THIS ISSUE

Imagine a not-too-distant future when routine analyses of urine samples might detect people at risk for osteoporosis. This is one of the potential applications of metal stable isotopes in the medical field. As guest editors Tom Bullen and Anton Eisenhauer point out, after having concentrated their efforts on detection and measurement, isotope researchers have now moved to the next step: developing applications for these tiny isotope differences. So read on and consider how you might contribute to this fast-expanding field.

FIVE YEARS OLD!

Elements closes its fifth year of publication with this issue. In 2009, we published 39 thematic articles, contributed by 80 authors from 11 countries. Triple Point and Parting Shots, written by two of the founding principal editors, both reflect on the accomplishments and challenges of these first five years. We have now covered 29 topics in the Earth sciences; our lineup is complete till the middle of 2011, 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 2010. We hope there will be something for everyone in this mix of review and leading-edge coverage of science.

This milestone calls for some celebration. Past principal editors Mike Hochella and Bruce Watson are organizing a special session entitled "Geochemistry Far from Equilibrium" at the next Goldschmidt Conference. IMA 2010 will present a series of *Elements* plenary lectures each day of the conference. Principal editor David Vaughan and past principal editor Ian Parsons are busy working out the program. More on these events will be provided in the next issue of *Elements*.

GOLD ISSUE REVIEWED IN SEG NEWSLETTER

Elements "Gold Issue" was reviewed by Scott Wood in the Society of Economic Geologists Newsletter. You can read the review and sample this very interesting newsletter, as we have arranged with SEG for a free link until the end of January for *Elements* readers:

www.segweb.org/publications/SEG_October_2009_Newsletter_Elements.pdf.

ELEMENTS IN THE NEWS

We are pleased to report that our managing editor, Pierrette Tremblay, received the Association of Earth Science Editors Award for Outstanding Editorial Contributions "for her outstanding editorial and organizational skills in creating and managing *Elements*, a highly successful bimonthly mineralogical/geochemical journal supported by 15 societies and read by society members in about 100 countries." She received the award in November, 2009, at the AESE annual meeting in Houston, Texas, where she gave a talk entitled "Extreme Copublishing: *Elements* Five Years Later."

THANKS

We are indebted to the guest editors (names in bold) and the 80 authors of Volume 5 who have worked hard to bring their science to the nonspecialist audience of *Elements*. Many will attest that it was a lot of work, but that the final product made it all worthwhile.

Ariel D. Anbar, **Derek C. Bain**, Bridget A. Bergquist, Joel D. Blum, Florian Böhm, Abdelmalek Bouazza, Robert J. Bowell, Laurie L. Brown, Richard K. Brown, **Thomas D. Bullen**, **Charles R.M. Butt**, Kathleen A. Carrado, George E. Christidis, G. Jock Churchman, James S. Cleverley, Claire M. Cobley, David R. Cooke, **John W. Delano**, Bertrand Devouard, John H. Dilles, Rafal E. Dunin-Borkowski, **Anton Eisenhauer**, Don D. Eisenhour, Karl Fabian, Lintern Fairbrother, **Joshua M. Feinberg**, Ray E. Ferrell Jr., Jörg Fischer-Bühner, **Emmanuel Fritsch**, Carmen Gaina, Will P. Gates, Jérôme Gattacceca, Jean-Pierre Gauthier, Lee A. Groat, Timothy L. Grove, Monika Guelke, Necip Güven, **Richard J. Harrison**, Shelley E. Haydel, Pamela S. Hill, **Robert M. Hough**, Warren D. Huff, Robert E. Kane, Stefanos Karampelas, Başak Kısakürek, Peter Komadel, Michael J. Krawczynski, Brendan M. Laurs, Maggy F. Lengke, Paul G. Lucey, Barbara A. Maher, Shane F. McClure, Suzanne A. McEnroe, Merlin Méheut, Artashes A. Migdisov, Marc D. Norman, Franck Notari, Mihály Pósfai, Frank Reith, Peter Robinson, Pierre Rochette, **Benjamin Rondeau**, George R. Rossman, Edwin A. Schauble, Silke Severmann, James E. Shigley, Gordon Southam, John A. Tarduno, G. Jeffrey Taylor, Richard M. Tosdal, Friedhelm von Blanckenburg, Nicolaus von Wirén, Thomas Walczyk, John L. Walshe, Benjamin P. Weiss, Dominik J. Weiss, Mark A. Wieczorek, Lynda B. Williams, Anthony E. Williams-Jones, Younan Xia.

We also acknowledge reviewers, copy editors, and proofreaders who toil in the background. Their contribution is essential to ensure *Elements*' high editorial standards.

Finally, and not least, we thank our advertisers who stayed the course in spite of an uncertain economic landscape: Activation Laboratories, Advanced Mineral Technologies, Amcol International, Arizona State University, Australian Scientific Instruments, Bartington Instuments, Cambridge University Press, CrystalMaker, Elsevier, Excalibur, GAAJ-ZENHOKYO Laboratory, GemNantes, International Center for Diffraction Data, ioGlobal, RockWare, Nu Instruments, Savillex, Smart Elements, Spectromat, Springer, Thermo Scientific. A special mention goes to RockWare, Savillex, and Excalibur, who advertised in each issue of 2009 and have committed to do the same in 2010.

Susan Stipp, David Vaughan, and **Hap McSween**

EDITORIAL *Cont'd from page 339*

I got from my old-fashioned education, from those really tough courses in differential equations, computer programming, quantum mechanics, optics and hydrological engineering, or from the eye-opening courses in sociology, non-verbal communication, Latin and psychology!

Today's young people need a broad set of skills and knowledge to keep as many doors open as possible for future employment and for solving society's problems. Our universities, industry and governments need a broad set of expertises among their department team members to be able to compete in the forefront of research, education, innovation and policy. Perhaps we ought to plan our group strategies, study programmes and recruitment announcements with the da Vinci profile in mind.

Susan L. S. Stipp*
stipp@nano.ku.dk

* Susan Stipp was the principal editor in charge of this issue.

Thematic Topics in 2010

Volume 6, Number 1 (February)

MINERAL EVOLUTION

Guest Editor: **Robert M. Hazen** (Geophysical Laboratory)

Stage 10 of mineral evolution saw the increasing influence of life on mineralization. The trilobite *Hoplolichas* (6 cm in length) from the Ordovician of Russia displays an elaborately sculpted calcitic shell. Robert Hazen collection, Smithsonian Institution

"Mineral evolution," the study of Earth's changing near-surface mineralogy, frames Earth materials research with a historical narrative. This 4.5-billion-year story integrates themes of planetary science, including geodynamics, petrology, geochemistry, thermodynamics, geobiology, and more. Mineralogy thus holds the key to unlocking our planet's history and assumes its rightful central role in the Earth sciences. The mineralogy of terrestrial planets evolves as a consequence of physical, chemical, and biological processes. Starting with ~12 refractory minerals in prestellar molecular clouds, processes in the solar nebula led to the ~250 different minerals found in meteorites. Initial mineral evolution of Earth's crust depended on a sequence of geochemical and petrologic processes that resulted in an estimated 1500 different mineral species. Ultimately, biological processes produced large-scale changes in atmospheric and ocean chemistry that may be responsible, directly or indirectly, for most of Earth's 4400 known mineral species. Mineral evolution thus highlights the coevolution of the geo- and biospheres.

Mineral Evolution: Mineralogy in the Fourth Dimension
Robert M. Hazen (Geophysical Laboratory) and John M. Ferry (Johns Hopkins University)

The Evolution of Elements and Isotopes
Hendrik Schatz (Michigan State University)

Mineralogical Evolution of Meteorites
Timothy J. McCoy (Smithsonian Institution)

Mineral Environments on the Earliest Earth
Dominic Papineau (Geophysical Laboratory)

The Great Oxidation Event and Mineral Diversification
Dimitri A. Sverjensky and Namhey Lee (Johns Hopkins University)

The Rise of Skeletal Biominerals
Patricia M. Dove (Virginia Tech)

Themes and Variations in Complex Systems
Robert M. Hazen (Geophysical Laboratory) and Niles Eldredge (American Museum of Natural History)

Volume 6, Number 2 (April)

SULFUR

Guest Editor: **Charles Mandeville** (American Museum of Natural History)

Translucent orthorhombic crystals of native sulfur on aragonite (AMNH 93) from near Cinciana, Arigento, Sicily. The larger of the two crystals is 3.0 cm in diameter x 3.7 cm high. Photo by Arthur Singer, courtesy of American Museum of Natural History

This issue of *Elements* focuses on the geochemistry of sulfur in high-temperature, low-temperature, and biogenically mediated processes over a wide range of scales, environments, and time intervals. Sulfur's multiple valence states (S^{2-} to S^{6+}) allow for its participation in a large variety of geochemical and biogeochemical processes. Sulfur may be one of the light elements contained in the Earth's core and may have been crucial in core formation. Sulfur is an essential component in all life on Earth. Sulfur geochemistry continues to be used in delineating the early evolution of Earth's atmosphere and hydrosphere, as a monitor of volcanic SO_2 and H_2S, and as a tracer of anthropogenic sources. Recent advances in the use of multiple sulfur isotopes (^{32}S, ^{33}S, ^{34}S, and ^{36}S) and in situ isotopic measurements will allow sulfur stable isotopes to develop as vital tracers in the Earth and planetary sciences, with applications to inorganic and biogenic processes.

Sulfur: A Ubiquitous and Useful Tracer in Earth and Planetary Sciences
Charles W. Mandeville (American Museum of Natural History)

Sulfur in Magmas
Nicole Métrich (CNRS-CEA, France) and Charles W. Mandeville (American Museum of Natural History)

Touring the Biogeochemical Landscape of a Sulfur-Fueled World
David T. Johnston (Harvard University)

Sulfur on Mars
Penelope L. King (University of New Mexico and the University of Western Ontario) and Scott M. McLennan (State University of New York at Stony Brook)

Ultraviolet Sensing of Volcanic Sulfur Emissions
Clive Oppenheimer (University of Cambridge)

New Perspectives on Ancient Sulfur Cycling and Coupled Biospheric Oxygenation
Timothy W. Lyons and Benjamin C. Gill (University of California, Riverside)

Volume 6, Number 3 (June)

METAMORPHISM AND THE ROLE OF FLUIDS

Guest Editor: **Bjørn Jamtveit** (University of Oslo)

Satellite images of the Loriesfontein area, Karoo Basin, South Africa. Bright circular areas (100–150 meters in diameter) are hydrothermal pipes filled with brecciated and cooked shale. The pipes formed as a result of methane degassing during contact metamorphism of black shale. This may have triggered global warming in the Early Jurassic.

Fluids play a critical role during metamorphic processes. They have first-order influence on both reaction kinetics and mass transfer, and thus also on the rate of metamorphism. "Volatile components," such as H_2O and CO_2, may strongly influence rock rheology even in the absence of a free fluid phase. Metamorphic fluids therefore control the coupling between chemical reactions, mass transport, and deformation. Microstructures, compositional gradients at various scales, and larger-scale deformation features all reflect the dynamics of fluid–rock interactions. Moreover, the migration of fluids produced during prograde metamorphic processes or consumed during retrogression links metamorphism with the hydrosphere, the atmosphere, and the biosphere. This issue sheds light on the origin of the various patterns that emerge in metamorphic rocks as a response to changes in pressure, temperature, and the composition of pore-filling fluid. By following the metamorphic fluids to or from the Earth's surface, we also aim to explain how metamorphism may affect our own environment.

Metamorphism: The Role of Fluids
Bjørn Jamtveit and Haakon Austrheim (University of Oslo)

Replacement Processes in the Earth's Crust
Andrew Putnis and Timm John (University of Münster)

Metamorphic Devolatilization and Fluid Flow: Time and Spatial Scales
James A.D. Connolly (ETH Zürich)

Alteration of the Oceanic Lithosphere and its Implications for Sea Floor Processes
Wolfgang Bach (University of Bremen and Woods Hole Oceanographic Institution) and Gretchen Früh-Green (ETH Zürich)

Metamorphic Fluids and Global Environmental Changes
Henrik Svensen and Bjørn Jamtveit (University of Oslo)

Thematic Topics in 2010

Volume 6, Number 4 (August)

ATMOSPHERIC PARTICLES

GUEST EDITOR: **Reto Gieré** (Albert-Ludwigs-Universität Freiburg)

In addition to CO_2 and other gases, considerable amounts of particulate matter are emitted into the atmosphere by various industrial facilities, including this sugarcane processing plant in Queensland, Australia. PHOTO BY RETO GIERÉ

Solid atmospheric particles range in size from a few nanometers to several micrometers and are generated through both natural processes and human activity. Even though these particles are derived from spatially limited source areas and typically become airborne during short-term events, they are ubiquitous globally due to atmospheric circulation. Depending on their physical and chemical properties, these solid aerosols have a major impact on the radiative properties of the atmosphere and glaciers, on cloud condensation, and on the chemical composition of oceans and soils. Because these particles affect transportation and human health, they have recently become the focus of government attention and regulation.

This issue of *Elements* will explore the atmosphere as an exciting new research area for mineralogists and geochemists. It will illustrate the most prominent types of atmospheric particles and discuss their key effects on climate and ecosystems worldwide.

Atmospheric Particles
Reto Gieré (Albert-Ludwigs-Universität Freiburg) and Xavier Querol (IDAEA-CSIC, Spain)

Airborne Particles in the Urban Environment
Bernard Grobéty (Université de Fribourg), Peter Stille (Université de Strasbourg), Volker Dietze (German Meteorological Service), and Reto Gieré (Albert-Ludwigs-Universität Freiburg)

Volcanic Ash Plumes
Adam Durant (University of Cambridge), Costanza Bonadonna (Université de Genève), and Claire Horwell (Durham University)

Global Dust Events
Edward Derbyshire (Royal Holloway College) and Johann Engelbrecht (Desert Research Institute, Reno, USA)

Particulate Carbon in the Atmosphere
Guenter Engling (Academia Sinica, Taiwan) and András Gelencsér (University of Pannonia, Hungary)

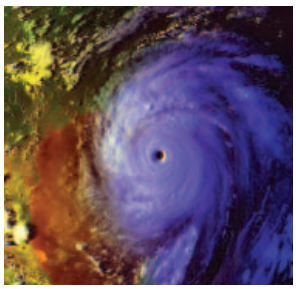
Impacts of Global Events on Oceans, Glaciers, and Climate
Santiago Gassó (University of Maryland Baltimore County), Vicki H. Grassian (University of Iowa), and Ron Miller (NASA Goddard Institute for Space Studies)

Volume 6, Number 5 (October)

THERMODYNAMICS OF EARTH SYSTEMS

Guest Editors: **Pascal Richet** and **Daniel R. Neuville** (IPGP-CNRS, France), **Grant S. Henderson** (University of Toronto), and **Roger Powell** (University of Melbourne)

During the past decades, thermodynamics has become an essential tool for understanding fundamental processes that have determined the structure and evolution of our planet. From the atmosphere to the ocean and sediments, from metamorphic terranes to magmatic provinces, the lower mantle, and the core, this issue of *Elements* will illustrate how a better understanding of the manner in which free energy depends on temperature, pressure, and chemical composition allows the Earth's activity to be better deciphered. At a time when climate change has become a major concern, thermodynamic studies of the atmosphere and ocean have not only an academic interest, but also considerable practical importance.



An AVHRR (advanced very high-resolution radiometer) 3-channel color composite daytime image of the eye of hurricane Katrina on August 28, 2005. COURTESY OF STEVEN BABIN AND RAY STERNER OF THE JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

The Effects of Ocean Acidification Due to CO_2 Dissolution
Frank J. Millero and Benjamin DiTrolio (University of Miami)

Phase Changes in the Moist Atmosphere
Andreas Bott (University of Bonn)

Water–Rock Interactions
Pierpaolo Zuddas (Université Claude Bernard)

***P–T* Histories of Metamorphic Rocks**
Roger Powell (University of Melbourne) and Timothy J.B. Holland (University of Cambridge)

Magma Formation and Evolution
Pascal Richet (IPGP-CNRS) and Giulio Ottonello (Università di Genova)

The Lower Mantle and Core
Surendra K. Saxena (Florida International University)

Volume 6, Number 6 (December)

SUSTAINABLE REMEDIATION OF SOILS

GUEST EDITOR: **Mark E. Hodson**

Nine months after addition of suitable organic amendments, grass was able to grow on this soil previously damaged and made highly acidic by coal-mining activities. PHOTO BY PHIL PUTWAIN, ECOLOGICAL RESTORATION CONSULTANTS

Humanity requires healthy soil in order to flourish. Soil is central to food production, regulation of greenhouse gases, and provision of amenity. But soil is fragile and easily damaged by uninformed management or accidents. One source of damage is contamination with the chemicals that are used to provide the lifestyles to which the developed world has become accustomed. Repairing or cleaning up this damage so that soil can again be used for beneficial purposes is a vitally important task. Traditionally, soil "clean up" involved removing the contaminated soil and replacing it with clean soil from elsewhere. Clearly this is not sustainable. Increasingly researchers and practitioners look to clean up contaminated soil and make it good for reuse, rather than simply discarding it. Mineralogy and geochemistry are central to the design and implementation of many of these new approaches.

The Need for Sustainable Remediation
Mark E. Hodson (University of Reading)

Assisted Phytoremediation: Helping Plants to Help Us
Filip Tack and Erik Meers (University of Ghent, Belgium)

Use of Organic Amendments for Remediation
Rufus Chaney (United States Department of Agriculture)

Use of Nanoparticles for Remediation—Solving Big Problems with Little Particles
Bernd Nowack and Nicole C. Mueller (EMPA-Swiss Federal Laboratories for Materials Testing and Research)

Mineral-Based Amendments for Remediation
Peggy O'Day (University of California, Merced) and Dimitri Vlassopoulos (S.S. Papadopulos & Associates)

Bioremediation: The Work of Bacterial Alchemists
Blanca Antizar-Ladislao (University of Edinburgh)