ASH FALL

*Newsletter of the Volcanology and Igneous Petrology Division*
*Geological Association of Canada*

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## From the Editor

It has been a while since the last edition of Ashfall and I aplogise for that, but at the end of the day I can only publish what you, the membership, submit and lately submissions have been few and far between. So if over the summer you are involved with any exciting field work please consider writing about it for Ashfall.

In May 2009 the NSF Ridge 2000 & MARGINS and NOAA-OE-sponsored Eruption Response cruise confirmed an eruption at the West Mata volcano (NE Lau Basin). They have provided some spectular photos and descriptions of the eruption on the cruise website.

On June 12, 2009 the crew of the International Space Station captured this spectacular image of Sarychev volcano in the early stages of an eruption. According to the NASA web site Sarychev Peak is one of the most active volcanoes in the Kuril Island chain and is located on the northwestern end of Matua Island. The last explosive eruption occurred in 1989 with eruptions. NASA also reported that ash from the June eruption has been detected 2407 kilometers ESE and 926 kilometers WNW of the volcano, and commercial airline flights were diverted away from the region to minimize the danger of engine failures from ash intake. The NASA web site stated that "the plume appears to be a combination of brown ash and white steam. The vigorously rising plume gives the steam a bubble-like appearance; the surrounding atmosphere has been shoved up by the shock wave of the eruption. The smooth white cloud on top may be water condensation that resulted from rapid rising and cooling of the air mass above the ash column, and is probably a transient feature (the eruption plume is starting to punch through)." Patrick Vantuyne has taken the image one step further and created a 3D image from this photograph which can be viewed with a pair of red blue stereo glasses.

Cheers - Pete

Sarychev volcano in an early stage of eruption on June 12, 2009. Photo taken from the International Space Station. Source - http://spaceflight1.nasa.gov

# 2009 AWARDS

## GÉLINAS MEDALS

*Every year the Volcanology and Igneous Petrology Division of the Geological Association of Canada presents three medals for the most outstanding theses, written by Canadians or submitted to Canadian universities, which comprise material at least 50% related to volcanology and igneous petrology. A gold medal is awarded for the best Ph.D. thesis, a silver medal for the best M.Sc. thesis and an antique copper medal for the best B.Sc. thesis. Nominated theses are evaluated on the basis of originality, validity of concepts, organization and presentation of data, understanding of volcanology and petrology, and depth of research.*

**Gold medal - Yan Lavallee**

Yan Lavallée's thesis on experimental volcanology at the Ludwig-Maximilian-University of Munich is the subject of magma rheology. It centers on rheological investigations of the brittle-ductile transition in silicic lavas. It is an extraordinary piece of scientific work which has resulted in publications in first class scientific journals including Nature, Geology and Reviews of Scientific Instruments. The work is divided into three parts: 1) the development of a new experimental facility for the controlled deformation of large high-temperature volcanologically-relevant samples, including acoustic emissions capabilities; 2) a study involving acoustic emissions of actively deforming lava which provides the first proof of the seismogenic nature of silicic lava during deformation. It confirms the truly brittle nature of the glass transition in volcanic processes. In this sense it completes the paradigm change to magma as a brittle substance during silicic explosive and effusive eruptions; 3) a non-Newtonian rheological law has been generated for crystal-rich dome lavas. This general law permits for the first time the accurate parameterisation of the non-Newtonian rheology of lava domes, a vital contribution to their modelling. Yan is truly a talented young earth scientist who is rapidly making his presence felt in the volcanological community. He is a worthy recipient of the Leopold Gelinas Gold Medal. - *Citation by Don Dingwell*

**Silver medal - Geneviève Robert**

The 2009 Silver Gélinas medal goes to Geneviève Robert of the Department of Earth and Coean Sciences at the University of British Columbia. Her thesis entitled "Rheology of Porous Rhyolite" involved high temperature (T) experiments used to deform (cause flow of) natural, porous, volcanic materials under specific conditions of T, fluid pressure and strain rate. These experiments provided estimates of magma viscosity for volcanic systems undergoing foaming (conduit) or collapsing/compacting (welding) of porosity. She also documented a series of high-T, hydrous deformation experiments on cores of volcanic ash to map magma rheology as a function of T, porosity, and fluid pressure. These data are critical for building constitutive laws for the rheology of multiphase (melt+crystals+bubbles) volcanic materials. Geneviève's thesis has been published in two peer reviewed papers in Chemical Geology and American Mineralogist. Congratulations, Geneviève, the medal is well-deserved. - *Citation by Pete Hollings*

**Bronze medal - Francis MacDonald**

Francis MacDonald is a geological engineer from Earth & Ocean Sciences at The University of British Columbia. For his Honours thesis, he chose to work on a volcanological problem that he could address from a rock mechanics perspective. His thesis was entitled "*Control of rock strength on the initiation of kimberlite eruptions*". The thesis investigated of volcanic conduit formation processes for kimberlite volcanoes using the experimental apparatus at the Centre for Experimental Studies of the Lithosphere (CESL) under the supervision of Lori Kennedy (Rock Mechanics) and Kelly Russell. His thesis involved: (a) geometrical analysis of the conduits /pipes, (b) sampling of country rocks to the conduits, (c) experimental measurements of rock strength for these rocks as a function of confining pressure (triaxial rock press), and (d) measurement of tensile strengths of these same rocks. He then used these experimental measurements to constrain his models for elastic failure related to kimberlite dyke propagation and to conduit evacuation. He concluded that if a kimberlite dyke was connected to a magma source at >150km depth, driving pressures in the dyke would exceed resisting pres-

sure and rock strength at a depth of ~500m. In the case of the A154N pipe at Diavik there is no field evidence to support this model. Also, explosive failure would occur even deeper levels if rock mass heterogeneities are considered. If the depth of the dyke is approximated by the crustal thickness (~40km), overpressure in the dyke will not cause compressive failure in the rock. The dyke tip will continue to propagate until it breaches the surface, where conduit formation will begin. The presence of "Dewey's dyke" at Diavik supports this model.

Kelly Russell's nomination stated "Lori Kennedy and I were greatly impressed by Francis's passion for applying his engineering background to address this very challenging rock mechanics problem in volcanology. Once the problem was framed up and he was mentored on experimental procedures he worked completely independently and completed a prodigious number LSR and tensile strength measurements. The numerical analysis portion of his thesis was beyond the original expectations of either Lori Kennedy or Kelly Russell. Francis's thesis shed light on the problem of kimberlite conduit formation but also identified as yet unresolved issues. We think that this is also a good indicator of excellent science and on that basis we are nominating Francis Macdonald for the GAC Leopold Gelinas Bronze Medal for the best undergraduate research thesis in volcanology and igneous petrology."

**Francis's acceptance speech**

I would like to thank the Volcanology and Igneous Petrology Division of the Geological Association of Canada for honoring me with the Leonard Gelinas bronze medal. This distinction is one of the highlights of my academic career thus far. Regretfully, I could not accept the award in person as I am on a field trip in Turkey.

I could not have accomplished anything without the help of many people along the way, principally everyone associated with the Volcanology and Petrology Lab at UBC (Stephen, Curtis, Shelley, Jackie), and most of all my advisors, Dr. Lori Kennedy and Dr. Kelly Russell. Lori guided me through many hours of experimental procedures and showed me the ropes for laboratory experimentation. Kelly provided me with the idea for this project. I would like to thank him for guiding me through this project, for all the insightful feedback he gave me, and most of all, for instilling a love of volcanology in me. I have now found a science that ties together all of the subjects I have found most stimulating over the years.

The biggest lesson that I have taken away from this project is that science is not about answers. The biggest challenge in science is to convey a well-posed question, which is both an art and a science in itself.

Roisin Kyne stands on the edge of the El Chichon crater, Mexico, during a break from her Honours thesis sampling.

The two photographs above were taken during the Plinian eruption of Redoubt volcano, Alaska on 4 April 2009. At dawn of 4 April, Norbert Fischer and Marco Fulle observed a particularly powerful Plinian eruption from Ninilchik, 75km SE of the volcano.. These photos show both the red glow on the flanks of the volcano and lightning within the expanding cloud. Photos from the Stromboli Online web site.

# CAREER ACHIEVEMENT AWARD

*The Career Achievement Award is made by the Volcanology and Igneous Petrology Division of the Geological Association of Canada in recognition of career achievements in the field of volcanology and/or igneous petrology. Candidates will be judged on their lifetime scientific contribution*

**Citation for Don Baker**


I wish herewith to nominate Professor Don Baker of my department for the 2009 Career Achievement Award of the Volcanology and Igneous Petrology Division of the Geological Association of Canada. Although Professor Baker is by no means near the end of his career, he has made sufficient major contributions to igneous petrology during the past 25 years to qualify him strongly for this award. Indeed, he is one of the leading experimental igneous petrologists in the world at the current time, and has substantially advanced science in his field through the publication of 70 refereed journal articles and other publications that cumulatively have been cited over 1100 times.

Professor Baker first attracted the attention of the igneous petrology community in the 1980s with a series of highly cited experimental studies that investigated the effects of pressure, composition and volatiles on the liquid lines of descent of magmas of mafic to intermediate bulk compositions. In the earliest of these studies (Baker and Eggler, 1983;126 citations), which focused on the volcanic arc environment, he provided the first robust experimental data bearing on the origin and evolution of high alumina basalts at elevated pressures, and showed, contrary to the view prevailing at the time, that these rocks are not necessarily low pressure derivatives of tholeitic magmas. Instead, some may be the products of fractionation of more mafic magmas at substantially higher pressure and, in turn, could have fractionated at lower pressure to form the andesitic lavas, which dominate this environment. In a subsequent paper (Baker and Eggler, 1987; 149 citations), he expanded on this work by showing the important role that water plays in determining the path of magma evolution in these systems. Specifically, he demonstrated that, under anhydrous conditions, thermal divides preclude the formation of alkali basalts from tholeiites and andesites from basalts, whereas the presence of small amounts of $H_2O$ removes these divides and permits the proposed evolutionary paths. Continuing with this theme, but focusing on the continental rift environment, Professor Baker tackled another conventional wisdom, namely that the nepheline-normative trachytes and phonolites, and peralkaline rhyolites, characteristic of this environment, are the products of the fractional crystallization of primitive alkali basalts at mantle depths. In a highly cited paper (Mahood and Baker, 1986; 97 citations), he showed, instead, that the genesis of these magmas is better explained by fractionation at shallow depth, where Fe-Ti oxide crystallization is able to drive the alkali basalt magma to high silica concentrations and produce silicic peralkaline magmas.

After working with conventional equilibrium magmatic processes, Professor Baker moved his attention in the late 1980's to non-equilibrium processes, and particularly that of diffusion, understanding of which is essential to interpreting processes such as magma mixing or assimilation. This new direction soon led to several notable successes, including the first experimental demonstration that homogenization of isotopes by diffusion is decoupled from chemical homogenization (Baker, 1989; 79 citations). This paper was followed by a series of pioneering papers in the early 1990s that elegantly elucidated the role of halogens and water in controlling chemical interdiffusion (e.g., Baker, 1990; 88 citations; Baker; 68 citations), showing, for example, that whereas fluorine decreases the activation energy of diffusion, chlorine actually increases it. These papers are the starting point for the work that is currently going on in this active field of research. Recently, Professor Baker has extended his studies of diffusion by combining them with studies of bubble growth in both experimental and natural systems and with numerical models to investigate the effects of diffusion on the compositions of bubbles (e.g., Baker et al., 2006). This work, impacting as it does on the chemical changes accompanying the exsolution of aqueous fluids from magmas, will find applications in fields as diverse as active volcanology and porphyry/epithermal ore genesis.

Although, as noted above much of his recent research has been concerned with non-equilibrium magmatic processes, Professor Baker has continued to make major contributions to our understanding of equilibrium magmatic processes. This work has focused recently on sulphide-silicate equilibria, for which he and his students have produced what may be arguably considered the best empirical model currently available (Liu et al., 2007).

Finally, I would be remiss, if I did not mention Professor Baker's work in statistical physics, which includes titles such as "The continuum percolation threshold for interpenetrating squares and cubes" published in Physical Review

E (Baker et al. 2002; 17 citations) and "Nonlinearlity and multifractality of climate change in the past 420,000 years" published in Geophysical Research Letters (Ashkenazy et al., 2003; 15 citations). These publications speak volumes to the breadth of Professor Baker's interests and his ability to impact not only the relatively large field of igneous petrology and volcanology but also fields well beyond it.

In summary, I hoped that you will agree, as I have tried to show, that Professor Baker is an outstanding igneous petrologist who has made seminal contributions to the fields of igneous petrology and volcanology and will be a very worthy recipient of the 2009 Career Achievement Award of the Division of Volcanology and Igneous Petrology.

*Citation by A.E. (Willy) Williams-Jones, FRSC, Professor of Geochemistry.*

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**2008 Volcanology and Igneous Petrology Division Financial Summary**

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| **Balance January 1, 2008** | **5197.48** | |
| | **Credits** | **Debits** |
| Dues* | 8.00 | |
| Publication sales | | |
| Support for shortcourse | | 1000.00 |
| Annual Business Meeeting , lunch | | 734.55 |
| Newsletter | | |
| Postage, Copying, Miscellaneous Office | | |
| Web page charges | | 31.40 |
| VIP Award Medal Engraving | | 183.75 |
| Profit from shortcourse | 109.30 | |
| Bank Charges | | 7.20 |
| Bank interest | 5.51 | |
| **Totals** | **122.81** | **1956.90** |
| **Balance December 31, 2008** | **3363.39** | |

*Note - dues for 2008 were not received until late January 09 so are not included here