



The Geological Society of America Bulletin is a leading international journal for major scholarly research in all branches of the earth sciences. Published continuously since 1890.

T A B L E O F C O N T E N T S

- | | | | |
|-----|--|-----|--|
| 3 | Three-dimensional strain accumulation and partitioning in an arcuate orogenic wedge: An example from the Himalaya Suoya Fan and Michael A. Murphy | 212 | Rifting and subduction records of the Paleo-Tethys in North Laos: Constraints from Late Paleozoic mafic and plagiogranitic magmatism along the Song Ma tectonic zone Yuzhi Zhang, Xue Yang, Yuejun Wang, Xin Qian, Yukun Wang, Qiyu Gou, Vongpaseuth Seneboutalath, and Aimei Zhang |
| 19 | Jurassic tectonics of the eastern North China Craton: Response to initial subduction of the Paleo-Pacific Plate Wenxing Hao, Rixiang Zhu, and Guang Zhu | 233 | Distinguishing tectonic versus climatic forcing on landscape evolution: An example from SE Tibetan Plateau Fangbin Liu, Martin Danišik, Dewen Zheng, Kerry Gallagher, and Junsheng Nie |
| 37 | Evidence for mixed contribution of mantle and lower and upper crust to the genesis of Jurassic I-type granites from Macao, SE China Pedro Quelhas, João Mata, and Ágata Alveirinho Dias | 243 | Has Earth ever been ice-free? Implications for glacio-eustasy in the Cretaceous greenhouse age using high-resolution sequence stratigraphy Wen Lin, Janok P. Bhattacharya, Brian R. Jicha, Brad S. Singer, and William Matthews |
| 57 | Trace-elemental and petrographic constraints on the severity of hydrographic restriction in the silled Midland Basin during the late Paleozoic ice age Junwen Peng, Qilong Fu, Toti E. Larson, and Xavier Janson | 253 | Provenance and tectonic setting of late Paleozoic sedimentary rocks from the Alxa Tectonic Belt (NW China): Implications for accretionary tectonics of the southern Central Asian Orogenic Belt Dongfang Song, Wenjiao Xiao, Brian F. Windley, and Chunming Han |
| 74 | Thrusting, exhumation, and basin fill on the western margin of the South China block during the India-Asia collision Kai Cao, Philippe Hervé Leloup, Guocan Wang, Wei Liu, Gweltaz Mahéo, Tianyi Shen, Yadong Xu, Philippe Sorrel, and Kexin Zhang | 277 | Cyclostratigraphic calibration of the Eifelian Stage (Middle Devonian, Appalachian Basin, Western New York, USA) Damien Pas, Anne-Christine Da Silva, D. Jeffrey Over, Carlton E. Brett, Lauren Brandt, Jin-Si Over, Frederik J. Hilgen, and Mark J. Dekkers |
| 91 | Infaunal response during the end-Permian mass extinction Mao Luo, Luis A. Buatois, G.R. Shi, and Zhong-Qiang Chen | 287 | Deep-water channel morphologies, architectures, and population densities in relation to stacking trajectories and climate states Chenglin Gong, Ronald J. Steel, Kun Qi, and Yingmin Wang |
| 100 | On the reconciliation of biostratigraphy and strontium isotope stratigraphy of three southern Californian Plio-Pleistocene formations Alexandra J. Buczek, Austin J.W. Hendy, Melanie J. Hopkins, and Jocelyn A. Sessa | 307 | Quaternary slip rates on the White Mountains fault zone, eastern California: Implications for comparing geologic to geodetic slip rates across the Walker Lane Zachery M. Lifton, Jeffrey Lee, Kurt L. Frankel, Andrew V. Newman, and Jeffrey M. Schroeder |
| 115 | The Olympic-Wallowa lineament: A new look at an old controversy Stephen P. Reidel, Karl R. Fecht, Ingrid L. Hutter (Harrold), Terry L. Tolan, and Mickie A. Chamness | 325 | Ordo-Silurian assemblage in the Indochina interior: Geochronological, elemental, and Sr-Nd-Pb-Hf-O isotopic constraints of early Paleozoic granitoids in South Laos Yuejun Wang, Yuzhi Zhang, Xin Qian, Vongpaseuth Seneboutalath, Yang Wang, Yukun Wang, Chengshi Gan, and Khin Zaw |
| 134 | Transition from the lithospheric to asthenospheric mantle-derived magmatism in the Early Jurassic along eastern Bangong-Nujiang Suture, Tibet: Evidence for continental arc extension induced by slab rollback Wang-Chun Xu, Hong-Fei Zhang, Li-Ran Chen, Bi-Ji Luo, Liang Guo, and Jing-Liang Guo | 347 | Investigating the formation of the Cretaceous Western Interior Seaway using landscape evolution simulations Ching Chang and Lijun Liu |
| 149 | Multiproxy records in middle-late Miocene sediments from the Wushan Basin: Implications for climate change and tectonic deformation in the northeastern Tibetan Plateau Weitao Wang, Peizhen Zhang, Zhicai Wang, Kang Liu, Hongyan Xu, Caicai Liu, Huiping Zhang, Wenjun Zheng, and Dewen Zheng | 362 | Changes in productivity associated with algal-microbial shifts during the Early Triassic recovery of marine ecosystems Yong Du, Huyue Song, Jinnan Tong, Thomas J. Algeo, Zhe Li, Haijun Song, and Jiandong Huang |
| 159 | Inhomogeneous thinning of a cratonic lithospheric keel by tectonic extension: The Early Cretaceous Jiaodong Peninsula-Liaodong Peninsula extensional provinces, eastern North China craton Junlai Liu, Mo Ji, Jinlong Ni, Liang Shen, Yuanyuan Zheng, Xiaoyu Chen, and John P. Craddock | 379 | Loess in eastern equatorial Pangea archives a dusty atmosphere and possible upland glaciation Lily S. Pfeifer, Gerilyn S. Soreghan, Stéphane Pochat, and Jean Van Den Driessche |
| 177 | Crustal and upper mantle structure beneath the South China Sea and Indonesia V. Corchete | 393 | Triassic-Jurassic evolution of the eastern North China Craton: Insights from the Lushun-Dalian area, South Liaodong Peninsula, NE China Zhiheng Ren, Wei Lin, Michel Faure, Lingtong Meng, Huabiao Qiu, and Jipei Zeng |
| 185 | Provenance changes across the mid-Cretaceous unconformity in basins of northeastern China: Evidence for an integrated paleolake system and tectonic transformation Shuang-Qing Li, Song He, and Fukun Chen | 409 | Biomarker evidence of algal-microbial community changes linked to redox and salinity variation, Upper Devonian Chattanooga Shale (Tennessee, USA) Yi Song, Geoffrey J. Gilleaudeau, Thomas J. Algeo, D. Jeffrey Over, Timothy W. Lyons, Ariel D. Anbar, and Shucheng Xie |
| 199 | Late Cenozoic drainage reorganization of the paleo-Yangtze river constrained by multi-proxy provenance analysis of the Paleo-lake Xigeda Bin Deng, David Chew, Chris Mark, Shugen Liu, Nathan Cogné, Lei Jiang, Gary O'Sullivan, Zhiwu Li, and Jinxi Li | 425 | Geochemistry of contrasting stream types, Taylor Valley, Antarctica Russell S. Harmon, Deborah L. Leslie, W. Berry Lyons, Kathleen A. Welch, and Diane M. McKnight |



THE
GEOLOGICAL
SOCIETY
OF AMERICA®

EDITORS

Brad S. Singer

University of Wisconsin–Madison
gsabull@geology.wisc.edu

Rob Strachan

University of Portsmouth
rob.strachan@port.ac.uk

Wenjiao Xiao

Chinese Academy of Sciences
wj-xiao@mail.iggcas.ac.cn

GEOLOGICAL SOCIETY OF AMERICA

Executive Director

Vicki S. McConnell

President

J. Douglas Walker

President-Elect

Barbara L. Dutrow

Past President

Donald I. Siegel

Treasurer

Richard C. Berg

Council

July 2017–June 2021

Carmala N. Garziona
Joan E. Fryxell
Suzanne O'Connell

July 2018–June 2022

Wendy A. Bohron
Nathan A. Niemi
Jeff N. Rubin

July 2019–June 2023

Margaret Eggers
Katharine W. Huntington
Glenn Thackray

July 2020–June 2024

Madeline E. Schreiber
Susan G. Stover
Manfred R. Strecker

GSA Student Advisory Council Chair

Rebecca A. Taormina

Committee on Publications

Christopher M. Bailey

Wendy A. Bohron

Kristin Caddick

Shanaka L. de Silva

Gerald Dickens

Mihai Ducea

Lisa G. Dunn

Christian Koerberl

Jamie S.F. Levine

Eric Peterson

Troy Rasbury

David B. Rowley

Brad S. Singer

The Geological Society of America Bulletin

(ISSN 0016-7606 USPS 216-300 CODEN BUGMA) is published bimonthly by The Geological Society of America, Inc. (GSA), with offices at 3300 Penrose Place, Boulder, Colorado. 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 *GSA Bulletin*, Sales & Service, P.O. Box 9140, Boulder, CO 80301-9140, USA, or e-mail to gsaservice@geosociety.org.

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 *GSA Bulletin*, ISSN 0016-7606. 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 Bulletin*, [include year, month, and page number, if known, where 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 2021 calendar year. GSA Members and Fellows: \$99 (print + online), \$60 (online only). GSA Student, K–12 Teacher, and Early Career Professional Members: \$60 (print only; online included in membership). Nonmembers and institutions: \$1,375 (print + online + archive). Details on subscription choices, formats, and pricing at: www.geosociety.org/publications/. For orders, call GSA Sales & Service at +1.800.472.1988 or +1.303.357.1000, or e-mail gsaservice@geosociety.org. Claims: for nonreceipt 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.

Staff: Director of Publications, Jeanette Hamman; Managing Editor, Cary Cospér (ccosper@geosociety.org); Editorial Staff, Jennifer Olivarez.

GSA Bulletin Online: <http://www.gsapubs.org>.

Online Submission: <https://gsabulletin.msubmit.net>.

GSA Online: <http://www.geosociety.org>.

GSA BULLETIN BOARD OF ASSOCIATE EDITORS

2019–2021

Ian Boomer

University of Birmingham

William Guenther

University of Illinois

Ya-Ju Hsu

Institute of Earth Sciences,

Academia Sinica

Ganqing Jiang

University of Nevada–Las Vegas

Christian Koerberl

University of Vienna

Tim Kusky

China University of Geosciences

Yongjiang Liu

Ocean University of China

Shasta Marrero

Cardiff University

Alan Rooney

Yale University

Karel Schulmann

University of Strasbourg

John Waldron

University of Alberta

Fu-Yuan Wu

Chinese Academy of Sciences

Changqing Yin

Sun Yat-sen University

Haijiang Zhang

University of Science and

Technology of China

XiXi Zhao

State Key Laboratory of

Marine Geology

Haibo Zou

Auburn University

2020–2022

Cinzia Cervato

Iowa State University

Bradley D. Cramer

University of Iowa

Marcin Dabrowski

Polish Geological Institute

Emmanuel Gabet

San Jose State University

Bernhard Grasemann

University of Vienna

Jacqueline Halpin

University of Tasmania

Shan Li

Chinese Academy of Geological

Sciences

Massimo Mattei

University Roma TRE

Troy Rasbury

SUNY Stony Brook

Eric M. Roberts

James Cook University

Ross Secord

University of Nebraska–Lincoln

Michael Elliot Smith

Northern Arizona University

Richard B. Waitt

U.S. Geological Survey

Lu Wang

China University of Geosciences,

Wuhan

2021–2023

Jean H. Bédard

Geological Survey of Canada

Kathryn Cutts

Rio de Janeiro State University

Peter Eichhubl

University of Texas–Austin

Emily Finzel

University of Iowa

Stacia Gordon

University of Nevada, Reno

John Jansen

Czech Academy of Sciences

Zheng-Xiang Li

Curtin University

David Macdonald

British Geological Survey

Stefano Mazzoli

University of Naples 'Federico II'

Michael Ort

Northern Arizona University

Brian Pratt

University of Saskatchewan

Wolf Uwe Reimold

University of Brasília

Nancy Riggs

Northern Arizona University

Enrico Tavarnelli

Università di Siena

Cees R. van Staal

Geological Survey of Canada

ON THE COVER

Cover: A large NE-directed thrust fault exposed in the Neoproterozoic low-grade metasedimentary rocks near the Dalian City, NE China. See "Triassic–Jurassic evolution of the eastern North China Craton: Insights from the Lushun-Dalian area, South Liaodong Peninsula, NE China" by Ren et al., p. 393–408.

Photo by: Zhiheng Ren.