

# Proceedings of the International Ocean Discovery Program

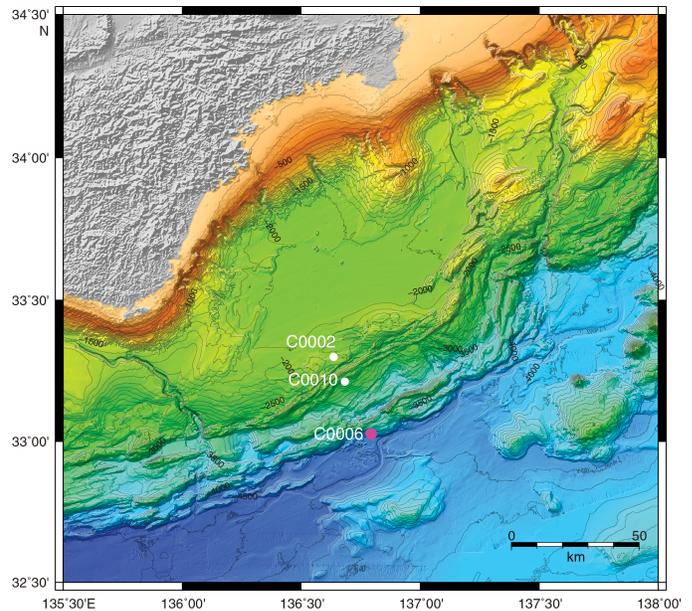
## Volume 380

### NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)

Expedition 380 of the D/V *Chikyu*  
from and to Shimizu, Japan  
Site C0006  
12 January–7 February 2018

#### Volume authorship

Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists



## Publisher's notes

This publication was prepared by the D/V *Chikyu* Science Operator, the Center for Deep Earth Exploration (CDEX), at the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and the *JOIDES Resolution* Science Operator (JRSO) at Texas A&M University (TAMU) as an account of work performed under the International Ocean Discovery Program (IODP). Funding for IODP is provided by the following international partners:

National Science Foundation (NSF), United States  
Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan  
European Consortium for Ocean Research Drilling (ECORD)

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, TAMU, or Texas A&M Research Foundation.

Shipboard-collected data from this expedition are accessible at <http://sio7.jamstec.go.jp>.

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: Core-Log-Seismic-Integration at Sea (CLSI@Sea) Lab Manager, Lena Maeda, signs the IODP Expedition 380 LTBMS CORK head in the moonpool just before its deployment in Hole C0006G. Copyright JAMSTEC.

## Copyright

Except where otherwise noted, this work is licensed under the Creative Commons Attribution 4.0 International (CC BY 4.0) license (<https://creativecommons.org/licenses/by/4.0/>). 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 <http://publications.iodp.org/proceedings/380/380title.html#bib>.

## ISSN

World Wide Web: 2377-3189

## Volume DOI

<https://doi.org/10.14379/iodp.proc.380.2018>

## Publication date

20 December 2018

## Contents

### Expedition reports

#### Chapters

##### [Expedition 380 summary](#)

K. Becker et al.

##### [Expedition 380 methods](#)

M. Kinoshita et al.

##### [Site C0006](#)

M. Kinoshita et al.

#### Supplementary material

Supplementary material for the Volume 380 expedition reports includes thermistor string calibration and swellable packer information, an example LTBMS sensor check sheet, and an example LTBMS sensor check sheet for the acoustic modem in Microsoft Word format; instrument test information in Microsoft Excel format; and expedition daily reports in PDF. A full list of directories can be found in SUPP\_MAT in the volume zip folder or on the [Supplementary material for Volume 380 expedition reports](#) web page.

### 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) expeditions, produced using QGIS (<http://www.qgis.org>), and all Integrated Ocean Drilling Program, Ocean Drilling Program (ODP), and Deep Sea Drilling Project (DSDP) expeditions, produced using Generic Mapping Tools (GMT) of Paul Wessel and Walter H.F. Smith (<http://gmt.soest.hawaii.edu>), are available in PDF.

#### [IODP Expedition 380 site map](#)

[IODP map](#) (Expeditions 349–357, 359–372, 374, 380, and 381)

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

[ODP map](#) (Legs 100–210)

[DSDP map](#) (Legs 1–96)

## Acknowledgments

The Expedition 380 scientists wish to acknowledge the excellent operational and engineering support from the Center for Deep Earth Exploration (CDEX), Mantle Quest Japan, Marine Works Japan, and subcontractors that resulted in the successful installation of the Hole C0006G Long-Term Borehole Monitoring System (LTBMS) in almost exactly its planned configuration 17 days ahead of schedule. We especially appreciate the outstanding planning and operational support from CDEX Operations Superintendent Tomokazu Saruhashi, who boldly predicted at the prespud meeting that we might finish the installation early, and the forbearance of Ryūjin for keeping the Kuroshio Current from interfering with achieving that goal.

Support for LTBMS sensors, parts, and accessories was provided in part by the Japan Society for the Promotion of Science Grants-in-Aid for Scientific Research (JSPS KAKENHI) grant Number JP15H05717.

## Foreword

The International Ocean Discovery Program (IODP) represents the latest incarnation of almost five decades of scientific ocean drilling excellence and is generally accepted as the most successful international collaboration in the history of the Earth sciences. IODP builds seamlessly on the accomplishments of previous phases: the Deep Sea Drilling Project, Ocean Drilling Program, and Integrated Ocean Drilling Program. The 2013–2023 IODP Science Plan (*Illuminating Earth's Past, Present, and Future*) defines four themes and thirteen challenges for this decade of scientific ocean drilling that are both of fundamental importance in understanding how the Earth works and of significant relevance to society as the Earth changes, at least in part in response to anthropogenic forcing. This phase of IODP represents a renewed level of international collaboration in bringing diverse drilling platforms and strategies to increasing our understanding of climate and ocean change, the deep biosphere and evolution of ecosystems, connections between Earth's deep processes and surface manifestations, and geologically induced hazards on human timeframes.

The *Proceedings of the International Ocean Discovery Program* presents the scientific and engineering results of IODP drilling projects, expedition by expedition. As in the preceding Integrated Ocean Drilling Program, expeditions in the new IODP are conducted by three implementing organizations, each providing a different drilling capability. These are the US Implementing Organization (USIO; through September 2014) and the *JOIDES Resolution* Science Operator (JRSO; as of October 2014), providing the leased commercial 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, for example, in polar environments and in shallow waters. Scheduling decisions for each capability are made 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 scientific ocean drilling programs in that it has neither a central management organization nor commingled funding for program-wide activities. Yet this phase of IODP retains a fundamental integrative structural element: a "bottom-up" 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; all submitted proposals are then evaluated by a Science Evaluation Panel in the context of the Science Plan.

The new IODP also has a second internationally integrative level for high-level discussion and consensus-building: the IODP Forum. The Forum is charged with assessing program-wide progress toward achieving the Science Plan. At present, IODP involves 26 international financial partners, including the United States, Japan, an Australia/New Zealand consortium (ANZIC), Brazil, China, India, South Korea, and the eighteen members of ECORD (Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland, and the United Kingdom). This enhanced membership in the new IODP represents a remarkable level of international collaboration that remains one of the greatest ongoing strengths of scientific ocean drilling.

James A. Austin Jr.  
Chair, IODP Forum

# International Ocean Discovery Program

*JOIDES Resolution* Science Operator

Website: <http://iodp.tamu.edu>

## IODP JRSO

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 JRSO Curation and Laboratories

IODP Gulf Coast Repository (GCR)  
Texas A&M University  
1000 Discovery Drive  
College Station TX 77845-9547  
USA  
Tel: (979) 845-8490; Fax: (979) 845-1303  
Email: [rumford@iodp.tamu.edu](mailto:rumford@iodp.tamu.edu)

European Consortium for Ocean Research Drilling, Science Operator (ESO)

Website: <http://www.ecord.org>

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

British Geological Survey  
The Lyell Centre  
Research Avenue South  
Edinburgh EH14 4AP  
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)

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

Website: <http://www.jamstec.go.jp/chikyuu/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 Japan Curation and Laboratories

IODP Kochi Institute for Core Sample Research (KCC)  
Japan Agency for Marine-Earth Science and Technology  
200 Monobe Otsu  
3175-25 Showa-machi  
Nankoku City, Kochi 783-8502  
Japan  
Tel: (81) 88-864-6705; Fax: (81) 88-878-2192  
Email: [kcc.contact@jamstec.go.jp](mailto:kcc.contact@jamstec.go.jp)

## Expedition 380 participants\*

### Expedition 380 scientists

**Masataka Kinoshita****Co-Chief Scientist**

Earthquake Research Institute  
University of Tokyo  
Japan  
[masa@eri.u-tokyo.ac.jp](mailto:masa@eri.u-tokyo.ac.jp)

**Keir Becker****Co-Chief Scientist**

Department of Marine Geosciences  
University of Miami  
USA  
[kbecker@rsmas.miami.edu](mailto:kbecker@rsmas.miami.edu)

**Sean Toczko****Expedition Project Manager**

Center for Deep Earth Exploration  
Japan Agency for Marine-Earth Science and Technology  
Japan  
[sean@jamstec.go.jp](mailto:sean@jamstec.go.jp)

**Joshua Edgington****Observatory Specialist**

Texas A&M University  
USA  
[jkoler1337@tamu.edu](mailto:jkoler1337@tamu.edu)

**Toshinori Kimura****Observatory Specialist**

Japan Agency for Marine-Earth Science and Technology  
Japan  
[kimurat@jamstec.go.jp](mailto:kimurat@jamstec.go.jp)

**Yuya Machida****Observatory Specialist**

Japan Agency for Marine-Earth Science and Technology  
Japan  
[ymachida@jamstec.go.jp](mailto:ymachida@jamstec.go.jp)

**Alexander Roesner****Observatory Specialist**

MARUM—Center for Marine Environmental Sciences  
University of Bremen  
Germany  
[aroesner@uni-bremen.de](mailto:aroesner@uni-bremen.de)

**Burhan Senyener****Observatory Specialist**

MARUM—Center for Marine Environmental Sciences  
University of Bremen  
Germany  
[burhan@uni-bremen.de](mailto:burhan@uni-bremen.de)

**Tianhaozhe Sun****Observatory Specialist**

Pennsylvania State University  
USA  
[txs557@psu.edu](mailto:txs557@psu.edu)

### NanTroSEIZE chief project scientists

**Gaku Kimura****Chief Project Scientist**

Tokyo University of Marine Science and Technology  
Japan  
[gkimur0@kaiyodai.ac.jp](mailto:gkimur0@kaiyodai.ac.jp)

**Harold Tobin****Chief Project Scientist**

Department of Geology and Geophysics  
University of Wisconsin—Madison  
[htobin@wisc.edu](mailto:htobin@wisc.edu)

### NanTroSEIZE specialty coordinators

**Eiichiro Araki****Observatories**

Research and Development Center for Earthquake and Tsunami  
Japan Agency for Marine-Earth Science and Technology  
Japan  
[araki@jamstec.go.jp](mailto:araki@jamstec.go.jp)

**Gaku Kimura****Structural Geology**

Tokyo University of Marine Science and Technology  
Japan  
[gkimur0@kaiyodai.ac.jp](mailto:gkimur0@kaiyodai.ac.jp)

**Kyuichi Kanagawa****Structural Geology**

Chiba University  
Department of Earth Science  
Graduate School of Science/Faculty of Science  
Japan  
[kyu\\_kanagawa@faculty.chiba-u.jp](mailto:kyu_kanagawa@faculty.chiba-u.jp)

**Gregory Moore****Geophysics**

Department of Geology and Geophysics  
University of Hawaii  
USA  
[gmoore@hawaii.edu](mailto:gmoore@hawaii.edu)

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

**Demian Saffer**  
**Physical Properties**  
Pennsylvania State University  
USA  
[dsaffer@psu.edu](mailto:dsaffer@psu.edu)

**Michael Strasser**  
**Sedimentologist**  
University of Innsbruck  
Austria  
[michael.strasser@uibk.ac.at](mailto:michael.strasser@uibk.ac.at)

**Michael B. Underwood**  
**Lithostratigraphy**  
Department of Earth and Environmental Science  
New Mexico Institute of Mining and Technology  
USA  
[underwoodm@missouri.edu](mailto:underwoodm@missouri.edu)

**Yasu Yamada**  
**Logging**  
Research and Development Center for Ocean Drilling Science  
Japan Agency for Marine-Earth Science and Technology  
Japan  
[yyamada@jamstec.go.jp](mailto:yyamada@jamstec.go.jp)

## Operational and technical staff

### Shipboard personnel and technical representatives

#### **Captains (Mantle Quest Japan)**

Yukio Dowaki  
Takemasa Kobayashi

#### **Offshore Installation Managers (Mantle Quest Japan)**

Masayuki Kawasaki  
Teruyuki Koyama

#### **Operations Superintendents (CDEX)**

Terumichi Ikawa  
Tomokazu Saruhashi

#### **Drilling Engineers (CDEX)**

Noriaki Sakurai  
Keita Tabuchi  
Takahiro Yokoyama

#### **Downhole Motor Engineer (Halliburton)**

Victor Busing

#### **Cementing Engineers (Schlumberger)**

Junichi Furusawa  
Liu Shuai  
Liu Tong Xin

#### **Running Tool/High Current Drillpipe Support System Engineers (NuStar)**

Ryan Wee Bo Jia  
Noh Okom  
Lim Yin Xuan

#### **Mud Engineers (Telnite)**

Hiroki Ishikawa  
Katsuki Mori

#### **Casing Handling Engineers (Frank's)**

Ali Bin Junos  
Ahmad Kalalo  
Mario Christian Kandio  
Sandy Isaac Maith

#### **UWTV Engineers (OCC Corporation)**

Kohei Hotta  
Hitoshi Okinaga  
Tsukasa Yoshida

#### **FACT Installation Engineers (Teledyne ODI)**

Zulkifli Bin Saini  
Craig Robertson

#### **Swellpacker Engineer (Halliburton)**

Roshaan Tze Lung Liew

#### **Trainee (INPEX)**

Ryota Fujinaga  
Takuya Hirowatari  
Shen Rongting

#### **Trainee (JAPEX)**

Koji Deguchi  
Tazuru Nishiyama

#### **Laboratory Officer (Marine Works Japan)**

Tomoyuki Tanaka

#### **Assistant Lab Officers (Marine Works Japan)**

Soichi Moriya

#### **Curator (Marine Works Japan)**

Toshikuni Yabuki

#### **Laboratory Technicians (Marine Works Japan)**

Nobuhiro Anraku  
Takehiro Higashi  
Naoyasu Ichikawa  
Daiki Kawata  
Atsushi Kurasawa  
Jun Matsuoka  
Shigako Nigi  
Masumi Sakaguchi  
Yasusei Sato  
Ritsuko Sawada  
Kazuma Takahashi  
Sho Yatsuka  
Kanako Yoshida

#### **Technical Engineers (CDEX)**

Keita Akiyama  
Junya Ishiwata  
Masanori Kyo  
Yasuhiro Namba

**Tool Pushers (Mantle Quest Japan)**

Michio Fukaya  
Charles Ronald Paul MacGregor  
Ikuo Matsuzawa  
Paul Thornton

**IODP Publication Services staff\*****Douglas Cummings**

Graphics Specialist II

**Gudelia (“Gigi”) Delgado**

Publications Coordinator

**Ekanta Desai**

Graphics Specialist II

**Patrick H. Edwards**

Production Editor 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

**Service Coordinator**

Kenzo Nakai  
Takaya Sasaki

**Amy McWilliams**

Supervisor of Editing

**Julie Myers**

Production Editor II

**Lorri Peters**

Manager of Publication Services

**Sandi Sherar Ruddick**

Editor II

**Kenneth Sherar**

Production Editor III

**Alyssa Stephens**

Graphics Specialist III

**Crystal Wolfe**

Production Editor III

**Jean Wulfson**

Graphics Specialist III

**Ann Yeager**

Distribution Specialist

\*At time of publication.

## Expedition-related bibliography\*

### IODP publications

#### Scientific Prospectus

Becker, K., Kinoshita, M., and Toczko, S., 2017. *Expedition 380 Scientific Prospectus: NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. International Ocean Discovery Program. <https://doi.org/10.14379/iodp.sp.380.2017>

#### Preliminary Report

Kinoshita, M., Becker, K., Toczko, S., and the Expedition 380 Scientists, 2018. *Expedition 380 Preliminary Report: NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. International Ocean Discovery Program. <https://doi.org/10.14379/iodp.pr.380.2018>

#### Proceedings volume

Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, 2018. *NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. Proceedings of the International Ocean Discovery Program, 380: College Station, TX (International Ocean Discovery Program). <https://doi.org/10.14379/iodp.proc.380.2018>

#### Expedition reports

Becker, K., Kinoshita, M., Toczko, S., Edginton, J., Kimura, T., Machida, Y., Roesner, A., Senyener, B., and Sun, T., 2018. Expedition 380 summary. In Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, *NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. Proceedings of the International Ocean Discovery Program, 380: College Station, TX (International Ocean Discovery Program). <https://doi.org/10.14379/iodp.proc.380.101.2018>

Kinoshita, M., Becker, K., Toczko, S., Edginton, J., Kimura, T., Machida, Y., Roesner, A., Senyener, B., and Sun, T., 2018. Expedition 380 methods. In Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, *NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. Proceedings of the International Ocean Discovery Program, 380: College Station, TX (International Ocean Discovery Program). <https://doi.org/10.14379/iodp.proc.380.102.2018>

Kinoshita, M., Becker, K., Toczko, S., Edginton, J., Kimura, T., Machida, Y., Roesner, A., Senyener, B., and Sun, T., 2018. Site C0006. In Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, *NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. Proceedings of the International Ocean Discovery Program, 380: College Station, TX (International Ocean Discovery Program). <https://doi.org/10.14379/iodp.proc.380.103.2018>

#### Supplementary material

Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, 2018. Supplementary material, <https://doi.org/10.14379/iodp.proc.380supp.2018>. *Supplement to Becker, K., Kinoshita, M., Toczko, S., and the Expedition 380 Scientists, NanTroSEIZE Stage 3: Frontal Thrust Long-Term Borehole Monitoring System (LTBMS)*. Proceedings of the International Ocean Discovery Program, 380: College Station, TX (International Ocean Discovery Program). <https://doi.org/10.14379/iodp.proc.380.2018>

\*The Expedition-related bibliography is continually updated online (<http://publications.iodp.org/proceedings/380/380title.html#bib>). Please send updates to [PubCrd@iodp.tamu.edu](mailto:PubCrd@iodp.tamu.edu).