

# GEOLOGY

DECEMBER 2021 | VOLUME 49 | NUMBER 12

- 1411 The impact of postdepositional alteration on iron- and molybdenum-based redox proxies**  
Suemeyya Eroglu, Florian Scholz, Renato Salvatelli, Christopher Siebert, Ralph Schneider and Martin Frank
- 1416 Efficient release of bromine by super-eruptions**  
Clara M. Waelkens, John Stix, Brian Monteleone and Pierre Burckel
- 1421 Distinguishing volcanic from impact glasses—The case of the Cali glass (Colombia)**  
Ludovic Ferrière, Alvaro P. Crósta, Wencke Wegner, Eugen Libowitzky, Fabio Iwashita and Christian Koeberl
- 1426 The unevenness of the north Iberian crustal root, a snapshot of an elusive stage in margin reactivation**  
Gabriela Fernández-Viejo, Patricia Cadenas, Jorge Acevedo and Sergio Llana-Fúnez
- 1431 Current and sea level control the demise of shallow carbonate production on a tropical bank (Saya de Malha Bank, Indian Ocean)**  
Christian Betzler, Sebastian Lindhorst, Thomas Lüdmann, John J. Reijmer, Juan-Carlos Braga, Or M. Bialik, Jesus Reolid, Jan Oliver Eisermann, Kay Emeis, Tim Rixen and Dass Bissessur
- 1436 Curved orogenic belts, back-arc basins, and obduction as consequences of collision at irregular continental margins**  
Nicholas Schliffke, Jeroen van Hunen, Frédéric Gueydan, Valentina Magni and Mark B. Allen
- 1441 Clear as mud: Clinoform progradation and expanded records of the Paleocene-Eocene Thermal Maximum**  
Luca G. Podrecca, Maria Makarova, Kenneth G. Miller, James V. Browning and James D. Wright
- 1446 Diverse gas composition controls the Moby-Dick gas hydrate system in the Gulf of Mexico**  
Alexey Portnov, A.E. Cook and S. Vadakkepuliymbatta
- 1452 Pulsed volcanism and rapid oceanic deoxygenation during Oceanic Anoxic Event 1a**  
Kohen W. Bauer, Cinzia Bottini, Robert Frei, Dan Asael, Noah J. Planavsky, Roger Francois, N. Ryan McKenzie, Elisabetta Erba and Sean A. Crowe
- 1457 Spontaneous reheating of crystallizing lava**  
Alan G. Whittington and Alexander Sehlke
- 1462 Zircon (U-Th)/He thermochronology reveals pre-Great Unconformity paleotopography in the Grand Canyon region, USA**  
B.A. Peak, R.M. Flowers, F.A. Macdonald and J.M. Cottle
- 1467 Rhabdophane Th-Pb ages indicate reactivation of Mesoarchean structures in west Pilbara Craton during breakup of Greater India and Australia-Antarctica**  
Birger Rasmussen, Jian-Wei Zi and Janet R. Muhling
- 1473 Early Pleistocene climate-induced erosion of the Alaska Range formed the Nenana Gravel**  
Rachel N. Sortor, Brent M. Goehring, Sean P. Bemis, Chester A. Ruleman, Marc W. Caffee and Dylan J. Ward
- 1478 Cryogenian glaciostatic and eustatic fluctuations and massive Marinoan-related deposition of Fe and Mn in the Urucum District, Brazil**  
B.T. Freitas, I.D. Rudnitzki, L. Morais, M.D.R. Campos, R.P. Almeida, L.V. Warren, P.C. Boggiani, S. Caetano-Filho, C. Bedoya-Rueda, M. Babinski, T.R. Fairchild and R.I.F. Trindade
- 1484 Late Weichselian ice-sheet flow directions in the Russian northern Barents Sea from high-resolution imagery of submarine glacial landforms**  
Julian A. Dowdeswell, Aleksandr Montelli, Grigori Akhmanov, Marina Solovyeva, Yana Terekhina, Sergey Mironyuk and Mikhail Tokarev
- 1489 A molecular biomarker for end-Permian plant extinction in South China**  
Chunjiang Wang and Henk Visscher
- 1495 Active faulting controls bedform development on a deep-water fan**  
Vittorio Maselli, Aaron Micallef, Alexandre Normandeau, Davide Oppo, David Iacopini, Andrew Green and Zhiyuan Ge
- 1501 Detrital signals of coastal erosion and fluvial sediment supply during glacio-eustatic sea-level rise, Southern California, USA**  
G.R. Sharman, J.A. Covault, D.F. Stockli, Z.T. Sickmann, M.A. Malkowski and S.A. Johnstone
- 1506 River sinuosity describes a continuum between randomness and ordered growth**  
Ajay B. Limaye, Eli D. Lazarus, Yuan Li and Jon Schwenk
- 1511 Near-constant retreat rate of a terrestrial margin of the Laurentide Ice Sheet during the last deglaciation**  
Thomas V. Lowell, Meredith A. Kelly, Jennifer A. Howley, Timothy G. Fisher, Peter J. Barnett, Roseanne Schwartz, Susan R.H. Zimmerman, Nathaniel Norris and Andrew G.O. Malone
- 1516 Tunnel valley infill and genesis revealed by high-resolution 3-D seismic data**  
James D. Kirkham, Kelly A. Hogan, Robert D. Larter, Ed Self, Ken Games, Mads Huuse, Margaret A. Stewart, Dag Ottesen, Neil S. Arnold and Julian A. Dowdeswell
- 1521 Fjord network in Namibia: A snapshot into the dynamics of the late Paleozoic glaciation**  
Pierre Dietrich, Neil P. Griffis, Daniel P. Le Heron, Isabel P. Montañez, Christoph Kettler, Cécile Robin and François Guillocheau
- 1527 Interaction bounding surfaces exposed in migrating transverse aeolian ridges on Mars**  
Mackenzie Day
- 1531 Author Index**

# GEOLOGY

GEOLOGY publishes timely, innovative, and provocative articles relevant to its international audience, representing research from all fields of the geosciences.

GEOLOGY (ISSN 0091-7613 USPS 994-580 CODEN GLGYB) is published monthly by the Geological Society of America, Inc. (GSA), with offices at 3300 Penrose Place, Boulder, Colorado, USA. Mailing address is P.O. Box 9140, Boulder, CO 80301-9140, USA. Periodicals postage paid at Boulder, Colorado, and at additional mailing offices. Postmaster: Send address changes to Geology, Sales & Service, P.O. Box 9140, Boulder, CO 80301-9140, USA.

Copyright © 2021, The Geological Society of America, Inc. (GSA). All rights reserved. Copyright not claimed on content prepared wholly by U.S. government employees within the scope of their employment. Individual scientists are hereby granted permission, without fees or further requests to GSA, to use a single figure, a single table, and/or a brief paragraph of text in other subsequent works and to make unlimited photocopies of items in this journal for noncommercial use in classrooms to further education and science. In addition, an author has the right to use his or her article or a portion of the article in a thesis or dissertation without requesting permission from GSA, provided the bibliographic citation and the GSA copyright credit line are given on the appropriate pages. For any other form of capture, reproduction, and/or distribution of any item in this journal by any means, contact: Permissions, GSA, P.O. Box 9140, Boulder, CO 80301-9140, USA, fax +1-303-357-1073, editing@geosociety.org; reference Geology, ISSN 0091-7613. Permission is granted to authors to post the abstracts only of their articles on their own or their organization's Web site providing the posting includes this reference: "The full paper was published in the Geological Society of America's journal Geology, [include year, month, and page numbers, if known, where the article appears or will appear]."

GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of their race, citizenship, gender, religion, sexual orientation, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

SUBSCRIPTIONS for 2022 calendar year. All GSA Members receive free online access to Geology with their membership. Prices for print subscriptions: Members and Fellows: \$99; Student, K–12 Teacher, and Early Career Professional Members: \$60. Nonmembers and institutions: \$1,425 (print + online). Details on subscription choices, formats, and pricing at [www.geosociety.org/publications/](http://www.geosociety.org/publications/). For all orders, call GSA Sales & Service at +1.800.472.1988 or +1.303.357.1000, or e-mail [gsaservice@geosociety.org](mailto:gsaservice@geosociety.org). Claims: for nonreceipt or damaged copies, please contact GSA Sales & Service. Claims are honored for one year; please allow sufficient delivery time (up to 8 weeks) for overseas copies.

## GSA ONLINE

Organization home page: [www.geosociety.org](http://www.geosociety.org)  
Journals and books: [www.gsapubs.org](http://www.gsapubs.org)  
Manuscript submission: <https://geology.msubmit.net>

## EDITORS

**Kathleen C. Benison**  
West Virginia University  
[Kathleen.Benison@mail.wvu.edu](mailto:Kathleen.Benison@mail.wvu.edu)

**Chris Clark**  
Curtin University  
[geologyscienceeditor@curtin.edu.au](mailto:geologyscienceeditor@curtin.edu.au)

**William Clyde**  
University of New Hampshire  
[Will.Clyde@unh.edu](mailto:Will.Clyde@unh.edu)

**Gerald Dickens**  
Trinity College Dublin  
[DICKENSG@tcd.ie](mailto:DICKENSG@tcd.ie)

**Marc D. Norman**  
Australian National University  
[marc.norman@anu.edu.au](mailto:marc.norman@anu.edu.au)

**Urs Schaltegger**  
University of Geneva  
[urs.schaltegger@unige.ch](mailto:urs.schaltegger@unige.ch)

## GEOLOGY STAFF

**Director of Publications**  
Jeanette Hammann

**Managing Editor**  
Lyne Yohe  
[lyohe@geosociety.org](mailto:lyohe@geosociety.org)

**Editorial Staff**  
Jennifer Olivarez  
[jolivarez@geosociety.org](mailto:jolivarez@geosociety.org)

## GSA OFFICERS

**Executive Director**  
Vicki S. McConnell

**President**  
Barbara L. Dutrow

**President-Elect**  
Mark Gabriel Little

**Past President**  
J. Douglas Walker

**Treasurer**  
Richard C. Berg

## EDITORIAL BOARD

**2019–2021**  
John Cottle  
Jacob A. Covault  
Elena Druguet  
Paul Kapp  
Shoufa Lin  
Jonas B. Ruh  
J. Gregory Shellnut  
Martine Simoes  
Zoltán Sylvester  
An Yin

**2020–2022**  
Olivier Bachmann  
Whitney Behr  
Carolyn Boulton  
Matthew E. Clapham  
Aaron Diefendorf  
Dong Feng  
Sam Johnstone  
Meredith A. Kelly  
Marcelo Ketzner  
Li-Wei Kuo  
Sergio Llana-Fúnez  
Andrew J. Parsons  
Oliver Plümpfer  
Maria Seton  
Ron Steel  
Lucie Tajcmanova  
Paola Vannucchi  
Malcolm W. Wallace

**2021–2023**  
Michael Blum  
Giovanni Camanni  
Hsin-Hua Huang  
Micha Ruhl  
Justin Strauss  
Michael Taylor

## COUNCILORS

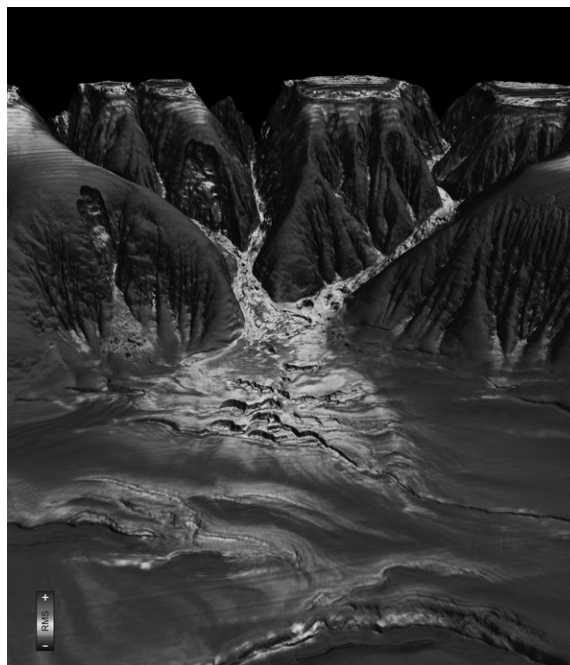
**2018–2022**  
Wendy A. Bohrsen  
Nathan A. Niemi  
Jeff N. Rubin

**2019–2023**  
Margaret Eggers  
Katharine W. Huntington  
Glenn Thackray

**2020–2024**  
Madeline E. Schreiber  
Susan G. Stover  
Manfred R. Strecker

**2021–2025**  
J. Wright Horton Jr.  
Jean Hsieh  
Donna Jurdy

**GSA Student Advisory Council Chair**  
Rebecca A. Taormina



**COVER:** Combined bathymetry and root-mean-square (RMS) amplitude response from the tectonically active margin of the Levant Basin (eastern Mediterranean Sea). In the center of the image, a deep-water fan, highlighted by high RMS amplitude values, is cut by an active normal fault. Sedimentary bedforms occur only on the fault footwall, indicating the important control of the topography generated by active tectonics on the flow behavior of turbidity currents. See "Active faulting controls bedform development on a deep-water fan" by Maselli et al., p. 1495–1500.