


 The logo for Geosphere, featuring the word "Geosphere" in a bold, red, sans-serif font with a black shadow effect, set against a circular background of a red and black textured map of the Earth.


 The logo for The Geological Society of America, consisting of a stylized green and purple wave-like shape to the left of the text "THE GEOLOGICAL SOCIETY OF AMERICA" in a purple, serif font.

THE GEOLOGICAL SOCIETY
OF AMERICA®

ACTIVE MARGINS IN TRANSITION— MAGMATISM AND TECTONICS THROUGH TIME: AN ISSUE IN HONOR OF ARTHUR W. SNOKE THEMED ISSUE

647 Thermochronology of extensional orogenic collapse in the deepcrust of Zealandia

Joshua J. Schwartz, Harold H. Stowell,
Keith A. Klepeis, Andy J. Tulloch,
Andrew R.C. Kylander-Clark,
Bradley R. Hacker, and Matthew A. Coble

GEOHERMAL ENERGY FROM SEDIMENTARY BASINS: CHALLENGES, POTENTIAL, AND WAYS FORWARD THEMED ISSUE

678 Multifluid geo-energy systems: Using geologic CO₂ storage for geothermal energy production and grid-scale energy storage in sedimentary basins

Thomas A. Buscheck, Jeffrey M. Bielicki,
Thomas A. Edmunds, Yue Hao, Yunwei Sun,
Jimmy B. Randolph, and Martin O. Saar

ANATOMY OF RIFTING: TECTONICS AND MAGMATISM IN CONTINENTAL RIFTS, OCEANIC SPREADING CENTERS, AND TRANSFORMS THEMED ISSUE

697 Four-dimensional surface evolution of active rifting from spaceborne SAR data

Francesco Casu and Andrea Manconi

706 Volcanic field elongation, vent distribution, and tectonic evolution of a continental rift: The Main Ethiopian Rift example

Francesco Mazzarini, Nicolas Le Corvec,
Ilaria Isola, and Massimiliano Favalli

CREVOLUTION 2: ORIGIN AND EVOLUTION OF THE COLORADO RIVER SYSTEM II THEMED ISSUE

721 Paleogeographic implications of late Miocene lacustrine and nonmarine evaporite deposits in the Lake Mead region: Immediate precursors to the Colorado River

James E. Faulds, B. Charlotte Schreiber,
Victoria E. Langenheim, Nicholas H. Hinz,
Thomas H. Shaw, Matthew T. Heizler,
Michael E. Perkins, Mohamed El Tabakh,
and Michael J. Kunk

768 Reevaluation of the Crooked Ridge River— Early Pleistocene (ca. 2 Ma) age and origin of the White Mesa alluvium, northeastern Arizona

Richard Hereford, L. Sue Beard,
William R. Dickinson, Karl E. Karlstrom,
Matthew T. Heizler, Laura J. Crossey,
Lee Amoroso, P. Kyle House, and Mark Pecha

ORIGIN AND EVOLUTION OF THE SIERRA NEVADA AND WALKER LANE THEMED ISSUE

790 Implications for the structure of the Hat Creek fault and transfer of right-lateral shear from the Walker Lane north of Lassen Peak, northern California, from gravity and magnetic data

V.E. Langenheim, R.C. Jachens,
L.J.P. Muffler, and M.A. Clynnne

Current Issue Articles

809 Lateral magma flow in mafic sill complexes

Craig Magee, James D. Muirhead,
Alex Karvelas, Simon P. Holford,
Christopher A.L. Jackson, Ian D. Bastow,
Nick Schofield, Carl T.E. Stevenson,
Charlotte McLean, William McCarthy,
and Olga Shtukert

842 Three-dimensional magma flow dynamics within subvolcanic sheet intrusions

C. Magee, B. O'Driscoll, M.S. Petronis, and
C.T.E. Stevenson

867 How diking affects the tectonomagmatic evolution of slow spreading plate boundaries: Overview and model

Valerio Acocella and Daniele Trippanera

884 Cenozoic tilting history of the south slope of the Altyn Tagh as revealed by seismic profiling: Implications for the kinematics of the Altyn Tagh fault bounding the northern margin of the Tibetan Plateau

Haifeng Zhao, Yanyan Wei, Ya Shen,
Ancheng Xiao, Liguang Mao, Liqun Wang,
Junya Guan, and Lei Wu

900 Linking deep and shallow crustal processes during regional transtension in an exhumed continental arc, North Cascades, northwestern Cordillera (USA)

Robert B. Miller, Stacia M. Gordon,
Samuel Bowring, Brigid Doran,
Noah McLean, Zachary Michels,
Erin Shea, and Donna L. Whitney

925 Carboniferous basin in Holm Land records local exhumation of the North-East Greenland Caledonides: Implications for the detrital zircon signature of a collisional orogen

William C. McClelland, Jane A. Gilotti,
Thejashwini Ramarao, Lars Stemmerik,
and Finn Dalhoff

GEOSPHERE is an online-only journal that targets an international audience and publishes high-quality research results from all fields of the geosciences. It particularly seeks papers that take advantage of the electronic format.



Geosphere

(continued)

- 948 Age and anatomy of the Gongga Shan batholith, eastern Tibetan Plateau, and its relationship to the active Xianshui-he fault**

Michael P. Searle, Nick M.W. Roberts, Sun-Lin Chung, Yuan-Hsi Lee, Kristen L. Cook, John R. Elliott, Owen M. Weller, Marc R. St-Onge, Xi-Wei Xu, Xi-Bin Tan, and Kang Li

- 971 The Point Sal–Point Piedras Blancas correlation and the problem of slip on the San Gregorio–Hosgri fault, central California Coast Ranges**

Joseph P. Colgan and Richard G. Stanley

- 985 Mid-crustal deformation of the Annapurna-Dhaulagiri Himalaya, central Nepal: An atypical example of channel flow during the Himalayan orogeny**

A.J. Parsons, R.J. Phillips, G.E. Lloyd, R.D. Law, M.P. Searle, and R.D. Walshaw

- 1016 Detrital zircon U-Pb geochronology and Hf isotope geochemistry of the Roberts Mountains allochthon: New insights into the early Paleozoic tectonics of western North America**

Gwen M. Linde, James H. Trexler, Jr., Patricia H. Cashman, George Gehrels, and William R. Dickinson

- 1032 Southeastern Atlantic deep-water evolution during the late-middle Eocene to earliest Oligocene (Ocean Drilling Program Site 1263 and Deep Sea Drilling Project Site 366)**

Samantha J. Langton, Nathan M. Rabideaux, Chiara Borrelli, and Miriam E. Katz

REPLY

- 1048 Rates of river incision and scarp retreat in eastern and central Grand Canyon over the past half million years: Evidence for passage of a transient knickzone**

Lon D. Abbott, Craig Lundstrom, and Chance Traub

GEOSPHERE (ISSN 1553-040X) is published bi-monthly 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.

Copyright © 2016, 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 Geosphere, ISSN 1553-040X. 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 online journal Geosphere, [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, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

SUBSCRIPTIONS for 2016 calendar year. GSA Members and Fellows: \$35. GSA Student, K-12 Teacher, and Early Career Professional Members: cost is included in membership. Nonmembers and institutions: \$255. For more details on subscription choices, formats, and pricing, visit www.geosociety.org/pubs/. For member and nonmember orders, call GSA Sales & Service at +1.888.443.4472 or +1.303.357.1000, or e-mail gsaservice@geosociety.org.

GSA ONLINE

Organization home page: www.geosociety.org
 Journals and books: www.gsapubs.org
 Manuscript submission:
www.editorialmanager.com/geosphere/



SCIENCE EDITORS

Shanaka de Silva
 Oregon State University
geosphere@geo.oregonstate.edu
 +1-541-737-1212

Raymond M. Russo
 University of Florida
rmrusso2010@gmail.com
 +1-352-392-6766

GEOSPHERE STAFF

Director of Publications:
 Jeanette Hammann

Editorial: Gina Harlow;
geosphere@geosociety.org

Production: Eric Christensen

GSA OFFICERS

Executive Director: Vicki S. McConnell
President: Jonathan G. Price
Vice President: Claudia I. Mora
Past President: Harry (Hap) McSween
Treasurer: Bruce R. Clark

COMMITTEE ON PUBLICATIONS

Julia A. Baldwin
 John J. Clague
 Richard A. Davis
 Shanaka de Silva
 David E. Fastovsky
 John M. Holbrook
 Matt Hudson
 Craig H. Jones
 Brian G. Katz
 Joanne V. Lerud-Heck
 J. Brendan Murphy
 David Schofield
 Jennifer A. Thomson
 Arlo B. Weil
 Steven J. Whitmeyer

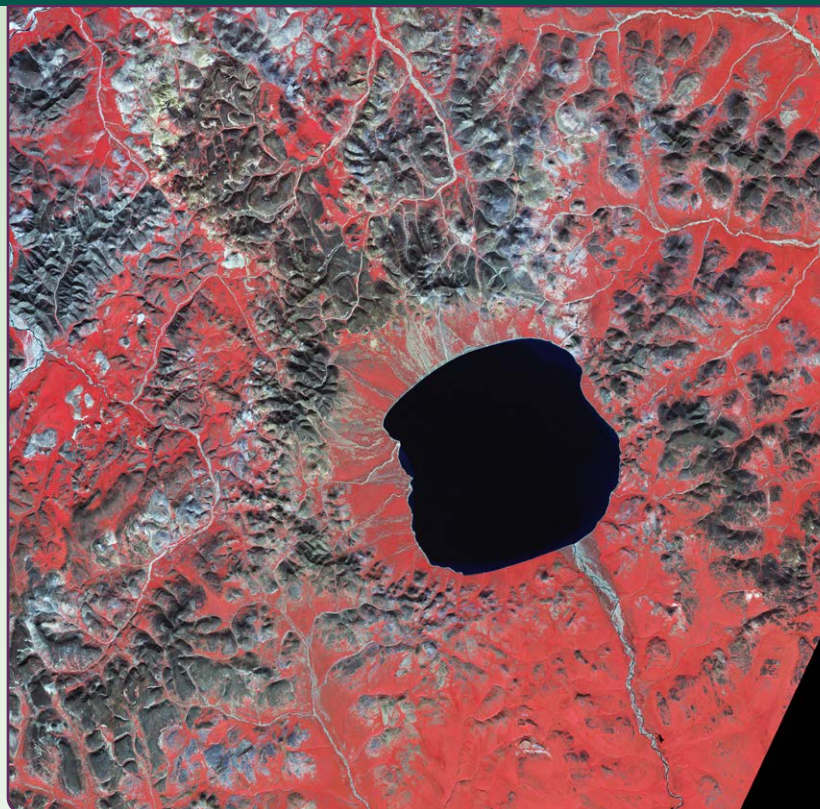
COUNCIL

2012–2016: Isabel P. Montanez
 William W. Simpkins
 Marilyn J. Suiter

2013–2017: Elizabeth J. Catlos
 John J. Clague
 Neil Fishman

2014–2018: Timothy J. Bralower
 Anke Friedrich
 Stephen G. Pollock

2015–2019: Christopher (Chuck) M. Bailey
 Mary J. Kraus
 Frank J. Pazzaglia



At center is Lake El'gygytyn within an impact crater (15 km across) in eastern Russia. False-color image captured 18 August 2008.

Credit: NASA image created by Jesse Allen, using data from NASA/GSFC/METI/ERSDAC/JAROS, and the U.S./Japan ASTER Science Team.

GEOSPHERE BOARD OF ASSOCIATE EDITORS

Valerio Acocella
 Università Roma Tre

Colin Amos
 Western Washington University

Clare E. Bond
 University of Aberdeen

Cinzia Cervato
 Iowa State University

Michael J. Cheadle
 University of Wyoming

Fred Day-Lewis
 U.S. Geological Survey

Rhawn Dennison
 Cornell College

Rita Economos
 University of California, Los Angeles

Susan Eriksson
 Eriksson Associates,
 Boulder, Colorado

G. Lang Farmer
 University of Colorado

Andrew M. Goodliffe
 University of Alabama

Jose M. Hurtado
 University of Texas at El Paso

Giampiero Iaffaldano
 The Australian National University

Pamela E. Jansma
 University of Texas at Arlington

Craig H. Jones
 University of Colorado

Richard R. Jones
 University of Durham

Todd LaMaskin
 University of North Carolina
 at Wilmington

Jeff Lee
 Central Washington University

Jan Marie Lindsay
 The University of Auckland

Gianreto Manatschal
 Institute Physique du Globe/Ecole et
 Observatoire des Sciences de la Terre/
 University of Strasbourg – CNRS

Brian D. Marshall
 U.S. Geological Survey

Francesco Mazzarini
 Istituto Nazionale di Geofisica
 e Vulcanologia

Brandon McElroy
 University of Wyoming

Roberto Stanley Molina-Garza
 Universidad Nacional Autónoma
 de México

Terry L. Pavlis
 University of Texas at El Paso

Eric J. Pyle
 James Madison University

Anthony E. Rathburn
 Indiana State University

Julie Roberge
 ESIA-Ticomán, Instituto
 Politécnico Nacional

Steven C. Semken
 Arizona State University

Michael H. Taylor
 University of Kansas

Barbara J. Tewksbury
 Hamilton College

Alan Whittington
 University of Missouri

Michael L. Williams
 University of Massachusetts

Lesli Wood
 University of Texas at Austin

Huaiyu Yuan
 Macquarie University