

## EIGHTH APPLIED ISOTOPE GEOCHEMISTRY SYMPOSIUM (AIG-8)



The AIG-8 group posing on the shore of the St. Lawrence River

The Geological Survey of Canada hosted the 8<sup>th</sup> Applied Isotope Geochemistry Symposium under the umbrella of the International Association of GeoChemistry (IAGC) from August 30 to September 4, 2009. The organizing committee (Jason Ahad, Geneviève Bordeleau, Tom Bullen, Pascale Côté, Marie-Noëlle Croteau, Roger Koopmann, Martine Savard, and Marie-Josée Tremblay) invited the isotopists of the world to convene at the Manoir Richelieu in La Malbaie (Quebec). This choice was well appreciated by all participants, as the Charlevoix region is known for its *joie-de-vivre* and for offering unique regional delicacies.



The Manoir Richelieu, an inspiring conference venue nestled in the Laurentians and overlooking the St. Lawrence River

Seventy-four scientists from 12 countries interacted in a plenary session lasting four days. The scientific program was excellent and

centered on seven scientific themes: climate and climate reconstruction, contaminant tracing and remediation, isotope geochemistry for exploration, atmosphere–hydrosphere–biosphere–lithosphere interactions, multitracer approaches, anthropogenic environmental perturbations, nontraditional isotopes and novel analytical approaches. These themes were proposed by the scientific committee, Marie-Noëlle Croteau (USGS), Kurt Kyser (Queen's University), Bernhard Mayer (University of Calgary), Alain Prinzhofer (IFP), and Martine Savard (GSC). The breadth of the presentations indicates that isotope geochemistry serves an increasing number of themes in environmental research, while still being judiciously applied to solve questions relative to resource exploration and lithospheric processes. Four keynote speakers presented the following lectures: “Biospheric Coupling of Terrestrial Water and Carbon Fluxes: Implications for the Climate System” (Prof. Jan Veizer, University of Ottawa), “Mass-Independent Fractionation Effects on Isotope Geochemistry in Mineral Exploration” (Prof. Kurt Kyser, Queen's University, Kingston), “Use of Geochemical and Isotope Tracers to Evaluate the Fate of Cyanide in Mine Tailings” (Prof. Ramon Aravena, University of Waterloo), and “Recent Developments in Strontium Isotope Fractionation Studies: Techniques and Applications” (Dr. Jan Fietzke, Leibniz Institute of Marine Sciences, Kiel).

The Faure Award Committee (Tom Bullen, Barry Batts, Shaun Frape) unanimously decided to give an *ex aequo* prize to David Snider (University of Waterloo) and Mirjam Kiczka (ETH Zurich), both PhD students who scored equally high due to their excellent oral presentations: respectively,  $^{18}\text{O}/^{16}\text{O}$  Ratios of  $\text{N}_2\text{O}$  and  $\text{NO}_3^-$  Produced in



(Top) Léopold Nadeau explaining the finding of the meteorite impact by Dr. Jehan Rondot in 1966. (Left) Section through a shatter cone in an Ordovician limestone bed. (Right) Dr. Castonguay explaining the development of Logan's Line and the Appalachian Front, with the St. Lawrence River and Isle-aux-Coudres in background

Agricultural and Temperate Forest Soils – Isotope Labelling Experiments and Implications for Source Partitioning” and “Fe Isotope Fractionation by Plants – Mass Balances and Controlling Factors.”

The mid-conference field trip allowed the participants to discover the stunning landscapes and fascinating rock textures resulting from the impact of a meteorite in the Charlevoix area during the Late Ordovician. The field trip guides, Drs. Léopold Nadeau and Sébastien Castonguay of GSC-Québec, also explained how the Laurentians and Appalachians formed. The field trip ended on a boat, which took participants to the Saguenay Fjord for whale watching!

The meeting was sponsored by Natural Resources Canada, IAGC, Spectromat Inc., FPIInnovations, the Mineralogical Association of Canada, and the Institut national de la recherche scientifique. This financial support covered the costs of the field trip, helped four students with their accommodation costs, and diminished the registration fees of all students. In addition, the Geological Survey of Canada offered logistical support and aided with the organization of the event.

Let's all meet again in 2011 near Barcelona, Spain, for AIG-9!

Au revoir! Hasta la vista!

**Martine M. Savard**  
Geological Survey of Canada (GSC-Québec)  
Chair of AIG-8

## 24<sup>th</sup> INTERNATIONAL APPLIED GEOCHEMISTRY SYMPOSIUM

The 24<sup>th</sup> International Applied Geochemistry Symposium (IAGS 2009), organized by the Association of Applied Geochemists (AAG), was held in Fredericton (New Brunswick, Canada) on the campus of the University of New Brunswick in late May to early June. This biennial AAG meeting was cosponsored by the International Association of GeoChemistry (IAGC) and the International Association of GeoAnalysts (IAG) and included the North Atlantic Minerals Symposium (NAMS). The meeting was jointly organized by geoscientists from the University of New Brunswick (UNB), the New Brunswick Department of Natural Resources (NBDNR), the New Brunswick Research and Productivity Council, the New Brunswick Department of the Environment, and professionals drawn from the consulting engineering and mineral exploration industry in New Brunswick, in conjunction with a professional conference organizer from UNB.

The meeting was preceded by three professional development workshops, held on Sunday, May 31: (1) Isotope Applications in Mineral Exploration and Environmental Management, organized by Bruce Eglington (University of Saskatchewan), Rob Creaser (University of Alberta), Larry Heaman (University of Alberta), Mike Villeneuve (Geological Survey of Canada, Ottawa), and Kurt Kyser (Queens University); (2) Indicator Mineral Exploration Technology, organized by Harvey Thorleifson (University of Minnesota and the Minnesota Geological Survey) and Beth McClenaghan (GSC, Ottawa), and 8 others; (3) Uranium Deposits: Genetic Geochemical Models to Prospect-Scale Geochemical Exploration Technologies, organized by Irvine R. Annesley (JNR Resources Inc.), Ken Wheatley (Forum Uranium Corp.), and Sam Romberger (Colorado School of Mines). These were very well attended and we thank all the presenters for their help in making each a success.

Five interesting pre- and postmeeting field trips were held: (1) Intrusion-Related Polymetallic Deposits in Southwestern and Central New Brunswick, led by Kay Thorne (NBDNR–Minerals); (2) Coal-Mining Operations in Central New Brunswick, led by Michelle Coleman (NB Coal); (3) Uranium Occurrences in the Late Devonian Carboniferous Basin of SW New Brunswick, led by Dave Lentz (UNB); (4) Tectono-Stratigraphic Setting of VMS Deposits of the Bathurst Mining Camp, New Brunswick, led by Steven McCutcheon (NBDNR–Minerals); (5) Environmental Geochemistry and Reclamation and Remediation Techniques as Applied in the Bathurst Mining Camp, New Brunswick, led by Jim Walker (NBDNR–Minerals).



Gerry Govett, 24<sup>th</sup> IAGS Honorary Chairman

The plenary session to honor the contributions of Gerry Govett (24<sup>th</sup> IAGS Honorary Chairman) covered a broad range of topics. The session, entitled “Deep Search Geochemical Exploration Methods,” was chaired by Wayne Goodfellow (GSC), Gwendy Hall (consultant), and Matt Leybourne (GNS Science). Dr. D. Kirk Nordstrom (U.S. Geological Survey) gave the IAGC’s International Ingerson Lecture, and Prof. Kurt Kyser delivered the AAG’s Distinguished Lecturer’s talk.

The plenary session was followed by 14 special sessions (oral and poster), organized and chaired by volunteers from AAG and IAGC. Each of the special sessions began with a keynote speaker; these presentations were highlighted in an earlier issue of *Elements*

(5: 130). The special session cochairs were also involved in reviewing the extended abstracts, which form a two-volume set (>1200 pages) that was produced and edited by Dave Lentz, Kay Thorne, and Kristy Beal. Both volumes are available online on the AAG website. Numerous posters and exhibits were on display on the viewing level of the UNB Student Union Building.



Opening reception “meet and greet,” Sunday evening in Lady Dunn Hall



Erin Smith (geologist with NBDNR–Minerals) fiddling at the awards banquet



Guest speaker Oliver Bonham

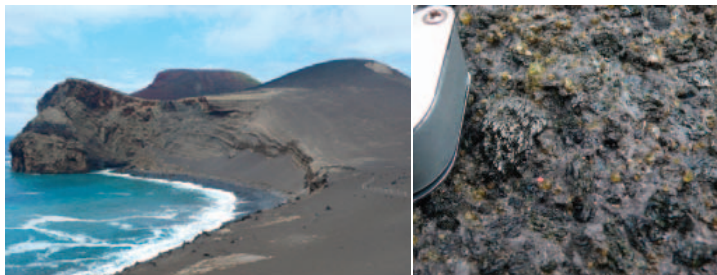
The welcoming reception (with entertainment) on the Sunday evening was held at Lady Dunn Hall (UNB). A BBQ was held on Monday, a pub crawl downtown on Tuesday, and the conference banquet and awards ceremony on Wednesday evening at the UNB Student Union Building. The guest speaker was Oliver (Ollie) Bonham, chief executive officer of the Canadian Council of Professional Geoscientists (CCPG). In his presentation “Refilling our Field Vests,” he talked about the global experience for up-and-coming geoscientists. An account of the poster awards presented that evening and descriptions of the AAG and IAGC awards are available in *Elements* 5: 328. The evening was capped off with a Maritime kitchen party, hosted by our very own Erin Smith (UNB geology alumnus).

The local organizing committee, AAG, IAGC, and IAG thank all the enthusiastic volunteers and our generous sponsors (ACME, SGS, AngloAmerican, Barrick, Newmont, Freewest, SilverStandard, AREVA, Maxwell, and the Geological Survey of Canada) for their help in making this meeting a success. Their sponsorship helped lower the registration cost for students and provided ten US\$500 travel grants to student presenters. The profits from the meeting will endow a new UNB undergraduate scholarship, the Gerry Govett Geoscience Scholarship, in honor of the former UNB professor and a very important AAG volunteer.

**David Lentz**  
University of New Brunswick

## PENROSE CONFERENCE, AZORES, MAY 10–15, 2009

It is increasingly evident that some plumes rise from the core–mantle boundary. Accordingly, there is much interest today in the role they play, not only in whole-mantle convection, but also in the recycling of near-surface materials. The buoyancy flux of plumes varies by a factor of three or more, and much study has concentrated on the high-flux Hawaiian plume. The Azores plume provides an interesting contrast because of its low buoyancy flux and the large variation in radiogenic and stable isotopes in erupted products. Additionally, it has long been suggested that the Azores reflect melting in the presence of volatiles and at elevated temperatures. Thus, while the Azores plume cannot transport as much heat as its Hawaiian counterpart, it may show the best evidence for recycling of materials subducted beneath an arc.



Site of the 1958–1959 Capelinhos eruption

Pico ankaramite

Recent studies have suggested that this may have occurred 2.5–3 Gy ago, making the Azores unique in providing evidence for Archaean subduction and very long-term storage of this material in the mantle.

Accordingly, a highly successful Penrose Conference was held under the auspices of GSA on Pico Island, Azores, on 10–15 May 2009, with student support provided by the Geochemical Society. The meeting involved 25 participants, including four students, and consisted of three days of oral and poster presentations and two one-day field trips on Pico and Faial Islands. In addition, some attendees spent the preceding weekend examining exposures on São Miguel.

Victor Hugo Forjaz began the presentations with a detailed synthesis of the state of knowledge about the age relationships and geology of the nine islands making up the archipelago. Among the eastern islands, volcanic activity has migrated from east to west, counter to the movement of the Atlantic plate and consistent with migration across a site of partial melting. Munir Humayun presented new, high-precision FeO/MnO data from the Azores showing that there are both high- and low-Fe lavas (with respect to MORB) and that there is a positive correlation between Fe/Mn and Os isotopes. Christoph Beier then presented geochemical and geochronological constraints on the evolution of the Azores plateau, focusing on submarine samples that suggest there may have been two principal phases of plateau development, at 4–6 Ma and from 2 Ma to the present. Charlie Langmuir gave an overview of the major element, trace element and isotopic characteristics of ocean island basalt reservoirs, and spoke about the evidence for elevated mantle temperatures beneath ocean islands, the roles of volatiles and recycled components, and the extent to which they might account for mantle heterogeneity.

The next day, Bruce Schaefer detailed the current state of Os isotope investigations in the Azores and the evidence for the recycling of an Archaean component showing signs of low-temperature stable isotope fractionation. Simon Turner then summarized the current U-series isotope data from the Azores, including the extent to which there is symmetry in mantle composition and melting dynamics across the plume, and he showed that melting rates do not appear to be controlled by mantle heterogeneities. In a slight change of pace, João Mata presented new data on carbonatites from the Cape Verde Islands. Showing nostalgia for his PhD days in the Azores, Bill White gave the results of calculations of the composition of subducted material after it has survived processing beneath an island arc. Kaj Hoernle discussed the



Conference participants at the Capelinhos eruption site

origins and evolution of the Manahiki Hikurangi Plateau, which originally may have covered 3000 km<sup>2</sup>.

Tyrone Rooney moved the discussion to East Africa and invoked a major role for lithospheric mantle in the source region of the Ethiopian basalts. Zvi Garfunkel explored the various origins of intraplate magmatism in the African plate, and Karsten Haase brought us back to the Azores to look at partial melting along the Mid-Atlantic Ridge, emphasizing asymmetry and the possible roles of small “blobs” of enriched material. Conny Class reappraised the issue of He isotopes and their implications for mantle convection. In the final session, Scott King reviewed geodynamic models and how piles of recycled material might get pushed around by plate motion at the core–mantle boundary. Tracy Rushmer explored possible links between the concentrations of heat-producing elements in mantle plumes and the buoyancy flux of the plumes (as determined geophysically), but found that no such link is observed, suggesting that another source of heat is responsible for negative buoyancy–conduction from the core. Craig O’Neill ended the sessions by showing how numerical models can be used to investigate the likelihood of entrainment of ancient slab material in plumes, and he showed that such materials can survive for up to 2.5 Gy.

The pre-conference field trip on São Miguel, led by Luis Almeida and Christoph Beier, took participants to spectacular coastal outcrops on the volcano of Sete Cidades, including the Ponta da Ferraria viewpoint from which one can see, along the coast, a whole stratigraphic section of the volcano’s past 74,000 years. Also visited were gabbroic and possible mantle xenoliths at Mosteiros and the Serra Gorda vent system. The clouds finally cleared away towards the end of the field trip, providing a spectacular view.

The third day of the meeting featured a field trip on Pico Island, led by Zilda Franca. The excursion started with a nice view of the Arrife fault system and continued with a spectacular ankaramite locality at São Roque do Pico. Participants also viewed pahoehoe lava fields and visited a spectacular lava tunnel. The day ended with an invitation by the local government to visit the whaling museum.

The fourth day started with a ferry transfer from Pico to Faial. We visited a large outcrop at Castelo Branco, where the local Azores TV station filmed the group. In the north, at Baía da Areira da Quinta, we examined mantle xenoliths, and then continued to the deposits of the 1958–1959 eruption of the Capelinhos volcano. The day finished with a fine view of the Ribeirinha horst and graben system.

While the evidence for mantle plumes was considered overwhelming, participants in the meeting agreed unanimously that more information on plumes with varying buoyancy flux and geochemistry will be needed before plumes can be fully integrated into global convection and recycling models. Major outstanding problems in the Azores remain the enigmatic non-emergence of the Mid-Atlantic Ridge and the asymmetric distribution of the islands within an otherwise relatively smooth topographic swell. The role of mafic rocks (eclogite, pyroxenite) remains very hard to test. Future advances will depend on multidisciplinary work involving geophysics and geochemistry.

The organizers (Christoph Beier, Zilda Franca, Tracy Rushmer, Simon Turner, Liz Widom) express their thanks to GSA, the Geochemical Society and all of the participants who helped make the meeting successful.

**Simon Turner**, Macquarie University, Australia

## INTERNATIONAL SCHOOL ON HIGH-PRESSURE CRYSTALLOGRAPHY

The 2009 International School on High-Pressure Crystallography took place at the Ettore Majorana Center for Scientific Culture, June 4–14, 2009, in the picturesque Sicilian town of Erice. This 41<sup>st</sup> edition of the International School of Crystallography, organized at the Majorana Center, was directed by E. Boldyreva (Novosibirsk University) and P. Dera (University of Chicago). Financial support was provided by the NSF EAR Geophysics Program, the Consortium for Materials Properties Research in Earth Sciences (COMPRES), the International Union of Crystallography, the European Crystallographic Association, the International Center for Diffraction Data, and several industrial sponsors. Major funding was provided by a grant from the NATO Science for Peace and Security program, through which the 2009 Erice school was recognized as a NATO Advanced Study Institute (ASI).

The 2009 Erice school was well attended, with 122 participants (46 lecturers and 76 undergraduate, graduate, and post-graduate students), and included 10 days of intensive study, hands-on instruction, and panel discussions. Live video feed of all the lectures was transmitted via the Internet and made available to those who could not attend the school in person. Thanks to the support from NSF and COMPRES, we were able to offer full accommodation and registration-fee scholarships to six graduate students and young scientists from the United States.

The meeting agenda included a unique blend of topics and disciplines that are never covered at a single event. The format of the school, with emphasis on education rather than on a review of recent accomplishments, allowed attendees to explore the multidisciplinary facets of high-pressure science and its applications in everyday life, technology, and security. In addition to 45-minute lecture presentations, the school offered several excellent and widely attended hands-on workshops, which allowed the student participants to learn many advanced tricks of the trade from top experts in the field.

The lectures focused on several important aspects of high-pressure science: physics (properties and structure), chemistry (chemical reactions, transport), materials science (new materials), and engineering (mechanical properties); implications for geology, geophysics, and planetary science (minerals in their natural, deep-Earth environments); biology and medicine. In addition, direct or indirect (e.g. economic) applications of high-pressure science in several fields of modern technology were considered. Such a variety of topics explains a very “densely packed” program, which “kept the participants under pressure” during the 10 days.

The school started off with an introduction to the most modern experimental techniques used to generate high-pressure and high-temperature conditions and to study the behavior of samples at these conditions. Special emphasis was placed on experimental methods used in mineral-physics research. Several excellent lectures reviewed the field of hard and superhard materials with potential technological applications. Synthetic routes in terms of chemistry, technical approaches to synthesis at extreme conditions (e.g. using a diamond anvil cell, a large-volume press, or novel detonation techniques), both *ex situ* and *in situ* methods of characterization of the structure and properties of the novel materials were presented. Several expert lecturers reviewed computational approaches to predicting structures and properties of materials at high pressure as well as designing new materials with specific properties. Another large block of presentations dealt with geophysical applications of high-pressure experiments and introduced phase transitions in the deep Earth and their relation to seismic phenomena and seismic observations. Other topics included the possibilities and mechanisms of incorporation of water into rock-forming minerals (e.g.



Participants in the International School on High-Pressure Crystallography

during the process of subduction) and its consequences for seismically active areas, the phenomenon and consequences of spin transitions in iron-containing minerals present in the Earth's lower mantle, and trends in structural transformations in upper-mantle minerals. The geophysics session concluded with the discussion of plastic deformation, defect formation, and texture development in rocks and minerals. Next, a large and exciting group of presentations explored the behavior of molecular materials at extreme conditions; many of these are relevant for planetary science. Problems such as *in situ* crystallization at high pressure, solvothermal crystallization, polymorphism control, hydrogen bond transformations, and conformational transformations were introduced. The final theme of the conference was biological matter and biomimetics at extreme conditions, including environmental and geobiological aspects, deep-sea environments, habitability limits, and deactivation of viruses and bacteria. The majority of the presentations are available online at <http://cars9.uchicago.edu/surfacewiki/HPCrystallography/Erice2009/LecturePresentations>.

As an important outcome of the round-table discussion on data-processing software, the Digital Resources for High-Pressure Crystallography (DigResHPX) package is now available to the high-pressure crystallography community. It includes a high-pressure crystallography blog (<http://hpdac.net/>), a mailing list ([hpdac@hpc.amu.edu.pl](mailto:hpdac@hpc.amu.edu.pl)), and high-pressure crystallography wiki (<http://cars9.uchicago.edu/surfacewiki/HPCrystallography>). These online tools and services provide a communication platform for exchange of technical information, advice, references, discussions etc. relevant to high-pressure crystallography.

A book with contributions based on the lecture presentations will be published as a new volume in the NATO Science for Peace and Security Series B: Physics and Biophysics by Springer Publishing Company in mid-2010.

**Przemyslaw Dera and Elena Boldyreva**  
School Directors