FROM THE EDITORS

THIS ISSUE

The idea for this thematic issue originated from an "Urban Geochemistry" session at the 2010 Goldschmidt Conference. The session was small, but all talks had societal relevance. What interested me most was a fascinating presentation by Deborah Morrison, in which she reported on a study of lead in children. I learned, among other things, about the potential link between low-level lead poisoning and attention deficit disorder in children. I approached Berry Lyons, the session convener, and suggested he consider proposing an issue devoted to urban geochemistry. In short order, he and Russell Harmon, his cochair of the newly formed Urban Geochemistry Working Group of the International Association of GeoChemistry, put together a proposal.

Multidisciplinarity takes on a whole new dimension when applied to tackling problems in urban geochemistry: Earth scientists work alongside public health officers, urban planners, medical doctors, etc. As I pore over reference lists, I am always impressed by the broad range of journals and sources cited in *Elements* articles: take a minute to read some of the reference lists and see how many journals are totally new to you. Here is an example of a reference cited in one article of this issue and published by the Healthy Building Network, a nonprofit organization whose mission is to "transform the market for building materials to advance the best environmental, health and social practices": Toxic chemicals in building materials—An overview for health care organizations (www.healthybuilding.net/healthcare/Toxic%20Chemicals%20in%20Building%20Materials.pdf).

2013 PREVIEW

With this issue, *Elements* closes its eighth year of publication. We have now covered 47 topics in the Earth sciences, our lineup is complete till the end of 2014, and we have many proposals on hand. Please check the preview on the next two pages to get a taste of the exciting topics we are going to cover in 2013.

THANKS

We thank the guest editors and authors of the six issues in volume 8, who made a special effort to bring their science to the nonspecialist audience of *Elements*. We also acknowledge the contribution of reviewers, copy editors, and proofreaders, who toil in the background.

Finally, and not least, we thank our advertisers for their support: Actlabs, AHF Analysentechnik, The Arkenstone, Australian Scientific Instruments, Bruker AXS, Bruker Nano GmbH, Cambridge University Press, CAMECA, CrystalMaker, Excalibur Minerals Corporation, FEI, Geochemical Transactions, The Geochemist's Workbench, IAGeo, International Center for Diffraction Data, IsoPrime, JdL Centre, Leonard Himes Fine Minerals, McCrone Microscopes and Accessories, Nikon Metrology, Pala International, Pan Stanford Publishing, Rigaku, Savillex, SPECTRO, and Thermo Scientific. A special mention goes to **The Geochemist's Workbench**, **CAMECA**, **Savillex**, **SPECTRO**, **FEI**, **Rigaku**, **Bruker**, and **Excalibur Minerals Corporation**, who advertised in each issue.

Best wishes to everyone for the coming year!

Pierrette Tremblay, Managing Editor
on behalf of the editorial team

This thematic issue is a contribution of the IAGC Urban Geochemistry Working Group

FROM THE EXECUTIVE COMMITTEE

An executive committee made up of seventeen members is quite unusual, but then, so is *Elements*! The *Elements* executive committee (EC) consists of a representative from each of the participating societies in our "family." Beginning with a mere five societies, *Elements* now has 17 societies, ranging from small to large. Representatives are the critical link for ensuring the flow of information between their society and *Elements*.

The primary function of the EC is to provide financial oversight for *Elements*, a task facilitated by our ever-vigilant managing editor, who is constantly on the lookout for ways to reduce our costs and improve our revenues. Each year, the EC also has the duties of reviewing and approving the yearly budget, setting the member dues, safeguarding finances through oversight of investments and spending, and nominating and approving the principal editors. In addition, there are a host of issues that arise, either organically within the EC, such as strategic initiatives, or those imposed from the outside. In the last few years, our strategic initiatives have included developing course packets using *Elements* articles, approving funding to support a mobile media application, establishing a presence in social media ("like" *Elements* on Facebook), considering new features for the magazine, discussing topics for issues, and charting its future course. The EC has also contended with the changing global financial market, be it financial transaction fees, reserves, and/or investments.

All of these items are dealt with during two conference calls, in the spring and fall, and a once-a-year in-person meeting, usually held in conjunction with the Goldschmidt Conference. Our meetings are typically characterized by lively debate, thoughtful opinions, and consensus-building to promote *Elements*. Whatever the task, all members undertake their responsibility with the humor and seriousness needed to keep *Elements* functioning at its highest level. And, above all, we are efficient!

The Executive Committee meeting in Montreal was well attended – although some members escaped before being photographed. Shown here (left to right) are: Bernardo Cesare (SIMP), Jon Davidson (MSGBI), Dan Frost (for Liane Benning, EAG), Friedhelm von Blanckenburg (DMG), Iain Samson (MAC), Tom Bullen (IAGC), Edwin Schauble (GS), Jacinta Enzweiler (for Michael Wiedenbeck, IAG), Crawford Elliott (CMS). Not in the photo are: Takashi Murakami (JAMS), Marek Michalik (Min Soc. Poland), Carlos Ayora (SEM), and Barb Dutrow (MSA) who took the photo.

If you have any suggestions, please do not hesitate to contact your representative.

Barbara Dutrow, Chair
Elements Executive Committee

THEMATIC TOPICS IN 2013

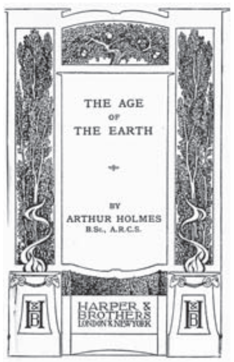
Volume 9, Number 1 (February)

ONE HUNDRED YEARS OF ISOTOPE GEOCHRONOLOGY

GUEST EDITORS: **Daniel J. Condon** (British Geological Survey) and **Mark D. Schmitz** (Boise State University)

In 1913, Frederick Soddy's research on the fundamentals of radioactivity led to the discovery of "isotopes." That same year, Arthur Holmes published his now famous booklet *The Age of the Earth*. Combined, these two landmark events established the field of science we know as "isotope geochronology." Today, isotope geochronology underpins much of our knowledge of the absolute age of minerals and rocks, and the records they contain. This field is constantly evolving, reflecting and responding to scientific drivers that require more highly resolved timescales, the microscopic analysis of smaller zoned minerals, or the generation of robust data sets in novel materials. This series of articles provides perspectives on the state of the art in the field of radioisotope dating—from the challenges of dating the Solar System's oldest materials to resolving the record of Quaternary climate change, and the four and a half billion years in between.

- **One hundred years of isotope geochronology, and counting**
  Daniel J. Condon (British Geological Survey) and Mark D. Schmitz (Boise State University)
- **Accuracy and precision in geochronology**
  Blair R. Schoene (Princeton University), Daniel J. Condon (British Geological Survey), Leah E. Morgan (SUERC, Scotland), and Noah M. McLean (British Geological Survey)
- **High-precision geochronology**
  Mark D. Schmitz (Boise State University) and Klaudia F. Kuiper (VU University Amsterdam)
- **High-spatial-resolution geochronology**
  Alexander A. Nemchin (Curtin University), Matthew S. A. Horstwood (British Geological Survey), and Martin J. Whitehouse (NORDSIM, Sweden)
- **Dating the oldest rocks and minerals in the Solar System**
  Yuri Amelin (Australian National University) and Trevor R. Ireland (Australian National University)
- **Quaternary geochronology: Tightening time constraints and tie-points**
  David A. Richards (Bristol University) and Morten B. Andersen (Bristol University)
- **Revolution and evolution: One hundred years of U–Pb geochronology**
  James M. Mattinson (University of California, Santa Barbara)



A century ago, Arthur Holmes' 1913 booklet, *The Age of the Earth*, outlined the basic tenets of geochronology in a remarkable early application of radioactive decay to constraining the geologic timescale and the age of the Earth.

Volume 9, Number 2 (April)

SERPENTINITES: KEY ROLES, FROM GEODYNAMICS TO THE ORIGIN OF LIFE

GUEST EDITORS: **Stéphane Guillot** (University of Grenoble) and **Keiko Hattori** (University of Ottawa)

Serpentinites, primarily composed of serpentine minerals and formed by hydration of peridotites, increasingly attract the attention of a wide range of scientists, including geophysicists, structural geologists, engineers, and astrobiologists. As serpentinites have wide stability fields, they form in a variety of environments, from the Earth's surface to the interior of the mantle. They are important as reservoirs of water in the deep mantle and in the recycling of elements in subduction zones. Because of their physical properties, serpentinites play important roles in seismic activity and geodynamics, including earthquakes in subduction zones, rifting, oceanic spreading, strike-slip faulting, and the exhumation of deeply subducted rocks. Serpentinites are also economically important because obducted serpentinites contain more than half the world's reserves of nickel. The formation of serpentinites is accompanied by the production of hydrogen and methane, producing unique ecosystems on the ocean floor. The generation of hydrocarbons during serpentinization is the essential first step in the origin of life on Earth and possibly other planets.

- **Introduction to serpentinites**
  Stéphane Guillot (University of Grenoble) and Keiko Hattori (University of Ottawa)
- **Serpentinites: What, Why, Where?**
  Bernard W. Evans (University of Washington), Keiko Hattori (University of Ottawa), and Alain Baronnet (University of Marseille)
- **Physical properties of serpentinites and geodynamic implications**
  Greg Hirth (Brown University) and Stéphane Guillot (University of Grenoble)
- **Serpentinites for carbon sequestration**
  Peter Kelemen (Columbia University) and Gregory M. Dipple (University of British Columbia)
- **Alteration of peridotites and genesis of nickel deposits**
  Charles R. M. Butt (CSIRO, Australia) and Dominique Cluzel (University of New Caledonia)
- **Serpentinites, hydrogen, and life**
  Tom M. McCollom (University of Colorado) and Jeffrey S. Seewald (Woods Hole Oceanographic Institution)

Ni serpentine of New Caledonia. Nickel deposits in New Caledonia form by intense weathering of serpentinites under tropical conditions. PHOTO: S. GUILLOT

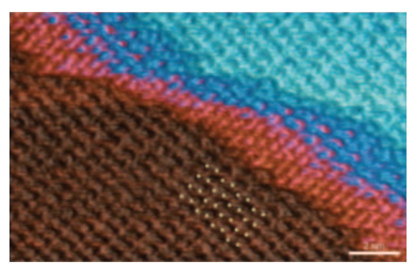
Volume 9, Number 3 (June)

THE MINERAL–WATER INTERFACE: WHERE MINERALS REACT WITH THE ENVIRONMENT

GUEST EDITORS: **Christine V. Putnis** (University of Münster) and **Encarnación Ruiz-Agudo** (University of Granada)

Reactions occurring at mineral–water interfaces are central to geochemical processes. They affect a wide range of important environmental issues, such as the composition of natural waters, weathering and soil formation, element cycling, biomineralization (including minor-element incorporation), acid mine drainage, and nuclear waste disposal. Recent studies using state-of-the-art spectroscopic and microscopic techniques have characterized the molecular structure of mineral surfaces, the distribution of fluids near surfaces, and dynamic processes such as dissolution, growth, and mineral replacement. These studies provide insights into the kinetics and mechanisms of reactions occurring at mineral surfaces, and they test the validity of predictions based on theory. These recent advances constitute the central theme of this issue of *Elements*. Modeling approaches used in mechanistic studies are also introduced. Such approaches complement direct, in situ, molecular-scale observations of processes occurring at mineral–water interfaces.

- **Mineral–water interface reactivity**
  Christine V. Putnis (University of Münster) and Encarnación Ruiz-Agudo (University of Granada)
- **Revisiting the kinetics and mechanisms of mineral dissolution**
  Andreas Luttge (MARUM, University of Bremen, Rice University, Babes-Bolyai University), Rolf S. Arvidson (MARUM, University of Bremen), and Cornelius Fischer (MARUM, University of Bremen, Rice University)
- **From atoms to minerals: How do ions and molecules arrange themselves to form crystals**
  Henry Teng (The George Washington University)
- **Environmental remediation by crystallization of solid solutions**
  Manuel Prieto (University of Oviedo), José Manuel Astilleros (Complutense University, Madrid, IGEO), and Lurdes Fernández-Díaz (Complutense University, Madrid, IGEO)



Atomic-scale imaging reveals the mechanisms of crystal dissolution and growth. The image illustrates atomic-scale resolution of a calcite surface showing protruding oxygen atoms of the $CaCO_3$ structure on a $\{10\bar{1}4\}$ surface; discrete atomic structure is revealed at the dissolving crystal front. Dissolution details were imaged by atomic force microscopy (AFM dimension fastscan, Bruker Nano Surfaces operating in peak force tapping mode).

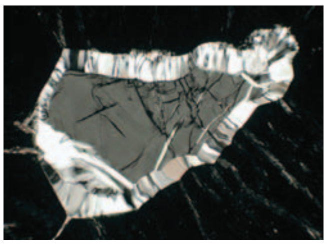
- **The control of crystal nucleation and growth by additives**
  Carlos Rodriguez-Navarro (University of Granada) and Liane G. Benning (University of Leeds)
- **Virtual probes of reactivity: Aqueous–mineral interfaces go GUI!**
  Andrew G. Stack (Oak Ridge National Laboratory), Julian D. Gale (Curtin University), and Paolo Raiteri (Curtin University)

Volume 9, Number 4 (August)

CONTINENTAL CRUST AT MANTLE DEPTHS

Guest editor: **Jane A. Gilotti** (University of Iowa)

The discovery of diamond and coesite in crustal rocks is compelling evidence that continental material has experienced pressures that can be achieved only at mantle depths. The classical idea that continents are too buoyant to subduct has given way to the notion of density changes driving deep subduction during the collision process, thus enabling some crust to be exhumed to the surface and the rest to sink into the mantle. Over twenty localities of unequivocal continental crust containing diamond or coesite are now recognized around the globe, and their study constitutes a new field in petrology, dubbed ultrahigh-pressure metamorphism. Using microscopic observations, phase equilibrium modeling, geochronology, and geodynamic modeling, we track the journey of ultrahigh-pressure rocks to the mantle and back. Continental ultrahigh-pressure terranes impact our understanding of plate tectonics through time, crustal recycling and mantle geochemistry, melting in subduction zones, and collisional processes in general.



Coesite, the high-pressure polymorph of SiO_2, is partially converted to stripy palisade quartz and surrounded by radial fractures in garnet (black) as the rock is exhumed from mantle depth back to Earth's surface. Photo: Hans-Peter Schertl

- **Continental crust at mantle depths**
  Jane A. Gilotti (University of Iowa)
- **Minerals and microstructures in continental crust at mantle depths**
  Hans-Peter Schertl (Ruhr University Bochum) and Patrick J. O'Brien (Potsdam University)
- **Constructing the pressure–temperature path of ultrahigh-pressure rocks**
  Hans-Joachim Massonne (University of Stuttgart)
- **Linking time to the pressure–temperature path of ultrahigh-pressure rocks**
  William C. McClelland (University of Iowa) and Thomas J. Lapen (University of Houston)
- **Deep fluids in subducted continental crust**
  Jörg Hermann (Australian National University), Yong-Fei Zheng (University of Science and Technology of China), and Daniela Rubatto (Australian National University)
- **Formation and exhumation of ultrahigh-pressure terranes**
  Bradley R. Hacker (University of California, Santa Barbara), Taras V. Gerya (Swiss Federal Institute of Technology, Zürich), and Jane A. Gilotti (University of Iowa)

Volume 9, Number 5 (October)

NITROGEN AND ITS (BIOGEOCOSMO) CHEMICAL CYCLING

Guest editors: **Gray E. Bebout** (Lehigh University), **Marilyn L. Fogel** (Geophysical Laboratory) and **Pierre Cartigny** (Institut de Physique du Globe de Paris)

Nitrogen is the most abundant element in Earth's atmosphere and a key component of the biosphere. It is also a critical part of the surface/near-surface cycling of nutrients, thus directly impacting our lives. Changes in the biogeochemical cycling of nitrogen through Earth's history could reflect fundamental changes in its pathways from inorganic to biological reservoirs in response to change in the environment (e.g. oxygen fugacity in the atmosphere and oceans). Recognition of the importance of nitrogen to life on Earth, and likely elsewhere in the Solar System, has led to the mantra "Follow the Nitrogen" as one vehicle for focusing efforts in the search for extraterrestrial life. Nitrogen serves as a useful tracer of the transfer of "organic" signatures into the deep Earth (in records preserved in metamorphic and igneous rocks and in volcanic gases and rocks). It has been speculated that biological fixation of nitrogen and storage in rapidly forming continental crust has led to drawdown of nitrogen from the early-Earth atmosphere, strongly influencing the chemical evolution of the atmosphere and related surface conditions.

Aquamarine (beryl) crystals embedded in muscovite: these minerals are known to store organic-sourced nitrogen as molecular nitrogen and ammonium, respectively. Photograph courtesy of Desert Winds Gems and Minerals (www.desertwindsgemsandminerals.com)

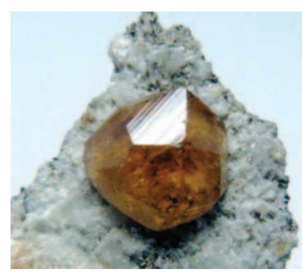
- **Modern biogeochemical nitrogen cycling: Stable isotopes as tracers of anthropogenic nitrogen sources, deposition, and impacts**
  Meredith G. Hastings (Brown University), Karen L. Casciotti (Woods Hole Institution), and Emily M. Elliott (University of Pittsburgh)
- **Biogeochemical cycling of nitrogen on the ancient Earth**
  Christophe Thomazo (University of Bourgogne) and Dominic Papineau (Boston College)
- **Mineralogy, residency, and isotopic behavior of nitrogen**
  Vincent Busigny (Institut de Physique du Globe de Paris) and Gray E. Bebout (Lehigh University)
- **Deep-Earth nitrogen cycling**
  Pierre Cartigny (Institut de Physique du Globe de Paris) and Bernard Marty (CRPG, Nancy)
- **Extraterrestrial cycling of nitrogen and the search for extraterrestrial life**
  Marilyn L. Fogel and Andrew Steele (Geophysical Laboratory, Carnegie Institution for Science)

Volume 9, Number 6 (December)

GARNET: COMMON MINERAL, UNCOMMONLY USEFUL

Guest editors: **Ethan F. Baxter** (Boston University), **Mark J. Caddick** (Virginia Tech), and **Jay J. Ague** (Yale University)

Garnet is among the most studied—and most beloved—minerals, owing to its commonality in diverse geologic contexts, its often large euhedral crystals, its sometimes dazzling colors, and its propensity for preserving information about its growth history. Chemically zoned garnet represents a remarkable tool for deciphering metamorphic conditions and the evolving tectonic processes that drive garnet growth over many millions of years. In the deep Earth, garnet is a key rock-forming mineral, influencing the physical properties of the mantle and the composition of mantle-derived magmas. Garnet has been sought for ages as a semiprecious gemstone (the birthstone of January) and has been mined or synthesized (including nonsilicate garnet) for industrial purposes, including laser, magnetic, and ion-conductor technology. This issue of *Elements* will emphasize the most recent innovations in thermodynamic, geochemical, geochronologic, and industrial applications of garnet, while providing perspective on decades of garnet-related research.



Grossular garnet, Jeffrey Mine, Québec. Photo courtesy of Desert Winds Gems and Minerals (www.desertwindsgemsandminerals.com)

- **Garnet: Common mineral, uncommonly useful**
  Ethan F. Baxter (Boston University), Mark J. Caddick (Virginia Tech), and Jay J. Ague (Yale University)
- **Garnet in nature, culture, and technology**
  Charles A. Geiger (Salzburg University)
- **Garnet as a monitor of conditions in the evolving crust and lithosphere**
  Mark J. Caddick (Virginia Tech) and Matthew J. Kohn (Boise State University)
- **Garnet geochronology: Timekeeper of tectonometamorphic evolution**
  Ethan F. Baxter (Boston University) and Erik E. Scherer (University of Münster)
- **Garnet as a monitor of the kinetics of tectonometamorphic processes**
  Jay J. Ague (Yale University) and William D. Carlson (The University of Texas at Austin)
- **Garnet in the mantle and igneous systems**
  Bernard J. Wood (University of Oxford) and Andrew K. Matzen (University of Oxford)