Elements

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An International Magazine of Mineralogy, Geochemistry, and Petrology

Frontiers in Textural and Microgeochemical Analysis

3D Textural Analysis of Rocks

Modeling Igneous Textures

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Timescales of Magmatic Processes

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Elements

An International Magazine of Mineralogy, Geochemistry, and Petrology

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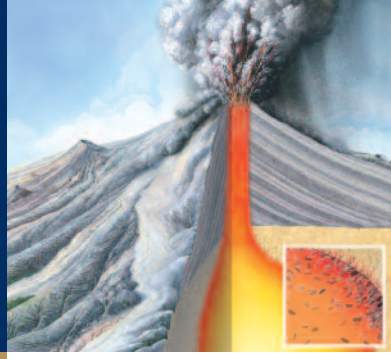

ABOUT THE COVER: Eruption of a volcano and crystallization in a magma chamber below. Petrologists use information stored in crystals in igneous rocks to investigate crystal growth, textural and chemical evolution, and the rates and timescales of processes in magma chambers. IMAGE COURTESY OF GARY HINCKS (www.garyhincks.com)

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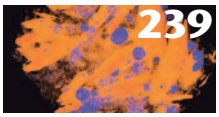

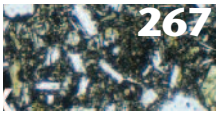

Departments

The Mineralogical Society of America is composed of individuals interested in mineralogy, crystallography, petrology, and geochemistry. Founded in 1919, the Society promotes, through education and research, the understanding and application of mineralogy by industry, universities, government, and the public. Membership benefits include special subscription rates for *American Mineralogist* as well as other journals, 25% discount on Reviews in Mineralogy & Geochemistry series and Monographs, *Elements*, reduced registration fees for MSA meetings and short courses, and participation in a society that supports the many facets of mineralogy. For additional information, contact the MSA business office.

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The Mineralogical Society of Great Britain and Ireland, also known as the MinSoc, is the international society for all those working in the mineral sciences. The Society aims to advance the knowledge of the science of mineralogy and its application to other subjects, including crystallography, geochemistry, petrology, environmental science and economic geology. The Society furthers its objects through scientific meetings and the publication of scientific journals, books and monographs. The Society publishes three journals, *Mineralogical Magazine* (print and online), *Clay Minerals* (print and online) and the e-journal *MINABS Online* (launched in January 2004).

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The Mineralogical Association of Canada was incorporated in 1955 to promote and advance the knowledge of mineralogy and the related disciplines of crystallography, petrology, geochemistry, and economic geology. Any person engaged or interested in the fields of mineralogy, crystallography, petrology, geochemistry, and economic geology may become a member of the Association. Membership benefits include a subscription to *Elements*, reduced cost for subscribing to *The Canadian Mineralogist*, a 20% discount on short course volumes and special publications, and a discount on the registration fee at the annual meeting.

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The Clay Minerals Society (CMS) began as the Clay Minerals Committee of the US National Academy of Sciences – National Research Council in 1952. By 1962, the CMS was incorporated with the primary purpose of stimulating research and disseminating information relating to all aspects of clay science and technology. The CMS holds an annual meeting, workshop, and field trips, and publishes *Clays and Clay Minerals* and the CMS Workshop Lectures series. Membership benefits include reduced registration fees to the annual meeting, discounts on the CMS Workshop Lectures, and *Elements*.

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The Geochemical Society is an international non-profit organization for scientists involved in the practice, study, and teaching of geochemistry. Membership includes a subscription to *Elements*, access to the online quarterly newsletter *Geochemical News*, as well as an optional subscription to *Geochimica et Cosmochimica Acta* (24 issues per year). Members receive discounts on publications (GS Special Publications, MSA, Elsevier and Wiley/Jossey-Bass), and on conference registrations, including the V.M. Goldschmidt Conference, the fall AGU meeting, and the annual GSA meeting.

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The European Association for Geochemistry was founded in 1985 to promote geochemical research and study in Europe. It is now recognized as the premiere geochemical organization in Europe encouraging interaction between geochemists and researchers in associated fields, and promoting research and teaching in the public and private sectors.

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The International Association of GeoChemistry (IAGC) has been a preeminent international geochemical organization for over 40 years. Its principal objectives are to foster cooperation in, and advancement of, applied geochemistry, by sponsoring specialist scientific symposia and the activities organized by its working groups, and by supporting its journal *Applied Geochemistry*. The administration and activities of IAGC are conducted by its Council, comprising an Executive and ten ordinary members. Day-to-day administration is performed through the IAGC business office.

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The Société Française de Minéralogie et de Cristallographie, the French mineralogy and crystallography society, was founded on March 21, 1878. The purpose of the Society is to promote mineralogy and crystallography. Membership benefits include the "bulletin de liaison" (in French), the *European Journal of Mineralogy* and now *Elements*, and reduced registration fees for SFMC meetings.

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The Association of Applied Geochemists is an international organisation founded in 1970 that specializes in the field of applied geochemistry. Its aims are to advance the science of geochemistry as it relates to exploration and the environment, further the common interests of exploration geochemists, facilitate the acquisition and distribution of scientific knowledge, promote the exchange of information, encourage research and development, advance the status of the profession, and sponsor symposia, seminars and technical meetings.

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The Deutsche Mineralogische Gesellschaft (German Mineralogical Society) was founded in 1908 to "promote mineralogy and all its subdisciplines in teaching and research as well as the personal relationships among all members." Its great tradition is reflected in the list of honorary fellows, which include M. v. Laue, G. v. Tschermak, P. Eskola, C.W. Correns, P. Ramdohr, and H. Strunz, to name a few. Today, the Society especially tries to support young researchers, e.g. to attend conferences and short courses. Membership benefits include the *European Journal of Mineralogy*, the DMG Forum, *GMit*, and now *Elements*.

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The Società Italiana di Mineralogia e Petrologia (Italian Society of Mineralogy and Petrology), established in 1940, is the national body representing all researchers dealing with mineralogy, petrology, and related disciplines. Membership benefits include receiving the *European Journal of Mineralogy*, *Plinius*, and *Elements*, and a reduced registration fee at the annual meeting.

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The International Association of Geoanalysts is a worldwide organization supporting the professional interests of those involved in the analysis of geological and environmental materials. Major activities include the management of proficiency testing programmes for bulk rock and microanalytical methods, the production and certification of reference materials and the publication of the Association's official journal *Geostandards and Geoanalytical Research*.

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The Mineralogical Society of Poland, founded in 1969, draws together professionals and amateurs interested in mineralogy, crystallography, petrology, geochemistry, and economic geology. The Society promotes links between mineralogical science and education and technology through annual conferences, field trips, invited lectures, and publishing. There are two active groups: the Clay Minerals Group, which is affiliated with the European Clay Groups Association, and the Petrology Group. Membership benefits include subscriptions to *Mineralogia Polonica* and *Elements*.

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Affiliated Societies

The International Mineralogical Association, the European Mineralogical Union, and the International Association for the Study of Clays are affiliated societies of *Elements*. The affiliated status is reserved for those organizations that serve as an "umbrella" for other groups in the fields of mineralogy, geochemistry, and petrology, but that do not themselves have a membership base.

E. Bruce Watson

Risking the Future of Geoscience

Earlier this year, the University at Albany (New York) moved to terminate its undergraduate and graduate degree programs in the geological sciences. Those of us who know "UAlbany" as the former and current base of some notable Earth scientists look upon this decision with bewilderment. Before passing judgment, however, we should note that the move was initiated by academic staff in the Department of Earth and Atmospheric Sciences and does not include elimination of the UAlbany Earth sciences curricula altogether: courses and degree programs in atmospheric and environmental sciences will continue.

UAlbany is not unique. About five years ago, the University of Connecticut made a similar decision to close the Department of Geology and Geophysics and disperse the faculty to other departments.[1] George Washington University also disbanded its small but energetic Geology Department in 2003, an action that left the District of Columbia with no undergraduate program in the geosciences at any college or university.

To those of us in the field, these decisions are unsettling and seemingly counter to societal and educational needs. Geoscientists are the only scientists knowledgeable about the Earth and its key systems, many of which "serve" humankind in some manner and most of which are impacted by human activities. Knowledge of Earth systems carries with it the unique perspective of vast timescales whose record informs us about our planet's history—key for predicting Earth's short- and long-term futures. The Earth systems perspective now permeates our educational programs and much of the research we do, and this perspective is vital on college and university campuses today. Our students will make decisions in their lifetimes for which Earth systems knowledge is fundamental and essential, whether in the fields of resources (water, minerals, energy), global climate change, CO_2 sequestration, disposal of nuclear materials and other hazardous waste products, or in the area of natural hazards such as earthquakes and floods.

Perhaps we can benefit from the UAlbany example. The developments on that campus resulted from a series of administrative decisions made over a 20-year period that essentially predetermined "failure" of the geological sciences. The number of solid-Earth scientists was allowed to fall below critical mass. This led to the diminution of the graduate student population and the inability to offer competitive degree programs at any level, which had a negative feedback on enrollment. As funds from the state government diminished, deans and provosts at individual campuses in the university system sought to augment existing, academically strong programs where student interest was high, while at the same time limiting duplication of talent and expertise among the four public university research centers in the state: Stony Brook University is strong in the Earth and environmental sciences—why duplicate that strength at the Albany campus 250 kilometers away? From the standpoint of New York State taxpayers, this is a valid point. But from it follows the next question of how well a non-duplication policy fulfills the needs of the students at any given campus—not necessarily within their chosen degree field, but in terms of what they need to know for their own lives and for developing informed opinions on societal issues. The non-duplication policy also leads to specialization of campuses, which makes them vulnerable to shifts in student interest and societal needs.

Academic administrators face the challenge of balancing the budget and responding to the perceived immediate and "global" needs of their institutions. This inevitably means that institutional priorities do not coincide with those of all academic departments. Interestingly, administrative views of the Earth sciences vary enormously: some major U.S. universities see our field as central to addressing the human aspirations and challenges of the 21st century and are building vigorously. Many are taking a less aggressive approach by maintaining a viable base in the Earth sciences, appreciating the importance of stability, and leaving open the possibility of future growth. A few are taking the UAlbany route. Why is there such a disparity of attitudes toward the Earth sciences among administrators of institutions of higher education? Part of the answer may be rooted in the history, location, and culture of the institution: for example, the importance of the geosciences is taken for granted in places like Texas and Alberta, whose economies run on oil and gas. Other factors are more complex. Leading technological universities like MIT preselect for qualities in their undergraduate student populations that naturally lead to few students taking degrees in the Earth sciences. Most Earth scientists are consumers of technology—as opposed to being leaders in the development of technology—so in technological circles we are not perceived to be positioned on any research frontier. This perception misses the point, of course, but among students it is exacerbated by a lack of exposure to modern Earth science in secondary schools. If student interest is the primary measure of the importance of a discipline, some geoscience departments will remain in a weak position no matter how compelling the argument for the presence of Earth systems awareness on campus.

Another factor that unquestionably affects the attitudes of university administrators toward geoscience departments is the limited availability of external funds for research. In the present funding climate, even a strong geoscience department does not have access to the research dollars that

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[1] Interestingly, the UConn decision was reversed before it was executed, when a newly appointed administrator acted quickly to establish a Center for Integrative Geosciences.

EDITORIAL MEETING IN BRIEF

The editors met on Thursday June 28 at the Frontiers meeting in Cambridge, England. Rod Ewing, founding editor, attended part of the meeting, and we welcomed his sage input. Although we have regular conference calls throughout the year, face-to-face meetings are invaluable: nothing replaces sitting around a table and bouncing ideas back and forth. The main items on the agenda were solidifying our line-up for 2008, and indeed three new themes were confirmed: nanogeoscience, platinum-group elements, and carbon dioxide sequestration. Watch for our December issue when we will present an overview of the 2008 topics. Many proposals and ideas for thematic issues have been submitted in recent months, and these will be considered for the 2009 line-up.

DAVID VAUGHAN, PRINCIPAL EDITOR, 2008–2010

We welcomed David Vaughan, incoming principal editor for 2008, at our editorial meeting. Although David's term of office officially starts in January, when he will replace Ian Parsons who will be concluding his three-year term, David is now included in all our discussions. We will introduce David more formally in the first issue of 2008.

EXECUTIVE COMMITTEE MEETING

Every participating society appoints a representative to sit on the executive committee overseeing *Elements*. Eleven societies were represented at the executive committee meeting, convened and chaired by Peter Treloar. Members of the executive committee joined the editors at the end of the day for a fruitful exchange of ideas and sharing of information.

ELEMENTS ON GEOSCIENCEWORLD

Elements is joining GeoScienceWorld, an aggregation of peer-reviewed journals that are indexed, linked, and inter-operable with GeoRef (see *Elements* vol. 1 no. 5, p. 313 and www.geoscienceworld.org). This will provide a high-quality online access to *Elements* articles.

ELEMENTS' IMPACT FACTOR

Elements received its first impact factor from the Institute of Scientific Information: 1.562 for 2006, its second year of publication. The 2006 impact factor of a journal is calculated as the number of citations received in 2006 for papers published in that journal in 2004 and 2005, divided by the number of articles published in those two years. As *Elements* just started publication in 2005, our impact factor was based on citations we received for 2005 papers. Thus, we are very pleased that our impact factor is as high as it is already. Papers that have cited *Elements* were published in the standard mineralogy and petrology journals but also in a wide range of journals on the fringe of our community, meaning we are reaching a wider audience.

Ian Parsons, Bruce Watson, Susan Stipp and **Pierrette Tremblay**

LETTER TO THE EDITORS

Congratulations to *Elements*, lead editor Michael Hochella, and guest editor David Mogk for organizing the April issue dealing with teaching mineralogy, petrology, and geochemistry, especially in the undergraduate curriculum. The online bibliography and resources through Carleton is a great addition. As in other matters, the "Triple Point" piece by Peter Heaney adds usefully to the discussion.

For what it is worth, I am an "end-user," working in an industry (mining) that needs people well trained in and enthusiastic about mineralogy and petrology. There is an expression in an unrelated field that seems *à propos*: we are never more than one generation from extinction. From this it follows that a prudent person would regard the teaching of the next generation as one of his or her responsibilities. I am of an age at which many of the great teachers with whom I was lucky enough to work have left us, so it is refreshing to see that there are still serious people committed to and involved in great teaching. As Professor Hochella points out and as the articles in the April issue illustrate, great teachers are, like great researchers, the product of intention, effort, and openness to improvements and to new ideas that challenge old beliefs; above all they are committed individuals. I can think of many wonderful people who were both great teachers and great researchers. Surely, that is an honorable, even exemplary, combination to which many of us can aspire.

Keep up the good work, teachers. And keep up the good work of maintaining balance in the range of interesting and important matters you bring us, *Elements*.

Mark J. Logsdon
Geochimica, Inc., California

EDITORIAL *(cont'd from page 227)*

are available to, for example, a bioscience department of equivalent standing. At resource-limited institutions, this funding reality affects decisions about faculty appointments. It is not easy to argue against the view that a biologist who has access to, say, $1M/year in research funding is more valuable than a geologist who has access to only a fraction of that. Over a career, the difference in research income is substantial, and this is a powerful fact in the minds of those responsible for fiscal planning.

Most administrators are unaware of the remarkable evolution of the Earth sciences in recent decades. Although driven partly by advances in instrumentation, this change is due mainly to our heightened sensitivity to the interconnectedness of atmosphere, oceans, land, and life and the redesign of departments and curricula that has followed from this new perspective. The shift toward an Earth systems view has led many of us to see the environment as a unifying theme in the Earth sciences. It is natural to blame administrators for their failure to appreciate the significance of this change, but such a reaction isn't likely to improve the standing of geoscience departments. As difficult as it might be, we need to acknowledge that the blame lies partly with us. With some exceptions, the geoscience community has not been aggressive or articulate in conveying the essence and importance of what we do and what we know, and this failure has allowed our image problems to persist in some academic circles. In his address to AGU members in San Francisco last December, Al Gore lauded us for having developed the methods and acquiring the data to understand global climate—but he also reprimanded us for not communicating our knowledge effectively. We need to work on communicating with administrators and thus help them understand the role of geoscience departments in education, research, and society. This is the best way to sustain the vitality of our field in universities worldwide.

We also need to recognize that the nature of our field is difficult for other scientists to appreciate. On the one hand, we are applied scientists, in the sense that we use the tools of chemistry, physics, biology, and mathematics to study the systems of interest to us. On the other hand, our interests cover the spectrum from the very applied (resources, hazards, environmental remediation) to the purest and most fundamental of natural sciences, that is, simply wanting to understand how our planet works at all scales. The applied and the basic scientists among us make good partners within single departments, but this only renders us more enigmatic to those viewing us from other disciplines.

An important goal of the *Elements* editorial team is to make the essence of what we do more transparent to those outside the geosciences and, in so doing, to further the interests of our field. The guest editors and contributing authors are the vehicles through which *Elements* aims to do this, but you, our readers, can help keep us on track by sending us your views!

Bruce Watson[2]
Principal Editor

[2] Bruce Watson was the principal editor in charge of this issue.

What's Your h-Index?

Peter J. Heaney

It is the beginning of June, and baseball is ambling into the turn from spring to summer. The Yankees stand in second place in the American League East, 10 games behind the Red Sox. Devoted fans of New York know better than to panic. The season is young, and the state of affairs is familiar. The Red Sox always start hot, but just when it seems that *this* year, Boston really might make it to the post-season, the team trips, wavers, and then ineluctably tumbles head-over-heels down down down in the rankings until it no longer can contend even for a wildcard berth. Supporters of the Red Sox are the True Believers, and they point to their World Series title of 2004 as proof that even the most stubborn of sports curses can be dispelled.

To validate their most fervent hopes, fans of both teams turn to the tea leaves to predict the season's outcome, and in baseball those tea leaves are statistics—reams and reams of statistics that have been collected since Henry Chadwick introduced the concepts of the box score, the batting average, and the earned run average in the mid-19th century. Baseball maintains statistics for every conceivable combination of defensive and offensive parameters, and aficionados pore over these numbers with the concentration of Talmudic scholars to understand why their teams are where they are and how they will do tomorrow. The Yanks have won their last 6 in a row and 8 of their last 10. Could this portend the turnaround that every Yankee fan demands? But Boston's relief pitching seems unbeatable. Hideki Okajima boasts a 1.14 ERA, 0.79 WHIP, 1.55 BAA… The statistical panoply is boundless, and the idioms are a foreign language to the uninitiated.

Despite the many comparisons that can be made between baseball and academia—free agency, team rankings, and hierarchical salary structures come to mind—universities have been comparatively immune to the numerological analyses that baseball players have had to endure. After all, how does one measure the impact of a theater professor who stages a production of *Waiting for Godot*? By the number of seats filled? The amount of support raised by external grants? All parties involved in hiring and promotion decisions in the liberal arts recognize that personnel evaluations, though informed by statistics, ultimately are qualitative, for better and for worse.

> "No one puts a "K" next to Wayne Gretzky's name in the scoring summary when he pops the puck over an open net, or an "E" when his pass goes wide of a winger on the right side; no one writes "L" after Warren Moon's name when the Oilers lose to the Lions. Baseball, by contrast, looks for blame and then elucidates it, writing down the whiff or the miscue in the scorecard and filing it away in the record books forever."
>
> – Roger Angell, "Hard Lines" in Baseball by Ward and Burns

Scientists, on the other hand, are people who measure things for a living, and as our careers progress, we are asked to appraise our colleagues with increasing frequency—to assess funding requests, tenure issues, and nominations for prestigious awards. Our zeal for quantification drives the search for hard numbers to support our gut instincts, and the absence of suitable metrics for benchmarking one geochemist's performance against another's is an unacceptable frustration.

Boldly stepping into this breach between reality and expectation is the ISI Web of Science (WoS), which allows the precise calculation of a scientist's influence with a single mouse click. It began modestly in 1955 as the Science Citation Index, which was intended to facilitate searches of the scientific literature. Many of us are old enough to remember long hours spent searching through the heavy tomes of the SCI, which filled bookshelf after bookshelf in library reference sections, squinting our eyes to read the fine print and puzzling out the often mysterious abbreviations used for journal titles. The World Wide Web literally was created to complete what the SCI started, and now the blazingly fast search engines of the WoS have streamlined beyond our first imagining the pursuit of papers that cite an article of particular interest.

Thomson Scientific soon realized that scientists were accessing the WoS not merely to survey the literature but to count the number of citations for individual articles. In 2006, the company introduced a new capability called Citation Report along with a suite of author identification tools. Together, these features allow a user to pinpoint any scientist and to produce a dataset related to that scientist's productivity: graphs of published articles and citations by year, average number of citations per paper, and an itemization of all papers in any order specified by the user. In this way, the Citation Report transforms the purpose of the WoS from a simple bibliographic resource to a normative vehicle that has standardized the reckoning of scientific achievement.

The metric in the Citation Report that has generated the most buzz is the so-called "h-index," a parameter best explained by example: an author with an h-index of 20 has written 20 articles that have been cited 20 or more times. The advantages of this index are explained in a paper written in 2005 by the parameter's originator, J.E. Hirsch, and published in the *Proceedings of the National Academy of Sciences* (102: 16569-16572). As summarized by ISI, the h-index "is useful because it discounts the disproportionate weight of highly cited papers or papers that have not yet been cited." Indeed, my completely non-random and non-rigorous explorations with Citation Reports confirm a strong correlation between the h-index and geological superstardom. Without naming names, it is interesting to note how many of the most prominent members of our community can boast h-indices in the vicinity of 40 or higher.

The caveats associated with citation statistics are well known. Many subdisciplines within the geosciences still value comprehensive monographs over lpu's (least publishable units), and the slow rates of production that characterize these kinds of articles yield commensurately small citation values. Moreover, citation statistics inherently represent a popularity contest. Certain topics excite attention that is intense but ultimately of slight import. Conversely, some of the most creative and revolutionary papers are recognized only after decades have passed precisely because of their farsighted nature.

Nevertheless, my guess is that the h-index is here to stay, if only because of its appealing simplicity. The problem with this parameter is that it better captures the character of baseball than of science. Baseball statistics are constructed to showcase consistency. Fans study batting and pitching *averages* and *totals* over many seasons to discriminate between the good and the great. If single moments were of the highest significance, then Bill Mazeroski and Joe Carter would be considered the most impressive batters of all time. They are the only players with walk-off home runs hit in the bottom of the ninth inning in the final game of a World Series. As estimable as these athletes are, no one would rate them with the very best in baseball history; the lifetime batting average for each is close to .260, far below the numbers for Ty Cobb (.366) or Ted Williams (.344).

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2007 AGU VGP FELLOWS

Congratulations to the 2007 Fellows of the American Geophysical Union (Volcanology, Geochemistry, and Petrology Section)!

Susan Brantley

For her profound contributions to environmental geochemistry, her innovation and leadership in developing new initiatives, and her major impact on national geoscience education.

Rodney C. Ewing

For his many extraordinary and fundamental contributions to materials science and mineralogy that have innovative applications to nuclear waste management.

Thomas H. Heaton

For contributions to seismology, especially in the areas of wave propagation, and earthquake source physics, and to a better understanding of earthquake hazards.

Bernard Marty

For outstanding contributions to the understanding of the origins of both terrestrial and extraterrestrial volatiles and their use in the interpretation of planetary-scale processes.

Thomas F. Pedersen

For his insightful studies of marine sediments to understand how oceanographic conditions affect, and are affected by, changes in Earth's climate.

David Pollard

For his unsurpassed blending of field observations and mechanical modeling.

Georges Poupinet

For pioneering the use of earthquake doublets and for elevating the level of solid-Earth geophysics in France.

Joseph R. Smyth

For his outstanding contributions to the mineral physics of the Earth and for fundamentally changing our perception of the role of water in the Earth's deep interior.

Frank Spear

For his contributions to understanding the dynamic character of metamorphism and orogeny through unified field, analytical, and numerical studies.

John W. Valley

For contributions to petrology and geochemistry, for discoveries regarding the geologic evolution of the early Earth, and for the development of analytical methods on which those discoveries are based.

HELMHOLTZ-HUMBOLDT RESEARCH AWARD TO HOLLY STEIN

Holly Stein near the village of Os in Norway

Colorado State University Senior Research Scientist Holly Stein will receive the prestigious Helmholtz-Humboldt Research Award for her groundbreaking research in ore deposit geology and geochemistry. Stein is founder and director of the AIRIE Program (Applied Isotope Research for Industry and the Environment), Department of Geosciences, a leading research group in Re–Os geochronology and tracer studies. Re–Os dating contributes critical information for understanding metallogenesis and the temporal relationship of ore deposits to geologic, metamorphic, and tectonic processes. In particular, AIRIE developed the technology to date molybdenite. Stein draws on her experience in economic geology to contribute new insights and solve problems in other geoscience disciplines.

Recently, the AIRIE Program has turned to Re–Os dating of syn-sedimentary sulfides and organic material in black shales and migrated hydrocarbons, with applications to petroleum exploration. The work is backed by $2.3 million from the Norwegian Research Council and petroleum industry (Eni Norge, Statoil). The project will be carried out under the auspices of the Norwegian Geological Survey, where Stein has a 50% position, Bernard Bingen and Judith Hannah are co-investigators.

The Helmholtz Association and Alexander von Humboldt Foundation grant up to six research awards annually to internationally recognized scientists. The award categories cover all disciplines of science, including energy, Earth and environment, health, technology, structure of matter, transport, and space. Nominations for the awards are made by members of the Helmholtz Association National Research Center in Germany. Awardees are scientists whose discoveries, theories, and findings have a strong influence on the immediate and broader disciplines beyond their specific research area.

Stein will receive 50,000 euros and attend a reception in Berlin hosted by the president of Germany. She will have a formal affiliation with the GeoForschungsZentrum in Potsdam, where she will work primarily with Rolf Romer on Sn–W–Mo–U metallogenesis in the renowned Erzgebirge. Stein will deliver lectures at several universities in Germany.

Stein received her BS from Western Illinois University and later received that institution Outstanding Woman Alumna Award. She received her MS and PhD from the University of North Carolina at Chapel Hill. She has been active in geologic societies and on editorial boards. Stein received the 2005 Silver Medal from the Society of Economic Geologists for excellence and original work in the geology of mineral deposits. In 2000, she received a Fulbright Research Fellowship, and in 1992 she received a Gilbert Fellowship from the USGS to work with Re–Os chemist John W. Morgan. At that time, she envisioned the broader application of Re–Os geochemistry to the understanding of metallogenesis and continental crustal processes.

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In science, by contrast, the dramatic home run changes the world. Wilhelm von Röntgen discovered X-rays in 1895 and thereby opened the atomic universe to human inspection. James Watson and Francis Crick published the structure of DNA in 1953, and that one paper has fueled a revolution in molecular biology that continues to this day. The stature of these researchers in the scientific pantheon is assured by these single acts of creation because the machinery that drives a field of science can be wholly re-invented when an individual insight upends our primary assumptions.

None of which is meant to denigrate those with lofty h-indices. A value of 40 implies a remarkable production of more than one high-impact paper per year over many decades. But if your papers are struggling to find an appreciative audience, keep aiming for the far wall. You just might snag an idea hanging on the outside corner and knock our current reality out of the ballpark.

Peter J. Heaney
Penn State University

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Meet the Authors

Bruce L.A. Charlier currently holds a Natural Environment Research Council Fellowship in isotope geochemistry at the Open University. He obtained a BSc from Brunel University and a PhD from the Open University, which was followed by a postdoctoral researcher position at Durham University. His main research interests center on the quantification of rates and timescales of magmatic processes, in particular through studies of U-series disequilibrium in zircon from young, highly evolved magmatic systems. His research also focuses on the extraction of isotopic information recorded at single-crystal scale in order to constrain magmatic pathways. He has developed novel sampling and mass spectrometric methodologies to obtain this level of detail.

Fidel Costa studied Earth sciences at the University of Barcelona and moved to Geneva to do a PhD in geochemistry and igneous petrology. He was a Marie Curie Fellow at the CNRS-ISTO in Orléans (France) and held a postdoctoral position at the Ruhr-Universitat Bochum (Germany). He is currently a Ramon y Cajal Fellow at the CSIC (Institut Jaume Almera) in Barcelona. He combines natural observations with experimental work and numerical modeling to understand the pre-eruptive conditions and dynamics of magmas below volcanoes, the kinetics of element migration in minerals, and the duration of magmatic processes.

Jon P. Davidson became aware of the power of combining isotopic approaches with petrographic and textural criteria in igneous rocks while at UCLA (1988–2000). He subsequently moved to Durham as chair of Earth Sciences, where he built the TiMAG (textural and isotopic microanalysis group) research group with Dougal Jerram. He received his BSc from Durham University and PhD from Leeds before crossing the Atlantic for postdoctoral appointments at SMU and Michigan. His research interests have focused on combining field, petrographic and geochemical perspectives to understand volcanoes, subduction zones and the origin of the crust. In 1998 he was awarded the Wager Medal of IAVCEI. Currently he chairs the Volcanic and Magmatic Studies Group (VMSG) of the Geological Society of London.

Catherine Ginibre received her master's degree in experimental petrology in Rennes (France). She did her PhD (2000) in Göttingen (Germany) using the electron microprobe to study zoning patterns in feldspars. She received a Marie Curie Fellowship for postdoctoral research at Durham, where she worked on Sr isotope microsampling techniques. In Geneva (Switzerland) since 2004, she studies the relationships among fluids, melts and crust in the Andes using a combination of microanalytical methods (electron microscope and microprobe, Raman spectroscopy, LA-ICP–MS, fluid inclusion microthermometry). She is also in charge of Geneva users of the electron microprobe in Lausanne.

Taber G. Hersum is interested in the dynamics of multiphase geological materials, particularly applied to the understanding of magmatic systems. Much of his work is focused on using numerical models to simulate grain-scale processes, such as phase change, elastic deformation, and porous melt flow, in partially molten rocks. This work is complemented by field studies in localities such as the McMurdo Dry Valleys of Antarctica. He received his education in geology and applied mathematics at Washington (BS 2001) and Johns Hopkins University (PhD 2005). He is currently a postdoctoral fellow at the Lamont-Doherty Earth Observatory.

Michael D. Higgins studied at Cambridge and Newcastle-upon-Tyne before moving to Canada for his PhD at McGill University in Montreal. The idea of having a whole 80-kilometer diameter mafic intrusion to himself appealed, and he has been in Canada ever since, now at the Université du Québec à Chicoutimi. His interest in quantitative textural analysis grew out of a study of anorthosite. Since then he has studied the textures of many other igneous rocks, culminating in a book on the subject published last year by Cambridge University Press. He has also worked in geochronology and meteoritics, and his first book was on the links between the geology and archeology of Greece.

Dougal A. Jerram is based at Durham University where he currently holds the TOTAL Lectureship, having joined as the Elf Research Fellow in 1998. He completed his PhD in the development of textural analysis techniques at Liverpool and moved to the University of Würzburg in 1996, where he expanded his research into flood basalts and associated basins. He has published extensively in the fields of rock microstructure and textural analysis, 2D and 3D modeling of textures and volcanic basins, volcanology, and field geology. His main areas of research involve innovative textural analysis of rocks, understanding the development of crystal populations in igneous rocks, and the onset and evolution of flood basalt provinces. In 2006 he received an award from the Murchison Fund of the Geological Society of London, in recognition of his early significant contribution to Earth sciences.

Andreas Kronz studied mineralogy at the University of Mainz (Germany), where he received his doctorate in 1997. The same year, he moved to Göttingen to set up and direct the electron microprobe lab in the Department of Geochemistry. His research interests focus on a variety of topics where in situ analytical techniques can be combined. Improving electron microprobe analytics to quantify low element concentrations led to a number of new applications focused on minor element concentrations in common minerals such as quartz, rutile, feldspar, and zircon. He is also interested in archeometry.

Bruce D. Marsh is interested in all the physical and chemical aspects of the generation, extraction, collection, ascension, emplacement, and eruption of magma. He enjoys blending field geology with complementary laboratory experiments and theoretical analyses. At the same time, he maintains a keen appreciation of the people, history, and art of doing science in all fields of natural science and exploration. He was born and raised in the woods of the Upper Peninsula of Michigan and received his education in geology, geophysics, and geochemistry at Michigan State (BSc), Arizona (MSc), and Berkeley (PhD). He has been on the faculty at Johns Hopkins University since 1974. His present principal field areas are the McMurdo Dry Valleys of Antarctica and the Sudbury impact feature.

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Daniel J. Morgan obtained his PhD in 2003 from the Open University, focusing on the timescales of magmatic processes at Vesuvius volcano. Since then he has worked as a PDRA at Durham University with the EU-funded ERUPT project and as a Marie Curie research fellow at Université Joseph Fourier, Grenoble. In early 2007 he won a President's Award from the Geological Society of London. He is currently a lecturer at the University of Leeds, UK.

Simon Turner is an ARC Federation Fellow and professor of geochemistry at Macquarie University. He previously held a Royal Society University Research Fellowship at the Open University and then Bristol University in the UK. His interests include the origins of post-orogenic granites and shoshonitic rocks, detrital mineral ages and sediment provenance, the origins and timing of continental flood basalts, the petrogenesis of ocean island basalts, and the formation of subduction-related magmas. Recently, he has concentrated his work on short-lived (U-series) isotope studies and the timescales of natural processes, especially magma formation, segregation, and differentiation as well as erosion and soil formation.

Gerhard Wörner received his master's and PhD degrees at the University Bochum. During his PhD, he spent one year in the US, working with the USGS. In 1980, he witnessed the Mount St. Helens eruption as a member of the USGS team. Since then he has worked on the eruption, origin, and differentiation of magmas and the evolution of magma systems in varied tectonic settings (Central Andes, Costa Rica, Panama, Kamchatka, Antarctica, Europe). He became a professor of geochemistry at the University of Göttingen in 1993. He has received several prizes for his work, including the Leibniz Prize of the German Science Foundation.