin, USA

University of Tokyo, Japan

University of Washington, USA

Woods Hole Oceanographic Institution, USA

\*At time of expedition.



---

# Implementing organizations

## IODP European Implementing Organization: European Consortium for Ocean Research Drilling, Science Operator (ESO)

Web site: [www.eso.ecord.org/](http://www.eso.ecord.org/)

### IODP-ESO Coordinator: Science, Logistics, and Operations

British Geological Survey  
Murchinson House  
West Mains Road  
Edinburgh EH9 3LA  
United Kingdom  
Tel: (44) 131-667-1000; Fax: (44) 131-668-4140  
E-mail: [eso@bgs.ac.uk](mailto:eso@bgs.ac.uk)

### IODP-ESO Petrophysics

European Petrophysics Consortium  
Department of Geology  
University of Leicester  
Leicester LE1 7RH  
United Kingdom  
Tel: (44) 116-252-3611; Fax: (44) 116-252-3918  
E-mail: [sjd27@leicester.ac.uk](mailto:sjd27@leicester.ac.uk)

### IODP-ESO Curation and Laboratories

Integrated Ocean Drilling Program  
Bremen Core Repository  
Center for Marine Environmental Sciences  
DFG Research Center for Ocean Margins  
University of Bremen  
Leobener Strasse  
28359 Bremen  
Germany  
Tel: (49) 421-218-65561; Fax: (49) 421-218-98-65565  
E-mail: [bcr@marum.de](mailto:bcr@marum.de)

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

Web site: [www.jamstec.go.jp/chikyu/eng/index.html](http://www.jamstec.go.jp/chikyu/eng/index.html)

### IODP-Japan Science Operator

Center for Deep Earth Exploration (CDEX)  
Japan Agency for Marine-Earth Science and  
Technology  
Yokohama Institute for Earth Sciences  
3175-25 Showa-machi  
Kanazawa-ku, Yokohama  
Kanagawa 236-0001  
Japan  
Tel: (81) 45-778-5643; Fax: (81) 45-778-5704  
E-mail: [cdex@jamstec.go.jp](mailto:cdex@jamstec.go.jp)



---

## IODP U.S. Implementing Organization

Web site: [www.iodp-usio.org/](http://www.iodp-usio.org/)

### IODP-USIO Systems Integration Contractor

Consortium for Ocean Leadership  
1201 New York Avenue, NW, 4th Floor  
Washington DC 20005  
USA  
Tel: (202) 232-3900; Fax: (202) 462-8754  
E-mail: [info@oceanleadership.org](mailto:info@oceanleadership.org)

### IODP-USIO Science Services, LDEO

Lamont-Doherty Earth Observatory  
of Columbia University  
PO Box 1000, 61 Route 9W  
Palisades NY 10964  
USA  
Tel: (845) 365-8672; Fax: (845) 365-3182  
E-mail: [borehole@ldeo.columbia.edu](mailto:borehole@ldeo.columbia.edu)

### IODP-USIO Science Services, TAMU

Integrated Ocean Drilling Program  
Texas A&M University  
1000 Discovery Drive  
College Station TX 77845-9547  
USA  
Tel: (979) 845-2673; Fax: (979) 845-4857  
E-mail: [information@iodp.tamu.edu](mailto:information@iodp.tamu.edu)



---

# Expedition 339 science party\*

## Expedition 339 scientists

**Francisco J. Hernández-Molina**

**Co-Chief Scientist**

Departamento Geociencias Marinas  
Universidad de Vigo  
Facultad de Ciencias Del Mar  
36310 Vigo  
Spain  
[fjherman@uvigo.es](mailto:fjherman@uvigo.es)

**Dorrik A.V. Stow**

**Co-Chief Scientist**

Institute of Petroleum Engineering  
Heriot-Watt University  
Edinburgh  
Scotland EH14-4AS  
United Kingdom  
[dorrik.stow@pet.hw.ac.uk](mailto:dorrik.stow@pet.hw.ac.uk)

**Carlos Alvarez Zarikian**

**Expedition Project Manager/Staff Scientist**

Integrated Ocean Drilling Program  
Texas A&M University  
1000 Discovery Drive  
College Station TX 77845-9547  
USA  
[zarikian@iodp.tamu.edu](mailto:zarikian@iodp.tamu.edu)

**Johanna Lofi**

**Logging Staff Scientist**

Géosciences Montpellier  
Université Montpellier II  
CC 60, Place Eugène Bataillon  
34095 Montpellier Cedex 05  
France  
[johanna.lofi@gm.univ-montp2.fr](mailto:johanna.lofi@gm.univ-montp2.fr)

**Trevor Williams**

**Logging Staff Scientist**

Borehole Research Group  
Lamont-Doherty Earth Observatory  
of Columbia University  
PO Box 1000, Route 9W  
Palisades NY 10964  
USA  
[trevor@ldeo.columbia.edu](mailto:trevor@ldeo.columbia.edu)

**Gary D. Acton**

**Stratigraphic Correlator**

Department of Geology  
University of California, Davis  
One Shields Avenue  
Davis CA 95616  
USA  
[gdacton@ucdavis.edu](mailto:gdacton@ucdavis.edu)

**André Bahr**

**Physical Properties Specialist**

Institute of Geosciences  
University of Frankfurt  
Altenhoferallee 1  
60438 Frankfurt  
Germany  
[a.bahr@em.uni-frankfurt.de](mailto:a.bahr@em.uni-frankfurt.de)

**Barbara Balestra**

**Paleontologist (nannofossils)**

School of Earth and Environmental Sciences  
Queens College (CUNY)  
60-35 Kissena Boulevard  
Flushing NY 11367  
USA  
[balestrabb@gmail.com](mailto:balestrabb@gmail.com)

**Emmanuelle Ducassou**

**Sedimentologist**

EPOC, UMR CNRS 5805  
Université de Bordeaux I  
Avenue des Facultes  
33405 Talence  
France  
[e.ducassou@epoc.u-bordeaux1.fr](mailto:e.ducassou@epoc.u-bordeaux1.fr)

**Roger D. Flood**

**Sedimentologist**

Marine Sciences Research Center  
State University of New York, Stony Brook  
Endeavour 145  
Stony Brook NY 11794  
USA  
[roger.flood@sunysb.edu](mailto:roger.flood@sunysb.edu)

\*Addresses at time of expedition, except where updated by the participants.



**José-Abel Flores**  
**Paleontologist (nannofossils)**  
Departamento de Geología  
Universidad de Salamanca  
Facultad De Ciencias  
37008 Salamanca  
Spain  
[flores@usal.es](mailto:flores@usal.es)

**Satoshi Furota**  
**Sedimentologist**  
Department of Natural History Sciences  
Hokkaido University  
Kita-ku  
Sapporo 060-0810  
Japan  
[furota@mail.sci.hokudai.ac.jp](mailto:furota@mail.sci.hokudai.ac.jp)

**Patrick Grunert**  
**Paleontologist (foraminifers)**  
Institute of Earth Sciences  
University of Graz  
Heinrichstrasse 26  
8010 Graz  
Austria  
[patrick.grunert@uni-graz.at](mailto:patrick.grunert@uni-graz.at)

**David A. Hodell**  
**Inorganic Geochemist**  
Department of Earth Sciences  
Godwin Laboratory for Palaeoclimate Research  
University of Cambridge  
Cambridge CB2 3EQ  
United Kingdom  
[dah73@cam.ac.uk](mailto:dah73@cam.ac.uk)

**Francisco J. Jimenez-Espejo**  
**Physical Properties Specialist**  
Institute of Biogeosciences  
Japan Agency for Marine-Earth Science and  
Technology  
Natsushima-cho 2-15  
Yokosuka 237-0061  
Japan  
[fjjspejo@jamstec.go.jp](mailto:fjjspejo@jamstec.go.jp)

**Jin Kyoung Kim**  
**Inorganic Geochemist**  
Research Group for Marine Resources in the Korea  
EEZ  
Korea Ocean Research and Development Institute  
1270 Sadong  
Ansan 426-744  
Korea  
[jink92@kordi.re.kr](mailto:jink92@kordi.re.kr)

**Lawrence A. Krissek**  
**Sedimentologist**  
School of Earth Sciences  
Ohio State University  
275 Mendenhall Laboratory  
125 South Oval  
Columbus OH 43210-1308  
USA  
[lkrissek@asc.ohio-state.edu](mailto:lkrissek@asc.ohio-state.edu)

**Junichiro Kuroda**  
**Sedimentologist**  
Institute for Research on Earth Evolution (IFREE)  
Japan Agency for Marine-Earth Science and  
Technology  
2-15 Natsushima-cho, Yokosuka  
Kanagawa 237-0061  
Japan  
[kurodaj@jamstec.go.jp](mailto:kurodaj@jamstec.go.jp)

**Baohua Li**  
**Paleontologist (foraminifers)**  
Department of Micropalaeontology  
Nanjing Institute of Geology and Palaeontology  
Academia Sinica  
39 East Beijing Road  
Nanjing 210008  
China  
[bh-li@nigpas.ac.cn](mailto:bh-li@nigpas.ac.cn)

**Lucas Lourens**  
**Stratigraphic Correlator**  
Institute of Earth Sciences  
Utrecht University  
Budapestlaan 4  
3584 Utrecht  
The Netherlands  
[llourens@geo.uu.nl](mailto:llourens@geo.uu.nl)

**Madeline D. Miller**  
**Inorganic Geochemist**  
Department of Mechanical Engineering  
California Institute of Technology  
1200 East California Boulevard  
MC 100-23  
Pasadena CA 91125  
USA  
[madeline@caltech.edu](mailto:madeline@caltech.edu)





---

**Futoshi Nanayama**

**Sedimentologist**

Institute of Geology and Geoinformation  
National Institute of Advanced Industrial Science  
and Technology  
Geological Survey of Japan (AIST)  
Site 7, Higashi 1-1-1, Tsukuba  
Ibaraki 305-8567  
Japan  
[nanayama-f@aist.go.jp](mailto:nanayama-f@aist.go.jp)

**Naohisa Nishida**

**Sedimentologist**

Institute of Geology and Geoinformation  
National Institute of Advanced Industrial Science  
and Technology  
Geological Survey of Japan (AIST)  
Site 7, Higashi 1-1-1, Tsukuba  
Ibaraki 305-8567  
Japan  
[n.nishida@aist.go.jp](mailto:n.nishida@aist.go.jp)

**Carl Richter**

**Paleomagnetist**

Department of Geology and Energy Institute  
University of Louisiana  
PO Box 44530  
Lafayette LA 70504-0002  
USA  
[richter@louisiana.edu](mailto:richter@louisiana.edu)

**Maria F. Sanchez Goni**

**Palynologist**

EPOC, UMR CNRS 5805  
Université de Bordeaux I  
Avenue des Facultes  
33405 Talence  
France  
[mf.sanchezgoni@epoc.u-bordeaux1.fr](mailto:mf.sanchezgoni@epoc.u-bordeaux1.fr)

**Francisco J. Sierro Sánchez**

**Paleontologist (foraminifers)**

Departamento de Geología  
Universidad de Salamanca  
Facultad de Ciencias  
C/Parque s/n  
37008 Salamanca  
Spain  
[sierro@usal.es](mailto:sierro@usal.es)

**Arun D. Singh**

**Paleontologist (foraminifers)**

Department of Geology  
Banaras Hindu University  
Varanasi  
221 005 Uttar Pradesh  
India  
[arundeosingh@yahoo.com](mailto:arundeosingh@yahoo.com)

**Craig R. Sloss**

**Sedimentologist**

Department of Biogeosciences  
Queensland University of Technology  
GPO Box 2434  
Brisbane QLD 4001  
Australia  
[c.sloss@qut.edu.au](mailto:c.sloss@qut.edu.au)

**Yasuhiro Takashimizu**

**Sedimentologist**

Mathematical and Natural Sciences  
Niigata University  
8050 Ikarashi, 2-no-cho Nishi-ku  
Niigata 950-2181  
Japan  
[takashimi@ed.niigata-u.ac.jp](mailto:takashimi@ed.niigata-u.ac.jp)

**Alexandrina Tzanova**

**Organic Geochemist**

Department of Geological Sciences  
Brown University  
324 Brook Street  
Box 1846  
Providence RI 02912  
USA  
[alexandrina\\_tzanova@brown.edu](mailto:alexandrina_tzanova@brown.edu)

**Antje Voelker**

**Paleontologist (foraminifers)**

Marine Geology Department  
Geological Survey of Portugal (LNEG)  
Estrada da Portela  
Zambujal  
2610-143 Amadora  
Portugal  
[antje.voelker@lneg.pt](mailto:antje.voelker@lneg.pt)

**Chuang Xuan**

**Paleomagnetist**

College of Oceanic and Atmospheric Sciences  
Oregon State University  
104 COAS Administration Building  
Corvallis OR 97331  
USA  
[cxuan@coas.oregonstate.edu](mailto:cxuan@coas.oregonstate.edu)



---

## Observers

**Estefanía Llave Barranco**  
**Geological Survey of Spain**  
Instituto Geológico y Minero de España (IGME)  
28760 Tres Cantos  
Spain  
[e.llave@igme.es](mailto:e.llave@igme.es)

**Ana Cristina Freixo Roque**  
**Instituto Geológico e Mineiro**  
Geological Survey of Portugal (LNEG)  
Estrada da Portela  
Apartado 7586  
2721-866 Zambujal  
Portugal  
[crisrina.roque@lneg.pt](mailto:crisrina.roque@lneg.pt)

## Education and outreach

**Hélder Pereira**  
**Education Officer**  
Grupo de Biologia e Geologia  
Escola Secundária de Loulé  
Avenida Laginha Serafim  
8100-740 Loulé  
Portugal  
[hpereira@es-loule.edu.pt](mailto:hpereira@es-loule.edu.pt)

## Operational and technical staff

### Siem Offshore AS officials

**Terry Skinner**  
Master of the Drilling Vessel

**James Samuel Mclelland**  
Offshore Installation Manager



---

## IODP-USIO shipboard personnel and technical representatives

**Grant Banta**

Marine Computer Specialist

**Heather Barnes**

X-Ray Laboratory

**John Beck**

Imaging Specialist

**Christopher Bennight**

Chemistry Laboratory

**Timothy Blaisdell**

Applications Developer

**Chad Broyles**

Curatorial Specialist

**Etienne Claassen**

Marine Instrumentation Specialist

**Trevor Cobine**

Paleomagnetism Laboratory

**Roy Davis**

Laboratory Officer

**Thomas Gorgas**

Core Laboratory

**Ronald Grout**

Operations Superintendent

**Ted Gustafson**

Thin Section Laboratory

**Hillary Hall**

Marine Laboratory Specialist (temporary)

**Sandra Herrmann**

Underway Geophysics Laboratory

**Michael Hodge**

Marine Computer Specialist

**Dwight Hornbacher**

Applications Developer

**Jan Jurie Kotze**

Marine Instrumentation Specialist

**Erik Moortgat**

Chemistry Laboratory

**Chieh Peng**

Assistant Laboratory Officer

**Paul Pleasant**

Publications Specialist

**Steve Prinz**

Assistant Laboratory Officer

**Melissa Rotella**

Marine Laboratory Specialist (temporary)

**Kerry Swain**

Logging Engineer

**Yulia Vasilyeva**

Physical Properties Laboratory

---

## IODP-USIO Publication Services staff\*

**Lyndal Arceneaux**  
Student Assistant

**Karen Benson**  
Production Specialist II

**Gudelia (“Gigi”) Delgado**  
Senior Publications Coordinator

**Patrick H. Edwards**  
Production Specialist IV

**Tim Fulton**  
Graphics Specialist II

**Jaime A. Gracia**  
Supervisor of Production

**Jenni Hesse**  
Editor III

**Rhonda Kappler**  
Graphics Specialist III

**Shana C. Lewis**  
Editor III

**Ginny Lowe**  
Reports Coordinator

**Amy McWilliams**  
Editor III

**Angeline T. Miller**  
Manager of Publication Services

**Deborah L. Partain**  
Supervisor of Graphics

**Lorri Peters**  
Supervisor of Editing

**Kenneth Sherar**  
Production Specialist III

**Alyssa Stephens**  
Graphics Specialist II

**Crystal Wolfe**  
Production Specialist III

**Jean Wulfson**  
Graphics Specialist II

**Ann Yeager**  
Distribution Specialist

\*At time of publication.



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Expedition 339 Scientists

### Core descriptions

Visual core descriptions (VCDs), smear slide data, and core images are included in this section. VCDs and smear slides are combined into PDF files for each site. The entire set of core images in PDF is available in the IMAGES directory.

#### **Site U1385**

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#### **Site U1386**

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## Site U1390

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# Expedition research results

## Data reports

Titles are available in [HTML](#).

## Syntheses

Titles are available in [HTML](#).

# Supplementary material

Supplementary material for this volume includes hand-drawn visual core description sheets in PDF format and draw logs in PDF and EPS formats. See [README.TXT](#) in the SUPP\_MAT directory for a full listing of directories and files.

# 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/](http://gmt.soest.hawaii.edu/)).

### [IODP Expedition 339 site map](#)

[IODP map](#) (Expeditions 301–336 and 339)

[ODP map](#) (Legs 100–210)

[DSDP map](#) (Legs 1–96)



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# Expedition-related bibliography

## IODP publications

### *Scientific Prospectus*

Stow, D., Hernández-Molina, F.J., Hodell, D., and Alvarez Zarikian, C.A., 2011. Mediterranean outflow: environmental significance of the Mediterranean Outflow Water and its global implications. *IODP Sci. Prosp.*, 339. doi:10.2204/iodp.sp.339.2011

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### *Preliminary Report*

Expedition 339 Scientists, 2012. Mediterranean outflow: environmental significance of the Mediterranean Outflow Water and its global implications. *IODP Prel. Rept.*, 339. doi:10.2204/iodp.pr.339.2012

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Expedition 339 Scientists, 2013. Site U1389. In Stow, D.A.V., Hernández-Molina, F.J., Alvarez Zarikian, C.A., and the Expedition 339 Scientists, *Proc. IODP*, 339: Tokyo (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.339.107.2013

Expedition 339 Scientists, 2013. Site U1390. In Stow, D.A.V., Hernández-Molina, F.J., Alvarez Zarikian, C.A., and the Expedition 339 Scientists, *Proc. IODP*, 339: Tokyo (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.339.108.2013

Expedition 339 Scientists, 2013. Site U1391. In Stow, D.A.V., Hernández-Molina, F.J., Alvarez Zarikian, C.A., and the Expedition 339 Scientists, *Proc. IODP*, 339: Tokyo (Integrated Ocean Drilling Program Management International, Inc.). doi:10.2204/iodp.proc.339.109.2013

\*The [Expedition-related bibliography](#) is continually updated online. Please send updates to [PubCrd@iodp.tamu.edu](mailto:PubCrd@iodp.tamu.edu).



# Directory structure\*

<b>339.PDF</b> (Preliminary pages and table of contents)		
<b>README.TXT</b> (ASCII information about the Expedition Reports ISO disc image)		
<b>ACROREAD</b> (Acrobat Reader installation software and instructions for different platforms)	<b>MAC_OS</b> <b>WINDOWS</b> <b>UNIX</b> <b>README.TXT</b>	
<b>EXP_REPT</b> (Expedition Reports section of <i>Proc. IODP, 339</i> )	<b>CHAPTERS</b> (Expedition Reports chapters)	<b>339_101.PDF</b> (Expedition 339 summary) <b>339_102.PDF</b> (Methods) <b>339_103.PDF</b> (Site U1385) <b>339_104.PDF</b> (Site U1386) <b>339_105.PDF</b> (Site U1387) <b>339_106.PDF</b> (Site U1388) <b>339_107.PDF</b> (Site U1389) <b>339_108.PDF</b> (Site U1390) <b>339_109.PDF</b> (Site U1391)
	<b>CORES</b> (Visual core descriptions, smear slide data, and core images)	<b>CORU1385.PDF</b> (Site U1385) <b>CORU1386.PDF</b> (Site U1386) <b>CORU1387.PDF</b> (Site U1387) <b>CORU1388.PDF</b> (Site U1388) <b>CORU1389.PDF</b> (Site U1389) <b>CORU1390.PDF</b> (Site U1390) <b>CORU1391.PDF</b> (Site U1391) <b>SS_U1385.PDF</b> (Site U1385) <b>SS_U1386.PDF</b> (Site U1386) <b>SS_U1387.PDF</b> (Site U1387) <b>SS_U1388.PDF</b> (Site U1388) <b>SS_U1389.PDF</b> (Site U1389) <b>SS_U1390.PDF</b> (Site U1390) <b>SS_U1391.PDF</b> (Site U1391)
		<b>IMAGES</b>
	<b>OVERSIZE</b> (Large-format files of data tables)	<b>339_104</b> (Site U1386 files) <b>339_105</b> (Site U1387 files) <b>339_107</b> (Site U1389 files) <b>339_109</b> (Site U1391 files)
	<b>TABLES</b> (ASCII files of data tables)	<b>339_103</b> (Site U1385 files) <b>339_104</b> (Site U1386 files) <b>339_105</b> (Site U1387 files) <b>339_106</b> (Site U1388 files) <b>339_107</b> (Site U1389 files) <b>339_108</b> (Site U1390 files) <b>339_109</b> (Site U1391 files)
	<b>MAPS</b> (Drilling location maps)	<b>339_MAP.PDF</b> (Expedition 339 site map)
		<b>IODPMAP.PDF</b> (IODP map, Expeditions 301–336 and 339)
		<b>ODPMAP.PDF</b> (ODP map, Legs 100–210)
		<b>DSDPMAP.PDF</b> (DSDP map, Legs 1–96)
	<b>SUPP_MAT</b> (Author-prepared supplementary material)	<b>README.TXT</b>

\*Directory structure reflects the Expedition Reports content and volume material produced on ISO disc image.

