

Elements

An International Magazine of Mineralogy, Geochemistry, and Petrology



Elements is published jointly by the Mineralogical Society of America, the Mineralogical Society of Great Britain and Ireland, the Mineralogical Association of Canada, the Geochemical Society, The Clay Minerals Society, the European Association of Geochemistry, the International Association of GeoChemistry, the Société Française de Minéralogie et de Cristallographie, the Association of Applied Geochemists, the Deutsche Mineralogische Gesellschaft, the Società Italiana di Mineralogia e Petrologia, the International Association of Geoanalysts, the Polskie Towarzystwo Mineralogiczne (Mineralogical Society of Poland), the Sociedad Española de Mineralogía, the Swiss Society of Mineralogy and Petrology, the Meteoritical Society, the Japan Association of Mineralogical Sciences, and the International Association on the Genesis of Ore Deposits. It is provided as a benefit to members of these societies.

Elements is published six times a year. Individuals are encouraged to join any one of the participating societies to receive Elements. Institutional subscribers to any of the following journals—*American Mineralogist*, *Clay Minerals*, *Mineralogical Magazine*, and *The Canadian Mineralogist*—also receive one copy of Elements as part of their 2019 subscription. Institutional subscriptions are available for US\$165 (US\$180 non-US addresses) a year in 2019. Contact the executive editor (jrosso.elements@gmail.com) for information.

Copyright 2019 by the Mineralogical Society of America.

All rights reserved. Reproduction in any form, including translation to other languages, or by any means—graphic, electronic, or mechanical, including photocopying or information storage and retrieval systems—without written permission from the copyright holder is strictly prohibited.

Publications mail agreement no. 40037944

Printed in USA

ISSN 1811-5209 (print)

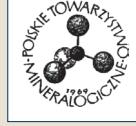
ISSN 1811-5217 (online)

elementsmagazine.org

pubs.geoscienceworld.org/elements

GeoScienceWorld

Participating Publisher



Volume 15, Number 5 • October 2019

CREDIT: DEEP CARBON OBSERVATORY/ALAMY

Catastrophic Perturbations to Earth's Deep Carbon Cycle

Guest Editors: Celina A. Suarez, Marie Edmonds, and Adrian P. Jones



Earth Catastrophes and their Impact on the Carbon Cycle

Celina A. Suarez, Marie Edmonds, and Adrian P. Jones



On the Origin(s) and Evolution of Earth's Carbon

Sami Mikhail and Evelyn Füri



The Influence of Large Bolide Impacts on Earth's Carbon Cycle

Balz S. Kamber and Joseph A. Petrus



Deep Carbon and the Life Cycle of Large Igneous Provinces

Benjamin A. Black and Sally A. Gibson



Earth's Outgassing and Climatic Transitions: The Slow Burn Towards Environmental "Catastrophes"?

N. Ryan McKenzie and Hehe Jiang



Interpreting the Carbon Isotope Record of Mass Extinctions

Martin Schobben, Bas van de Schootbrugge, and Paul B. Wignall

DEPARTMENTS

Editorial – Celebration of the Periodic Table	295
From the Editors	296
Meet the Authors	298
Society News	
Deutsche Mineralogische Gesellschaft	339
Mineralogical Association of Canada	340
European Mineralogical Union	341
Mineralogical Society of Great Britain and Ireland	342
Italian Society of Mineralogy and Petrology	344
Association of Applied Geochemists	346
Association Internationale pour l'Étude des Argiles	347
Japan Association of Mineralogical Sciences	348
Mineralogical Society of Poland	349
Meteoritical Society	350
Clay Minerals Society	352
Société Française de Minéralogie et de Cristallographie	353
Mineralogical Society of America	354
Geochemical Society	356
European Association of Geochemistry	357
Meeting Report – Goldschmidt 2020	358
CosmoElements – Exploring the Moon in the 21 st Century ..	360
Calendar	363
Advertisers in this issue	363