THEMATIC TOPICS IN 2011

Volume 7, Number 1 (February)

COSMOCHEMISTRY

Guest Editor: **Dante S. Lauretta** (University of Arizona)

The Cat's Eye planetary nebula. Courtesy of J.P. Harrington and K.J. Borkowski (University of Maryland) and NASA

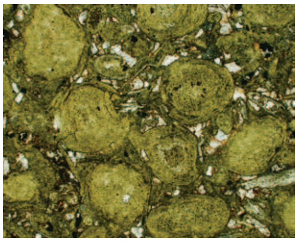
Cosmochemistry is the study of extraterrestrial materials aimed at understanding the nature of Solar System bodies, including the planets, their natural satellites, and small bodies. An important goal is to increase our understanding of the chemical origin of the Solar System and the processes by which its planets and small bodies have evolved to their present states. Research in cosmochemistry covers a wide range of disciplines and techniques, including mineralogy, petrology, major and trace element chemistry, isotope compositions, radiometric ages, magnetism, and radiation-exposure effects. These studies provide a wealth of data about the processes of stellar evolution, planetary system formation, alteration in asteroidal and cometary interiors, and the accretion history of the Earth, including the origin of Earth's volatile and organic material.

- **A cosmochemical view of the Solar System**
  Dante S. Lauretta
- **Presolar history recorded in extraterrestrial materials**
  Ann Nguyen (Johnson Space Center) and Scott Messenger (ESCG/Jacobs Technology)
- **The asteroid–comet continuum: In search of lost primitivity**
  Matthieu Gounelle (Museum National d'Histoire Naturelle, Paris)
- **Organic chemistry of carbonaceous meteorites**
  Zita Martins (Imperial College London)
- **Stable isotope cosmochemistry**
  Douglas Rumble (Geophysical Laboratory), Ed Young (UCLA), Anat Shahar (Geophysical Laboratory), and Weifu Guo (Geophysical Laboratory)
- **Chronometry of meteorites and the formation of Earth and Moon**
  Thorsten Kleine (Westfalische Wilhelms-Universität Münster) and John F. Rudge (University of Cambridge)

Volume 7, Number 2 (April)

IRON IN EARTH SURFACE SYSTEMS

Guest Editors: **Kevin G. Taylor** (Manchester Metropolitan University) and **Kurt O. Konhauser** (University of Alberta)



Thin section photomicrograph of a marine oolitic ironstone (Jurassic, eastern England), composed of the green Fe-silicate mineral berthierine, a characteristic mineral that forms under conditions of suboxic diagenesis dominated by iron reduction

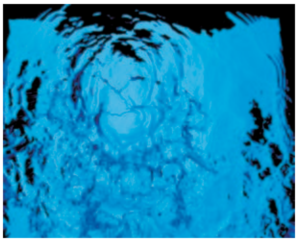
Iron is the fourth most abundant element at the Earth's surface. As an essential nutrient and electron source/sink for the growth of microbial organisms, it is metabolically cycled between reduced and oxidized chemical forms. This flow of electrons is invariably tied to the reaction with other redox-sensitive elements, including oxygen, carbon, nitrogen, and sulfur. The end result of these interactions is that iron is intimately involved in the geochemistry, mineralogy, and petrology of modern aquatic systems and their associated sediments, particulates, and pore waters. In the geological past, vast iron sediments, the so-called banded iron formations, suggest that iron played an even greater role in marine geochemistry, and these deposits are now being used as proxies for understanding the chemical composition of the ancient oceans and atmosphere. This issue will explore not only the modern expression of iron cycling but also its record in Earth's history.

- **Iron in Earth surface systems: A major player in chemical and biological processes**
  Kevin G. Taylor and Kurt O. Konhauser
- **Iron transport from the continents to the open ocean: The ageing–rejuvenation cycle**
  Robert R. Raiswell (University of Leeds)
- **Iron in microbial metabolisms**
  Kurt O. Konhauser, Andreas Kappler (University of Tübingen), and Eric E. Roden (University of Wisconsin–Madison)
- **Ferruginous oceanic conditions: A dominant feature of the ocean through Earth's history**
  Simon W. Poulton (Newcastle University) and Donald E. Canfield (University of Southern Denmark)
- **Geomicrobiology of iron in extreme environments**
  Alexis Templeton (University of Colorado)
- **Iron in marine sediments: Minerals as records of chemical environments**
  Kevin G. Taylor and Joe H. S. Macquaker (Memorial University of Newfoundland)

Volume 7, Number 3 (June)

GLOBAL WATER SUSTAINABILITY

Guest Editors: **Janet Hering** (Eawag), **Chen Zhu** (Indiana University), and **Eric H. Oelkers** (CNRS, Toulouse)



H_2O Autograph Series
© DigitalVision Ltd.
All rights reserved

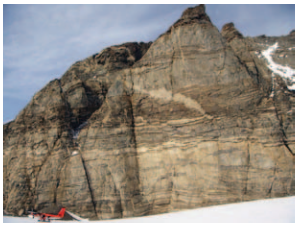
The term *water resources* refers to natural waters (vapor, liquid, or solid) that occur on the Earth and that are of potential use to humans. These resources include oceans, rivers, lakes, groundwater, and glaciers. The Earth has plenty of water, over 1.4×10^9 km^3. However, 97% of global water is saline seawater. Of the 3% that is freshwater, nearly 70% is locked in the polar icecaps and glaciers. The majority of nonglacier freshwater is groundwater (98%). Surface freshwater (rivers and lakes), which has historically served most human needs, constitutes only a small fraction of the Earth's water resources. Water interacts with minerals, soils, sediments, and rocks, and hence studies of Earth materials have a direct bearing on water resources. Studies of the acquisition, mobility, and fate of elements and isotopes in water provide valuable signatures for tracking water cycles at regional and global scales and are essential for the development of remediation technologies for contaminated water.

- **Societal needs for water and our dependence and influence on water**
  Eric H. Oelkers, Janet Hering, and Chen Zhu
- **Millennium Development Goals for water supply and sanitation: Geochemical aspects of water quality and treatment**
  Richard Johnston, Michael Berg, Annette Johnson, Elizabeth Tilley, and Janet Hering (Eawag)
- **Groundwater as a critical yet vulnerable resource**
  Frank W. Schwartz and Motomu Ibaraki (Ohio State University)
- **Hydrogeochemical processes and water resource management**
  Chen Zhu and Frank W. Schwartz (Ohio State University)
- **Management of water produced in oil and gas production**
  Kelvin B. Gregory and David Dzombak (Carnegie Mellon University)
- **Water conservation, efficiency, and reuse**
  Henry Vaux (University of California–Riverside)

Volume 7, Number 4 (August)

WHEN THE CONTINENTAL CRUST MELTS

Guest Editors: **Edward W. Sawyer** (Université du Québec à Chicoutimi), **Michael Brown** (University of Maryland), and **Bernardo Cesare** (University of Padova)



Interlayered orthogneiss (close to top, lighter grey) and migmatitic paragneiss (top, middle, and bottom, darker brown-grey) intruded by sills of granite (close to bottom, light beige) which together comprise the Fosdick migmatite–granite complex of West Antarctica (Photo Christine Siddoway, Colorado College)

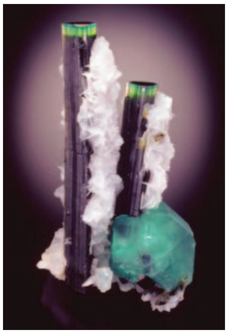
Partial melting is the most important process affecting the continental crust. It is responsible for the large-scale compositional and density structure that has stabilized the crust over geological time. Partial melting occurs extensively in the deep crustal roots of mountain ranges that form where continents collide. The thin film of melt that develops on the edges and faces of mineral grains results in a substantial weakening of the crust, which concentrates deformation into the melt-bearing rocks and allows them to deform faster. This issue of *Elements* deals with the source of the heat responsible for widespread melting and the information that can be retrieved from mineral assemblages and microstructures in lower crustal rocks. It also explores the mechanisms of melt transfer and the large-scale geodynamic consequences of melting the crust as it deforms.

- **When the continental crust melts**
  Edward W. Sawyer, Michael Brown, and Bernardo Cesare
- **How does the crust get really hot?**
  Christopher Clark (Curtin University), David Healy (University of Aberdeen), Simon Harley (Edinburgh University), and Ian Fitzsimons (Curtin University)
- **Reconciling melting experiments with thermodynamic calculations**
  Richard White (University of Mainz), Gary Stevens (University of Stellenbosch), and Tim Johnson (University of Mainz)
- **Melted rocks under the microscope: Microstructures and their interpretation**
  Marian Holness (University of Cambridge), Bernardo Cesare, and Edward W. Sawyer
- **Crustal melting and the flow of mountains**
  Rebecca Jamieson (Dalhousie University), M. Unsworth (University of Cambridge), Nigel Harris (Open University), Claudio Rosenberg (Free University of Berlin), and Karel Schulmann (Strasbourg University)
- **Organizing melt in the crust: From granulite and migmatite to granite**
  Michael Brown, Fawna Korhonen (Curtin University), and Christine Siddoway (Colorado College)

Volume 7, Number 5 (October)

TOURMALINE: FROM GEMSTONE TO GEOCHEMICAL INDICATOR

Guest Editors: **Darrell J. Henry** and **Barbara L. Dutrow** (Louisiana State University)



Elbaite, albite, and fluorite cluster 10.6 cm high, from Stak Nala, N.A., Pakistan (Photograph courtesy of Jeff Scovil ©, collection of Jeff Scovil)

From the Vikings' sunstone to a modern piezometric pressure sensor, tourmaline is an intriguing mineral with a new degree of significance. Tourmaline was considered by 18th century physicists as the key to a grand unification theory relating heat, electricity, and magnetism, but new studies define its role as an indicator of Earth's processes. With its plethora of chemical constituents and its wide stability range, from near-surface conditions to the pressures and temperatures of the mantle, tourmaline has become a valuable mineral for understanding crustal evolution. Tourmaline encapsulates a single-mineral thermometer, a provenance indicator, a fluid-composition recorder, and a geochronometer. Although also prized as a gemstone, tourmaline is clearly more than meets the eye.

- **Tourmaline: Nature's DVD**
  Darrell J. Henry and Barbara L. Dutrow
- **From polarity to piezometry: Tourmaline crystallography and applications**
  Frank C. Hawthorne (University of Manitoba) and Dona Dirlam (Gemological Institute of America)
- **No element left behind: Tourmaline isotopes**
  Horst Marschall (University of Bristol) and Shao-Yong Jiang (University of Nanjing)
- **Tourmaline as a guide to ore deposits**
  John Slack (U.S. Geological Survey) and Bob Trumbull (GFZ, Potsdam)
- **Tourmaline in sedimentary, igneous, and metamorphic systems**
  Darrell J. Henry, Vincent van Hinsberg (Oxford University), and Barbara L. Dutrow
- **Tourmaline as a gemstone**
  Federico Pezzotta (University of Milan) and Brendan Laurs (Gemological Institute of America)

Volume 7, Number 6 (December)

MINE WASTES

Guest Editors: **Karen Hudson-Edwards** (Birbeck College, University of London), **Heather E. Jamieson** (Queen's University), and **Bernd Lottermoser** (University of Tasmania)

Abandonned tailings pile in the city of Potosi in the Bolivian Andes

Since the dawn of civilization, humankind has been extracting metals and minerals for the production of goods, energy, and building materials. These mining activities have created great wealth, but they have also produced colossal quantities of solid and liquid wastes, known collectively as "mine wastes." Mine wastes represent the greatest proportion of waste produced by industrial activity. In fact, the quantity of solid mine wastes and the quantity of Earth materials moved by fundamental global geological processes are of the same order of magnitude—approximately several thousand million tons per year. Therefore, the large-scale production, secure disposal, and sustainable remediation of mine wastes represent problems of global significance. Over the past 10–15 years, novel geochemical, mineralogical, microbiological and toxicological techniques have led to a much better understanding of the character, weathering mechanisms, long-term stability, ecotoxicology, and remediation of mine wastes. This issue of *Elements* will bring readers up to date with these current findings and will highlight new frontiers for mine waste research.

- **History and significance of mine wastes**
  Karen Hudson-Edwards
- **Chemistry and mineralogy of metallic mine wastes**
  Heather Jamieson
- **Chemistry and mineralogy of coal and oil sands mine wastes**
  Kim Kasperski and Randy Mikula (Natural Ressources Canada)
- **Acid mine drainage and other mine waste waters**
  Kirk Nordstrom (USGS)
- **Ecotoxicology of mine wastes**
  Geoff Plumlee (USGS)
- **Recycling, reuse, and rehabilitation of mine wastes**
  Bernd Lottermoser and Graeme Spiers (Laurentian University)