Oman Drilling Project

Scientific Drilling in the Samail Ophiolite, Sultanate of Oman
Proceedings of the Oman Drilling Project

Phase 1
Drilling
December 2016–March 2017
Core description
15 July–15 September 2017

Phase 2
Drilling
November 2017–February 2018
Core description
5 July–5 September 2018

Volume authorship
Kelemen, P.B.,
Matter, J.M.,
Teagle, D.A.H.,
Coggon, J.A.,
and the Oman Drilling Project Science Team

Published by International Ocean Discovery Program
Prepared by International Continental Scientific Drilling Program (ICDP) and JOIDES Resolution Science Operator, Texas A&M University


**DOI**

https://doi.org/10.14379/OmanDP.proc.2020
Oman Drilling Project collaborators

Project leadership
Jürg M. Matter
Project Director
Judith Coggon
Project Manager

Principal investigators
Peter B. Kelemen
Columbia University
Jürg M. Matter
University of Southampton
Damon A.H. Teagle
University of Southampton
Wolfgang Bach
University of Bremen
Georges Ceuleneer
French National Institute for Scientific Research (CNRS)
Gretchen Früh-Green
Swiss Federal Institute of Technology (ETH Zurich)
Marguerite Godard
Université de Montpellier (CNRS)
Greg Hirth
Brown University
Benoit Ildefonse
Université de Montpellier (CNRS)
Bjorn Jamtveit
University of Oslo
Frieder Klein
Woods Hole Oceanographic Institution
Jürgen Koepke
Leibniz University Hannover
Christopher John MacLeod
Cardiff University
Craig E. Manning
University of California, Los Angeles
Katsuyoshi Michibayashi
Shizuoka University
Eiichi Takazawa
Niigata University
Susumu Umino
Kanazawa University

Funding agencies
International Continental Scientific Drilling Program (ICDP)
Alfred P. Sloan Foundation—Deep Carbon Observatory
International Ocean Discovery Program (IODP)
National Aeronautics and Space Administration (NASA)
US National Science Foundation
German Research Foundation
European Research Council
Swiss National Science Foundation
Japan Society for the Promotion of Science
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

Operations and drilling
AZD Engineering Consultancy
Geo-Solutions Engineering Ltd.
Hamoud Al-Rashidi & Bros. Trading
Lalbuksh Voltas Engineering Services & Trading

Project partners
Columbia University, Lamont Doherty Earth Observatory, USA
University of Southampton, School of Ocean and Earth Science, UK
Sultan Qaboos University, Sultanate of Oman
Ministry of Regional Municipalities and Water Resources (MRMWR), Sultanate of Oman
Public Authority for Mining, Sultanate of Oman
German University of Technology in Oman
Oman Drilling Project

Contents

Chapters

Introduction
1. Summary
2. Introduction to the Oman Drilling Project
3. Methods and explanatory notes
4. Scientific drilling Phases 1 and 2

Science Theme 1A: Gabbro Traverse
5. Introduction to Science Theme 1A
6. Site GT1: layered cumulate gabbros and deep fault zones
7. Site GT2: transition from foliated to layered gabbros
8. Site GT3: sheeted dike to gabbro transition

Science Theme 1B: Transition from lower ocean crust to upper mantle
9. Introduction to Science Theme 1B
10. Site CM1: layered gabbros, crustal ultramafic rocks, and mantle harzburgite
11. Site CM2: crust–mantle transition zone and into upper mantle

Science Theme 2: Fluid and mass exchange
12. Introduction to Science Theme 2
13. Site BT1: fluid and mass exchange on a subduction zone plate boundary

Science Theme 3: Multiborehole observatory
14. Introduction to Science Theme 3
15. Site BA1
16. Site BA2
17. Site BA3
18. Site BA4

Visual core descriptions
Graphic summary reports (VCD). Additional Supplementary material includes E_Tabulated VCD data, K1_On-site curation and description, and K2_On-site igneous unit summaries.
Site GT1 · Site GT2 · Site GT3
Site CM1 · Site CM2 · Site BT1
Site BA1 · Site BA2 · Site BA3 · Site BA4

Images
Core table images. Additional Supplementary material includes C_Close-up photographs, D1 Whole thin section images, D2_Photomicrographs, D3_BSE images, G_XCT data, I1_Split core images, K4_On-site 360 DMT core scans, K5_On-site DMT box scans, and K6_On-site tablet photos.
Site GT1 · Site GT2 · Site GT3
Site CM1 · Site CM2 · Site BT1
Site BA1 · Site BA2 · Site BA3 · Site BA4

Supplementary material
B_Thin section descriptions (70 MB)
C_Close-up photographs (6.25 GB)
D1_Whole thin section images (143 GB)
D2_Photomicrographs (10 GB)
D3_BSE images (BT1B) (100 MB)
E_Tabulated VCD data (51 MB)
F1_XRF recalibration
F2_Core scanning XRF (15 GB)
F3_XRD data (1 GB)
G_XCT data (61 GB)
H_Whole-round MSCL data (325 MB)
I1_Split core images (188 GB)
J_Split-core MSCL data (400 MB)
K1_On-site curation and descriptions (5 MB)
K2_On-site igneous unit summaries (0.5 MB)
K3_On-site core-section sketches (10 GB)
K4_On-site 360 DMT core scans (174 GB)
K5_On-site DMT box scans (147 GB)
K6_On-site tablet photos (21.2 GB)
L_Wireline logging (5 GB)
M_Spectral imaging data
N_Drill site reports
# Oman Drilling Project Science Team

## Phase 1

### Onsite drilling team

**Peter Kelemen**  
Department of Earth and Environmental Sciences  
Columbia University  
USA  
peterk@ldeo.columbia.edu

**Jürg M. Matter**  
Project Director  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
j.matter@southampton.ac.uk

**Damon Teagle**  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
damon.teagle@southampton.ac.uk

**Jude Coggon**  
Project Manager  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
jude.coggon@southampton.ac.uk

**Juan Carlos de Obeso**  
Department of Earth and Environmental Sciences  
Columbia University  
USA  
deobeso@ldeo.columbia.edu

**Michelle Harris**  
Geography, Earth and Environmental Sciences  
Plymouth University  
United Kingdom  
michelle.harris@plymouth.ac.uk

**Emma Bennett**  
School of Earth and Ocean Sciences  
Cardiff University  
United Kingdom  
bennette7@cardiff.ac.uk

**Nico Bompard**  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
n.bompard@soton.ac.uk

**Marine Boulanger**  
Department of Petrology  
Centre de Recherches Pétrographiques et Géochimiques (CRPG)  
France  
machineb@crpg.cnrs-nancy.fr

**Lyderic France**  
Department of Geosciences, CRPG-CNRS  
Université de Lorraine  
France  
lyde@crpg.cnrs-nancy.fr

**Gretchen Früh-Green**  
Department of Earth Sciences  
Federal Institute of Technology  
Switzerland  
frueh-green@erdw.ethz.ch

**Dieter Garbe-Schönberg**  
Institute of Geosciences  
Christian-Albrecht University of Kiel  
Germany  
dgs@mpi. uni-kiel.de

**Benoit Ildefonse**  
Department of Géosciences, CNRS  
Université de Montpellier  
France  
benoit.ildefonse@umontpellier.fr

**Ana Jesus**  
Department of Applied Geosciences  
German University of Technology in Oman  
Oman  
aana.jesus@gutech.edu.om

**Jürgen Koepke**  
Institut fuer Mineralogie  
Leibniz University Hannover  
Germany  
koepke@mineralogie.uni-hannover.de

**Louise Koornneef**  
Geography, Earth and Environmental Sciences  
Plymouth University  
United Kingdom  
louise.koornneef@plymouth.ac.uk

**Romain Lafay**  
Institute of Earth Sciences  
University of Lausanne  
Switzerland  
romain.lafay@unil.ch

**Johan Lissenberg**  
School of Earth and Ocean Sciences  
Cardiff University  
United Kingdom  
lissenbergcJ@cardiff.ac.uk

**Chris MacLeod**  
School of Earth and Ocean Sciences  
Cardiff University  
United Kingdom  
macleod@cardiff.ac.uk
Mohsin Al Shukaili
Ministry of Regional Municipalities and Water Resource
Sultanate of Oman
alshukailimohsin@gmail.com

Ali Al Qassabi
Ministry of Regional Municipalities and Water Resources
Sultanate of Oman
alimq7@gmail.com

Kyaw Moe
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Institute for Marine-Earth Exploration and Engineering
Japan
moe@jamstec.go.jp

Yasu Yamada
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Institute for Marine-Earth Exploration and Engineering
yyamada@jamstec.go.jp

ChikyuOman 2017 description team

Peter Kelemen
Co-Chief Scientist
Department of Earth and Environmental Sciences
Columbia University
USA
peterk@ldeo.columbia.edu

Damon Teagle
Co-Chief Scientist
School of Ocean and Earth Science
University of Southampton
United Kingdom
Damon.Teagle@southampton.ac.uk

Eiichi Takazawa
Co-Chief Scientist
Department of Geology
Niigata University
Japan
takazawa@geo.sc.niigata-u.ac.jp

Katsuyoshi Michibayashi
Co-Chief Scientist
Institute of Geosciences
Shizuoka University
Japan
michibayashi@shizuoka.ac.jp

Michelle Harris
Alteration Lead/Staff Scientist/Co-Chief Scientist
Geography, Earth and Environmental Sciences
Plymouth University
United Kingdom
michelle.harris@plymouth.ac.uk

Jude Coggon
Oman Staff Scientist
School of Ocean and Earth Science
University of Southampton
United Kingdom
jude.coggon@southampton.ac.uk

Juan Carlos de Obeso
Oman Staff Scientist/Alteration
Department of Earth and Environmental Sciences
Columbia University
USA
deobeso@ldeo.columbia.edu

Natsue Abe
Physical Properties
R&D Center for Ocean Drilling Science
JAMSTEC
Japan
abenatsu@jamstec.go.jp

Tetsu Akitou
Alteration Petrologist
Department of Earth Sciences
Okayama University
Japan
nozaka@cc.okayama-u.ac.jp

Salim Ahmed AlShahri
Omani Trainee
Geological Survey and Research
Public Authority for Mining
Oman
s.alshahri1@gmail.com

Hamood Hamed Shames Al-Siyabi
Omani Trainee
Surface and Groundwater Assessment
MRMWR
Oman
Aomani120@yahoo.com

Saif Masoud Alhumaimi
Omani Trainee
Geological Survey
Public Authority for Mining
Oman
saif.m@pam.gov.om

Maqbool Hussein AlRawahi
Omani Trainee
Surface and Groundwater Assessment
MRMWR
Oman
maqbool.h@mrmwr.gov.om

Musaab Shaker Al Sarmi
Omani Trainee
Earth Science Department
Sultan Qaboos University
Oman
musaabs@squ.edu.om
Bader Hamed Alwaeli  
Omani Trainee  
Earth Science Department  
Sultan Qaboos University  
Oman  
baderw@squ.edu.om

Andreas Beinlich  
Alteration Petrologist  
Department of Applied Geology  
Curtin University  
Australia  
andreas.beinlich@curtin.edu.au

Emma Bennett  
Geochemistry  
School of Earth and Ocean Science  
Cardiff University  
United Kingdom  
bennette7@cardiff.ac.uk

Marine Boulanger  
Igneous Petrologist  
Department of Petrology, CRPG-CNRS  
Université de Lorraine  
France  
marineb@crpg.cnrs-nancy.fr

Elliot Carter  
Geochemistry  
School of Earth and Environmental Sciences  
University of Manchester  
United Kingdom  
elliot.carter@manchester.ac.uk

Mike Cheadle  
Structural Geologist  
Department of Geology and Geophysics  
University of Wyoming  
USA  
cheadle@uwyo.edu

Mark Cloos  
Structural Geologist  
Department of Geological Sciences  
University of Texas at Austin  
USA  
cloos@jsg.utexas.edu

Matthew Cooper  
Geochemistry  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
mjco@noc.soton.ac.uk

Laura Crispini  
Structural Geologist  
Scienze della Terra dell’Ambiente e della Vita  
University of Genova  
Italy  
laura.crispini@unige.it

Joëlle D’Andres (was Ducommun)  
Alteration Petrologist  
Research School of Earth Sciences  
Australian National University  
Australia  
joelle.ducommun@anu.edu.au

Luke Deamer  
Structural Geologist  
Department of Geology  
Cardiff University  
United Kingdom  
deamerl@cardiff.ac.uk

Jeremy Deans  
Structural Geologist  
Department of Geography and Geology  
University of Southern Mississippi  
USA  
jeremy.deans@usm.edu

Kathi Faak  
Igneous Petrologist  
Institute for Geology, Mineralogy and Geophysics  
Ruhr-Universitaet Bochum  
Germany  
Kathrin.Faak@rub.de

Marguerite Godard  
Geochemistry  
Department of Géosciences, CNRS  
Université de Montpellier  
France  
Marguerite.Godard@umontpellier.fr

Rebecca Greenberger  
Infrared Spectrometry  
Department of Geological and Planetary Sciences  
California Institute of Technology  
USA  
grgreenbe@caltech.edu

Yumiko Harigane  
Structural Geologist  
Research Institute of Geology and Geoinformation  
National Institute of Advanced Industrial Science  
and Technology  
Japan  
y-harigane@aist.go.jp

Kohei Hatakeyama  
Physical Properties  
Department of Earth and Planetary Systems Science  
Hiroshima University  
Japan  
kohei-hatakeyama@hiroshima-u.ac.jp

Andrew Horst  
Paleomagnetist  
Department of Geology  
Marshall University  
USA  
horsta@marshall.edu
Oman Drilling Project

Takashi Hoshide
Igneous Petrologist
Graduate School of International Resource Sciences
Akita University
Japan
hoshide@gipc.akita-u.ac.jp

Benoit Ildefonse
Physical Properties
Department of Géosciences, CNRS
Université de Montpellier
France
benoit.ildefonse@umontpellier.fr

Keisuke Ishii
Igneous Petrologist
Graduate school of Science and Technology
Niigata University
Japan
f17e061a@mail.cc.niigata-u.ac.jp

Ana Jesus
Igneous Petrologist
Department of Applied Geosience
German University of Technology in Oman
Oman
ana.jesus@gutech.edu.om

Kevin Johnson
Igneous Petrologist
Department of Geology and Geophysics
University of Hawaii
USA
kjohnso2@hawaii.edu

Michael Kettermann
Structural Geologist
Structural Geology, Tectonics and Geomechanics
Aachen University
Germany
michael.kettermann@emr.rwth-aachen.de

Hogyum Kim
Paleomagnetism
School of Earth and Environmental Sciences
Seoul National University
Republic of Korea
kamhokam@snu.ac.kr

Jürgen Koepke
Igneous Petrologist
Institut fuer Mineralogie
Leibniz University Hannover
Germany
koepke@mineralogie.uni-hannover.de

Kentaro Kondo
Igneous Petrologist
Graduate School of International Resource Sciences
Akita University
Japan
kentarokondo21@gmail.com

Louise Koornneef
Paleomagnetist
Geography, Earth and Environmental Sciences
Plymouth University
United Kingdom
louise.koornneef@plymouth.ac.uk

Alissa Kotowski
Structural Geologist
Jackson School of Geosciences
University of Texas at Austin
USA
kotowski@utexas.edu

Fatna Kourim
Geochemistry
Earth Science Institute
Academia Sinica
Taiwan
k.fatna@gmail.com

Yuki Kusano
Igneous Petrologist
Geological Survey of Japan
National Institute of Advanced Industrial Science and Technology
Japan
y.kusano@aist.go.jp

Romain Lafay
Alteration Petrologist
Institute of Earth Sciences
University of Lausanne
Switzerland
romain.lafay@unil.ch

James Andrew Leong
Alteration Petrologist
School of Earth and Space Exploration
Arizona State University
USA
jmleong@asu.edu

Chris MacLeod
Structural Geologist
School of Earth and Ocean Sciences
Cardiff University
United Kingdom
macleod@cardiff.ac.uk

Craig Manning
Alteration Petrologist
Department of Earth, Planetary and Space Sciences
University of California, Los Angeles
USA
manning@epps.ucla.edu

Catriona Menzies
Geochemist
School of Ocean and Earth Science
University of Southampton
United Kingdom
c.menzies@soton.ac.uk
Dominik Mock
Alteration Petrologist
Institute for Mineralogy
Leibniz University of Hanover
Germany
dom.mock@web.de

Tomoaki Morishita
Igneous Petrologist
Earth Science Course
Kanazawa University
Japan
moripta@gmail.com

Tony Morris
Paleomagnetist
Geography, Earth and Environmental Sciences
Plymouth University
United Kingdom
amorris@plymouth.ac.uk

Du Khac Nguyen
Igneous Petrologist
School of Natural System
Kanazawa University
Japan
nguyenkhacdu@humg.edu.vn

Toshio Nozaka
Alteration Petrologist
Department of Earth Sciences
Okayama University
Japan
nozaka@cc.okayama-u.ac.jp

Keishi Okazaki
Physical Properties
Kochi Institute for Core Sample Research
JAMSTEC
Japan
okazakik@jamstec.go.jp

Americus Perez
Geochemist
Department of Earth Sciences
Kanazawa University
Japan
adperez@stu.kanazawa-u.ac.jp

Suzanne Picazo
Igneous Petrologist
Institute of Earth Sciences
University of Lausanne
Switzerland
suzanne.picazo@gmail.com

Ryoko Senda
Geochemist
Faculty of Social and Cultural Studies
Kyushu University
Japan
senda@scs.kyushu-u.ac.jp

Yamato Tateishi
Physical Properties
Department of Earth Sciences
Okayama University
Japan
nozaka@cc.okayama-u.ac.jp

Jessica Till
Paleomagnetist
Geomechanics and Rheology
German Research Centre for Geosciences
Germany
Germanyijtill@hi.is

Susumu Umino
Igneous Petrologist
School of Natural Science and Technology
Kanazawa University
Japan
sesumin@staff.kanazawa-u.ac.jp

Janos Urai
Structural Geologist
Structural Geology Tectonics and Geomechanics
Aachen University
Germany
j.urai@ged.rwth-aachen.de

Yoichi Usui
Paleomagnetist
Deep Earth Structure and Dynamics Research
JAMSTEC
Japan
yoichi@jamstec.go.jp

David Zeko
Alteration Petrologist
Earth, Ocean and Atmospheric Sciences
University of British Columbia
Canada
dzeko@eoas.ubc.ca

Barbara Zihlmann
Alteration Petrologist
School of Ocean and Earth Science
University of Southampton
United Kingdom
barbara.zihlmann@soton.ac.uk

Phase 2
Onsite drilling team

Peter Kelemen
Department of Earth and Environmental Sciences
Columbia University
USA
peterk@ldeo.columbia.edu

Jürg M. Matter
Project Director
School of Ocean and Earth Science
University of Southampton
United Kingdom  
J.Matter@southampton.ac.uk

Damon Teagle  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
Damon.Teagle@southampton.ac.uk

Jude Coggon  
Project Manager  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
jude.coggon@southampton.ac.uk

Grace Andrews  
School of Ocean and Earth Science  
University of Southampton  
United Kingdom  
Grace.Andrews@southampton.ac.uk

Claire Aupart  
Geology Department  
University of Oslo  
Norway  
c.o.m.aupart@geo.uio.no

Anne Line Auzende  
Department of Mineralogy and Environments  
Institut des Sciences de la Terre  
France  
anne-line.auzende@univ-grenoble-alpes.fr

Wolfgang Bach  
Geoscience Department  
University of Bremen  
Germany  
wbach@uni-bremen.de

Harry Becker  
Department of Geological Sciences  
Freie Universitaet Berlin  
Germany  
hbecker@zedat.fu-berlin.de

Mathieu Benoit  
Géosciences Environment Toulouse, CNRS  
France  
mathieu.benoit@get.omp.eu

Eric Boyd  
Department of Microbiology and Immunology  
Montana State University  
USA  
eboyd@montana.edu

Dawn Cardace  
Department of Geosciences  
University of Rhode Island  
USA  
cardace@uri.edu

Georges Ceuleneer  
Geosciences Environnement Toulouse, CNRS  
France  
georges.ceuleneer@get.obs-mip.fr

Sayantani Chatterjee  
Department of Natural History Science  
Hokkaido University  
Japan  
sayantani.chatterjee89@gmail.com

Benoit Cordonnier  
Department of Geosciences  
University of Oslo  
Norway  
cordonnier.benoit@gmail.com

Laura Crispini  
Scienze della Terra Dell’Ambiente e della Vita  
University of Genova  
Italy  
laura.crispini@unige.it

Juan Carlos de Obeso  
Department of Earth and Environmental Sciences  
Columbia University  
USA  
deobeso@ldeo.columbia.edu

Nick Dygert  
Jackson School of Geosciences  
University of Texas at Austin  
USA  
nick.dygert@gmail.com

Eric Ellison  
Department of Geological Sciences  
University of Colorado – Boulder  
USA  
ellison.e@gmail.com

Alireza Eslami  
Department of Economic Geology  
Tarbiat Modares University  
Iran  
alirezaesl@live.com

Aled Evans  
School of Ocean and Earth Sciences  
University of Southampton  
United Kingdom  
A.Evans@soton.ac.uk

Elizabeth Fones  
Department of Microbiology and Immunology  
Montana State University  
USA  
foneselizabeth@gmail.com

Gretchen Früh-Green  
Department of Earth Sciences  
ETH Zurich  
Switzerland  
frueh-green@erdw.ethz.ch

Emmanouil Giampouras  
Petrology-Geochemistry-Geochronology
Oman Drilling Project

Andalusian Institute of Earth Sciences
Spain

e.giampouras@csic.es

Clemens Glombitza
Exobiology Branch
NASA Ames Research Center
USA
clemens.glombitza.nasa.gov

Marguerite Godard
Department of Géosciences, CNRS
Université de Montpellier
France
Marguerite.Godard@umontpellier.fr

Juan Miguel Guotana
Division of Natural System
Kanazawa University
Japan
jmguotana@stu.kanazawa-u.ac.jp

Kohei Hatakeyama
Department of Earth and Planetary Systems Science
Hiroshima University
Japan
kohei-hatakeyama@hiroshima-u.ac.jp

Tanja Hörner
ICDP Operational Support Group
German Research Centre for Geosciences - GFZ
Germany
thoerner@gfz-potsdam.de

Keisuke Ishii
Graduate School of Science and Technology
Niigata University
Japan
f17e061a@mail.cc.niigata-u.ac.jp

Bjørn Jamtveit
Physics of Geological Processes
University of Oslo
Norway
bjorn.jamtveit@geo.uio.no

Max Jansen
School of Earth and Ocean Sciences
Cardiff University
United Kingdom
maxipede@yahoo.com

David Jousselin
Recherches Pétrographiques et Géochimiques
Université de Lorraine
France
jousse@crpg.cnrs-nancy.fr

Delphine Klaessens
Recherches Pétrographiques et Géochimiques
Université de Lorraine
France
dklaeesse@crpg.cnrs-nancy.fr

Jürgen Koepke
Institut fuer Mineralogie
Leibniz University Hannover
Germany
koepke@mineralogie.uni-hannover.de

Fatna Kourim
Earth Science Institute
Academia Sinica
Taiwan
k.fatna@gmail.com

Emily Kraus
Civil and Environmental Engineering
Colorado School of Mines
USA
ekraus@mymail.mines.edu

Marvin Lilley
Department of Oceanography
University of Washington
USA
lilley@uw.edu

Elisabetta Mariani
Earth, Ocean and Ecological Sciences
University of Liverpool
United Kingdom
mariani@liverpool.ac.uk

Katsuyoshi Michibayashi
Institute of Geosciences
Shizuoka University
Japan
michibayashi@shizuoka.ac.jp

Kyaw Moe
Rotary site
R&D Center for Ocean Drilling Science
JAMSTEC
Japan
moe@jamstec.go.jp

Daisuke Morii
Department of Geosciences
Shizuoka University
Japan
morii.daisuke.15@shizuoka.ac.jp

Tomoaki Morishita
Earth Science Course
Kanazawa University
Japan
moripta@gmail.com

Julie Noël
Department of Geosciences
Université de Montpellier
France
Julie.Noel@gm.univ-montp2.fr

Daniel Nothaft
Department of Geological Sciences
Jordan
yan1992@gmail.com

Wendu Zhu
Department of Geology
University of Maryland
USA
wzhu@umd.edu

Onsite wireline logging team

Jürg M. Matter
Project Director
School of Ocean and Earth Science
University of Southampton
United Kingdom
J.Matter@southampton.ac.uk

Philippe A. Pezard
Geoscience Montpellier, CNRS
University of Montpellier
France
Philippe.Pezard@GM.Uni-Montp2.Fr

Kyaw Moe
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Institute for Marine-Earth Exploration and Engineering
Japan
moe@jamstec.go.jp

Yasu Yamada
Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Institute for Marine-Earth Exploration and Engineering
Japan
yyamada@jamstec.go.jp

Mohamed-Amine Bechkit
Houari Boumedienne University
Algiers, Algeria
Mohamed-Amine.Bechkit@hotmail.fr

Laurent Brun
Geoscience Montpellier, CNRS
University of Montpellier
France
laurent.brun@umontpellier.fr

Bernard Célerier
Geoscience Montpellier, CNRS
University of Montpellier
France
Bernard.Celerier@gm.univ-montp2.fr

Gilles Henry
Geoscience Montpellier, CNRS
University of Montpellier
France
Gilles.henry@gm.univ-montp2.fr

Jehanne Paris
Geoscience Montpellier, CNRS
University of Montpellier
France
Jehanne.paris@hotmail.fr

Gérard Lods
Geoscience Montpellier, CNRS
University of Montpellier
France
Gerard.Lods@gm.univ-montp2.fr

Salim Al Amri
Ministry of Regional Municipalities and Water Resources
Sultanate of Oman
Salimalamri1988@gmail.com

Mohsin Al Shukaili
Ministry of Regional Municipalities and Water Resource
Sultanate of Oman
alshukailimohsin@gmail.com

Chikyu Oman 2018 description team

Peter Kelemen
Co-Chief Scientist
Department of Earth and Environmental Sciences
Columbia University
USA
peterk@ldeo.columbia.edu

Jürg M. Matter
Geophysical Logs
School of Ocean and Earth Science
University of Southampton
United Kingdom
J.Matter@southampton.ac.uk

Damon Teagle
Co-Chief Scientist
School of Ocean and Earth Science
University of Southampton
United Kingdom
Damon.Teagle@southampton.ac.uk

Eiichi Takazawa
Co-Chief Scientist
Department of Geology
Niigata University
Japan
takazawa@geo.sc.niigata-u.ac.jp

Katsuyoshi Michibayashi
Co-Chief Scientist
Institute of Geosciences
Shizuoka University
Japan
michibayashi@shizuoka.ac.jp

Marguerite Godard
Co-Chief Scientist
Department of Geosciences, CNRS
Université de Montpellier
France
Marguerite.Godard@umontpellier.fr

Jude Coggon
Staff Scientist
School of Ocean and Earth Science
University of Southampton
United Kingdom
jude.coggon@southampton.ac.uk

Saebeyul Choe
Staff Scientist
Department of Earth and Planetary Sciences
American Museum of Natural History
USA
schoe@amnh.org

Natsue Abe
Physical Properties Lead
R&D Center for Ocean Drilling Science
JAMSTEC
Japan
abenatsu@jamstec.go.jp

Yuya Akamatsu
Physical Properties
Department of Earth and Planetary Systems Science
Hiroshima University
Japan
b145350@hiroshima-u.ac.jp

Salim Al Amri
Omani Trainee
Department of Geophysics
MRMWR
Oman
salimalamri1988@gmail.com

Mohamed Al Busaidi
Omani Trainee
Department of Earth Science
Sultan Qaboos University
Oman
u113249@Student.squ.edu.om

Anwar Al-Hajri
Omani Trainee
Department of Applied Geoscience
German University of Technology in Oman
Oman
14-0110@student.gutech.edu.om

Majid Al Jabri
Omani Trainee
Water Resources
MRMWR
Oman
m.blkhadem@gamil.com

Mahmood Al-Sarmi
Omani Trainee
Earth Science Department
Sultan Qaboos University

Oman
musaabs@squ.edu.om

Said Almusharafi
Omani Trainee
Geological Survey
Public Authority for Mining
Oman
said.m@pam.gov.om

Ibrahim AlSawafi
Omani Trainee
Geological Research and Heritage Department
Public Authority for Mining
Oman
ibrahim.alsawafi@pam.gov.om

Elena Amador-French
Infrared Spectrometry
Division of Geological and Planetary Sciences
California Institute of Technology
USA
esamador@caltech.edu

Joseph Aslin
Structural Geologist
Earth, Ocean and Ecological Sciences
University of Liverpool
United Kingdom
joeaslin@liverpool.ac.uk

Claire Aupart
Host Rock Petrologist
Geology Department
University of Oslo
Norway
c.o.m.aupart@geo.uio.no

Wolfgang Bach
Vein Petrologist Lead
Geoscience Department
University of Bremen
Germany
wbach@uni-bremen.de

Samuel Barbier
Structural Geologist
Department of Geology
Université Lyon 1 Claude Bernard
France
samuel.barbier@etu.univ-lyon1.fr

Valentin Basch
Structural Geologist
Scienze della Terra dell’Ambiante e della Vita
University of Genova
Italy
valentin.basch@gmail.com

Elliot Carter
Geochemist
School of Earth and Environmental Sciences
University of Manchester
Oman Drilling Project

Jürgen Koepke
Igneous Lead
Institut fuer Mineralogie
Leibniz University Hannover
Germany
koepke@mineralogie.uni-hannover.de

Fatna Kourim
Geochemist Lead
Earth Science Institute
Academia Sinica
Taiwan
k.fatna@gmail.com

Kanchana Kularatne
Host Rock Petrologist
Department of Stable Isotope Geochemistry
Institut de physique du globe de Paris
France
kularatne@ipgp.fr

Benjamin Malvoisin
Vein Petrologist
Institut des Sciences de la Terre
Université de Lausanne
Switzerland
benjamin.malvoisin@unil.ch

Manuel Menzel
Structural Geologist
Instituto Andaluz de Ciencias de la Tierra
Spanish National Research Council
Spain
manuel.menzel@csic.es

Kyaw Moe
R&D Center for Ocean Drilling Science
JAMSTEC
Japan
moe@jamstec.go.jp

Tomoaki Morishita
Alteration Petrologist
Earth Science Course
Kanazawa University
Japan
moripta@gmail.com

Atsushi Okamoto
Alteration Petrologist
Graduate School of Environmental Studies
Tohoku University
Japan
okamoto@mail.kankyo.tohoku.ac.jp

Keishi Okazaki
Physical Properties
Kochi Institute for Core Sample Research
JAMSTEC
Japan
okazakik@jamstec.go.jp

Ryosuke Oyanagi
Alteration Petrologist
Department of Solid Earth Geochemistry
JAMSTEC
Japan
oyanagi0616@gmail.com

Gyuseung Park
Igneous Petrologist
School of Earth and Environment System
Seoul National University
Republic of Korea
gyudori@snu.ac.kr

Betchaida Payot
Igneous Petrologist
National Institute of Geological Sciences
University of the Philippines
Philippines
bdpayot@gmail.com

Philippe Pezard
Geophysical Logs
Department of Geosciences, CNRS
Université de Montpellier
France
ppezard@gulliver.fr

Marie Python
Igneous Petrologist
Faculty of Social and Cultural Studies
Kyushu University
Japan
marie@sci.hokudai.ac.jp

Mathieu Rospabé
Geochemist
Geosciences Environment Toulouse Laboratory
University of Toulouse
France
mathieu.rospace@get.obs-mip.fr

Ryoko Senda
Geochemist Lead
Faculty of Social and Cultural Studies
Kyushu University
Japan
senda@scs.kyushu-u.ac.jp

Alexander Sousa
Geochemist
Department of Geoscience
University of Rhode Island
USA
alexander_sousa@uri.edu

Akihiro Tamura
Alteration Petrologist
Department of Earth Sciences
Kanazawa University
Japan
aking826@staff.kanazawa-u.ac.jp
Lotta Ternieten
Host Rock Petrologist
Department of Earth Sciences
Swiss Federal Institute of Technology in Zurich
Switzerland
lotta.ternieten@erdw.ethz.ch

Benjamin Tutolo
Host Rock Petrologist
Department of Geoscience
University of Calgary
Canada
benjamin.tutolo@ucalgary.ca

Ole Ivar Ulven
Physical Properties
Department of Geosciences
University of Oslo
Norway
o.i.ulven@fys.uio.no

Gabriel Theophilus Valera
Host Rock Petrologist
National Institute of Geological Sciences
University of the Philippines Diliman
Philippines
gvvalera@up.edu.ph

Nehal Warsi
Alteration Petrologist
School of Ocean and Earth Science
Southampton University
India
nhwarsi@gmail.com

Jon Zaloumis
Geochemist
School of Earth and Space Exploration
Arizona State University
USA
jzaloumis@gmail.com

Chang Zhang
Geochemist
State Key Laboratory of Lithospheric Evolution
Institute of Geology and Geophysics
China
zhangchang@mail.iggcas.ac.cn

Wenlu Zhu
Physical Properties Lead
Department of Geology
University of Maryland
USA
wzhu@umd.edu

Operational and technical support

Phase 1

Wireline diamond coring
Driller (GeoSolutions Engineering)
Shaikh Oliullah (Wali)

Site Geologist (Lalbuksh Voltas Engineering Services & Trading)
Sunil Kumar

Site Manager (Lalbuksh Voltas Engineering Services & Trading)
Ramraj Gopikrishnan

Roughnecks (GeoSolutions Engineering)
Abdul Khaliq
Mohammad Jameel
Mr. Alauddin
Mohd Mohiuddin

Rotary drilling
(Hamoud Al-Rashidi & Bros. Trading)
Driller
Sajid Hameed
Drilling Supervisor
Mohamed Irfan

Rock crushing
(University of Southampton)
Barbara Zihlmann
Robert Gough
Gareth Viney
Charlie Oldman
James Bird

OmanChikyu 2017 description

Laboratory Manager
Lena Maeda

Laboratory Officers
Soichi Moriya
Tomoy Tanaka
Toru Fujiki

Curators
Kazuhiro Yoshida
Masaru Yasunaga

Laboratory Technicians
Atsushi Kurasawa
Daiki Kawata
Emi Deguchi
Hiromichi Soejima
Jun Matsuoka
Kanako Yoshida
Phase 2

**Wireline diamond coring**
*Geosolutions Engineering*

**Drillers**
- Shikh Oliullah (Wali)
- Mr. Mansoor

**Assistant Driller**
- Abdul Khaliq

**Site Geologist**
- Abdul Rasak Tharayil

**Roughnecks**
- Mohammed Nabi
- Sadik Khan
- Mohd Maqsood

**Rotary drilling**
*Lalbuksh Voltas Engineering Services & Trading*

**Driller**
- Mr. Nadeem

**Drilling Supervisor**
- Sunil Pillai

**Drilling Supervisor/Hydrogeologist**
- Sunil Kumar

Drilling Engineer
- Ramraj Gopikrishnan

**Drilling Superintendents**
- Mr. Sarbjit
- Vidyadharan Thampi

**Drilling Mechanic**
- Mohd Siddique

**Rock crushing**
*University of Southampton*
- Catriona Menzies
- Nicolas Bompard
- James Fielding

**OmanChikyu 2018 description**

**Laboratory Manager**
- Yusuke Kubo

**Laboratory Officers**
- Soichi Moriya
- Tomoy Tanaka
- Toru Fujiki

**Curators**
- Shigako Nigi
- Masaru Yasunaga

**Laboratory Technicians**
- Akihiko Fujihara
- Atsushi Kurasawa
- Azusa Suzuki
- Chiaki Sasaki
- Daiki Kawata
- Hideki Yamamoto
- Hikaru Kawase
- Hiromi Takeda
- Htet Naing Lin
- Kanako Yoshida
- Kazuma Takahashi
- Kei Fujiya
- Masayuki Abe
- Masumi Sakaguchi
- Nobuhiro Anraku
- Paing Zu
- Reina Miyahara
- Rui Nitahara
- Ryo Ogawa
- Susumu Konno
- Tomonori Watai
- Toshikuni Yabuki
- Yoshiki Kido
- Yu Shimazaki
- Yuta Oda
- Yuya Hitomi

**IODP Publications Specialist**
- Jean Wulfson
Publications staff (JRSO)*

Douglas Cummings
Graphics Specialist II

Gudelia (“Gigi”) Delgado
Publications Coordinator

Ekanta Desai
Graphics Specialist II

Patrick H. Edwards
Supervisor of Production

Jenni Hesse
Editor IV

Willow Grosz
Editor II

Rhonda Kappler
Graphics Specialist IV

Ginny Lowe
Reports Coordinator

Amy McWilliams
Supervisor of Editing

Julie Myers
Production Editor III

Lorri Peters
Manager of Publication Services

Kenneth Sherar
Production Editor III

Alyssa Stephens
Graphics Specialist III

Crystal Wolfe
Production Editor IV

Jean Wulfsen
Supervisor of Graphics

Ann Yeager
Distribution Specialist

*At time of publication
Foreword

Funding

The Oman Drilling Project (OmanDP) has been undertaken by an international community of scientists from numerous countries and institutions. It has been possible through co-mingled funds from numerous agencies and institutions:

- International Continental Scientific Drilling Program (ICDP; Kelemen, Matter, Teagle Lead PIs),
- Alfred P. Sloan Foundation Deep Carbon Observatory (Grant 2014-3-01, Kelemen PI),
- National Science Foundation (Award NSF-EAR-1516300, Kelemen Lead PI),
- NASA Astrobiology Institute (Award NNA15BB02A, Templeton PI),
- German Research Foundation (DFG Grant KO 1723/21-1, Koepke PI),
- Japanese Society for the Promotion of Science (JSPS Awards 16H06347, Michibayashi PI; and KAKENHI 16H02742, Takazawa PI),
- European Research Council (Adv Grant 669972; Jamveit PI),
- Swiss National Science Foundation (SNF Grant 20FI21-163073, Früh-Green PI),
- Japan Agency for Marine-Earth Science and Technology (JAMSTEC),
- International Ocean Discovery Program JOIDES Resolution Science Operator (IODP JRSO),

with important contributions from the Sultanate of Oman Ministry of Regional Municipalities and Water Resources (MRMWR), the Oman Public Authority of Mining, Sultan Qaboos University, Columbia University of New York (USA), and the University of Southampton (UK).

Disclaimer

Opinions, findings, and conclusions or recommendations expressed in this publication are those of the authors and do not necessarily reflect the views of any of the above listed supporting agencies.

Oman Drilling Project Management and Governance

The Oman Drilling Project is guided by a Project Steering Committee (PSC) comprising the lead principal investigators, specialist experts, and important liaisons with national and international bodies such as MRMWR, JAMSTEC, IODP, and ICDP.

Oman Drilling Project Steering Committee

- Prof. Peter Kelemen (Columbia University, New York): Chief Scientist of the Oman Drilling Project; Chair PSC; Lead Principal Investigator on Oman Drilling Project
- Prof. Juerg M. Matter (University of Southampton): Principal Investigator on Oman Drilling Project; Principal contact with ICDP; Principal liaison with Omani Government and other bodies; geophysical logging, physical properties measurements, and hydrology
- Prof. Damon A.H. Teagle (University of Southampton): Principal Investigator on Oman Drilling Project, Vice Chair of PSC; Chair of the Sampling Oversight and Allocation Committee (SOAC)
- Dr. Jude Coggon (University of Southampton): OmanDP Project Manager (2015–2019); logistics, personnel, website, organization, publications
- Eng. Zaher Bin Khalid Al Sulaimani: In-Country Project Manager; Logistics and liaison in Oman
- Eng. Said Al-Habsi (MRMWR, Sultanate of Oman): Chair of the Oman Drilling Committee (ODC)
- Dr. Ali Al Rajhi (Public Authority for Mining, Sultanate of Oman): Permitting and government liaisons in Oman
Prof. Alexis Templeton (Department of Geological Sciences, University of Colorado Boulder, USA): Biogeochemical and microbiological sampling and borehole incubation experiments

Dr. Marguerite Godard (Directrice de Recherche, CNRS, Universit de Montpellier, France): Geochemical and isotopic analyses of rock samples

Prof. David Goldberg (Lamont-Doherty Earth Observatory, USA): Geophysical logging and borehole packer testing

Dr. Benoit Ildefonse (Directeur de Recherche, CNRS, Universit de Montpellier, France): Outreach; liaison with IODP

Prof. Jürgen Koepke (Leibniz Universitaet, Germany): Petrology of igneous and high-T metamorphic rocks from the lower crust and mantle

Prof. Chris MacLeod (School of Earth and Ocean Sciences, Cardiff University, UK): Structural and petrological work on igneous and high-T metamorphic rocks in the middle crust and sheeted dikes

Prof. Craig Manning (Department of Earth & Space Sciences, University of California Los Angeles, USA): Analyses of low-T metamorphic rocks

Prof. Katsuyoshi Michibayashi (Nagoya University, Japan): Structural analyses of igneous and high-T metamorphic rocks from the lower crust and upper mantle

Dr. Jay Miller (IODP Manager of Technical & Analytical Services, Texas A&M University, USA): Core logging; publication of Initial Report; other liaison with IODP personnel

Prof. Sobhi Nasir (Head, Department of Geology, Sultan Qaboos University, Oman): Participation of undergraduates and graduate students from Oman

Prof. Matthew Shrenk (Michigan State University, USA): Biogeological sampling and borehole incubation experiments

Prof. Everett Shock (Arizona State University, USA): Water and gas sampling and analysis

Prof. Eiichi Takazawa (Niigata University, Japan): Detailed site selection and associated surface mapping and sampling

Day-to-day decisions were made by a Core Team comprising the Chief Scientist and Chair of the PSC (Kelemen), the Oman DP Project Director and Manager (Matter and Coggon, respectively), Mr. Zaher al Sulaimani of the Oman Water Society, and the Vice-Chair of the PSC and Chair of the Sample Oversight and Allocation Committee (Teagle).

Oman Drilling Committee

The Oman Drilling Committee (ODC) was established by representatives of the major stakeholders in the Sultanate of Oman with interests in the Oman Drilling Project. The role of the ODC is to provide independent advice and assist with the drilling permitting processes and other matters. The membership comes from a range of Omani government organizations and Sultan Qaboos University:

- Eng. Said Al-Habsi (Chair): MRMWR
- Dr. Rashid Al-Abri (Co-Chair): MRMWR
- Eng. Salim Al-Khanbashi: MRMWR
- Haider Al-Ajmi: MRMWR
- Dr. Ali Al-Rajahi: Public Authority for Mining
- Prof. Sobhi Nasir: Sultan Qaboos University
- Ibrahim Al Ajmi (Director General for Climate Affairs): Ministry of Environment and Climate Affairs

ChikyuOman 2017 Decision-Making Team

The Oman Drilling Project Phase 1 drill cores were described and analyzed onboard the JAMSTEC Drilling Vessel Chikyu from 15 July to 15 September 2017 (ChikyuOman2017). For these shipboard activities aboard Chikyu a Decision-Making Team (DMT) was established for effective decision making and sharing of information between the OmanDP PSC, the shipboard Co-Chiefs, Staff Scientists, the wider Science party, and
the Center for Deep Earth Exploration (CDEX) Laboratory Managers. When wider discussion was required, for example budget-related issues, the DMT shared information with a broader constituency including the OmanDP PSC, ODS group leaders, and JAMSTEC administrators. Oversight of data and sampling will remain the responsibility of the OmanDP Sample Oversight and Allocation Committee (SOAC) but with refined procedures to approve and facilitate shipboard and personal sample requests (see below).

Membership of the ChikyuOman2017 Phase 1 Decision Making Team (DMT):

- Prof. Damon Teagle, Co-Chief Scientist (Part A)
- Prof. Eiichi Takazawa, Co-Chief Scientist (Part A)
- Prof. Peter Kelemen, Co-Chief Scientist (Parts A and B)
- Prof. Katzu Michibayashi, Co-Chief Scientist (Part B)
- Dr. Michelle Harris, Staff Scientist (Site BT1)/Co-Chief Scientist (Site GT3)
- Dr. Jude Coggon, Staff Scientist (Part A)
- Dr. Natsue Abe, Staff Scientist (Parts A and B)
- Mr. Juan Carlos de Obeso, Staff Scientist (Part B, Site GT3)
- Ms. Chiaki Igarashi, Administration and CDEX Laboratory Manager
- Dr. Akihiro Tamura, ChikyuOman2017 Project Manager

**ChikyuOman 2018 Decision-Making Team**

The Oman Drilling Project Phase 2 drill cores were described and analyzed onboard the JAMSTEC Drilling Vessel *Chikyu* from 5 July to 5 September 2018, ChikyuOman2018. For these shipboard activities aboard *Chikyu* a second DMT was established for effective decision making and sharing of information between the OmanDP PSC, the shipboard Co-Chiefs, Staff Scientists, the wider Science party, and the CDEX Laboratory Managers. When wider discussions were required, for example budget related issues, the DMT shared information with a broader constituency including the OmanDP PSC, ODS group leaders, and JAMSTEC administrators. Oversight of data and sampling will remain the responsibility of the OmanDP SOAC but with refined procedures to approve and facilitate shipboard and personal sample requests (see below).

Membership of the OmanChikyu 2018 Decision Making Team (DMT):

- Prof. Damon Teagle, Co-Chief Scientist (Part A)
- Prof. Eiichi Takazawa, Co-Chief Scientist (Part A)
- Prof. Peter Kelemen, Co-Chief Scientist (Parts A and B)
- Prof. Katzu Michibayashi, Co-Chief Scientist (Part B)
- Dr. Margot Godard, Co-Chief Scientist (Part B)
- Dr. Jude Coggon, Staff Scientist (Part A)
- Ms. Saebyul Choe, Staff Scientist (Parts A and B)
- Dr. Moe Kyaw, JAMSTEC liaison
- Dr. Natsue Abe, JAMSTEC liaison
- Ms. Chiaki Igarashi, Administration and CDEX Laboratory Manager

**Oman Drilling Project Sample, Data, and Obligations Policies**

These policies were developed to ensure transparent access by scientists to Oman Drilling Project samples and data. They are closely related to and similar to established policies used by IODP and other ICDP projects. Scientists who received samples and access data incurred obligations on their use and reporting of the science outcomes from research based on these samples or data. The distribution and use of all cores, samples, and data fall under oversight of the OmanDP Sample Oversight and Allocation Committee (SOAC), a subgroup of the Project Steering Committee.

**Oman Drilling Project Sample Oversight and Allocation Committee (SOAC)**

- Prof. Damon Teagle: Chair of OmanDP SOAC; Principal Investigator OmanDP
The goals of the Oman Drilling Project sample policies were to ensure the:

- Availability of samples and data to Science Party members so they can fulfill the objectives of the drilling project and their responsibilities to the OmanDP;
- Dissemination of the scientific findings of the Oman Drilling Project coring, logging, sampling, experimentation, and related activities to gain maximum scientific exposure and public engagement;
- Scientific community has access to findings and, following the moratorium periods, data and samples to encourage scientific analyses over a wide range of research disciplines; and
- Preservation of core and cuttings material as an archive for future description and observations, nondestructive analyses, and sampling.

Sample and Data Requests

There are two classes of sample requesters: Members of the Science Party and Post-Moratorium Researchers. Both groups incur their own particular obligation once a data or sample request has been approved and delivered.

The Moratorium Period is defined as two and a half years following the end of the description of the cores. The Oman Drilling Project will be divided into two Science Parties relating to the 2016–2017 and 2017–2018 Phases of operation. For Phase 1 of the OmanDP the moratorium period will be from September 2017 until the end of February 2020. For Phase 2 of the OmanDP the moratorium period will be from September 2018 until the end of February 2021. To submit a sample/data request you must be registered with OmanDP (via the application form). Membership of one phase does not necessarily ensure membership in the other Science Party unless certain criteria are fulfilled. For example, membership of the OmanDP Phase 1 Science Party requires at least one of the following:

1) Participation on site during the Phase 1 drilling, sampling, logging, experiment operations, of OmanDP;
2) Contribution to the visual and/or instrumental logging of the Phase 1 Oman DP cores during ChikyuOman2017 (July–September, 2017); or
3) A financial contribution to Oman Drilling Project via one or more scientific research grants that provides funds for drilling operations and/or core logging onboard Chikyu.

In addition, the SOAC will also consider sample requests, on a case by case basis, from science groups who provide specific skills or approaches NOT provided by colleagues covered by 1, 2, and/or 3, above.

Personal sample requests are prioritized by the OmanDP SOAC. The SOAC encourages a pooled sampling approach, as commonly used during IODP expeditions, to ensure that a comprehensive suite of geochemical, mineralogical, and physical properties measurements are made on a representative suite of shared samples/powders. The SOAC also encouraged boutique isotopic and other geochemical measurements to be initially undertaken on the well-characterized pool samples.

Post-moratorium researchers are those who submit sample and data requests after the specific OmanDP Phase moratorium period ends. Sample applications by educators and outreach institutions are also considered on a case-by-case basis.

All data and observations produced from the on-site drilling and logging phases and shipboard activities of the Oman Drilling Project will be published in this open access volume akin to the IODP Expedition Reports following the moratorium period. During the moratorium period, data and samples will be restricted to the Science Party of that phase of the OmanDP.

Requests for data or samples must be made through official OmanDP processes and use the OmanDP sample request form. These requests will be assessed by the SOAC and accepted, refined, combined, or rejected to
ensure the best scientific outcomes. Core samples were generally only taken during the core logging activities (in 2017 onboard Chikyu) in a series of sampling meetings immediately following the description of each hole. To oversee these sampling events the SOAC delegated specific sample allocation to a shipboard team comprising the Co-Chief Scientists and Staff Scientists with assistance from the Curator. These teams resolved conflicts and ensured a fair and efficient distribution of samples. All sample request conflicts were resolved aboard.

Obligations for Members of the OmanDP Science Parties receiving Samples and/or Data

All members of the OmanDP Science Parties who receive samples or data incur obligations to conduct research during the moratorium period and publish their data and results in an English language peer-reviewed scientific journal or a peer-reviewed data report that will supplement the open access OmanDP Initial Reports, within 48 months of the core description campaign. Failure to meet these obligations may result in the rejection of future sample requests and may influence participation in other aspects of the Oman Drilling Project.

All publications arising from the OmanDP operations must acknowledge the Oman Drilling Project using a modified version of the following wording:

This research used samples and/or data provided by the Oman Drilling Project. The Oman Drilling Project (OmanDP) was made possible through co-mingled funds from the International Continental Scientific Drilling Project (ICDP; Kelemen, Matter, Teagle Lead PIs), the Sloan Foundation Deep Carbon Observatory (Grant 2014-3-01, Kelemen PI), the National Science Foundation (Award NSF-EAR-1516300, Kelemen lead PI), NASA Astrobiology Institute (Award NNA15BB02A, Templeton PI), the German Research Foundation (DFG Grant KO 1723/21-1, Koepke PI), the Japanese Society for the Promotion of Science (JSPS grants 16H06347, Michibayashi PI; and KAKENHI 16H02742, Takazawa PI), the European Research Council (Adv grant 669972; Jamveit PI), the Swiss National Science Foundation (SNF grant 20FI21_163073, Früh-Green PI), Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the International Ocean Discovery Program JOIDES Resolution Science Operator (IODP JRSO), and contributions from the Sultanate of Oman Ministry of Regional Municipalities and Water Resources, the Oman Public Authority of Mining, Sultan Qaboos University, CNRS-Université Montpellier (France), Columbia University of New York (USA), and the University of Southampton (UK).

Publications should include the words Oman Drilling Project as keywords provided to the journal or book published of the manuscript.

Authors should send a PDF copy of the manuscript to the Chair and Vice-Chair of the OmanDP Project Steering Committee and the Project Director (Kelemen, Teagle, and Matter, respectively).

All data generated should be made openly available and either lodged in the OmanDP Proceedings Volume supplements as data reports or archived in an open access data repository (e.g., PetDP).

Authors wishing to publish scientific papers within the Moratorium Period must receive prior approval in writing by a majority of the scientific party and the support of the OmanDP Project Steering Committee. This approval will be coordinated by the OmanDP Project Manager, who will circulate the manuscript among the scientific party, tabulate responses, and notify the author of the scientific party’s decision. Unless specifically agreed, all publications within the Moratorium period must include the Oman Drilling Project Science Team in the authorship.

Acknowledgments

The Oman Drilling Project has received essential assistance from hundreds of volunteers, many of whom covered their own travel expenses as well as providing weeks to months of their time and effort without compensation. We are very grateful for this exceptional community effort.

The In-Country Manager of the Oman Drilling Project is Eng. Zaher Al Sulaimani, Director of the Oman Water Centre. It is likely that the Oman Drilling Project would not have succeeded without his wise guidance. We also thank his son, Mazin Al Sulaimani, for able and efficient assistance with logistics. Eng. Nehal Warsi served as Site Geologist, our dedicated and reliable representative, every day of drilling for two seasons (7 months in total) and also volunteered a month of his time to help with core description on board the Drilling Vessel Chikyu. Funding for the Oman Drilling Project was generously provided by the International Continental Scientific Drilling Program (ICDP), the US National Science Foundation (NSF), the Sloan Foundation Deep Carbon
Observatory (DCO), the US National Aeronautics and Space Administration (NASA), the European Research Council (ERC), the German Research Foundation (DFG), the Swiss National Science Foundation, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the Japanese Society for the Promotion of Science (JSPS), and the International Ocean Discovery Program (IODP). We are particularly grateful for advice from Dr. Uli Harms of ICDP, for support from JAMSTEC President Dr. Asahiko Taira, and for extensive assistance with proposal preparation from Dr. Nobu Eguchi at JAMSTEC. Special thanks also go to Jesse Ausbel of the Sloan Foundation Deep Carbon Observatory and Dr. Leonard Johnson and Dr. Dennis Geist of the US NSF.

In-kind and administrative support for the Oman Drilling Project in Oman was kindly provided by personnel at the Ministry of Regional Municipalities and Water Resources (especially His Excellency Minister Dr. Ahmed Al Shili, Eng. Said Al Habsi, Director General of Water Resources Assessment, Eng. Salim Al Khanbashi, Director General of Surface & Groundwater Assessment, Dr. Rashid Al Abri, Eng. Nasser Mohammed Nasser Al Batashi, Eng. Haider Ahmed Mohammed Alajmi, Mohsin Al Shukaili, Ali Al Shukaili, Eng. Abdullah Al Kasbi, Said Al Mangi, and Suleiman Al Mangi), the Public Authority for Mining (especially Dr. Ali Al Rajhi, Director General of Research & Geological Surveys, Mohamed Al Batashi, and Mohamed Al Arai), the Ministry of Environment and Climate Affairs (especially His Excellency Minister Dr. Mohammed Al Toobi), the faculty of Sultan Qaboos University (especially Prof. Sobhi Nasir, Her Excellency Deputy Vice Chancellor Prof. Rahma Al Mahrooqi, His Excellency Vice Chancellor Prof. Ali Al Bemani, Prof. Osman Abdalla, Dr. Issa El-Hussain, and Majid Al-Saifi), the faculty of the German University of Technology in Oman (especially Heads of the Dept. of Applied Geosciences, Prof. Michaela Bernecker and Prof. Willfried Bauer and faculty members Dr. Ana Jesus and Dr. Ekkehard Holzbecher), and Petroleum Development Oman (especially Geosolutions Manager Dr. Hisham Al Siyabi and XGL Dr. Hamad Al Shuali).

Special thanks go to Dr. Uli Harms and the ICDP Operational Support Team: Dr. Ronald Conze, Dr. Thomas Gorgas, Dr. Tanja Hörner, and Dr. Thomas Wiersberg for their assistance in and valuable advice in designing and setting up the drill site core logging protocols and for being available at all hours of the day and night to help us to solve problems and ensure smooth drill site operations.

We worked with several drilling contractors in Oman. We particularly thank GeoSolutions Engineering, owned and operated by Managing Director Sultan Al Saadi, who is assisted by the exceptionally able Driller Shaikh Oliullah (Wali) and by Geologist Abdul Rasak Tharayil. Their attention to quality and efficiency were above and beyond the call of duty and resulted in timely acquisition of 3200 meters of core with 100% recovery.

During core description onboard Drilling Vessel (D/V) Chikyu, we were ably assisted by the ship’s crew and technical staff. We particularly thank President Dr. Asahiko Taira, Dr. Kyoshi Suyehiro, Dr. Nobu Eguchi, Director of the Science Services Department, Center for Deep Earth Exploration (CDEX), Chikyu Laboratory Managers Dr. Lena Maeda and Dr. Yusuke Kubo, shore-based Expedition Manager Dr. Chiaki Igarashi, and Ms. Maya Takebayashi Noguchi at JAMSTEC.

We thank Dr. Jay Miller and Dr. Brad Clement at IODP JRSO at Texas A&M University (TAMU) for their advice and assistance in planning and organizing logistics and protocols for shipboard core description. In addition, Shana Lewis, Rhonda Kappler, Jean Wulfson, and Phil Rumford kindly joined us onboard D/V Chikyu to provide publications and curation support, and Lorri Peters and her team at JRSO TAMU worked extremely hard to edit and produce this volume.

Among the scientists involved with the Oman Drilling Project, a few deserve special thanks here. Project Manager Dr. Jude Coggon and Project Director Prof. Jürg Matter did an amazing, exceptional job of managing logistics, arranging contracts, and supervising operations in the field and during core description. Niigata University Prof. Eiichi Takazawa and his students found and mapped the drill sites at the crust–mantle transition zone. Nagoya University Prof. Katsu Michibayashi provided his own research funds to enable core description onboard D/V Chikyu in summer 2017. Katsu and Eiichi, together with Dr. Natsue Abe of JAMSTEC, Dr. Jude Coggon, and Prof. Damon Teagle of Southampton University, Dr. Marguerite Godard of the University of Montpellier, Dr. Michelle Harris of Plymouth University, and Prof. Peter Kelemen and graduate student Juan Carlos de Obeso of Columbia University, served as Co-Chief Scientists and Staff Scientists onboard D/V Chikyu. Prof. Alexis Templeton, Dr. Eric Ellison, and graduate student Katy Rempfert from the University of Colorado built and operated the biogeochemistry laboratory on the drill site in January 2018.
Dedication

His Majesty Sultan Qaboos bin Said al Said
18 November 1940–10 January 2020
Sultan of Oman, 23 July 1970–10 January 2020

The Oman Drilling Project, the results within this volume and our future scientific outcomes are dedicated to His Majesty Sultan Qaboos bin Said al Said.

Sultan Qaboos recognized the importance of the unique geology of Oman to his country and the great role that science can play in the development of peace and prosperity. He was instrumental in opening up Oman to national and international scientific collaborations that, together with the warm welcome of the people of Oman, have allowed the mountains of the Samail Ophiolite to become one of the world’s most iconic geological terrains.