

THE GEOCHEMICAL NEWS

Newsletter of The Geochemical Society
in cooperation with The European Association of Geochemistry



In This Issue...

In Memoriam: Larry Haskin (1935 - 2005)

***Discovery in the Desert: Geochemistry at
Sandia National Laboratory***

***Review: RiMG v. 33, Geochemistry of
Non-Traditional Stable Isotopes***

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THE GEOCHEMICAL SOCIETY

The **Geochemical Society** is a nonprofit scientific society founded to encourage the application of chemistry to the solution of geological and cosmological problems. Membership is international and diverse in background, encompassing such fields as organic geochemistry, high- and low-temperature geochemistry, petrology, meteoritics, fluid-rock interaction, and isotope geochemistry. The Society produces a *Special Publications Series*, *The Geochemical News* (this quarterly newsletter), the *Reviews in Mineralogy and Geochemistry Series* (jointly with the Mineralogical Society of America), the journal *Geochimica et Cosmochimica Acta* (jointly with the Meteoritical Society), and co-publishes the electronic journal *G³* (jointly with the American Geophysical Union: AGU); grants the *V.M. Goldschmidt*, *F.W. Clarke* and *Clair C. Patterson Awards*, and, jointly with the European Association of Geochemistry (EAG), the Geochemistry Fellows title; sponsors the V.M. Goldschmidt Conference, held in North America in odd years and elsewhere in even years, jointly with the EAG; and co-sponsors the Geological Society of America annual meeting and the AGU spring meeting. The Society honors our first President, F. Earl Ingerson, and our first Goldschmidt Medalist, Paul W. Gast, with the *Ingerson* and *Gast Lectures*, held annually at the GSA Meeting and the V.M. Goldschmidt Conference, respectively. The Geochemical Society is affiliated with the American Association for the Advancement of Science and the International Union of Geological Sciences.

Members of the Organic Geochemistry Division are individuals with interests in studies on the origin, nature, geochemical significance, and behavior during diagenesis and catagenesis of naturally occurring organic substances in the Earth, and of extraterrestrial organic matter. GS members may choose to be affiliated with the OGD without any additional dues. The OGD presents the **Alfred E. Treibs Award** for major achievements in organic geochemistry, and **Best Paper** awards (student and professional) in organic geochemistry.

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THE GEOCHEMICAL NEWS

January 2005

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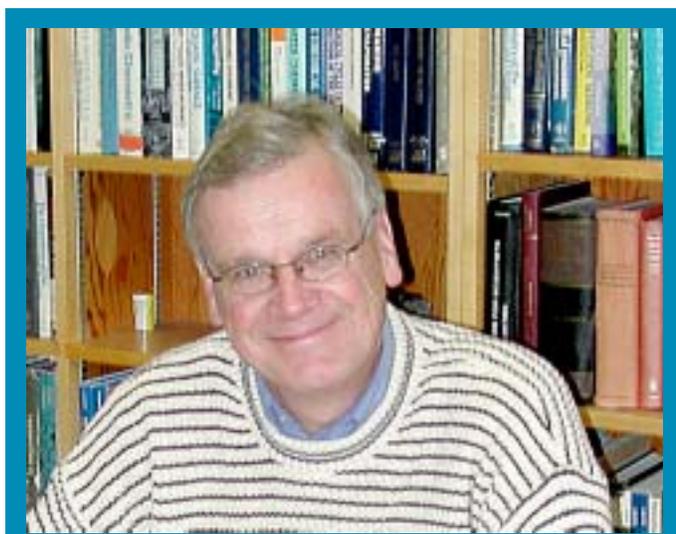
From President Tim Drever,

This issue of the *Geochemical News* is appearing at the time of the Goldschmidt Conference in Moscow, Idaho. This is our only paper issue of the year. With the launching of *Elements* we went to three on-line only issues of GN plus the one hard copy. I think the first on-line only issue earlier this year looked really good. The online format offers the editors greater flexibility, particularly in the use of color illustrations. I had some misgivings originally about the change but I am now sold on the advantages of the on-line format. However, we really need feedback from the membership: how do you like this new format? Is there anything we should change? Speaking of *Elements*, you should have received the second issue by now. From what I have seen, it's every bit as good as the first. I hope it represents just a first step towards greater interaction among the various geochemical and mineralogical societies. I just attended the meeting of the GSA Associated and Allied Societies. One of the proposals is to set up an on-line bulletin board for meeting planning. As soon as any preliminary plans are made for any meeting, the information will be posted on the web. This should lead to fewer conflicts and also, perhaps, to joint meetings where two organizations seem to have a common theme.

The Goldschmidt conference has received over 1600 abstracts; it promises to be a great meeting. It also represents the 50th anniversary of our society, which is an occasion for serious celebration. The GS Board of Directors meeting will be held on May 20th, immediately before the Goldschmidt. If there are any issues you think we should be addressing, please contact me or one of the other Directors. We are here to serve the membership, so let us have your ideas. Several members have suggested that our venerable logo, from the days of Leroy lettering rather than computer graphics, is due for an update. If you have any creative ideas, send them to me! Or offer it as a competition for your students. The winning entry will be suitably rewarded.

I look forward to seeing many of you in Idaho. Remember, you're only fifty once.

Tim Drever, GS President



Tim Drever

Editors' Corner

We hope you enjoy this special printed issue of *Geochemical News*, the first since our switch to an all-electronic format with the January issue, and the first of what is planned as an annual hardcopy printing of GN, for distribution at each year's Goldschmidt Conference. Otherwise, following this issue we will return to our new all-electronic and only-electronic format. In the July 2005 issue we plan to showcase news and events from the 2005 Goldschmidt Conference in Moscow, Idaho, so if you are a session organizer or chair, please keep track of the most noteworthy talks, because we'd like to point up the highlights of the upcoming Idaho meeting.

In this issue we are saddened to report the death of Professor Larry A. Haskin, a pioneer in rare earth element geochemistry, a giant in lunar petrology, and the former Ph.D. advisor to one of us (Haas). Larry was greatly respected throughout the geochemical community not only for his prolific scientific accomplishments, but also because he was a truly decent human being of profoundly exceptional character and integrity. As a mentor, Larry was the model of upstanding professionalism and leadership; never impatient, or capricious, or small, as most of us come to be at times. He taught me trace element geochemistry, but also he tried to teach me how a worthy scientist behaves. Often I cannot meet the standard he would have counseled, but in trying it is his example I seek. I no longer work on basalts, and I no longer think much about fractional crystallization, but Larry's most enduring lessons I carry to this day, and for my part hope to pass on in some small way to my students. Larry proved the adage, "They don't make them like the used to." He'll be missed.

Until next issue,

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Editors



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COVER: Earthrise over the lunar horizon, at the Apollo 11 landing site. Photo credit NASA, scanning credit Kipp Teague. Obtained from the online Apollo Image Gallery, at www.apolloarchive.com.

FROM THE BUSINESS OFFICE

Geochemical News #124 – Goldschmidt Conference Issue

The July issue of the Geochemical News will focus on the annual Goldschmidt conference, which has grown into one of the largest (if not the largest!) annual international conferences devoted to geochemistry. This issue will feature highlights from the 15th Annual Goldschmidt Conference, to be held May 20-25, 2005 in Moscow, Idaho and will also contain important information on the venue, scientific program and logistics of the 16th Annual Goldschmidt Conference, to be held Aug 27- Sept 1, 2006 in Melbourne, Australia.

Goldschmidt 2006: geochemistry downunder

Speaking of next year's Goldschmidt conference, it is not too early to start looking ahead to Melbourne. To register your interest in the conference, please visit the conference website at: <http://www.goldschmidt2006.org/>

Got GCA?

If you have become a member of the Geochemical Society through your Goldschmidt Conference registration, then there is an additional benefit you may not be aware of.

Members of the Geochemical Society may purchase a personal subscription to *Geochimica et Cosmochimica Acta*. Subscriptions include all calendar year issues including the Goldschmidt Abstracts special issue. Further GCA subscriptions includes personal on-line access to GCA through Elsevier's Science Direct. On-line access includes issues from 1995 to date.

Subscription rates for 2005 are \$130 for professional members and \$30 for student members. If you are interested in a GCA subscription, please contact the business office for a form.

Geochemical Society at the 2005 GSA Annual Meeting

The Geochemical Society will be co-sponsoring the following sessions at the 2005 GSA Annual Meeting in Salt Lake City, Utah from October 16-19, 2005:

- Occurrence and Fate of Arsenic in Hydrogeologic Systems
- Reaction Kinetics in Aquifers
- Mine Rock piles and Pyritically Altered Areas— their slope stability and effect on water quality
- Integrated Field, Geochemical & Geophysical Studies of the Yellowstone-Snake River-Columbia River Volcanic System



Seth Davis

GS is also co-sponsoring the field trip on October 13-15, titled: Basaltic Volcanism of the Central and Western Snake River Plain and its Relation to the Yellowstone Plume

And finally, GS will have an exhibit in the GSA exposition hall. We will have society information, special publications for sale, and will be accepting membership renewals. This is a good opportunity to meet with the business manager if you have comments or suggestions for the Geochemical Society.

Best regards,
Seth Davis
Business Manager

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Report on the GCA Publishers Meeting

By Nathaniel Ostrom, Chair of the Joint Publications Committee

In early February, I attended a publishers meeting in New York which is an annual event to allow the two societies (Geochemical Society and Meteoritical Society), the Executive Editor, Chair of the JPC and representatives from Elsevier to discuss the status of the journal. The overall consensus is that the journal is doing quite well on a quality and quantity basis. The total number of published pages is near 5400 article pages per year and has been increasing steadily from a low of less than 4000 in 1998. The journal is now quite close to the maximum levels reached in the 1990's when Gunter Faure was executive editor.

The primary concern raised was the long time for publication which at the moment averages 14 months from submission to print. Much of this is a consequence of delays by authors or reviewers which the journal has little control over. The initial review averages about 80 days, revisions are received after another 100 days, and about 20-30 days is the typical handling time for post-acceptance (final author review of proofs and transmittance to the publisher's office). The primary delay in this process is in production which is currently taking about 6 months.

The key limitation in production at present is an insufficient number of copy editors. A typical journal has 2 copy editors; GCA has 5 and this is still not sufficient. Publication time could be reduced to 3 months with the addition of 1 or more copy editors. Elsevier is well aware of the problem and they are taking steps to hire and train more copy editors. At present, there is a significant backlog of articles waiting to be published. The journal has been increasing the number of pages published in each issue and with the continuation of this process we expect that the backlog issue will gradually diminish over the next year.



Nathaniel Ostrom

The Organic Geochemistry Division of the Geochemical Society Announces the Recipient of the 2005 Treibs Award

Dr. Jaap S. Sinninghe Damste is amply deserving of the 2005 Alfred Treibs Award, as demonstrated by consideration of his diverse and sustained record of accomplishments documented in over 300 publications over the last 20+ years. As a common theme through his career, Jaap has pioneered the use of numerous highly-specific biomarkers to reconstruct paleoenvironments with high resolution in order to recognize palaeo-environment dynamics and palaeo-climatic change both in the recent past and over longer, geological time scales.

As part of his dissertation work, Jaap discovered and rigorously identified hundreds of new organic sulfur compounds in sediments and oils. This led to totally new insights into the global C- and S cycles and also demonstrated that through sulfurization many specific, yet labile biomolecules were preserved in the geosphere, suggesting new possibilities for reconstructing palaeo-environments through the utilization of these sulfurized biomarkers.

In recent years, Jaap has effectively used novel tools such as the TEX-86 temperature proxy to understand important aspects of earth history. Jaap's exploitation of the aryl-isoprenoid proxy introduced by Summons and Powell has been very effectively directed both to studies of modern and historical systems. Jaap and his coworkers are also leading producers of new information about oceanic archaea and their biogeochemical role.

The time and place of the presentation of the 2005 Treibs Award to Dr. Sinninghe Damste will be announced at a later date.



Jaap S. Sinninghe Damste

Weathering System Science Consortium (WSSC) Update

The Weathering System Science Consortium (WSSC) is a cross-disciplinary consortium of scientists focused on studying processes shaping and transforming Earth's outermost thin veneer between the top of the vegetation canopy and the lower limits of groundwater. In this thin zone, known as the Critical Zone, life is supported, atmospheric exchange occurs, soil forms, mass movements sculpt landscapes, and toxins are removed or added to surface water.

WSSC started in October 2003, when a small group of scientists convened an NSF-sponsored workshop in Baltimore to consider how to promote science investigating biogeochemistry in the Critical Zone. Since the initial Baltimore meeting, WSSC has been promoting activities aimed at developing a vision for a consortium dedicated to research in the Critical Zone. Some of the specific actions by the WSSC in this regard include the development of a website (<http://www.wssc.psu.edu/>), an open meeting at the American Geophysical Union meeting in San Francisco (December 2003); presentation of "WSSC: An initiative to study Earth's weathering engine" at the 2004 Goldschmidt conference (Brantley, Chadwick et al. 2004); publication of an *Eos* article (Anderson, Blum et al. 2004); promotion of the consortium at a special session at the 11th International Water Rock Interaction Symposium in Saratoga Springs, New York (June 2004); organization of the 2005 Goldschmidt conference session titled "The Earth's weathering engine; coupling chemical weathering with physical erosion, biology, hydrology and climate"; and the positioning of leadership, researchers and staff to develop the infrastructure for formally establishing a WSSC.

WSSC has also fostered collaboration with European counterparts to help in the development of a European weathering initiative. European scientists met at a workshop in October 2004 and drafted a position paper that was sent to the European Commission; a similar position paper was sent to the Natural Environment Research Council (NERC), UK, after a workshop between US and UK scientists. The UK paper is a formal expression of interest for a NERC community meeting to plan a soils research strategy with a major weathering science component that could contribute significantly to WSSC and link to the EU initiative on soils and weathering.

Building on these advances, a second WSSC workshop held in January 2005 advocated organizing research efforts around a Critical Zone Exploration Network (CZEN). The goal of a CZEN is to apply environmental gradient studies and interdisciplinary approaches to study the complexities of the zone. The network of sites, people, ideas, tools, and data envisioned will provide a framework for launching Critical Zone science beyond ordinary small investigator research, while providing tools and context for the small investigator approach as well.

Currently, an NSF-sponsored workshop entitled "Frontiers in Exploration of the Critical Zone" is scheduled for October 24-26, 2005 at the University of Delaware. Researchers interested in building the CZEN or suggesting network components should plan to present a poster and short oral presentation; additional information will be posted on the CZEN (WSSC) website.

Publisher's Editorial

Elsevier and open access: *Will the real "open access" please stand up?*

Introduction

There is broad agreement in the academic and publishing communities on three core principles of knowledge sharing. The first is that scientific journals are the life-blood of intellectual enquiry and progress in understanding. The second is that these journals should be readily available to as broad an audience as can usefully benefit from access to them. The third core principle is that, for knowledge to advance and for researchers to avoid repeating the mistakes of the past, archiving needs to be comprehensive, future-proof and guaranteed for all time. Where disagreement does exist is in how these principles and objectives for preserving the fruits of scholarship should best be achieved, including how science publishing should be funded. In the rapid transition from the print to the electronic age over the last decade, the traditional model of science publishing has adapted to increase access to its current and back catalogue while at the same time reducing the unit cost of articles. Proponents of the various "open access" models contend that there is room for wider access still, at no cost to the users at the point of access. "Open access" means many different things to many different people. In the flux of ideas generated by the new and rapidly developing phenomenon of web publishing, "open access" proponents were able to convince others that traditional publishers, both commercial and not-for-profit societies, were "anti-open access" or even "anti-access", period. Tested against the realities of electronic publishing, this did not last very long. The trick, of course, is defining what open access really is.

The “Author-Pays” Model

The **author-pays** model is the most important type of open-access experiment. “Author pays”, to put it bluntly, turns the economics of science publishing on its head. Instead of the reader (or the library) subscribing to scientific information resources, it is the author (or the author’s institution) that pays for the information to be published so that anyone can access it for free. Some sharp tongues have referred to this model as a “scientific vanity press”, but this is neither fair, nor accurate. Like many ideas that seek to revolutionize an industry, “author pays”, at first glance, looks like a good one. Nobody has to pay anything to read the scientific literature. The benefits for developing countries and cash-strapped libraries are self-evident – at least on the surface. In addition, proponents of this model have been successful in their marketing efforts, from positioning their business model as a *movement*, to signing up a number of high-profile academic personalities to sing its praises – celebrity endorsers, so to speak.

Elsevier has many concerns, even passionate ones, about the “author-pays” publishing model. Here are the most important, both economic and passionate:

- **“Author pays” is not financially viable.** The solutions, as they currently stand, proposed by BioMedCentral (BMC) and Public Library of Science (PLoS), are not economically viable. Their current author submission fees of \$525 and \$1,500 respectively, are not enough to recoup the costs of producing an article, which are closer to \$3,000 to \$ 4,000, nor to keep it available online for the years to come (i.e., download and system-maintenance costs). Currently, both BMC and PLoS survive only through foundation grants, membership and other support not flowing from core activities.
- **“Author pays” discriminates between those who can pay and those who cannot.** The publication of research results should be open to everybody whose work merits publication, and not just to those who can afford to publish. Under the “author-pays” model, it will become increasingly difficult for authors from developing countries or under-funded disciplines to get their results published. This goes against the important scientific paradigm that publication should be open to all.
- **“Author pays” will not guarantee continuity.** A one-off payment received at publication is at odds with the obligation to maintain systems and infrastructures to make articles available into the future. The “author-pays” model ignores the fact that electronic distribution requires substantial and continuous investments to keep the technology up to date. Under the “author-pays” model, there is hardly any incentive for publishers to invest long term, since they will not be paid for this in the future.

Some traditional publishers are nevertheless experimenting with “author pays”. Springer’s “Open Choice”, for example, allows an author to choose the traditional publishing route or to pay \$3,000 to allow free access to their article. Springer have said that they do not believe their “Open Choice” will catch on in a major way, but some of their authors wanted it, so they are offering it. However, there is a general feeling the majority of authors are simply unwilling to pay enough to cover the cost. In a recent independent author survey¹, half of the respondents said that they would not be willing to pay anything to be published. Of the half that said they would be willing to pay something, the average amount they were willing to pay was only \$247. So authors themselves do not seem to be overly enthusiastic about this new model, and it remains to be seen if the model is viable and whether it will be able to attract large article flows.

Conclusion

Journal publishing is undergoing significant changes as a result of the internet, which has lowered the barrier to entry to publishing. It has also lead to increased usage of scientific information all over the world. It has allowed libraries to offer innovative and efficient services to their users, and has allowed them to form purchasing consortia. Further changes in science publishing, and indeed any sort of publishing, are inevitable due to advances brought about by the internet.

“Open access”, especially “author pays”, is not a *movement*, it is not a *groundswell of grassroots activism*, it is not *The Next Big Thing*. It is simply a different business model. Like all science publishers, commercial and not-for-profit societies alike, Elsevier is interested in enhancing access to high-quality scientific information but knows from experience that, in order to guarantee quality and maintain accessibility, more is required than simply setting up a website, and even that has cost associated with it. The tired old cliché, alas, still rings true, “there is no such thing as a free lunch”. And at Elsevier, we’re not so sure the cooks should be paying to feed us.

Friso Veenstra
 Publisher, Geophysical Sciences
 Elsevier, Amsterdam

http://ciber soi.city.ac.uk/ssp2004-rowlands_files/frame.htm

In Memoriam: Larry A. Haskin (1934-2005)

Larry (never Lawrence) Haskin died on March 24, 2005, of myelofibrosis, a bone marrow disease for which he had been treated for more than 15 years. At the time of his death he was a retired but active professor of the Department of Earth and Planetary Sciences at Washington University in Saint Louis. Professionally, Larry identified himself as a teacher, geochemist, physical chemist, planetary scientist, and sometimes farmer. He described the focus of his work as follows: "to further precise, accurate geochemical analysis; gain quantitative understanding of trace element behavior through rock analysis and geochemical modeling, with experimental work to provide modeling parameters and better understanding; and introduction to the application of some methods of physical chemistry to geochemical work (neutron activation analysis, electron paramagnetic resonance, silicate electrochemistry, planetary Raman spectroscopy)."

Larry was born and raised on a farm west of Kansas City. He was mainly interested in agriculture and law while in high school, but he was also curious about the names of chemicals on fly- and weed-spray cans. He said that his decision to major in chemistry at Baker University was impulsive, but he discovered that the field of chemistry suited him. He earned a Ph.D. in physical chemistry from the University of Kansas in 1960 under the direction of F. Sherwood Rowland. Although his thesis research project was on hot-atom radiochemistry, he also analyzed some limestones for trace amounts of uranium by the technique of neutron activation, a diversion that first led him to conclude that rocks were chemically interesting systems.

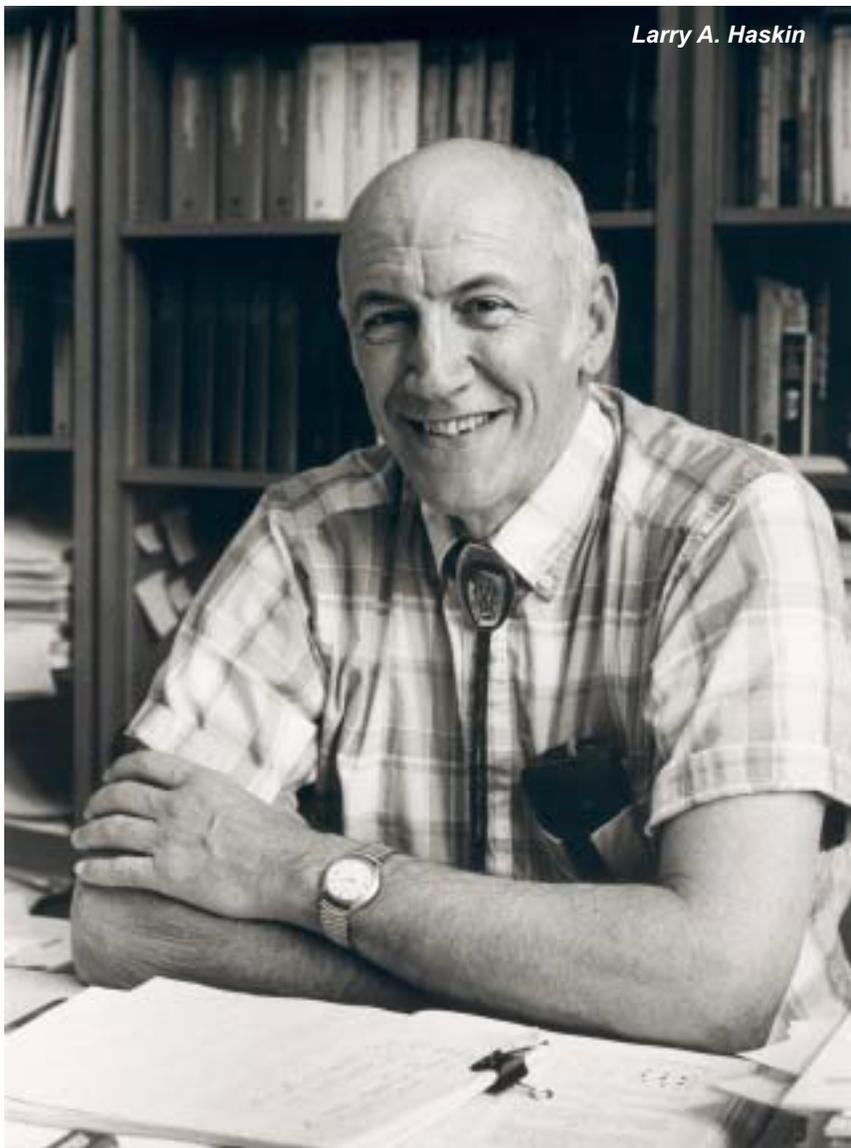
Larry taught chemistry for nine months at Georgia Tech in 1959–60. After a summer at Argonne National Laboratory working on the

effects of angular momentum on compound nuclear reactions, he was appointed Instructor in the Chemistry Department at the University of Wisconsin-Madison in 1960. He reached the rank of Professor there in 1968. At Wisconsin, he taught mainly freshman chemistry and graduate-level radiochemistry. A subbasement radiochemistry lab and roomful of gamma-ray spectrometry equipment for NAA (neutron activation analysis) were the heart of the research laboratory. Still interested in trace elements in rocks, he became one of the founders of the field of rare-earth element

geochemistry and gradually abandoned work on nuclear reactions. His paper "Dispersed and not-so-rare earths" with Fred Frey, one of his early students, was the first scientific paper I ever read (Haskin and Frey, 1966) and one that I still recommend to new students in geochemistry.

In the late 1960's Larry became one of the first NASA-funded principal investigators for study of anticipated samples from the Apollo missions to the Moon. Although lunar sample studies dominated his efforts in the 1970's, Larry was simultaneously working on environmental geochemical issues and trace-element fingerprinting of obsidian artifacts. In 1973, ten months after the last Apollo mission, Larry and his research group moved from Madison to Houston, where Larry became the Chief of the Planetary and Earth Sciences Division at

the NASA Johnson Space Center. His major accomplishment at JSC was to begin the task of securing the lunar sample collection for future researchers by building a safer, modern curatorial facility and moving a portion of the collection away from storm-prone Houston. Larry missed academia and was delighted in late 1976 to become Professor and Chairman of the Department of Earth and Planetary Sciences, Professor of Chemistry, and a fellow of the



Larry A. Haskin

McDonnell Center for the Space Sciences at Washington University. His mission was to build a foundering geology department into a first-class department of earth and planetary sciences. In 1986, Washington University promoted him to the position of Ralph E. Morrow Distinguished University Professor. He officially retired at the end of 2002.

Much of Larry's research during the 1970's and 1980's bridged lunar geochemical systems and terrestrial analogs of lunar geochemical systems. With students and post-docs, he developed better experimental methods and better models for how trace elements behave in rock-forming situations. Larry and his associates adapted electrochemical techniques used in aqueous solutions to study trace elements in silicate liquids at 1500° C. Later, they showed that electrolysis of lunar soil could produce oxygen gas and iron and silicon metals efficiently for use in space. Larry was an enthusiastic and inexorable visionary. In the mid 1990's he became convinced that it should be possible, at any point on the lunar surface, to pick up a rock and calculate the probability, for each nearby crater or basin, that the rock was part of the ejecta deposit of the crater or basin. He spent a good part of the last ten years developing a mass-balance-constrained model for lunar ejecta deposits that could answer the questions he asked as a geochemist.

In 1994 he had a casual conversation with Alian Wang, a physicist and spectroscopist working in our department. Alian mentioned that a Raman spectrometer could be made very small with modern technologies. As a physical chemist, Larry knew the potential of Raman spectroscopy for mineral characterization. The primary focus of the last ten years of his professional life was to build and fly a Raman spectrometer for use on robotic missions to Mars – the "Mars Microbeam Raman Spectrometer" or MMRS. Although the MMRS was not flown as part of the Athena payload, his work led him to be a member of the Athena science team for the Mars Exploration Rovers missions. Despite his deteriorating health, Larry spent the several months of the last year of his life in Pasadena, as a MER science team member asking hard geological questions of his younger colleagues. The last manuscript that Larry drafted was on the water alteration of the rocks and soils at Gusev Crater, Mars.

Larry was a Guggenheim fellow at the Max Planck Institute for Nuclear Physics near Heidelberg in 1966–67, and he received NASA's Exceptional Scientific Achievement Award in 1971. He served on numerous NASA committees, including the Lunar Sample Analysis Planning Team, Physical Sciences Committee, Lunar Advisory Committee, Lunar and Planetary Review Panel, Solar System Exploration Committee, Solar System Exploration Management Council, Lunar Exploration Science Working Group, Exploration Science Working Group, Space and Earth Sciences Advisory Committee, and NASA Advisory Council as well as several NRC committees, including Mercury Review Panel, U.S. National Committee on Geochemistry, and Committee on Planetary and Lunar Exploration. He served as president of the Geochemical Society (1987–1989). In 2000 he received a recognition that he valued most. He was among nine Washington University faculty who received the first Outstanding Faculty Mentor Awards following nomination by current and former students. Larry's most lasting legacy is the cadre of enthusiastic mentorees that have worked with him. Larry is survived by his wife (and early scientific colleague) Mary (Haskin and Gehl, 1962, 1963a,b; Haskin and Haskin, 1966, 1968), children Dierk, Rachel, and Jean, and four grandchildren.

Selected Publications, in Chronological Order

- Haskin L. A. (1960) *Analysis for Uranium by Neutron Activation and Reactions of Energetic Recoil Tritium with Solvent Mixtures*. Ph.D. dissertation, University of Kansas, Lawrence.
- Haskin L. A., Fearing H. W., and Rowland F. S. (1961) Neutron activation analysis for U, especially in limestones, by measurement of Xe. *Anal. Chem.* **33**, 1298–1301.
- DeGrazia A. R. and Haskin L. (1964) On the gold contents of rocks. *Geochim. Cosmochim. Acta* **28**, 559–564.
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Meet the New GS/EAG Fellows

Nicholas T. Arndt is recognized for his seminal work on komatiites: ultramafic lavas that erupted primarily in the Archean era and provide first-hand information about the temperature and composition of Earth's early mantle. Throughout his career, Dr. Arndt has provided a rare integration of detailed field work, petrology and isotope and trace element geochemistry that has served to bridge the gap between geodynamics, geochemistry and petrology to illuminate the differentiation and origin of komatiites, and from this, the nature of the early Earth. Dr. Arndt received his PhD at the University of Toronto in 1975 and has held a number of research posts in the USA, Canada, Germany and France, where he took up his present position at the Universit Joseph Fourier, Grenoble, in 1991.



Stein B. Jacobsen

Stein B. Jacobsen is recognized for his fundamental insights into geo- and cosmochemistry. These include (but are not limited to) defining the Sm-Nd evolution of chondritic meteorites, development of transport models for crust-mantle evolution and modeling Sr and Nd isotopic constraints on crustal growth and recycling, establishing the Sr and Nd isotopic signatures of the oceans through much of Earth history, pioneering work on the ^{182}Hf - ^{182}W system in meteorites and subsequent constraints on core-mantle differentiation and the accretion history of the Earth. Dr. Jacobsen received his PhD from the California Institute of Technology in 1980 and joined the Harvard faculty in 1981.



Nicholas T. Arndt

the source and cycling of organic matter in aquatic environments and for his outstanding cooperation and collaboration within the geochemical community, including the mentoring of young scientists. A hallmark of Dr. Wakeham's research is his development of state-of-the-art analytical methodologies for analysis of organic matter in natural environments, a highlight of which has been to illuminate the sources and fates of lipids in the ocean water column and sediments. Dr. Wakeham obtained his PhD from the University of Washington in 1976 and, after a two-year postdoc at the Swiss Federal Institute of Technology, spent nine years as a research scientist at the Woods Hole Oceanographic Institute before moving to the Skidaway Institute of Oceanography in 1987.

Stuart G. Wakeham is recognized for his fundamental contributions towards understanding



Stuart G. Wakeham



Lynn M. Walter

Lynn M. Walter is recognized for her seminal contributions to understanding low temperature water-rock interactions and for her education and mentoring of a large number of young geochemists. Highlights of her work include ground-breaking papers on mineral dissolution kinetics, the origin of dolomite, weathering of carbonate rocks and the origin and composition of waters and gases in sedimentary basins. Dr. Walter received her PhD from the University of Miami (Miami, FL) in 1983 and spent five years at Washington University, St. Louis, before moving to her current position at the University of Michigan, Ann Arbor.

And joining the GS Board of Directors are...

Laurie Reisberg will join the GS Board of Directors in April 2005. Dr. Reisberg's research interests center on the evolution of the Earth's mantle. She has used radiogenic isotopes to study the origin and age of the subcontinental lithosphere, the relationship between the lithosphere and the convecting mantle, and the interactions between mantle peridotites and percolating melts and fluids. Her particular speciality is the Re-Os isotopic system. She has applied this technique not

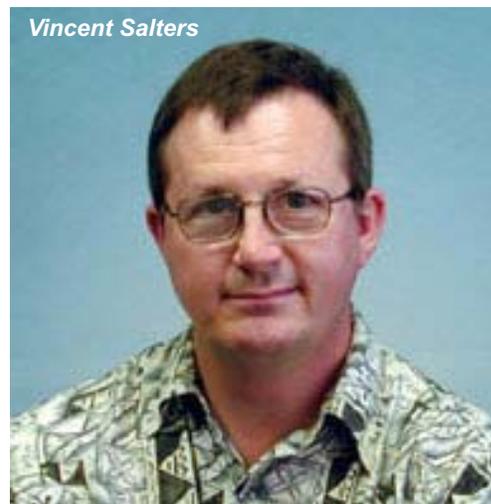


Laurie Reisberg

only to study mantle evolution, but also to investigate the highly siderophile element budget of the Earth, the origin of precious metal deposits, Himalayan erosion, and most recently, groundwater processes. She is a research scientist at the Centre de Recherches Petrographiques et Geochimiques (CRPG-CNRS) in Nancy, France.

Vincent Salters' research interests are in trace element and isotope geochemistry. Most of Salters' research is concentrated on quantifying processes that bear on the differentiation of our planet using trace elements and isotopic techniques. This research includes melt generation beneath mid-ocean ridges both through trace element and isotope studies as well as through experimental partitioning studies. It also includes studies of ocean island basalts to determine the processes that generate chemical and isotopic enrichments in the Earth's mantle. In addition, Salters has active research interest in low temperature processes, especially in the area of speciation of metals and relationship between speciation and bioavailability. This work centers on instrumentation development and novel analytical techniques which allows a new "look" at the speciation of metals with dissolved organic matter.

Vincent Salters



The 2005 Clarke and Patterson Medal Winners

James A. Van Orman is the recipient of the 2005 F.W. Clarke Medal. The medal recognizes Van Orman for his experimental and theoretical contributions to our understanding of diffusion in the deep Earth and its consequences for trace-element geochemistry and rheological behavior. Dr. Van Orman received his PhD from the Massachusetts Institute of Technology in 2000. He was then an NSF Postdoctoral Fellow at the Carnegie Institution of Washington for two years before moving to his current position as Associate Professor at Case Western Reserve University in Cleveland, Ohio.

James A. Van Orman



Kenneth Bruland, of the University of California Santa Cruz, is the winner of the 2005 Clair C. Patterson Medal for Environmental Chemistry. The medal recognizes Bruland's exceptional contributions to the field of trace metal biogeochemistry and elemental cycling in the ocean. Bruland pioneered the development of modern sampling and analytical protocols for the determination of trace metals and metalloids in natural waters. Bruland's early work produced some of the first "oceanographically consistent" profiles of trace metals in the Pacific Ocean and was central for guiding subsequent conceptual interpretations and analytical efforts. He helped establish

Kenneth Bruland



²³⁴Th disequilibria in the mixed layer of the ocean as a basis for

measuring new production. Most recently, Bruland's group has made major contributions to our understanding of the importance of natural organic ligands on the chemical speciation and biological utilization of elements such as Fe and Zn in marine systems. His interdisciplinary research has significantly enhanced knowledge of the behavior and biogeochemical importance of trace metals in the ocean, and provided a basis for investigation of environmental pollution and toxicological effects of metals. Bruland earned his B.A. in Chemistry from Western Washington University and his Ph.D. in oceanography from Scripps Institution of Oceanography. He joined UCSC in 1974.

Geochemistry at U. S. National Labs: *Sandia National Laboratories*

Randall T. Cygan, Patrick V. Brady, Malcolm D. Siegel,
Carlos F. Jové Colón, and Charles R. Bryan

Introduction

The pink-colored granite of the Sandia Mountains in central New Mexico provides the backdrop for geochemistry research activities at Sandia National Laboratories in Albuquerque, New Mexico. Sandia National Laboratories is funded primarily by the U. S. Department of Energy and is managed by Lockheed Martin Corporation. Additional research facilities in Livermore, California; Carlsbad, New Mexico; Amarillo, Texas; and Kauai, Hawaii (Yes, Kauai!) combine to make Sandia the leading national security, science, engineering, and energy laboratory in the world. Sandia partners with a variety of other government, industry, and academic institutions to provide “exceptional service in the national interest” for a wide array of applied and basic science concerns. Established in 1948 by President Harry S. Truman, Sandia was originally responsible for designing all of the non-nuclear parts of nuclear weapons. Since those early days of the Cold War, Sandia has expanded its role to address key issues in science and engineering projects that contribute in various ways to national security and critical energy issues. Today, Sandia employs approximately 8,600 people, has an annual budget of \$2.3 billion, and is involved in diverse research ranging from the design of environmental microsensors for homeland security to the development of a noninvasive blood glucose monitoring device for diabetes patients.

Geochemical research at Sandia originally developed in part from corrosion studies of metals and alloys conducted in the mid-1970s, mostly in support of technical efforts to extract alternative energy by drilling into volcanic systems. The expanding need to evaluate materials stability under relatively high temperature and high pressure led to the hiring of several qualified PhD scientists from the ranks of leading experimental petrology laboratories in universities. William Luth, in particular, did much to expand Sandia’s geochemistry staff and laboratory facilities during this early period and into the 1980s. Sandia’s present-day

Geoscience and Environment Center—comprised of Geochemistry, Geophysics, Geomechanics, Geohydrology, and Geotechnology Departments—owes much to Luth’s ability to recognize the essential role of geoscience research in alternative energy, waste management, environmental, material science, and national security issues. Also during the 1970s, Sandia took on a leadership role in the development of the Waste Isolation Pilot Plant (WIPP) for the permanent storage of low-level nuclear waste in bedded salt deposits near Carlsbad, New Mexico. Geophysicists and geochemists from Sandia led continental drilling projects in Hawaii, Oregon, California, and Alaska during this period. With a firmly established reputation in these various arenas, scientists at Sandia were poised to participate in growing research programs in environmental geochemistry, especially as applied to the safe storage and remediation of radionuclides and the cleanup of hazardous chemical wastes, both important concerns to the U. S. Department of Energy and the legacy of the Cold War.

Through the 1990s and to the present day, geochemistry staff at Sandia have continued to lead research programs in environmental chemistry, radionuclide and chemical waste remediation, water quality and potability, waste stream management, materials synthesis and processing, and numerous other research topics. Many of these studies emphasize the fundamental aspects of geochemical processes, often at the atomic- and nano-scale. Yet, technical solutions are often obtained through extension of the laboratory and theoretical studies, leading to development, testing, and ultimate application to the field site. The Geochemistry Department operates several modern wet chemistry laboratories that contain advanced experimental, analytical, spectroscopic, and imaging tools. Along with access to other state-of-the-art analytical and computational facilities throughout the labs, these facilities and the research staff provide an impressive foundation for geochemistry research to continue to flourish at Sandia.



The following sections provide snapshot summaries of several ongoing geochemical research programs at Sandia National Laboratories. Although not meant to be exhaustive and detailed, they provide examples of the range of fairly basic to relatively applied research projects at Sandia. Most of the geochemistry research is performed in Albuquerque at the main laboratory site, although the Carlsbad facility hosts much of the current research related to WIPP. Funding of geochemical research is provided by several sources and includes various U. S. Department of Energy programs: Office of Basic Energy Sciences, Environmental Management Science Program, Environmental Molecular Science Institute, Advanced Simulation and Computing, National Energy Technology Laboratory, Office of Civilian Radioactive Waste Management, and Waste Isolation Pilot Plant. Among the other funding agencies are the U. S. Nuclear Regulatory Commission, U. S. Environmental Protection Agency, Defense Advanced Research Projects Agency, and the Laboratory Directed Research and Development program at Sandia National Laboratories.

Radioactive Waste Disposal

Geochemistry at Sandia is an integral part of nuclear waste repository programs such as the WIPP in Carlsbad and the Yucca Mountain Project (YMP) in Nevada. Geochemical activities related to these programs focus on supporting Performance Assessment (PA) models. These models are used in the predictive evaluation of radionuclide releases from the waste isolation system. The PA model is evaluated within the scope of regulatory requirements in accord with nuclear waste disposal and environmental safety.

The WIPP transuranic radioactive waste repository is situated in southeastern New Mexico, approximately 35 miles from the nearest significant population center (Figure 1). The repository is located 655 m underneath the surface within a Permian bedded salt formation. Given the physical and chemical conditions in this environment, accurate knowledge of actinide solubilities and aqueous complexation in brines is needed to derive appropriate solubility ranges for implementation in the WIPP PA. The basis for the actinide solubility model includes the use of the Pitzer

activity coefficient approach for modeling concentrated electrolyte solutions. Sandia developed the Pitzer thermodynamic database for WIPP solubility calculations. Another aspect of geochemistry applied to the WIPP project includes experimental and modeling activities assessing the efficiency of the backfill material comprised primarily of MgO (periclase). This backfill

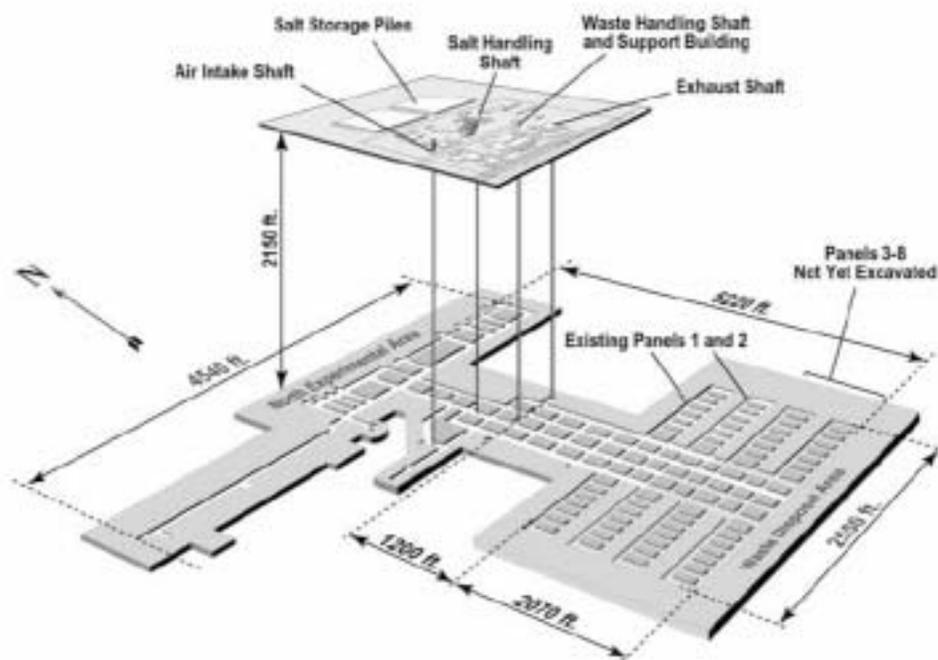


Fig. 1. Schematic depiction of the Waste Isolation Pilot Plant in southeastern New Mexico.

buffers brine chemistry, thereby reducing actinide solubility at the WIPP repository horizon. Reaction of MgO(s) with H₂O and CO₂ produces brucite and magnesite, thereby reducing CO₂ availability and generating mildly alkaline pH conditions where most actinide solubilities are relatively low.

Other geochemistry issues relevant to underground waste repositories include modeling of the chemical evolution of fluids within the waste site as a consequence of evaporation, mixing, thermal transients, variable pH and Eh, and other related processes. Evaluation of chemical changes due to these complex processes is made through the use of equilibrium aqueous speciation and reaction path calculations based on specialized thermodynamic databases. Characterization of the fluid chemistry is important in the assessment of corrosion environments on and within waste packages, and radionuclide solubilities and colloid stability in in-package and in-drift solutions. Other Sandia-based activities include experimental investigations to establish: 1) the likely redox state inside breached waste packages at the repository, 2) the effectiveness of waste package corrosion products in retarding problematic radionuclides, and 3) the development of

effective radionuclide sorbents or “getters” to impede radionuclide mobility in repository areas beyond the waste package.

Geochemical Molecular Modeling

Advances in molecular modeling software and the availability of faster computer workstations over the past decade have provided an opportunity for geochemists to expand their theoretical tools. Today, it is not unusual to combine laboratory and field observations with atomistic-based computer models to better understand geochemical processes. Molecular models, or computer experiments, provide a convenient method for controlling variables in complex mineral and mineral-fluid systems to better evaluate structure, dynamics, thermodynamics, and kinetics. Sandia has been at the forefront of these efforts since the early 1990s with theoretical work relating to understanding the behavior of radionuclide sorption on mineral surfaces.

Classical simulation methods, in which the energies of atomic interactions are described by relatively simple analytical functions, are often used to evaluate large complex systems with the number of atoms ranging from hundreds to perhaps millions. Monte Carlo and molecular dynamics (MD) simulations can now be performed on either a personal computer or workstation. Large-scale simulations, involving many hundreds of thousands of atoms, require computer clusters or massively parallel supercomputers. At Sandia, we have the capability of running MD simulations of a million atoms for a million time steps—one nanosecond based on a femtosecond time step. Similarly, quantum approaches with either Hartree-Fock or density functional methods have allowed the geochemist to perform *ab initio* calculations on much smaller chemical systems (typically under a hundred atoms), but without relying on a parameterized force field. Recent research at Sandia relating to the interaction of water on oxide surfaces has used *ab initio* MD methods in which the Schrodinger’s equation is solved for every dynamics time step, although simulation time is limited on the order of several picoseconds.

Molecular modeling at Sandia has been used to explore numerous geochemical and material science problems over the past years. MD methods have been incorporated to examine the efficacy of various waste treatment approaches. The recent development at Sandia of a generalized energy force field for the simulation of complex hydrated systems has led to several new research efforts for evaluating the binding of various metal cations or organic contaminants on the surface of an oxide or hydroxide, and in the interlayer of complex clay.

One example of the latter

is provided in Figure 2 for the case of uranyl (UO_2^{2+}) sorption from an aqueous solution onto the basal surface of montmorillonite. Large-scale MD calculations were performed for up to a nanosecond of simulation time using the LAMMPS parallel code and a Linux PC cluster. A snapshot from the equilibrated system exhibits the sorption of two different uranyl complexes onto the basal surface. Ultimately, analysis of the simulations and derivation of atomic density profiles provide a unique method for evaluating partition coefficients (K_D) for chemical species between a solid and an aqueous solution. For example, the uranyl-montmorillonite model provides a technical basis for evaluating the wide range of K_D values from experimental and field studies of uranium sorption and groundwater transport, especially for incorporation in PA models.

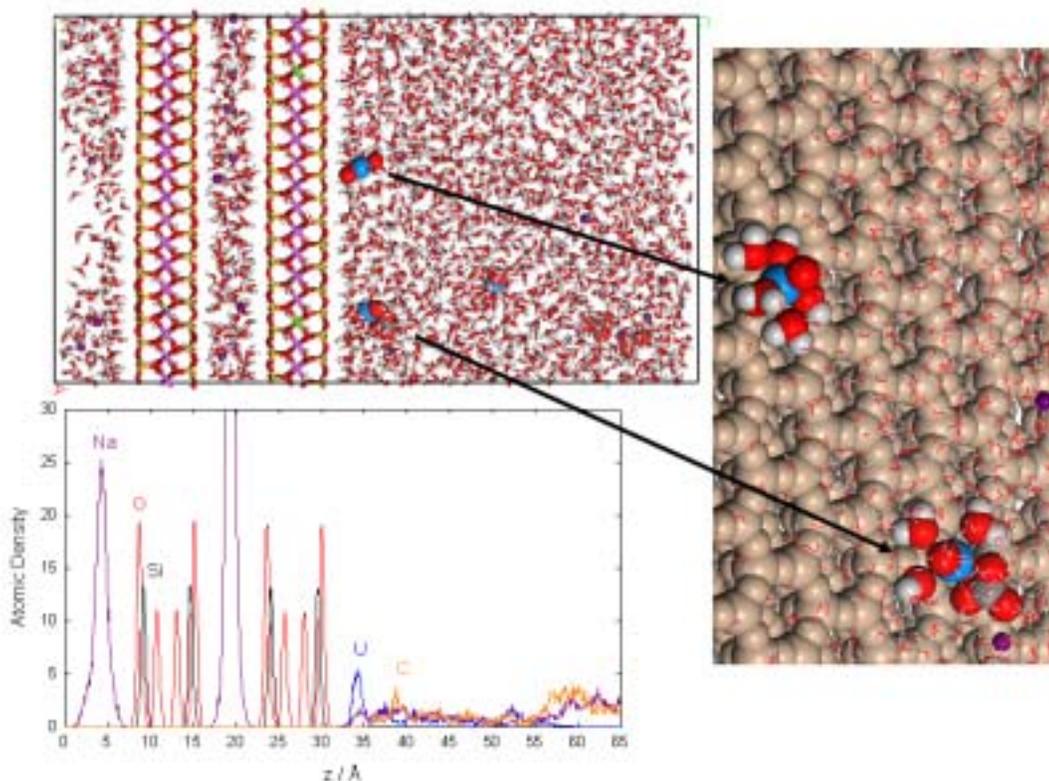


Fig. 2. Results of a large-scale molecular dynamics simulation of the sorption of uranyl groups onto the basal surface of montmorillonite clay. The upper images show views of the sorbed uranyl complexes, one as a uranyl hydrate and the other as a uranyl carbonate hydrate. The lower plot provides the corresponding atomic density profile normal to the clay basal layer. Research is sponsored by the U. S. Nuclear Regulatory Commission.

Advanced Desalination Technologies

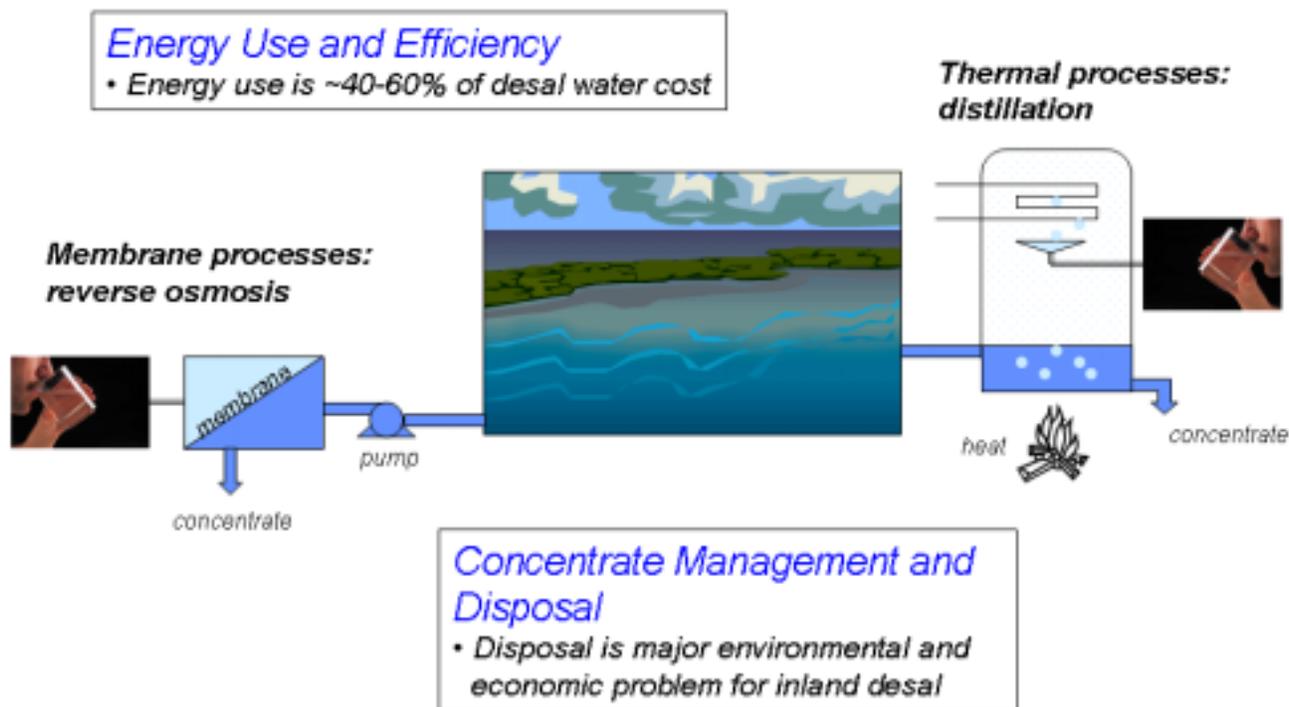


Fig. 3. Major technical pathways for the desalination and the production of potable water. Technical challenges include the energy efficiency and waste stream management.

Related molecular modeling studies in geochemistry at Sandia include the simulation of metal-anion pairing and sorption on oxides and hydroxide surfaces, the structure and dynamics of gas hydrate systems, the behavior of water in various clay phases, the stability of layered double hydroxides (LDH; inverse clays), the intercalation of amino acid anions in LDH, and the sorption of metals onto the cell wall of microbes. Collaborative efforts in materials science have also led to successful molecular modeling projects. Classical and quantum methods have been used to successfully model the structure and behavior of lithium manganese compounds for bulk and thin film battery components. Similarly, molecular modeling efforts have contributed to understanding atmospheric corrosion of metals, especially in evaluating the behavior of water at the metal-water and oxide-water interface. Crystal growth and morphology of zincite have been extensively investigated to support the development of nanostructured oxides for applications as diverse as optical sensors to the controlled separation of proteins.

Desalination and Water Purification

Recurring drought in the western United States, the increasing overallocation of water in much of the rest of the country, and concern about water-borne micropollutants has prompted a national search for technological solutions that can produce “new water”—useable water from brackish groundwater, from seawater,

from agricultural and municipal return flows, or from water previously made unusable by the presence of trace contaminants such as arsenic or perchlorate. Nine orders of magnitude span the contaminant removal levels needed for water purification: from NaCl at parts per thousand (ppt) in seawater, to arsenic and perchlorate at parts per billion (ppb), to NDMA (n-nitrosodimethylamine) and pharmaceuticals at parts per trillion (ppt). Removing a contaminant present at 1 ppt is equivalent to extracting the dissolved mass of a grain of sugar from an Olympic-sized swimming pool. The science of water treatment is obviously being challenged as never before.

The problem might be broken down into two distinct processes: micropollutant removal from water through sorption/oxidation/reduction and removal of water itself from macropollutants (brines). Both tend to be controlled by interfacial processes. Micropollutant removal often relies on inorganic filter media (typically metal oxides). Reverse osmosis through organic membranes is used for desalting (Figure 3). And there is the expectation that engineered biologically-active interfaces will play a larger role in both treatments in the future.

One aspect of the future of water treatment is fairly easy to anticipate: most, if not all, *major technical advances will come from an improved understanding of the microscopic behavior of water and contaminants at engineered interfaces*. Research at Sandia proceeds on this hypothesis by teaming Sandia and outside researchers on a wide variety of research topics that hold in common the linking of fundamental microscopic behavior with macroscopic improvements in the science of water treatment. Sandia represents a unique convergence of technical expertise

in interfacial chemistry, molecular design, and aquatic chemistry—all in a region that is facing several simultaneous train wrecks of water problems including salt accumulation, arsenic contamination, and persistent drought.

Sandia's water treatment work bridges from the theoretical to the applied through several programs: Long range Desalination/Water Purification research, and "jump-start" testing. Arsenic treatment pilot testing is in partnership with the American Water Works Association Research Foundation—AwwaRF—and WERC (see below). The jump-start program seeks to accelerate the implementation and commercialization of new desalination technologies, primarily at the Tularosa Basin National Desalination Research Facility, presently being constructed near Alamogordo, New Mexico. At the same time, Sandia is working with AwwaRF, the WaterReuse Foundation, and the Bureau of Reclamation to develop a national roadmap for desalination/water purification research. Some research areas are listed below to provide a flavor of Sandia's water science research effort:

Fig. 4. Sandia Pilot Arsenic Treatment Pilot System: Each of the three columns and the cartridge on left contains a different adsorbent medium. The three columns on right contain a single medium (granular ferric oxide) with different contact times.



- Molecular design of sorbents for arsenic and perchlorate
- Development of self-sealing evaporation ponds
- Clathrate crystallization desalination
- Optimization of GAC surface chemistry for perchlorate removal
- Electrodialysis for concentrate management of inland brines
- Biomimetic membrane design
- Enzymatic reduction of biofouling

Arsenic and Drinking Water

The Arsenic Water Technology Partnership (AWTP) program is a multi-year program funded by a congressional appropriation through the U. S. Department of Energy to develop and test in-

novative technologies that have the potential to reduce the costs of arsenic removal from drinking water. The AWTP members include Sandia National Laboratories, the American Water Works Association (Awwa) Research Foundation, and WERC (A Consortium for Environmental Education and Technology Development). The program is designed to move technologies from bench-scale tests to field demonstrations. The Awwa Research Foundation is managing bench-scale research programs; Sandia is conducting the pilot demonstration program and WERC will evaluate the economic feasibility of the technologies investigated and conduct technology transfer activities.

The scope for field demonstration testing by Sandia includes 1) selection of sites and identification of technologies for pilot demonstrations, 2) laboratory studies to develop rapid small-scale test methods, and 3) pilot-scale studies at community sites involving side-by-side tests of innovative technologies. The goal of site selection is to identify sites that allow examination of treatment processes and systems under conditions that are relevant to different geochemical settings throughout the country. A num-

ber of candidate sites have been identified through reviews of groundwater quality databases, conference proceedings and discussions with state and local officials. These include sites in New Mexico, Arizona, Colorado, Oklahoma, Michigan, and California.

Most of the treatment technologies being considered for pilots fall into two broad categories: 1) sorption processes that use fixed bed adsorbents and 2) membrane processes including coagulation/filtration with or without electrochemical processes. Several innovations that could lead to lower treatment costs have been proposed for adsorptive media systems. These include: 1) higher capacity and selectivity using mixed oxides composed of iron and other transition metals, titanium and zirconium based

oxides, or mixed resin-metal oxides composite media; 2) improved durability of virgin media and greater chemical stability of the spent media; and 3) use of inexpensive natural or recycled materials with a coating that has a high affinity for arsenic. Improvements to filtration-based treatment systems include: 1) enhanced coagulation using improved iron compounds, polyelectrolytes, and electrical gradient or via electrochemical reactions and 2) improved filtration with nanocomposite materials.

The conceptual treatment process for arsenic adsorption media filters is based on passing arsenic-contaminated feed water through a fixed bed of media that has a strong affinity for arsenic. The removal capacity and effectiveness of the arsenic removal media is dependent on a number of factors, of which surface area and specific chemical affinity of the arsenic for the surface are of primary importance. Other factors that determine the capacity and effectiveness of adsorbent media are accessibility of the pore sites for arsenic ions, time available for arsenic ions to migrate to pore sites, competing ions for pore sites, concentration of arsenic in the feed water, and the pH of the feed water. As water passes down through a filter vessel containing fixed bed media, the arsenic concentration declines until it is no longer detectable. As the upper portion of the media becomes saturated, the treatment region (mass transfer zone) progresses downward until all adsorptive capacity is used and arsenic breakthrough occurs. In the pilot tests, the innovative technologies are evaluated in terms of adsorptive capacity for arsenic; robustness of performance with respect to water quality parameters including pH, TDS, foulants such as Fe, Mn, silica, and organics, and other metals and radionuclides; and potentially deleterious effects on the water system such as pipe corrosion from low pH levels, fluoride removal, and generation of disinfection by-products.

The first pilot test is being conducted on water from a geothermal spring used to supply drinking water to Socorro, New Mexico, a town of about nine thousand residents located eighty miles south of Albuquerque. The objectives of the Socorro Pilot include evaluation of: 1) the treatment performance of five adsorptive media using the same water source, 2) the effects of pH adjustment and contact time on the performance of selected media; and 3) limited assessment of maintenance and operational requirements for all media. The adsorptive media include two granular ferric oxides, a titanium oxide, a zirconium oxyhydrate, and a hybrid anion exchange resin-ferric oxide material (Figure 4). The treatment performance is based on the arsenic removal capacity of all five media under ambient pH conditions (approximately 7.7). Three of the media are also evaluated at an adjusted pH of 6.8 to determine the effect on arsenic removal capacity. The pH is lowered using a CO₂ injection system, which does not require the use of mineral acids. A second parameter, empty bed contact time (EBCT), is varied for one of the granular ferric oxide media to determine the correlation between treatment contact time and arsenic removal capacity. The results of this last test will help design future, potentially shorter, pilot tests.

The new Maximum Contaminant Level (MCL) for arsenic may be one of the most costly health regulations ever promulgated. The projected annual national compliance cost of implementing the new 10 g/L standard ranges from \$165 million, estimated by the U.S. EPA to \$605 million, estimated by AwwaRF. Sandia's program may help to alleviate some of the burdens associated

with the standard by 1) comparing the costs and performance of alternative methods for arsenic treatment in specific community wells in side-by-side pilot tests of several different technologies and 2) by identifying potentially deleterious effects associated with different technologies. As technologies progress from a bench-scale demonstration phase to full-scale commercial production, it is likely that significant cost reductions will be realized. However, at this time, the potential magnitude of cost savings associated with innovative adsorptive media or other treatment processes can not be accurately estimated. Through direct field demonstration and the associated outreach program, the Sandia program can provide independent evaluations of the relative merits of the numerous alternative technologic choices that will be presented to communities throughout the U. S. In addition, although the compliance deadline for the new arsenic standard is January 2006, there will be opportunities for water utilities to apply for exemptions, extensions and variances. These will allow communities the time to gather additional information from this and other programs and make a more informed choice of technology. The information might prevent expensive mistakes from being made by small communities, especially those that have few technical or financial resources to carry out adequate assessments of the claims made by vendors about their products.

Coda

Finally, for those wondering about the origin of the word *Sandia* from which the laboratories has taken its name, you may want to consult your high school Spanish dictionary. *Sandia* is the Spanish word for *watermelon*, and was supposedly used by the sixteenth-century Spanish explorers of the Rio Grande valley to describe the majestic west-facing mountains reflecting the setting sun. The Precambrian Sandia granite is capped by a distinctive white band of Pennsylvanian carbonates to collectively suggest a section of watermelon to the imaginative, and, perhaps, thirsty Spanish explorer. Ultramafic xenoliths associated with the granite might even be interpreted as the watermelon seeds.

Additional information on Sandia National Laboratories and geochemical activities at the labs can be obtained at www.sandia.gov and www.sandia.gov/eeselector/gc/gc/geochem, respectively. Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.



BOOK REVIEW:

Geochemistry of Non-Traditional Stable Isotopes

Reviews in Mineralogy and Geochemistry, volume 55

Clark M. Johnson, Brian Beard and Francis Albarède, editors

This volume accompanied the MSA short course, "Geochemistry of non-traditional stable isotopes" which was held in May 2004 at the Toronto AGU meeting. The term "non-traditional stable isotopes" refers to elements other than CNOSH (the "traditional stable isotopes") in which mass-dependent fractionations have been found in terrestrial and meteoritic materials. The book starts with a delightful foreword by Jim O'Neil, which is followed by a section on fundamentals and background, which includes a good overview chapter by the convenors of the conference; an excellent chapter from Edwin Schauble (UCLA) on calculation of equilibrium and kinetic isotope fractionations (this talk was widely regarded as the best presentation at the meeting); a very solid review of nucleosynthesis and isotopic anomalies in extraterrestrial materials; and a chapter on analytical methods which has an elegant and formal characterization of multicollector ICPMS (MC-ICPMS). The background section of the book is then followed by chapters which focus in on the individual elements Li, Mg, Cl, Ca, Se, Cr, Fe, Cu, Zn, and Mo. Each of these provides an excellent review of the current knowledge of the systematics of mass-dependent fractionation for the element being treated.

While there is a long history of investigation of the isotope ratios of Li, Cl, Ca, and Se, using IRMS, TIMS, and SIMS, this volume appropriately serves to focus attention on MC-ICPMS. It is the advances in the analytical capabilities of MC-ICPMS instruments, and our increasing understanding of how to make accurate measurements with MC-ICPMS instruments, that are driving the field. The goal is to put the isotope ratios of the "non-traditional isotopes" on the same footing as those of carbon, oxygen, hydrogen, nitrogen and sulfur, so that they too can be used as tracers and fingerprints of physical processes and material sources, capable of providing quantitative constraints on physical processes and elemental cycling. We are not there yet, by any means, but progress is rapid. At the point that we can just refer to "stable isotope geochemistry" without differentiating between "traditional" and "non-traditional", we will know that we are there.

At a conference that I attended in the '80s, Ernst Zinner responded to a question on the future directions of the search for pre-solar system grains with the succinct answer "isotopes, isotopes, isotopes". That is no less true today than it was then.

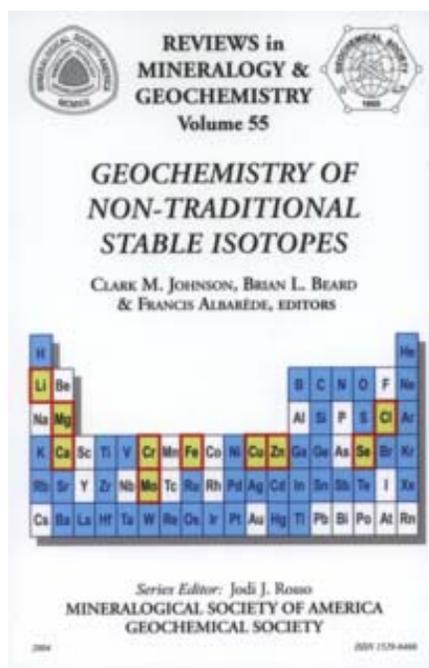
The ability to measure hitherto inaccessible information that is recorded in the natural variations of the stable isotopes of Fe, Zn, Cu, Mo, Mg, Si, Ti, Cu, Tl, Hg, Cd, Sn, Tl, Sb etc., will lead to a lively development of this field for the foreseeable future.

Even though almost all of the researchers currently investigating variations in non-traditional isotopes are geo- (or cosmo-) chemists (as was the case with the traditional isotopes), the discoveries of, *inter alia*, Fe isotope variations in humans, Hg isotope variations in the environment and Cd isotope variations in food webs, indicate that geochemists will be joined by researchers from many disciplines in measuring and interpreting the variations in the non-traditional isotopes. Even after fifty years, there are new and exciting developments in stable isotope methodology (development of isotope ratio monitoring technologies) and systematics (non-mass dependent fractionation of O and S isotopes, isotopomers and isotopologues) so I would expect that the opening up of the rest of the periodic table for investigation will prove to be no less exciting than the last fifty years has been for "traditional stable isotopes".

This book has all of the characteristics that we have come to associate with MSA review volumes- it is well written and well edited; it is both timely and up to date; it is readable; and it is eminently affordable. This book is not so much a smorgasbord, offering up an overview of all of the "non-traditional stable isotopes", as it is a sampler of the work that is going on.

Because each of the contributions is comprehensive and provides an historical background, the individual chapters each stand on their own and will serve as valuable starting points for students and people new to the field for quite some time to come. Paraphrasing from a book review I once read, ("if you like this sort of book, this is the sort of book that you will like"), "if you like isotopes, this is the sort of book that you will like!"

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Safford, Arizona USA
thermochuck@starband.net



MEETINGS CALENDAR

Apr 3-7, 2005: International Conference on the Biogeochemistry of Trace Elements (ICOBTE), Adelaide, Australia. E-mail: 8thICOBTE_AT_csiro.au; Web site: <http://www.clw.csiro.au/conferences/8thicobte/>

Apr 4-6, 2005: SEGh2005, 23rd European Conference Society for Environmental Geochemistry and Health, University of Paisley, U.K. Web site: <http://www.paisley.ac.uk/es/seg/index.asp>

Apr 5-8, 2005: First Cuban Earth Sciences Convention & Exhibition of New Technologies and Services, International Convention Center (Palacio de las Convenciones) Havana, Cuba. Contacts: Dr. Evelio Linares Cala and Dr. Manuel A. Iturralde-Vinent; E-mail: bello_AT_cinpet.cupet.cu and Iturralde_AT_mnhnc.inf.cu; Web site: <http://www.scg.cu/geociencias05.htm>

Apr 6-8, 2005: Trace gas & aerosol flux measurement techniques, Risoe, Denmark. Web site: <http://www.risoe.dk/konferencer/BIAPLUX/Workshop2005.htm>

Apr 14-20, 2005: 5th International Symposium on Eastern Mediterranean Geology, Thessaloniki, Greece. Web site: <http://geonet.geo.auth.gr/5thISEMG/>

Apr 24-27, 2005: Mining Rocks: Mining Industry Conference and Exhibition CIM/ICM, Annual Meeting, Metro Toronto Convention Centre, Toronto, Canada. Web site: <http://www.cimtoronto2005.org>

Apr 24-29, 2005: World Geothermal Congress - 2005, Antalya, Turkey. Web site: <http://www.wgc2005.org/>

Apr 25-29, 2005: European Geosciences Union (EGU) XXX General Assembly, Nice, France. Sponsors: EGU, AGU. Contact: EGU Office, Max-Planck-Str. 13, 37191 Katlenburg-Lindau, Germany; Phone: +49-5556-1440; Fax: +49-5556-4709; E-mail: egu_AT_copernicus.org; Web site: www.copernicus.org/EGU/EGU.html

May 2-6, 2005: 37th International Li ge Colloquium on Ocean Dynamics: Gas Transfer at Water Surfaces, Liège, Belgium. Web site: <http://modb.cec.uilg.be/colloquium/2005.html>

May 5-7, 2005: The Fourth International Colloquium "Magmatism, Metamorphism and Associated Mineralizations", Agadir, Morocco. Organization: The Department of Geology of the Faculty of Sciences of Agadir, under the auspices of the Minister of Scientific Research. Contact: Secrariat du colloque 3MA, Département de géologie, Faculté des Sciences, Agadir B.P. 8106 Cité Dakhla, Agadir, Morocco; Phone: +212 48 22 09 57; Fax: +212 48 22 01 00; E-mail: Colloque3ma_AT_esta.ac.ma or Colloque3ma_AT_yahoo.fr; Web site: <http://3ma.esta.ac.ma>

May 15-18, 2005: Window to the World, John Ascuaga's Nugget, Sparks, Nevada, USA. Contact: Geological Society of Nevada, P.O. Box 13375 Reno, NV 89507, USA; Phone: +1 775 3234569; Fax: +1 775 323 3599; E-mail: gnsymp_AT_unr.edu; Web site: <http://www.gsn2005.org/>

May 15-18, 2005: Halifax 2005, Dalhousie University, Halifax, Canada. 2005 joint meeting of the Geological Association of Canada, the Mineralogical Association of Canada, the Canadian Society of Petroleum Geologists and the Canadian Society of Soil Sciences. Web site: <http://www.halifax2005.ca/>

May 18-20, 2005: Eurock 2005, International Symposium, Brno, Czech Republic. Contact: Dr Pavel Konecny, Inst. of Geonics AS CR, Studentskt 1768, CZ-70800 Ostrava-Poruba, Czech Republic; Phone: +420 69 6979111; Fax: +420 69 6919452; E-mail: konecpa_AT_ugn.cas.cz

May 18-20, 2005: The Second Conference on SDIMI 2005 - "Sustainable Development Indicators in the Mineral Industries 2005", Aachen, Germany. Contact: Ms. Mirjam Rosenkranz, RWTH Aachen University, Institute of Mining Engineering I, Wuellnerstraße 2 - 52062 Aachen, Germany; Phone: +49-(0)241-80-9 5673 or -9 5667; Fax: +49-(0)241-80 92-272; E-mail: rosenkranz_AT_bbk1.rwth-aachen.de; Web site: www.sdimi.org

May 20-24, 2005: Fifteenth Annual V.M. Goldschmidt Conference, Moscow, Idaho, USA; Web site: <http://www.uidaho.edu/gold2005>

May 23-25, 2005: Geoline 2005: International Symposium on Geology and Linear Infrastructures, Lyon, France. Scientific communications: Patrick Ledru, BRGM/Direction de la recherche, Av Claude Guillemin/B.P.6000, 45060 Orleans CEDEX 2, France; E-mail: geoline2005_AT_brgm.fr; Registration, accommodation, etc. Coralie Hossenlopp, Transit Communications, 18 Place Tolozan, 69001 Lyon, France. E-mail: coralie.hossenlopp_AT_mci-group.com

May 23-27, 2005: AGU Joint Assembly, New Orleans, Louisiana, U.S.A. Contact: AGU Meetings Department, 2000 Florida Avenue, NW, Washington, DC 20009 U.S.A.; Phone: +1-202-777-7333; Fax: +1-202-328-0566; E-mail: meetinginfo_AT_agu.org; Web site: www.agu.org

June 12-17, 2005: Acid Rain 2005 - 7th International Conference on Acid Deposition, Prague, Czech Republic. Contact: E-mail acid2005_AT_chml.cz; Web site: <http://www.acidrain2005.cz/>

June and July 2005: marine science summer courses, Bermuda Biological Station for Research, Web site: <http://www.bbsr.edu/Education/summercourses/summercourses.html>

June 3-5, 2005: The Sixth Informal Conference on Atmospheric and Molecular Science, LO-Skolen Conference Center, Helsingør, Denmark. Web site: <http://k15.ki.ku.dk/noneck/>

June 5-9, 2005: XIII International Conference on Heavy Metals in the Environment, Rio de Janeiro, Brazil. Web site: http://www.rioconventionbureau.com.br/rcvb_ingles/congressos/com_frames.htm

June 5-9, 2005: 105th General Meeting American Society for Microbiology, Atlanta, GA, U.S.A. Web site: <http://www.asm.org/Meetings/index.asp?bid=470>

June 6-10, 2005: International Ocean Research Conference, Paris, France. Sponsored by The Oceanography Society and UNESCO's Intergovernmental Oceanographic Commission. Includes session on Biogeochemical Cycles of Trace Elements and Implications for Marine Ecosystems. Web site: <http://www.tos.org/conference.htm>

June 11-15, 2005: 42nd Annual Meeting of The Clay Minerals Society, Burlington, Vermont, USA. Contact: Peter C. Ryan, Geology Department, Middlebury College, Middlebury, Vermont 05753, USA; Phone 1-802-443-2557; E-mail: pryan_AT_middlebury.edu; Web site: <http://www.clays.org>

June 13-17, 2005: 67th Annual International Conference & Exhibition European Association of Geoscientists & Engineers (EAGE), Madrid, Spain. E-mail: eage_AT_eage.org; Web site: <http://www.eage.nl/conferences/index2.phtml?confid=17>

June 19-24, 2005: ASLO Summer meeting, Santiago de Compostela, Spain. Contact: Helen Schneider Lemay, Registration Coordinator and Meeting Manager, ASLO Business Office, 5400 Bosque Boulevard, Suite 680, Waco, Texas 76710-4446, U.S.A.; Phone: +1 254 399 9635 or toll-free: 800-929-ASLO; Fax: +1 254 776 3767; E-mail: business_AT_aslo.org; web site: <http://aslo.org/santiago2005/>

June 20-24, 2005: Uranium 2005: Uranium Production and Raw Materials for the Nuclear Fuel Cycle, International Atomic Energy Agency Headquarters, Vienna, Austria. Contact: Karen Wenrich, Scientific Secretary, International Atomic Energy Agency, Phone: +43 1 2600 22754; Fax: +43 1 26007; E-mail: Uranium2005_AT_iaea.org; Web site: <http://www-pub.iaea.org/MTCD/Meetings/Meetings.asp>

June 26- July 1, 2005: Significant Processes, Observations and Transformations in Oceanic Nitrogen (SPOT-ON), Warnemünde/Rostock, Germany. Contact: M. Voss, Seestr. 15, Baltic Sea Research Institut Warnemünde, Germany D-18119; Phone: +49 381 5197 209; Fax: +49 381 5197 211; E-mail: maren.voss_AT_io-warnemuende.de; Web site: <http://www.io-warnemuende.de/spot-on/>

June 27-29, 2005: Fourth International Symposium on Turbulence and Shear Flow Phenomena (TSFP-4), Williamsburg, Virginia, U.S.A. Contact: T. B. Gatski E-mail: tsfp4_AT_ofdlab.larc.nasa.gov; Web site: <http://tsfp4.larc.nasa.gov>

June 27-29, 2005: Advances in Marine Ecosystem Modelling Research (AMEMR), Plymouth, U.K. Web site: <http://www.amemr.info/>

June 27-July 1, 2005: International Conference on Mining and the Environment and Metals and Energy Recovery: Securing the Future, Skellefteå, Sweden. Contact: Expolaris Kongresscenter, Skellefteå, SE-931 78 Skellefteå, Sweden; Phone: +46-919-736000; Fax: +46-910-736010; E-mail: kongresscenter_AT_skelleftea.se or tomas.fran_AT_metalgruppen.se or manfred.lindvall_AT_boliden.se or helena.ornberg_AT_kongresscenter.skelleftea.se

July 2-7, 2005: Australian Earth Sciences Convention 2006, Melbourne, Australia. E-mail: earth2006_AT_meetingplanners.com.au; Web site: <http://www.earth2006.org.au/>

July 3-9, 2005: 7th International Ecogite Conference, Seggau, Austria. Contact: iec7_AT_uni-graz.at; Web site: <http://www.uni-graz.at/IEC-7>

July 6-9, 2005: ECROFI XVIII (European Current Research On Fluid Inclusions), Centro Didattico del Laterano, Siena, Italy. E-mail: ecrofiXVIII_AT_unisi.it; Web site: <http://www.unisi.it/eventi/ECROFI XVIII>

July 7-9, 2005: Belomorian Mobile Belt and Its Analogues: Geology, Geochronology, Geodynamics and Metallogeny (BMB_2005), Petrozavodsk, Russia. Web site: http://geoserv.karelia.ru/Rus/conf/BMB/bmb_e.html

July 17-21, 2005: 17th Caribbean Geological Conference, San Juan, Puerto Rico. Contact: J.H. Schellekens, Dept. of Geology, University of Puerto Rico, P.O. Box 9017, Mayagüez, Puerto Rico, 9017; Phone: +1 787 265 3845; E-mail: Geoconf_AT_upr.edu

July 17-22, 2005: 14th International Symposium on Carotenoids, Edinburgh, U.K. Contact: Prof. Andrew J. Young, School of Biological and Earth Sciences, John Moores University, Byron St. Liverpool L3 3AF, U.K. Phone: +44 151 231 2173; Fax: +44 151 207 3224; E-mail: a.j.young_AT_livjm.ac.uk

July 24-27, 2005: Chapman Conference on the Role of Marine Organic Carbon and Calcite Fluxes in Driving Global Climate Change, Past and Future, Woods Hole, MA, USA. Contact: M. Brill, AGU. Phone: +1 202 777 7333; Fax: +1 202 328 0566; E-mail: meetinginfo_AT_agu.org; Web site: <http://www.agu.org/meetings/cc05fcall.html>

July 31-Aug 5, 2005: Gordon Conference on Inorganic Geochemistry, Metals in ore-forming systems: Sources, transport, deposition, Proctor Academy, Andover, New Hampshire, U.S.A. E-mail: Steve.Garwin_AT_geoinformex.com or christoph.heinrich_AT_erdw.ethz.ch or cline_AT_ccmail.nevada.edu; Web site: <http://www.segweb.org/GordonConf.pdf>

July 31-Aug 8, 2005: Fifth International Dyke Conference IDC5, Pohjola/Wilderness Hotel, Polar Circle, Rovaniemi, Finland. Contact: Rovaniemi-Lapland Congresses, University of Lapland, PO BOX 122, FIN-96101 Rovaniemi, Finland; Phone: +358 (0)16 341 2799; Fax: +358 (0)16 317 843; E-mail: congres_AT_ulapland.fi; Web site: <http://idc5.gsf.fi/>

Aug 7-11, 2005 10th International Platinum Symposium: "Platinum-Group Element - from Genesis to Beneficiation and Environmental Impact", Oulu, Finland. Contact: Congress Oulu, P.O. Box 56, Fin-90015 Oulun kaupunki, Finland; E-mail: congressoulu_AT_ouka.fi; Web sites: <http://www.congressoulu.fi/> and <http://platinumsymposium.oulu.fi/>

Aug 7-12, 2005: 8th International Conference on Fluvial Sedimentology, Technical University Delft conference centre, Delft, The Netherlands. Contact: Prof. Dr. S.B. Kroonenberg, Mijnbouwstraat 120, 2628 RK Delft, The Netherlands; Phone: +3115 278 1328; Fax: +31 15 278 1189; E-mail: organizing.committee_AT_8thfluvconf.tudelft.nl; Web site: <http://www.8thfluvconf.tudelft.nl/>

Aug 8-11, 2005: Earth System Processes II, Calgary, Alberta, Canada. Ancient earth systems, modern earth system processes, and earth system futures. An interdisciplinary, integrative scientific meeting exploring the interactions among Earth's lithosphere, atmosphere, hydrosphere, cryosphere, and biota. Organization: Geological Society of America and Geological Association of Canada. Web site: <http://www.geosociety.org/meetings/esp2/>

Aug 18-21, 2005: The 8th Biennial SGA (the Society for Geology Applied to Mineral Deposits) Meeting "Mineral Deposit Research: Meeting the Global Challenge", Beijing, China. Contact: 8th SGA Biennial Meeting, Secretary: Dr. Jingwen Mao, Institute of Mineral Resources Chinese Academy of Geological Sciences, 26 Baiwanzhuang Road, Beijing, 100037 China; Fax: +86-10 68 33 63 58; E-mail: mail_AT_sga2005.com; Web site: <http://www.sga2005.com>

Aug 21-27, 2005: 13th International Clay Conference, Claysphere: past, present and future, Waseda University, Tokyo, Japan. Contact: Prof. T. Sakamoto; Phone: +81 86 252 8922; E-mail: iccl3_AT_das.ous.ac.jp; Web site: <http://www.soc.nil.ac.jp/cssj2/13ICC/>

Aug 22-26, 2005: 13th International Symposium on Placer And Weathered Rock Deposits (PWR-2005) Placer And Weathered Rock Deposits in Activated Platforms and Orogenes, Perm, Russia. Contact: Prof. Natalia Patyk-Kara, IGEM RAS; Phone +7-095-230 8427; Fax:

MEETINGS CALENDAR

+7-095-230 2179; E-mail pkara_AT_igem.ru; Dr. Vladimir Naumov, Permõ State University; E-mail naumov_AT_psu.ru, Prof. Boris Osovetsky, Permõ State University, E-mail minmuseum_AT_psu.ru

Aug 22-26, 2005: Dynamic Planet 2005, Cairns, Australia. Contact: Secretariat, GPO Box 2609, Sydney, Australia; Phone: +61 2 9241 1478; Fax: +61 2 9241 1478; E-mail info_AT_dynamicplanet2005.com; Web site: <http://www.dynamicplanet2005.com/>

Aug 23-27, 2005: GES-7, 7th International Symposium on the Geochemistry of the Earth's Surface, Aix-en-Provence, France. Web site: <http://www.cerege.fr/GES7/index.htm>

Aug 23-31, 2005: XX Congress of International Union of Crystallography, Florence, Italy. Congress Secretariat, XX Congress and General Assembly of the International Union of Crystallography c/o Dipartimento di Energetica, University of Florence, via S. Marta 3, 50139 Firenze, Italy; Phone: +39-055-4796209; Fax: +39-055-4796342; E-mail: iucr_AT_iucr2005.it; Web site: www.iucr2005.it

Aug 28-Sept 2, 2005: 10th International Symposium on the Interactions between Sediments and Water, Lake Bled, Slovenia. E-mail: ichme_AT_cetem.gov.br; Web site: <http://www.iawws.com>

Aug 28-Sept 2, 2005: European Aerosol Conference (EAC2005), Ghent, Belgium. Web site: <http://www.eac2005.be> (url possibly incorrect)

Aug 28-Sept 1, 2005: 230th National Meeting ACS, Washington DC, U.S.A. Web site: <http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=meetings/future.html>

Aug 29-Sept 2, 2005: STOMP - Structure, Tectonics and Ore Mineralization Processes, Economic Geology Research Unit, James Cook University, Townsville, Australia. E-mail: Timothy.Baker_AT_jcu.edu.au or Thomas.Blenkinsop_AT_jcu.edu.au; Web site: <http://www.es.jcu.edu.au/STOMP/>

Sept 2005: MAEGS-14 Natural hazards related to recent geological processes and regional evolution, Association of European Geological Societies, University of Turin, Torino, Italy. E-mail: marco.giardino_AT_unito.it

Sept 4-8, 2005: WETPOL International Symposium on Wetland Pollutant Dynamics and Control, Ghent, Belgium. Web site: <http://biomath.ugent.be/wetpol>

Sept 4-20, 2005: IAGOD - Metallogeny of the Pacific Northwest: Tectonics, Magmatism & Metallogeny of Active Continental Margins, Vladivostok, Russia. Web site: <http://www.fegi.ru/iagod/>

Sept 5-9, 2005: 7th symposium on the Cretaceous, University of Neuchâtel, Neuchâtel, Switzerland. Contacts: Karl Foellmi and Thierry Adatte, Geological Institute, University of Neuchâtel; Phone: 41-32-7182655 Fax: 42-32-7182601 E-mail: Karl.foellmi_AT_unine.ch, thierry.adatte_AT_unine.ch Web site: <http://www.unine.ch/geologie/isc7/>

Sept 7-11, 2005: 6th International Conference on Geomorphology, with special session on evaporite karst processes and problems. Congress Hall-Auditorium of Zaragoza, Zaragoza, Spain. Contact: Organizing Secretariat Geomorfología, Facultad de Ciencias, Universidad de Zaragoza, C/Pedro Cerbuna 12, Zaragoza 50009, Spain; Fax: +34 976 761106; E-mail: iag2005_AT_posta.unizar.es; Web site: <http://wzar.unizar.es/actos/SEG/index.html>

Sept 11-14, 2005: 22th Annual Meeting The Society for Organic Petrology (TSOP), Louisville, Kentucky USA. Contact: Dr. James Hower, Center for Applied Energy Research, University of Kentucky, 2540 Research Park Drive, Lexington, KY 40511-8410; Phone: +1 859 257 0261; Fax: +1 859 257 0360; E-mail: hower_AT_caer.uky.edu; Web site: <http://igs.indiana.edu/tsop2005>

Sept 11-15, 2005: 12th International Meeting on Boron Chemistry, Sendai, Japan. Contact: Prof. Kibai Qiu, IUPAC-2005 Secretariat c/o Chinese Chemical Society, P.O. Box 2709, Beijing 10080, China; Phone: +86 (10) 6256 8157; Fax: +86 (10) 6256 8157; E-mail: qiux_AT_iccas.ac.cn

Sept 11-16, 2005: AIG-6 - 6th International Symposium on Applied Isotope Geochemistry, Prague, Czech Republic. Web site: <http://www.aig6.cz>

Sept 11-16, 2005: International Conference Uranium Mining and Hydrogeology (UMH IV), Freiberg, Germany. Fax: +49 (0)3731-392720; E-mail: UMH_AT_geo.tu-freiberg.de; Web site: www.geo.tu-freiberg.de/umh

Sept 12-16, 2005: 22nd International Meeting on Organic Geochemistry (22nd IMOG), Seville, Spain. 12-16 September 2005. Web site: <http://www.imog05.org>

Sept 12-16, 2005: 68th Annual Meteoritical Society Meeting, Gatlinburg, Tennessee, USA; Web site: <http://geoweb.gg.utk.edu/2005/metsoc2005.html>

Sept 13-15, 2005: Water, Health and Environment 2005, Tanta, Egypt. E-mail: bakenaz_AT_decl.tanta.edu.eg; Web site: <http://www.cig.ensmp.fr/~iahs/index.html>

Sept 14-19, 2005: International Conference on Environmental (Geoecological) Problems in Karst, IAH, Belgrade, Yugoslavia. E-mail: jemcov_AT_ppt.yu

Sept 19-23, 2005: 22nd International Geochemical Exploration Symposium (IGES): "From Tropics to Tundra", Perth, Western Australia. Web site: <http://www.promaco.com.au/conference/2005/iges/>

Sept 20-24, 2005: 2nd International Congress of Seas and Oceans, Szczecin - Swinoujscie, Poland. E-mail: icso_AT_wsm.szczecin.pl; Web site: <http://www.wsm.szczecin.pl/iirm/kongres/>

Sept 26-29, 2005: MRS 2005 Scientific Basis for Radioactive Waste Management XXIX, Gent, Belgium.

Sept 26-30, 2005: Symposium on Supercontinents and Earth Evolution, Perth, Australia. Web site: www.promaco.com.au/conference/2005/tsrc

Sept 29-Oct 1, 2005: VII. Alpine Workshop, Opatija, Croatia. This Workshop is organized as a joint meeting together with the 3rd Croatian Geological Congress. Contact: E-mail: alpshop_AT_gfz.hr; Web site: <http://alpshop.gfz.hr/form2.txt>

Fall, 2005: Short course Neutron Scattering applied to Earth Sciences, San Francisco, California. Organizers: Rudy Wenk, University of California - Berkeley, California.

Sponsors: Mineralogical Society of America and The Geochemical Society

Oct 1-4, 2005: Sheared magmas in nature and experiment: bridging the brittle and ductile fields (an international conference in honor of Ron H. Vernon), Kloster Seon, Munich, Bavaria, Germany. Contact: Jörn H. Kruhl, Tectonics & Material Fabrics Section, Technische Universität München, Arcisstr.21, D-80290 München, Germany; Fax: +49 892892 5852; E-mail: kruhl_AT_tum.de; Web site: <http://elite.geophysik.uni-muenchen.de>

Oct 7-13, 2005: Geological Society of America - Penrose Field Forum on: Rethinking the Assembly and Evolution of Plutons: Field Tests and Perspectives. A field excursion across the Mesozoic Cordilleran batholith from Yosemite to the White Mountains, California. Contact: John M. Bartley, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112-0111, USA; Phone: +1 801 5851670; E-mail: bartley_AT_mines.utah.edu

Oct 9-14, 2005: 42nd Annual AIPG Meeting, "Geologic Information: Racing into the Digital Age", Radisson Plaza Hotel, Lexington, Kentucky, USA. Organized by the American Institute of Professional Geologists. Contact: Tom Spalding; Phone: +1 502 458 1209; E-mail: AIPG2005_AT_yahoo.com

Oct 14-15, 2005: Short course Low-Temperature Thermochronometry: Techniques, Interpretations, and Applications, Snowbird, Utah. Organizers: Todd A. Ehlers (University of Michigan) and Peter Reiners (Yale University). Sponsor: Mineralogical Society of America and Geochemical Society of America. Web site: http://www.minsocam.org/MSA/SC/ThermChrnlg_SC_descrptn.html

Oct 15-21, 2005: Workshop on Caldera Volcanism: Analysis, Modeling and Response, Tenerife, Spain. Contact: Joachim Gottsmann and Joan Martí, Institute of Earth Sciences "Jaume Almera", Department of Natural Hazards, CSIC, Illu's Sol i Sabar's s/n, 08028 Barcelona, Spain; Phone: +34 93 409 54 10; Fax: +34 93 411 00 12; E-mail: jjgottsma_AT_ija.csic.es

Oct 16-19, 2005: GSA 2005 Annual Meeting & Exposition - with Mineralogical Society of America, Salt Lake City, Utah. Web site: <http://www.geosociety.org/>

Oct 17-19, 2005: International Lead-Zinc Processing Symposium 2005, Kyoto, Japan. E-mail: akiofuwa_AT_waseda.jp

Oct 19-20, 2005: Compression Deformation within Passive Margins, Burlington House, The Geological Society of London. Contact: Lydia Dumont, The Geological Society, Burlington House, Piccadilly, London, W1J 0BG; Phone: +44 20 7434 9944; Fax: +44 20 7494 0579; E-mail: lydia.dumont_AT_geolsoc.org.uk; Web site: http://www.geolsoc.org.uk/template.cfm?name=Passive_Margins

Oct 21-26, 2005: International Conference of Computational Methods in Sciences and Engineering 2005 (ICCMSE 2005), Loutraki, Korinthos, Greece. Web site: <http://www.uop.gr/~iccmse/>

Oct 25-29, 2005: Seventh International Conference on the Mediterranean Coastal Environment MEDCOAST 05, Kusadası, Turkey. Web site: www.medcoast.org.tr

Oct 25-Nov 11, 2005: 10th Brazilian Geochemical Congress and 2nd Geochemical Symposium of the Mercosul Countries. Porto de Galinhas, Recife, Brazil. Contact: Phone/Fax: +55 81 2126 8242; E-mail valderez_AT_ufpe.br; Web site: <http://www.ufpe.br/xcbqg>

Nov 6-11, 2005: International Gondwana 12 Conference, Mendoza, Argentina; Web site: <http://cig.museo.unlp.edu.ar/gondwana>

Nov 7-11, 2005: 20th World Mining Congress & Expo 2005, Tehran, Iran. Contact: Mr. A. Almasi, Chief of Executive Committee, No. 25, Ostad Nejatollahi Avenue, Tehran 1599913717, Iran; E-mail: info_AT_wmcc2005.com; Web site: <http://www.20wmcc2005.com/index.php?page=home>

Nov 8, 2005: 1st conference of the new NERC-funded Natural Aquatic Colloids network (Aquanet). University of Birmingham Conference Park, U.K. Web site: <http://www.gees.bham.ac.uk/research/aquanet/>

Nov 13-15, 2005: Geology Forum 05, Cape Town, South Africa. Topic: metalliferous ore deposits. Contact: Jon Wills; E-mail: jon_AT_min-eng.com; Website: <http://www.min-eng.com/geologyforum05/index.html>

Nov 30-Dec 2, 2005: 5th Fennoscandian Exploration and Mining Conference, Rovaniemi, Finland. Contact: Regional Council of Lapland, Ms. Riitta Muhojoki, Project Secretary, P.O. Box 8056, Fin-96101 Rovaniemi, Finland; Phone: +358-16-3301230; Fax: +358-16-318705; Web site: <http://www.lapinliitto.fi/fem2005>

Dec 5-9, 2005: AGU Fall Meeting, San Francisco, California, U.S.A. Contact: E. Terry, AGU Meetings Department, 2000 Florida Avenue NW, Washington, DC 20009 U.S.A.; Phone: +1-202-777-7335; Fax: +1-202-328-0566; E-mail: eterry_AT_agu.org; meetinginfo_AT_agu.org; Web site: www.agu.org/meetings

Dec 2005: Short Course Molecular Geomicrobiology: From genes to geochemical cycles, at AGU Fall Meeting. Organizers: Jill Banfield, University of California - Berkeley, CA; Javiera Cervini-Silva, University of California - Berkeley, CA and Ken Nealson, Jet Propulsion Laboratory, Pasadena, CA. Sponsors: Mineralogical Society of America and The Geochemical Society. Web site: <http://www.minsocam.org/MSA/SC/index.html#Geomicrobiology>

Dec 6-10, 2005: 6th European Meeting on Environmental Chemistry, Belgrade, Serbia and Montenegro. Contact: Dr. Branimir Jovancevic, Department of Chemistry, University of Belgrade, Akademski trg 12-16, POB 158, 11001 Beograd, Serbia and Montenegro; E-mail: bjovanci_AT_chem.bg.ac.yu; Web site: <http://helix.chem.bg.ac.yu/emec6/>

Dec 16-22, 2005: 13th International Conference of the Geological Society of Africa, Cairo, Egypt, 16-22. Contact: Dr Mahmoud Abdeen, GSAF Vice-President (North Africa); E-mail: m_m_abdeen_AT_hotmail.com; Web site: <http://gsaf.narss.org/>

Jan 4-6, 2006: IGC 2006 International Groundwater Conference on Sustainable Development and Management of Groundwater Resources in Arid and Semi-Arid Regions with Special Reference to Hard Rocks. Dindigul, Tamilnadu, India. Contact: Dr. K. Thyagarajah, PSNA College of Engineering & Technology, Kothandram, Nagar, Palani Road, Dindigul-624 622 (Tamilnadu), India; Phone: +91 451 2554032 or 2554262; Fax: +91 451 2554249; E-mail principal_AT_psnacet.org

Jan 9-12, 2006: 27th Nordic Geological Winter Meeting. Oulu, Finland. Contact: Prof. Kauko Laajoki; Phone: +358 8 5531433; E-mail: kauko.laajoki_AT_oulu.fi; Web site: <http://wintermeeting.oulu.fi/index.html>

Jan 13-18, 2006: Depositional Systems and Stratigraphic Development, International

MEETINGS CALENDAR

Conference on Deltas. University Brunei Darussalam, Brunei. Joint meeting of 3rd Annual Meeting of IGGP-475 'Deltas in the Monsoon Asia-Pacific Region (DeltaMAP)' and 2nd Meeting of CCOP DELSEA project. Contact: Yoshiki Saito; E-mail: yoshiki.saito_AT_aist.go.jp; Web site: <http://unit.aist.go.jp/igp/rg/coast-rg/ADP.html>

Feb 13, 2006: GAW8 - 8th International Conference On The Geology Of The ARAB World, Cairo, Egypt. Web site: <http://salty2k.com/gaw8/>

Feb 20-24, 2006: AGU Ocean Sciences Meeting, Honolulu, Hawaii.

March 19-24, 2006: InterRad XI: Radiolarians in Stratigraphy & Paleocyanography (11th Meeting of the International Association of Radiolarian Paleontologists & Circum-Pacific Triassic Stratigraphy & Correlation; symposium hosted by IGCP 467 and the Subcommission on Triassic Stratigraphy). Wellington, New Zealand. Contact: E-mail: c.hollis_AT_gns.cri.nz or h.campbell@gns.cri.nz or janet.simes_AT_conferences.co.nz

March 26-29, 2006: 18th Industrial Minerals International Congress. San Francisco, USA. Contact: Fax: +22 20 7827 5292; E-mail: conferences_AT_indmin.com; Web site: www.indmin.com

March 26-30, 2006: 231th National Meeting ACS, Atlanta, GA, U.S.A. Web site: <http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=meetings\Future.html>

Apr 2-7, 2006: European Geosciences Union (EGU), General Assembly, Vienna, Austria. Contact: EGU Office, Max-Planck-Str. 13, 37191 Katlenburg-Lindau, Germany; Phone: +49 5556 1440; Fax: +49 5556 4709; E-mail: egu_AT_copernicus.org; Web site: www.copernicus.org/EGU/egu_info/prevga.html

Apr 3-7, 2006: Backbone of the Americas - Patagonia to Alaska, International Conference. Convened by the Geological Society of America and the Asociaci3n Geol3gica Argentina. Mendoza, Argentina. Contact: GSA Meetings Dept., P.O. Box 9140, Boulder, CO 80301-9140, USA; Phone: +1 303 447 2020; Fax: +1 303 447 1133; E-mail: meetings_AT_geosociety.org; Web site: www.geosociety.org/meetings/06b0a/index.htm

Apr 9-12, 2006: American Association of Petroleum Geologists and Society for Sedimentary Geology (SEPM), "Perfecting the Search," Joint Annual Meeting. Houston, TX, USA. Contact: AAPG Conventions Department, PO Box 979, 1444 S. Boulder Ave., Tulsa, OK 74101-0979, USA; Phone: +1 918 560 2679; Fax: +1 918 560 2684; E-mail: convene_AT_aapg.org

Apr 24-28, 2006: AQUAinMED, International Congress "Ground Water in Mediterranean Countries". Malaga, Spain. Contact: Direccion de Hidrogeologia y Aguas Subterraneas, Instituto Geologico y Minero de Espana, Rios Rosas, 23, 28003 Madrid, Spain; E-mail: aquainmed_AT_igme.es; Web site: <http://www.igme.es>

May 14-18, 2006: IAVCEI 2006 China, Continental Basalt Volcanism, China. E-mail: xlhuang_AT_gig.ac.cn

June 3-7, 2006: Joint 43rd Annual Meeting of The Clay Minerals Society and Annual Meeting of the Groupe Fran ais des Argiles (French Clay Group), Oleron Island, France. Contact: Sabine Petit, Universite de Poitiers, CNRS Hydr'ASA, 40 Av. du Recteur Pineau, 86022 Poitiers Cedex, France; Phone: +33 5 49 45 37 56; E-mail: sabine.petit_AT_hydrasa.univ-poitiers.fr; Web site: <http://www.clays.org>

July 2-7, 2006: The Australian Earth Sciences Convention 2006; ASEG, in collaboration with GSA; ASEG's 18th International Conference and Exhibition, and GSA's 18th Australian Geological Convention. Melbourne, Australia. Web sites: www.earth2006.org.au

July 3-5, 2006: Colloquim for African Geology, Maputo. Contact: AGMM c/o Lopo Vasconcelos; E-mail: CAG21_AT_uninet.co.mz or lopo_AT_uninet.co.mz; Web site: <http://www.geoscience.org.za/>

July 9-15, 2006: 18th World Congress of Soil Science. Philadelphia, Pennsylvania, USA. Web site: www.18wcss.org

July 13-26, 2006: 12th IMCG Congress 2006 - Finland, land of mires; Field Symposium and General Assembly. Finland. Web site: <http://www.imcg.net/>

July 16-23, 2006: 7th International Conference on the Occurrence, Properties, and Utilization of Natural Zeolites (Zeolite 006), Socorro, New Mexico, USA. Contact: Dr. Bowman; E-mail: bowman_AT_nmt.edu

July 23-28, 2006: 19th General Meeting of the International Mineralogical Association, Kobe, Japan. Contact: Prof. T. Yamanaka, E-mail: b61400_AT_center.osaka-u.ac.jp; Web site: http://www.congre.co.jp/ima2006/index_e.html

Aug 6-11, 2006: 8th International Conference on Mercury as a Global Pollutant, Madison, Wisconsin USA. Contact: James Hurley; E-mail: hurley_AT_aqua.wisc.edu; Web site: <http://www.mercury2006.org/>

Aug 26-27, 2006: GIA Gemological Research Conference in conjunction with its 4th International Gemological Symposium, Manchester Grand Hyatt, San Diego, California. Contact: Dr. James E. Shigley, Phone: +1-760-603-4019; E-mail: gemconference_AT_gia.edu; Web site: http://www.gia.edu/newsroom/608/21821/news_release_details.cfm

Aug 27-Sept 1, 2006: 16th Annual V.M. Goldschmidt Conference. Melbourne, Australia. E-mail: goldschmidt2006_AT_tourhosts.com.au; Web site: <http://www.goldschmidt2006.org>

Aug 27-Sept 1, 2006: 17th International Mass Spectrometry Conference (IMSC), Prague, Czech Republic. Web site: <http://www.imsc2006.org/>

Aug 27-Sept 1, 2006: 17th International Sedimentological Congress, Fukuoka, Japan. Contact: Ryo Matsumoto, Department of Earth & Planetary Sciences, University of Tokyo Hongo, Tokyo 113, Japan; E-mail: ryo_AT_eps.s.u-tokyo.ac.jp; Web site: <http://www.isc2006.com/>

Sept 3-8, 2006: Gordon Research Conference on Rock Deformation: Processes & Patterns, Big Sky, Montana, USA. Organizers: Mark Jessell, Laboratoire des Mecanismes et Transferts en Geologie, Universit Paul Sabatier, 31400, Toulouse, France; E-mail: mjessell_AT_imgt.obs-mip.fr; Greg Hirth, WHOI, Department of Geology & Geophysics, Woods Hole, MA 02543, USA; E-mail: ghirth_AT_who.edu; Web site: <http://www.imgt.obs-mip.fr/grc2006>

Sept 10-14, 2006: 232th National Meeting ACS, San Francisco, CA, U.S.A. Web site: <http://www.chemistry.org/portal/a/c/s/1/acsdisplay.html?DOC=meetings\Future.html>

Sept 14-17, 2006: 10th International Congress of the International Association of Engineering Geology and the Environment. Engineering geology for tomorrow's cities,

Nottingham, UK. E-mail: info_AT_iaeg2006.com; Web site: www.iaeg2006.com

Sept 22-25, 2006: International Geoscience Education Organisation, 5th International Conference, Bayreuth, Germany. Contact: Hans-Albert Dahlheim, GEO-Zentrum a.d.KTB, Am Bohrturm 2, D-92670, Windischeschenbach, Germany; Phone: +49-9681-91275; Fax: +49-9681-91274; E-mail: hadah_AT_gfz-potsdam.de

Oct 22-25, 2006: GSA 2006 Annual Meeting & Exposition - with Mineralogical Society of America, Philadelphia, Pennsylvania. Web site: <http://www.geosociety.org/>

Dec, 2006 - 7th European Meeting on Environmental Chemistry, Brno, Czech Republic. Contact: Dr. Josef Caslavsky, Institute of Analytical Chemistry, Czech Academy of Science, Veveří 97, 61142 Brno, Czech Republic; E-mail: caslav_AT_iach.cz; Web site: <http://www.science.plym.ac.uk/ace/Meetings.html>

Dec 11-15, 2006: AGU Fall Meeting, San Francisco, California, U.S.A. Contact: E. Terry, AGU Meetings Department, 2000 Florida Avenue NW, Washington, DC 20009 U.S.A.; Phone: +1-202-777-7335; Fax: +1-202-328-0566; E-mail: eterry_AT_agu.org; meetinginfo_AT_agu.org; Web site: www.agu.org/meetings

2007: Short course Water in Nominally Anhydrous Minerals. Organizers: Hans Keppler, University of Tuebingen, Tuebingen, Germany. Sponsors: Mineralogical Society of America and The Geochemical Society. Web site: <http://www.minsocam.org/MSA/SC/#anhydrous>

July 2007: IUGG General Assembly, Perugia, Italy. Web site: www.iugg.org

July 2007: Rock Mechanics: 11th Congress of the International Society of Rock Mechanics. Lisbon, Portugal. Contact: Sociedade Portuguesa de Geotecnia, LNEC, Av. do Brasil, 101, 1700-066 Lisboa, Portugal; Phone: +351 218443321; Fax: +351 2184433021; E-mail: spg_AT_lnecc.pt; Web site: <http://www.isrm2007.org>

July 2-13, 2007: XXIVth The International Union of Geodesy and Geophysics (IUGG), General Assembly. Perugia, Italy. Contact: Prof. Lucio Ubertaini; E-mail: lucio.ubertini_AT_uniroma1.it or secretary_AT_iugg2007perugia.it; Web site: <http://www.iugg2007perugia.it/>

July 29-Aug 6, 2007: INQUA Congress: 17th International, of the International Union for Quaternary Research. Cairns, Australia. Contact: Prof. John Dodson; E-mail: johnd_AT_geog.uwa.edu.au

Aug 2007: International Congress ICAM V 2007: International Council for Applied Mineralogy; Geological Society of Norway. Tromsø, Norway. Web site: www.geologi.no or www.icamv.org

Sept 2007: International Congress ICAM V 2007, Tromsø, Norway. Organized by International Council for Applied Mineralogy and Geological Society of Norway. Web sites: <http://www.geologi.no/cgi-bin/geologi/emaker?id=1909> or <http://www.icamv.org>

Sept 23-28, 2007: Society of Exploration Geophysicists (SEG) International Exposition & 77th Annual Meeting. San Antonio, Texas, USA. Contact: E-mail: meetings_AT_seg.org; Web site: [meeting_seg.org](http://www.meeting_seg.org)

Oct 28-31, 2007: GSA 2007 Annual Meeting & Exposition - with Mineralogical Society of America, Denver, Colorado. Web site: <http://www.geosociety.org/>

Dec 10-14, 2007: AGU Fall Meeting 2007, San Francisco, CA, U.S.A.

Dec 2006: Short Course Medical Mineralogy and Geochemistry, at AGU Fall meeting, San Francisco, California. Sponsors: Mineralogical Society of America and The Geochemical Society. Organizers: Nita Sahai, University of Wisconsin, Madison, WI and Martin A. Schoonen, State University of New York - Stony Brook, Stony Brook, NY. Web site: <http://www.minsocam.org/MSA/SC/#medical>

Dec 2006: Short Course Neutron Scattering applied to Earth Sciences, at AGU Fall Meeting, San Francisco, California. Sponsors: Mineralogical Society of America and The Geochemical Society. Organizers: Rudy Wenk, University of California - Berkeley, CA and Nancy L. Ross, Virginia Polytechnic Institute and State University, Blacksburg, VA. Web site: <http://www.minsocam.org/MSA/SC/#neutron>

Dec 2006: 7th European Meeting on Environmental Chemistry, Brno, Czech Republic. Contact: Dr. Josef Caslavsky, Institute of Analytical Chemistry, Czech Academy of Science, Veveří 97, 61142 Brno, Czech Republic; E-mail: caslav_AT_iach.cz

June 9-15, 2008: 13th International Peat Congress: After Wise Use - The Future of Peatlands, Tullamore, Ireland. Web site: <http://www.peatsociety.fi>

Aug 5-14, 2008: 33rd International Geological Congress (IGC 2008): Nordic Countries: Norway, Sweden, Denmark, Finland and Iceland, Oslo, Norway. Web site: <http://www.ngu.no/igc2008>

Oct 26-30, 2008: Annual Meeting Geological Society of America - with Mineralogical Society of America, Chicago, Illinois, U.S.A. Web site: <http://www.geosociety.org/meetings/index.htm>

Dec 15-19, 2008: AGU Fall Meeting, San Francisco, CA, USA. Web site: <http://www.agu.org/meetings>

June 6, 2012: IAVCEI 2012 Alaska, Centennial of 1912 Katmai Eruption (tentative). Contact: Steve McNutt and John Eichelberger, Alaska Volcano Observatory UAF GI P.O. Box 757320 Fairbanks, AK 99775-7320; Phone: +1 907-474-7131; Fax: +1 907-474-5618. Web site: <http://www.iaavcei.org/>

Aug 5-15, 2012: 34th International Geological Congress (IGC 2012, Australia), Brisbane, Australia.

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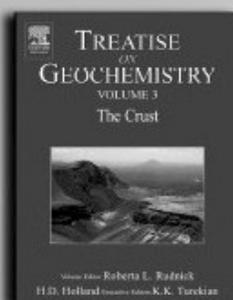
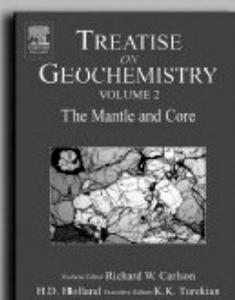
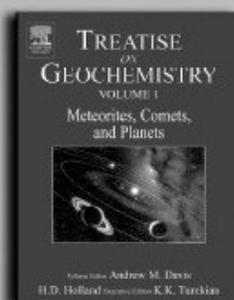
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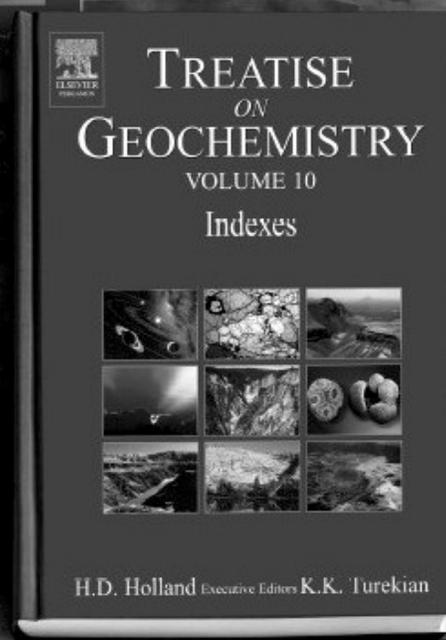
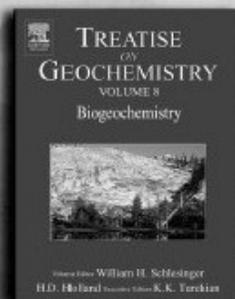
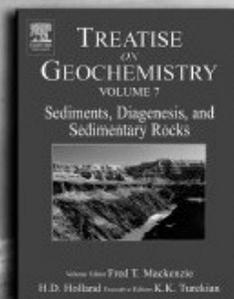
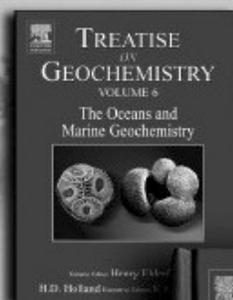
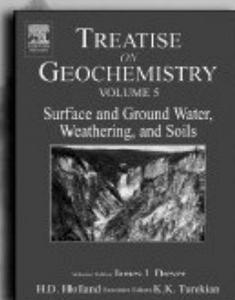
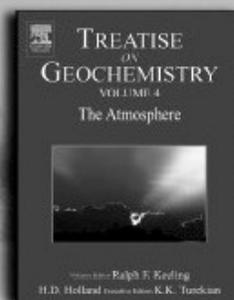
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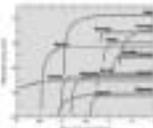
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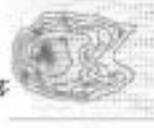


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