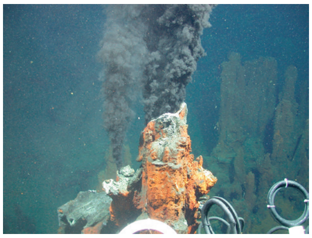
THEMATIC TOPICS IN 2020

Volume 16, Number 1 (February)

ABIOTIC HYDROGEN AND HYDROCARBONS IN PLANETARY LITHOSPHERES

GUEST EDITORS: **Laurent Truche** (Université Grenoble Alpes, ISTerre, France), **Thomas M. McCollom** (University of Colorado, Boulder, USA) and **Isabelle Martinez** (IPGP, France)



Molecular hydrogen (H_2), methane, and hydrocarbons with an apparent abiotic origin have been observed in a variety of geologic settings, including serpentinized ultramafic rocks, submarine hydrothermal vents, and deep fractures within ancient cratons. Recent discoveries have reported the presence of hydrogen emanating from the icy crust of Saturn's moon Enceladus, and methane in the atmosphere of Mars. Owing in large part to the utilization of hydrogen and methane by chemosynthetic biological communities on Earth (and maybe other planetary bodies), geologic production of these compounds has become the subject of intense scientific study. Geologically produced hydrogen and methane are also of interest as possible energy resources. This issue will highlight recent developments in the understanding of geologic sources of hydrogen and methane, the biological utilization of these compounds, and the potential for human exploitation of these resources.

- **Hydrogen and Abiotic Hydrocarbons: Molecules that Change the World** Laurent Truche (Université Grenoble Alpes, ISTerre, France), Thomas M. McCollom (University of Colorado, Boulder, USA), and Isabelle Martinez (IPGP, France)
- **Abiotic Sources of Molecular Hydrogen on Earth** Frieder Klein (Woods Hole Oceanographic Institution, USA), Jesse D. Tarnas (Brown University, USA), and Wolfgang Bach (University of Bremen, Germany)
- **Behavior of Hydrogen in Aqueous Fluids Under High Temperature and Pressure** Elena Bazarkina (Néel Institut, CNRS, France), I-Ming Chou (Institute of Deep-Sea Science and Engineering, China), Alexander F. Goncharov (Carnegie Institution of Washington, USA), and Nikolay N. Akinfiev (Moscow State Geological Prospecting University, Russia)
- **Abiotic Synthesis of Methane and Organic Compounds in Earth's Lithosphere** Eoghan P. Reeves (University of Bergen, Norway) and Jens Fiebig (Universität Frankfurt, Germany)
- **Geologic Hydrogen and Methane as Fuel for Life** Bénédicte Ménez (IPGP, France)
- **Hydrogen, Hydrocarbons, and Habitability Across the Solar System** Christopher R. Glein (Southwest Research Institute, USA) and Mikhail Yu. Zolotov (Arizona State University, USA)
- **Perspective Article: New Perspectives in the Industrial Exploration of Native Hydrogen** Eric C. Gaucher (Total S.A., France)

Volume 16, Number 2 (April)

RAMAN SPECTROSCOPY IN THE EARTH AND PLANETARY SCIENCES

GUEST EDITORS: **Jill D. Pasteris** (Washington University in Saint Louis, USA) and **Olivier Beyssac** (CNRS-Sorbonne University Paris, France)

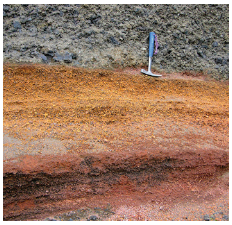
The application of Raman (microprobe) spectroscopy in the geosciences has rapidly broadened and deepened over the past 40 years. This has been sparked by both improvements in technology and recognition of the quantitative, as well as qualitative, capabilities of the technique. Raman spectroscopy claims relative ease of use; is typically nondestructive at the (sub-)micrometer scale; has the ability to analyze solids, liquids, and gases; can differentiate polymorphs; and can enlarge the available spectral databases for minerals. Geoscientists can create Raman maps/images based on selected spectral features, which simultaneously capture chemical–structural and microtextural information. In a single sample, one may investigate quantitatively the P–T path history during metamorphism, determine the composition and internal pressure of mixed volatiles in micrometer-size fluid inclusions, study the strain pattern or radiation damage in minerals, and/or target possible biosignatures.

- **Welcome to Raman Spectroscopy: Successes, Challenges, and Pitfalls** Jill D. Pasteris (Washington University in Saint Louis, USA) and Olivier Beyssac (CNRS-Sorbonne University Paris, France)
- **Micro-scale Chemistry: Raman Analysis of Fluid and Melt Inclusions** Robert J. Bodnar (Virginia Tech, USA) and Maria Luce Frezzotti (University of Milan–Bicocca, Italy)
- **Applications of Raman Spectroscopy in Mineralogy and Geochemistry** Lutz Nasdala (University of Vienna, Austria) and Christian Schmidt (GFZ German Research Centre for Geosciences, Potsdam, Germany)
- **Applications of Raman Spectroscopy in Metamorphic Petrology and Tectonics** Andrey V. Korsakov (Sobolev Institute of Geology and Mineralogy, Russia), Matthew J. Kohn (Boise State University, USA) and Maria Perraki (Technical University of Athens, Greece)
- **Geoscience Meets Biology: Raman Spectroscopy in Geobiology and Biomineralization** Andrew Steele (Carnegie Institution of Washington, USA), Marc D. Fries (NASA Johnson Space Center, USA) and Jill D. Pasteris (Washington University in Saint Louis, USA)
- **New Trends in Raman Spectroscopy: From High-Resolution Geochemistry to Planetary Exploration** Olivier Beyssac (CNRS-Sorbonne University Paris, France)

Volume 16, Number 3 (June)

THE REDOX ENGINE OF EARTH

GUEST EDITORS: **Roberto Moretti** (IPGP, Guadeloupe), **M. Rita Cicconi** (IPGP, France) and **Daniel R. Neuville** (IPGP, France)



The redox state is one of the master variables that drove the formation of the Earth and that now also controls life processes. From the dawn of geochemistry, a knowledge of redox states has been essential to understanding the compositional makeup of our planet and the fundamental processes that occur in any natural chemical system, from the core to the atmosphere, from magmatic systems to aquatic systems. The social and economic impact of redox geochemistry is enormous because of the control it plays on metal mobility, solubility, metal availability and any associated complexing ligands, and the widespread use of redox indicators for environmental hazard assessment. This issue of Elements will illustrate how understanding redox processes can help us to understand much of Earth's activity.

- **Introduction: Earth's Electrodes** M. Rita Cicconi (IPGP, France), Roberto Moretti (IPGP, Guadeloupe), and Daniel R. Neuville (IPGP, France)
- **Redox Processes in Early Earth Accretion and in Terrestrial Bodies** Kevin Righter (NASA Johnson Space Center, USA), Christopher D. Herd (University of Alberta, Canada), and Asmaa Boujibar (Carnegie Institution for Science, Washington DC, USA)
- **The Redox Boundaries of Earth's Interiors** Yingwei Fei (Carnegie Institution for Science, Washington DC, USA) and Vincenzo Stagno (Sapienza Università di Rome, Italy)
- **Magma, the Largest Repository and Carrier of Earth's Redox Processes** M. Rita Cicconi (IPGP, France), Charles Le Losq (Australian National University, Australia), Roberto Moretti (IPGP, Guadeloupe), and Daniel R. Neuville (IPGP, France).

- **Volcanic and Hydrothermal Redox Engines** Roberto Moretti (IPGP, Guadeloupe)
- **Electron Transfer Drives Metal Cycling in the Critical Zone** Mélanie Davranche (Université de Rennes 1, CNRS, France), Marc F. Benedetti (IPGP, France), and Alexandre Gélabert (IPGP, France)
- **Biogeochemical Controls on the Redox Evolution of Earth's Oceans and Atmosphere** Christofer T. Reinhard (Georgia Institute of Technology, USA) and Noah J. Planavsky (Yale University, USA)

Volume 16, Number 4 (August)

LITHIUM: LESS IS MORE

Guest Editors: **Robert J. Bowell** (SRK Consulting Ltd., UK), **Philip A.E. Pogge von Strandmann** (University College London and Birkbeck, University of London, UK) and **Edward S. Grew** (University of Maine, USA)

Lithium is concentrated in Earth's upper continental crust and is an essential constituent of 122 mineral species with the greatest mineralogical diversity found in pegmatites. Lithium occurs naturally in two isotopes, ^{6}Li and ^{7}Li, which are readily fractionated, thus becoming sensitive to geological and environmental processes. Closed-basin brines (58%) and pegmatites plus related granites (26%) constitute the main sources of exploitable lithium worldwide. Rechargeable batteries that take advantage of lithium's light weight and high electrochemical potential offer the greatest potential benefit to the most people. Lithium compounds are also used to control bipolar disorder. In a word, life as we know it at the start of the 21st century would not be possible without lithium.

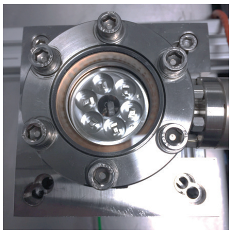
- **The Minerals of Lithium, a Quintessential Crustal Element** Edward S. Grew (University of Maine, USA)
- **The Cosmic Lithium Story** Katharina Lodders (Washington University in Saint Louis, USA)
- **Is it Time for Lithium Isotopes?** Horst R. Marschall (Goethe Universität Frankfurt am Main, Germany) and Ming Tang (Rice University, USA)
- **Lithium and Lithium Isotopes in Earth Surface Cycles** Philip A.E. Pogge von Strandmann (University College London and Birkbeck, University of London, UK), Simone A. Kasemann (University of Bremen, Germany) and Josh Wimpenny (Lawrence Livermore National Laboratory)
- **Natural Resources: Where Do We Find Lithium at Economic Potential?** Robert J. Bowell (SRK Consulting Ltd., UK), Julien Declercq (SRK Consulting Ltd., UK), and Camilo de los Hoyos (SRK Consulting S.A., Argentina)
- **Lithium in Society** Thomas Bibienne (Nemaska Lithium Inc., Canada), Jean-François Magnan (Nemaska Lithium Inc., Canada), and Alexander Benedikt Ansgar Rupp (German Heart Centre Munich, Institute of Laboratory Medicine, Germany)

Volume 16, Number 5 (October)

NOBLE GAS THERMOCHRONOLOGY

Guest Editors: **Marissa M. Tremblay** (Purdue University, USA), **Emily H. G. Cooperdock** (University of Southern California, USA), and **Peter K. Zeitler** (Lehigh University, USA)

Noble-gas thermochronology takes advantage of the time-dependent production of noble gases and the thermally activated diffusion of these gases to constrain the temperature histories of minerals found in crustal rocks. Thermochronology has become widely used to address research questions across Earth and planetary science. These questions include when and how valleys are cut by glaciers; from where sediment is sourced; what thermal conditions occur on fault planes during slip; and how the surfaces of planetary bodies evolve on billion-year timescales. This issue will highlight how noble-gas thermochronology can be used to address questions like these, as well as what new avenues of research noble-gas thermochronology could be used for in the future.



- **The Thermal History of Rocks as Recorded by Noble Gases** Peter K. Zeitler (Lehigh University, USA) and Cecile Gautheron (Université Paris Sud, France)
- **Detrital Thermochronology: Recorder of the Earth's Dynamic Past** Daniel F. Stockli (University of Texas at Austin, USA) and Yani M. R. Najman (Lancaster University, UK; University of Colorado, Boulder, USA)
- **Faults, Fluids, and Heat: New Insights from Fe-Oxide (U–Th/He) Thermochronology** Emily H. G. Cooperdock (University of Southern California, USA) and Alexis K. Ault (Utah State University, USA)
- **Vestiges of Deep Time: Noble-Gas Thermochronology of Ancient Rocks** Kalin T. McDannell (Geological Survey of Canada, Canada) and Rebecca M. Flowers (University of Colorado, Boulder, USA)
- **Noble-Gas Thermochronology of Extraterrestrial Materials** Marissa M. Tremblay (Purdue University, USA) and William S. Cassata (Lawrence Livermore National Laboratory, USA)
- **Lazed and Diffused: Untangling Noble-Gas Thermochronology Data** Matthew Fox (University College London, UK) and David L. Shuster (University of California, Berkeley, USA)

Volume 16, Number 6 (December)

HYDROTHERMAL FLUIDS

Guest Editors: **Matthew Steele-MacInnis** (University of Alberta, Canada) and **Craig E. Manning** (University of California, Los Angeles, USA)

Fluids are one of the principal agents of heat and mass transfer in the Earth. This thematic issue will explore the physical and chemical properties of hydrothermal fluids and how they affect geologic processes. The issue will discuss our current understanding of the nature of hydrothermal fluids across a range of geologic settings; interactions between fluids and rocks; and the interrelationships between fluid-driven processes in different settings. Each chapter will highlight both broad and specific overlaps between "normal" and ore-forming hydrothermal fluids, and describe how the features of hydrothermal systems reflect the specific properties of the fluids in each setting.

- **Hydrothermal Properties of Geologic Fluids** Matthew Steele-MacInnis (University of Alberta, Canada) and Craig E. Manning (University of California, Los Angeles, USA)
- **Crustal Metamorphic Fluids** Katy A. Evans (Curtin University, Australia) and Andrew G. Tomkins (Monash University, Australia)
- **Fluids in Submarine Hydrothermal Settings** Esther M. Schwarzenbach (Freie Universität Berlin, Germany) and Matthew Steele-MacInnis (University of Alberta, Canada)
- **Fluids in Subduction Zones and the Upper Mantle** Craig E. Manning (University of California, Los Angeles, USA) and Maria-Luce Frezzotti (Università degli Studi di Milano, Italy)
- **Magmatic-Hydrothermal Fluids** Andreas Audétat (Universität Bayreuth, Germany) and Marie Edmonds (University of Cambridge, UK)
- **Geothermal Fluids** Isabelle Chambefort (GNS Science, New Zealand) and Andri Stefansson (University of Iceland, Iceland)