

# Proceedings of the International Ocean Discovery Program

## Volume 352

### Izu-Bonin-Mariana Fore Arc

Expedition 352 of the riserless drilling platform

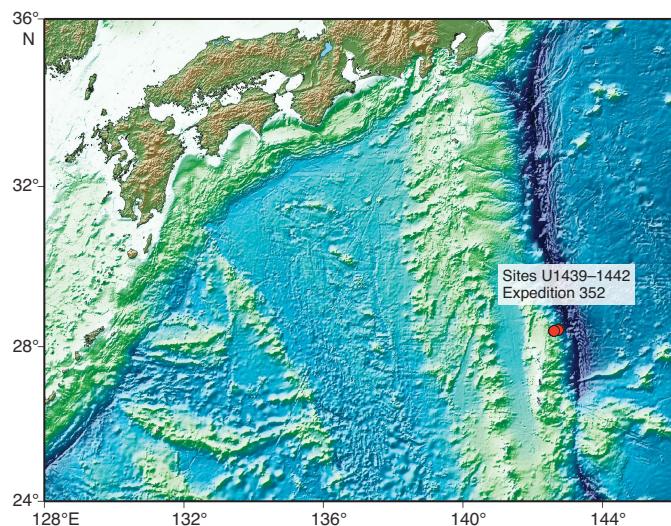
Yokohama, Japan, to Keelung, Taiwan

Sites U1439–U1442

30 July–29 September 2014

#### Volume authorship

Reagan, M.K., Pearce, J.A., Petronotis, K.E., and the Expedition 352 Scientists



## Publisher's notes

Funding for the program was provided by the following agencies at the time of this expedition:

National Science Foundation (NSF), United States  
Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan  
European Consortium for Ocean Research Drilling (ECORD)  
Ministry of Science and Technology (MOST), People's Republic of China  
Korea Institute of Geoscience and Mineral Resources (KIGAM)  
Australian Research Council (ARC) and GNS Science (New Zealand), Australian/New Zealand  
Consortium (ANZIC)  
Ministry of Earth Sciences (MoES), India  
Coordination for Improvement of Higher Education Personnel, Brazil (CAPES)

Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the participating agencies, IODP Management International, Inc., Consortium for Ocean Leadership, Lamont-Doherty Earth Observatory of Columbia University, Texas A&M University, or Texas A&M Research Foundation.

The bulk of the shipboard-collected core data from this expedition is accessible from the International Ocean Discovery Program (IODP) *JOIDES Resolution* Science Operator, 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, International Ocean Discovery Program *JOIDES Resolution* Science Operator, Texas A&M University, 1000 Discovery Drive, College Station TX 77845-9547, USA. Tel: (979) 845-8495; Fax: (979) 458-1617; Email: [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; Email: [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 boninite breccia. Photograph by Mark K. Reagan.

## Copyright

Except where otherwise noted, this work is licensed under a [Creative Commons Attribution License](#). Unrestricted use, distribution, and reproduction are permitted, provided the original author and source are credited.

Examples of how to cite this volume or part of this volume are available at [publications.iodp.org/proceedings/352/352title.html#bib](http://publications.iodp.org/proceedings/352/352title.html#bib).

## ISSN

World Wide Web: 2377-3189

# Contents

## Expedition reports

### Chapters

#### [Expedition 352 summary](#)

M.K. Reagan et al.

#### [Expedition 352 methods](#)

M.K. Reagan et al.

#### [Site U1439](#)

M.K. Reagan et al.

#### [Site U1440](#)

M.K. Reagan et al.

#### [Site U1441](#)

M.K. Reagan et al.

#### [Site U1442](#)

M.K. Reagan et al.

### Core descriptions

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

#### [Site U1439](#)

Visual core descriptions · Smear slides · Thin sections

#### [Site U1440](#)

Visual core descriptions · Smear slides · Thin sections

#### [Site U1441](#)

Visual core descriptions · Smear slides · Thin sections

## Acknowledgments

This research used samples and data provided by the International Ocean Discovery Program (IODP). We thank all of the personnel aboard the R/V *JOIDES Resolution* during Expedition 352 for their skill and dedication. Particular thanks go to the Technical Support staff for the quality and timeliness of their work. Stephen Midgley deserves special recognition for his recommendation to drill in casing, which allowed the final two holes to be drilled. The editorial staff at the IODP *JOIDES Resolution* Science Operator in TAMU are thanked for help with publication of this document. Suichi Kodaira, Mikaya Yamashita, and Daniel Lizarralde are thanked for site surveys and help interpreting and uploading the survey data. We gratefully acknowledge Bob Stern for his key role in the initial formulation and development of the proposal. We also thank Osamu Ishizuka and the other drilling proposal proponents, as well as the members of the Science Evaluation Panel (Chair: Dick Kroon) for making Expedition 352 possible.

### [Site U1442](#)

Visual core descriptions · Smear slides · Thin sections

### Supplementary material

Supplementary material for this volume includes DESC workbooks; portable XRF analyses data and calculations used to describe structural features in Microsoft Excel; and the JRSO underreamers, bicenter reamers, and mud motors information sheet in PDF. See [README.TXT](#) in the SUPP\_MAT directory for a full listing of files and directories.

## Expedition research results

### Data reports

Titles are available in [HTML](#).

### Syntheses

Titles are available in [HTML](#).

## Drilling location maps

A site map showing the drilling locations for this expedition and maps showing the drilling locations of all International Ocean Discovery Program (IODP), produced using QGIS ([www.qgis.org](http://www.qgis.org)), Integrated Ocean Drilling Program, Ocean Drilling Program (ODP), and Deep Sea Drilling Project (DSDP), produced using Generic Mapping Tools (GMT) of Paul Wessel and Walter H.F. Smith ([gmt.soest.hawaii.edu](http://gmt.soest.hawaii.edu)), expeditions are available in PDF.

### [IODP Expedition 352 site map](#)

[IODP map](#) (Expeditions 349–352)

[Integrated Ocean Drilling Program map](#) (Expeditions 301–348)

[ODP map](#) (Legs 100–210)

[DSDP map](#) (Legs 1–96)

## Foreword

The International Ocean Discovery Program (IODP) represents a renewal and strategic refocusing of what has been widely hailed as one of the most successful and ambitious international scientific programs in the world. Based solidly on the 45-year scientific legacy of the Deep Sea Drilling Project, Ocean Drilling Program, and Integrated Ocean Drilling Program, the new IODP Science Plan (*Illuminating Earth's Past, Present, and Future*) defines 4 main themes and 13 challenges for the next decade of scientific ocean drilling that are both of fundamental importance in understanding how Earth works and of high relevance to society as Earth changes. The new IODP represents an extraordinary level of international collaboration in utilizing scientific ocean drilling to understand climate and ocean change, the deep biosphere and evolution of ecosystems, connections between Earth's deep processes and surface impacts, and geological processes and hazards on human scales.

The *Proceedings of the International Ocean Discovery Program* presents the scientific and engineering results of IODP drilling projects on an expedition basis. As in the preceding Integrated Ocean Drilling Program, expeditions in the new IODP will be conducted by three implementing organizations, each providing a different drilling platform. These are the U.S. Implementing Organization (USIO; through September 2014) and the *JOIDES Resolution* Science Operator (JRSO; as of October 2014), providing the research vessel *JOIDES Resolution* for riserless drilling operations; JAMSTEC's Center for Deep Earth Exploration (CDEX), providing the drillship *Chikyu* for riser and occasional riserless operations; and the European Consortium for Ocean Research Drilling (ECORD) Science Operator (ESO), providing mission-specific platforms (MSPs) for expeditions that extend the IODP operational range where neither drillship is suitable. Scheduling decisions for each of the platforms are made separately by three independent Facility Boards, each of which includes scientists, operators, and platform funding partners: the *JOIDES Resolution* Facility Board (JRFB), *Chikyu* IODP Board (CIB), and ECORD Facility Board (EFB). At the beginning of the new IODP, the three Facility Boards agreed to utilize Publication Services at the USIO and now the JRSO for production of all expedition *Proceedings* volumes and reports.

The new IODP differs from prior legacy programs in that it has no central management authority nor commingled funding for program-wide activities. Yet the new IODP retains a key integrative structural element: evaluation of all proposals for drilling expeditions by a single advisory structure composed of scientists representing all international program partners. International scientists may submit drilling proposals to the Science Support Office; the proposals are then evaluated by the Science Evaluation Panel in the context of the new Science Plan.

The new IODP also has a second internationally integrative level for high-level discussion (but no executive authority): the IODP Forum. The Forum is defined as the custodian of the Science Plan and is charged with assessing program-wide progress toward achieving the Science Plan. As of the Forum's first annual meeting (May 2014), IODP involves 27 international financial partners, including the United States, Japan, an Australia/New Zealand consortium (ANZIC), Brazil, China, India, South Korea, and the 19 members of ECORD (Austria, Belgium, Canada, Denmark, Finland, France, Germany, Iceland, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom). The enhanced membership in the new IODP represents a remarkable level of international collaboration that remains one of the greatest strengths of scientific ocean drilling.

Keir Becker  
Inaugural Chair of the IODP Forum

# International Ocean Discovery Program Implementing Organizations

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

Website: [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  
Email: [eso@bgs.ac.uk](mailto:eso@bgs.ac.uk)

### IODP-ESO Curation and Laboratories

IODP Bremen Core Repository (BCR)  
Center for Marine Environmental Sciences (MARUM)  
University of Bremen  
Leobener Strasse  
28359 Bremen  
Germany  
Tel: (49) 421-218-65560; Fax: (49) 421-218-98-65560  
Email: [bcr@marum.de](mailto:bcr@marum.de)

### 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  
Email: [sjd27@leicester.ac.uk](mailto:sjd27@leicester.ac.uk)

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

Website: [www.jamstec.go.jp/chikyu/e/](http://www.jamstec.go.jp/chikyu/e/)

### 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  
Email: [cdex@jamstec.go.jp](mailto:cdex@jamstec.go.jp)

## IODP U.S. Implementing Organization

Website: [iodp.tamu.edu](http://iodp.tamu.edu)

### 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  
Email: [info@oceaneleadership.org](mailto:info@oceaneleadership.org)

### IODP-USIO Science Services, TAMU

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

### 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  
Email: [borehole@ldeo.columbia.edu](mailto:borehole@ldeo.columbia.edu)

# Expedition 352 participants\*

## Expedition 352 scientists

### Julian A. Pearce

#### Co-Chief Scientist

School of Earth & Ocean Sciences  
Cardiff University  
Main Building, Park Place  
Cardiff CF10 3AT  
United Kingdom  
[pearceja@cardiff.ac.uk](mailto:pearceja@cardiff.ac.uk)

### Mark K. Reagan

#### Co-Chief Scientist

Department of Earth & Environmental Sciences  
The University of Iowa  
121 Trowbridge Hall  
Iowa City IA 52242  
USA  
[mark-reagan@uiowa.edu](mailto:mark-reagan@uiowa.edu)

### Katerina Petronotis

#### Expedition Project Manager/Staff Scientist

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

### Sally Morgan

#### Logging Staff Scientist

Department of Geology  
University of Leicester  
University Road  
Leicester LE1 7RH  
United Kingdom  
[sm509@le.ac.uk](mailto:sm509@le.ac.uk)

### Renat Almeev

#### Physical Properties Specialist

Institut für Mineralogie  
Leibniz University of Hannover  
Callinstrasse 3  
30167 Hannover  
Germany  
[r.almeev@mineralogie.uni-hannover.de](mailto:r.almeev@mineralogie.uni-hannover.de)

### Aaron J. Avery

#### Paleontologist (nannofossils)

Earth, Ocean and Atmospheric Sciences  
Florida State University  
909 Antarctic Way  
Tallahassee FL 32306  
USA  
[aaron@paleodata.com](mailto:aaron@paleodata.com)

### Claire Carvallo

#### Paleomagnetist

Institut de Minéralogie et de Physique des Milieux Condensés  
(IMPMC)  
Université Pierre et Marie Curie  
4 Place Jussieu  
75005 Paris  
France  
[carvallo@impmc.upmc.fr](mailto:carvallo@impmc.upmc.fr)

### Timothy Chapman

#### Petrologist

School of Geosciences, F05  
University of Sydney  
Camperdown NSW 2006  
Australia  
[t.chapman@sydney.edu.au](mailto:t.chapman@sydney.edu.au)

### Gail L. Christeson

#### Physical Properties Specialist

University of Texas Institute for Geophysics  
JJ Pickle Research Campus Building 196  
10100 Burnet Road  
Austin TX 78758-4445  
USA  
[gail@ig.utexas.edu](mailto:gail@ig.utexas.edu)

### Eric C. Ferré

#### Structural Geologist

Department of Geology  
Southern Illinois University at Carbondale  
1259 Lincoln Drive, Parkinson Lab  
Carbondale IL 62901-4234  
USA  
[eferre@geo.siu.edu](mailto:eferre@geo.siu.edu)

### Marguerite Godard

#### Inorganic Geochemist

Geosciences Montpellier- UMR 5243  
Université Montpellier II  
CC 60, Place Eugene Bataillon  
34095 Montpellier  
France  
[mgodard@univ-montp2.fr](mailto:mgodard@univ-montp2.fr)

### Daniel E. Heaton

#### Petrologist

College of Earth, Ocean and Atmospheric Sciences  
Oregon State University  
104 CEOAS Administration Building  
Corvallis OR 97331-5503  
USA  
[dheaton@coas.oregonstate.edu](mailto:dheaton@coas.oregonstate.edu)

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

**Maria Kirchenbaur**  
**Inorganic Geochemist**  
Geologisches Institut  
Universität Köln  
Zulpicher Strasse 49  
50674 Köln  
Germany  
[mkirchen@uni-koeln.de](mailto:mkirchen@uni-koeln.de)

**Walter Kurz**  
**Structural Geologist**  
Institute of Earth Sciences  
University of Graz  
Heinrichstrasse 26  
A-8010 Graz  
Austria  
[walter.kurz@uni-graz.at](mailto:walter.kurz@uni-graz.at)

**Steffen Kutterolf**  
**Sedimentologist**  
GEOMAR Helmholtz Centre for Ocean Research Kiel  
Wischthofstrasse 1-3  
24148 Kiel  
Germany  
[skutterolf@geomar.de](mailto:skutterolf@geomar.de)

**Hong-Yan Li**  
**Petrologist**  
State Key Laboratory of Isotope Geochemistry  
Guangzhou Institute of Geochemistry,  
Chinese Academy of Sciences  
511 Kehua Street, Wushan  
Guangzhou 510640  
China  
[hongyanli@gig.ac.cn](mailto:hongyanli@gig.ac.cn)

**Yibing Li**  
**Inorganic Geochemist**  
Institute of Geology  
Chinese Academy of Geological Science  
Baiwanzhuang Road 26  
Beijing 100037  
China  
[yibing007@gmail.com](mailto:yibing007@gmail.com)  
[tansei007@aliyun.com](mailto:tansei007@aliyun.com)

**Katsuyoshi Michibayashi**  
**Physical Properties Specialist**  
Institute of Geosciences  
Shizuoka University  
836 Ohya, Suruga-ku  
Shizuoka 422-8529  
Japan  
[sekmich@ipc.shizuoka.ac.jp](mailto:sekmich@ipc.shizuoka.ac.jp)

**Wendy R. Nelson**  
**Petrologist**  
Earth & Atmospheric Sciences  
University of Houston  
312 Science & Research Building 1  
Houston TX 77204  
USA  
[wrnelson2@uh.edu](mailto:wrnelson2@uh.edu)

**Julie Prytulak**  
**Petrologist**  
Department of Earth Science & Engineering  
Imperial College London  
South Kensington Campus Prince Consort Road  
London SW7 2AZ  
United Kingdom  
[j.prytulak@imperial.ac.uk](mailto:j.prytulak@imperial.ac.uk)

**Marie Python**  
**Alteration Petrologist**  
Hokkaido University  
Department of Earth and Planetary Sciences  
Kita-ku, Kita 10, Nishi 8  
Hokkaido Sapporo 060-0810  
Japan  
[marie@sci.hokudai.ac.jp](mailto:marie@sci.hokudai.ac.jp)

**Alastair H.F. Robertson**  
**Sedimentologist**  
School of Geosciences  
University of Edinburgh  
West Mains Road  
Edinburgh EH9 3JW  
United Kingdom  
[alastair.robertson@ed.ac.uk](mailto:alastair.robertson@ed.ac.uk)

**Jeffrey G. Ryan**  
**Inorganic Geochemist**  
Department of Geology  
University of South Florida, Tampa  
4202 East Fowler Avenue SCA 528  
Tampa FL 33620  
USA  
[ryan@mail.usf.edu](mailto:ryan@mail.usf.edu)

**William W. Sager**  
**Paleomagnetist**  
Earth & Atmospheric Sciences  
University of Houston  
127B Science and Research Building 1  
Houston TX 77204  
USA  
[wwsager@uh.edu](mailto:wwsager@uh.edu)

**Tetsuya Sakuyama**  
**Physical Properties Specialist**  
Institute for Research on Earth Evolution (IFREE)  
Japan Agency for Marine-Earth Science and Technology  
(JAMSTEC)  
2-15 Natsushima-cho  
Yokosuka Kanagawa 237-0061  
Japan

Present address (8 October 2015):  
Osaka University  
Department of Science  
3-3-138 Sugimoto, Sumiyoshi-ku  
Osaka 558-8585  
Japan  
[sakuyama@sci.osaka-u.ac.jp](mailto:sakuyama@sci.osaka-u.ac.jp)

**John W. Shervais**  
**Petrologist**  
Department of Geology  
Utah State University  
4505 Old Main Hill  
Logan UT 84322-4505  
USA  
[john.shervais@usu.edu](mailto:john.shervais@usu.edu)

**Kenji Shimizu**  
**Petrologist**  
Institute for Research on Earth Evolution (IFREE)  
Japan Agency for Marine-Earth Science and  
Technology (JAMSTEC)  
2-15 Natsushima-cho  
Yokosuka 237-0061  
Japan  
[shimmy@jamstec.go.jp](mailto:shimmy@jamstec.go.jp)

## Education and outreach

**Elizabeth A. Christiansen**  
**Education Officer**  
H.H. Dow High School  
Midland MI 48640  
USA  
[christiansenEA@gmail.com](mailto:christiansenEA@gmail.com)

**Scott A. Whattam**  
**Petrologist**  
Department of Earth and Environmental Sciences  
Korea University  
Seoul 136-701  
Republic of Korea  
[whattam@korea.ac.kr](mailto:whattam@korea.ac.kr)

## Operational and technical staff

### Siem Offshore AS officials

**Steve Bradley**  
Master of the Drilling Vessel

**Amy E. West**  
**Education Officer**  
San Luis Obispo CA  
USA  
[amy@amyewest.com](mailto:amy@amyewest.com)

### IODP-USIO shipboard personnel and technical representatives

**Lisa Brandt**  
Chemistry Laboratory

**Wayne Malone**  
Offshore Installation Manager (OIM)

**Timothy Bronk**  
Assistant Laboratory Officer

**Rachael Gray**  
Chemistry Laboratory

**Chad Broyles**  
Curatorial Specialist

**Margaret Hastedt**  
Core Laboratory

**Lisa Crowder**  
Assistant Laboratory Officer

**Michael Hodge**  
Marine Computer Specialist

**Keith Dupuis**  
Publications Specialist

**Stephen Midgley**  
Operations Superintendent

**Emily Fisher**  
Thin Section Laboratory

**William Mills**  
Laboratory Officer

**Seth Frank**  
X-ray/Microbiology Laboratory

**Algie Morgan**  
Applications Developer

**Timothy Fulton**  
Imaging Specialist

**Zenon Mateo**  
Underway Geophysics Laboratory

**Clayton Furman**  
Schlumberger Logging Engineer

**Beth Novak**  
Paleomagnetism Laboratory

**Randy Gjesvold**  
Marine Instrumentation Specialist

**Gerrick Van Rensburg**  
Marine Instrumentation Specialist

## **IODP Publication Services staff\***

**Douglas Cummings**  
Graphics Specialist II

**Gudelia ("Gigi") Delgado**  
Senior Publications Coordinator

**Keith Dupuis**  
Graphics Specialist II

**Patrick H. Edwards**  
Production Specialist IV

**Jaime A. Gracia**  
Supervisor of Production and Graphics

**Jenni Hesse**  
Editor III

**Rhonda Kappler**  
Graphics Specialist III

**Shana C. Lewis**  
Editor III

**Ginny Lowe**  
Reports Coordinator

**Amy McWilliams**  
Editor IV

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

**Lorri Peters**  
Supervisor of Editing

**Kenneth Sherar**  
Production Specialist III

**Alyssa Stephens**  
Graphics Specialist III

**Crystal Wolfe**  
Production Specialist III

**Jean Wulfson**  
Production Specialist III

**Ann Yeager**  
Distribution Specialist

\*At time of publication.

# Expedition-related bibliography\*

## IODP publications

### Scientific Prospectus

Pearce, J.A., Reagan, M.K., Stern, R.J., and Petronotis, K., 2013. *Expedition 352 Scientific Prospectus: Izu-Bonin-Mariana Fore Arc*. International Ocean Discovery Program. <http://dx.doi.org/10.14379/iodp.sp.352.2013>

### Preliminary Report

Expedition 352 Scientists, 2015. *Expedition 352 Preliminary Report: Izu-Bonin-Mariana Fore Arc*. International Ocean Discovery Program. <http://dx.doi.org/10.14379/iodp.pr.352.2015>

### Proceedings volume

Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, 2015. *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program). <http://dx.doi.org/10.14379/iodp.proc.352.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K., Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Expedition 352 summary. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.101.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K., Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Expedition 352 methods. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.102.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K.,

Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Site U1439. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.103.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K., Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Site U1440. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.104.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K., Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Site U1441. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.105.2015>

Reagan, M.K., Pearce, J.A., Petronotis, K., Almeev, R., Avery, A.A., Carvallo, C., Chapman, T., Christeson, G.L., Ferré, E.C., Godard, M., Heaton, D.E., Kirchenbaur, M., Kurz, W., Kutterolf, S., Li, H.Y., Li, Y., Michibayashi, K., Morgan, S., Nelson, W.R., Prytulak, J., Python, M., Robertson, A.H.F., Ryan, J.G., Sager, W.W., Sakuyama, T., Shervais, J.W., Shimizu, K., and Whattam, S.A., 2015. Site U1442. In Reagan, M.K., Pearce, J.A., Petronotis, K., and the Expedition 352 Scientists, *Izu-Bonin-Mariana Fore Arc*. Proceedings of the International Ocean Discovery Program, 352: College Station, TX (International Ocean Discovery Program).

<http://dx.doi.org/10.14379/iodp.proc.352.106.2015>

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