Elements



**EDITORIAL OFFICE**

Université du Québec
Institut national de la recherche scientifique
Eau, Terre et Environnement
Natural Resources Canada / Ressources naturelles Canada
Geological Survey of Canada / Commission géologique du Canada
PARTNERS OF THE QUÉBEC GEOSCIENCE CENTRE

490, rue de la Couronne
Québec (Québec) G1K 9A9 Canada
Tel.: 418-654-2606
Fax: 418-654-2525

Layout: POULIOT GUAY GRAPHISTES
Copy editor: THOMAS CLARK
Proofreaders: THOMAS CLARK, DOLORES DURANT
Printer: CARACTÉRA



**www.elementsmagazine.org**

# QUIET REVOLUTION IN THE GEOCHEMICAL SCIENCES

E. Bruce Watson

I am writing these words on my way home from the 2008 Goldschmidt Conference in Vancouver, so it's possible that I'm writing in a state of overstimulation: by any measure it was an extraordinary meeting that lived up to its promise to cover science "*from SEA to SKY*."

Much of the credit for the success of this year's Goldschmidt Conference should go to the organizers and sponsors of the meeting, and I hope all of you will join me in congratulating the program committee and chairs Rick Carlson, Barbara Sherwood Lollar, and Dominique Weis. Still, I think there is more going on in the field of geochemistry than a scenic venue and thoughtful planning: the conference took place within the context of far-reaching, fundamental developments in the geochemical sciences. These developments have been apparent at many recent meetings, and I think they will continue to be prominent for the foreseeable future. At the risk of being overly dramatic, I believe we are in the midst of a quiet revolution in the geochemical sciences.

At the root of this revolution is the unprecedented proliferation of technology that not only drives the science we're doing but also is driven by it.

At the root of this revolution is the unprecedented proliferation of technology that not only drives the science we're doing but also is driven by it. One side of the equation is the breathtaking advancement in our ability to measure the isotopic and elemental composition and structure of Earth materials—solid, fluids, vapors, and organic materials—at scales ranging vastly through time and space, down even to the nanometer and molecular level. Some of my colleagues in analytical geochemistry assure me that thirty years ago we were able to measure certain isotope ratios and trace-element abundances in many systems with precision and accuracy equalling today's capability. While this observation is certainly true, it misses the key point that today's analyst needn't be as experienced nor as committed to specific types of measurements in order to do them well. For better or for worse, we have entered a period of exploration in analytical geochemistry in which discoveries are limited more by ideas than by analytical capabilities. The proliferation of technology has stimulated exploration of isotope ratios (e.g. non-traditional stable isotopes) that would never have been attempted even a decade ago: this, in turn, has engendered an adventuresome attitude among scientists that few laboratories could have justified previously. Some might argue that technology has put powerful tools in the hands of babes, but I think the evidence is that, on balance, this is a good thing.

Can we, as practicing scientists, be proud of this revolution, and can we really claim it as our own "grass roots" movement? Or, are we simply exploiting the technology made available to us by the innovative engineers employed by (for example) the gracious sponsors of our meetings and publications? Here, I think we are on a two-way street. I was told recently by a sales representative of a major instrument manufacturer that, of all the communities in which his instruments are marketed (physics, chemistry, materials science, biology), it is by far the geoscientists who are the most vocal in pushing for new capabilities. So maybe we are not simply the fortunate beneficiaries of corporate invention and entrepreneurship, but rather integral partners in the science/technology symbiosis. Our ambition and ideas drive the development of commercial instruments, and these in turn energize and diversify our science.

It is especially interesting to me that we seem to be at a juncture where our ability to measure chemical "signatures" has far outstripped our ability to interpret those signatures in a unique way. On fronts ranging from the origin of life to magmatic evolution, for example, intriguing inferences are being drawn from small apparent anomalies in isotope ratios; however, in none of these areas have we comprehensively evaluated the mechanisms that could produce these anomalies. This makes the present time especially exciting and challenging for experimentalists like myself, whose "job" it is to characterize the behavior of elements and isotopes under controlled laboratory conditions and attempt to extrapolate findings to natural systems. In the distant future—if we are lucky and tireless—perhaps we will complete the interpretational framework for signatures, anomalies, and structures documented in natural systems. In the meantime, the profusion of new analytical results from natural samples provides experimentalists with ample motivation and inspiration, and in that respect makes us part of the revolution.

*Cont'd on page 220*

## THIS ISSUE

Guest editors James Brenan and James Mungall have brought together a cast of international authors to give you an up-to-date overview of the economic, scientific, and environmental significance of the platinum-group elements.

## PAST PRINCIPAL EDITOR HONORED

Michael F. Hochella Jr. was honored during the recent Goldschmidt Conference for his distinguished service to the Geochemical Society, as vice president, president, and past president (1998–2003), as co-organizer of the 2001 V.M. Goldschmidt Conference, and as "former Principal Editor of the extraordinarily successful *Elements* magazine."

Citationist Scott Wood and Michael Hochella

As citationist Scott Wood pointed out, "Mike's Presidential service in the Geochemical Society was distinguished by several extraordinary achievements. He was the major driving force in involving the Geochemical Society in the *Reviews in Mineralogy* series, culminating in the change of the name to *Reviews in Mineralogy and Geochemistry*. In 2001 Mike co-organized a highly successful Goldschmidt Conference held in Hot Springs, Virginia, with Bob Bodnar. Although Mike retired from active service on the GS Board of Directors after 2003, it was not long before he was to serve the society again, this time as one of the founding Principal Editors of the magazine *Elements*. From the early days when Rod Ewing first pitched to the Geochemical Society his idea for a scientific magazine to be co-published by several mineralogical and geochemical societies, Mike was a strong supporter of the concept. According to Principal Editor Ian Parsons, Mike played a 'pivotal role' in making *Elements* the success it has become."

Here are some excerpts from Mike's response: "Whether science or service awards have come my way, I'm just doing what I love to do. I can't imagine anything more important, in the long run, than understanding this third rock from the sun, what makes it work, where it came from and where it's going, and how to best care for it. To be so privileged, and to be able to call all of you colleagues, is the greatest joy in my life next to my family. And if I can constructively and productively serve this constituency, as this award implies, then I am definitely on the right track, and I will continue to do that, whether I am testifying to a congressional subcommittee on Capital Hill, or telling a large introductory class that what we do is worth it. …Earth science, in all its grand forms and permutations, is as important to the global society as ever. Insofar as our societies help us organize and project, anything we can do to serve our organizations is more important than we can possibly imagine."

## *ELEMENTS* AT THE GOLDSCHMIDT CONFERENCE

The editors met for a full day on July 14, 2008. In attendance were principal editors Bruce Watson, Susan Stipp, and David Vaughan, incoming principal editor Hap McSween, past principal editors Ian Parsons and Rod Ewing (also chair of the Executive Committee), and managing editor Pierrette Tremblay. We reviewed the past year with its highlights and challenges and brainstormed about where we want *Elements* to be five years from now. Among the highlights of the year, those deserving most mention are that *Elements* is now available on GeoScienceWorld and that an online version is available to members of participating societies.

*Elements* editors love a party, and Susan Stipp, Ian Parsons and Pierrette Tremblay were there to toast Tim Drever (MORE ON TIM DREVER'S PARTY ON PAGE 222).

Part of each principal editors meeting is devoted to reviewing proposals for future thematic issues. We had ten proposals on hand to review. We accepted and slated two to complete our 2009 lineup. We asked for revised proposals for three of them, and we plan to slate them in 2010 if the revisions are accepted. Some of the questions we ask ourselves when we review proposals are: Will this topic be of interest to a broad spectrum of members of our community? Will it be of interest to scientists outside our community? To industry? To policy makers? Is this a frontier area of research? Will this be particularly good for teaching? In any given year, we seek to ensure that mineralogists, geochemists, and petrologists will be particularly interested in some of the *Elements* issues, and that they will find it fun to learn about fields that are not their own from the other issues.

**Bruce Watson, Susan Stipp,**
and **David Vaughan,** Principal Editors,
and **Pierrette Tremblay,** Managing Editor

## EDITORIAL *(cont'd from page 219)*

New technologies have contributed to our science on other fronts besides chemical and isotopic analysis. New spectrometers allow us to look more closely at rocks and minerals for telltale indicators of geologic history (e.g. tiny grains of coesite indicating ultrahigh-pressure metamorphism; the hydrogen content of nominally anhydrous minerals as a barometer of mantle water fugacity). New microscopes provide images of minerals at the atomic scale. Beamlines at user facilities around the world (see *Elements* 2, number 1) let us explore structures and properties of phases that were previously inaccessible. The general availability of extraordinarily powerful computers enables us to deduce, through quantum-mechanical and molecular-dynamical models, the energetics and mobility of atoms in fluids and minerals and at the interfaces between them.

Is there really any difference between the present decade and past ones in the interval since V. M. Goldschmidt first elevated our science to the status of a unique discipline? I admit that it may be a matter simply of degree, but I do think the present time is unusual. Incredibly powerful tools are now accessible to a rapidly growing number of scientists applying chemistry and mineralogy to the study of the Earth. This has led to a proliferation not just of data but also of ideas—as well as an extraordinary blossoming of hypotheses that are realistically testable. From our present vantage point of immersion in this scientific ferment, it is easy to overlook the remarkable growth of the geochemical sciences that drives and is driven by advances in analytical capabilities and other technologies. One day, I predict, we will look back upon this time period (say, 2000–2016, assuming Goldschmidt 2008 is the temporal midpoint!) as the defining interval during which our community recognized and quantified many of the chemical processes and phenomena that link the biosphere, atmosphere, oceans, and solid Earth. This is what our science is about, and right now is an exciting time—even if it's not quite a revolution.

We should bear in mind that much of the knowledge we are accumulating can inform the increasingly urgent international discussion of energy and the environment. Perhaps we will also be able to look back on this time as one during which the geochemical sciences began to influence governmental decisions and policy.

**Bruce Watson***
Rensselaer Polytechnic Institute (watsoe@rpi.edu)

* Bruce Watson was the principal editor in charge of this issue